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**Technical Specifications
for
Remediation Area 3
Lime Sludge Ponds**

**FDF Project No. 20205
Document No. 20205-TS-0001
Contract No.**

**April 1999
Revision B**

**Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FDF Subcontract No. 98PC001322
Task Order P-022**



**4055 Executive Park Drive
Cincinnati, Ohio 45241**

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U.S. DEPARTMENT OF ENERGY

2163

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

REMEDATION AREA 3
LIME SLUDGE PONDS
TECHNICAL SPECIFICATIONS

PARSONS

Approved by:

Carlton Schroeder, Project Manager

Date

Date: 4/12/99
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FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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TECHNICAL SPECIFICATIONS

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REMEDATION AREA 3
LIME SLUDGE PONDS
TECHNICAL SPECIFICATIONS

Division 2

PARSONS

Prepared by: _____

Checked by: _____

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SECTION 02050
SURVEYING

PART 1 GENERAL

1.1 SCOPE

This Section includes, but is not limited to:

- A. Establishing temporary survey Control Points.
- B. Setting limits and boundaries of construction and excavation activities.
- C. Performing surveys for:
 - 1. Verification of the existing conditions.
 - 2. Support surveys during the construction and construction activities.
 - 3. Measurement and payment.
- D. Preparing and furnishing red-line and as-built survey documentation including: sketches, drawings, and field notes (electronic and hard copy).

1.2 RELATED SECTIONS AND PLANS

- A. Section 02100 - Site Preparation.
- B. Section 02270 - Erosion and Sediment Control.
- C. Part 6 - Statement of Work.
- D. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

National Geodetic Survey Standards.

1.4 QUALIFICATIONS

- A. Oversight for survey work shall be provided and certified by a Land Surveyor licensed in the State of Ohio.
- B. Survey work shall be performed under the direct supervision of a person who has at least 5 years of experience in construction surveying.
- C. Work performed in referencing of Fernald Environmental Management Project (FEMP) or United States survey monuments shall be stamped/certified by an Ohio licensed Land Surveyor.

1.5 SUBMITTALS

- A. Provide submittals as required in Part 6 of the Contract Documents. Unless specified otherwise, submittals shall be made to the Construction Manager for review and approval.
- B. Submit qualifications for Land Surveyor licensed in the State of Ohio and the survey supervisor in accordance with Part 6 of the Contract Documents. Provide resume demonstrating required years of experience as specified in Article 1.4.
- C. Submit weekly survey sketches showing the locations and elevations of existing underground utilities and structures encountered during construction which are not shown on the Construction Drawings or differ from those shown on the Construction Drawings, and newly installed utilities.
- D. Submit electronic and hard copy of survey activities, survey notes, field notes, sketches and drawings for the following surveys within seven (7) calendar days of the completion of each survey:
 - 1. Preliminary surveys.

2. Intermediate surveys.
 3. As-built, (Final) surveys.
- E. Submit as-built survey work documentation by the end of each week for the work of the preceding week, or as requested by the Construction Manager.
- F. Submit 2 copies of field notes prepared by the licensed Land Surveyor on a bi-weekly basis (as a minimum) or upon request by the Construction Manager. Dated and signed field notes shall be legibly recorded in standardized field notebooks with format as defined in this Section. Notation shall be consistently applied to surveying work; the stake marking format and the field book notation shall be compatible. Identify survey Control Points on the field notes, sketches, and drawings.
- G. Submit a list of the survey instruments that will be used along with supporting documentation that it is capable of reading to the precision specified in this Section.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain on site, a complete and accurate log documenting survey work as it progresses.
- B. Maintain on site, drawings clearly showing existing Control Points and temporary survey Control Points, including coordinates and elevations, used to perform work. These drawings shall be updated the same day as new control points are set.
- C. Maintain on site, an accurate and current set of redline drawings with as-built locations. Data shall be incorporated within seven (7) calendar days of the respective construction activity.

1.7 EXAMINATION OF EXISTING CONDITIONS

- A. Prior to the start of work, verify the accuracy of the existing conditions shown on the Construction Drawings. Immediately notify the Construction Manager in writing of deviations from the existing conditions indicated on the Construction Drawings.
- B. Stake the locations of earthwork, as shown on the Construction Drawings and review proposed work with the Construction Manager in the field prior to start of excavation.

1.8 SURVEY CONTROL POINTS

- A. Locate and verify existing Control Points as shown on the Construction Drawings and identify any other survey monuments in the work area in accordance with this Section. The Construction Manager will provide coordinate and elevation data for FEMP Control Points if not shown on the Construction Drawings. Use only FEMP approved Control Points.
- B. Protect and preserve existing Control Points.
- C. Existing FEMP Survey Control Points damaged or disturbed during construction activities will be replaced/reset by the Construction Manager. The Contractor shall be responsible for the costs of replacing/resetting survey Control Points.

1.9 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8 of Contract Documents.

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PART 2 PRODUCTS AND INSTRUMENTS

- A. Provide materials as required to perform the surveys, including, but not limited to: instruments, tapes, rods, mounts, tripods, stakes, hubs, nails, ribbon, and other reference markers.
- B. The survey instruments shall be precise and accurate to meet the needs of the project. Survey instruments shall be capable of reading to a precision of 0.01 feet with a setting accuracy of 8 seconds.

PART 3 EXECUTION**3.1 GENERAL**

- A. The accuracy of horizontal and vertical control shall meet or exceed Third-Order, Class I and Third-Order, Class II, respectively, as defined by National Geodetic Survey Standards. Elevation shall be referenced to National Geodetic Vertical Datum (NGVD) of 1929 and horizontal coordinates to North American Datum (NAD) 1983.
- B. Establish elevations, lines, and levels that are tied into the FEMP Survey Control System. Topographic contours shall be shown to the nearest foot. Field run data shall be taken to adjacent existing undisturbed area (50 ft. minimum overlap) to create a smooth contour transition.
- C. Maintain accurate and complete notes of surveys:
 - 1. Handwritten survey notes and information shall be documented in survey field books. A copy of the numbered, dated and signed field book pages shall be given to the Construction Manager weekly, or upon request, for use in reviewing the work.
 - 2. Electronically collected field survey information shall be collected and backup equipment shall be available in the event of equipment malfunction.

- a. Electronic format for printed output of data collector's field survey notes shall be compatible with the field book notation format.
 - b. Electronic format for survey data shall be Intergraph Microstation 5.0 or other compatible system as approved by the Construction Manager.
- D. Measurement and payment surveys for elevation and for horizontal distance shall be to the nearest 0.5 foot +/- 0.1 foot.
- E. Perform construction and excavation layout surveys in advance of scheduled excavation activities. The Contractor is responsible for rework and/or construction delays caused by survey or staking errors.
- F. Set grade stakes and slope stakes for excavation activities as work progresses in accordance with accepted surveying practices.
- G. Establish and maintain temporary survey control points (horizontal and vertical control), as necessary, to support construction excavation activities.
- H. Temporary Control Points, Accuracy and Documentation:
 - 1. Record the following information in survey notebooks for each benchmark established:
 - a. Designation of survey benchmark. Coordinate through the Construction Manager for the designation protocol so as not to duplicate existing points.
 - b. State Plane Coordinates in North American Datum (NAD), 1983;
 - c. Elevation based on National Geodetic Vertical Datum (NGVD) of 1929;
 - d. Date of establishment;

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- e. Description and sketch of each survey benchmark location including reference to a minimum of three permanent features that can be seen from the survey benchmark with the corresponding measurement from the feature to the survey benchmark shown on the above referenced sketch.
2. Document survey work in the field notebooks using the format and procedures described below:
 - a. Title and consecutive notebook number on the front cover;
 - b. Consecutively numbered pages;
 - c. Table of contents, indicated by survey task, on the first numbered page;
 - d. Legend indicating symbols and abbreviations used in survey notes;
 - e. Names of survey team for each task;
 - f. Notes on weather, equipment, etc.;
 - g. Date and time on each page to indicate when work was recorded;
 - h. Notes in a uniform character such that they can be interpreted and used by anyone with survey knowledge;
 - i. Description and/or sketches of the existing survey control used.

3.2 SUPPORT SURVEYS

- A. Contractor shall temporarily mark in the field any new underground utilities and installations until the new as-built surveys are obtained and incorporated into the red-line markups.
- B. Preliminary Surveys:
 1. As part of the verification of existing conditions, perform topographic surveys of areas to be excavated prior to construction activities.
 2. Initial topographic survey shots shall be at a minimum of 50-foot intervals with additional shots as required to define the topography and key features.

3. Establish location for the installation of the erosion and sediment control measures specified in Section 02270.
4. Establish limits of earthwork shown on the Construction Drawings. Maximum staking interval shall be 50 feet unless otherwise directed by the Construction Manager.
5. Establish work limits required for installation of construction fencing and boundary fencing as specified in Section 02100 and as shown on the Construction Drawings unless otherwise directed by the Construction Manager.

C. Intermediate Surveys:

1. Perform surveys during progress of the construction activities to verify the accuracy of field work as directed by the Construction Manager.
2. Perform surveys for measurement and periodic progress payment as specified in this Section.
3. Perform surveys during progress of excavation to confirm limits of the excavation.

D. As-built (Final) Surveys:

1. Final topographic survey shots shall be at a minimum of 50-foot intervals or as required to define the topography of final excavated areas at the Lime Sludge Ponds (LSP). Additionally, the following points shall be surveyed and noted as applicable.
 - a. Grade breaks.
 - b. Points of horizontal curvature and tangency.
 - c. Roads, ditches, pipes, valves, manholes, lift stations, riser pipes, culverts, channels, utility structures, lift stations, meters, valves, K-65 tie-in and fences.
 - d. Limits of final excavation in the LSP excavation.
 - e. Spot elevations every 25 feet along the top and toe of slopes of the excavations.
 - f. Finish grades.

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2. Horizontal and vertical locations of all utilities installed.
3. Perform survey for final measurement and payment.

3.3 SURVEYS FOR MEASUREMENT AND PAYMENT

- A. Perform surveys for periodic progress payments and final payment to determine quantities of work.
- B. Calculate and certify quantities of work and submit survey notes and calculations to the Construction Manager for review, evaluation and payment.
- C. Measurement and payment surveys for elevation and for horizontal distance shall be to the nearest 0.5 foot +/- 0.1 foot, respectively.

END OF SECTION

SECTION 02100
SITE PREPARATION

PART 1 GENERAL

1.1 SCOPE

This Section includes but is not limited to:

- A. Installation of boundary fence and construction fence.
- B. Fugitive dust control.
- C. Protection of existing groundwater monitoring wells and survey benchmarks.
- D. Clearing and wood chipping.
- E. Removal of existing fencing.
- F. Installation of guardrail.
- G. Removal and disposal of asphaltic pavement.

1.2 RELATED SECTIONS

- A. Section 02150 - Traffic Control.
- B. Section 02270 - Erosion and Sediment Control.
- C. Section 02506 - Aggregate Materials.
- D. Part 6 - Statement of Work.
- E. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 SUBMITTALS

- A. Provide submittals as required by Part 6. Unless specified otherwise, submittals shall be made to the Construction Manager for review and approval.
- B. Submit as a part of the Safe Work Plan the following:
 - 1. Methods for protection of the monitoring wells to remain within the south contractor laydown area, during construction.
 - 2. Methods for protection of the K-65 Trench crossing.
 - 3. Methods for minimizing soil disturbance within the Contractor laydown areas.
 - 4. Access plan and access control between the uncontrolled area to the south of the LSP and the contractor laydown area.
- B. Submit a Fugitive Dust Control Plan in accordance with Part 6.
- C. Submit, along with the Fugitive Dust Control Plan, manufacturer's Material Safety Data Sheets (MSDS), and recommendations for material handling and usage in accordance with Part 6.
- D. Submit construction fence and boundary fence material specifications, including steel T posts.

1.4 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Dust Suppression Agent shall be as specified for Crusting Agent in Section 02270.

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- B. Boundary fence shall be galvanized steel welded wire fabric, 12-1/2 gauge, 2 inch by 4 inch mesh or equivalent, as approved by the Construction Manager, minimum 4 feet high. Posts shall be 6 foot steel T as used for Construction Fence.
- C. Construction fence shall be orange, high density polyethylene fabric, 4 foot in height, opening size approximately 4 inches by 1/2 inch, minimum tensile strength of 2000 lbs/ft of width. Posts shall be 6 foot steel T.
- D. Rope fence shall be 3/8 inch yellow nylon.
- E. Guardrail and post shall be as specified on the Construction Drawings. The welded wire fabric attached to the guardrail post shall be the same as used for boundary fence.

PART 3 EXECUTION

3.1 GENERAL

- A. Verify existing conditions, including underground and aboveground utilities.
- B. Notify Construction Manager prior to removal of all utilities and receive confirmation from Construction Manager that utilities to be removed or tapped have been properly isolated and de-energized prior to commencement of work. Construction Manager will properly isolate and de-energize utilities that are to be removed, abandoned, disconnected, or tied into.
- C. Install erosion and sediment control measures, in accordance with Section 02270 and the Construction Drawings, within a drainage area prior to clearing or excavation activities.
- D. Remove existing asphaltic pavement as indicated on the Construction Drawings.

3.2 FUGITIVE DUST CONTROL

Fugitive dust control shall be as specified in Part 6 and in accordance with the approved Fugitive Dust Control Plan.

3.3 BOUNDARY FENCE/CONSTRUCTION FENCE/GUARDRAIL

- A. Boundary fence, guardrail and construction fence shall be installed at locations indicated on the Construction Drawings. Contractor shall install temporary construction fence along west boundary until grade work has been completed then install boundary fence at permanent location.
- B. Maintain and repair boundary fence and construction fence until completion of the Contract.

3.4 CLEARING

- A. All trees within the excavation area shall be cut one foot above ground. The trees shall be handled so that the contact between the ground and the trees are minimized. After cutting the trees, chip directly into haul equipment and transport to the SWU Woodchip Stockpile, as indicated on the Construction Drawings.
- B. Remove all tree stumps, shrubs, and woody undergrowth within areas to be excavated as noted on Construction Drawings. All tree stumps, shrubs, etc. shall be chipped and thoroughly mixed with Impacted Material. Material shall then be transported to the OSDF as Impacted Material. The volume of organics per truckload shall be no more than 20 percent, by visual observation.

3.5 HAULING

- A. Materials shall be hauled to their appropriate locations shown on the Construction Drawings, as specified in the approved Traffic Plan, in accordance with Section 02150.

3.6 PROTECTION OF EXISTING STRUCTURES

- A. Protect trees, plant growth, and features that are outside the work limits.
- B. Locate, identify, and protect from damage utilities that are to remain.
- C. Maintain existing roadways within work limits per the Contractor's approved Fugitive Dust Control Plan submitted in accordance with this Section.

END OF SECTION

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SECTION 02150
TRAFFIC CONTROL

PART 1 GENERAL

1.1 SCOPE

This Section includes, but is not limited to, requirements for the Traffic Plan.

1.2 RELATED SECTIONS AND PLANS

- A. Part 6 - Statement of Work.
- B. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

- A. State of Ohio, Department of Transportation (ODOT):
 - 1. Construction and Material Specification, January 1, 1997, except as supplemented or otherwise modified herein and/or shown on the Construction Drawings.
 - 2. Ohio Manual of Uniform Traffic Control Devices (MUTCD) for Streets and Highways, current edition.
 - 3. Standard Construction Drawings, current edition.

1.4 SUBMITTALS

- A. Submit a Traffic Plan in accordance with Part 6. Unless specified otherwise, submittals shall be made to the Construction Manager for review and approval. The Traffic Plan shall include as a minimum:
 - 1. Planned traffic routes for hauling excavated material from the following material sources to their appropriate destinations (sources may yield several material types):

MATERIAL	SOURCE	DESTINATION
Stumps, shrubs and undergrowth (mix with Lime Sludge)	LSP Clearing	OSDF
Trees (chipped)	LSP Clearing	SWU Woodchip Stockpile
Lime Sludge/soil and soil like material	Lime Sludge Ponds	OSDF
Above WAC Material (if encountered)	LSP	SP-7
Debris	LSP excavation (general); pipe materials and appurtenances	OSDF
Special Materials - Other	LSP excavation (general)	Special Material Transfer Area
Impacted Sediments	Ditches or sumps designated by the Construction Manager	OSDF

2. Crossings for pedestrians and equipment.
3. Maintenance of SWU Haul Road from LSP to OSDF and to SWU Woodchip Stockpile when hauling woodchips.
4. Maintenance and cleaning of paved traffic routes, pedestrian crossings and equipment crossings.
5. Description of impact to other site traffic control during construction activities and during long breaks in the work.
6. Access control to and from radiological controlled areas. Include provisions to provide equipment and wheel washing as required
7. Use of signs, flaggers, and other items or methods used to control traffic.

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8. Schedule of equipment traffic through the OSDF Wheel Wash Pad and OSDF Equipment Wash Facility. Coordination between Contractors will be performed by the Construction Manager.

1.5 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8.

PART 2 PRODUCTS

2.1 MATERIALS

Construction materials for traffic control shall be as defined by the Traffic Plan and shall conform to ODOT specifications, MUTCD and ODOT Standard Construction Drawings, unless otherwise approved by the Construction Manager.

PART 3 EXECUTION

3.1 MATERIAL HAUL ROAD CROSSINGS

- General - Contractor may be stopped at any crossing for more than 5 minutes during an emergency event in which site Emergency Response Team or fire fighting force is activated, Utility Engineer is investigating, or a nearby utility is in need of immediate repair.

3.2 PARKING

- A. Contractor laydown areas are as shown on the Construction Drawings.

END OF SECTION

SECTION 02205
IMPACTED MATERIAL EXCAVATION AND HANDLING

PART 1 GENERAL

1.1 SCOPE

This Section includes the requirements for the excavation, loading, hauling, and unloading of impacted materials and related activities including, but not limited to:

- A. Excavation of the following impacted materials: debris, soil and soil like material, sediment, and lime sludge, as shown on the Construction Drawings.
- B. Excavating, handling, and sizing of abandoned underground utility lines and appurtenances, including but not limited to stormdrains (ST), culverts, and effluent lines shown on the Construction Drawings.
- C. Loading and hauling of excavated Above-WAC material, if encountered, and unloading and placing at the SP-7 stockpile area shown on the Construction Drawings.
- D. Loading and handling of Special Materials, if encountered, and transferring to the Special Material Transfer Area shown on the Construction Drawings.
- E. Size reduction of impacted debris as necessary to meet Impacted Materials Placement Plan (IMPP) Category 2 requirements.
- F. Supplemental excavation, as required.
- G. Equipment washing as necessary to transport material.
- H. Mixing and blending of lime sludge with soil and other impacted material to reduce free liquids.

I. Loading and hauling of materials from well abandonment (by others).

1.2 RELATED SECTIONS

- A. Section 02050 - Surveying.
- B. Section 02270 - Erosion and Sediment Control.
- C. Section 02900 - Seeding.
- D. Part 6 - Statement of Work.
- E. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

- A. Impacted Materials Placement Plan (IMPP), On Site Disposal Facility (OSDF), 20100-PL-0007, current revision.
- B. Waste Acceptance Criteria (WAC) Attainment Plan for On Site Disposal Facility (OSDF), 20100-PL-00014, current revision.
- C. Fernald Environmental Management Project Plan (FEMP) PL-2194, Spill Prevention Control and Countermeasure (SPCC) Plan, current revision.
- D. Fernald Environmental Management Project (FEMP) Procedure RP-00100, Identification and Movement of Radioactive Material, current revision.
- E. EPA SW 846 Method 9095 Paint Filter Test.
- F. Fernald Environmental Management Project Procedure, EW-1022, Onsite Tracking and Manifesting of Bulk Excavated Material.

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1.4

SUBMITTALS

- A. The Excavation Work Plan shall be integrated into the Safe Work Plan specified in Part 6 and Part 8. The Excavation Work Plan shall include, as a minimum, the following:
1. Detailed methods and procedures for excavation of materials outlined in the scope of this Section. Include methods for segregating impacted material specified in the IMPP during excavation and size reduction methods to ensure the WAC in the IMPP are met.
 2. Technical approach for the coordination and implementation of excavation related activities including submittals, surveying, fence installation and removal, loading requirements, haul road maintenance, material identification and documentation, supplemental excavation, seeding, stabilization of exposed excavated areas, perimeter drain installation, geomembrane liner and geonet installation, and dewatering.
 3. Integrated schedule for impacted material excavation with Contractor's Project Schedule as specified in Part 6, for the excavation, including loading, hauling and unloading, and excavation related activities showing sequence, duration, critical activities, resources for each activity, equipment, number of crews and crew size, and start and completion date of each activity.
 4. Coordination of personnel and equipment in the excavation areas.
 5. Methods for the excavation, management, loading, segregation, transfer, and staging of Special Materials, and Above-WAC Material if encountered.
 6. Methods for loading, hauling and unloading methods for the Above-WAC Material, if encountered, to the SP-7 Stockpile.
 7. Methods for loading, hauling, and unloading impacted materials to the OSDF.
 8. Location, sequencing, and construction of interim working stockpiles, if necessary.

9. Methods for complying with the FEMP Plan PL-2194 for spill prevention, control, and countermeasures.
10. Methods for mixing lime sludge with soil materials.

- B. Technical documents for bedliners, diapers and other spill control devices.

1.5 EXISTING CONDITIONS

Prior to the start of excavation of impacted material, examine and verify the existing conditions as specified in Section 02050.

1.6 HEALTH AND SAFETY REQUIREMENTS

Environmental Health, Safety, and Training requirements shall be as specified in Part 8 of the Contract Documents.

1.7 DEFINITIONS

- A. Impacted Material: Impacted material is defined as material placed by previous Department of Energy (DOE) operations and soil and debris with contaminant levels above the established Final Remediation Levels (FRLs).
- B. OSDF material categories: Categories into which the Contractor shall segregate impacted material as defined in the Impacted Materials Placement Plan (IMPP).
- C. Unclassified Impacted Material: Unclassified impacted material is defined as impacted material encountered during excavation, regardless of type, character, composition, and condition thereof, not otherwise specified in this Section. OSDF Categories of unclassified impacted material shall be as specified in the IMPP for the OSDF. Unclassified impacted material also includes debris encountered during excavation.

- D. Debris: Debris consists of impacted material such as construction materials, concrete, asphalt, steel rebar, Asbestos Containing Material (ACM), fencing and other materials not defined as a Special Material. Criteria for debris shall be as specified in the IMPP and WAC Attainment Plan for the OSDF.
- E. Above-WAC Material: Soil, soil mixed with debris, debris, or soil-like impacted material with total uranium concentrations above the OSDF WAC or any other material that does not meet the OSDF WAC.
- F. Special Material: Impacted material which requires special handling as listed below and further defined in IMPP:
1. Nonpressurized containers, including drums, boxes, cans;
 2. Pressurized containers;
 3. Non-soil residues;
 4. Transformers and electrical equipment;
 5. Lead acid batteries;
 6. Uranium metal, including derbies, ingots and irregularly shaped scrap;
 7. Medical/infectious waste;
 8. Tires;
 9. Miscellaneous debris, including oil and air filters, personal protective equipment (PPE), radiators, tools, heavy equipment, office materials and documents, and lead flashing.
 10. Brick.
- G. Piping: Piping, conduit and appurtenances (pumps, valves, etc.).
- H. Sediment: Sediment material accumulated in ditches and in erosion and sediment control structures.

PART 2 PRODUCTS

2.1 MATERIALS

- A. The Construction Manager will furnish materials, equipment, and personnel for radiological characterization and monitoring of impacted material.
- B. Signs for radiological control areas will be furnished by the Construction Manager. Sign posts shall be provided and installed by the Contractor.
- C. Provide diapers, bed liners and/or other materials as required to prevent spillage of free liquids from Lime Sludge during loading and hauling.
- D. Deliver encapsulant materials (if required) in original, new, and unopened containers bearing manufacturer's name, label, and the following information:
 - 1. Name or title of material.
 - 2. Manufacturer's stock number and date of manufacture.
 - 3. Manufacturer's name
 - 4. Thinning and application instructions.Encapsulants shall be as specified by the following:
 - a. Childers - CP-240 CHIL-LOCK.
 - b. Certified Technologies - Certane 2050.
 - c. Expert Environmental Products - EPPCO #1.
 - d. International Protective Coatings - Serpiloc.
 - e. Or approved equivalent.

Note: Encapsulants shall have a coloring agent or dye so that, when applied, there is obvious verification that a coating has been applied.

2.2 EQUIPMENT

- A. Provide equipment of size and type to excavate, size reduce, load, haul, and unload impacted material to meet the Contract requirements. Haul equipment must be

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equipped with placard carriers and mounted sealable PVC tubes to serve as manifest carriers. Equipment used for excavating impacted material shall be clearly marked. The Construction Manager will provide signs stating "Radioactive Material" in accordance with FEMP Procedure RP-00100.

- B. Provide equipment of size and type to excavate, load, haul, unload, place, manage, and compact Above-WAC Material from the LSP to the SP-7 Stockpile area.
- C. Equipment used to haul impacted material over the existing SWU Haul Road as shown on the Construction Drawings shall be equal to or less than the gross vehicle weight, and axle loading for a Caterpillar CAT D300E truck (gross vehicle weight of 106,700 pounds, and axle load of 37,400 pounds). Pavement width of the existing two-way SWU Haul Road is 24 feet. Select equipment and equipment width to ensure safe operation on this road.
- D. All excavation and haul equipment shall have enclosed cabs. Enclosed cab is defined as equipment cab isolated from outside environment (intact windows, doors, panels and floors surrounding driver with all windows and doors shut) which provides a barrier from intrusion of outside airborne particles. Any HVAC (heating, ventilating or air conditioning) units associated with the equipment cab must not provide a direct path for outside air. Air conditioned cabs shall either recirculate air within the cab or HEPA filter external air entering the cab.
- E. Provide water tank trucks, tank trucks for the dust suppressant/crusting agent, portable tanks, pressure distributors, or other equipment designed to apply water, dust suppressant and crusting agent uniformly and in controlled quantities to variable surface widths to provide dust suppression/erosion control as required in Part 6.

- F. Provide portable wash equipment to wash vehicle tires and vehicle exteriors prior to entering haul roads, as necessary.
- G. Trucks used for hauling of the impacted material shall be equipped with automatic load cover tops.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Blend lime sludge with soil so that mixture does not contain free liquids. The Construction Manager reserves the right to perform testing per EPA SW 846 Method 9095 Paint Filter Test to verify amount of free liquids in blended material.
- B. Provide documentation of material movements per the Construction Drawings and FEMP procedure EW-1022.
- C. Continuously observe excavation activities. Stop excavation in the area and immediately notify the Construction Manager when Special Material or unidentified utilities are encountered.
- D. The Construction Manager and regulatory agencies may collect impacted material samples from the excavation, haul equipment and in the OSDF at any time during the project.
- E. During excavation, segregate materials. Size reduce material to meet physical WAC specified in IMPP.
- F. Blasting, including use of explosives or explosive devices, is not permitted.
- G. Unexpected discovery of cultural resources: Upon the unexpected discovery of any object suspected to be historic, prehistoric, or archeological site, feature or object, immediately cease ground disturbing

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activities around the find and contact the Construction Manager.

H. The following requirements shall apply to equipment for excavating, stabilizing, mixing, handling, loading, segregating, size reducing, hauling, and unloading for impacted material:

1. Equipment shall be kept within the boundary of the LSP area during non-work periods.
2. Equipment shall not be permitted to leave the Above-WAC excavations, if encountered, until equipment decontamination activities are completed by the Contractor and radiological survey of the equipment is approved by the Construction Manager for the radiological control areas.
3. The automatic cover shall be in place during all periods of equipment movement on-site, whether empty or full. Loaded equipment shall be covered at all times.

I. Loading requirements:

1. During loading, haul equipment shall be located within the loading area, as indicated on the Construction Drawings, that will be maintained administratively by the Construction Manager. Loading areas will be delineated in the field. The Contractor shall not access the loading area directly from the active excavation areas. The Contractor shall keep the loading area clear and free of dirt and mud.
2. During loading, haul equipment shall remain in the loading area to the extent practical.
3. Loading equipment shall load the haul equipment by reaching over and into the loading area and dumping directly into the haul equipment.
4. Haul equipment shall be loaded in a manner that prevents spillage and accumulation of impacted material on the wheels and components of haul equipment. Remove all visible material that accumulates on exterior of truck.

5. Contractor shall coordinate the maintenance of the SWU Haul Road from the LSP to the OSDF with the Construction Manager. Other Contractors may be using the haul road.
6. The Construction Manager will visually inspect and monitor haul equipment in the loading area. The Construction Manager will allow haul equipment to leave the loading area after monitoring indicates that the equipment is not contaminated
7. If visual material/residue is found on the outside of haul equipment, the Contractor shall clean the equipment within the loading area (with low volume, high pressure washer or approved equivalent). Any wash water shall be collected in the LSP excavation sumps.
8. Haul equipment shall be loaded so as to minimize load shifting during transit.
9. Haul equipment shall be loaded to minimize spillage during loading. Material shall be loaded to be below the top of the bed.
10. Prior to loading and hauling, all material designated for the OSDF, shall be void of free liquid under the guidelines of the EPA Paint Filter Test (EPA SW 846 Method 9095). The Construction Manager reserves the right to perform an EPA Paint Filter Test at any time. Any material that fails the Paint Filter Test shall be reworked as directed by the Construction Manager.

I. Hauling requirements:

1. During off work hours and when not in use, park haul equipment in the areas designated by the Construction Manager.
2. Upon exiting the OSDF, to return to the LSP, haul equipment shall use the wheel wash pad.
3. Haul equipment shall remain on haul roads designated on the Construction Drawings. Equipment that enters these roads shall not be allowed to exit, except at the OSDF, LSP Excavation Area, SP-7 Stockpile Area, and/or Special Material Transfer Area without approval by the Construction Manager.

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4. Operation of tracked equipment is prohibited on the SWU Haul Road and all other paved surfaces.

J. Perform stabilization of excavated areas using crusting agent or seeding in accordance with Sections 02270 and 02900, respectively.

K. Tolerances for excavation depths as shown on the Construction Drawings shall be 0 to +6 inches. Tolerances for horizontal control of excavation limits and excavation break points shall be +/- 6 inches.

L. Immediately notify the Construction Manager if any material suspected of or known to contain asbestos is encountered. Move excavation to another location at no additional cost to FDF until asbestos work is approved to proceed:

1. FDF shall notify the EPA and all other applicable governmental agencies before the start of work.
2. The Contractor shall adhere to and comply with work practices and procedures set forth in the most current and applicable Federal, State, and local codes, regulations, and standards.
3. The Contractor shall obtain certifications and licenses to perform asbestos work.

3.2 ABOVE-WAC MATERIAL EXCAVATION (Contingency)

A. Prepare SP-7 Stockpile Area to receive Above-WAC material. Requirements for unloading and stockpiling Above-WAC material at the SP-7 stockpile shall include:

1. Placing material in the stockpile at locations designated by the Construction Manager.
2. Immediately repairing damage to the stockpile structures to the original condition (i.e., silt fence, perimeter fence, etc.) caused by the Contractor, at no additional cost to FDF.

3. Applying crusting agent within seven (7) calendar days, upon completion of the stockpile or if the stockpile is to be inactive for more than forty-five (45) calendar days as specified in Section 02270. Dust suppressant shall be in accordance with Part 6 and the approved Fugitive Dust Control Plan.
 4. Compacting/sealing the surface of the stockpile in use at the close of each work day to prevent fugitive dust and runoff.
 5. Ensuring that equipment and material used in placing and managing Above-WAC impacted material removed from either area without the approval of the Construction Manager. Equipment shall not be removed from area before washing. Equipment washing shall be performed within the SP-7 Stockpile Area. Wheels, tires, undercarriage and body of equipment shall be washed free of visible mud, dirt and debris.
 6. Stockpile side-slopes shall not exceed a maximum slope of 3H:1V and a height to base ratio 0.2.
- B. During excavation of Above-WAC material, maintain sumps within the Above-WAC excavation to collect water encountered during excavation and to prevent runoff of water onto adjacent areas. Water collected in these sumps shall be directed to the Bio-surge Lagoon.

3.3 UNCLASSIFIED IMPACTED MATERIAL EXCAVATION

- A. Select equipment and excavation methods to minimize obstruction of continuous visual observation of the excavation by the Construction Manager.
- B. Excavate berm material in 12 inch (+/-) loose lifts. The Construction Manager will perform real-time monitoring after each lift.
- C. Lime Sludge material shall not be excavated in lifts and shall not have real-time monitoring.

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- D. All underground pipelines and underground utilities shall be excavated and removed as they are encountered as specified herein. The excavation shall proceed using standard excavation techniques to the lines and grades shown on the Construction Drawings. In no case will the Contractor be paid for over excavation without prior written approval from the Construction Manager.
- E. If unexpected Above-WAC or Special Materials are encountered, stop excavation, notify the Construction Manager, and move the excavation operation to another location as directed by the Construction Manager.

3.4 UTILITY REMOVAL

- A. Piping removed shall be visually monitored by the Construction Manager during excavation. Piping having process related waste clinging to it, as determined by the Construction Manager, shall be size reduced and containerized as Above-WAC debris. Filled containers shall be transferred to the Special Materials Transfer Area. All other piping shall be size reduced and disposed in the OSDF, unless otherwise directed by the Construction Manager.
- B. All utility lines indicated to be removed shall be capped and/or plugged as indicated on the Construction Drawings.

3.5 REMOVAL OF SEDIMENT

- A. Remove accumulated sediment from existing ditches and erosion and sediment control measures as described in Section 02270 or as directed by the Construction Manager.
- B. Haul removed sediment to the OSDF as unclassified impacted material unless otherwise directed by the Construction Manager.

3.6 SPECIAL MATERIAL EXCAVATION

- A. Special Materials identified during excavation shall be excavated, segregated, handled and staged at the Special Materials Transfer Area as directed by the Construction Manager.
- B. The Construction Manager will be responsible for final disposition of the Special Materials.
- C. Special Materials Transfer Area shall be located as shown on the Construction Drawings.

3.7 SUPPLEMENTAL EXCAVATION

- A. After excavation is completed in an area to the limits shown on the Construction Drawings, the Contractor shall survey the excavated area in accordance with Section 02050. After survey, the Construction Manager will perform monitoring. The Construction Manager will take up to ten (10) calendar days to perform monitoring of an area. Perform supplemental excavation as directed by the Construction Manager.
- B. Supplemental excavation shall be considered as Unclassified Impacted Material excavation unless otherwise directed by the Construction Manager.

END OF SECTION

SECTION 02206
EARTHWORK

PART 1 GENERAL

1.1 SCOPE

This Section includes all earthwork not covered by Section 02205 and includes excavation and placement of backfill material in trenches for underground installation of Transfer Lines, new manhole on storm drain line, Perimeter Drain, lift stations and general earthwork. This work addresses non-impacted material only.

1.2 RELATED SECTIONS

- A. Section 02205 - Impacted Material Excavation and Handling.
- B. Section 02270 - Erosion and Sediment Control.
- C. Section 02506 - Aggregate Materials.
- D. Part 6 - Statement of Work.
- E. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 DEFINITION OF TERMS

- A. Earth Excavation: Removal of materials not classified as rock within limits shown on Construction Drawings.
- B. Unauthorized Excavation: Excavation not required by specifications or drawings or not authorized in writing by the Construction Manager.
- C. Trench backfill: Fill placed in a trench as indicated on the Construction Drawings.

- D. Fill: Earth used to bring an existing grade to a specified grade.
- E. Undercutting: Removal of soft or undesirable materials determined by Construction Manager, encountered in undisturbed subgrade below grades specified for excavation.
- F. Shoring: A structure, such as a metal hydraulic, mechanical, or timber shoring system that supports sides of an excavation and which is designed to prevent cave-ins.

1.4 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb³ (600 kN-m/m³)).
 - 2. ASTM D2922 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 3. ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- B. Occupational Safety and Health Administration (OSHA), Code of Federal Regulations (CFR):
 - 1. 29 CFR 1926 Subpart P - Excavations, latest revision.

1.5 SUBMITTALS

- A. Provide submittals as required in Part 6.
- B. Submit as a part of the Excavation Work Plan, as described in Section 02205, as a minimum, the following:

1. Submit for approval, name, address, and qualifications of an independent soil testing laboratory and resume of field technician.
2. Provide copies of all laboratory soil tests performed by soil testing laboratory and contractor within seven (7) calendar days of obtaining samples for performing laboratory test, or upon request by the Construction Manager.
3. Provide copies of all field soil tests performed by soil testing laboratory and contractor within seven (7) calendar days of obtaining samples for performing field test, or upon request by the Construction Manager.

1.6 PROJECT/SITE CONDITIONS

- A. Existing site surface and subsurface conditions, based on available site data, are indicated on the Construction Drawings.
- B. The Contractor shall use the west slope of the basin, after impacted material removal, as the source of fill material unless otherwise directed by the Construction Manager. The excavation shall have a side slope of 2H:1V. Blend area into existing slope. The excavation shall provide a stable slope. This borrow source is for fill around the lift stations only.

1.7 QUALITY ASSURANCE

- A. Independent Soil Testing Laboratory:
 1. The Contractor shall arrange and pay for the services of an independent soil testing laboratory to perform the laboratory and on-site construction quality testing of materials and construction activities specified in this Section.
 2. The independent soil testing laboratory shall have a minimum of 5 years experience in providing the construction quality testing services and shall be equipped with the required equipment. Field technician(s) shall have a minimum of 3 years experience in construction quality testing.

1.8 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Suitable compacted fill material and backfill material shall be free of debris, foreign objects, large rock fragments, organics, and other deleterious materials. Visible rock shall not exceed a maximum dimension of 3 inches in any dimension.
- B. Utility trenches shall be backfilled with the existing material excavated from the trench, except under roadways. Backfill under roadways shall be as indicated on the Construction Drawings.
- C. Pipe bedding material shall be specified in Section 02506.

2.2 EQUIPMENT

- A. Choice of equipment to perform required operations in conformance with these specifications shall be the responsibility of the Contractor. However, any equipment that results in waste or damage of material, or inaccurate work, or is otherwise objectionable is to be promptly replaced as directed by the Construction Manager.
- B. Furnish hand compaction equipment, such as walk-behind padfoot compactor, hand tampers, or vibratory plate compactor, for compaction of trench backfill and any other areas inaccessible to large compaction equipment.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that subgrade is not soft, spongy, or composed of otherwise unstable materials. If unstable materials are encountered, notify Construction Manager.
- B. Verify that areas to be filled or backfilled are free of debris, snow, ice, or water and that surfaces are not frozen.
- C. Prior to any earthwork activity, verify that erosion and sediment control measures required for the drainage area are in place and functional.

3.2 GENERAL

- A. Perform construction activities in such a manner that stormwater runoff from controlled construction areas does not flow into non-controlled areas.
- B. Unexpected discovery of cultural resources: Upon the unexpected discovery of any object suspected to be historic, prehistoric, or archeological site, feature or object, immediately cease ground disturbing activities around the find and contact the Construction Manager.
- C. Dust control shall be in accordance with Section 02100 and Part 6.

3.3 BACKFILL AND FILL FOR TRENCHES

- A. Utility Trenches:
 - 1. Any water collected in trenches shall be pumped to the storm drain system within the Former Production Area or as directed by Construction Manager.
 - 2. Backfill materials shall be placed into open trench in 8 inch loose lifts until reaching existing grade. Each lift shall be compacted with 5 passes of a mechanical or hand tamper. Backfill

material should be compacted to 90 percent Standard Proctor as determined by ASTM D698.

3. Trench excavation and backfilling activities shall be conducted in accordance with OSHA 1926, Subpart P.
4. Backfill material for perimeter drain shall be as specified in Section 02506.
5. Backfill under roadways shall be compacted to 95 percent Standard Proctor as determined by ASTM D698.

- B. Material excavation from Transfer Lines trench shall be reused as backfill unless otherwise directed by the Construction Manager. Excess material can be spread in place.

3.5 GENERAL EARTHWORK

- A. Subgrade material which cannot be conditioned to achieve a surface acceptable to the Construction Manager shall be undercut and replaced with fill material or other acceptable material as required by the Construction Manager.
- B. Subgrade material shall consist of soil free of debris, foreign objects, organics, and other deleterious materials.
- C. Place fill materials in 8 inch loose lifts. Compact to 90 percent of Standard Proctor in accordance with ASTM D698. Maintain moisture content at +/- 2 percent of optimum. Field density and moisture content test shall be in accordance with ASTM D2922 and D3017, respectively
- D. Fill material shall be tested for compaction and moisture content every 5000 square feet of material place or once per lift whichever is greater.

END OF SECTION

SECTION 02270
EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 SCOPE

This Section includes but is not limited to:

- A. Soil erosion and sedimentation control measures for work included in this Contract, including additional areas disturbed by the Contractor.
- B. Installation, maintenance, and removal of all temporary erosion control facilities, including maintenance of existing erosion and sediment control measures and facilities as shown on the Construction Drawings.
- C. Control of surface water and management of ponded water in construction and excavation areas.

1.2 RELATED SECTIONS AND PLANS

- A. Section 02205 - Impacted Material Excavation and Handling.
- B. Section 02900 - Seeding.
- C. Part 6 - Statement of Work.
- D. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

- A. Title 40, Code of Federal Regulations, Part 261, Hazardous Waste Management System, Identification and Listing of Hazardous Waste.

- B. State of Ohio, Department of Natural Resources (ODNR):
Rainwater and Land Development, Ohio's Standard for
Stormwater Management, Land Development, and Urban Stream
Protection - 1996.

1.4 SUBMITTALS

- A. Provide submittals as required in Part 6.
- B. For each product proposed for use, submit the following:
1. Manufacturer's product data and recommended methods of installation and maintenance; and
 2. Certification from supplier or manufacturer that the product meets the material requirements of this Section to include test results.
 3. Material Safety Data Sheet (MSDS), if applicable.
- C. Prepare and submit a Surface Water Management and Erosion and Sediment Control Plan that includes the following, at a minimum:
1. Descriptions of the surface water management and erosion and sediment control measures to be implemented throughout the duration of the contract;
 2. Methods for installing and maintaining surface water management and erosion and sediment control measures;
 3. Drawings illustrating, in plan view, the location and sequencing of the surface water management and erosion and sediment control measures;
 4. Methods and measures for collection and discharge of surface water from the excavated areas and measures to minimize erosion of the excavated areas during progress of the work, inclement weather and at the end of each work day;
 5. Methods of minimizing sediment to Storm Water Retention Basin (SWRB) from water pumped from the excavations.
 6. Sequence of work to ensure that stormwater management and erosion and sediment control measures are maintained until completion of work.

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- D. Contractor's records of inspection of erosion and sediment control measures as described herein shall be submitted weekly upon completion of the inspection report.

1.5 INSPECTION

- A. Inspect erosion and sediment control measures to evaluate the effectiveness of, and need for maintenance of, the control measures. Any repairs to the erosion and sediment control measures shall be corrected within 24 hours of problem discovery. Inspections shall occur, at a minimum, at the following frequencies by a representative of the Contractor and the Construction Manager:
1. Weekly;
 2. Daily after each rain event exceeding 0.5 inches at the Fernald Environmental Management Project (FEMP). Information shall be obtained from the Construction Manager for rain events.
 3. Daily inspections during rainfall events after two consecutive days of rainfall at the FEMP.
- B. All inspections shall be conducted and documented in accordance with this Section. The Contractor shall maintain a copy of the inspection records on site with the original submitted as specified in this Section.
- C. The inspection report shall summarize the scope of the inspection, name of the inspector(s), inspection date, observations relating to the implementation of the erosion and sediment control measures, destination of pumping ponded water, estimated quantity of ponded water and corrective action measures, if any, that are required. The report shall indicate if any areas are not in compliance or contain a verification that control measures are effective and in compliance with this Section.

1.6 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Silt fence, if used, shall at a minimum be composed of strong rot-proof polymeric fibers formed into a woven or non-woven fabric which have properties and dimensions as specified in ODNR and this Section.
- B. Seeding shall be in accordance with Section 02900.
- C. Crusting agent shall be as approved by the Construction Manager and shall meet the following requirements:
 1. The crusting agent shall be an emulsion comprised of a 100% organic emulsion produced from naturally occurring resins. The crusting agent shall not be comprised of chloride, lignosulfonate, petroleum, or asphaltic type emulsions. The crusting agent must provide dust suppression and surface stability for exposed soils, both disturbed and undisturbed soils. The crusting agent shall be compatible with application via a hydro seeder, and must not require intense cleaning of equipment after application. Once cured, the crusting agent shall be non-tracking (i.e., will not stick to boots or tires).
 2. The crusting agent shall not have hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261 for a hazardous waste in either its pre-applied or cured states.
 3. The crusting agent shall have a flash point greater than 200°F. The crusting agent shall be neither a flammable nor combustible liquid per DOT definition. The crusting agent must not be susceptible to significant deterioration from exposure to the elements, including sunlight.

PART 3 EXECUTION**3.1 GENERAL**

Construct and maintain erosion and sediment control measures as specified in this Section and as shown on the Construction Drawings. Maintain existing erosion and sediment control facilities and measures in accordance with this Section.

3.2 SILT FENCES

- A. Place prior to start of excavation activities, where needed. Remove accumulated sediment when deposition reaches one-third the height of the silt fence or sooner if accumulated sediment prevents performance of silt fence as directed by the Construction Manager; remove accumulated sediment within 24 hours of discovery. Sediment shall be removed as specified in this Section.
- B. Install breaks and overlaps to allow equipment access to the construction area.

3.3 STABILIZATION OF INACTIVE EXPOSED EXCAVATION AND CONSTRUCTION AREAS

- A. Disturbed areas that are planned to be left idle for more than 45 calendar days shall be stabilized as soon as possible, but no longer than seven (7) days after the last activity. Soils shall be stabilized by one of the following methods as directed by the Construction Manager:
 - 1. Crusting agents shall be applied in accordance with manufacturer's recommendations as specified in this Section.
 - 2. Seeding shall be applied as specified in Section 02900.

3.5 SEDIMENT REMOVAL

- A. Remove accumulated sediment from temporary sumps, ditches, and sediment control measures as directed by the Construction Manager. In no case shall sediment reduce the available depth in the ditches and sediment control measures to less than two-thirds the depth shown on the Construction Drawings.
- B. Dispose of sediment as specified in Section 02205.

3.6 CRUSTING AGENT

- A. The material shall be applied at the rates recommended by the manufacturer or as directed by the Construction Manager. Reapply as necessary to inhibit erosion and dust.
- B. Apply crusting agent according to manufacturers directions. Unless specified otherwise by manufacturer, dilute concentrate emulsion to ratio of four parts water to one part concentrate. Apply diluted solution at the rate of 2,500 gallons per acre.
- C. Dilution ratio and application rate are subject to further adjustment at direction of Construction Manager to optimize performance of crusting agent.

3.7 REMOVAL OF TEMPORARY EROSION CONTROL FACILITIES

Remove silt fence at the direction of the Construction Manager after the disturbed areas are established with satisfactory conditions of seeding as specified in Section 02900.

END OF SECTION

SECTION 02506
AGGREGATE MATERIALS

PART 1 GENERAL

1.1 SCOPE

This Section includes but is not limited to: Materials placement and compaction requirements for aggregate for pipe bedding, Perimeter Drain bedding and backfill and Special Material Transfer Area and Debris Area.

1.2 RELATED SECTIONS

Part 6 - Statement of Work.

1.3 REFERENCES

State of Ohio, Department of Transportation (ODOT), Construction and Material Specifications, January 1, 1997, except as supplemented or otherwise modified herein and/or shown on the Construction Drawings.

1.4 SUBMITTALS

- A. Provide submittals as required in Part 6.
- B. Submit the following for review and approval:
 - 1. Submit Certificate of Compliance of aggregate material attesting to conformance with the material requirements in Article 2.1.
 - 2. Manufacturer of geotextile along with technical data and certification from the manufacturer or supplier that the geotextile fabric meets the material requirements specified in this Section.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Aggregate Base materials for Special Material Transfer Area/Debris Stockpile and gravel walkway shall conform to ODOT Item 304.02.
- B. Coarse aggregate for perforated perimeter drain bedding and backfill shall conform to ODOT Item 703, # 2 stone.
- C. Geotextile fabric shall conform to ODOT Item 712.09, Type D.
- D. Pipe bedding for Transfer Line and non-perforated perimeter drain shall conform to ODOT Item 304.02.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that subgrade has been prepared.
- B. Subgrade surface shall be free of sticks, stones, or other materials which could damage the geotextile fabric.

3.2 GEOTEXTILE PLACEMENT

- A. Place geotextile on the prepared subgrade under the aggregate material within the SMTA/Debris Stockpile and gravel walkway in accordance with manufacturer's installation instructions and as follows:
 - 1. Take precautions to prevent damage to underlying subgrade, including rutting during placement of geotextile fabric.
 - 2. Geotextile fabric shall be placed directly over the subgrade. The geotextile fabric shall be placed and temporarily anchored in such a manner that placement of overlying materials will not tear or excessively stretch the fabric.

3. Geotextile fabric shall be installed to the limits of aggregate surface as indicated on the Construction Drawings. The geotextile fabric shall be unrolled as smooth as possible on the prepared subgrade. Wrinkles and folds in the geotextile fabric shall be removed by stretching and placing of sod staples or small aggregate piles as required. The fabric shall be installed according to the manufacturer's suggestion at curve locations.
4. The geotextile fabric shall be field joined, factory seamed, or manufactured in seamless width. Methods of field joining shall include overlapping of adjacent edges and ends of geotextile fabric a minimum of 18-inches. Sand bags or other weights may be used for temporary anchoring.
5. Geotextile fabric shall be covered with the required aggregate the same day as fabric laydown.
6. Construction traffic shall not be permitted directly on the geotextile fabric.
7. Geotextile fabric is not required when additional aggregate material is to be added to existing aggregate surface, unless otherwise directed by the Construction Manager.

3.4 AGGREGATE BASE AND COARSE AGGREGATE MATERIAL PLACEMENT

- A. Construct the aggregate surface to the limits and thicknesses indicated on the Construction Drawings.
- B. End dumping or tailgate dumping shall not be permitted directly onto the geotextile fabric. The aggregate shall be dumped adjacent to the fabric or on previously placed stone. The aggregate shall be spread from the backdumped pile using a bulldozer, loader, track hoe, or grader, with care being taken to avoid damage to the fabric by blades, tracks, tires, or buckets.
- C. Immediately following spreading, the aggregate material shall be shaped to the required smoothness and thickness, and compacted. The initial lift of aggregate on the geotextile shall be a minimum thickness of 6 inches after compaction. The desired degree of compaction will be

considered to have been reached when the surface is tightly bound and shows no undue rutting or displacement under operations of the roller or other equipment. The determination of undue rutting or displacement will be made by the Construction Manager.

- D. When additional aggregate material is to be added to existing compacted aggregate, scarify existing aggregate to a depth of 3 inches.

3.5 QUALITY CONTROL

A. Tolerances:

1. Grade the aggregate surface to a smooth uniform surface.
2. The thickness of the finished aggregate surface shall be no less, at any point, than the thickness indicated on the Construction Drawings.

END OF SECTION

SECTION 02668
TRANSFER LINES AND PERIMETER DRAIN

PART 1 GENERAL

1.1 SCOPE

This Section includes, but is not limited to:

- A. High density polyethylene pipe and fittings for transfer lines.
- B. Tie-in to existing pipe flanges at the K-65 trench.
- C. High density polyethylene perforated pipe and solid pipe, fittings and geonet for Perimeter Drain.
- D. Tie-in to existing storm sewer system.

RELATED SECTIONS AND PLANS

- A. Section 02206 - Earthwork.
- B. Section 02506 - Aggregate Materials.
- C. Section 15060 - Pipe, Fittings, Valves and Accessories.
- D. Part 6 - Statement of Work.

1.3 REFERENCES

- A. American Society for Nondestructive Testing (ASNT):
1. ASNT-SNT-TC-1A-96 Personnel Qualifications and Certification Recommended Practice, December 1992 Edition.
- B. American Society for Testing and Materials (ASTM) Standards:

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1. ASTM A126-95 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. ASTM D413 Test Methods to Determine Peel Strength of Geotextile to Geonet.
3. ASTM D1056 Standard Specifications for Gasketed Connections.
4. ASTM D1248-84 (1989)e1 Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
5. ASTM D2321 Standard Practice for Installing High Density Polyethylene (HDPE) Drain Pipe.
6. ASTM D2657-90 Standard Practice for Heat Joining Polyolefin Pipe and Fittings.
7. ASTM D3350-96 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
8. ASTM F714-97 Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
9. ASTM F810 Standard Specifications for Polyethylene (PE) Plastic Pipe Based on Perforations.

C. American Water Works Association (AWWA):
 AWWA C207-94 Steel Pipe Flanges for Waterworks Service.

D. American Association of State Highway and Transportation Officials:

1. AASHTO M252 Corrugated Pipes with Smooth Interior.
2. AASHTO M294 Corrugated Pipes with Smooth Interior.

1.5 SUBMITTALS

A. Provide submittals as required in Part 6.

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- B. Product Data: Provide data on all geonet, pipe materials, pipe fittings, accessories, manholes, manhole lids, lift station and the methods and equipment for HDPE fusion welding.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements of this Section.
- D. Submit documentation of training and certification of personnel qualified to perform butt-fusion welding of HDPE pipe and fittings.
- E. Pressure test and examination reports, within 7 calendar days after completion of test or examination.
- F. Nondestructive testing personnel qualifications shall be in accordance with ASNT SNT-TC-1A.

PART 2 PRODUCTS

2.1 MATERIALS

- A. All pipes shall be new material that has not been previously used. For new and existing steel pipe see Section 15060.
- B. Pipe bedding material shall be in accordance with Section 02506.
- C. Transfer Line and Fittings:
 1. Transfer pipe and fittings shall be Iron Pipe Size (IPS), high-density polyethylene (HDPE) PE 3408 pipe, Type III, Class C, Category 5, Grade P34, in accordance with ASTM D1248, with cell classification 345434C in accordance with ASTM D3350, Minimum Pressure Class 150. All piping and fittings shall be of the same material and shall have a Dimension Ratio (DR) as indicated on the Construction Drawings (ASTM F714). Pipe and fittings shall be from the same manufacturer. The manufacturer's name and DR shall be marked on the

side of the pipe. Transfer line and fittings shall be of the size indicated on the Construction Drawings.

2. Mechanical Joints:

- a. Mechanical joints shall be made using HDPE flange adapters. Provide nipple-end for butt fusion to transfer pipe. Flat-face suitable for use under pressure with flange sealing gasket.
- b. Metal back-up rings shall be Class D, slip-on type, in accordance with AWWA C207. Back-up rings shall be supplied by the manufacturer or supplier of HDPE pipe.
- c. Bolts used with back-up rings on mechanical joints shall be semifinished hex head, Type Grade B8, UNC threads.
- d. Nuts shall be semi-finished regular hex head, Grade 8F, UNC threads.

D. Perimeter Drain and Fittings:

1. Perimeter Drain Pipe and fittings shall be high-density polyethylene (HDPE) Sure-Lok by Hancor or approved equal. The Perimeter Drain shall have a smooth interior and annular exterior. Pipes of 4 inches to 10 inches shall meet the requirements of AASHTO M252, Type S.
2. The Perimeter Drain shall be perforated in accordance with ASTM F 810. Perforations shall consist of rows of equally spaced, 1/2 inch diameter holes on 5-in. centers. The Perimeter Drain pipe shall only be perforated for those length of pipe located along the bottom of the basin. Sections of pipe running from the bottom of the basin to the lift station or from the lift station to the outflow connection points shall not be perforated.
3. Join pipe with coupling bands or push on couplers that cover at least two full corrugations on each end of pipe. Standard (non-gasketed) connections shall meet the soil-tightness requirements of the AASHTO Standard Specification for Highway Bridges, Section 26, paragraph 26.4.2.4(e). Gasketed connections shall incorporate a closed cell

synthetic expanded rubber gasket meeting the requirements of ASTM D1056 Grade 2A2.

- 4. Fittings shall conform to AASHTO M252 and M294. Weld fabricated fittings on the interior and exterior of all junctions.
- 5. Pipe and fitting material shall meet the high density polyethylene requirements of ASTM D3350 Cell Classification 325420C; or ASTM D1248 Type III, Class C, Category 4, Grade P33.
- 6. Install according to ASTM D2321.

- E. Geonet shall be a geotextile/geonet/geotextile composite and shall be Tex-Net Ultra TN3001 as manufactured by National Seal Company or approved equivalent.
- F. Marking Tape: Plastic marking tape, color green with metallic strip for locating pipe.
- G. Manhole for lift station, meter box shall be as indicated on the Construction Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

Verify existing conditions, tie-in connection, line size, line type, location, and inverts in area of work. Any discrepancies shall be brought to Construction Manager's attention in a written statement immediately upon discovery.

3.2 PREPARATION

Remove scale and dirt on inside and outside of new pipe and fittings and existing pipe at joints, prior to assembly.

3.3 ERECTION/INSTALLATION/APPLICATION

- A. Install pipe from carbon steel to HDPE transition at the tie-in with the existing pipe flange at the K-65 Trench, as indicated on the Construction Drawings.

- B. Sections of pipe with cuts, gouges or scratches on the outside diameter (OD) surface that exceed 10 percent of the wall thickness of the pipe shall be removed completely and rejoin ends of the pipe. The inside diameter (ID) surface shall be free of cuts, gouges and/or scratches.
- C. Join HDPE piping and fittings by butt weld fusion method, in accordance with manufacturer's recommendations and ASTM D2657. Extrusion welding shall only be used where butt-fusion welding cannot be performed and as approved by the Construction Manager. Hot gas welding shall not be used.
- D. Route pipe as shown on Construction Drawings. The minimum bending radius shall be as specified by the pipe manufacturer.
- E. Install above ground as indicated on the Construction Drawings.
- F. Locate below ground installations as indicated on Construction Drawings. Trenching and backfilling shall be in accordance with Section 02206.
- G. Install Perimeter Drain as indicated on the Construction Drawings and as recommended by the manufacturer.
- H. Geonet Installation:
1. Lay geonet with machine direction of the fabric parallel to the slope.
 2. Shingle overlap adjacent rolls in the down slope or down stream direction a minimum of 12 inches.
 3. Secure overlapped seams with steel securing pins or as recommended by the manufacturer.
 4. Pin spacing shall be 2 feet in all directions along overlapped seams to secure geonet to the soil.

I. Testing of HDPE shall be as specified in Section 15060.

END OF SECTION

SECTION 02713
GEOMEMBRANE LINER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Geomembrane materials, manufacture, fabrication, and installation of a geomembrane liner on the excavated Lime Sludge Ponds.
- B. Geonet material as specified in Section 02668.
- C. Use of geosynthetics for erosion control is specified in Section 02270.

1.2 RELATED SECTIONS

- A. Section 02050 - Surveying.
- B. Section 02270 - Erosion and Sediment Control.
- C. Section 02668 - Transfer Lines and Perimeter Drain.
- D. Part 6 - Statement of Work.
- E. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D638-96 Standard Test Method for Tensile Properties of Plastics.

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2. ASTM D746-95 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
3. ASTM D1004 REV A -94 Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
4. ASTM D1204-94 Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperatures.
5. ASTM D1505-85 Standard Test Method for Density of Plastics by the Density-Gradient Technique.
6. ASTM D4437-84 Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
7. ASTM D5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

B. Federal Test Method Standard (FTMS):

1. FTMS 101B-71 Method 2065, Puncture Resistance and Elongation Test.

C. United States Environmental Protection Agency (US EPA):

1. US EPA Technical Guidance Document EPA/600/2-88/052 Lining of Waste Containment and Other Impoundment Facilities, 1988.
2. US EPA Technical Guidance Document EPA/530/SW-91/051 Inspection Techniques for the Fabrication of Geomembrane Field Seams, May 1991.

D. National Sanitation Foundation (NSF):

1. Standard Number 54-93 Flexible Membrane Liners.

1.4 SUBMITTALS

- A. Provide submittals as required by Part 6.
- B. Submit samples of the proposed geomembrane.
- C. Submit a Certificate of Compliance from the manufacturer in accordance with Part 6 of the Contract Documents for the geomembrane material.
- D. Submit quality control certificates issued by the producer of the raw materials used to manufacture the geomembrane. These certificates shall include the following.
 - 1. Origin, identification, and production plant location of the resin used to manufacture the geomembrane.
 - 2. Reports of testing conducted to verify the quality of the resin including the stabilization compounds used to manufacture the geomembrane, with signature of authorized official. Properties testing typically performed by the resin manufacturer shall be included in the reports.
- E. Submit liner installation plan showing proposed geomembrane panel layout, panel size, shop and field seams, and location of test coupons 20 working days prior to liner installation. The drawings shall include number or letter of panels and cross-reference surrounding panels, details of seaming the geomembrane, connections, penetrations, pipe boot fabrication, and other construction related details. Shop drawings shall be prepared in accordance with Part 6 of the Contract Documents.
- F. As-builts: Submit as-built drawings showing geomembrane panel layout, panels size, seam type and location, location of test coupons, and areas where repairs were made. Drawings shall be prepared in accordance with Part 6 and Section 02050.
- G. Submit inspection and testing data for factory fabricated seams.

- H. Submit geomembrane manufacturer's quality control manual including description of laboratory facilities.
- I. Submit results of the manufacturer's physical properties testing in accordance with the approved QA Manual. Testing shall include, but not be limited to, the typical properties outlined in Table 1.
- J. Submit Liner Subcontractor and Installation Supervisor qualifications in accordance with Part 6 and this Section.

1.5 DEFINITIONS OF TERMS

- A. **Manufacturer:** The manufacturer is the firm or corporation responsible for production of the finished rolls of geomembrane material from raw material polymer to be used in the project. The manufacturer is responsible for the condition of the geomembrane until the material is accepted by the Construction Manager or his/her field representative upon delivery. The manufacturer shall produce a consistent product meeting the project specifications and shall provide quality control documentation for the product specified herein.
- B. **Liner Subcontractor:** The Liner Subcontractor is the firm responsible for installation of the geomembrane. The Liner Subcontractor shall be the manufacturer or an approved installer trained and certified to install the manufacturer's geomembrane. The Liner Subcontractor shall provide an Installation Supervisor responsible for the field crew.
- C. **Film Tear Bond (FTB):** A failure in the ductile mode of one of the bonded sheets by testing prior to complete separation to the bonded area as depicted in US EPA Technical Guidance Document EPA/600/2-88/052. A seam shall be classified as a FTB if no greater than 10 percent of the seam width peels (separates) at any point.
- D. **Geomembrane:** A synthetic lining material.

1.6 QUALITY ASSURANCE PROGRAM

- A. A laboratory shall be maintained by the manufacturer of the geomembrane materials at the point of manufacture to ensure quality control in accordance with ASTM and FTMS testing procedures (referenced in Section 1.4, as applicable). That laboratory shall maintain records of its quality control results and provide to Fluor Daniel Fernald (FDF), prior to shipment, a Certificate of Compliance stating that all rolls of geomembrane material supplied are in compliance with specification physical properties requirements.
- B. The certificate shall include the name of the manufacturer, chemical composition, product description, statement of compliance to specification physical properties requirements, and the signature of authorized official attesting to the information required.
- C. Testing of factory fabricated seams for geomembrane shall be performed by the manufacturer. The manufacturer shall inspect and test 100 percent of factory fabricated seams in accordance with these specifications.
- D. Testing of geomembrane materials during construction will be performed by contractor.
- E. Geomembrane shall be randomly sampled and tested in accordance with the manufacturer's approved QC manual. Samples not meeting the minimum requirements specified shall result in the rejection of the applicable sheets.
- F. The Liner Subcontractor shall have installed a minimum of 1 million ft² of High-Density Polyethylene (HDPE) geomembrane.
- G. The Installation Supervisor shall have demonstrated experience in installing and seaming of a minimum of 500,000 ft² of HDPE geomembrane liner systems for similar applications. The Installation Supervisor shall remain on site and be responsible for the liner

layout, seaming, patching, repairs, testing coordination with FDF, and all other activities associated with installation of the geomembrane.

1.7 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Each roll of geomembrane shall be marked to show the following minimum information:
1. Name of manufacturer.
 2. Product type.
 3. Physical dimensions (length and width).
 4. Roll identification number.
- B. The Contractor shall review, inspect, and place into proper storage all materials received on site until their installation. All such materials shall be inspected to verify their conformance with the requirements of these specifications and that they are free of defects. Any nonconforming or defective materials shall be clearly marked and promptly repaired per approved procedure or removed from the job site.
- C. When the geomembrane materials are delivered to the construction site, FDF, or designated representative, will inspect to confirm that the material is the material that was specified and that the material is not damaged. Inspection activities shall prevent, detect, and correct the following:
1. Puncture from nails or splinters.
 2. Tears from operation of equipment or inadequate packaging.
 3. Blocking (the bonding together of adjacent membrane layers), which may be caused by excessive heat.
 4. Crumpling or tearing from inadequate packaging support.

D. Handling

1. Palletted geomembrane panels shall be accordion folded width-wise and length-wise without causing damage to the geomembrane.
2. Banding straps around the geomembrane and pallet shall be properly cushioned so as not to cause damage to any part of the geomembrane panel.
3. The stacking of palletted geomembrane panels on top of one another is not permitted.
4. Damage shall be avoided by careful handling of the geomembrane material during preparation for shipment and of the packaged crates and rolls of material.
5. When damage to a crate or roll cover has occurred, careful examination of the underlying material is required. If damage is found, the Contractor and FDF will carefully examine the entire shipment for damage.

E. Storage: Sufficient quantities of materials shall be stockpiled to meet project schedule and requirements. Materials shall be stored on site at locations designated by FDF.

F. The Contractor shall be responsible for unloading, storage, and care of the geomembrane material until such material has been incorporated into the work. Materials shall be stored in a manner that prevents damage in accordance with the manufacturer's recommendations. The materials shall be stored on a prepared surface (excluding wooden pallets) and shall not be stacked more than two rolls high.

G. The Contractor shall be responsible for replacing any damaged or unacceptable material at no expense to FDF.

1.9 SEQUENCING AND SCHEDULING

The Contractor shall provide a sequence and schedule of work for the approval of FDF as part of the Liner Installation Plan.

PART 2 PRODUCTS

2.1 MANUFACTURERS

HDPE liner shall be Frictionflex, textured both sides, by GSE Lining Technologies Systems Inc., equivalent products by SERROT Corp., POLY-FLEX Corp., National Seal Company, or other approved equal.

2.2 EQUIPMENT

- A. The Liner Subcontractor shall use appropriate installation and welding equipment per the manufacturer's instructions.
- B. Welding Equipment: The welding equipment used shall be capable of continuously monitoring and controlling the extrusion/fusion zone. The fillet-extrusion welding device provides continuous dynamic integration of the extrudate into the sheet material through the means of rotating tips in the nozzle. The composition of the extrudate (welding rod) is identical to the flexible membrane liner. This method of seaming is applied for all tees, patches, "fishmouths," and detail work. The fusion welding device employs a dual hot wedge (hot shoe) and compression. The system lifts both layers of flexible membrane liner off the subgrade, and fusion is brought about by melting the sheets against the hot wedge and compressing the two melted surfaces together, resulting in a total integration of the layers.

2.3 MATERIALS

- A. Liner: The textured 60 mil HDPE geomembrane shall be designed and manufactured specifically for the purpose of containment of liquids in hydraulic structures. It shall be manufactured from new, first-quality HDPE resin and shall meet the physical requirements indicated in the Physical Properties Table (Table 1).
- B. Other Materials

1. Boots for pipe and other structure penetrations shall be prefabricated and designed to fit site-specific conditions for the intended slope and size of pipe. Boots shall be of the same material as the geomembrane.

C. Typical Physical Properties:

Table 1 - Geomembrane Physical Properties (Textured)

Typical Properties	Test Method	Gage (Nominal) 60 mil (1.5 mm) HDPE
Density g/cc. (Min.)	ASTM D1505	0.94
Tensile Properties (Typical Min.)	ASTM D 638 Type IV Dumb Bell at 2 ipm	
1. Tensile Strength at Break (Pounds/inch width)		100
2. Tensile Strength at Yield (Pounds/inch width)		126
3. Elongation at Break (Percent)		200
4. Elongation at Yield (Percent)		13
Tear Resistance Initiation, lbs. (Min.)	ASTM D1004 Die C	42
Low Temperature Brittleness, F (Min.)	ASTM D746 Procedure B	-94
Dimensional Stability, Percent Change Each Direction (Max.)	ASTM D1204 212 degrees F 1 hr.	±1
Puncture Resistance, Pounds (Min.)	FTMS 101B Method 2065	75

2.4 FACTORY FABRICATION

- A. Geomembrane liner shall be factory seamed into panels as large as possible for transportation and for the areas to be lined.

- B. Factory fabrication shall be performed under environmental conditions as recommended by the manufacturer.
- C. The geomembrane material shall be continuously inspected for uniformity, damage, imperfections, holes, cracks, thin spots, foreign materials, tears, punctures, and blisters. Any imperfections shall be immediately repaired and reinspected.
- D. All seams shall be visually inspected and results documented.
- E. Nondestructive seam testing shall be performed on all fabricated seams over their full length in accordance with ASTM D4437 and the manufacturer's quality control manual. Test methods shall be vacuum chamber or pressurize air channel, except air lance may be used on inaccessible seams.
- F. All inspection and testing of factory seams shall be performed by the manufacturer's laboratory.
- G. Failure of the material and/or seams to meet all the requirements of these specifications may be cause for rejection of the geomembrane material and/or seams, as appropriate.
- H. In addition to visual inspection and nondestructive testing, a 48-inch sample shall be taken from each factory seam welding unit used in this work at the beginning of every work shift and every 4 hours of production thereafter. Samples shall be from the same production lot as the field panels (i.e., will not require patching of fabricated panels). Test specimens shall be cut at quarter points from each 48-inch seam sample (a total of three places) and tested for factory seam shear strength and peel adhesion. The seam shear strength shall be tested in accordance with ASTM D4437, as modified in Annex A of NSF 54, and shall have a tensile strength of at least 90 percent of the parent geomembrane strength. Failure of seam shall be classified as FTB. The peel adhesion shall be tested

in accordance with ASTM D4437, as modified in Annex A of NSF 54, and shall provide a peel strength that is greater than 60 percent of the parent geomembrane yield strength. Failure of seam shall be classified as FTB.

PART 3 EXECUTION

3.1 PREPARATION

- A. The earthen surface shall be smooth and true to grade with no exposed rocks, stones, sticks, roots, or other sharp objects or debris of any kind larger than 2" in any direction.
- B. Before starting installation of the liner, the Liner Subcontractor shall inspect the substrate for suitability with the requirements of the liner. The liner installer shall certify in writing that the surface on which the membrane is to be installed is acceptable before commencing work.
- C. During the time of liner installation, the Liner Subcontractor shall be responsible for protection and maintenance of the exposed subgrade until final acceptance of the liner.

3.2 ERECTION/INSTALLATION/APPLICATION

- A. Verify gradients and elevation of subgrade.
- B. Verify that subgrade is dry.
- C. Geomembrane liner shall be placed and anchored in such a manner that fabric will not excessively stretch or tear.
- D. Appropriate measures shall be taken during installation to provide sufficient slack in the liner to avoid the generation of excessive stresses in the liner due to temperature changes.

E. Field seams shall be made using either the dual hot wedge (fusion) welding or the fillet-extrusion welding process (for areas not accessible with the dual hot wedge method). Field seams shall be made only when weather conditions are favorable. The contact surfaces shall be free of dirt, dust, moisture, or other foreign material. The contact surfaces shall be aligned with sufficient overlap and bonded in accordance with the liner manufacturer's recommended procedures. Wrinkles shall be smoothed out, and seams shall be inspected by nondestructive testing techniques to verify their integrity.

F. Deployment

1. The geomembrane shall be deployed following the manufacturer's recommendations so that, at the time of installation, it will contain a minimum of wrinkles and be under minimum stress.
2. Each panel/roll of the geomembrane shall be rolled out and installed in accordance with the approved shop drawings. The layout shall be designed to keep field joining of the geomembrane to a minimum and to be consistent with proper methods of geomembrane installation.
3. The geomembrane shall be unfolded or unrolled so as to prevent damage to the underlying or prepared subgrade or geonet.
4. Should punctures, rips, or tears be encountered in the geomembrane material, the Contractor shall immediately notify FDF and repair as necessary.

G. Seaming Weather Conditions

1. Normal Weather Conditions
 - a. The normal required weather conditions for seaming are as follows:
 - 1) Ambient temperature as recommended by the manufacturer.
 - 2) No precipitation or other excessive moisture, such as fog, dew, or ponded water.
 - 3) No excessive winds.
 - b. These weather conditions shall be fulfilled during seaming process.

2. Cold Weather Conditions

- a. If the ambient temperature is below 40 degrees F, seaming of geomembrane shall not be permitted unless the Contractor can demonstrate to FDF's satisfaction that geomembrane seam quality is not adversely impacted. The following conditions shall also be met to ensure a quality seaming process:
- 1) Preheating the surface of the geomembrane to achieve normal temperature range.
 - 2) Preheating may be waived by FDF if the Contractor demonstrates that satisfactory welds of equivalent quality may be obtained without preheating at the expected temperature of installation.
 - 3) Preheating devices shall be approved by the manufacturer.
 - 4) Care shall be taken to ensure that surface temperatures are not lowered below the minimum required surface temperature for welding due to winds.
 - 5) Additional destructive test samples shall be taken at FDF's discretion.
 - 6) Trial seams shall be performed under the same ambient temperature conditions as the actual seams.

3. Warm Weather Conditions

- a. If the ambient temperature is above 104 degrees F, seaming of geomembrane shall not be permitted unless the Liner Subcontractor can demonstrate to FDF's satisfaction that geomembrane seam quality is not adversely impacted.
- b. Test seams shall be performed under the same ambient temperature conditions as the actual seams.
- c. Additional destructive test samples shall be taken at FDF's discretion.

H. Field Seaming

1. Panel field seaming shall be performed using the dual hot wedge welding techniques as outlined in Section 7 of US EPA Technical Guidance Document EPA/530/SW-91/051. Welding equipment and seaming temperatures shall be in accordance with the manufacturer's recommendations.
2. Field seams shall be oriented parallel to the line of maximum slope.
3. Unless directed otherwise by FDF, minimum overlap for field seams shall be in accordance with the manufacturer's recommendations.
4. The welding equipment used shall be capable of continuously monitoring and controlling the temperatures in the zone of contact where the machine is actually fusing the lining material to ensure that changes in environmental conditions will not affect the integrity of the weld.
5. Welding of field seams with an extrusion welder is only acceptable for repairing holes in the liner, repairing failed seams revealed by nondestructive testing, repairing areas where destructive testing is performed, at pipe/liner penetration boots, and other areas where the hot wedge welding machines cannot be used due to space restrictions.

I. The liner shall be placed over the prepared surface in such a manner as to ensure minimum handling. The geomembrane shall not be dragged over rough subgrade surfaces. Any damage to the base surface resulting from liner installation or liner handling equipment shall be repaired by the Liner Subcontractor at its own expense prior to placement of the liner. Vehicular traffic across the geomembrane shall not be allowed. The panels shall be such lengths and widths and shall be placed in such a manner as to minimize field seaming.

J. In areas where wind is prevalent, liner installation shall be started at the upwind side of the project and proceed downwind. The leading edge of the liner shall be secured at all times with sandbags or other means sufficient to hold it down during high winds.

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- K. Sandbags shall be used as required to hold the liner in position during installation. Materials, equipment, or other items shall not be dragged across the surface of the liner nor be allowed to slide down slopes on the liner.
- L. Liner panels shall be closely fit and sealed by extrusion weld around inlets, outlets, and other projections through the liner
- M. All joints shall be tightly bonded on completion of the work. Any liner surface showing injury resulting from scuffing, penetration by foreign objects, or distress from rough subgrade shall be repaired or replaced as approved by FDF.
- N. Each suspect location shall be nondestructively tested using methods described in Section 1.4 as appropriate. The Liner Subcontractor shall not proceed with any materials which will cover locations that have been repaired until satisfactory test results have been obtained.
- O. Pipe/Liner Penetration Boots
 - 1. The geomembrane boots shall be furnished and installed where indicated on the Construction Drawings.
 - 2. The geomembrane boots shall terminate in a skirt section suitable for welding to the geomembrane.
 - 3. Boots and skirts shall fit snugly around the pipe or structures. Prefabricated material shall be designed to fit site-specific conditions for the intended size and slope of pipe.
 - 4. The geomembrane shall be secured to the pipe or structures with clamps, sealing gaskets, O-rings and/or mastic compound as shown on the Construction Drawings after pipe/liner penetration geomembrane pipe 'boots' have been tested.

P. Any wrinkles that can fold over shall be repaired either by cutting out excess material or, if possible, allowing the liner to contract due to temperature reduction prior to placing the overlying material. In no case shall material be placed over the geomembrane which could result in the geomembrane folding.

Q. Destructive Seam Testing

1. Two types of samples shall be taken at each location, one for field tests and one for laboratory tests.
2. For the field tests, two seam samples, 1 inch wide by 12 inches long with the seam centered across the length shall be taken 42 inches apart. These sample coupons shall be removed by the Liner Subcontractor for every 500 feet of seam length. A minimum of three samples shall be tested, including at least one for each day's production seaming.
3. Upon obtaining each sample, assign a number to the sample and mark it accordingly. Record sample location on the layout drawing. Record the purpose of the sample (i.e., statistical, routing, or suspicious weld area).
4. These samples shall be tested in the field using a tensiometer capable of quantitatively measuring shear and peel strengths.
5. The sample coupon shall be divided into three equal parts: one part for laboratory testing, one part to the Construction Manager for archive storage, and one part to the Liner Subcontractor for field testing. The sample coupon shall be tested in the testing laboratory for shear strength and peel adhesion.

R. Repair Procedures

1. Any portion of the geomembrane failing a destructive test, nondestructive test, or any damaged portion shall be repaired in accordance with this Section and the manufacturer's recommendations.
2. All surfaces shall be clean and dry at the time of the repair.

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3. The repair procedures, materials, and techniques shall be approved in advance of the specific repair by FDF. Approved methods from which the selected repair shall be chosen are as follows:
 - a. Patching - used to repair large holes, tears, large panel defects, and destructive sample locations.
 - b. Capping - used to repair failed welds or to cover seams where welds cannot be nondestructively tested.
 - c. Removal - used to replace areas with large defects where the preceding methods are not appropriate. Also used to remove excess material (wrinkles) from the installed geomembranes.
4. If a sample fails one of the destructive tests, the seam shall be reconstructed using one of the following methods:
 - a. The seam shall be reconstructed between the location of the sample which failed and the location of the next passing sample in each direction.
 - b. The welding path is retraced to an intermediate location at least 10 feet from the location of the failed sample and a second sample is taken for additional testing. If the second test sample passes, the seam shall then be reconstructed between the location of the second test and the original sampled location. If the second test fails, this process shall be repeated.
5. All acceptable seams shall extend between two locations where samples passed the required test and shall include one test location along the reconstructed seam.
6. Each major repair requiring a patch or cap shall be identified on the as-built drawing.
7. Each repair shall be numbered and logged by the Liner Subcontractor. Each repair shall be nondestructively tested using methods described in this section. Repairs which pass the nondestructive test shall be taken as an indication of an adequate repair. Repairs more

than 100 feet long may be sufficient to require destructive test sampling, at FDF's discretion. Failed tests indicate that the repair shall be redone and retested until passing test results are achieved. FDF shall observe all nondestructive testing of repairs. The Liner Subcontractor shall record the number of each repair, the test location, date, and test outcome.

3.3 QUALITY CONTROL

A. General: The Liner Subcontractor shall conduct a fully documented quality assurance/quality control program to ensure that all installation work is performed which will result in a secure, watertight liner. All quality control inspection and testing shall be performed by qualified personnel who are thoroughly knowledgeable about all installation procedures and techniques used.

Three copies of all inspection and test reports generated by the Liner Subcontractor shall be submitted to FDF not later than the second work day following their generation. As a minimum, the Liner Subcontractor shall provide written verification of the results of all of the following inspections and tests.

B. Weld Quality Control

1. A trial seam, 3 feet long, from each welding machine shall be run each day prior to liner seaming and under the same conditions as exist for the liner seaming. Additionally, at least once every 4 hours during continuous operation.

a. Samples of seam shall be cut from the test weld 1/4 inch to 1/2 inch wide and tested by field tensiometer in the peel and shear modes.

b. Should failure of the seam occur, another trial seam shall be prepared and tested. If the additional sample fails, the seaming apparatus and seamer shall not be accepted until deficiencies are corrected.

c. The trial seam shall be marked with the time of day, date, ambient temperature, and welding machine used in its production.

- d. The seam sample shall be kept for subsequent testing on laboratory tensiometer equipment in accordance with the applicable ASTM D1004 and D4437 tests. If either sample fails through the weld, the welding machine shall be adjusted as appropriate and another test weld produced and tested until satisfactory results are achieved. A calibrated, hand-operable tensile testing machine shall be furnished by the Liner Subcontractor for the purpose of tensile testing.
2. All welds, on completion of the work, shall be tightly bonded. Any membrane area showing injury due to excessive scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional piece of HDPE membrane.
 3. A quality control technician, employed by the Liner Subcontractor, shall follow behind each seam crew and perform a visual inspection of the seamed area. Defective seams shall be marked and repaired in accordance with manufacturer's published repair procedure.
 4. No "fishmouths" shall be allowed within the seam area. Where "fishmouths" occur, the material shall be cut and overlapped, and an overlap-extrusion weld shall be applied.
- C. Nondestructive Testing: All field seams (100 percent) shall be tested nondestructively. Fillet-extrusion welds are tested with a vacuum chamber in accordance with ASTM 4437. Hot wedge welds shall be dual seam pressure tested, pressurizing the air channel created by the split face design of the hot wedge per GRI GM-6.
- D. Destructive Seam Testing
1. Two types of samples shall be taken at each location, one for field tests and one for laboratory tests.
 2. For the field tests, two seam samples, 1 inch wide by 12 inches long with the seam centered across the length shall be taken 42 inches apart. These sample coupons shall be removed by the Liner Subcontractor for every 500 feet of seam length,

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unless more frequent testing is required by FDF. A minimum of three samples shall be tested, including at least one for each day's production seaming. The seams shall not be covered by another material before they have been tested and accepted by FDF.

3. Upon obtaining each sample, assign a number to the sample and mark it accordingly. Record sample location on the layout drawing. Record the purpose of the sample (i.e., statistical, routing, or suspicious weld area).
4. These samples shall be tested in the field using a tensiometer capable of quantitatively measuring shear and peel strengths.
5. The sample coupon shall be divided into three equal parts: one part for laboratory testing, one part to the Construction Manager for archive storage, and one part to the Liner Subcontractor for field testing. The sample coupon shall be tested in the testing laboratory for shear strength and peel adhesion.

E. Repair Procedures

1. Any portion of the geomembrane failing a destructive test, nondestructive test, or any damaged portion shall be repaired in accordance with this section and the manufacturer's recommendations.
2. All surfaces shall be clean and dry at the time of the repair.
3. The repair procedures, materials, and techniques shall be approved in advance of the specific repair by FDF. Approved methods from which the selected repair shall be chosen are as follows:
 - a. Patching - used to repair large holes, tears, large panel defects, and destructive sample locations.
 - b. Capping - used to repair failed welds or to cover seams where welds cannot be nondestructively tested.

- c. Removal - used to replace areas with large defects where the preceding methods are not appropriate. Also used to remove excess material (wrinkles) from the installed geomembranes.
4. If a sample fails one of the destructive tests, the seam shall be reconstructed using one of the following methods:
 - a. The seam shall be reconstructed between the location of the sample which failed and the location of the next passing sample in each direction.
 - b. The welding path is retraced to an intermediate location at least 10 feet from the location of the failed sample and a second sample is taken for additional testing. If the second test sample passes, the seam shall then be reconstructed between the location of the second test and the original sampled location. If the second test fails, this process shall be repeated.
 5. All acceptable seams shall extend between two locations where samples passed the required test and shall include one test location along the reconstructed seam.
 6. Each major repair requiring a patch of cap shall be identified on the as-built drawing.
 7. Each repair shall be numbered and logged by the Liner Subcontractor. Each repair shall be nondestructively tested using methods described in this section. Repairs which pass the nondestructive test shall be taken as an indication of an adequate repair. Repairs more than 100 feet long may be sufficient to require destructive test sampling, at FDF's discretion. Failed tests indicate that the repair shall be redone and retested until passing test results are achieved. FDF shall observe all nondestructive testing of repairs. The Liner Subcontractor shall record the number of each repair, the test location, date, and test outcome.

3.4 **CLEANING**

Remove and manage excess materials in accordance with Part 6.

3.5 **PROTECTION**

Provide protection from damage until anchorage and welding of seams has been accomplished and all testing and inspections are completed and completion of subcontract.

END OF SECTION

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SECTION 02900
SEEDING

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PART 1 GENERAL

1.1 SCOPE

This Section includes but is not limited to:

- A. Soil preparation.
- B. Interim seeding.
- C. Permanent seeding.
- D. Summer seeding.
- E. Application of fertilizer.
- F. Application of mulch and mulch binder.
- G. Application of crusting agent.

1.2 RELATED SECTIONS AND PLANS

- A. Part 6 - Statement of Work.
- B. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

- A. Title 40, Code of Federal Regulations (CFR), Part 161, Identification and Listing of Hazardous Waste.
- B. Sitewide Excavation Plan, current revision.
- C. Land Use Authority, Master Plot, Overall Plan, current plan.

1.4 SUBMITTALS

- A. Provide submittals as required in Part 6. Unless specified otherwise, submittals shall be made to the Construction Manager for review and approval.
- B. Submit the following within thirty (30) calendar days from Notice to Proceed:
 - 1. Proposed seed mixes and application rates for seed, mulch, mulch binder, and fertilizers.
 - 2. Manufacturer's product data and recommended methods of application for seed, mulches, mulch binder, and fertilizer. Product data for fertilizer shall also include chemical analysis including uranium analysis to assure there is no resultant or derived uranium from fertilizer use unless waived by the Construction Manager.
 - 3. Material Safety Data Sheet (MSDS) for fertilizer and mulch binder.
- C. Provide a plan showing seeding type by area (interim or permanent) and a written statement of proposed changes to seed mix and application rate of seed mix and/or associated materials (i.e., fertilizer, mulch, and mulch binder) a minimum of ten (10) calendar days before seeding. Choice of seeding type shall follow the Land Use Authority, Master Plot, Overall Plan and other pertinent project information according to when areas will be redisturbed.
- D. Submit certificate of compliance for the following within fifteen (15) calendar days before the seeding. Do not sow seed until the Construction Manager has reviewed and approved the certificates.
 - 1. Certificate stating seed mixture, guaranteed percentages of purity, weed content, germination of seed, name of seller, the test date for the seed, and the net weight and date of shipment;
 - 2. Manufacturer's certificate stating the available nutrients contained in the proposed fertilizer;
 - 3. Manufacturer's certificate stating the wood cellulose mulch meets the requirements of this Section; and

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- 4. Manufacturer's certificate stating the mulch binder meets the requirements of this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver containerized materials in uniform packages bearing the name of the manufacturer, the net weight and a statement of content. Deliver containerized materials to the site in original, properly labeled, unopened, clean containers each showing the manufacturer's guaranteed analysis conforming to applicable regulations and standards.
- B. Store materials in a dry area in a manner to prevent physical damage from the elements.

1.6 HEALTH AND SAFETY REQUIREMENTS

Environmental Health and Safety, and Training requirements shall be as specified in Part 8.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Furnish seed labeled in accordance with the U.S. Department of Agriculture (USDA) Rules and Regulations under the Federal Seed Act and applicable State seed laws. Furnish seed in sealed bags or containers bearing the date of expiration. Do not use seed after its expiration date. Each variety of seed shall: have a purity of not less than 90 percent, have a percentage of germination not less than 80 percent, have a weed to seed content of not more than 0.75 percent and contain no noxious weeds. The above percentages are by weight.
- B. For interim seeding, the seed mixture shall be:
 - 1. Annual Rye - 60 pounds pure live seed (pls)/acre
 - 2. Perennial Rye - 60 pounds pls/acre
 Interim seeding may be applied from October through May.

- C. For permanent seeding, the seed mixture shall be (all measures are pounds pls/acre):

	April 15 - <u>May 31</u>	October 1 - <u>April 14</u>
1. Canada Wild Rye	2	3
2. Little Bluestem	2	3
3. Big Bluestem	3	4
4. Indian Grass	2	3
5. Switch Grass	1/2	1
6. Side Oats Gramma	1/2	1
7. Live Oats	20	25

- D. For summer (June - September) seeding, the seeding mixture shall be:
- Buckwheat - 60 pounds pls/acre.
The planting of buckwheat during the summer season will be followed by either interim or permanent seeding during the next seeding window.
- E. Obtain water from the on-site sources shown on the Construction Drawings or specified in Part 6, unless otherwise approved by the Construction Manager.
- F. Fertilizer:
- Use fertilizer that is dry or liquid commercial grade fertilizer, uniform in composition that meets the requirements of all State and Federal regulations and standards of the Association of Agricultural Chemists.
 - Fertilizer for interim seeding shall be VCOTE 34-0-14 as manufactured by George W. Hill or equal.
 - Fertilizer for permanent seeding is not required. If the Contractor chooses to apply fertilizer for permanent seeding, it shall be 0-4-4 or approved equal, with chemical analysis submitted in accordance with this section

- G. Furnish mulch meeting the following requirements:
1. Mulch shall be straw or wood cellulose fiber, free of clay, stone, foreign substances, and reasonably free of weeds.
 2. Furnish straw that does not contain sticks larger than 1/4-inch diameter or other materials that may prevent matting down during application. Use straw that is free from mold and other objectionable material and in an air-dry condition suitable for placing with mulch blower equipment or other equipment as approved by the Construction Manager. Straw shall be generally 6 inches or more in length.
 3. Mulch applied by hydrospraying shall be a wood cellulose processed into a uniform fibrous physical state. Use wood cellulose fiber containing a green dye that will provide for easy visual inspection for uniformity of slurry spread. The wood cellulose fiber including dye, shall contain no growth or germination inhibiting properties. The wood cellulose fiber shall be manufactured in such a manner that, after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous material. When sprayed on the ground, the material shall allow absorption and percolation of moisture. The wood cellulose fiber shall meet the following requirements:

<u>Item</u>	<u>Specification Limit</u>
Particle Length	0.375 inch (approximate)
Particle Thickness	0.047 inch (maximum)
pH	4.0 to 8.5
Ash Content	1.6 percent (maximum)
Water Holding Capacity (based on fiber dry weight)	500 percent (minimum)

H. Mulch binder agent shall be as approved by the Construction Manager and shall meet the following requirements:

1. The mulch binder shall be an emulsion comprised of a 100% organic emulsion produced from naturally occurring resins or an approved equal and be nontoxic to plants. The mulch binder shall not be comprised of chloride, lignosulfonate, petroleum, or asphaltic type emulsions. The mulch binder shall be compatible with application via a hydro seeder, and must not require intense cleaning of equipment after application. Once cured, the mulch binder shall be non-tracking (i.e., will not stick to boots or tires).
2. The mulch binder shall not have hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR Part 261, Subpart C, for a hazardous waste in either its pre-applied or cured states.
3. The mulch binder shall have a flash point greater than 200°F. The mulch binder shall be neither a flammable nor combustible liquid per DOT definition. The mulch binder must not be susceptible to significant deterioration from exposure to the elements, including sunlight.
4. The mulch binder shall be provided in concentrated solution and prepared so that it will not change in transportation or storage.

2.2 EQUIPMENT

Provide equipment of size and type to perform work specified in this Section.

PART 3 EXECUTION

3.1 GENERAL

- A. Stabilization of disturbed areas by seeding or by use of a crusting agent shall be performed at completion of excavation or within seven (7) calendar days of knowing a disturbed area will be idle for more than forty-five (45) calendar days, whichever is sooner.

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- B. Interim seeding is required for disturbed areas and soil piles which are scheduled to or may be further disturbed within two (2) years, but do not have significant potential of spreading contamination.
- C. Permanent seeding is required for disturbed areas and soil piles which will not be disturbed for more than two (2) years.
- D. Disturbed areas and soil piles which are scheduled to be significantly disturbed within two (2) years, are destined for the On-Site Disposal Facility, and/or need effective erosion control immediately, are to be stabilized with use of a crusting agent as specified in this Section.
- E. Area(s) to be seeded shall be generally free of debris, rock, root material, and other objects which may impede soil preparation and seeding activities. Perform soil preparation by tilling/cultivating, to a depth of approximately 2 inches, to eliminate uneven areas and low spots. Maintain lines, levels and contours.
- F. Repeat cultivation in areas where equipment used for hauling and spreading has compacted subgrade.

3.2 APPLICATION

- A. Seeding seasons are:
 - 1. For interim seeding, October through May.
 - 2. For permanent seeding, April 15 through May 31, and October 1 through April 14, each with a corresponding application rate.
 - 3. Seeding that must be done outside of the above seeding seasons shall be completed with the summer seeding mixture specified in this Section. Application of summer seeding shall be followed during the next seeding season by the application of either interim or permanent seeding, as appropriate, in accordance with the general execution requirements specified in this Section.

- B. Apply fertilizer, seed, mulch, and mulch binder to disturbed areas and areas excavated and graded in this Contract requiring seeding unless otherwise indicated or directed by the Construction Manager. All seeding seasons and all application rates for seed and related materials are subject to adjustment as directed or approved by the Construction Manager.
- C. Application of Fertilizer:
1. Apply fertilizer at a uniform rate of 1 pound per 1000 square feet.
 2. Disc fertilizer thoroughly into upper 2 inches.
 3. Lightly water to aid the distribution of fertilizer.
- D. Sequence of application of seeding mixture, mulch and mulch binder.
1. Apply seed mixture at the minimum rate as specified in this Section. Seeding shall be done by hydroseeding, broadcasting, or by drilling to a depth of 1/4 inch followed by cultipacking. When hydroseeding, the mixture tank shall be cleaned prior to use to ensure remnant seed is not introduced to the proposed seed mixture.
 2. Do not seed areas in excess of that which can be mulched within 24 hours.
 3. Apply mulch within 24 hours of seeding.
 4. Spread straw mulch in a uniformly thick layer.
 5. Apply water with a fine spray immediately after each area has been straw mulched. Wet soil at approximately a rate of 120 gallons per 1,000 square feet.
 6. Apply mulch binder at the rate specified in this Section.
- E. Spread straw mulch, either by hand or by blowing method, at the rate of 2 air-dried tons per acre. During June through September, increase straw mulch application rate to 3 air-dried tons per acre. Application of straw mulch by the blowing method is exempt from the dust control requirements specified in Part 6.

- F. Apply sprayed wood cellulose fiber at a net dry weight of 2,000 pounds per acre. Mix the wood cellulose fiber with water at a ratio of 50 pounds of wood cellulose fiber per 100 gallons of water.
- G. Maintain mulching material in place with a mulch binder. Apply mulch binder according to manufacturer's directions. Unless specified otherwise by the manufacturer, dilute concentrated mulch binder to ratio of four (4) parts water to one (1) part concentrate. Apply diluted mulch binder at a rate of 2,500 gallons per acre.

3.3 MAINTENANCE

- A. Maintain the seeded areas in satisfactory condition until acceptance of the seeding by the Construction Manager. Maintenance of the seeded areas includes repairing eroded areas, revegetating when necessary, watering and mowing (if applicable). A satisfactory condition of the vegetated area is defined as follows:
1. An area shall have a predominant stand of the seeded vegetation.
 2. Within 3 weeks, germination must occur over 95 percent of the area with no single bare area greater than 3 square feet.
 3. Within 3 months, 95 percent of the area must be covered with mature vegetation.
 4. The above timeframes for germination and coverage requirements are to be delayed during fall and winter seeding application. The performance criteria shall be measured beginning April 1 for seed applied the previous fall (applied between September and April).
- B. Areas that fail to meet these requirements shall be repaired or reseeded as necessary to produce an acceptable stand of vegetation, as specified in this Section. Areas that become bare during June through September shall be reseeded with the summer seeding mix specified in this Section.

- C. Maintain areas applied with a crusting agent to ensure proper erosion control. The crusting agent shall be reapplied to eroded and bare areas as necessary.

3.4 WARRANTY

- A. Seeded areas shall be subject to a warranty period of not less than 12 months from initial establishment of vegetation over 100 percent of the seeded areas.
- B. At the end of the warranty period, the Construction Manager will perform an inspection upon written request by the Contractor. Seeded areas not demonstrating satisfactory condition of vegetation as specified herein, shall be repaired, reseeded and maintained to meet all requirements as specified herein at the Contractor's expense.

3.5 ACCEPTANCE

- A. The seeded areas shall be accepted at the end of the warranty period if a satisfactory condition exists as defined in this Section.
- B. After all disturbed areas are stabilized and all necessary corrective work has been completed, the Construction Manager will certify in writing the final acceptance of the seeded areas.

END OF SECTION

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U.S. DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

REMEDATION AREA 3
LIME SLUDGE PONDS
TECHNICAL SPECIFICATIONS

Division 15

PARSONS

Prepared by: _____

Checked by: _____

SECTION 15060
PIPE, FITTINGS, VALVES, AND ACCESSORIES

PART 1 GENERAL

1.1 SCOPE

This Section includes, but is not limited to:

- A. Metal Pipe for Transfer Lines and within Lift Stations.
- B. Fabricated piping assemblies.
- C. Fittings.
- D. Valves.
- E. Specialty items.

1.2 RELATED SECTIONS AND PLANS

- A. Section 02668 - Transfer Lines and Perimeter Drain.
- B. Part 6 - Statement of Work.
- C. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME A13.1-81 Scheme for the Identification of Piping Systems (R1993).
 - 2. ASME B16.5-88 Pipe Flanges and Flanged Fittings.
1992 Addenda
 - 3. ASME B16.22-95 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 4. ASME B16.25-92 Buttwelding Ends.
 - 5. ASME B31.3-96 Process Piping.

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- B. American Society for Nondestructive Testing (ASNT):
1. ASNT-SNT-TC-1A-92 Personnel Qualifications and Certification Recommended Practice, December 1992 Edition.
- C. American Society for Testing and Materials (ASTM):
1. ASTM-A53-96 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 2. ASTM-A105/
A105M-96 Standard Specification for Carbon Steel Forgings for Piping Applications.
 3. ASTM A126-95 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 4. ASTM A182/
A182M-96 Standard Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 5. ASTM A193/
A193M-Rev. A-96 Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
 6. ASTM-A194/
A194M-96 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
 7. ASTM-A216/
A216M-93 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
 8. ASTM-A234/
A234M Rev. A-96 Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

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- 9. ASTM-A307-94 Standard Specification for Carbon Steel Bolts and Studs, 60,000 Psi Tensile Strength.
- D. American Water Works Association (AWWA)
 - 1. AWWA C203-97 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied.
 - 2. AWWA C207-94 Steel Pipe Flanges for Waterworks Service.
- E. American Welding Society (AWS):
 - 1. AWS A5.1-91 Carbon Steel Electrodes for Shielded Metal Arc Welding.
- F. Ohio Plumbing Code - 1998.

1.4 SUBMITTALS

- A. Submittals shall be in accordance with Part 6 of the Contract Documents.
- B. Submit product data for pipe, fittings, valves, and accessories.
- C. Submit shop drawings for shop-fabricated piping assemblies, including spool piece drawings.
- D. Submit installation, maintenance, and operation instruction manuals for valves and accessories.
- E. Submit certificates of conformance that material and equipment meet specification requirements.
- F. Submit test procedures for required pressure and flow testing. Test procedures shall include criteria for acceptable performance.
- G. Submit procedures for repair or replacement of piping failing tests and/or examination.
- H. Submit pressure and flow test and examination reports.

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- I. Submit welder and examiner qualifications, procedure qualification records, and welding procedure specifications.

1.5 QUALITY ASSURANCE

- A. Except where more stringent requirements are specified or indicated, the work specified herein shall conform to ASME B31.3.
- B. Welding Procedures and Qualifications
 - 1. Fabrication, assembly, and erection shall be in accordance with ASME B31.3.
 - 2. Welder qualifications shall be made available to, and approved by, the Construction Manager.
 - 3. Nondestructive testing personnel qualifications shall be in accordance with ASNT SNT-TC-1A.
- C. Inspection, Examination, and Testing
 - 1. Inspection, examination, and testing shall be in accordance with ASME B31.3.
 - 2. The construction Manager shall be given advance written notification prior to any testing.
 - 3. A written report of the examination and testing shall be submitted to the Construction Manager following the successful completion of examination and testing.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging
 - 1. Materials shall be cleaned to remove chips, slag, weld spatter, oil, grease, debris, and other foreign material prior to packaging for shipment. Openings shall be covered, capped, or plugged to prevent damage and the ingress of foreign materials during shipment and storage. Tape alone shall not be used for sealing openings.

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B. Storage and Handling

1. Piping materials and prefabricated assemblies shall be stored off the ground and handled with care so that physical damage, contamination, or corrosion of the piping materials does not occur. End seals of pipe, flange covers, valve covers, and similar protection shall not be removed until necessary for cleaning, fabrication, inspection, and erection.
2. Welding rods and electrodes shall be stored, handled, and identified to ensure the use of the proper welding rod. Electrode ovens for the storage of low-hydrogen welding rods shall be used.

PART 2 PRODUCTS

2.1 PRODUCTS/EQUIPMENT

A. Piping and Valve Specification

1. Piping materials and valves shall meet the requirements indicated on the piping material data sheets in Attachment A.
2. For HDPE underground piping, see Section 02668.
3. Provide one spare valve for each size and type installed.

B. Steel flanges shall conform to AWWA C207.

2.2 LABELING

A. Valve Identification

1. Each valve shall be identified with the unique valve number and description, as shown on the P&IDs.
2. The tag shall not be attached to any part of the valve which may interfere with valve operation.
3. Valve identification tags on insulated valves shall be located outside the insulation jacketing and be easily accessible for inspection.
4. Label size shall be based on using 1/2-inch letters.

5. Labels shall be constructed of nonreflective corrosion-resistant materials, with good contrast and legibility.

B. Pipe Identification

1. Identify the flow medium and the flow direction for piping systems including insulated pipe by labeling adjacent to each valve, adjacent to abrupt pipe directional change, and at intervals of 50 feet along exposed pipe. Pipes shall be labeled as indicated on the P&IDs and in accordance with ASME A13.1.
2. Content, size, material type, line number, and insulation requirements for each pipeline shall be identified on drawings as follows. Refer to the P&ID symbols and legend for additional information.

Example ST - 4" - A - 1000 - ET

<u>Medium Code</u>	<u>Size</u>	<u>Material Code</u>	<u>Line Number</u>	<u>Insulation</u>
ST	4"	A	1000	ET

C. Product Marking

1. Piping materials shall be marked in accordance with the applicable ASTM specification as indicated on the piping material data sheets in Attachment A.
2. Welding rod and electrode packages shall be marked in accordance with AWS A5.1.
3. Welding rods and electrodes shall be identified in accordance with AWS A5.1. In addition, welding rods 1/8-inch diameter and over shall be marked or stamped with positive identification marks at intervals of not more than 18 inches. Such marks shall include the classification number of the welding rod and the trade designation of the manufacturer.

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PART 3 EXECUTION**3.1 FIELD CONDITIONS**

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

3.2 PREPARATION

- A. Primer Application
1. Non-insulated carbon steel piping shall be prime coated per AWWA C203.
- B. Trenching and pipe bedding shall be as shown on the Construction Drawings.

3.3 ERECTION/INSTALLATION

- A. Layout, Cutting, and Fitting Up
1. Piping shall be Category D fluid service under ASME B31.3.
 2. Assembled piping shall be installed without springing, forcing, or cold bending. Cutting or otherwise weakening structural members to facilitate piping installation shall not be permitted.
 3. Butt-welded pipe shall be beveled in accordance with ASME B16.25.
 4. Install valves with stems upright or horizontal, not inverted.
 5. Slope field-routed piping and tubing, and arrange to drain at all low points.
- B. Welding
1. Welding electrodes shall be in accordance with AWS A5.1.
 2. Socketwelds shall be made by shielded metal arc or gas tungsten arc welding process.
 3. Socketweld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1/16 inch or no more than 1/8 inch.

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4. Field welding shall be minimized through maximum use of shop-fabricated piping assemblies.
5. Arc strikes and weld starts shall not be made on the base metal outside the weld groove nor inside an area which will be encompassed by a fillet or socket weld. Inadvertent arc strikes outside a weld zone shall be removed by grinding or filing, and the arc strike area shall be visually examined under 5X magnification.
6. Soldering shall be in accordance with ASTM B828.

C. Flanged Joints

1. Flange isolation kits shall be used between all dissimilar metal flanges.
2. The mating surfaces of the flanges shall be in a plane that is perpendicular to the axis of the pipe. Flanges shall be rotated so that the bolt holes straddle the vertical flange centerline. Gaskets shall be evenly centered between the flange faces with ring-type gaskets engaging fully upon raised-face flanges. Flanges shall mate flush and the bolts shall be tightened uniformly to draw the flanges evenly and firmly upon the gasket. Bolts shall be torqued within the flange manufacturer's recommended range and tightening sequence.
3. Where a raised-face flange mates with a flat-face flange, it shall be substituted with a flat-face flange of the material type specified on the attached Piping Material Data Sheet.
4. Flat ring-type gaskets shall be used between steel flanges equipped with raised serrated faces.
5. Where metallic flanges are bolted to non-metallic flanges, both shall be flat-faced flanges. Full-face gaskets shall be used.
6. When piping, valves, fittings, or equipment having cast iron flanges are used, mating flanges shall be flat faced with full-faced gaskets.
7. Flanged joints shall be made with new gasket and bolting materials. Bolts and nuts damaged during installation shall be replaced.

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- D. At least 5 percent of fabricated piping shall be visually examined by an examiner qualified and certified in accordance with ASNT SNT-TC-1A.

3.4 QUALITY CONTROL

A. Hydrostatic Testing

1. All new and existing piping systems shall be hydrostatically leak tested in accordance with ASME B31.3, Chapter VI.
2. Pressure vessels, equipment, and instruments shall not be included in these tests if they will be damaged by the test pressure.
3. Equipment which is not to be subjected to the pressure test shall be disconnected from the piping and a pipe spool inserted in its place, or the equipment may be isolated by way of a single-line blind. Valves may be used provided that the valve is suitable for the proposed test procedure.
4. Hydrostatic test pressures shall be 1.5 times the design pressure, as shown in the following table:

<u>SERVICE</u>	<u>MEDIUM CODE</u>	<u>MATERIAL CODE</u>	<u>DESIGN PRESSURE (psig)</u>	<u>TEST PRESSURE (psig)</u>
New WMF Lift Station Discharge Piping System (incl. Existing K-65 trench piping)	ST	A, B4	80	120
New Perimeter Drain Lift Station Discharge Piping System	PD	A, B4	20	30

5. Leak testing shall not start until the testing procedure has been approved by FDF.
6. Connections/joints (including welds) shall be left uninsulated, unpainted, and exposed for examination for leakage during testing.
7. The piping system shall be examined prior to leak testing to ensure that connections are tight.
8. Test pressure gauges shall be calibrated no more than 90 days prior to the hydrostatic leak test. Gauges shall be selected so that the test pressures are at the mid-range of the gauge. Documentation shall be maintained and made available showing reliability of calibrated equipment.
9. Every precaution shall be taken during testing to ensure personnel safety.
10. Pressure gauges shall not be subjected to pressure in excess of their scale range.
11. Control valves (unless being tested) shall be set and maintained in the full OPEN position.
12. Lines containing check valves shall have the pressure applied upstream of the check valve so that pressure is applied under the seat.
13. Joints found to be defective shall be repaired and retested. Retest pressures shall be the same as those originally specified for the test.
14. Hydrostatic test pressures shall not be applied until the piping system and the testing medium have reached thermal equilibrium.
15. High-point vents and low-point drains shall be provided for hydrostatic tests.

B. Flow testing shall be performed on pipe systems that utilize existing runs of pipe. The Contractor shall provide all necessary equipment to ensure a minimum flow rate of 400 gpm, and shall visually verify this flow at the discharge outlet at the BSL. Test pressure gauges from the previous hydrostatic testing shall be read and recorded at least once during the flow test. The flow test shall last only as long as required to verify all of the above requirements. Flow testing

shall not start until the testing procedure has been approved by FDF.

- C. Plumbing shall be inspected and tested to ensure compliance with the Ohio Plumbing Code.

3.5 CLEANING

- A. System Cleaning and Flushing
 - 1. The interior and exterior of pipe shall be kept clean at all times.

END OF SECTION

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ATTACHMENT A
PIPING MATERIAL DATA SHEETS

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PIPING MATERIAL DATA SHEET

2163

MAT'L CODE A
(SPEC)
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RATING: CLASS 150
FACING: RF
MATERIAL: CARBON STEEL

CORROSION ALLOWANCE: 0.125"
PRESSURE LIMIT: PER ASME/ANSI B16.5
TEMPERATURE LIMIT: -20°F TO 750°F

CODE NUMBER	ENCODER	SIZE FROM TO	DESCRIPTION	NOTES	REV
			<u>PIPE</u>		
		1/2" - 2"	SEAMLESS CARBON STEEL, ASTM A53 GRADE B, EXTRA STRONG, PLAIN ENDS		
		2-1/2" - LARGER	SEAMLESS CARBON STEEL, ASTM A53 GRADE B, STANDARD WEIGHT, BEVELED ENDS		
			<u>FLANGES</u>		
		1/2" - 2"	CLASS 150, CARBON STEEL, RF, ASTM A105, SOCKETWELD (XS BORE)		
		2-1/2" - LARGER	CLASS 150, CARBON STEEL, RFSF, ASTM A105, WELD NECK (STANDARD WEIGHT BORE)		
		1/2" - LARGER	CLASS 150, BLIND, CARBON STEEL, ASTM A105, RFSF		
			<u>FITTINGS</u>		
		1/2" - 2"	CLASS 3000, CARBON STEEL, ASTM A105, SOCKETWELD		
		1/2" - 2"	CLASS 3000, THREADED CARBON STEEL, ASTM A105; THREDOLET CAP	1, 4	1
			PLUG, ROUNDHEAD PLUG, HEX HEAD	1 4	
		2-1/2" - LARGER	SEAMLESS CARBON STEEL, BUTT WELD ENDS, ASTM A234 GRADE WPB, STANDARD WEIGHT		
			<u>SWAGES</u>		
		1/2" - 8"	SCHEDULE 80 CARBON STEEL, ASTM A234, GRADE WPB, PREPARE ENDS AS REQUIRED (BEVELED, PLAIN OR THREADED)	2	
			<u>GASKETS</u>		
		1/2" - LARGER	TEFLON, 1/8 INCH THICK		
			<u>BOLTING</u>		
			STUD BOLTS WITH 2 HEAVY HEX NUTS, ASTM A193 GRADE B7/ASTM A194 GRADE 2H		

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PIPING MATERIAL DATA SHEET

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RATING: CLASS 150
 FACING: RF
 MATERIAL: CARBON STEEL

CORROSION ALLOWANCE: 0.125"
 PRESSURE LIMIT: PER ASME/ANSI B16.5
 TEMPERATURE LIMIT: -20°F TO 750°F

CODE NUMBER	ENCODER	SIZE FROM TO	DESCRIPTION	NOTES	REV
			<u>GATE VALVES</u>		
		1/2" - 2"	CLASS 800, CARBON STEEL, ASTM A105, SOCKETWELD ENDS, OS&Y, BOLTED BONNET, SOLID WEDGE, 12% CR TRIM.	5	
		2-1/2" - LARGER	CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF FLANGE, 11-13 CR TRIM, OS&Y.	5	
			<u>BALL VALVES</u>		
		1/2" - 2"	1500 PSI WOG, CARBON STEEL, ASTM A216 GRADE WCB, THREE PIECE, SOCKETWELD, CHROMIUM PLATED BALL, TFE SEATS, LEVER OPERATOR, APOLLO 83-600 SERIES OR EQUAL	5	
		2-1/2" - 4"	CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF FLANGE, CHROME PLATED BALL, TFE SEATS, WRENCH OPERATOR, APOLLO 88-200 SERIES OR EQUAL.	5	
		6" - LARGER	CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF FLANGE, CHROME PLATED BALL, TFE SEATS, GEAR OPERATOR, APOLLO 88-200 SERIES OR EQUAL.	5	
			<u>CHECK VALVES</u>		
		2-1/2" - LARGER	CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF, FLANGE, CHROME TRIM, BOLTED COVER, SWING TYPE, LUNKENHEIMER FIG. 1572 OR EQUAL	3	
			<u>PIPE NIPPLES</u>		
			CARBON STEEL, ASTM A53, GRADE B		
		1/2" - 2"	SCH 160, TBE, SMLS 3" LONG		
		1/2" - 2"	SCH 160, TBE, SMLS 6" LONG		
		1/2" - 2"	SCH 160, POE-TOE, SMLS 3" LONG		
		1/2" - 2"	SCH 160, POE-TOE, SMLS 6" LONG		
			<u>NOTES</u>		
			1. USE FOR UNVALVED VENTS AND DRAINS.		
			2. USE SWAGES WHERE SMALL END IS 2" AND SMALLER. USE WELD REDUCER WHERE SMALL END IS 2-1/2" AND LARGER.		
			3. INSTALL IN HORIZONTAL POSITION OR WITH FLOW UP.		
			4. USE FOR PROCESS DRAINS.		
			5. EQUIP VALVE WITH LOCKING DEVICE WITH NOT LESS THAN 3/8" DIAMETER HOLE FOR LOCK.		

SECTION 15160
LIFT STATION PUMPS

PART 1 GENERAL

1.1 SCOPE

This Section includes, but is not limited to:

- A. One automatically controlled stormwater sump pump.
- B. One automatically controlled perimeter drain sump pump and one non-installed spare pump.

1.2 RELATED SECTIONS

- A. Section 15170 - Motors.
- B. Section 16050 - Basic Electrical Materials and Methods.
- C. Part 6 - Statement of Work.
- D. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI B16.1-89 Cast Iron Pipe Flanges and Flanged Fittings.

1.4 SUBMITTALS

- A. Provide submittals as required in Part 6 of the Contract Documents unless specified otherwise. Submittals shall be made to the Construction Manager for review and approval.
- B. Submit certified pump curves showing performance characteristics with pump and system operating point plotted, including minimum and maximum flow.

- C. Submit completed pump data sheets.
- D. Submit certificates of conformance to specification requirements and certificates guaranteeing performance at design point.
- E. Submit an Installation, Operation, and Maintenance Manual:
 - 1. The pump manufacturer shall supply a complete set of comprehensive written instructions to enable an operator to properly operate and maintain the equipment supplied. Content of the instructions shall assume the operator is familiar with pumps, motors, piping, and valves, but that the operator has not previously operated nor maintained the exact equipment supplied.
 - 2. The instructions shall be prepared as a system manual applicable solely to the pump equipment and related devices supplied by the manufacturer, as specified herein.
 - 3. The instructions shall include, but not be limited to, the following:
 - a. Descriptions of, and operating instructions for, each major component of the complete pump package as supplied.
 - b. Instructions on operation of the pump and pump controls in intended modes of operation.
 - c. Instruction for adjustments which must be performed at initial start-up of pump equipment, adjustments required after the replacement of liquid level control system components, and adjustments as required in the course of preventative maintenance as specified by the manufacturer.
 - d. Service instructions for major components not manufactured by the pump package manufacturer, but supplied by the manufacturer in accordance with the specifications. In such case, the literature supplied by the actual manufacturer shall be incorporated as appendices.
 - e. Electrical schematic diagram of the pump and

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control package.

- f. Layout drawings of the pump package as supplied showing the location of submersible pumps, baseplates, and guide assemblies. Drawings shall provide necessary information to ensure proper installation and alignment of the guides and baseplate to the pump.

F. Submit test procedures and test results.

1.5 QUALITY ASSURANCE

- A. Tests will be witnessed by the Construction Manager. The Contractor shall provide testing procedures fifteen (15) days prior to the test.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry place and protect from weather prior to shipment. Provide protection from weather and from damage during transit.
- B. Loose items shall be tagged and delivered in standard commercial package(s). The package(s) shall be protected from the weather, from climate conditions including temperature and humidity variations, and from dirt, dust, and other contaminants that could adversely affect assembly and operation.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. KSB, Inc.

2.2

PUMPS

- A. See Attachment A - Pump Data Sheets. Written exception shall be taken to any requirements a proposed pump-motor combination does not meet.
- B. See Section 15170 for Motor data.
- C. Impeller shall be of cast iron and precision balanced. Balancing shall not deform or weaken the impeller. Impeller fasteners shall be non-corroding.
- D. Design shall provide for proper balance of pump and guide shoe from the discharge connection while using a single lift chain.
- E. Components: Other major pump components such as stator housing, seal housing, and bearing brackets shall be of structural grade steel or cast iron. Exposed fasteners and lock washers shall be of stainless steel.
- F. Shaft Seal:
 - 1. The pump shaft shall be sealed against leakage by a double mechanical seal.
 - 2. The rotating seal faces shall be lubricated from an oil-filled reservoir between pump and motor, the oil serving as both lubricating and cooling media. The reservoir shall have separate oil fill and drain plugs to ensure accuracy when measuring lubricant level, and for ease of maintenance.
 - 3. Seal shall require no special maintenance or routine adjustment. However, it shall be easily inspected or replaced. No seal damage shall result from operating the pump for short periods without liquid.

2.3 DISCHARGE

- A. Description:

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1. Each pump shall be furnished with a submersible discharge connection system to permit removal and installation of the pump without the necessity of an operator entering the wet well. The design shall ensure an automatic and firm connection of the pump to the discharge piping when lowered into place.

B. Baseplate:

1. A cast iron base with integral guide system pilots shall be provided along with all hardware and anchor bolts required for permanent installation to the wet well floor. The base shall be designed with an integral 90-degree elbow for connection to the vertical discharge piping utilizing standard ANSI B16.1 Class 125 flanges.

C. Discharge Connection:

1. Each pump shall be provided with a replaceable cast iron guide shoe attached to the pump discharge flange. A replaceable seal shall be provided as an integral part of the guide shoe to form a seal with the baseplate connection and eliminate the possibility of leakage and erosive wear during operation. The seal shall contact mating faces in a static position and shall have adequate flexibility to flex under pumping pressure to increase seal efficiency. Metal-to-metal contact at the discharge connection shall not be acceptable.

D. Guide Rail System and Method of Operation:

1. Schedule 40 stainless steel guide rail pipe or stainless steel cable shall be provided for each pump.
2. Upper guide system brackets and a lifting chain shall be furnished for each pump. Bottom pilots shall be an integral part of the baseplate for ease of installation and proper alignment.

3. The guide shoe shall direct the pump down the guide system and onto the discharge connection in a simple linear movement. The design shall ensure that the buildup of sludge and grease on guide rails will not present problems during the lifting operation. The guide shoe shall be designed with integral hooks at the top to transmit the full weight of the pump to the baseplate flange. No portion of the pump shall be supported directly on the bottom of the wet well, guide system, or lifting chain.
4. An eyelet shall be provided at the upper end of the lifting chain for attaching to the wet well access frame.
5. Bolts, machine screws, nuts, washers, and lockwashers for complete assembly of the guide rails and discharge elbow shall be stainless steel.
6. Adjust final length of guide and lifting systems in the field.

2.4 LABELING

- A. Equipment identification: Pumps shall be provided with a permanently attached stainless steel nameplate indicating equipment name, number, model number, and rated capacity. Lettering shall be manufacturer's standard size and shall be stamped.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

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

3.2 ERECTION/INSTALLATION/APPLICATION

- A. The installation of the equipment shall be in accordance with the manufacturer's installation manual.
- B. A copy of the manufacturer's installation and service

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manual for each piece of the equipment shall be available at the site.

3.3 QUALITY CONTROL

- A. Tests: Acceptance operating tests shall be performed by the Contractor after installation. If the results are unsatisfactory, the Contractor shall adjust or replace the equipment to meet the specification requirements and retest the equipment.
- B. Inspection: The Contractor shall notify the Construction Manager of testing and inspection activities at least 24 hours prior to the start of all tests and/or inspections.
- C. Testing shall not start until the testing procedure has been approved by the Construction Manager.
- D. The Contractor shall demonstrate the ability to meet operating point as shown on the pump curve. Vibration shall be within the manufacturer's acceptable range.

3.4 MANUFACTURER ASSISTANCE

- A. The manufacturer shall provide installation supervision and start-up assistance. Service assistance shall be in accordance with the manufacturer's warranty.

3.5 TURNOVER

- A. Upon completion of the project, pump systems shall be turned over to the Construction Manager in good working condition.

END OF SECTION

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**ATTACHMENT A
PUMP DATA SHEETS**

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PUMP DATA SHEET

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PROJECT TITLE: Remediation Area 3 - Lime Sludge Ponds		TASK ORDER: P-022
PUMP NAME: LSP PMP-1 - (Stormwater Sump Pump)		QUANTITY: 1
TYPE PUMP: Submersible centrifugal		DRAWING NUMBER 92X-5900-N-01030
TYPE DRIVER: Submersible electric motor	SUPPLY W/PUMP	X YES NO

MANUFACTURER AND MODEL NO.: KSB, Inc., Model KRT K100-400	EQUIP NO.: PMP-1 & include name for spare
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OPERATING CONDITIONS

FLUID PUMPED: STORMWATER		AT A PUMPING TEMPERATURE OF: 60 °F	
SPECIFIC GRAVITY: 1.0 AT 60°F	AT P.T.	VISCOSITY: 1.1	AT P.T.
SOLIDS IN FLUID: 1-5 WT%	DENSITY: NA	SIZE: ≤1/2" dia.	ABRASIVE: NO
NATURE OF SOLIDS: NA		FLUID VAPOR PRESSURE:	FT. of FLUID @ P.T.
DESIGN CAPACITY: 400 GPM AT 160 FT. TH at P.T.	DESIRED RANGE: 350 GPM TO 450 GPM		
SUCTION PRESS: NA FT. PSIG	DISCHARGE PRESS: FT. PSIG	NPSH AVAIL: NA	

PUMP SPECIFICATIONS

TYPE PUMP: Centrifugal, direct-connected		NO. STAGES: 1	RPM: 3600 max.
TYPE IMPELLER: Open		SIZE: IN.	MAX SIZE: IN.
EFFICIENCY AT DESIGN CAPACITY: (min)%	BHP @ DESIGN CAPACITY:	MAXIMUM BHP:	50
TYPE BEARINGS: Oil-lubricated, anti-friction			
TYPE COUPLING:		LUBRICATION:	
TYPE OF SEAL: Double Mechanical			

CONNECTIONS - SIZE & RATING

SUCTION: IN. LB. Flange	DISCHARGE: 4 IN. Class 125 Flange
VENT: IN. LB.	DRAIN: IN.

CONSTRUCTION MATERIALS

RESTRICIONS:	
CASING: Cast iron	IMPELLER: Cast iron
SHAFT: Stainless steel	SHAFT SLEEVE: Stainless steel
CASE RING:	IMP. RING:
DISCHARGE ELBOW: Cast iron	RELIEF VALVE:

ELECTRIC MOTOR

VOLTS	PHASE	HERTZ	H.P.	NON-OVERLOAD	CLASS	GROUP	RPM	TYPE
460	3	60		YES				

REMARKS: 1) Vendor shall complete data sheet as required.
2) Provide one set of recommended pump spare parts.

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PUMP DATA SHEET

PROJECT TITLE: Remediation Area 3 Lime Sludge Ponds						TASK ORDER P-022			
PUMP NAME: LSP PMP-2 - include name for spare (Perimeter Drain Sump Pump)						QUANTITY: 1 + 1 spare			
TYPE PUMP: Submersible centrifugal						DRAWING NUMBER 92X-5900-N-01030			
TYPE DRIVER: Submersible electric motor		SUPPLY W/PUMP							
MANUFACTURER AND MODEL NO.: KSB Inc., Model KRT F65-140					EQUIP NO.: PMP-2 & include name for spare				
OPERATING CONDITIONS									
FLUID PUMPED: STORMWATER						AT A PUMPING TEMPERATURE OF: 60 °F			
SPECIFIC GRAVITY: 1.0 AT 60°F		AT P.T.		VISCOSITY: 1.1		AT P.T.			
SOLIDS IN FLUID: 1-5 WT%		DENSITY: NA		SIZE: ≤1/2" dia.		ABRASIVE: NO			
NATURE OF SOLIDS: NA				FLUID VAPOR PRESSURE:		FT. of FLUID @ P.T.			
DESIGN CAPACITY: 25 GPM AT 20 FT. TH at P.T.		DESIRED RANGE: 20 GPM TO 30 GPM							
SUCTION PRESS: NA FT. PSIG		DISCHARGE PRESS: FT. PSIG		NPSH AVAIL: NA					
PUMP SPECIFICATIONS									
TYPE PUMP: Centrifugal, direct-connected						NO. STAGES: 1		RPM: max. 1750	
TYPE IMPELLER: Open						SIZE: IN.		MAX SIZE: IN.	
EFFICIENCY AT DESIGN CAPACITY: (min)%				BHP @ DESIGN CAPACITY:		MAXIMUM BHP: 2			
TYPE BEARINGS: Oil-lubricated, anti-friction									
TYPE COUPLING:						LUBRICATION:			
TYPE OF SEAL: Double Mechanical									
CONNECTIONS - SIZE & RATING									
SUCTION: IN. LB. Flange				DISCHARGE: 2 ½ IN.. Class 125 Flange					
VENT: IN. LB.				DRAIN: IN.					
CONSTRUCTION MATERIAL									
RESTRICTIONS:									
CASING: Cast iron					IMPELLER: Cast iron				
SHAFT: Stainless steel					SHAFT SLEEVE: Stainless steel				
CASE RING:					IMP. RING:				
DISCHARGE ELBOW: Cast iron					RELIEF VALVE:				
ELECTRIC MOTOR									
VOLTS	PHASE	HERTZ	H.P.	NON-OVERLOAD	CLASS	GROUP	RPM	TYPE	
460	3	60		YES					
REMARKS: 1) Vendor shall complete data sheet as required. 2) Provide one set of recommended pump spare parts.									

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SECTION 15170
MOTORS**PART 1 GENERAL****1.1 SCOPE**

This Section includes, but is not limited to:

- A. Low-voltage, three phase induction motors.

1.2 RELATED SECTIONS

- A. Section 15160 - Lift Station Pumps.
- B. Section 16050 - Basic Electrical Materials and Methods.
- C. Section 16170 - Grounding and Bonding.
- D. Part 6 - Statement of Work.
- E. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

- A. American Bearing Manufacturers Association (ABMA):
1. ABMA 9-90 Load Ratings and Fatigue Life for Ball Bearings.
 2. ABMA 11-90 Load Ratings and Fatigue Life for Roller Bearings.
- B. Institute of Electrical and Electronics Engineers (IEEE):
1. IEEE 112-91 Standard Test Procedure for Polyphase Induction Motors and Generators.
- C. National Electrical Manufacturers Association (NEMA):
1. NEMA MG 1-93 Motors and Generators.

2. NEMA MG 13-84 Frame Assignments for AC
Integral-Horsepower Induction
Motors.

D. National Fire Protection Association (NFPA):
1. NFPA 70 National Electrical Code, 1999
Edition.

E. Underwriters Laboratories, Inc. (UL):
1. Electrical Construction Materials Directory-98.

1.4 SUBMITTALS

- A. Provide submittals as required in Part 6 of the Contract Documents.
- B. Submit product data: Provide full load amps, impedances, normal and short-circuit current ratings, NEMA frame size, and additional standard nameplate data. Provide efficiency and power factor for each of 1/2, 3/4, and full load. Provide dimensional enclosure details.
- C. Submit test reports: Indicate satisfactory completion of required tests and inspections. Submit results verifying performance in accordance with IEEE 112.

1.5 QUALITY ASSURANCE PROGRAM

- A. Conform to NFPA 70 and NEMA MG 1.
- B. Motors shall be listed in the UL Electrical Construction Materials Directory for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
1. Reliance Electric.
2. U. S. Motors.
3. General Electric.

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2.2 EQUIPMENT

A. General Construction and Requirements

1. Electrical Service: Refer to related sections of the specifications and the drawings for required characteristics. Motors shall be suitable for driven equipment.
2. Motors: Design for continuous operation at a temperature of 40 degrees C ambient, and for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
3. Visible Nameplate: Indicating motor horsepower, voltage, phase, frequency, rpm, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, serial number, and bearing numbers. Nameplate shall be stainless steel, permanently attached to the motor frame.
4. Electrical Connection: Conduit connection boxes, threaded for conduit and designed to allow for 90-degree step rotation of the conduit entrance. Oversize conduit boxes shall be provided.
5. Motor Service Factor: Furnish motors with service factors required herein. Motor size in hp shall be selected to serve the driven equipment over its full performance range as though the service factor were 1.0.
6. Motors drawing less than 250 W that are intended for intermittent service may be germane to equipment manufacturer and need not conform to these specifications.

B. Three Phase - Squirrel Cage Induction Motors

1. Motors shall be 460 V, three phase, 60 Hz.
2. Motors shall have a 1.15 service factor or higher.

3. The motor connection diagram shall be stainless steel, permanently stamped and attached to the motor either inside the conduit box or on the same side as the conduit box.
4. Starting Torque: To be matched to the driven equipment.
5. Starting Current: Not to exceed six times full-load current.
6. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics or as required by the driven equipment.
7. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors or as required by the driven equipment.
8. Insulation System: Non-hygroscopic NEMA Class F or better.
9. Testing Procedure: In accordance with IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and for compliance with performance data.
10. Motor Frames: NEMA MG 13 standard T-frames of steel, or cast iron with end brackets of cast iron.
11. Bearings: Grease lubricated, anti-friction ball bearings with housings equipped with plugged provision for prelubrication, rated for minimum ABMA 9 and 11, L-10 life of 20,000 hours.
12. Sound Power Levels: To NEMA MG 1.
13. Motors shall be high-efficiency type.
14. Motors shall be totally enclosed fan cooled (TEFC), unless specified or indicated otherwise.
15. Nominal Efficiency: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112.
16. Nominal Power Factor: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112.

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17. Lift Station Pump Motors Special Requirements:
- a. Watertight Integrity: Static seals at watertight mating surfaces shall be of the "O" ring type. Use of auxiliary sealing compounds shall not be required. The power and control cables shall enter the motor through a terminal housing. The pump and electrical cables shall be capable of continuous submergence without loss of waterproof integrity. The watertight integrity of the motor housing and shaft seal shall be tested during manufacture by pressurizing the motor cavity and submerging in water with motor operating.
 - b. Motor Protection: The motor shall be equipped with internal thermal and moisture switches. Three separate thermostatic switches (minimum) shall be embedded into the stator windings (one per phase). Each switch shall open independently and terminate motor operation if temperature of the protected winding reaches the high temperature setpoint. A mechanically activated, moisture-sensing, micro switch shall be installed in the motor housing. The switch shall be capable of detecting airborne moisture and terminate operation of motor before liquid enters the cavity. Use of probes or floats that rely on the presence of liquid to initiate signal are not acceptable.
 - c. Starts per hour: Motor shall be capable of 10 starts per hour.

C. Performance Schedule: Three Phase - Energy efficient, TEFC.

HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
1-1/2	3600	143T	82	85
2	3600	145T	82	87
3	3600	145T	84	85
5	3600	182T	85	86
7-1/2	3600	184T	86	88
10	3600	213T	87	86
15	3600	215T	89	89
20	3600	254T	90	89
25	3600	256T	90	92
30	3600	284T	91	91
40	3600	286T	92	92
50	3600	324T	93	89
60	3600	326T	93	91
75	3600	364T	93	88
100	3600	365T	92	88
1	1800	143T	82	84
1-1/2	1800	145T	84	85
2	1800	145T	84	85
3	1800	182T	86	86
5	1800	184T	87	87
7-1/2	1800	213T	88	86
10	1800	215T	89	85
15	1800	256T	91	85
20	1800	256T	91	86
25	1800	284T	91	85
30	1800	286T	92	88
40	1800	324T	92	83
50	1800	326T	93	85
60	1800	364T	93	88
75	1800	365T	93	88
100	1800	404T	93	83

For motors larger than 100 hp, provide manufacturer's standard high-efficiency motor.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Install motors in accordance with manufacturer's instructions.

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- B. Motors shall be aligned with the respective driven equipment as specified in related sections.
- C. External metal frames of motors and their respective driven equipment shall be connected to ground.

END OF SECTION

U.S. DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

REMEDATION AREA 3
LIME SLUDGE PONDS
TECHNICAL SPECIFICATIONS

Division 16

PARSONS

Prepared by: _____

Checked by: _____

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

2163

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Combination magnetic motor starters.
- B. Selector switches.
- C. Receptacles.
- D. Conduit.
- E. Wire and cable.
- F. Instrument cable.
- G. Nameplates.
- H. Wire markers and cable tags.
- I. Wireway and auxiliary gutters.
- J. Splicing and termination components.
- K. Boxes.
- L. Cabinets.
- M. Supporting Devices.
- N. Underground Warning Tape.
- O. Electrical Testing, General.

1.2 RELATED SECTIONS

- A. Section 02206 - Earthwork.
- B. Section 15160 - Lift Station Pumps.

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- C. Section 15170 - Motors.
- D. Section 16118 - Underground Ductbanks.
- E. Section 16170 - Grounding and Bonding.
- F. Section 16370 - Overhead Power Distribution.
- G. Section 16462 - Dry Type Transformers/Panelboards.
- H. Part 6 - Statement of Work.
- I. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C80.1-90 Rigid Steel Conduit-Zinc Coated.
- B. InterNational Electrical Testing Association (NETA):
 - 1. NETA ATS-95 Acceptance Testing Specification for Electrical Power Distribution Equipment.
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code, 1999 Edition.
- D. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA AB 1-93 Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA ICS 1-93 Industrial Control and Systems General Requirements.
 - 3. NEMA ICS 2-93 Industrial Control and System Controllers, Contractors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 4. NEMA ICS 4-93 Industrial Control and Systems Terminal Blocks.

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5. NEMA ICS 6-93 Industrial Control and Systems Enclosures.
 6. NEMA OS 1-89 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 7. NEMA WD 1-83 General Requirements for Wiring Devices.
 8. NEMA WD 6-88 Wiring Devices - Dimensional Requirements.
 9. NEMA 250-91 Enclosures for Electrical Equipment (1,000 Volts Maximum).
- E. Underwriters Laboratories Inc. (UL):
1. UL 360-96 UL Standard for Safety Liquid-Tight Flexible Steel Conduit.
 2. UL 486A-91 UL Standard for Safety Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 3. UL 510-94 UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
 4. UL 854-96 Service-Entrance Cables.
 5. UL 870-95 UL Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings.
 6. Electrical Construction Materials Directory - 98.

1.5 SUBMITTALS

- A. Provide submittals as required by Part 6. Unless specified otherwise, submittals shall be made to the Construction Manager for review and approval.

1.6 QUALITY ASSURANCE PROGRAM

- A. Work shall comply with NFPA 70. Use of conduit for equipment ground is prohibited.

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- B. Products shall be listed in the UL Electrical Construction Materials Directory, for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Combination Magnetic Motor Starters

1. Combination Magnetic Motor Starters: NEMA ICS 1, NEMA ICS 2, AC general purpose Class A magnetic starter for induction motors for the rated horsepower combined with a magnetic circuit breaker, NEMA AB 1, with instantaneous magnetic trip in each pole. Starter, circuit breaker, and control power transformer shall be in a common enclosure. Terminals, minimum 75 degrees C rated.
2. Provide externally operable handle interlocked to prevent opening of cover with circuit breaker in the ON position. Allow handle to be lockable in the OFF position.
3. Contactor Coil Operating Voltage: 120 V, 60 Hz.
4. Overload Relay: NEMA ICS 2, bimetal.
5. Control Power Transformer: 120 V secondary, 50 VA minimum. Provide fused primary and secondary of transformer, and ground unfused leg of secondary to enclosure.
6. Enclosure: NEMA ICS 6, Type 4X, outdoor.
7. Heater elements shall be included, as required, for the described service conditions.
8. Two auxiliary contacts (electrically dry), one each, normally closed and normally open, in addition to the hold-in contact, shall be provided.

B. Selector Switches

1. Enclosure, NEMA ICS 6, Type 4.
2. Two-position, maintained contact (start/stop), as indicated.
3. Three-position, maintained contact (hand/off/auto or local/off/remote), as indicated.

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C. Receptacles

1. Convenience Receptacle: 125 V, 15/20 A, NEMA WD 1, heavy-duty, general use with metal cover plate; conforming to NEMA WD 6, Configuration 5-20. 125 V, 30 A, NEMA WD 1, heavy-duty, general use with metal cover plate; conforming to NEMA WD 6, Configuration 5-30. Furnish with weatherproof "while in use" covers for outdoors, wet or industrial locations.
2. Convenience receptacles in potentially wet environments, in addition to those required by NFPA 70, shall be GFCI type for personnel protection with covers to protect the receptacle from water during usage.

D. Cabinets

1. Boxes: Galvanized steel with removable endwalls.
2. Box Size: As indicated on construction drawings.
3. Fronts: Steel, surface type with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
4. Knockouts: Provide as required for conduits indicated plus 25 percent spare.
5. Provide metal barriers to form separate compartments wiring of different systems and voltages.
6. Provide accessory feet for free-standing equipment.
7. Terminal Blocks: NEMA ICS 4.
 - a. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
 - b. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
8. Provide ground bus and ground terminal block, each connector bonded to enclosure.
9. Provide plastic channel with hinged or snap-on covers for internal wiring raceway.

2.2 MATERIALS

A. Conduit

1. Rigid steel, heavy wall, galvanized conduit conforming to ANSI C80.1. Rigid steel intermediate metal conduit (IMC) shall be acceptable for interior spaces. Conduit shall be 1/2 inch diameter minimum.
2. Liquid-tight flexible metal conduit conforming to UL 360. Conduit shall be 1/2 inch diameter minimum, 5 feet in length (maximum) unless indicated on construction drawings.
3. Conduit connections shall be threaded.

B. Wire and Cable

1. Single conductor, 600 volt insulated copper conductor, unless indicated otherwise. Conductors for power and lighting branch circuits shall not be smaller than No. 12 AWG. Conductors No. 12 AWG and No. 10 AWG shall be solid. Conductors No. 8 AWG and larger shall be stranded. Conductors for control shall not be smaller than No. 14 AWG stranded. Conductors for Class 1 remote-control and signal circuits shall be enclosed in cable and shall comply with NFPA 70. Power and lighting conductor insulation shall be Type THW, XHHW, or THWN. Conductors required to be rated 90 degrees C in accordance with NFPA 70 shall be insulation Type XHHW-2 or THW-2. Direct burial cable shall be type USE, conforming to UL 854.

C. Instrument Cable

1. Instrumentation cable shall be No. 16 AWG stranded tinned copper conductors. Conductors shall be polyethylene insulated and rated 600 volts, 60 degrees C. Conductors shall be twisted with aluminum-polymer shield; No. 18 AWG stranded, tinned copper drain wire. Cable shall have overall-chrome gray FR-PVC jacket.

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D. Nameplates

1. Nameplates shall be engraved, three-layer laminated plastic, 5/16-inch bold style, black letters on white background.

E. Wire Markers and Cable Tags

1. Wire markers shall be single-conductor slip on, heat-shrinkable sleeve with typed or printed black letters on a white background. Wire markers shall be W. H. Brady Co. computer-printable "Bradysleeve" or approved equal.
2. Cable tags shall be rectangular, flat, non-heat shrinkable tags with 1/8-inch-high letters. Cable markers shall be Raychem-type TMS or approved equal.

F. Wireway and Auxiliary Gutters

1. Wireway and Auxiliary Gutters: General purpose, NEMA ICS 6, Type 3R enclosure with knockouts on bottom.
2. Size: As required.
3. Cover: Screw cover with full gasketing.
4. Fittings: UL 870, lay-in type with removable top, bottom, and side; captive screws.
5. Material: Carbon steel.
6. Finish: Rust-inhibiting primer coating with gray enamel finish.

G. Splicing and Termination Components

1. Wire connectors, UL 486A, as applicable.
2. Insulation tape, UL 510.
3. Provide solderless terminal lugs, rated 75 degrees C minimum, on stranded conductors.

H. Boxes and Cover Plates

1. Junction and Pull Boxes
 - a. Junction and pull boxes shall be sized as indicated in accordance with NFPA 70, Article 370.

- b. Junction and pull boxes located indoors shall be code-gauge, galvanized sheet steel and shall be of welded construction with conduit knockouts or raceway openings and hinged or screwed covers as indicated. Type 3R, according to NEMA 250.
- c. Junction and pull boxes located outdoors shall have screwed, gasketed covers, and watertight hubs. Type 3R, according to NEMA 250.

2. Device and Outlet Boxes

- a. Device and outlet boxes shall be pressed steel, zinc, or cadmium coated in accordance with NEMA OS 1 unless otherwise indicated.
- b. Outlet boxes shall not be smaller than 4 inches octagonal by 1-1/2 inches deep and shall be provided with the proper size knockouts for the conduits intended. Unused knockouts shall remain closed or shall be sealed with knockout closures.
- c. Device or outlet boxes shall be of unit construction of a size required for the number of switches or outlets called for on the construction drawings. No sectional device boxes shall be permitted.
- d. Surface-mounted outlet boxes for receptacles, switches, or similar devices shall be cast type.

I. Supporting Devices

- 1. Support Channel shall be galvanized or painted steel.
- 2. Support hardware and accessories shall be corrosion resistant.
- 3. Supports shall be of all-welded construction.

J. Underground Warning Tape

- 1. 4-inch-wide plastic tape, colored yellow with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.1 SITE CONDITIONS

- A. Ensure site is ready to receive work before start of construction.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Conduit

1. Route conduit parallel or at right angles to building lines. Provide conduit supports at approximately 8-foot intervals. Route conduit so as not to create a hazard for tripping or to compromise head clearance. Minimum height above floor shall be 7 feet, 6 inches.
2. Cut conduit square using saw or pipecutter. Cut ends of conduit shall be reamed smooth.
3. Install no more than the equivalent of three 90 degree bends between junction boxes. Use hydraulic one-shot conduit bender or factory elbows for conduit diameter larger than 1-1/2 inch.
4. Use Form 8 conduit bodies to make sharp changes in direction. Avoid moisture traps, provide junction box with weep hole.
5. Provide cast metal boxes such as FS or FD in damp or wet locations.
6. Provide 1/8-inch nylon pull cord in empty conduits. Cap empty conduits to prevent entry of moisture and foreign objects.
7. Final conduit connections to motors or other vibrating equipment shall be made with approximately 3-foot liquid-tight flexible metal conduit.
8. Conduit and supports are to be field routed. They are not indicated explicitly on construction drawings.

B. Wire and Cable

1. Swab conduit before installing cable. Remove burrs, dirt, or other debris. For existing conduit, pull a mandrel through before pulling cable to verify roundness and bending radii.
2. When pulling cable into conduit, use wire pulling compound.
3. Splices shall be made only in outlet or junction boxes.
4. Provide equipment grounding conductor along with phase conductors in conduits.
5. Multiconductor cables shall contain an integral ground conductor.
6. Grounding conductors shall be connected to equipment with compression lugs. Grounding connections shall be made to clean, dry surfaces. Scale, rust, grease, and dirt shall be removed from surfaces to which grounding connections are to be made.
7. Conductors shall be color coded. Conductors No. 6 AWG and larger shall be identified using colored tape at terminals and splice points. Conductors No. 8 AWG and smaller shall be identified using colored insulation or jacket. Color coding shall be as follows:

480Y/277V Phase A	Yellow
Phase B	Orange
Phase C	Brown
Neutral (grounded)	Gray
Ground	Green
208Y/120V Phase A	Black
Phase B	Red
Phase C	Blue
Neutral (grounded)	White
Ground	Green
Plant Fire	Red and Yellow
Alarm System	Brown and Yellow

C. Nameplates

1. Clean surfaces prior to installing nameplates.
2. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using self-tapping screws.

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- D. Wire and Cable Markers
1. Provide wire markers on each conductor in pull boxes and junction boxes and at each load connection. Provide cable tags in pull boxes for multiconductor cables.
 2. Wire and cable tags shall identify panel and circuit number or control wire number, as required.
- E. Disconnect Switches
1. Mounting supports shall not be fastened to or penetrate wall panels.
- F. Receptacles
1. Install convenience receptacles as indicated on construction drawings.
 2. Label receptacles with panelboard and circuit number from which they are served.
- G. Combination Magnetic Motor Starters
1. Install motor controllers where indicated on construction drawings.
 2. Install motor controller with center line of disconnect operator 54 inches above grade.
 3. Install overload heater element in motor controller to match motor characteristics.
 4. Provide engraved nameplate identifying motor served.
- H. Selector Switches
1. Mount selector switches at a mounting height of 54 inches above grade adjacent to the equipment controlled.
- I. Clearances
1. Clearances from points of access to electrical equipment and other devices shall conform to the requirements of NFPA 70.

2. Equipment control devices and other electrical equipment requiring operation or maintenance shall have a minimum working clearance of 3 feet from the surface of operation or access, unless greater clearance is required by NFPA 70.

J. Boxes

1. Coordination of Box Locations

- a. Provide electrical boxes as indicated and as required for splices, taps, wire pulling, and equipment connections.
- b. Electrical box locations indicated are approximate unless dimensioned.
- c. Locate and install boxes to allow access.
- d. Do not install boxes back to back in walls. Provide 6-inches (minimum) separation in non-acoustic rated walls and 24 inches (minimum) separation in acoustic rated walls.
- e. Coordinate mounting heights of boxes and locations of outlets mounted above counters, benches, and backsplashes to ensure locations are useful.
- f. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

2. Outlet Box Installation

- a. Firmly secure in place outlet or utility boxes concealed in the construction. Set outlet or utility boxes true, square, and flush with the finish surfaces for the application of the appropriate cover plate.
- b. Provide knockout closures for unused knockout openings.
- c. Support boxes independently of conduit except for cast boxes when connected to two rigid metal conduits, both supported within 12 inches of the box to be supported.
- d. Use multiple gang boxes where more than one device is mounted together. Do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

3. Pull and Junction Box Installation
 - a. Support pull and junction boxes independently of conduit.
- K. Cabinets
 1. Install cabinet fronts plumb.
- L. Supporting Devices
 1. Installation of structural steel framing, concrete pads, etc., shall be complete before installing supporting devices.
 2. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structures in accordance with manufacturer's recommendations as indicated.
 3. Use expansion anchors for support on concrete surfaces.
 4. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
 5. Do not drill structural steel members for installing support devices.
 6. Fabricate supports from structural steel or steel channel. Rigidly bolt to structural steel to present a neat appearance. Use hexagon head bolts with spring lock washers under nuts.
 7. Install freestanding electrical equipment on concrete pads.
 8. Install surface mounted cabinets and enclosures with four anchors (minimum). Provide steel channel supports to stand cabinets and enclosures 1 inch from the wall.

3.3 QUALITY CONTROL

- A. Electrical Inspection and Testing - General
1. Electrical inspection and testing for work in this section and in other electrical sections shall conform to the following requirements and to NETA ATS. Tests required by NETA ATS for electrical work on this project shall be performed unless specific instruction is provided otherwise. Any additional requirements or exceptions shall be as noted in the other electrical sections for the specific electrical work of that section only.
 2. Testing shall be witnessed by FDF, CQC Consultant-Quality Control personnel (who must approve results) and manufacturer's service representative(s), if required. Notice of testing must be furnished 7 days in advance.
 3. Submit test results and calibration data on approved forms.
 4. Perform operational tests to demonstrate control and interlocking wiring.
 5. Visual inspections shall be performed for phasing and connections. Phasing shall be A, B, C clockwise at all three phase disconnects.
 6. Repair or replacement of components where test results are unacceptable, including those damaged during testing process, is required.
- B. Electrical Inspection and Testing - This Section
1. Perform continuity and operation tests on power and control circuits. Low voltage thermographic survey of cable connections required by NETA ATS are not required. Wire insulation for conductors No. 6 AWG and larger shall be megger tested between each conductor and ground. A 1000-volt megger shall be used for insulation rated 600 volts. Minimum resistance shall be 100 megohms.

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2. Insulation resistance tests shall not be performed on solid state equipment unless authorized by its manufacturer and in strict accordance with the manufacturer's recommendations. Solid state equipment includes static ground fault devices, such as ground fault circuit interrupters.
3. Confirm that electrical connections to utilization equipment have been made in accordance with manufacturer's instructions.
4. Perform motor tests according to NETA ATS.
5. Motor windings shall be checked for continuity.
6. Motor windings rated 460 volts nominal shall be megger tested with a 1,000-volt megger prior to connection of power leads. Minimum acceptable resistance shall be 100 megohms. Motor and phase rotation shall be checked with a phase rotation tester manufactured by G. Biddle Company (Catalog No. 56060) or equal on equipment which could be damaged by reverse rotation.
 - a. Motor and phase rotation shall be verified before energizing motors.
 - b. Motors shall be "bumped" to check for proper direction of rotation prior to performing operational tests on the equipment in the presence of Construction Manager.

END OF SECTION

SECTION 16118
UNDERGROUND DUCTBANKS

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PART 1 GENERAL

1.1 SCOPE

This Section includes but is not limited to:

- A. Underground Ductbanks.

1.2 RELATED SECTIONS

- A. Section 2050 - Surveying.
- B. Section 02206 - Earthwork.
- C. Part 6 - Statement of Work.
- D. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C80.1-90 Rigid Steel Conduit - Zinc-Coated.
- B. Institute of Electrical and Electronic Engineers (IEEE):
 - 1. IEEE C2-97 National Electrical Safety Code.
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code, 1999 Edition.

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- D. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA TC 3-90 PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - 2. NEMA TC 6-90 PVC and ABS Plastic Utilities Duct for Underground Installation.
- E. Underwriters Laboratories, Inc. (UL):
 - 1. Electrical Construction Materials Directories, 98.

1.4 PROJECT CONDITIONS

- A. Verify routing and termination locations of ductbank prior to excavation for rough-in.
- B. Accurately record actual locations of exact routing of ductbank by field survey as specified in Section 02050.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70 and IEEE C2.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Plastic Utilities Duct: NEMA TC 6; PVC.
- C. Plastic Utility Duct Fittings: NEMA TC 3.

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2.2 ACCESSORIES

- A. Underground Warning Tape: 4-inch-wide plastic tape, colored yellow with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavation, base material installation, and compaction are completed.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Underground Duct:

1. Install power ductbank 36 inches (minimum) to top of ductbank below finished grade.
2. Install duct with minimum slope of 4 inches per 100 feet. Slope duct to manholes.
3. Cut duct square using saw or pipe cutter; de-burr cut ends.
4. Insert duct to shoulder of fittings; fasten securely.
5. Join nonmetallic duct using adhesive as recommended by manufacturer.
6. Wipe nonmetallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
8. Provide suitable fittings to accommodate expansion and deflection where required.
9. Stagger duct joints vertically in concrete encasement 6 inches minimum.
10. Use suitable separators and chairs installed not greater than 4 feet on centers.
11. Band ducts together before placing concrete. Securely anchor duct to prevent movement during concrete placement.
12. Place concrete as indicated on construction drawings. Use mineral pigment to color concrete red.

13. Provide minimum 3-inch concrete cover at bottom, top, and sides of ductbank.
14. Provide pull rope in each duct except sleeves and nipples. Minimum 1/2-inch, 4,000 psi tensile strength polypropylene.
15. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.
16. Perform excavations and backfill trenches under provisions of Section 02206 of this specification package.
17. Interface installation of underground warning tape with backfilling. Install tape below finished surface as indicated on construction drawings.
18. All duct end bells shall be rigid steel.
19. Perform penetrations and sealing of duct bank with lift station junction boxes according to manufacturer's instructions.

END OF SECTION

SECTION 16170
GROUNDING AND BONDING

PART 1 GENERAL

1.1 SCOPE

This Section includes but is not limited to:

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.
- D. Fence grounding.

1.2 RELATED SECTIONS

- A. Section 02050 - Surveying.
- B. Section 15170 - Motors.
- C. Section 16050 - Basic Electrical Materials and Methods.
- D. Section 16370 - Overhead Power Distribution.
- E. Part 6 - Statement of Work.
- F. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

- A. InterNational Electrical Testing Association (NETA):
 - 1. NETA ATS-95 Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

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- B. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code, 1999 Edition.
- C. Underwriters Laboratories, Inc. (UL):
 - 1. UL 467-93 UL Standard for Safety Grounding and Bonding Equipment.
 - 2. Electrical Construction Materials Directory-98.

1.4 SYSTEM DESCRIPTION

- A. Rod electrode and grounding connections.
- B. Grounding System Resistance: 5 ohms maximum.

1.5 SUBMITTALS

- A. Provide submittals as required in Part 6 of the Contract Documents. Unless specified otherwise, submittals shall be made to the Construction manager for review and approval.
- B. Provide certification of ground testing instrumentation.
- C. Provide record of as-built locations, as specified in Section 02050, of grounding electrodes, if grounding electrodes are required.

1.6 QUALITY ASSURANCE PROGRAM

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed in the UL Electrical Construction Materials Directory as suitable for the purpose specified and indicated.
- C. Provide certification of ground testing instrumentation according to NETA ATS.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Acceptable Manufacturers
 - 1. Mechanical Connectors
 - a. Burndy.
 - b. Ideal.
 - c. Ilsco.
 - 2. Exothermic Connections
 - a. Cadweld.
 - b. Thermoweld.

2.2 MATERIALS

- A. Rod Electrode
 - 1. Copper-clad steel, 3/4-inch diameter, 10-foot length.
- B. Mechanical Connectors
 - 1. Bronze.
- C. Wire
 - 1. Stranded copper.
 - a. Grounding Conductor: Size to meet NFPA 70 requirements.
- D. Grounding and bonding materials shall conform to UL 467.

PART 3 EXECUTION**3.1 SITE CONDITIONS**

- A. Verify that final backfill and compaction have been completed before driving rod electrodes.
- B. Verify that underground utilities will not interfere with the proposed rod locations prior to driving rod electrodes.

3.2

ERECTION/INSTALLATION/APPLICATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install additional rod electrodes as required to achieve specified resistance to ground.
- C. Equipment Grounding Conductor: Provide separate, insulated conductor with each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- D. Connect ground conductors to reinforcing bars in foundation before pouring concrete. Tie to structural steel members when they are installed, by exothermic connection.
- E. Ground metal equipment enclosures by attachment to ground rod system, the building steel, or existing periphery grounding system.
- F. Ground pole-mounted equipment and static line conductors as indicated on the construction drawings.
- G. Drive ground rods until the top is 12 inches below grade.
- H. Fence Grounding: Fences shall be grounded with a ground rod at each fixed gate post and at each corner post:
 - 1. Drive ground rods as indicated.
 - 2. Attach a No. 4 AWG copper conductor, by fusion weld process, to the ground rods and extend it underground to the immediate vicinity of the fence post.

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- 3. Lace the conductor vertically into 12 inches of fence mesh and fasten it by two approved bronze compression fittings, one to bond the wire to the post and the other to bond the wire to the fence. Each gate section shall be bonded to its gatepost by a 1/8-inch by 1-inch flexible braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3.3 QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation as defined by contract documents and manufacturer's instructions. Accurately record as-built locations of grounding electrodes if required, and submit to Construction Manager. Test instrumentation shall conform to NETA ATS. Provide certification for instrumentation.
- B. Measure the system's resistance to the ground; perform testing in accordance with instrument manufacturer's recommendations using the fall-of-potential method. Measure resistance at each pole and at each 480 V service as a minimum. Provide written test reports indicating overall resistance to ground and resistance of each electrode to ground.

END OF SECTION

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SECTION 16370
OVERHEAD POWER DISTRIBUTION

PART 1 GENERAL

1.1 SCOPE

This Section includes but is not limited to:

- A. Poles.
- B. Pole hardware.
- C. Line conductors.
- D. Anchors.

1.2 RELATED SECTIONS

- A. Section 16050 - Basic Electrical Materials and Methods.
- B. Section 16170 - Grounding and Bonding.
- C. Part 6 - Statement of Work.
- D. Part 8 - Environmental Health and Safety, and Training Requirements.

1.3 REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code, 1999 Edition.
- B. American National Standards Institute (ANSI):
 - 1. ANSI C2-97 National Electrical Safety Code.
 - 2. ANSI C135.1-79 Galvanized Steel Bolts and Nuts for Overhead Line Construction.
 - 3. ANSI O5.1-92 Wood Poles Specifications and Dimensions.

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- C. American Society for Testing and Materials (ASTM):
1. ASTM A36/A36M-96 Standard Specification for Carbon Structural Steel.
 2. ASTM A475-95 Standard Specification for Zinc-Coated Steel Wire Strand.
 3. ASTM D698-91 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- D. American Wood-Preservers Association (AWPA):
1. AWPA C4-89 Poles - Pressure Process.
 2. AWPA C25-89 Standard for the Preservative Treatment of Crossarms by the Pressure Process.
- E. National Electrical Manufacturers Association (NEMA):
1. NEMA WC 7-88 Cross-Linked Thermosetting Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- F. Underwriters Laboratories, Inc. (UL):
1. UL 96-94 UL Standard for Safety Lightning Protection Components.
 2. Electrical Construction Materials Directory-98.

1.4 QUALITY ASSURANCE PROGRAM

- A. Conform to requirements of NFPA 70 and ANSI C2.
- B. Furnish products, where available, listed in the UL Electrical Construction Materials Directory, as suitable for the purpose specified and indicated.
- C. Installation shall comply with ANSI C2, Heavy Loading District, Grade B Construction.

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- D. Provide submittals as required in Part 6 of the Contract Documents. Unless specified otherwise, submittals shall be made to the Construction manager for review and approval.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect poles from damage and decay by stacking to provide free circulation of air. Maintain 1 foot minimum spacing between bottom pole and ground or ground vegetation. Do not store poles above decayed or decaying wood.
- B. Stack poles stored for more than 2 weeks on decay-resistant skids arranged to support poles without noticeable pole distortion.
- C. Handle treated poles with tools which will not produce an indentation greater than 1 inch deep. Do not drag treated poles along ground. Do not apply tools to that section of treated poles between 1 foot above and 2 feet below ground line.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Poles
1. Wood Poles: ANSI O5.1; treated southern pine poles of length and class indicated.
 2. Select poles for straightness, minimum sweeps, and short crooks.
 3. Preservative: ANSI O5.1 and AWPA C4, Pentachlorophenol.
 4. Apply preservative to poles as required by AWPA C4 with minimum net retention of 12 lbs/ft³ (285 kg/m³). Obtain complete sapwood penetration.
- B. Pole Hardware
1. Miscellaneous Pole Hardware: Hot-dipped galvanized after fabrication.
 2. Eye Bolts and Nuts: ANSI C135.1.

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3. Ground Rods: Copperweld 3/4 inch O.D. by 10 foot - 0 inches long.
4. Guy Strand: High strength, seven-strand steel cable galvanized to ASTM A475, Class A or B.
5. Guy Termination: Preformed wire type.
6. Guy Guards: 8-foot (2 m) long plastic, colored yellow.
7. Ground Wire: Soft drawn solid copper conductors, 4 AWG minimum size.
8. Air Terminal: UL 96; 18-inch copper air terminal.
9. Guy Adapter: Tripleye.

C. Line Conductors

1. Secondary Conductors: aluminum, three insulated conductors and messenger/ground wire with 600 volt cross-linked polyethylene insulation for phase conductors conforming to NEMA WC 7.

D. Anchors

1. Helical Screw Anchors: Galvanized steel, ASTM A36/36M.

PART 3 EXECUTION

3.1 SITE CONDITIONS

- A. Verify that field measurements are as shown on drawings.
- B. Verify that there are no underground utilities located below the poles prior to installation.

3.2 ERECTION/INSTALLATION/APPLICATION

- A. Install products in accordance with manufacturer's instructions.
- B. Plug unused holes in poles using treated wood dowel pins. Treat field-cut gains and field-bored holes with preservative.

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- C. Shorten poles when required by cutting from top end. Apply hot preservative to shortened end of pole.
- D. Set poles in straight line. Place curved poles with curvature in line with lead pole. Maintain an even grade.
- E. Dig setting holes large enough to permit use of power tampers to full depth. Place earth in maximum 6-inch layers and power tamp each layer until hole is restored to grade.
- F. Rake poles located at corners, angles, and dead ends so that poles are vertical after line installation.
- G. Do not install poles along the edge of cuts and embankments or where soil may be washed out.
- H. Identify each pole using aluminum marker stamped with characters 2-1/2 inches high, minimum. Locate to provide maximum visibility from roadway and fasten with aluminum nails. Obtain identifying numbers from Construction Manager.
- I. Minimum depths in normal firm ground, measured from lower side of pole:

OVERALL LENGTH	DEPTH FOR STRAIGHT LINES	DEPTH AT CURVES, CORNERS, AND POINTS OF EXTRA STRAIN
30'	5'-6"	5'-6"
35'	6'-0"	6'-0"
40'	6'-6"	6'-6"
45'	7'-0"	7'-6"
50'	7'-6"	8'-0"
55'	7'-6"	8'-0"

- J. Set crossarms at right angles to line for straight runs; and to bisect the angle of turns in line direction.
- K. Provide two braces for each crossarm.
- L. Install conductors to ANSI C2. Maintain clearances required by ANSI C2, except as follows: phase to phase - 20 inches, phase to ground - 16 inches, above roads, 480 V conductors - 23 feet, over buildings, all conductors, 8 feet. Conductor arrangement shall be phase A, B, C from north to south and from east to west for horizontal construction.
- M. Conductor taps shall be made with bail clamps and hot line connectors using compression connectors. Taps shall not be made directly on line conductors. Make aluminum connections to copper or other material using only splices, connectors, lugs, or fittings designed for that specific purpose.
- N. Install guys and anchors according to ANSI C2 requirements.
- O. Use small diameter steel probe to verify area is free of underground obstructions prior to installation of anchors.
- P. Bond metal enclosures on poles to pole ground wire in accordance with NFPA 70, ANSI C2 and manufacturer's instructions.
- Q. After initial energizing of transformers, measure the secondary voltage and adjust to nominal voltage by changing taps.

END OF SECTION

SECTION 16462
 DRY TYPE TRANSFORMER/PANELBOARDS

PART 1 GENERAL

1.1 SCOPE

Section includes, but is not limited to:

- A. Dry type, two-winding transformers integrated with primary and secondary main breakers and feeder breakers.

1.2 RELATED SECTIONS

- A. Section 16050 - Basic Electrical Materials and Methods.
- B. Section 16170 - Grounding and Bonding.
- C. Part 6 - Statement of Work.
- D. Part 8 - Environmental Health and Safety, and Training Requirement.

1.3 REFERENCES

- A. InterNational Electrical Testing Association (NETA):
 - 1. NETA ATS-95 Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA AB 1-93 Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA PB 1-90 Panelboards.

- 3. NEMA PB 1.1-91 General Instructions for
Proper Installation,
Operation, and
Maintenance of
Panelboards Rated 600
Volts or Less.
 - 4. NEMA ST 20-92 Dry Type Transformers for
General Applications.
 - 5. NEMA 250-91 Enclosures for Electrical
Equipment (1000 Volts
Maximum).
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code,
1999 Edition.
 - D. Underwriters Laboratories, Inc. (UL):
 - 1. Electrical Construction Materials Directory-98.

1.4 SUBMITTALS

- A. Provide submittals as required in Part 6 of the Contract Documents. Unless specified otherwise, submittals shall be made to the Construction Manager for review and approval.
- B. Product Data: Include outline and support point dimensions of enclosures and accessories; unit weight; voltage; kVA, number of phases, impedance ratings, and characteristics; X/R ratio; tap configurations; insulation system type; rated temperature rise; and main bus ampacity, integrated short circuit ampere rating, circuit breaker, arrangement, and sizes.
- C. Transformer Test Reports:
 - 1. Factory Test: NEMA ST 20. Indicate loss data; efficiency at 25, 50, 75, and 100 percent rated loads; and sound level.
 - 2. Field Test: Indicate primary and secondary voltages as measured.

1.5 QUALITY ASSURANCE PROGRAM

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed in the UL Electrical Construction Materials Directory for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver transformers/panelboards individually wrapped for protection and mounted on shipping skids.
- B. Accept transformers/panelboards on site. Inspect for damage.
- C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer/panelboards' internal components, enclosure, and finish.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Siemens.
- B. Westinghouse.
- C. Square D.

2.2 EQUIPMENT

- A. Two-winding transformers
 - 1. Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers; ratings as indicated on construction drawings.

2. Insulation system and average winding temperature rise for rated kVA as follows:
 - a. 1-30 kVA: Class 185 with 115 degrees C rise.
 - b. 16-500 kVA: Class 220 with 115 degrees C rise.
3. Case Temperature: Do not exceed 40 degrees C rise above ambient at warmest point.
4. Winding Taps:
 - a. Transformers: NEMA ST 20. Transformers shall have four full current taps, two at 2-1/2 percent each above and two at 2-1/2 percent each below normal voltage.
5. Sound Levels: NEMA ST 20, not to exceed 85 dBA at 3 feet.
6. Basic Impulse Level: 10 kV.
7. Ground core and coil assembly to enclosure by means of a visible, flexible copper grounding strap.
8. Mounting: Suitable for wall or floor mounting.
9. Coil Conductors: Continuous windings with terminations brazed or welded.
10. Enclosure: NEMA ST 20. Provide lifting eyes or brackets.
11. Isolate core and coil from enclosure, using vibration-absorbing mounts.
12. Nameplate: Include connection data and overload capacity based on rated allowable temperature rise.

B. Branch Circuit Panelboards

1. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.
2. Enclosure: NEMA PB 1; Type 3R conforming to NEMA 250.
3. Cabinet Size: As shown on manufacturer's drawings.
4. Cabinet Front: Hinged cover with paddle lock hinge.
5. Provide an integrated unit with transformer. Finish in manufacturer's standard gray enamel.
6. Provide panelboards with copper bus, ratings as scheduled on construction drawings. Provide copper ground bus in each panelboard.

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- 7. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical.
- 8. Molded Case Circuit Breakers: NEMA AB 1; plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, rated for 75 degrees C copper conductors. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where required. Provide 20 percent spare breakers installed in the panelboard.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

- A. Install transformer/panelboards in accordance with NEMA PB 1.1.
- B. Install plumb, and in accordance with manufacturer's instructions, and as indicated on construction drawings.
- C. Height: 6 feet, 6 inches to top of transformer section.
- D. Provide grounding connections in accordance with Section 16170.
- E. Provide filler plates for unused spaces in panelboards.
- F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- G. Provide engraved plastic nameplates identifying transformer/panelboard equipment number.
- H. After initial energizing of transformers, measure the secondary voltage and adjust to nominal voltage by changing taps.

3.2 QUALITY CONTROL

- A. Test according to general requirements of Section 16050 and to the relevant requirements of NETA ATS.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, grounding, and conformance of installation to contract documents and manufacturer's instructions. Check tightness of wiring and mounting connections for circuit breakers and transformer prior to energizing.
- C. Record primary and secondary voltages; submit to Construction Manager.
- D. Measure steady state load currents at each panelboard feeder. Rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION