MSLA 1-D LANDFILL CLOSURE PROJECT
TECHNICAL SPECIFICATIONS
NJSTART BID NO. 17DPP00036

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1.1 Summary of Work

The New Jersey Department of Environmental Protection (NJDEP) will be performing remedial closure measures for the MSLA 1-D Landfill. The MSLA 1-D Landfill is located in Kearny, Hudson County, New Jersey. The general project location is shown in the location plan on the Drawings Title Sheet. This Contract is for the landfill closure phase of work.

The landfill closure includes, but is not limited to: Subsurface Barrier Slurry Wall, Leachate Collection System, Landfill Cap, Landfill Gas Management System, Stormwater Management System, Operation & Maintenance Period and other miscellaneous activities.

During the previous phase of work (pre-closure site improvements), various site improvements were constructed to facilitate the landfill closure. Site improvements are reflected on the Contract Drawings.

END OF SECTION

1.2 General Requirements

1.2.1 Definitions

The terms used in the Specifications and Drawings have the definitions given in Section 2.0 of the RFP, as supplemented by those below. Wherever the words defined in this Section or pronouns used in their stead occur in the Specifications and Drawings, they shall have the meanings herein given.

Survey

The figures given on the Drawings or in the other Contract Documents after the word "elevation" or abbreviation of it shall mean the distance in feet above the North American Vertical Datum 1988 (NAVD88).

The elevations indicated on the Drawings and other locations pertaining to design and construction (unless noted otherwise) indicate the finish grade/elevation. Contractor shall adjust subgrade elevations, bottom of trenches, etc., accordingly

All control points shall be tied horizontally to the New Jersey State Plane Coordinate System (NAD 1983) with horizontal accuracy to at least the nearest 0.01-foot and vertically to the North American Vertical Datum 1988 (NAVD88), with elevation accuracy to the nearest 0.01-foot. Mapping shall be scaled at 1” = 50’ (or an appropriate scale to fit 36” x 42” sheets) with an elevation contour interval of 1-foot as well as spot elevations. A sketch generalizing the desired survey limits and typical content shall be included for clarity. Topographic mapping shall, at a minimum, show all final site features including structures, utility lines, drainage facilities (e.g., stormwater outfalls, combined sewer overflows, tide gates, etc.), tree and brush lines, banks, and all other significant physical and environmentally sensitive features evident at the time of survey. The Contractor shall establish and verify all ground control required for Surveying purposes.

1.2.2 Abbreviations

Where any of the following abbreviations are used in the Contract Documents, they shall have the meaning set forth.

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturer Association
AIHC	American Industrial Health Council

AISC	American Institute of Steel Construction
AMCA	Air Moving and Conditioning Association
AMRL	American Material Reference Laboratory
ANS	American National Standard
ANSI	American National Standards Institute
API	American Petroleum Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood-Preservers' Association
AWWA	American Water Works Association
CS	Commercial Standard
FTM	Federal Test Method
IBR	Institute of Boiler and Radiator Manufacturers
IEEE	Institute of Electrical and Electronics Engineers, Inc.
JIC	Joint Industry Conference Standards
KMUA	Kearny Municipal Utilities Authority
NRC	Nuclear Radiation Commission
NDB	National Bureau of Standards
NEC	National Electrical Code; latest edition
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association

NICET	National Institute for Certification of Engineering Technologies
NJDOT	New Jersey Department of Transportation
NJMC	New Jersey Meadowlands Commission
NSF	National Sanitation Foundation
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
Fed. Spec.	Federal Specifications issued by the Federal Supply Service of the General Services Administration, Washington, D.C.
125-lb. ANS	American National Standard for Cast-iron Pipe
250-lb. ANS	Flanges and Flanged Fittings, Designation B16.1-1975, for the appropriate class
AWG	American or Brown and Sharpe Wire Gage
NPT	National Pipe Thread
OS&Y	Outside screw and yoke
PVSC	Passaic Valley Sewerage Commissioners
RFA	Request for Authorization
Stl. WG	U.S. Steel Wire, Washburn and Moen, American Steel and Wire or Roebling Gage
UL	Underwriters' Laboratories
USCE	United States Army Corps of Engineers
USSG	United States Standard Gage
WOG	Water, Oil, Gas
WSP	Working steam pressure

1.2.3 Handling and Distribution of Materials

The Contractor shall handle, haul, and distribute all materials and all surplus materials on the different portions of the work; shall provide suitable and adequate storage room for materials and equipment

during the progress of the work, and be responsible for the protection, loss of, or damage to materials and equipment furnished by them, throughout the duration of the contract.

Storage, transport, and demurrage charges by transportation companies and vendors shall be borne by the Contractor.

1.2.4 Materials - Samples - Inspection

Unless otherwise expressly provided on the Drawings or in any of the other Contract Documents, only new materials shall be incorporated in the work. All materials furnished by the Contractor to be incorporated in the work shall be subject to the inspection of the Engineer. No material shall be processed or fabricated for the work or delivered to the work site without prior concurrence of the Engineer.

All costs for the storage, handling, testing and inspection of all materials shall be borne by the Contractor. Defective materials shall be removed immediately from the site of the work. The exception is that analytical sampling and testing for chemical composition will be performed by the Engineer.

Either prior to or after commencement of the work, the Contractor shall submit samples of materials to the Engineer, for confirmation of conformance with the specifications. Such samples, including but not limited to geosynthetic and soil samples, shall be furnished, taken, stored, packed, and shipped, as directed by the Engineer.

All samples shall be packed so as to reach their destination in good condition, and shall be labeled to indicate the material represented, the name of the work and location for which the materials are intended, and the name of the Contractor submitting the sample. To ensure consideration of samples, the Contractor shall notify the Engineer by letter that the samples have been shipped and shall properly describe the samples in the letter. The letter of notification shall be sent separate from and should not be enclosed with the samples.

The Contractor shall submit data and samples, or place their orders, sufficiently early enough to permit consideration, inspection and testing before the materials and equipment are needed for incorporation in the work. The consequences of their failure to do so shall be solely the Contractor's responsibility.

When required, the Contractor shall furnish to the Engineer five sworn copies of manufacturer's shop or mill tests (or reports from independent testing laboratories) relative to materials and equipment performance ratings and test data.

After review of the samples, data, etc., the materials and equipment used on the work shall in all respects conform therewith.

All acceptance testing shall be performed in the presence of the Engineer and NJDEP Construction Manager. The Engineer and/or State will independently perform confirmatory QA/QC chemical testing on imported fill (other than recycled aggregate), topsoil, and general fill. This testing will not excuse the Contractor from performing the testing as indicated in the specifications. If excedances

are found in any of the QA/QC tests, the Contractor will be responsible for segregating and properly disposing of the failing material at no cost to the State.

1.2.5 Inspection of Work Away From the Site

If work to be done away from the construction site is to be inspected on behalf of the State during its fabrication, manufacture, or testing, or before shipment, the Contractor shall give notice to the Engineer of the place and time where such fabrication, manufacture, testing, or shipping is to be done. Such notice shall be in writing and delivered to the Engineer at least one week in advance so that the necessary arrangements for the inspection can be made.

1.2.6 Contractor's Shop and Working Drawings

The shop drawings are interpretations of and are supplemental to the Contract Drawings and Specifications. Their intent shall demonstrate that this Contractor understands the design concept, and to provide the detailed information necessary for the fabrication, assembly, and installation of the products or materials specified. Neither the shop drawings nor comments placed on them by the Engineer shall be construed as being "Change Orders". If any deviations, discrepancies or conflicts between the Shop Drawings and the Contract Drawings and Specifications are discovered, either "prior to" or "after" the shop drawings have been reviewed, the Contract Drawings and Specifications shall have control and shall be implemented.

Prior to the first contractor submittal, the contractor will be required to coordinate with the NJDEP and Engineer for the submittal numbering system. The Contractor shall submit shop and working drawings of all materials, including but not limited to, riprap, aggregate, structural details, piping layout, wiring, materials fabricated especially for the Contract, and materials and equipment for which such drawings are specifically requested. Such submittals shall meet the requirements of RFP Section 5.5.8 – Shop Drawings and Samples, and Specification Section 1.3 - Submittals.

When shop and working drawings are required as specified below, the Contractor shall submit data in sufficient detail to enable the Engineer to determine whether the manufacturer and/or the supplier have the ability to furnish a product meeting the Specifications. The Contractor shall submit data relating to the materials and equipment it proposes to incorporate into the work in sufficient detail to enable the Engineer to identify and evaluate the particular product and to determine whether it conforms to the design concept and Contract requirements. Such data shall be submitted as specified for submission of shop and working drawings.

Such drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, etc., depending on the subject of the drawing. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct for the Contract.

When so specified or if considered by the Engineer to be acceptable, manufacturer's specifications, catalog data, descriptive matter, illustrations, etc., may be submitted in place of shop and working drawings. In such case the requirements shall be as specified for shop and working drawings, insofar

as applicable, except that five copies shall be submitted one of which shall be an original, two of which shall be returned to the Contractor.

The Contractor shall be responsible for the prompt and timely submittal of all shop and working drawings so that there shall be no delay to the work due to the absence of such drawings. Prior to the submittal of any shop drawings, the Contractor shall submit a schedule of proposed shop drawing transmittals. The schedule shall identify the subject matter of each transmittal, the corresponding specification section number and the proposed date of submission. During the progress of the work the schedule shall be revised and updated monthly or more frequently if needed. A revised and updated schedule shall be submitted with the monthly invoice package. Current changes to the shop drawing submittal schedule shall be shown in bold, shading or otherwise highlighted. The revised schedule shall be properly numbered for identification. The schedule shall also include a numbering system for the shop drawings and revisions.

No material or equipment shall be purchased or fabricated specifically for the Contract until the required shop and working drawings have been submitted as provided above and approved for conformance to the Contract requirements. All such materials and equipment and the work involved in their installation or incorporation into the work shall then be as shown in and represented by said drawings.

The Engineer shall review all shop and working drawings within 15 working days of their receipt and return marked up prints to the Contractor indicating approval, conditional approval or disapproval. Review time shall start upon receipt of the submittal by the Engineer. Until the necessary review has been made, the Contractor shall not order any materials nor proceed with any portion of the work (such as the construction of foundations), the design or details which are dependent upon the design or details of work, materials, equipment or other features for which review is required.

All shop and working drawings shall be submitted to the Engineer by and/or through the Contractor, who shall be responsible for obtaining shop and working drawings from their subcontractors and returning reviewed drawings to them. All shop and working drawings shall be prepared on standard size, 24-in. by 36-in. sheets, in AutoCAD Version 2000i or compatible, except those which are made by changing existing standard shop or working drawings. All drawings shall be clearly marked with the names of the State, Contractor, and building, equipment, or structure to which the drawing applies, and shall be suitably numbered. Each shipment of drawings shall be accompanied by a letter of transmittal giving a list of the drawing numbers and the names mentioned above and a diskette containing the corresponding *.DXF or *.DWG files.

Only drawings which have been checked and corrected by the fabricator shall be submitted to the Contractor by their subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to satisfy themselves that the subject matter thereof conforms to the Drawings and Specifications in all respects. All drawings which are correct shall be marked with the date, checker's name, and indication of the Contractor's approval, and then shall be submitted to the Engineer; other drawings shall be returned for correction.

If a shop drawing shows any deviation from the Contract requirements, the Contractor shall make specific mention of the deviations in their letter of transmittal.

The review of shop and working drawings hereunder will be general only, and nothing contained in the Technical Specifications shall relieve, diminish or alter in any respect the responsibilities of the Contractor under the Contract Documents and in particular, the specific responsibility of the Contractor for details of fabrication and dimensions necessary for proper fitting and construction of the work as required by the Contract and for achieving the result and performance specified hereunder.

Should the Contractor submit equipment that requires modifications to the structures, piping, electrical conduit, wires and appurtenances, layout, etc., detailed on the Drawings, they shall also submit details of the proposed modifications. If such equipment and modifications are accepted, the Contractor, at no additional cost to the State, shall do all work necessary to make such modifications.

The marked-up reproducible of the shop and working drawings or two marked-up copies of catalog cuts will be returned to the Contractor. The Contractor shall furnish additional copies of such drawings or catalog cuts when so requested.

1.2.7 Occupying Private Land

The Contractor shall not (except after written consent from the proper parties) enter or occupy with persons, tools, materials, or equipment, any properties outside of which NJDEP has secured access to for the Contractor. A copy of the written consent shall be given to the Engineer.

The Contractor shall not trespass on PSE&G properties, Block 285, Lots 1C and 14AB. If the Contractor wants use of these properties within the MSLA 1D Landfill fenceline, the Contractor may negotiate a License Agreement with PSE&G, independent of NJDEP. All costs associated with any PSE&G License Agreement will not be paid by NJDEP, but must be borne by the Contractor.

1.2.8 Interference with and Protection of Streets/Roadways

The Contractor shall not close or obstruct any portion of a street, road, or private way without obtaining permits from the proper authorities. If any street, road or private way shall be rendered unsafe by the Contractor's operations, they shall make such repairs or provide such temporary ways or guards as shall be acceptable to the proper authorities.

Streets, roads, private ways, and walks not closed shall be maintained passable and safe by the Contractor, who shall assume and have full responsibility for the adequacy and safety of provisions made therefore.

The Contractor shall, at least two weeks in advance, notify The Town of Kearny in writing, with a copy to the Engineer, if the closure of a street or road is necessary. The Contractor shall cooperate with the Police Department in the establishment of alternate routes and shall provide adequate detour signs, plainly marked and well lighted, to minimize confusion. The Contractor shall be responsible to provide, obtain and pay for all required permits, police officers, traffic control providers and vendors required, due to such closures. The costs for the police officers shall be reimbursed through Pass Through Item 1.4.1. The costs to coordinate and obtain the police protection shall be borne by the Contractor.

The Contractor shall not block or impede access to the gas plant by their personnel at any time.

1.2.9 Storage of Materials and Equipment

All materials and equipment to be incorporated in the work shall be placed so as not to injure any part of the work or existing facilities and so that free access can be had at all times to all parts of the work and to all public utility installations in the vicinity of the work. Materials and equipment shall be kept neatly piled and compactly stored in such locations as will cause a minimum of inconvenience to public travel and adjoining owners, tenants and occupants.

~~The Contractor shall not store any construction equipment and materials in front of the gas plant without making arrangements with the plant operators.~~ The Gas Plant within the fenced area in the northeastern corner of the site is vacant and this area can be used for storage.

1.2.10 Sanitary Regulations

The Contractor shall provide adequate sanitary facilities for the use of those employed or involved on the work, including the State and Engineer. Such facilities shall be made available when the first employees arrive on the site of the work, shall be properly secluded from public observation, and shall be constructed and maintained during the progress of the work in suitable numbers and at such points and in such manner as may be required.

The Contractor shall maintain the sanitary facilities in a satisfactory and sanitary condition at all times and shall enforce their use. The Contractor shall rigorously prohibit the committing of nuisances on the site of the work, on the lands of the State, or on adjacent property.

1.2.11 Lines, Grades and Measurements

The Contractor shall employ a competent surveyor licensed by the State of New Jersey as a Professional Land Surveyor. The Contractor shall require said surveyor to establish all lines, elevations, reference marks, batter boards, etc., needed by the Contractor during the progress of the work, and to verify such marks by instruments or other appropriate means.

The Engineer shall be permitted at all times to check the lines, elevations, reference marks, batter boards, etc., set by the Contractor, who shall correct any errors in lines, elevations, reference marks, batter boards, etc., disclosed by such check. Such a check shall not be construed to be an approval of the Contractor's work and shall not relieve or diminish in any way the responsibility of the Contractor for the accurate and satisfactory construction and completion of the entire work.

The Contractor shall make, check, and be responsible for all measurements and dimensions necessary for the proper construction of and the prevention of misfittings in the work.

Separate payment will not be made for layout, measurement for payment, checking lines, grades, and measurements. The Contractor shall include such costs in individual line items.

1.2.12 Dimensions of Existing Structures

Where the dimensions and locations of existing structures are of importance in the installation or connection of any part of the work, the Contractor shall verify such dimensions and locations in the field before the fabrication of any material or equipment, which is dependent on the correctness of such information. Such dimensions and locations shall be indicated on the Record Drawings.

1.2.13 Work to Conform

During its progress and on its completion, the work shall conform truly to the lines, levels, and grades indicated on the Drawings or given by the Engineer and shall be built in a thoroughly substantial and workmanlike manner, in strict accordance with the Drawings, Specifications, and other Contract Documents, including approved change orders or field orders.

All work done without proper lines or levels, or performed during the absence of the Engineer, will not be estimated or paid for except when such work is authorized by the Engineer in writing. Work so done may be ordered uncovered or taken down, removed, and replaced at the Contractor's expense.

1.2.14 Pipe Location

The Contractor must exercise all possible caution while working within/over the existing pipelines. All safety and construction standards and procedures of the Engineer, State, PSE&G and TRANSCO must be followed. No excavation with mechanical equipment shall be allowed within 24" of existing pipelines without clearly identifying the pipelines and approval from the pipeline owner. All pipelines shall be field verified, by hand excavating to determine exact location and depth prior to any mechanical excavation. No more than 170 feet in length of open cut shall be opened at one time when a foreign pipeline is within 5 feet from the edge of the trench. This is to avoid any operational impact to the existing pipelines in services. It is also the responsibility of the Contractor to coordinate all construction activities with PSE&G (Barbara Altenburg 973-430-7823) and TRANSCO (Nash Kalleeny 609-936-2423).

1.2.15 Guarantees and Warranties

The Contractor shall warranty work for two (2) years from the date of Final Completion and shall promptly repair, correct, replace, and re-perform any work that fails to conform with the Bid Contract at no additional cost to the State. Neither the State's acceptance of said Work, nor final payment therefore, shall relieve Contractor of its responsibility to provide conforming Work. Contractor shall reimburse the State for any and all costs, expenses, and direct and reasonably foreseeable consequential losses incurred by the State due to non-conforming Work or any other failure by Contractor or any Subcontractor to comply with this Contract. Copies of required inspection certificates and guarantees or warranties shall be provided to the Engineer within 30 days after the installation of materials or products, in accordance with Section 1.3 and Table 1.3-1.

1.2.16 Computation of Quantities

Measurements for payment will be made in accordance with United States standard measure

(National Bureau of Standards). The method of measurement and computations to be used in determination of quantities of work performed under the Contract are those methods generally recognized as conforming to good engineering practice. The methods of weight and measurement listed below may be used as an alternate method.

> The method of measurement and computations to be used in determination of quantities of Work performed under the Contract are those methods generally recognized as conforming to good engineering practice.
>
> Longitudinal measurements for area computations are made horizontally and deductions are not made for individual fixtures having an area of 9 square feet or less. Transverse measurements for area computations are the neat dimensions shown on the Plans or ordered in writing by the Engineer.
>
> All items which are measured by the linear foot, such as pipe culverts, are measured parallel to the base or foundation upon which such items are placed.
>
> In computing volumes of excavation, the average end area method is used.
>
> The thickness of plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing is measured in millimeters.
>
> Materials measured by volume in the hauling vehicle are measured at the point of delivery. Vehicles for this purpose may be of any size or type acceptable to the Engineer, provided that the body is of such shape that the actual contents may be readily and accurately determined.
>
> When requested by the Contractor and approved by the Engineer, in writing, material specified to be measured by the cubic yard may be weighed and such weights converted to cubic yard for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined and shall be agreed to by the Contractor before such method of measurement of pay quantities is used.
>
> Net certified scale weights will be used as a basis of measurement for all imported soil and recycled aggregate, subject to correction when material has been lost, wasted, or otherwise not incorporated in the Work.
>
> The term "lump sum" when used as a basis of payment means complete payment for the Work of that item, and that item will not be measured.
>
> When standard manufactured items are specified, such as fence, wire, plates, rolled shapes, and pipe conduit, and these items are identified by gauge, unit weight, section dimensions, etc, such identifications are considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances indicated in cited specifications, manufacturing tolerances established by the industries involved will be accepted.
>
> Whenever the phrase "quantity in the Proposal" is used in this Subsection, it is construed to mean the quantity in the Proposal adjusted for Change Orders.
>
> When the quantity in the Proposal is specified to be the pay quantity, either the Engineer or the Contractor may request that the quantity be measured. If such a request is made by the Contractor, it shall be accompanied by drawings, calculations, or other information indicating that the quantity in the Proposal is not correct.

In computing volumes of excavation, the average end area method is used. When cut and fill areas are mixed, the separate volumes of cut and fill shall be computed using a straight line interpolation between the end areas. A reasonable spacing between end areas shall be selected by the Contractor and approved by the Engineer.

When the installation depth of an imported borrow fill is predetermined as with the cap components, roadways, and channels, measurement shall be in the square yard, horizontal projection, plan dimension. Measurement for payment for Geomembrane, ~~Geogrid~~ Composite Drainage Net, and Geotextiles shall be in the square yard, horizontal projection, plan dimension. Geotextiles and Composite Drainage Net, if and where directed, shall be measured off the roll and paid by actual quantity used.

To allow for measurement of imported fill used to construct the cap which is to be measured on a square yard basis, the Contractor shall install measurement stakes, as approved by the Engineer, on a 70 ft x 70 ft grid, and at changes in grade. Stakes shall have markings showing the required thickness of the cap components. Costs for surveying, installation, removal, disposal and management of these stakes should be included in the prices bid for the imported fill material used for cap construction. Stakes will be installed in a manner that will not cause damage the liner. All repairs will be made by the Contractor at no cost to the State.

Defined volumes of fill for structural items shall be calculated as in-situ volume as placed at the specified density or unit weight. When requested by the Contractor and approved by the Engineer in writing, materials specified to be measured by cubic yard may be weighed and such weights converted to cubic yards for payment.

All materials will be measured for payment. Factors for conversion from weight measurement to volume measurement will be determined and shall be agreed to by the Engineer before such method of measurement of pay quantities is used.

For estimating quantities in which the computation of areas by geometric methods would be comparatively laborious, it is agreed that the planimeter shall be considered an instrument of precision adapted to the measurement of such areas. Measurement of Payment based on the horizontal plane will be based on the materials placed as measured from the two dimensional area as depicted on the Contract Plans.

Net certified scale weights or weights based on certified volumes will be used as a basis of measurement for payment. The State reserves the right to correct tonnage amount subject if material has been lost, wasted, or otherwise not incorporated in the Work.

1.2.17 General Slope Stability

The Contractor's attention is called to the fact that some of the side slopes of the wastefill are steep and may be marginally stable. The Contractor shall exercise caution in performing work in and around the wastefill so as not to adversely affect the stability of the wastefill, including but not limited to:

- limiting dynamic forces on top of any slopes steeper than 15%;
- limiting equipment speeds to less than 10 mph;
- avoiding hard braking by equipment on or near slopes steeper than 15%;
- limiting work on slopes steeper than 15% when wet or precedent saturated conditions exist;
- use low ground pressure (LGP) equipment on slopes steeper than 15%; and
- safeguarding/maintaining the cap cover soils around the toe of slopes from erosion.

1.2.18 Precautions During Adverse Weather

During adverse weather and against the possibility thereof, the Contractor shall take all necessary

precautions so that the work may be properly accomplished and satisfactory in all respects at no additional cost to the State. When required, protection shall be provided by use of tarpaulins, wood and building-paper shelters, or other suitable means.

During cold weather, materials shall be preheated, if required, and the materials and adjacent structure into which they are to be incorporated shall be made and kept sufficiently warm so that a proper bond will take place and a proper curing, aging, or drying will result. Protected spaces shall be artificially heated by suitable means which will result in a moist or a dry atmosphere according to the particular requirements of the work being protected. Ingredients for concrete and mortar shall be sufficiently heated so that the mixture will be warm throughout when used.

1.2.19 Temporary Heat

If temporary heat is required for the protection of the work, the Contractor shall provide and install suitable heating apparatus, shall provide adequate and proper fuel, and shall maintain heat as required and/or directed by the Engineer.
Temporary heating apparatus shall be installed and operated in such manner that finished work will not be damaged thereby.

After the heating system has been installed, tested, and made ready for operation, the Contractor may, at the Contractor's own risk and expense, use it for providing heat for protection of the work. They shall provide and pay for all fuel and care necessary, and when the work is ready for acceptance, they shall, at their own expense, make any necessary repairs to the system, even to the extent of replacing worn or damaged parts as directed. Separate payment will not be made for temporary heating.

1.2.20 Traffic Control

The site access point is located off of Harrison Avenue. The Contractor shall follow all conditions of the site access easement agreements. The contractor will also be required to coordinate with utility line companies and New Jersey Turnpike Authority to facilitate site access for portions of the work. Copies of the site access agreements are included in Appendix C.

The Contractor shall submit a site specific Traffic Control Plan for approval by the State as per Section 3.2.6. The Traffic Control Plan shall include, but not be limited to, on-site and off site traffic control, the use of traffic flagmen, sign posting, cones, fencing, and barrier. The Traffic Control Plan shall in no way relieve the Contractor of any responsibility or liability which is a result of their operations under the terms of the contract. Payment for this item will be made under Payment Item 3.2.1.

All vehicle traffic entering the site shall approach the Harrison Avenue entrance on Harrison Avenue/ Route 508 East and turn right into the site at the paved driveway installed during the previous phase of work at the Site. No left turns into and out of the Site are allowed. All vehicle traffic leaving the site shall exit at the constructed driveway and turn right onto Harrison Avenue/ Route 508 East. Traffic conditions are hazardous at the site entrance on Harrison Avenue and deviations from this traffic patterns will not be permitted. In addition, the Contractor should be aware that low trailers may "bottom out." In order to get trailer mounted equipment into the site, it may have to be offloaded on Harrison Avenue. This will require the assistance of the Kearny Police Department and is best

performed at off-peak traffic hours. The cost for use of local police will be reimbursed, at cost, from the Payment Pass Through Item 1.4.2.

1.2.21 Pre-Construction and Post-Construction Video

The Contractor shall prepare Pre-Construction and Post-Construction videos to adequately document pre-existing and final conditions of all work areas and easements. The videos shall be in Digital Versatile Disc (DVD) format and the DVD shall be labeled with the date, job title and location where the video was taken. The videos shall be clear and shall thoroughly document all existing structures and landscaping. The Engineer shall be present during these activities and provided four copies of the DVDs.

Prior to the delivery of any equipment, materials or supplies to the site of any work, or to the beginning of any of the construction work, the Contractor shall provide preconstruction videos as specified herein for the purpose of establishing the surface conditions existing in all of the areas to be affected by the construction.

The Contractor shall provide color videos showing pre-construction site conditions within limits of disturbance. Pre-construction video coverage shall include, but not be limited to, all existing conditions such as site entrance, perimeter access road, landfill top area, and slopes, eastern pond, eastern berm built during Site Improvements phase, existing gas collection features (gas wells, valves, above ground gas collection piping / flanges), existing storm water features such as swales, catch basins, and other site features and structures such as landscaping, trees, fences, previously constructed staging areas, manholes, monitoring wells, pump stations, existing gas plant.

Post construction video coverage shall include, but not be limited to, to any proposed construction features such as access road, constructed top area and side slope landscape (following topsoil installation and seeding), new gas collection wells and associated valves and appurtenances, newly constructed gas plant / flare station, new and existing monitoring wells, video along centerline of road way / newly constructed slurry wall, newly constructed storm water features such as swales, basins, outlet structures, culverts, proposed pump stations and clean outs and associated appurtenances, cap tie in areas, and any other newly constructed features.

For preparation of pre-construction and post-construction videos, the Contractor shall furnish services of competent commercial videographer to clearly videotape the project area. The purpose of the color audio-video taping of the project is to provide the necessary information for restoration of surface features after completion of the project. The Contractor shall be responsible for repairing any damage or defect not documented as existing prior to construction.

Costs for pre-construction and post-construction videos shall be included in Section 1.4 Mobilization and Section 1.5 Demobilization, respectively.

1.2.22 Interference with Existing Works

The Contractor shall at all times conduct their operations so as to interfere as little as possible with existing works. All work of connecting with, cutting into, and reconstructing existing pipes or

structures shall be planned to interfere with the operation of the existing facilities for the shortest possible time when the demands on the facilities best permits such interference, even though it may be necessary to work outside of normal working hours to meet these requirements. Before starting work which will interfere with the operation of existing facilities, the Contractor shall do all possible preparatory work and shall see that all tools, materials, and equipment are made ready and at hand.

The Contractor shall make such minor modifications in the work relating to existing structures as may be necessary, without additional compensation.

The Contractor shall have no claim for additional compensation by reason of delay or inconvenience in adapting his operations to meet the above requirements.

1.2.23 Permits, Access Agreements and Easements

The Contractor shall take out and maintain all necessary permits from the state, county, township or other public authorities; shall give all notices required by law; and shall post all bonds and pay all fees and charges incidental to the due and lawful prosecution of the work. The following are a list of some of the known permits which may be required to be obtained by the Contractor in the execution of the project.

- Local police, fire chief and construction approvals.
- All appropriate permits for transportation and disposal of wastes (solid or liquid), including transportation licenses, transfer station licenses, and Treatment, Storage and Disposal Facilities Permits.
- Electrical permits – Town of Kearny
- NJDEP Well Abandonment Permits
- Trailer occupancy permit – New Jersey Meadowlands Commission
- Construction Erosion and Sediment Control Plan Approval – Hudson County Soil Conservation District.

The Contractor is required to comply with the following permits which have been obtained (Copies are included in Appendix B).

- NJDEP Landfill Closure Plan Approval
- NJDEP Landfill Closure Permit
- NJDEP Tidelands License
- NJDEP Flood Hazard Area Permit

- Hudson-Essex-Passaic Soil Conservation District – Soil Erosion and Sediment Control Certification.

- NJDEP Permit to Construction/Certificate to Operate Air Quality Control Equipment (N.J.A.C. 7:27-8)

- ~~Construction Erosion and Sediment Control Plan Approval – Hudson County Soil Conservation District.~~

The Contractor is also required to comply with access/easement agreements, including insurance requirements, of the following property owners:

- New Jersey Department of Transportation

- Town of Kearny

- PSE&G

- Williams-TRANSCO

1.2.24 Other Contracts

The Contractor shall coordinate their work to eliminate conflicts with any other on-site contractors including those for gas pipeline owners and the State. Other known on-site operations which may affect construction include, but are not limited to:

- General operations of PSE&G and Transco-Williams.

The contractor shall comply with the PSE&G and Transco-Williams access agreements at all times.

1.2.25 Health and Safety

The attention of the bidders is directed to the fact that the submission of a site specific Health and Safety Plan (HASP) is required for this project. Minimum requirements for the submittal are presented in Section 3.1 of these Specifications.

1.2.26 Utilities

Temporary water service is expected to be available from hydrant on the Meadowlands Gas Treaters (Gas Plant) facility. The hydrant is damaged and the Contractor will be responsible for replacing the hydrant. The water meter is in the Gas Plant in an unheated building. Contractor shall provide heat for plumbing associated with the meter, as needed, to prevent freezing. Additionally, Contractor will be required to set up an account with the service provider (Suez Water Kearny). No separate payment will be made for repairing hydrant, for heating the pipes, or for water. Those costs are considered incidental to the work.
~~Additionally,~~

Electrical Service is described in Section 1.9.~~The attention of the bidders is directed to the fact that there is no water service on the property. The Contractor will be required to provide any water to the site necessary for completion of the work and for sanitary facilities and trailers. There is non-potable water in a fire line located in front of the gas plant; however the Town will not permit the Contractor to use the onsite hydrant. A hydrant at the Town of Harrison DPW may be available for the Contractor to use, pending permission by the Town. The Contractor will be responsible for obtaining all permits/costs required for obtaining water. The Contractor shall also expect to truck water from offsite.~~

~~Contractor shall make his own evaluation of the electrical supply at the site. Limited power is available at the flare pad and pump station. Contractor shall be prepared to use generators if he determines that the power supply onsite is not usable. There is no separate pay item for this task. The cost for this task should be included in Bid Item 1.4 – Mobilization and Bid Item 1.7 – Field Office Maintenance, as detailed in these sections.~~

Telephone and internet service are accessible to the project (Verizon). Internet shall be made available in the proposed office trailer. The Contractor shall connect these services as described in Section 1.8. The Contractor will be reimbursed for any connection fees and the monthly costs for internet service under Payment Item 1.8.

1.2.27 Cleaning Up

During its progress of the work and the adjacent areas affected thereby shall be kept clean and all rubbish, surplus materials, and unneeded construction equipment shall be removed and all damage repaired so that the public and private property owners will be inconvenienced as little as possible.

Where material or debris has washed or flowed into, or been placed in, existing watercourses, ditches, gutters, drains, pipes structures, work done under this contract, or elsewhere during the course of the Contractor's operations, such material or debris shall be entirely removed and satisfactorily disposed of during the progress of the work, and the ditches, channels, drains, pipes, structures, and work, etc., shall, upon completion of the work, be left in a clean and neat condition.

On or before the completion of the work, the Contractor shall, unless otherwise especially directed or permitted in writing, tear down and remove all temporary buildings and structures built by them; shall remove all temporary works, tools, and machinery or other construction equipment furnished by them; shall remove, acceptably disinfect, and cover all organic matter and material containing organic matter in, under, and around toilet facilities, houses, and other buildings used by them; shall remove all rubbish from any grounds which he has occupied; and shall leave the roads and all parts of the premises and adjacent property affected by their operations, including temporary roads, staging and support areas, in a neat and satisfactory condition.

The Contractor shall thoroughly clean all materials and equipment installed by them and their subcontractors, and on completion of the work shall deliver it undamaged and in fresh and new-appearing condition. All mechanical equipment shall be left fully charged with lubricant and ready for operation.

The Contractor shall restore or replace any public or private property damaged by their work, equipment, or employees, to a condition at least equal to that existing immediately prior to the beginning of operations. To this end the Contractor shall perform all necessary highway or driveway, walk, and landscaping work. Suitable materials, equipment, and methods shall be used for such restoration. The restoration of existing property or structures shall be done as promptly as practicable as work progresses and shall not be left until the end of the contract period.

1.2.28 If and Where Directed Items

The Price Schedule may request bids on one or more Pay Items to be incorporated into the Project "if and where directed" by the Engineer. Such items or quantities may not be located on the Plans. The estimated quantities set out in the Price Schedule for such items are presented solely for the purpose of obtaining a representative bid price, but are not intended to indicate the State's anticipation as to the quantities of such items which are to be actually incorporated into the Project. Depending on field conditions, such "if and where directed" items may or may not be incorporated into the Project and if incorporated may be many times the estimated quantity or only a fraction thereof.

Incorporation of such items shall only be made on written directions of the State. In the absence of written directions, no such items shall be incorporated into the Project and if incorporated will not be paid for. The State may order incorporation of such items at any location within the Project, and at any time during the Contract Time. Claims for additional compensation shall not be made because of any increase, decrease or elimination of such items, nor because of an increase or decrease in the amount of work due to the field conditions encountered in incorporating such items into the Project.

1.2.29 Project Meetings

The Contractor shall anticipate attending the following meetings during construction. The Cost for attending these meetings shall be incorporated in the contract bid items. No additional payment will be made for attending meetings. Meetings may occur: at the site; Town of Kearny offices; the Contractor’s office; or offices of the subcontractors or suppliers.

1.2.29.1 Pre-Construction and Construction Conferences

Before construction is started, preconstruction conferences shall be held. During the first conference The State, the Engineer, and the Contractor will discuss the procedures to be followed by the Contractor during the construction process.

A second conference, if necessary, may include representatives of The State, Engineer, Contractor, State and Local Authorities and would concern compliance with State and Federal regulations and the environmental plans and specifications.

1.2.29.2 Job Meetings

During construction, job meetings shall be held to review construction and restoration progress and to resolve difficulties, which might delay completion of the work. Attendees at these meetings shall include representatives of the State, the Engineer, the Contractor, and any appropriate subcontractors.

The Engineer may schedule regular job meetings at least weekly during the life of the Contract. The time and location of meetings is to be set by the Engineer. The Contractor, unless otherwise notified by the Engineer, is to have an authorized representative attend each meeting.

The purpose of these meetings is for maintaining communication between the State, Engineer and Contractor, including the Contractor's subcontractors and suppliers. The meetings are to be used to coordinate various parts of the work, update construction schedules, prepare progress estimates and respond to questions that may be raised by the various participants.

END OF SECTION

1.3 Submittals

The following, Table 1.3-1 is a representative list of submittals to the Engineer that are required of the Contractor. The list may not be definitive and is included so the Contractor will be aware of the large number of submittals required of them. The Contractor shall submit shop and working drawings in accordance with section 1.2.6 of these specifications. Material and sample requirements shall comply with Section 1.2.4 of these specifications. Submittal status should be updated monthly by the Contractor. Separate payment will not be made for this task.

TABLE 1.3-1
SUBMITTALS

Item	Tech. Spec. Section No.	Time of Submittal	To Be Submitted
. Initial Project Schedule	RFP, Section 5.5.4.B	Within 30 days of the effective date of the Agreement	**
. Construction Plan, including Site Operation Plan and Schedule, description of major construction activities, Environmental Pollution Control, Dust and Vapor Mitigation Control Plan, Spill and Discharge Control Plan, Security Plan, Traffic Control Plan, Construction Water Management Plan, Decontamination Facilities, Construction Quality Control Plan	3.2	Within 30 days of the effective date of the Agreement. Prior to any site activities (except for mobilization)	**
. Health and Safety Plan	3.1	Within 30 days of the effective date of the Agreement. Prior to any site activities (except for mobilization)	**
. Disposal of any Materials Off-Site	3.3	Within 5 working days after disposal.	Copy of disposal agreement (prior to disposal) Bills of Lading Disposal Receipts 1 original, 6 copies

	Item	Tech. Spec. Section No.	Time of Submittal	To Be Submitted
·	Shop Drawings Submittal Schedule	1.2	Prior to submittal of shop drawings. Schedule to be updated monthly or more frequent if needed	**
·	Field Office	1.6, 1.7	*	**
	Erosion and Sediment Control Plan	2.1, 2.2, 3.6	Within 30 days of the effective date of the Agreement. Prior to any site activities (except for mobilization)	**
·	Clean Fill Documentation for any imported Soils	2.8, 2.13, 2.20, 2.21, 2.24	*	**
	Equipment / Materials for Well Abandonment	2.1	*	**
	Well Abandonment Report	2.1	*	**
	Temporary Protective Fence	1.4	*	**
·	Project Signs	1.4	*	**
·	Concrete	2.25	*	**
·	Geotextiles - material information, product data	2.14	*	**
·	Coarse Aggregate (#57), material information, source, and preliminary laboratory analysis	2.20	*	**
·	Product Data Sheets and all requested relevant information, including proposed guarantees and warranties	---	At least one month prior to intended installation. Product data sheets must be approved by Engineer prior to installation.	**
·	Testing and Inspection Reports	1.10	Within 12 hours of completion	7 copies

Item	Tech. Spec. Section No.	Time of Submittal	To Be Submitted
· Laboratory Testing Results	1.10	Within 12 hours of testing	4 copies (2 copies each to the Engineer and NJDEP)
· Field Inspection and Testing Reports	1.10	At end of each work day	4 copies (2 copies each to the Engineer and NJDEP)
· Guarantees, Warranties, Inspection Certificates, Installation Instructions, Permits, and Quality Control Manuals for all installed products	---	Within 30 days of installation	**
· Regulatory Inspection Certificates	1.10	Within 30 days of installation	**
Survey Data	2.4, 4.2	Within 7 days of survey	**
Survey/Record Drawings	1.11	Within 15 days of Substantial Completion	1 Reproducible Set (6 sets of copies), 7 Copies of the Digital File Version
· Health and Safety Closeout Report	1.5, 3.1	Within 15 days of Substantial Completion	1 Reproducible Set (6 sets of copies)
· Pre-Construction and Post-Construction Video	1.4, 1.5	Prior to mobilizing on site and at Final Construction Completion	6 copies
· O&M Manual	4.1, 4.2	1 Month Prior to Operation of Equipment and 1 Month prior to Final Construction Completion	**

Item	Tech. Spec. Section No.	Time of Submittal	To Be Submitted
Silt Fence	2.2	*	**
Straw Bales	2.2	*	**
Stabilized Construction Entrance (aggregate and geotextile type B)	2.2	*	**
Check Dams and Heavy Duty Erosion Control Matting	2.2	*	**
Dewatering System – equipment shop drawings and written report	2.3	A minimum of 30 days prior before beginning work	**
Temporary Support System for excavations, engineering computations and shop drawings	2.3	A minimum of 30 days prior before beginning work	**
Slag-Cement-Bentonite Barrier Wall – As-built Drawings	2.6	Within 15 days after completing of construction	**
Slag-Cement-Bentonite Barrier Wall– Plan providing list of test equipment, procedures, and materials to be used to verify mix design, Plan describing general work sequence and layout of operations, Record of barrier wall mixes, mix quantities and adjustments for every batch, Test Report, Method Statement,	2.6	*	**
Slag-Cement-Bentonite Barrier Wall – Record of Soundings	2.6	Submit daily during slurry wall construction	**
Slag-Cement-Bentonite Barrier Wall – Quality Control Testing	2.6	Daily	**
Slag-Cement-Bentonite Barrier Wall– Materials (details of the proposed suppliers)	2.6	14 days prior to mobilization to site for commencement of barrier wall trenching	**
Slag-Cement-Bentonite Barrier	2.6	14 days prior to the	**

Item	Tech. Spec. Section No.	Time of Submittal	To Be Submitted
Wall – Proposed testing laboratory details		first test commencing	
Slag-Cement-Bentonite Barrier Wall – Scheduling of Laboratory tests (record of all samples taken giving the location, date, depth, reference number of the samples)	2.6	Within 24 hours of sampling	**
Slag-Cement-Bentonite Barrier Wall– Reporting of laboratory test results	2.6	Within one week of completion of test	**
Monitoring Well Installation – Shop Drawings	2.7	*	**
Monitoring Well Installation – NJDEP Groundwater Well Construction Permits	2.7	*	**
Monitoring Well Installation – NJDEP Form A and Form B reports	2.7	Within 15 days of installation	**
Imported Fill (Modified I-13) – Source information and preliminary test results	2.8	Within 15 days of anticipated delivery to Site	**
Imported Fill (Modified I-13) – inplace testing results	2.8	Once a week	**
Leachate Collection System – Shop drawings for all materials associated with leachate collection system including (but not limited to) bedding (CA#3), 10 inch diameter leachate collection piping and fittings, 4 inch diameter forcemain pipe and fittings, leachate and forcemain cleanouts, valves, etc	2.10	*	**
Testing during Leachate Collection System Installation	2.10	Once a week	**
Pump Station - material and equipment shop drawings and operation and maintenance	2.11	*	**

Item	Tech. Spec. Section No.	Time of Submittal	To Be Submitted
manuals			
Geomembrane (product data, materials, layout and detail drawings, instructions, statement of qualifications, testing, etc)	2.12	At least 30 days prior to delivery of geomembrane	**
Geomembrane – required testing during construction	2.12	Once a week	**
Drainage Layer (Modified I-5 or Modified I-13), material source and material information	2.13	* (any testing requirements during construction should be submitted on a per week basis)	**
Composite Drainage Net – product information	2.13	* (any testing requirements during construction should be submitted on a per week basis)	**
Infiltration Strip Drain – product information, installation requirements, etc	2.13, 2.15	* (any testing requirements during construction should be submitted on a per week basis)	**
Gas Collection System (extraction wells, condensate traps, piping, valves and all other gas collection appurtenances) – material information, product data, installation requirements	2.16, 2.17	* (any testing requirements during construction should be submitted on a per week basis)	**
Gas Handling System Blower – material / equipment shop drawings, installation requirements, operation and maintenance requirements	2.18	* (any testing requirements during construction should be submitted on a per week basis)	**

Item	Tech. Spec. Section No.	Time of Submittal	To Be Submitted
· Riprap, material information, source, and preliminary laboratory analysis	2.21	*	**
· Storm Piping – 12" and 18" diameter HDPE downpipes and accessories (product data, installation instructions)	2.22	*	**
Stormwater structures: records of quality control testing during construction	2.22	Once per week	**
Stormwater structures: project record documents and drawings	2.22	See record drawings	**
· Storm Water Inlet and accessories - product data, installation instructions, etc.	2.22	*	**
· Stilling Well and accessories - product data, installation instructions, etc.	2.22	*	**
Stormwater Overflow Structure and accessories - product data, installation instructions, etc.	2.22	*	**
Stormwater Discharge Pipe and accessories including Antiseep Collar and check valve – product data, installation instructions, quality control testing	2.22	*	**
Drainage Culvert and accessories including HDPE flared end section - product data, installation instructions, quality control testing	2.22	*	**
· Gabions – material information, testing, installation instructions, samples	2.23	*	**
Topsoil - material information, source, testing	2.24, 3.5	*	**
· Straw Mulching, Interim Crop Cover	2.24	*	**

Item	Tech. Spec. Section No.	Time of Submittal	To Be Submitted
Marketable Residual Product, Fertilizer, Seed, Lime	2.24	*	**
Erosion Control Matting - material information, source, testing	2.24	*	**
Swale Reinforcement Matting - material information, source, testing	2.24	*	**
Access Road – aggregate source, material, plan for perimeter road construction	2.26	*	**
Inclinometer – product information, installation information, testing	2.27	*	**
Micropiles – Test data, shop drawings	2.28	*	**
Chain link fence and gate – product data	2.29	*	**
PVSC Testing data	4.1.3	Copies of documents sent to PVSC	**
Hazardous Substance Staging Area	3.4	*	**

* - At least fifteen days prior to intended installation. Shop drawings must be approved by Engineer prior to installation.
** - 1 Original and 6 copies

END OF SECTION

1.4 Mobilization

1.4.1 General Description

Mobilization shall consist of preparatory work and operations necessary for the movement of personnel, equipment, supplies, and incidentals to the Project Site, and other work performed or costs incurred prior to beginning Work.

Installation of temporary protective fence as indicated in the drawings, shall be included in Mobilization. Temporary fencing shall consist of blaze orange, ultraviolet stabilized HDPE with a minimum tensile strength of 5000 lbs/in^2 in accordance with ~~ASTM 648~~ ASTM D648. Posts shall be flanged leg U-bar or flanged leg channel section having a uniform thickness of 0.118 inches or more. Posts shall be of sufficient length and reasonably anchored to support the entire barrier fence. Blaze orange construction fencing shall be installed as depicted on the plans.

There is telephone and internet service accessible to the project. The Contractor shall reconnect these services to the proposed office trailer area. The Contractor will be reimbursed for any Verizon connection fees and the monthly costs for internet and phone service under Payment Item 1.8.

1.4.2 Pre-Construction Site Survey

The Contractor shall be aware that the existing topography and site features are based on surveys performed in 2000 and 2011. Settlement of the landfill since the survey was conducted is anticipated. The grading design included in the drawings is based on the old survey. To avoid unnecessary / excessive filling of the Site, the grading will be revised at the start of the project.

During mobilization the Contractor shall perform a Pre-Construction Survey and provide the results to the Engineer to revise the Site grading as needed. Based on the Pre-Construction Survey performed by the Contractor, the proposed site grading will be revised by the Engineer. The Engineer will provide the Contractor revised plans within four weeks (28 days) of receipt of an approved survey by the Contractor.

The Contractor may continue with all work while the revised plans are prepared by the Engineer; however, no additional costs or change orders will be considered for work underway or completed during this time that needs to change based on the revised plans. Any work that needs to be re-done based on the final grading shall be responsibility of the Contractor. Minor changes in work quantities of items may occur as part of the plan revisions which may require a change order. Additionally, the Contractor is made aware that the grading may be adjusted further to avoid excessive cuts and/or fills to meet final grades.

The scope of services for the survey shall include survey of the existing conditions in a proposed construction area. The following items detail the services:

SURVEY SCOPE OF WORK

Tasks that will be performed by the surveyor are detailed below. ~~Any site clearing required to~~

~~perform this surveying work will included in the cost for Mobilization.~~

All surveys must be signed, sealed and certified by a New Jersey Licensed Land Surveyor, and mapping shall follow the basic standards as described in Geographic Information System, Digital Data Standards (NJDEP, May 1998). The basis of bearings and elevations of all surveys generated shall be in accordance with the New Jersey State Plane Coordinates (1983 Datum) and North American Geodetic Vertical Datum (NAGVD) of 1988. All coordinates, elevations and distances shall be in feet. The surveyor is responsible for obtaining sufficient documentation and evidence to render survey plats which are correct and accurate. The Contractor shall assume that work can be performed in Level D.

Typical tasks to be completed by surveyor shall include, but not be limited to the following:

- Location of permanent site features such as buildings, roads, surface water bodies, etc;
- Locations of existing monitoring wells and slope inclinometers.
- Locations of existing gas extraction wells.

Adjacent Boundary

In order to confirm property lines identified in township file searches etc., the surveyor shall provide the property lines of the landfill site and only intersecting property lines of adjacent properties.

The information collected from the Boundary Survey shall be included on the topographic Site Map, clearly depicting the site property boundaries and corners, adjacent property corners intersecting the landfill site, onsite easements, right-of-ways, and structures. Current tax parcel information (Block, Lot) for the site and adjacent properties must also be clearly indicated.

All boundaries/corners shall be defined in terms of the New Jersey State Plane Coordinates. The acreage is to be rounded to the nearest one-thousandth of an acre. All straight line courses will be defined by bearings and distances. Curves will be defined by radius, arc length, chord bearing and chord length. All work shall, at a minimum, include the requirements as set forth in the State Board of Professional Engineers and Land Surveyors Administrative Rules and Regulations, Chapter 40, Subchapter 5, Paragraph 13:40-5.1.

Topographic Survey and Mapping

A topographic/existing conditions map shall be produced using topographic information from a ground survey. The map will include all areas that are included within this project's Limit of Disturbance as shown on the Drawings Existing Condition Plan Sheet, and shall be scaled at 1" =50' with an elevation contour interval of 1 foot. In order to obtain topography, the surveyor shall perform a detailed ground survey over the landfill property on a 50 ft grid, with additional spot elevations added between points as necessary (such as toe of slope, edge of road, etc.). Mapping shall, at a minimum, show all existing features including structures, streams, ditches, locations of all known surface and subsurface utilities based on existing available documents and markouts, water bodies, streets, fences, and other significant physical and environmentally sensitive features.

The topographic map shall include the following significant topographic, physical and environmentally sensitive features mapped at a scale of 1" =50':

- Topography represented with 1-foot contour intervals and spot elevations;
- Locations of all existing buildings/permanent structures, roadways, streams, ponds, and ditches;
- Property boundary lines of the Site and adjacent properties within 200 feet of the highlighted area.

Deliverables

An electronic file deliverable shall either be in AutoCAD native format (also known as DWG format), or in AutoCAD's drawing exchange format (also known as DXF format). Electronic delivery of the topographic site map shall include a digital coverage of each layer in New Jersey State Plane Coordinates suitable to be uploaded directly into NJDEP's Geographic Information System. Contours shall be zero-width 3D polylines, layer separated into intermediate and index intervals and contour labels shall follow the same scheme. All contours shall be assigned elevations. Spot elevations shall be AutoCAD points with appropriate Z-values. All entities on the topographic map shall be included in separate layers with appropriate names, such as "property lines", etc.

~~Final delivery for the Site will~~Deliverables ~~.~~include one electronic file of the topographic site map on a CD-ROM~~.~~ and 4 full-size plots of the final topographic site map.~~.~~ In addition, hardcopies of the following backup information will be required within 15 days from the acceptance of any electronic deliverable.

- Copies of all field notes and calculations;
- Tie details for all established benchmarks and ground control; and
- Copies of documents, deeds, etc., found during the record search for the Site and boundary survey.

1.4.3 Traffic Police

A police officer shall be provided, if required by the Town of Kearny and/or the County, as approved by the Engineer, to assist with traffic control during construction. The police officer will be from the Kearny Township Police Department.

At the onset of the project the Contractor shall make application to, and establish an escrow account with, the Town of Kearny Police Department; contact Ms. Sharon Dominguez, 201-955-7893. The Town will be paid from that account for the officers involved in traffic control at the site. The Contractor shall maintain sufficient funds in the escrow account throughout the construction period for payment of the police officers involved. The Contractor will be reimbursed by the State from the Pass Through set forth in Item 1.4.2.

The Contractor shall provide a minimum of two days advance notice to the Kearny Police Department Traffic Bureau, 201-998-1313 to have an officer on site for that day's work. The Contractor shall telefax the Engineer a confirmation of the phone call with the date and time of request, number of

officers requested, and name of the person at the police station who took the request.

1.4.4 Signs

Signs shall consist of purchase, delivery, and installation and construction and directional signs, including sign supports. The following sign shall be provided as shown on the Drawings and posted no later than two weeks prior to the initiation of field activities associated with the Site:

One (1) new project construction sign is to be located as directed by the Engineer. The sign must have a NJDEP point of contact number to allow clear communication between the community and the person responsible for conducting the remediation. This number shall be provided to the Contractor by the NJDEP. The project sign shall meet the following specifications (see the drawings for sign content):

1. Size - The project signs shall be 4 feet high x 8 feet wide x 3/4 inches thick. The entire surface of the sign shall be primed in white. The reverse side of the sign will be finished in white paint.

2. Material - The sign will be exterior grade plywood with an aluminum overlay. The aluminum overlay will cover the entire front surface of the sign and its four edges. The aluminum overlay shall be type 040 with a factory-baked white enamel finish.

3. Lettering - Lettering will be upper and lower case in Standard Block Fashion. Letter size and sign design shall be determined by the bidder with final approval by the NJDEP.

4. Color - The sign will have a white background with blue letters and a blue border. The blue color shall be Sapphire Blue. All paint shall be high quality fade and weather resistant formulated for exterior applications.

5. Posts - The posts will be 12 feet high x 4 inches wide x 4 inches thick pressure treated wood. They will be primed and finished in white paint.

6. Hardware - All hardware will be first quality rust resistant cadmium plated. All hardware will be 3/8 inches in diameter.

7. Life Expectancy - The sign and its components should have a life expectancy of at least five years.

Two (2) new “NO VEHICLES ARE PERMITTED” signs are to be located as directed by the Engineer. The project sign shall meet the following specifications (see the drawings for sign content):

1. Size - The project signs shall be 2 feet high x 3 feet wide x 3/4 inches thick. The entire surface of the sign shall be primed in white. The reverse side of the sign will be finished in white paint.

2. Material - The sign will be exterior grade plywood with an aluminum overlay. The

aluminum overlay will cover the entire front surface of the sign and its four edges. The aluminum overlay shall be type 040 with a factory-baked white enamel finish.

3. Lettering - Lettering will be upper case in Standard Block Fashion. Letter size and sign design shall be determined by the bidder with final approval by the NJDEP.

4. Color - The sign will have a yellow background with black letters and a black border. All paint shall be high quality fade and weather resistant formulated for exterior applications.

5. Posts - The post will be 10 feet high x 4 inches wide x 4 inches thick pressure treated wood. They will be primed and finished in white paint.

6. Hardware - All hardware will be first quality rust resistant cadmium plated. All hardware will be 3/8 inches in diameter.

7. Life Expectancy - The sign and its components should have a life expectancy of at least five years.

1.4.5 Temporary Fence

Temporary fencing shall consist of blaze orange, ultraviolet stabilized HDPE with a minimum tensile strength of 5000 lbs/in2 in accordance with ASTM 648. Posts shall be flanged leg U-bar or flanged leg channel section having a uniform thickness of 0.118 inches or more. Posts shall be of sufficient length and reasonably anchored to support the entire barrier fence. Temporary fencing shall be installed as depicted on the plans. Temporary fence shall be maintained as directed during construction and shall be removed and disposed of/ recycled when no longer required on the Project.

~~Contractor shall be required to install temporary chain link fence and pedestrian access gates around the trailer staging area. The temporary fencing shall be erected before construction activity in the staging area. Temporary fence shall be constructed according to the requirements for permanent fence (under Section 2.29) except used materials may be used. The fence shall be installed on stands made of hot dipped galvanized steel pipe at grade. This stand is intended to go on the ends of the fence. Temporary fence shall be maintained as directed during construction and shall be removed and disposed of/ recycled when no longer required on the Project.~~

1.4.6 Measurement and Payment

The Contractor will not be permitted to proceed with mobilization until the Contractor's Health and Safety and Construction Plans are complete and accepted by the NJDEP. Furthermore, no payments for any line item work will be processed until these plans are completed and the Notice to Proceed has been issued. Mobilization shall consist of preparatory work and operations, necessary for the initiation of the Contract, movement of personnel, equipment, supplies and incidentals to the Project site, and other work performed or costs incurred prior to beginning work. Mobilization shall also include a pre-construction site survey, pre-construction video, temporary access roads, establishing electric power, temporary chain link fence, and water for the construction trailers. Mobilization shall

also include providing and installing the required signs. Mobilization shall also include installation of protection of gas lines required by TRANSCO and PSE&G. Mobilization shall not include payment for the roadway aggregate material, filter fabric, and clearing and grading associated with the mobilization activities. These items will be paid for under the unit price bid for each item.

Payment for Mobilization will be made on a lump sum basis upon completion of all the work items listed above, regardless of the fact that the Contractor may have, for any reason, shut down his work on the Project or moved equipment away from the Project and back again.

Payment for Bid Item 1.4.1 will be made in accordance with the following schedule:

- Upon completion of work required under Mobilization - the price bid for Mobilization, up to 3% of the Total Bid Price will be paid;
- Upon substantial completion of all work on the Project, payment for the amount bid for Mobilization in excess of 3% of the Total Bid Price will be made.

Payment for Bid Item 1.4.2 Traffic Police will be made monthly based on the actual cost as evidenced by paid bills from the Town of Kearny Police Department. An estimated amount to cover these reimbursements has been included on the Bid page as a Pass Through. The Pass Through is only for services provided by the police. The Contractor's overhead and profit costs, coordination costs, etc, associated with the effort are to be included in the Contractor's bid price under Item 1.4.1.

For Traffic Police, the Contractor will be paid for documented deposits made to the escrow account. Copies of invoices, the Contractor's payment checks, and paid receipts from the Police Department, must be submitted with the Contractor's invoice. Copies of the Officer's daily time sheets as well as a summary spreadsheet accounting for the various officers involved, their rates, hours per day, total hours, and charges for the period they are involved at the site, shall also be obtained by the Contractor from the Town of Kearny Police Department and submitted with the Contractor's invoices. Pass Through in Item 1.4.2 not paid for traffic police will not be paid to the Contractor, and will result in a reduction in cost to the contract price.

Payment will be made under:

Pay Item No.	Pay Item	Pay Unit
1.4.1	Mobilization	Lump Sum
1.4.2	Traffic Police	Pass Through

END OF SECTION

1.5 Demobilization

1.5.1 General Description

Site cleanup shall be performed in accordance with Section 1.2.28 and with any requirements in the Site Access/Use Agreements. ~~A pre-final inspection will then be conducted to identify any remaining tasks to be completed. From these tasks, a punch list of remaining tasks will be prepared. These items must be finished before Demobilization is completed. With an exception to Record Drawings submissions, any final submission (paper work, warranties, health and safety closeout report, etc.) are required as part of this task. Requirements for Record Drawings are described in specification section 1.11. Payment for Record Drawings will be made under Pay Item 1.11.~~

All areas occupied and/or disturbed by the Contractor in connection with the work shall be cleaned of all rubbish, excess materials, geotextiles, trailers, temporary structures and other equipment or materials and the area shall then be restored to the condition that existed prior to mobilization.
~~Before pre-final inspection and after substantial completion, all areas occupied and/or disturbed by the Contractor in connection with the work shall be cleaned of all rubbish, excess materials, geotextiles, trailers, temporary structures and other equipment or materials and the area shall then be restored to the condition that existed prior to mobilization.~~

1.5.2 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Pay Unit
1.5	Demobilization	Lump Sum

Payment for final cleanup and Demobilization will be made on a lump sum basis upon completion of all the work items listed in this section and the post-construction DVD (per Section 1.2.21).

END OF SECTION

1.6 Field Office Setup

1.6.1 Description

Along with the separate office and equipment needed by the Contractor, the Contractor shall provide two (2) office trailers to be used exclusively by the State and the Engineer.

Space for locating the trailers is available within the Gas Plant in the northeast portion of the site, which is currently unused. The final location of the trailers shall be approved by the Engineer.

1.6.2 General requirements for field office are:

Adequate free parking shall be provided and maintained for the field offices.

Materials

General Construction: The offices shall be an approved and weatherproof buildings or mobile trailers of the type specified in the contract documents. The trailers shall have insulated double walls, floors and roof. The structures shall have a minimum ceiling height of 7 feet and shall be provided with weatherproof windows. Weatherproof external doors each equipped with adequate locking devices and all internal doors will be provided with locks and four (4) keys. Each window shall have a minimum area of eight square feet, shall be screened, equipped with vinyl blinds and of a type that will open and close to provide adequate ventilation. The offices shall be placed on concrete blocks and leveled, with full-length skirts provided. A firmly secured railed entrance platform and steps shall be provided at each exterior door. All windows shall have heavy-duty security screens bolted from the interior. Horizontal locking bars, with like keyed master locks, and shall be provided on all exterior doors. The field office and their associated equipment shall be new, or recently renovated to new condition subject to Engineer's approval. Trailer shall be strapped and anchored to the ground.

- Lighting: Electrical light, non-glare type luminaries to provide a minimum illumination level of 100-foot candles at desk height level.

- Heating and Cooling: Adequate equipment to maintain an ambient air temperature of 70° F. ± 5°.

- Water Cooler and Heater with bottled water supply and paper cup dispenser.

-

~~First Aid Kit: Containing the following minimum list of supplies:~~

~~Quantity~~	~~Size~~	~~Item~~
~~32~~	~~19 by 75 mm~~	~~Brand sheer bandages~~
~~20~~	~~25 by 75 mm~~	~~Brand fabric bandages~~
~~4~~	~~Medium~~	~~Non-stick pads~~
~~2~~	~~50 mm~~	~~Soft-gauze bandages~~
~~2~~		~~Oval eye pads~~

~~1~~	~~1300 mm~~	~~Triangular bandage~~
~~1~~	~~13 by 4500 mm~~	~~Hypo-allergenic first-aid tape~~
~~10~~		~~Antiseptic wipes~~
~~1~~	~~3.5 g~~	~~Burn cream, foil pack~~
~~1~~	~~227 g~~	~~First-aid cream~~
~~1~~	~~100 caplets~~	~~Acetaminophen Extra-Strength caplets~~
~~1~~		~~Scissors~~
~~1~~		~~Tweezer~~
~~1~~		~~First-aid guide~~
~~1~~	~~15 mL~~	~~Ophthalmic irrigation solution~~
~~1~~		~~Contents cards~~
~~10~~		~~Disposable gloves~~
~~10~~	~~0.33 mL~~	~~Ammonia inhalants~~

- Toilet: A portable sanitation unit, ADA Compliant, H 90” x W 77” x D77” shall be provided near the State/Engineer Trailer. This unit shall be for the exclusive use of the State and Engineer Personnel and shall be padlocked after hours to prevent vandalism. Toilet facilities shall be cleaned and sanitized a minimum of once per week except from May 15 through September 15 in which these facilities shall be cleaned and sanitized a minimum of twice per week.

- Fire Extinguisher: Non-toxic, dry chemical, fire extinguisher meeting Underwriters Laboratories, Inc., approval for Class A, Class B and Class C fires with a minimum rating of 2A: 10B: 10C.

- Thermometer: An outdoor minimum - maximum thermometer.

- ~~Photocopying Machine: Heavy duty, electric, dry process photocopying machine with automatic feed and enlargement/reduction capacity capable of making photocopies ranging in size from 8 1/2" X 11" to 11" X 17" and an adequate supply of copy paper (8 1/2" x 11", 8 1/2" x 14", 11 x 17") and toner. The supply of copy paper and toner shall be replenished by the Contractor as required by the Engineer.~~

- Signs: The Contractor shall furnish and install necessary signs to locate and identify the State/Engineer office.

1.6.3 Additional Requirements, State/Engineer Office:

Type A field offices shall be of weatherproof construction located on or in the immediate vicinity of the Project, having a floor area of not less than 520 square feet and a ceiling height of not less than 7 feet, and having partitions and doors providing three communicating rooms, one with a floor area of not less than 260 square feet and two with a floor area of not less than 130 square feet each.

Each of the trailers shall be equipped with:

3 - Free standing office desks with drawers and locks.
3 - Swivel Chairs.
1 - 3’ x 6’ High Quality Folding Table.
6 - Metal Cushioned Office chairs.

1 - Or more clothes closets of ample size for maximum office requirements.
1 - Heavy Duty 3 hole paper punch.
1 - Refrigerator (Frigidaire 4.4 Cu. Ft. Compact Refrigerator or approved equal).
1 - Coffee Maker.
1 - Microwave Oven.
3 - Three-shelf book cases 3' w x 3' h x 1'd.
4 - Waste-paper receptacles.
3 - High Quality File Cabinets, 4 drawers each, legal size, with lock and keys.
1 - Drafting-type tables each 3 feet by 6 feet and supported by wall brackets and legs.
1 - Draftsman's stools.
1 - Metal storage cabinet with 4 adjustable shelves, tumbler lock and two keys (approximate size 72 inches high by 36 inches wide by 18 inches deep).
3 - Fire extinguishers, one mounted in each room
1- Paper Towel Dispenser
1- Broom and dust pan
~~1 - Multifunction Fax/Printer/Scanner Machine, Color Canon Pixma MX850 or equal acceptable to the Engineer. Contractor shall provide all paper, toner, cartridges, ink or parts to keep the machine fully functional for the duration of the project. Machine shall be repaired or replaced as needed to provide uninterrupted service. Machine shall modified and/or all additional equipment be provided to allow unit to send/receive faxes from internet communication services provided in Section 1.8.~~
1- Porcelain on steel markerboard (4'h x 8'w, Dry Erase Type) for dual use as a magnetic bulletin board and writing surface. Steel shall be 24 gauge standard steel. Shall include, a full-length map rail and accessory tray with silicone rubber Dura-SafeTM corners, Smooth low-gloss surface, dust-free surface without ghosting and factory framed in anodized aluminum or solid wood. Shall include L-clips, rawl plugs and screws for installation and warranty.
24 Heavy-duty three ring binders, 4" width minimum.
1- Photocopying Machine: Heavy duty, electric, dry process, multifunction, photocopying machine with automatic feed and enlargement/reduction capacity capable of making photocopies ranging in size from 8 1/2" X 11" to 11" X 17" and an adequate supply of copy paper (8 1/2" x 11", 8 1/2" x 14", 11 x 17") and toner, Lexmark CX410e, or equal as approved by the Engineer. Copier shall be: capable of printing, copying, scanning and telefaxing; shall be network and wireless ready; two USB host terminals; one Ethernet 10/100 Base TX network; two, modem port/phone lines; and capable of printing at 30 pages/min or greater in color or B&W. The supply of copy paper and toner shall be replenished by the Contractor as required by the Engineer. Contractor shall keep the machine fully functional for the duration of the project. Machine shall be repaired or replaced as needed to provide uninterrupted service. Machine shall be modified and/or all additional equipment be provided to allow unit to send/receive faxes from internet communication services provided in Section 1.8 Machine shall be mounted on an adjustable printer stand.
1- Wireless Gigabit Router with LAN Ethernet ports: Works with all major cable Internet providers. Equipped with firewall and allows for data encryption. Works with Microsoft Windows 8.0 and higher.

1.6.4 Office Construction Details

General Requirement: The buildings shall be fully equipped and made available for use and occupancy by the State and Engineer immediately after roadway surface is installed in the site support area and before any other contract work.

All buildings shall be maintained in good condition and appearance by the Contractor for the designated period after which all portable buildings or trailers, fencing, surfacing and utilities shall be removed from the location, the areas cleaned, and left in a neat and acceptable condition as approved by the Engineer.

~~Contractor may need to temporarily relocate the office trailers during the project to facilitate the required work in this contract. No extra payment will be considered for this effort.~~

Contractor shall connect electrical service to trailers, in accordance with Section 1.9 Electricity.

1.6.5 Submittals

Submittals shall be according to Section 1.3.

1.6.6 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Pay Unit
1.6	Field Office Setup	Lump Sum

The Contractor will be paid the bid price for providing two office trailers to the Site, as described in this Section. All field office items will also become the property of the Contractor at the conclusion of the project.

Separate payment will not be made for setup or maintenance of the Contractor's field office(s).

END OF SECTION

1.7 Field Office Maintenance

1.7.1 General Description

Maintenance of the construction offices, for the time required, shall consist of maintaining the furniture, equipment, supplies and utilities, providing lavatory supplies, janitorial and waste disposal services weekly, and snow removal services. Maintenance of the field office shall include the monthly rent. The fax machine and related equipment shall be repaired or replaced within 48 hours of becoming inoperable or defective. Equipment should be maintained in working order for the duration of the contract.

Contractor shall provide these services for both State and Engineer's offices including:

- Janitor and waste disposal services (weekly)
- Maintenance of all equipment provided with the trailers
- Furniture maintenance and repair as needed
- Bathroom supplies as needed
- Coffee service (as needed)
- Bottled water (as needed)
- Snow removal (>1" snowfall in 24 hours)
- Office equipment removed/replaced (as needed)

The Contractor shall be responsible, until use and occupancy of the Engineer's and State's offices are relinquished, for any and all damage, direct or indirect, of whatever nature, occurring to property which is kept in State's and Engineer's offices that the Contractor is required to furnish as an item(s) of the contract. Such damages would include any loss caused by, but not limited to, fire, theft, vandalism, or malicious mischief.

1.7.2 Electricity

The Contractor shall provide electricity to the trailers during the contract period in accordance with Section 1.9 Electricity.

1.7.3 Submittals

Submittals shall be according to Section 1.3.

1.7.4 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Pay Unit
1.7	Field Office Maintenance	Month

Payment for Bid Item 1.7 Field Office Maintenance, including the use and maintenance of the field offices and various types of surveying equipment will be made for each month or fraction thereof that the field office is required, starting with the first month after Bid Item 1.6, Field Office Setup, is complete, except that payment will not be made for any month or fraction thereof due to the Contractor's delays. HVAC, water, and sanitary service shall be considered incidental to field office maintenance and not paid for separately. The Contractor shall not be paid additional monthly maintenance costs beyond the Contract limits due to his delays.

END OF SECTION

1.8 Internet Service

Telephone and internet services are accessible to the project. Contractor will need to provide internet (telephone is not required) services to the Engineer, and NJDEP's trailers (services provided to the Contractor's trailer are the Contractor's responsibility).

1.8.1 Internet Description

The internet connection shall provide download speeds of minimum 20 Megabits per second. ~~The internet connection shall be wireless or high-speed DSL or equal service capable of connecting up to 3 concurrent users simultaneously.~~

1.8.3 Measurement and Payment

Payment for Bid Item 1.8 Internet Service for the State and Engineer's Offices will be made monthly based on the actual cost as evidenced by paid bills from the internet company (Verizon or others), including connection fees to establish service. An estimated amount to cover these reimbursements has been included on the Bid Documents.

Payment will be made under:

Pay Item No.	Pay Item	Pay Unit
1.8	Internet Service	Pass Through

END OF SECTION

1.9 Electricity / Inspections / Permit Fees

1.9.1 Description

The Contractor shall provide electrical service during the construction ~~contract~~ period for the State's and Engineer's office trailers, North Pump Station, ~~and~~ South Pump Station and Gas Flare System. The Contractor shall make all arrangements with PSE&G for electrical service, as indicated on the drawings and obtain all necessary permits. The Contractor may also be required to provide temporary electric service including obtaining, placing into service, and maintaining/fueling and demobilizing generators and permits, if~~as~~ needed ~~and permits~~.

~~The Contractor shall provide separate metering for the State and Engineer's trailers.~~

~~T~~For the State and Engineer's trailers the Contractor may elect to provide power with diesel powered ~~gasoline~~ generator(s) or tie into the PSEG grid. If the Contractor chooses to tie into the grid, the Contractor is responsible ~~entirely at his own risk in~~for obtaining power in a timely manner. Delay by PSEG in providing power to the trailers and construction equipment shall not be considered a cause for schedule extension and/or claims for added costs, by the Contractor, on the State.

For the proposed ~~two (2~~North Pump ~~and South) p~~Pump ~~s~~Station, power is available from the existing KMUA Pump Station Building. For the proposed South Pump Station,~~s~~ the Contractor may have to provide temporary power for the entire construction period ~~as well as up to the full two (2) years of Operations and Maintenance~~. South Pump Station power shall be provided through the use of a~~two~~ diesel generator~~s; one each for each pump station~~. Generator power provided to the pump stations shall conform to Section 2.11 Pump Stations, specifically Section 2.11.~~3~~4.C.~~.~~ Generators shall be maintained and fueled in order to minimize any down time. This includes fuel deliveries as needed accounting for non-working hours~~holidays,~~ and bad weather ~~and the like~~. Contractor shall be responsible and present on-site for fuel delivery truck access. Under no circumstances shall fuel ~~be~~ delivery take place without a responsible person(s) from the Contractor being present on-site. Response to applicable system alarm(s) pertaining to either pump station generated Wireless Monitoring and Control System (Section 2.42) shall consider generator malfunction for whatever reason, e.g. mechanical failure, lack of fuel, etc.

The Contractor shall notify the Williams-TRANSCO Gas Pipeline Company and PSE&G prior to working on their easements and/or over or on their gas pipelines. If required by Williams-TRANSCO or PSE&G, the Contractor shall obtain their gas pipeline engineering and inspection services. Payment for the gas pipeline engineering and inspection service fees will be made by the Contractor and reimbursed by the State from Pay Item 1.9.2.

The Contractor shall pay the NJMC Trailer Permit fees for the State and Engineer trailers, any Township permits or inspection fees, and the fee for Soil Erosion and Sediment Control Plan. These fees shall be reimbursed through a Pass Through.

Submittals shall be according to Section 1.3.

1.9.2 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Unit
1.9.1	Electricity	Pass Through
1.9.1A	Electricity: State and Engineer's Trailers	Month
1.9.1B	Electricity: South Pump Station	Month
1.9.2	Gas Pipeline Engineering & Inspection	Pass Through
1.9.3	Trailer/Permit Fees	Pass Through

~~Electricity use will be measured by the number of kilowatt-hours used.~~ NJDEP will pay for electricity monthly under Bid Item 1.9.1, Electricity. The Contractor will be compensated the direct cost upon receipt of a PSE&G bill for the South Pump station, gas flare and state and engineer's trailers. ~~The Contractor will be compensated for the electrical use by the State and Engineer's trailers calculated using the standard retail rate for the local electrical utility or the direct cost upon receipt of a PSE&G bill for the site.~~ The Contractor will not be paid for electricity to the Contractor's trailer. Contractor will not be paid for any electricity required for actual construction work or equipment.
~~The Contractor will not be paid extra due to his delays.~~

If there is a delay with PSE&G providing power to the site at no fault of the Contractor, NJDEP will pay for temporary generators monthly under Bid Items 1.9.1A and B, Electricity.

Trailer ~~E~~electric tie in costs (metered and/or generator) shall be incorporated into the Field Office Setup ~~Cost~~ (Bid Item 1.6). Pump Station generator mobilization and tie into the pump stations costs shall be incorporated into North Pump Station (Bid Item 2.11.3~~1~~) and South Pump Station (Bid Item 2.11.4~~2~~). ~~No separate payment will be made.~~ The Contractor will be reimbursed directly for any electrical permit fees under Bid Item 1.9.3, ~~Electrical~~ Trailer/Permit ~~Permit~~ Fees, upon presentation of a receipt.
Fees to PSE&G for the permanent power will be paid directly by the NJDEP.

The Contractor will be reimbursed for Pipeline inspections service fees by Williams-TRANSCO Gas Pipeline Company and PSE&G engineering under Bid Item 1.9.2, Gas Pipeline Engineering and Inspection, upon submission of a copy of the receipt to NJDEP. No payment will be made for the Contractor's handling or administrative and overhead expenses under this Pay Item. The Contractor is responsible to pay Williams-TRANSCO Gas Pipeline Company or PSE&G promptly, and the State will not be responsible for interest or penalty charges due to late payments as a result of the Contractor's delays.

The Contractor shall pay the NJMC Trailer Permit fees for the State and Engineer trailers, any Township permits or inspection fees, and the fee for Construction ~~-~~Soil Erosion ~~and~~ Sediment Control Plan. The Contractor will be reimbursed for the NJMC Trailer Permit fees for the State and Engineer trailers, any Township permits or inspection fees, and the fee for the Construction ~~Soil~~ Erosion and Sediment Control Plan (Bid Item 3.6) under Bid Item 1.9.3, Trailer/Permit Fees, upon submission of a copy of the receipts to NJDEP. No payment will be made for the Contractor's handling or

administrative and overhead expenses under this Pay Item. The Contractor is responsible to pay and the State will not be responsible for interest or penalty charges due to late payments as a result of the Contractor's delays.

END OF SECTION

1.10 Geotechnical Testing

1.10.1 Description

The Contractor shall retain an Independent Testing Agency (ITA), as approved by the Engineer, to perform QA/QC testing as described in sections 1.10.1 through 1.10.6. The ITA shall perform or subcontract QA/QC tests to a qualified laboratory as approved by the Engineer. Testing locations shall be as designated and/or approved by the Engineer.

1.10.2 Reference Standards

A. NJDOT Standard Specifications.

B. ASTM Standards for Soil and Rock; Building Stones Section 4, Volume 04.08.

C. ASTM Standards for Concrete and Aggregates

D. ASTM Standards for Geosynthetics, latest edition.

E. AASHTO Standards for soils, aggregates, pavement structures.

F. USCE Manual - EM1110-2-1906, Appendix VII and X.

G. OSHA Standards for Health and Safety issues.

H. FTM for geosynthetics

I. NSF for geosynthetics

1.10.3 Independent Testing Agency

The Independent Testing Agency shall provide qualified experienced personnel as necessary to perform field testing and sampling of on and off-site materials. At a minimum these personnel shall be individually licensed as nuclear gauge operators by the Nuclear Regulatory Commission (NRC), be certified at minimum grade 1 level by the American Concrete Institute (ACI) and have at least two (2) years experience in the sampling and testing of construction materials as applicable to the assigned task of responsibility.

The agency's laboratory shall be adequately equipped and manned to meet the requirements of testing, be accredited by the American Materials Reference Laboratory (AMRL) and participate in yearly AMRL reviews. Laboratory testing geosynthetics should be accredited by the Geosynthetic Accreditation Institute-Laboratory Accreditation Program.

The testing agency shall at a minimum be capable of performing the following testing.

1. ASTM Standard Tests:

C39: Test Method for Compressive Strength of Cylindrical Concrete Specimens

C143: Test Method for Slump of Hydraulic Cement Concrete

C231: Test Method for Air Content of Freshly Mixed Concrete by Pressure Method

C1064: Test Method for Temperature of Freshly Mixed Hydraulic Cement Concrete~~Freshly Mixed Portland Cement Concrete~~

~~D2166: Unconfined Compressive Strength Testing of Cohesive Soil~~

D4318: Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils (Atterberg Limits)

D422: Standard Test Method for Particle-Size Analysis of Soils (Withdrawn 2016) (AASHTO T27)~~D422: Particle Size Analysis of Soils (AASHTO T27)~~

~~D427: Shrinkage Factors of Soils~~

D698 e12e: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3))~~D698: Test for Moisture-Density Relationship of Soils and Soil-Aggregate Mixtures Using 5.5 lb. (2.49 kg.) Rammer and 12 in. (305 mm) Drop. (AASHTO T99, Method C) ("Standard Proctor")~~

D1556: Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method (or D2167)~~Test for Density of Soil in Place by the Sand Cone Method (or D2167)~~

D1557: Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort~~Test for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. (4.54 kg) Rammer and 18 in. (457 mm) Drop ("Modified Proctor")~~

~~D2167: Test for Density of Soil in Place by the Rubber-Balloon Method (or D1556)~~

D2216: Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass~~Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures~~

D5084: Standard Test Methods for Measurement of Hydraulici Conductivity of Saturate Porous Materials Using a Flexible Wall PermeameterD2434: Standard Test Method for Permeability of Granular Soils (Constant Head)

D2922: Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

D6938: Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

D2950: Test Method for Density of Bituminous Concrete in Place by Nuclear MethodsDensity of Bituminous Concrete in Place by Nuclear Method

D3017: Test for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)

D4437: Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet GeomembranesTest Method for Determining the Integrity of Field Seams Used in Joining Polymeric Sheet Geomembrane

D4885: Test Method for Determining Performance Strength of Geomembranes by the Wide Strip Tensile Method

D4959: Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating

D5321: Direct Shear Testing (Between Soils and Geosynthetics): Interface Friction Determination by Direct Shear Testing

D2937: Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method

D4767: Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils

D6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

D5084: Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

C127: Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate

D6693: Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

2. Other tests: Type and frequency specified herein.

Field seam destructive testing shall occur as described in Section 2.12.

Testing equipment shall be calibrated in accordance with manufacturer recommendations and frequency or at a minimum once per year. Certificates of calibration shall be available for the Engineer's review.

The Testing Agency laboratory shall be adequately staffed with qualified personnel to perform required testing in sufficient turnaround time so as not to delay or interfere with the Contractor schedule. Minimum testing turnaround time capabilities shall be defined as part of the subcontractor (testing agency) bid to the general Contractor. It shall be the Contractor's responsibility to meet construction schedules as approved by the Engineer.

The ITA shall maintain an in-house P.E. to review all testing reports and data prepared by ITA.

1.10.4 Testing Agency Responsibilities

Procure samples as required by the testing and sampling requirements of each work item. Sample locations shall be as approved by the Engineer.

Perform specified inspection, sampling, and testing of products in accordance with specified standards.

Test materials and mixes for the compliance requirements of the Contract Documents.

Promptly report testing results to the State/Engineer and Contractor within the agreed upon turnaround time in accordance to the requirements of Section 1.3.

Perform additional inspections and tests required by the State/Engineer, in accordance with Contract requirements.

1.10.5 Testing and Inspection Reports

A. Laboratory testing results shall be submitted to the Engineer and Contractor in duplicate within 12 hours of completion of testing. Reports shall include at a minimum the following:

1. Name, address and phone number of testing agency
2. Project title and number
3. Name of inspector/sampler/person performing analysis
4. Date, time, location, and description of sample
5. Date, type and procedure of testing performed

6. Testing results
7. Report date

B. Field Inspection and Testing Reports shall be completed and submitted to the Engineer at the end of each day in the form of a Daily Field Report (DFR). DFR's shall be completed by each individual inspector on-site and may be accompanied by a summary report prepared by the inspection supervisor. Daily Field Reports shall include at a minimum:

1. Name of testing agency
2. Project title and number
3. Name of Inspector/name and classification of person completing the report.
4. Testing that may have been performed that day, along with results, location and material tested.
5. Date and weather conditions
6. Contractor, Supervisor and equipment
7. Duration of time on-site
8. Signature of person completing report
9. Detailed documentation of activities observed, monitored and tested during the day and any problems that may have arisen and corrective action taken.

Submittals shall be in accordance with Section 1.3.

1.10.6 Limits of Testing Agency Authority

A. Testing Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Testing Agency may not approve or accept any portion of the work.

C. Testing Agency may not assume any duties of Contractor.

D. Testing Agency has no authority to stop the work.

1.10.7 Contractor Responsibilities

A. It shall be the Contractor's responsibility to provide full cooperation to the Testing Agency, State, and Engineer in accessing areas of testing and inspection.

B. Provide incidental labor, equipment and facilities to provide access for QA/QC personnel for work to be tested, to obtain and handle samples at the site or at source of products to be tested, and to facilitate tests and inspections, storage and curing of test samples.

C. Notify Engineer and testing agency 24 hours prior to expected time for operations requiring inspection and testing services.

1.10.8 Schedule of Tests and Inspections

A. Inspection and testing requirements are detailed in the individual sections of these specifications.

1.10.9 Testing Frequencies

The following Table 1.10-1 provides general testing frequencies. Individual specification sections may provide additional testing and frequency requirements. Contractor shall perform the more stringent testing frequency required in the event there is a contradiction between Table 1.10-1 and the individual material specification section.

TABLE 1.10-1
TESTING FREQUENCIES

Material	Testing Frequency	Specification Section
Slag CB Barrier Wall – Quality Control Testing	As specified in specification section	2.6.8
Slag CB Barrier Wall – Insitu Testing	As specified in specification section	2.6.22
Fill I-13	1 Sieve Analysis and 1 Modified Proctor per 10,000 Cubic Yards and Proposed Borrow Source 1 Compaction Density Test/2,500 Square Feet of Each Lift	2.8
Fill I-5	1 Sieve Analysis, 1 Standard Proctor, and 1 Permeability per 10,000 Cubic Yards and Proposed Borrow Source 1 Compaction Density Test/2,500 Square Feet of Each Lift	2.8
Geomembrane	Refer to Section 2.12 and Table 2.12-1	2.12
Composite Drainage Net	Refer to Section 2.13 and Table 2.13-1~~2~~	2.13
Geotextiles	Refer to Section 2.14 and Table 2.14-1	2.14
Coarse Aggregate #57	1 Sample/3000 Tons	2.20
Riprap	1 sieve analysis / Proposed Source	2.21
Topsoil	One 10 Pound sample/Source	2.24
Seeding	1 Soil Test / 2,500 Square Yard	2.24
Concrete	1 Set of 4 Cylinders per 50 Cubic Yards with at least 1 set of Cylinders Collected for each day that Concrete is placed. First 5-25 Cubic Yards of Pour per day/ Composite Sample Each Additional 50 Cubic Yards of Pour per day/ Composite Sample	2.25
RA Type B aggregate	1 Sieve Analysis per 5,000 Cubic Yards (reused or imported RA type B) and Proposed Borrow Source	2.26

1.10.10 Measurement and Payment

The cost of performing the required testing and sampling, including personnel, consumable supplies, power, utilities, and report preparation will be paid under the individual work items for which testing is required. Payment will only be made after the State has received any report associated with laboratory testing.

The State will pay the bid unit prices for the following additional ex-situ tests requested by the State Construction Manager. The State will not pay for tests that fail or for tests not requested by the State. A failed test is one that does not meet the specifications for the material/ item being tested.

Payment will be made under:

Pay Item No.	Pay Item	Unit
1.10.1	Sieve Analysis (ASTM D422 / AASHTO T27), If and Where Directed	Each
1.10.2	Relative Density (ASTM D1556, ~~ASTM D2167,~~ or ASTM D6938~~D2922~~), If and Where Directed	Each
1.10.3	Modified Proctor (ASTM D1557), If and Where directed	Each
1.10.4	Concrete Compressive Strength (ASTM C39), If and Where Directed	Each
1.10.5	Permeability (ASTM D2434 / D5084), If and Where Directed	Each
1.10.6	Direct Shear Testing Between Soils and Geosynthetics (ASTM D5321), If and Where Directed	Each
1.10.7	Grout Compressive Strength (ASTM C39), If and Where Directed	Each
1.10.8	Field Seam Destructive Testing, If and Where Directed	Each
1.10.9	Moisture Content Testing (ASTM D2216~~D4959~~), If and Where Directed	Each
1.10.10	Density (ASTM D2937), If and Where Directed	Each
1.10.11	Atterberg Limits (ASTM D4318), If and Where Directed	Each
1.10.12	Standard Proctor Compaction (ASTM D698), If and Where Directed	Each
1.10.13	Triaxial Compression (ASTM D4767), If and Where Directed	Each
1.10.14	Bulk Specific Gravity (ASTM C127), If and Where Directed	Each
1.10.15	Geomembrane Tensile Strength (ASTM D6693), If and Where Directed	Each
1.10.16	Geomembrane peel and shear strength	Each

(ASTM D6392), If and Where Directed

END OF SECTION

1.11 Record Drawings

1.11.1 Description

The Contractor shall keep one record copy of all Contract Documents, at the site in good order and annotated to show all revisions made during construction. Such annotations shall be kept current and may be inspected by the State or Engineer monthly or more frequently. Failure to maintain current record drawings will be cause to delay progress payments. Record drawings shall be available to the Engineer at all times during the life of the Contract.

~~Prior to pre-final inspection, Contractor shall furnish a reproducible copy of the record drawings.~~ Prior to substantial completion, Contractor shall furnish a reproducible copy of the record drawings. At the completion of the Contract and before final payment is made, Contractor shall furnish the Engineer six (6) sets of reproducible copies and seven (7) CD disks~~one set of reproducibles and five CD disks~~ of the corresponding AutoCAD Version 2000i (or compatible) files of the final approved record drawings reflecting all revisions herein described below.

Record drawings shall be based on the construction design drawings and shall include, at a minimum:

- Notations of material changes, if other than that specified
- Incorporation of Field Order Details
- Incorporation of Approved Change Orders
- Specific horizontal and vertical surveyed locations of all items constructed and any existing items that were found in discrepancy of the design plans and
- Notations of pay item quantity changes and or adjustments.

Record drawings shall contain a copy of all drawings included in the construction documents. Drawings warranting "no changes made or noted during construction" shall be so noted and included in the set of record drawings. Record drawings shall be signed and sealed by the Professional Licensed Engineer retained by the Contractor, and by the Contractor's responsible representative.

The Contractor shall deliver six (6) copies of the draft Record Drawings for the State and Engineers comment. Record Drawings will undergo an extensive review during which, the Contractor shall incorporate review comments into the final Record Drawings, including a re-survey if necessary.

1.11.2 Record Drawings Deliverables

The Contractor shall provide the Record Drawings, with the Contractor's hand markups (red line), in hard copy and .pdf file format. The Record Drawings and the Contractor's hand markups are considered as two separate plan sets that will be required to be submitted. The .pdf shall reflect the color (red line) markups of the Contractor. Black and white submittals will not be accepted. Final delivery shall include pdf files, bond paper prints and electronic files.

Bond Paper Prints
Final delivery for the project site shall include six (6) sets of white bond paper prints (36" x 42") of the survey maps scaled at 1" = 50' (or an appropriate scale to fit 36" x 42" sheets).

Each set shall be signed and sealed by a licensed surveyor. It is understood that several drawings will be required to make up one complete map, including a cover sheet with plan sheet key map.

Electronic Files

Final delivery for the site shall include seven (7) electronic files of the Record Drawings and Contractor hand markups on a CD-ROM. This electronic file shall either be in .pdf format and 2000i AutoCAD native format (also known as DWG format), or in AutoCAD's drawing exchange format (also known as DXF format). Electronic delivery of the record drawing shall include a digital coverage of each layer in New Jersey State Plane Coordinates suitable to be uploaded directly into NJDEP's Geographic Information System. Contours shall be zero-width 3D polylines, layer separated into intermediate and index intervals and contour labels shall follow the same scheme. All contours shall be assigned elevations. Spot elevations shall be AutoCAD points with appropriate Z-values. All entities on the topographic maps shall be included in separate layers with appropriate names, such as “gas line” or “tree line”, etc.

Backup Information

In addition to the electronic file deliverable, the following backup information shall be provided:

- One (1) copy of all field notes, sketches, and calculations;
- Tie details for all established benchmarks and ground control;
- One (1) copy of all relevant documents associated with the site survey;

1.11.3 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Unit
1.11.1	Record Drawings	Lump Sum ($5,000)
1.11.2	Record Drawings (Additional Cost)	Lump Sum

Payment for 1.11.1 Record Drawings will be made on a $5,000 lump sum basis upon completion of the Final Record Drawings Deliverables to the satisfaction of the NJDEP and the Engineer as per the requirements of this specification section.

If the Contractor’s costs are greater than the $5,000 allocated in Pay Item 1.11.1 to complete the work in Section 1.11, then the Contractor shall provide his additional costs in Pay Item 1.11.2. If the Contractor does not require additional compensation, then the Contractor shall provide $0.00 for Pay Item 1.11.2.

END OF SECTION

MSLA 1-D LANDFILL CLOSURE PROJECT
TECHNICAL SPECIFICATIONS
NJSTART BID NO. 17DPP00036

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2.1 Site Clearing and Grubbing

2.1.1 General Description

This work shall consist of clearing and grubbing the site area of vegetation, debris and above-ground site improvements as indicated on the plans by the limits of disturbance in preparation for construction operations.

~~This work shall consist of clearing the site area of vegetation, debris and above-ground site improvements as indicated on the plans by the limits of disturbance in preparation for construction operations.~~

2.1.2 Existing Conditions

Variations to conditions or discrepancy in actual conditions as they apply to site preparation operations are to be brought to the attention of the Engineer prior to the commencement of any site work.

The Contractor is alerted that existing grades around the landfill are soft, wet and offer poor stability. In addition, the site is heavily vegetated with established trees. The Contractor shall familiarize himself with the existing conditions prior to the start of work. The Contractor shall anticipate difficulties with equipment maneuvering, material delivery, material installation, and all other items that may be encountered due to the site conditions.

Later claims for additional compensation due to additional labor, equipment or material required on account of difficulties encountered or underground water conditions will not be considered.

2.1.3 Protection

Locate and protect bench marks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed it shall be referenced by a Licensed Land Surveyor and replaced, as necessary, by the same, at no cost to the State.

Locate and identify existing utilities that are to remain and protect them from damage. Protect existing utilities during clearing operations. Re-establish if disturbed or destroyed, at no cost to the Owner.

Extreme care must be taken to avoid damaging existing drainage structures, monitoring wells, existing gas wells identified for use with the future system, inclinometers and piezometers; unless noted otherwise.

Notify the New Jersey One Call System between 5 and 10 days prior to any excavation. Phone: 1-800-272-1000.

Conduct operations with minimum interference to public or private accesses and facilities. Maintain access and egress at all times and clean or sweep any roadways daily or as required by the governing authority. At such times as deemed necessary by the State, dust control shall be provided in accordance with the Dust Control Plan (Section 3.2.3).

Provide traffic control as required and as indicated on the Traffic Control Plan, in accordance with the Contract Documents, the U.S. Department of Transportation "Manual of Uniform Traffic Control Devices" and the New Jersey State Department of Transportation requirements.

2.1.4 Materials

Protection Materials: May be new or used, suitable and adequate for the intended purpose.

2.1.5 Erosion and Sedimentation Control

Contractor shall refer to the Erosion and Sedimentation Control Plan for Staging of Construction Activities.

If Contractor would like to revise the Staging of Construction Activities as shown on the E&S Control Plan, approval of revised staging must be obtained from the Hudson, Essex & Passaic County Soil Conservation District, and the New Jersey Department of Environmental Protection. Costs for this work shall be borne by the Contractor.

Submittals shall be in accordance with Section 1.3.

2.1.6 Preparation

Verify that existing plant life and clearing limits are clearly tagged, identified and marked in such a manner as to insure their safety throughout construction operations.

The Contractor shall cut through the brush to provide access for surveyors. The Contractor should be aware of hidden debris in the brush that can cause damage to their equipment.

2.1.7 Clearing

Clear areas required for access to site and execution of work. The Contractor shall dispose of vegetative waste within the waste relocation area shown on the plans.

All slopes of cuts, embankments, ditches, channels, waterways and all structures, both old and new, shall be cleared of all brush, hedge, weeds, heavy vegetation and other objectionable material growth. Clearing shall extend to a maximum of 5 feet beyond the top of slopes of roadway excavation and top of slopes of ditches and channels. No clearing shall be performed beyond the limits of disturbance indicated on the plans. Trees and stumps shall be chipped and spread on the landfill in thin lifts (no thicker than 4”) before grading and capping.

Vegetation within and around the Gas Plant shall be cleared and grubbed with the exception of select trees, as directed by the Engineer. Herbicides shall be applied to kill stumps of cleared trees and brush in which the removal would result in damage to existing structures, asphalt and concrete. Maintenance applications of non-selective and pre-emergence herbicides shall be applied within and

around the Gas Plant during the life of the project. Herbicide applications shall only be performed by a Licensed Applicator.

Vegetation along Harrison Avenue shall be cut periodically to maintain site lines for entering and exiting the site.

Existing concrete pads in the northeast corner of the site, as shown on the drawings, shall be removed and stored within the fenced in area of the Gas Plant.
~~Abandoned electrical poles and wires shall be disposed of offsite as part of Site Clearing and Grubbing.~~

The existing utility pole in the area between Stat 1+00 and 3+00, near the toe of the landfill, shall be removed to a minimum of 15 ft below grade and disposed of either by chipping and spreading the chips onsite, or by removing it offsite to an approved landfill.

In accordance with N.J.A.C 7:26-2A.8, exposed waste materials shall be covered with six (6) inches of clean soil or approved alternative cover material at the end of each working day (or more frequently if odors or vectors are a problem). A minimum of twelve (12) inches of clean soil shall be applied to all wastes exposed for any period exceeding 24 hours and extending up to six months. Daily cover shall be the Contractor's responsibility, no additional materials or payment will be made for daily cover. To the extent possible existing cover material should be used as daily cover.

~~Wells in the existing gas collection system identified for use in the proposed gas venting system shall be protected from damage during construction. Any damage to these wells rendering them unsuitable for use with the proposed gas system shall be repaired at the Contractor's expense.~~

Appropriate health and safety measures shall be employed during the site clearing work, in accordance with Section 3.1 of these Specifications, explosive gases and waste or contaminated materials may be encountered.

Any such materials for scrap recycling which have salvage value (such as aluminum, brass, copper pipe or wire, lead, gold, silver, zinc, stainless steel, I beams, iron, tin MUST be documented and a credit given to the State. A receipt for the amount received by the Contractor for these materials, from the recycling facility where it is disposed, must be provided to the Engineer. This amount will be a credit for the State to be deducted from the Contractor's payment invoices.

Contractor shall provide bill of lading/manifests to the Engineer at the end of each work day for all materials disposed offsite.

2.1.8 Pruning

When pruning is required, prune tree branches injured during clearing operations, or when directed by Engineer by making clean cuts, free from splinters, flush with parent branch or trunk.

Do not disturb branches or roots of any trees which are to remain.

2.1.9 Tires

Tires exposed above cap subgrade, or as directed by the Engineer, shall be removed and staged in an area selected by the Contractor, as approved by the Engineer. ~~Tires encountered within the limits of work shall be staged in an area selected by the Contractor, approved by the Engineer.~~ Tires shall not be reburied onsite but pressure washed to remove all surficial dirt, as approved by the Engineer. After staging and washing NJDEP will sample tires for disposal purposes. The tires shall be removed and disposed of at a NJDEP approved facility that can accept the tires. Additional payment will not be made if tires are required to be taken off their rims for disposal purposes.

2.1.10 Wetlands

The Contractor shall note the locations of wetlands indicated on the drawings. The Contractor shall not perform any clearing of the wetlands located on or off site, except as detailed in the permits for this project. The Contractor shall protect the wetlands, not permitted for disruption, from damage due to clearing operations and shall be responsible to restore any damage to these wetlands from his operations as well as pay any fines that may arise due to failure to protect them.

2.1.11 Well Abandonment

The Contractor shall abandon the existing groundwater monitoring and gas venting wells where indicated on the plans. Wells shall be abandoned as per NJDEP regulations (N.J.A.C. 7:9D-3) for abandonment of monitoring wells, including obtaining permits. The Contractor shall provide a well driller licensed in NJ to abandon wells. Existing well records are available in Appendix E. No well records were available for the existing gas vents; however, to comply with NJDEP regulations, the Contractor shall submit a Well Search Request to DEP/Water Allocation. This will also require surveying the actual locations as part of the closure. Abandoned wells shall be cut a minimum of 15 feet below ground surface. The Contractor shall furnish all labor, materials, and equipment required to abandon the specified monitoring wells.

An estimated total of approximately 70 gas wells / monitoring wells shall be abandoned as per this specification section during site clearing activities.

2.1.11.1 Submittals

Prior to commencing work, Contractor shall submit, for approval by the NJDEP and the Engineer, the personnel and equipment and materials proposed for well abandonment operations. Personnel must be licensed and experienced in drilling and well abandonment operations. Materials must meet industry standards and project specifications.

Following completion of well abandonment operations, the Contractor shall submit a Well Abandonment Report to the proper NJDEP department. Additionally, the Contractor shall submit a copy of the Well Abandonment Report to the Engineer.

2.1.11.2 Materials

The cement bentonite grout to be used during well abandonment operations shall be a mixture of Portland Cement sodium base bentonite clay and water as described below.

- One 94 pound (lb) bag Type I Portland Cement
- 5.6 lb powdered bentonite
- Nine gallons potable water (water may be reduced to a minimum of 6 gallons per mix in case where excessive use of grout is expected due to highly fractured or permeable formations)

2.1.11.3 Execution

In general, well abandonment must include the following:

- Removal of the casing to a minimum depth of 15 feet below ground surface.
- Monitoring well shall be sealed by cement bentonite grout pressure injected through a pipe discharging at the bottom of the space to be filled. The screened interval shall be totally removed, or if this is not possible, shall be sealed separately, tested, and approved by the Engineer before sealing the remainder of the well.
- Sealing shall be performed from bottom of the well up to fifteen (15) feet below the existing ground surface. The top 15 feet of the existing ground shall be backfilled with earthen materials and compacted to the approval of the Engineer.

All cuttings and well abandonment debris shall be disposed of on-site. All debris shall be considered contaminated and therefore shall be placed under the landfill cap.

2.1.12 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Unit
2.1.1	Site Clearing and Grubbing	Lump Sum
2.1.2	Tire Removal and Disposal	Each
2.1.3	Well Abandonment	Linear Foot

The Contractor shall be paid the lump sum bid price for Bid Item 2.1.1, Site Clearing and Grubbing, upon completion of clearing the areas as shown on the Drawings. If the Contractor does not clear the entire site in one operation, the Contractor may request that Lump Sum payment for Site Clearing be prorated, based on the aerial percentage of the total site cleared.

The Contractor shall be paid the per tire bid price for Bid Item 2.1.2, Tire Removal and Disposal, upon submission of a disposal receipt to the Engineer. All tires (truck, car, rimmed, or unrimmed) will be paid the same unit price.

The Contractor shall be paid the bid item price per linear foot for bid item 2.1.3, Well Abandonment for abandoning wells as shown on the Contract Drawings. The contractor shall measure the depth of the well prior to abandonment by a sounding or other method, as approved by the Engineer. The bid item price for well abandonment shall include the cost for all permits, well searches, materials, equipment and labor associated with abandoning wells.

A receipt for the amount received by the Contractor for any materials removed off-site for which there is salvage value, from the recycling facility where it is disposed, must be provided to the Engineer. This amount will be a credit for the State to be deducted from the Contractor's payment invoices.

END OF SECTION

2.2 Erosion and Sedimentation Control

2.2.1 General

The Contractor shall employ soil erosion and sediment control measures during the life of the project to control erosion and minimize sedimentation of rivers, streams, lakes, reservoirs, wetlands, floodplains, bays, and coastal waters. This work shall consist of the construction and maintenance of various temporary soil erosion and sediment control measures, including relocating them as required for stage construction.

The Contractor shall incorporate all permanent pollution control features into the project at the earliest practicable time. The Contractor shall install temporary sediment control devices in addition to those required to be installed in accordance with the Erosion and Sediment Control Plan, including but not limited to filter fence, straw bales, and rock filters, if and where directed by the Engineer. Silt Fence or straw bales shall include furnishing and installation of sediment barriers and the maintenance of the same in accordance with the Contract Documents.

2.2.2 Materials

2.2.2.1 General

Wood stakes, posts and boards shall be solid, reasonably knot-free lumber conforming to the nominal size specified on the plans.

Coarse aggregate #57 shall consist of broken stone or washed gravel. Broken stone shall be uniform in texture and quality in accordance to Sections 2.20 of these specifications.

Other materials shall conform to the following Sections:

Mulch 2.24
Seed Mixtures 2.24
Geotextiles 2.14

2.2.2.2 Silt Fence

Silt fence shall consist of geotextile fabric, Mirafi 100X, Propex Geotex 2130, or equal as approved by the Engineer. Silt Fence height shall be at least 3 feet to provide for a 2.0 foot high fence after 1.0 foot of fabric is buried in the existing soil. Fence posts shall be installed at a slight angle toward the anticipated runoff source. Sections of fabric shall be overlapped a minimum of 1’-6”, then joined in such a manner that, when in operation, the sections work effectively as a continuous fence.

2.2.2.3 Straw Bale Barriers

Straw shall be stalks of oats, wheat, rye, or barley relatively free from seeds, noxious weeds, and other foreign matter, free from decaying matter and from organic matter soluble in water and shall be bound

with wire or baling twine. The twine shall be an ultraviolet light stabilized polypropylene which has a knot strength of 170 pounds and straight break strength of 300 pounds.

Straw Bale barriers shall be installed around the waste relocation pile, and, utilized by the Contractor on an as-needed basis as an emergency erosion control measure. Straw Bales shall be embedded 4 inches into the ground and anchored in place with 2 wood stakes per bale.

2.2.2.4 Stabilized Construction Entrance

A temporary construction entrance constructed of aggregate on top of roadway geotextile type B shall be used to reduce or eliminate tracking of soils material onto paved streets and other paved areas.

Contractor shall install the stabilized construction entrance at locations where construction traffic enters and leaves construction site from or onto paved street or paved area, as shown on the plans.

Contractor shall place roadway geotextile, type B, over entire graded area and cover with a minimum 12" thick layer of 1 to 2-1/2 inch stone or recycled concrete.

Contractor shall perform maintenance on Stabilized Construction Entrance as follows:

a. Periodically and as directed by Engineer, apply layer of stone or recycled concrete to maintain entrance.

b. Immediately remove soils material or debris tracked onto areas of adjacent street or paved areas.

Contractor shall remove and restore stabilized construction entrance area following restoration schedule upon completion of project and when entrance is no longer required.

2.2.3 Check Dams

Materials

The Contractor shall furnish and install heavy duty erosion control matting associated with check dams along 200 foot length of steep swale (approximately 10% slope) located in the west portion of the Site, as indicated on the Contract Drawings. Check dams shall be Nilex GeoRidge or equal as approved by the Engineer. Heavy duty swale reinforcement matting shall be North American Green P550 or equal as approved by the Engineer.

Installation

Check dams shall be installed once the swale is constructed to slow down water velocity coming down the steep slope. Check dams shall be nine feet long and shall be installed at eight foot spacing as shown on the details in Contract Drawings.

Check dams shall be placed in the middle of the heavy duty swale reinforcement matting and anchored with 10" spiral spikes. Check dams shall be secured with a minimum of 3 anchors on the upstream side and 2 anchors on the downstream side of the swale. Once vegetation growth within swale is achieved, Contractor shall remove check dam from swale as directed by the Engineer.

2.2.4 Soil Erosion and Sediment Control Maintenance

Soil erosion and sediment control measures shall be maintained throughout the life of the project, to ensure that the measures function properly. Soil erosion and sediment controls shall be immediately inspected after each rain and any corrective work shall immediately be performed to return the soil erosion and sediment control measures to proper function, as directed. Coarse aggregate, silt fence, or strawbales damaged due to washouts or siltation shall be replaced as necessary or as directed by the Engineer.

The Contractor shall install erosion and sedimentation control devices in accordance with this Section and the Erosion and Sediment Control Plan.

2.2.5 Stormwater Pollution Prevention

The Contractor shall be responsible to prepare the Stormwater Pollution Prevention Plan (SPPP). Preparation and adherence to the SPPP shall be paid under bid items 3.2.1 and 3.2.2, respectively. The Contractor will be responsible for any fines incurred for violations of the SPPP.

2.2.5.1 Inspection and Reporting Requirements

Routine Inspections

Routine inspections (on a weekly basis, at a minimum) of the site shall be conducted and documented to identify areas contributing to the stormwater discharge authorized by this equivalency and evaluate whether the stormwater pollution prevention plan (SPPP), is being properly implemented and maintained, or whether additional measures are needed to implement the SPPP. Routine inspections shall be submitted to the Engineer on a monthly basis.

Annual Reports and Certifications

A report summarizing each routine inspection performed shall be prepared annually. This report shall be accompanied by an annual certification, on a form provided by the Department that the facility is in compliance with its SPPP, except that if there are any incidents of noncompliance, those incidents shall be identified in the certification. If there are incidents of noncompliance, the report shall identify the steps being taken to remedy the noncompliance and to prevent such incidents from recurring. The report and certification shall be signed and dated in accordance with N.J.A.C. 7:14A-4.9, and shall be maintained for a period of at least five years. This period may be extended by written request from the Department at any time (see N.J.A.C. 7:14A-6.6).

Reports of Noncompliance

All instances of noncompliance not reported under N.J.A.C. 7:14A-6.10 shall be reported to the Department annually.

Notification of Completion

The Soil Conservation District responsible for certifying the RFA (Request for Authorization) will provide the Department a copy of the report of compliance issued under N.J.A.C. 2:90-1 for completed construction activities. The report of compliance shall serve as the notification of completion.

2.2.5.2 Construction Site Waste Control Component of the Stormwater Pollution Prevention Plan (SPPP)

The SPPP shall be included in the Construction Plan.

The construction site waste control component of the SPPP consists of the requirements below.

Material Management to Prevent or Reduce Waste

Any pesticides, fertilizers, fuels, lubricants, petroleum products, anti-freeze, paints and paint thinners, cleaning solvents and acids, detergents, chemical additives, and concrete curing compounds shall be stored in containers in a dry covered area. Manufacturers' recommended application rates, uses, and methods shall be strictly followed to the extent necessary to prevent or minimize the presence of waste from such materials in the stormwater discharge authorized by this permit. (The preceding sentence does not apply to any manufacturers' recommendations about fertilizer or other material that conflict with the erosion and sediment control component of the facility's SPPP.)

Waste Handling

The following requirements apply only to construction site waste that has the potential to be transported by the stormwater discharge authorized by permit. The handling at the construction site of waste building material and rubble and other construction site wastes, including litter and hazardous and sanitary wastes, shall conform with the State Solid Waste Management Act, N.J.S.A. 13:1E-1 et seq., and its implementing rules at N.J.A.C. 7:26, 7:26A, and 7:26G; the New Jersey Pesticide Control Code at N.J.A.C. 7:30; the State litter statute (N.J.S.A. 13:1E-99.3); and OSHA requirements for sanitation at 29 C.F.R. 1926 (except where such conformance is not relevant to the stormwater discharge authorized by this permit). The construction site shall have one or more designated waste collection areas onsite or adjacent to the site, and an adequate number of containers to store waste. Waste shall be collected from such containers before they overflow, and spills at such containers shall be cleaned up immediately.

Construction site wastes include but are not limited to:

i. "Construction and demolition waste," as defined in N.J.A.C. 7:26-1.4 as follows: "waste building material and rubble resulting from construction, remodeling, repair, and

demolition operations on houses, commercial buildings, pavements and other structures. The following materials may be found in construction and demolition waste: treated and untreated wood scrap; tree parts, tree stumps and brush; concrete, asphalt, bricks, blocks and other masonry; plaster and wallboard; roofing materials; corrugated cardboard and miscellaneous paper; ferrous and non-ferrous metal; non-asbestos building insulation; plastic scrap; dirt; carpets and padding; glass (window and door); and other miscellaneous materials; but shall not include other solid waste types."

ii. Any waste building material and rubble resulting from such operations that is hazardous for purposes of N.J.A.C. 7:26G (the Hazardous Waste rules).

iii. Discarded (including spilled) pesticides, fertilizers, fuels, lubricants, petroleum products, anti-freeze, paints and paint thinners, paint chips and sandblasting grits, cleaning solvents, acids for cleaning masonry surfaces, detergents, chemical additives used for soil stabilization (e.g., calcium chloride), and concrete curing compounds.

iv. Other "litter," as defined at N.J.S.A. 13:1E-215.d as follows: "any used or unconsumed substance or waste material which has been discarded whether made of aluminum, glass, plastic, rubber, paper, or other natural or synthetic material, or any combination thereof, including, but not limited to, any bottle, jar or can, or any top, cap or detachable tab of any bottle, jar or can, any unlighted cigarette, cigar, match or any flaming or glowing material or any garbage, trash, refuse, debris, rubbish, grass clippings or other lawn or garden waste, newspapers, magazines, glass, metal, plastic or paper containers or other packaging or construction material, but does not include the waste of the primary processes of mining or other extraction processes, logging, sawmilling, farming or manufacturing."

v. Sanitary sewage and septage.

vi. Contaminated soils encountered or discovered during earthmoving activities or during the cleanup of a leak or discharge of a hazardous substance.

Concrete truck washout onsite is prohibited outside designated areas. Designated washout areas shall be lined and bermed to prevent discharges to surface and ground water. Hardened concrete from concrete truck washout shall be removed and properly disposed of.

Discharges of raw sanitary sewage or septage onsite are strictly prohibited. Adequate facilities with proper disposal shall be provided and maintained onsite or adjacent to the site for all workers and other sanitary needs.

Spills; Discharges of Hazardous Substances; Federally Reportable Releases

Spill kits shall be available onsite or adjacent to the site for any materials that are listed above and used or applied onsite. All spills of such material shall be contained and cleaned up immediately. Cleaned up materials shall be properly disposed of.

Discharges of hazardous substances (as defined in N.J.A.C. 7:1E-1.6) in construction site wastes are subject to the provisions of the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11 et seq., and to Department rules for Discharges of Petroleum and Other Hazardous Substances at N.J.A.C. 7:1E. No discharge of hazardous substances resulting from an onsite spill shall be deemed to be "pursuant to and in compliance with [this] permit" within the meaning of the Spill Compensation and Control Act at N.J.S.A. 58:10-23.11c.

Releases in excess of reportable quantities (RQ) established under 40 C.F.R. 110, 117, and 302 that occur within a 24-hr period must be reported to the National Response Center (800 424-8802).

2.2.6 Submittals

Submittals shall be in accordance with Section 1.3.

2.2.7 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Unit
2.2.1	Erosion and Sedimentation Control	Month
2.2.2	Additional Silt Fence, If and Where Directed	Linear Foot
2.2.3	Additional Straw Bales, If and Where Directed	Each

The Contractor will be paid the bid unit price for materials, installation, maintenance and removal (where applicable) for each month or fraction thereof that erosion and sedimentation control is required in accordance with the Construction Erosion and Sediment Control Plan approved by the Hudson County Soil Conservation District.. All temporary and permanent sediment control devices, labor, and equipment shall be considered part of Pay Item 2.2.1, which includes check dams to be installed (and later removed) within footprint of steep swale portion in west end of Site, as per specification section 2.2.3.

Separate payment will not be made for maintenance, repair or replacement of erosion and sedimentation control devices nor for relocation. Separate payment will be paid per Bid Item 2.2.2, Additional Silt Fence, If and Where Directed and Bid Item 2.2.3, Additional Straw Bales, If and Where Directed. Refer to Section 1.2.29 for addition language regarding if and where directed items.

END OF SECTION

2.3 Dewatering and Temporary Support of Excavations

2.3.1 General

This Section includes construction specifications for dewatering and temporary support of excavations. Dewatering and temporary support of excavations will be used for various subgrade works.

Contractor is to make arrangements with KMUA and PVSC to utilize the existing KMUA pump station for disposal of water removed by dewatering.
~~In general leachate or contact water (water that has come in contact with waste) shall be pumped to a 'leaching field' within the capping area. The leaching field shall be sufficient to allow the pumped water to infiltrate the capping area.~~

Excavations for the Barrier Wall and Leachate collection system installation shall be limited to 200 feet in length of open unsupported trench at any one time. This requirement may be waived by the Engineer if the contractor submits calculations supporting additional length of open trench. The Contractor shall provide temporary support for pump station installation.

2.3.2 Performance Requirements

Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations and permit construction to proceed on dry, stable subgrades. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented. Prevent surface water from entering excavations by grading, dikes, or other means. Accomplish dewatering without damaging existing buildings adjacent to excavation. Underwater installation of leachate collection pipe and gas headers will be allowed if they are pigged and/or pressure tested. Remove dewatering system if no longer needed.

2.3.3 Submittals

Shop Drawings for Information: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of headers and discharge lines; and means of discharge and disposal of water. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system. Include a written report outlining control procedures to be adopted if dewatering problems arise. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.

Shop Drawings for Information: For temporary support of excavations show location, and details of temporary support system. Provide calculations demonstrating suitability of temporary support system for the intended purpose. Include Shop Drawings signed and sealed by the qualified professional engineer

Qualification Data: For installer and engineer.

Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

Record drawings at Project closeout identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions performed during dewatering. Note locations and capping depth of wells and well points.

Field Test Reports: Before starting excavation, submit test results and computations demonstrating that dewatering system is capable of meeting performance requirements.

Submittals shall be in accordance with Section 1.3.

2.3.4 Quality Assurance

Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.

Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section "Project Management and Coordination."

2.3.5 Project Conditions

Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data. Make additional test borings and conduct other exploratory operations necessary for dewatering. The geotechnical report is referenced elsewhere in the Project Manual.

Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Engineer if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

2.3.6 Preparation

Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering

operations. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

2.3.7 Installation

Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed, or until dewatering is no longer required.

Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades except during underwater installation of the leachate collection piping and gas pipe headers. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability. All discharges shall be pumped and drained into the top of the landfill.

Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations. Maintain piezometric water level a minimum of 24 inches below surface of excavation.

Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

Promptly repair damages to adjacent facilities caused by dewatering operations.

2.3.8 Temporary Support of Excavations

Working Drawings: At least 30 days before beginning work, submit working drawings for approval. Include the following:

1. Size, cross-section, section modulus, and physical properties of the sheeting that will provide the maximum longitudinal bending moment for proper functioning.
2. Bracing design to protect workers, adjoining properties, and the public.
3. The combined stress calculations to determine the maximum effect of the principal stresses on the sheeting. Include a check for the principal stresses against the appropriate material yield point.
4. The effects of bending stresses in the longitudinal direction and the transverse direction.
5. The maximum forces that the sheeting is subjected to during construction operations.
6. The Contractor may use the Hencky-von Mises (Yield Distortion Energy) criterion to combine stresses and relate the principal stresses to a failure criterion (Material Yield Point).
7. Method for removing obstructions.
8. Method for addressing underground facilities and utilities that coincide with sheeting.
9. If required, dewatering plan, including method of dewatering and controlling sediment and contaminants from entering adjacent waterbodies, wetlands and environmentally sensitive areas. Do not use earthen berms as a method of dewatering.
10. Drawings shall be signed and sealed by a Professional Engineer licensed in the State of New Jersey.

Construction: Excavate and remove materials that obstruct the installation as specified in Section 2.4. Do not install within 200 feet of concrete that is being placed or has been placed within the previous 24 hours unless approved by the Engineer. Ensure that the sheeting has no gaps and is continuous for its entire length.

Dewatering: If required, dewater as specified in the approved dewatering plan. Continue dewatering operations until the temporary sheeting is removed or as directed by the Engineer.

Removal: Remove temporary sheeting when it is no longer required. Backfill voids left from temporary sheeting to provide uniform finish grades. Except for timber, the Engineer may approve leaving the temporary sheeting in place. When temporary sheeting is left in place, remove the upper portion to at least 3 feet below finish ground.

2.3.9~~8~~ Measurement and Payment

No additional payment will be made for dewatering or temporary sheeting of excavations. Dewatering and temporary sheeting of excavations will be considered part of the work being completed and the cost for dewatering will be included in that task.

The disposal of water removed by dewatering utilizing the existing KMUA Pump Station and NJDEP Metering Station shall be in accordance with Section 4.1. Disposal fees shall be reimbursed by

NJDEP from the Pass Through Pay Item 4.1.2. Contractor shall satisfy all sampling, analysis, reporting and pretreatment requirements of KMUA and PVSC for the disposal of water removed by dewatering at no additional cost to the State. This includes and is not limited to providing sedimentation tanks and control devices, and all sampling, analysis, and reporting requirements. The cost of these requirements will be considered part of work being completed and included in this task.

END OF SECTION

2.4 Wastefill and Earth Excavation

2.4.1 General

Wastefill and earth excavation shall consist of excavation of wastefill, landfill cover and earth below existing grade within the approximate extent of wastefill to the neat lines shown on the Drawings. The final grades for subgrade and final cap shall be as per the revised plans provided by the Engineer that will be based on the Pre-Construction Survey as described in Section 1.4 Mobilization. Wastefill and earth excavation shall also include placement, grading, and compaction of the material. The Contractor shall be responsible for surveying pre-excavation and post-excavation cross sections in order to measure the quantity of wastefill and earth excavation. Areas in which excavation is performed to achieve subgrade elevations will require Contractor compaction before placement of cap components. Compaction shall be performed as outlined in Section 2.5, Wastefill Placement and Compaction. If after compaction any excavation area is below subgrade elevation, Contractor shall add Wastefill material, compact, and re-survey until subgrade elevation is achieved at no additional cost to the State.

Wastefill and earth excavation includes the excavation of wastefill within the limit of wastefill shown on the Drawings. Wastefill and earth excavation does not includes excavation for channels above existing grade or temporary erosion and sediment control structures.

Excavation of wastefill, landfill cover and earth below existing grade is to be used as fill, and only as such, under the landfill cap.

The Contractor shall obtain digging permits prior to start of excavation by contacting the Garden State Underground Plant Location Service (1-800-272-1000). Verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed but indicated in locations to be traversed by piping, ducts, and other work to be installed.

2.4.2 Construction

The Contractor shall conduct this operation to minimize wastefill excavation and odors in accordance with Section 2.5. The Contractor will not be compensated for excavation beyond the neat lines shown on the drawings.

Cross sections at the excavation surveyed by the Contractor will be used for measurement and payment of wastefill and earth excavation, in accordance with these Specifications. The information on the cross sections and plans shall show existing, final grades and any field adjustments. Contractor shall secure the services of a Professional Surveyor Licensed in New Jersey.

The Contractor shall employ appropriate health and safety procedures during the wastefill excavation, in accordance with the Health and Safety Plan to be prepared according to Section 3.1 of these specifications. Explosive gases, drums, buried hazardous waste and contaminated materials may be encountered during operations. Excavated wastefill material shall be contained and prevented from spilling onto cleaned or capped areas prior to disposal in uncapped areas on top of the wastefill.

During wastefill and earth excavation activities and excavation for stormwater channels, downpipes, temporary erosion and sediment control structures, barrier wall trench, leachate collection piping trench, and gas collection piping trench, Contractor shall segregate and stockpile approximately 13,000 cubic yards of excavated Recycled Aggregate Type B (RA Type B) which was previously installed during previous phase of the contract. This RA Type B material shall be re-used for final grading of perimeter access road in accordance with ~~s~~Section 2.26 of these specifications and details on the Contract Drawings, under the gabion wall, and/or to achieve grades on the southern and eastern portions of the perimeter access road. RA Type B shall be sourced from following locations: 1) Excavation of perimeter roadway material to install Leachate Collection Trench, 2) Excavation of perimeter roadway material to install Slurry Wall Trench, 3) Excavation of perimeter swale to install geomembrane (1 foot thick replaced with Modified Fill, 12-inch thick), 4) Approximately 0.75 ft cut outside of the perimeter road approximately between stations 35+50 and 40+75; and, 5) Area where Northern Detention Basin to be constructed (from approximately Station 0+00 to 4+25).

Large items of wastefill which extend across limits of excavation shall be cut or broken to avoid disturbance of waste below the excavation surfaces. Disinterred containers of hazardous substances shall be handled in accordance to Section 3.3~~16~~ of these Specifications. If encountered, piping for the existing gas venting system shall be cut and abandoned in place.

Wastefill placement and compaction shall be in accordance with Section 2.5 of these Specifications. Testing will be according to Section 1.10.

2.4.3 Test Pits

Test pits, as directed by the Engineer, shall be excavated to the dimensions of 20’ long, 4’ wide, and 12’ deep. Material excavated during test pit activities will be returned into the excavation upon acceptance by the Engineer. Excavated material will be returned in the reverse order it was removed (i.e. most recently excavated material returned first).

2.4.4 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Unit
2.4.1	Wastefill and Earth Excavation	Cubic Yard
2.4.2	Excavation of Test Pits, if and where directed	Each
2.4.3	Wastefill and Earth Excavation, if and where directed	Cubic Yard

Bid Item 2.4.1, Wastefill and Earth Excavation, will be measured by the cubic yard of excavation as determined from the cross sections at the excavation, and paid according to the bid unit price per cubic yard. Payment will include the associated surveying, re-grading, placement, testing, and compaction of wastefill and/or earth. Any double handling or reuse of the material is incidental to the work. Separate payment will not be made for excavations for channels in the wastefill, for temporary

channels, for excavations below the neat lines or limits of excavation shown on the Contract Drawings, for excavation for installation of temporary erosion and sediment control structures, and for trench excavations for installation of barrier wall, leachate collection piping, gas collection piping, or storm downpipes. Excavation costs for these items shall be included in the unit cost for the appropriate bid items. Separate payment will not be made for excavation and stockpiling of RA Type B material to be used for the perimeter roadway reconstruction, perimeter road subgrade below the geomembrane, and associated with gabion wall construction. ~~Costs for that work should be included under Bid Item 2.26.2.~~

Excavation of test pits if and where directed basis, is in Bid Item 2.4.2 while excavation of wastefill and earth, if and where directed is in Bid Item 2.4.3.

END OF SECTION

2.5 Wastefill Placement and Compaction

2.5.1 General

Wastefill Placement and Compaction shall consist of: placement and compaction of wastefill and earth excavated from the landfill and placed as fill in the areas designated on the drawings.

2.5.2 Wastefill Placement and Compaction

The Contractor shall place all wastefill materials generated as part of construction activities, including: slurry trench excavation, leachate collection trench installation, and grading, on the prepared waste disposal area. Fill material obtained from the waste areas will be placed below the cap system, exclusively, and will be segregated from fill materials obtained from off-site.

A test strip shall be completed within the wastefill fill areas, with a common variable-weight, vibratory, 30 ton ~~heavy roller~~ sheepsfoot or landfill compactor, to determine the appropriate weight and number of passes (up to 10 maximum) to be used. Once a specific technique has been identified and approved by the Engineer, this technique shall be used for grading and compacting all wastefill fill materials placed in the waste disposal area.

In some areas, the Engineer may require additional passes of the compaction equipment beyond that identified in the test strip, if, in the opinion of the Engineer, the agreed compaction technique does not appear to achieve adequate stability.

Wastefill fill layers shall be placed and compacted in lift thicknesses not exceeding 12", and waste materials exceeding 12" in smallest dimension shall be buried within the previously compacted wastefill material so as to permit continuous fill layer placement. Wastefill and RA layers shall be placed and compacted in lift thicknesses not exceeding 6" where used as a foundation for the gabion basket wall per construction Detail 6 on Sheet 56.

It will not be necessary to check the density and/or moisture content of placed and compacted wastefill fill material. However, if in the opinion of the Engineer, the wastefill fill materials or underlying wastefill is too wet to permit adequate compaction, the wet areas shall be stabilized by removing water and/or backfilling with #57 aggregate. Water removed from the wastefill top must be handled as described in Section 2.3 Dewatering. Backfill material placed in wet areas shall be end dumped. The manner of filling and advancing the backfill wedge shall be such as to force all wet material laterally to the sides of the excavation and not to trap it under the fill. Accumulations of wet material at the sides of the embankment shall be removed as the embankment wedge advances, mixed with dry embankment material as necessary for drying, and spread in a thin lift over dry areas of the wastefill.

2.5.3 Measurement and Payment

No separate payment will be made for work conducted as per Section 2.5, Wastefill Placement and Compaction. The cost of this work shall be included in the respective Pay Items that generate waste and earth for placement under the landfill cap.

END OF SECTION

2.6 Slag Cement Bentonite Barrier Wall

2.6.1 General

The closure design includes installation of a perimeter barrier wall (i.e. cut off wall) to contain leachate within the site boundary. The proposed barrier wall is three (3) feet wide and would be keyed a minimum of three (3) feet into the clay layer that underlies the Site. Depending on site topography, the wall depth is expected to range from 30 to 60 feet. Stability analysis conducted during the conceptual design phase showed that strength must be added to the proposed barrier wall in order to increase the factor of safety against stability failure during and after construction.

Barrier wall construction will begin near Stat. 35+00 and progress along the northwest side of the landfill. This leg will be completed first before barrier wall construction will be permitted on the eastern or southern legs. Observations will be made during installation to evaluate for potential ground movements. If excessive ground movements are observed during installation along the northwest side of the landfill, as determined by the Engineer, measures will be implemented along the other sides of the landfill to protect gas pipelines.

Laboratory tests were conducted to obtain mixing, sedimentation, strength, and permeability characteristics and to develop suitable mix design for the barrier wall of the MSLA 1-D landfill. A total of 12 barrier mix samples were prepared using municipal water from Kearny (which is the likely source of water to be used during construction). Samples were cured in groundwater or landfill leachate obtained from the site. Ideally, the mix with the highest strain under design stress with an adequate factor of safety, lowest coefficient of permeability, relatively low bleed values, satisfactory wall stability, and the minimum filtrate loss will be selected as the optimal mix design for the barrier wall. The Contractor is encouraged to review the report, entitled “Final Results and Evaluations of the Barrier wall Wall Mix Design Studies”, dated February 2008, prepared by the Louis Berger Group and select the most suitable mix design to achieve the project objectives. Below is a summary of the findings, results and conclusions:

1. Mixes containing attapulgite were eliminated from the evaluation of potential mix designs due to the immediate segregation (settlement) of the clay from the mixing water. The remaining tests were performed on BKSP (Black Hills Bentonite, S-5 Natural) and BHNAT Bentonite Performance Minerals, Bara-Kade SP) bentonite mixes containing 3 to 5 percent bentonite, 2 to 4 percent cement, and 16 to 18 percent slag (with the remaining component of the mix design being municipal water).

2. It was found that flash setting was a common phenomenon during preparation of the mixes. Therefore, it is essential that during construction the contractor must conduct mix trials using a high shear mixer to avoid flash setting.

3. The sample BHNAT S-3 (3% BHNAT bentonite, 2% Type 1 Portland Cement, 18% Lafarge NewCem® Slag Cement, 77% Town of Kearny potable water, by weight) performed the optimum mix in terms of strength, permeability, mixing, and segregation properties.

4. BKSP, S-4 (5% BHNAT bentonite, 2% Type 1 Portland Cement, and 18% Lafarge NewCem® Slag Cement, 77% Town of Kearny potable water, by weight) is considered an alternative mix design for the barrier wall. During construction the use of a high shear mixer and slow addition of cement and slag would be required to reduce the potential for flash setting.

Contractor is required to keep the slag-CB backfill free from waste and/or soil, using his own means and methods acceptable to the Engineer, without additional cost to the State. If waste/soil is present, the Engineer may require removal and replacement of the contaminated slag-CB mix at no additional cost to the State. Some soil mixing into the barrier wall material cannot be avoided without going to a two-step process and in areas where it appears high, additional permeability sampling should be performed. In addition, the Engineer may require additional depth for wall so that these heavier particles can settle out in the bottom of the wall.

2.6.2 Submittals

The following shall be submitted in accordance with Section 1.3:

~~In addition, prior to the construction, the material being used in the cut-off wall shall be tested in accordance with N.J.A.C. 7:26-2A.7(c)2ix and N.J.A.C. 7:26-2A.7(c) 7, 8 and 10 to ensure that the material meets the minimum design and testing requirements.~~

2.6.2.1 Shop Drawings

As-Built Profile – A scale drawing showing the profile of the completed barrier wall trench with the limits of each batch of Slag-CB backfill clearly delineated as placed. As-built shall include both surveyed and sounding data during construction. Drawing shall include a full plan view of surveyed location of walls and cross section indicating constructed wall and any variances from design depth.

2.6.2.2 Work Plan

Backfill Material – A plan providing a list of test equipment, procedures, and materials to be used to verify the mix design for the Slag-CB backfill. This shall include proposed methods to prepare and measure materials to verify proper proportions.

Trench Excavation / Slag-CB Barrier Wall Installation – A plan describing the general work sequence and layout of operations, including the proposed stop end locations. The layout of operations shall include scale drawings which depict backfill preparation and storage areas. The plan shall describe Contractor qualifications, personnel (Superintendent, equipment operators, batch plant operators, etc), equipment, method of trench excavation, use or disposal of excavated material, bottom cleaning, barrier wall mix preparation and maintenance, Slag-CB backfill preparation and placement, and site clean-up. The plan shall provide a description of quality control equipment and test procedures (field and laboratory procedures), sample test forms for reporting test results, and offsite laboratory proposed for use. The plan shall also include proposed methods of controlling spills, vapors, odors, dust, noise, exhaust generated during Slag-CB Barrier Wall installation. The plan shall also include methods for handling generated spoils and estimated quantities (this includes hardened slurry re-

excavation). This should also include estimated schedule for completion. Any proposed variances from Specifications and Drawings should be included in the Work Plan.

Surveying – methods for determining and verifying the coordinates, elevations, and depths of the Slag-CB Barrier Wall.

Slag Cement-Bentonite Barrier Wall Mixes – A record of barrier wall mix quantities, proportions of additives utilized, and adjustments in the barrier wall mix.
Slag-CB Backfill Mixing and Placement – A record of Slag-CB backfill material mix quantities and mix adjustments for each batch.

2.6.2.3 Test Reports

Backfill Material Mix Study – Prior to approval of selected mix materials, the contractor shall perform a mix design study and prepare a report which summarizes the procedures and results of the Slag-CB backfill mix testing. The report shall include a description of mix proportions, gradations, slumps, viscosity, fluid loss (bleeding), densities, permeabilities, and moisture contents of 3 samples of the final Slag-CB backfill mix using the materials proposed for use.

Quality Control Testing Results Report – The Contractor shall provide the Engineer and the State with the Quality Control Testing Result report within 1 week of collecting samples for testing in accordance with section 2.6.8.

Laboratory Testing Results – Refer to section 2.6.22.2.4

In-situ Testing Results Report – The Contractor shall provide the Engineer and the State with the Insitu Testing Result report in accordance with section 2.6.22.

2.6.2.4 Daily Construction Reports

Provide detailed records of daily Slag-CB barrier wall production. This shall include daily totals and running totals for volumes of barrier wall construction and slurry materials used (electronically to the State and the Engineer) during the duration of the Work. Reports shall be submitted to the State and the Engineer by 10:00 AM the following day, throughout the duration of the Work. The reports shall, at a minimum include the following:

- Station ID(s)
- Date
- Equipment Used
- Top Elevation of Slag-CB at beginning and end of the day
- Top elevation of hardened Slag-CB from previous day(s) production
- Bottom Elevation and width of Slag-CB barrier wall and trench sounding data including station locations, depth, and time
- Slag-CB barrier wall production (SF)
- Calculation of materials used
- Start and finish time
- Clean-outs performed

- Summary of unforeseen Project Site conditions or equipment problems that affected Slag-CB barrier wall construction
- Variances from the Contract Documentation
- A record of Slag-CB backfill material mix quantities and mix adjustments for each batch.
- Slag-CB slurry logs including fresh slurry mix data (records of plant mixed slurry properties, quantities, proportions and admixtures) and trench slurry mix data (a record of in trench slurry properties during construction).

2.6.2.5 Final Report

A final report shall be submitted upon completion of the Slag-CB barrier wall construction which shall include, but not limited to, the following:

- Quantities of materials delivered to the Site, and used during each week with back-up (weight receipts, bills of lading, flow meter records, or equal)
- A record of barrier wall mix quantities, proportions of additives utilized, and adjustments in the barrier wall mix.
- A record of Slag-CB backfill material mix quantities and mix adjustments for each batch.
- A record of sounding data taken during construction of the barrier wall
- Modifications to the project schedule
- Spoils disposal / handling methods and quantities managed
- Any unforeseen Project Site conditions or equipment problems that affected work
- Variances from the Contract Documentation

2.6.2.6 Certificates

Bentonite – A copy of the test results from the bentonite manufacturer for each lot shipped to the site and a certificate of compliance stating that the bentonite complies with applicable standards.

2.6.2.7 Method Statement

The Contractor shall submit a statement outlining his proposed method of working and details of the plant to be used. This statement shall include but not be limited to:

(i) Method of excavation
(ii) Program of the barrier wall trench works.

2.6.3 Qualifications

Barrier Wall Constructor – The Barrier Wall Constructor, either Contractor or his Barrier Wall Constructor subcontractor, shall have experience in Slag-CB or Cement Bentonite barrier wall construction projects of similar or greater magnitude (depth, length) and complexity (materials, terrain) as this project. The qualifications and experience of the Barrier Wall Constructor and personnel who shall be responsible for conducting the operations shall be submitted to the Engineer at a minimum of 4 weeks prior to mobilization of equipment specific to barrier wall construction.

Include references (name and telephone number) of the owners of the Barrier Wall Constructor's previous barrier wall construction projects.

Barrier Wall Specialist – The barrier wall specialist shall be an individual with a minimum of 2 years successful managing and supervising experience in the following: controlling composition, mixing, testing, placing, cleaning and maintaining barrier wall mix; supervision of alignment, verticality and depth of barrier wall trenches; controlling blending, mixing and placement of Slag-CB or Cement Bentonite backfill; and a thorough knowledge of barrier wall construction equipment and material testing.

Trench Excavation Equipment Operator – The trench excavation equipment operator shall have experience using similar trench excavation equipment to be used for this contract in a minimum of 2 projects of similar or greater magnitude (depth).

2.6.4 Delivery, Storage, and Handling

Materials delivered and placed in storage shall be protected from the weather, dirt, dust or other contaminants.

2.6.5 Materials

At least fourteen days prior to mobilization to site for commencement of the barrier wall trench works, the Contractor shall provide for the Engineer's approval details of the proposed suppliers of materials including water, cement,, bentonite, slag, admixture, if any and, where possible, the sources. Once approval has been given, the material and water suppliers shall not be changed without further approval by the Engineer in writing.

Containers or storage locations for material storage shall be protected from precipitation, moisture, and other potential deleterious events.

Containers for material storage shall be properly labeled per the supplier’s requirements and Contractor shall maintain material safety data sheets for the materials.

The components of the Slag-CB are:

Bentonite – The bentonite shall be sodium cation base montmorillonite powder that conforms to API Spec 13A, Section 2.3~~s 5, 12, and 13~~ and that has been proven successful in trials or previous barrier wall construction. No bentonite treated with peptizing agents will be allowed.

Cement – Portland Cement Type I or Type II Complying to ASTM C150 shall be used.

Slag – Ground granulated blast furnace cement complying ASTM C 989 shall be used.

Water – The Contractor shall supply and condition water required for mixing with barrier wall backfill mix. The water shall be potable. Water shall be potable and be supplied from the local mains. Where this is not possible, alternative sources will be approved provided satisfactory

compatibility can be demonstrated by testing prior to commencement of the trench works. Water shall have a hardness of less than 100 ppm, pH between 6 and 8, and total dissolved solids content of less than 500 ppm.

Admixtures – The use of admixtures shall be subject to approval by the Engineer. Proposed admixtures shall be submitted to the Engineer for review a minimum of 14 days prior to their use. The contractor's proposed admixtures shall have been successfully used on previous cut-off wall contracts or their effects shall be demonstrated in trial mixes prior to the commencement of the trench works.

2.6.6 Equipment

The Contractor shall furnish the necessary plant and equipment for use on this project.

2.6.6.1 Trench Excavation Equipment

The trench shall be excavated by equipment suitable to reach the design depth at its optimum capacity, which may be extended-reach backhoe (manufactured for deep trenching), or barrier wall equipment accompanied by fraser type cutter, or barrier/diaphragm wall crane equipped with clamshell/bucket type cutter, or other equipment approved by the Engineer. The buckets /cutters/fraser utilized with such equipment may be perforated, tapered and equipped with bottom-side cutter teeth protruding no more than 6 inches on each side. The bucket/cutter/fraser shall be designed to maintain the width of the trench and to minimize raveling of the trench sides during use. Regardless of the equipment used, the bucket/cutter/fraser shall be capable of excavating the minimum required width in a single pass. The equipment shall be able to reach at least 5 feet deeper than the maximum depth shown on the drawings. The equipment shall have a special tool, or attachment for excavations through landfill obstacles.

2.6.6.2 Barrier Wall Mixing and Cleaning Equipment

If any slag-CB mix is recirculated from the trench, Barrier wall cleaning equipment and a de-sander shall be available to reduce sand, sediment, or other solids as necessary to maintain the sand content or density requirements of the slurry in the trench.

The barrier wall mixing plant shall be equipped with a high-speed/high-shear, colloidal mixer or a high-velocity/high pressure venturi jet mixer used in conjunction with a high-speed/high-shear centrifugal pump. Mixers shall be capable of achieving complete dispersion of bentonite and additives, and shall be capable of continually mixing the barrier wall to provide uniform blended slurry. The slurry shall be mechanically or hydraulically agitated in the storage facility to maintain uniform properties throughout. Pumps, valves, hoses, supply lines and all other equipment needed to adequately supply slurry to trench shall be furnished. Plant shall be equipped with load cells or other type of scale to precisely proportion and verify reagents added.

The mixing plant shall be capable of continuously batching and mixing the slurry in sufficient quantity without interruption due to inadequate batching, mechanical limitations, or volume limitations. Automatic metering systems (where used) shall be calibrated in the presence of the Engineer prior to

the beginning of the slurry production and whenever required by the Engineer. All automatic metering systems shall also have a manual backup method for verifying quantities. Properly calibrated volumetric containers and scales required for proper calibration shall be provided by the Contractor. Batch type mixers may be used, subject to provisions of an accurate means of proportioning the individual grout constituents, and shall be able to allow for uninterrupted Slag-CB barrier wall installation where practical.

~~Barrier wall cleaning equipment and a de-sander shall be available to reduce sand, sediment, or other solids as necessary to maintain the sand content or density requirements of the slurry in the trench. On no account contaminated barrier wall shall be used in trench excavation unless cleaned through the de-sander and cleaning equipment and tools.~~ Mixing of the water and bentonite shall occur first in the high-speed colloidal shear mixer, along with a hydration period of 24 hours, unless a shorter duration is approved by the Engineer. The hydration period on no account shall be less than 12 hours. Slag and cement shall then be added to the hydrated bentonite in a separate low energy mixer.

2.6.6.3 Field Laboratory Equipment

The field laboratory shall contain as a minimum the following equipment:

- Mold and rod for slump test.
- Marsh funnel sets.
- Standard filter press.
- Mud balances (direct reading of density).
- Barrier wall sampler.
- ~~Number 200 sieves.~~
- ~~Set of standard sieves and sieve shaker.~~
- ~~Oven for moisture content.~~
- Balance.
- pH meter.
- Mixers.
- Direct-reading viscometer.
- Sand content sets.
- 4 inch Cylindrical mold.
- 1000 ml graduated cylinders for measuring Bleed.

2.6.7 Barrier wall Mixes

The Slag-CB backfill, consisting of 3 percent BHNAT bentonite, 2 percent cement, and 18 percent slag (or as approved), shall be thoroughly mixed and shall conform to the standards specified in herein just prior to placement in the trench, or as approved by the Engineer.

2.6.8 Quality Control Testing

The Contractor shall provide at least one Quality Control Inspector for barrier wall preparation and maintenance, trench excavation, and Slag-CB backfill preparation and placement.

The Contractor shall re-excavate the hardened slurry backfill and replace with acceptable slurry at the direction of the Engineer if the QC or QA samples do not meet the requirements of the performance standards (describe in this specification section). This shall be completed within one working day of the rejected sample at no additional cost to the NJDEP.

2.6.8.1 Water

A minimum of 1 test for each specified requirement shall be performed for each water source used. Testing for total dissolved solids shall be in accordance with EPA 600/4-79/020, Method 160.3.

2.6.8.2 Slag-CB Backfill Material Production Testing

Slag-CB mixture shall be sampled from the mixing plant at least three times during production days for Density, Viscosity, Bleed and Temperature. The age of the fluid at the time of testing and location where sampled shall be recorded. Sampling and testing shall be performed just prior to placing Slag-CB backfill material in the trench. Each batch of material shall be assigned a number to be included with quality control test reporting.

Each batch of material sampled shall be tested for ~~Slump~~Density, Viscosity, ~~Specific Gravity,~~ Bleed, ~~strain, strength, permeability,~~ and Temperature (as defined herein). The target bleed value shall not exceed ~~1~~2%. In the event that the measured values differ significantly from the target values then the Contractor shall propose measures for correcting the ~~specific gravity~~ density, viscosity and bleed. Sample results shall be reported to the Engineer within one hour of receiving the test results~~within 24 hours of testing~~.

In addition, the Contractor shall collect grout cube samples one set (four cube samples) for each 5,000 square feet of wall section, and also additional grout cube samples if and when directed for laboratory stress and permeability testing.

2.6.8.3 ~~Slump~~ Density Test

The density of the Slag-CB backfill shall be calculated using a calibrated mud balance in ~~4 inch cylindrical mold as described in~~ ASTM D4380. ~~Slag-CB backfill shall be placed in the mold and rodded 10 times. Additional Slag-CB backfill shall then be added to fill the mold. The weight and volume of the molded Slag-CB backfill shall then be used to determine the density.~~

2.6.8.4 Viscosity

The viscosity shall be measured by test Method API-13B-1 using a calibrated Marsh Funnel, or Direct-indicating Viscometer.

~~2.6.8.5 Specific Gravity~~

~~The specific gravity shall be measured using the following procedures:~~

~~Equipment~~

~~a) A set of calibrated weighing scales of sufficient accuracy to permit measurement of weight to within ± 0.1g.~~
~~b) A fixed volume container with a flat upper edge generally no smaller than 1.0 liter capacity with a closely fitting top plate.~~

~~Procedure~~
~~a) The empty fixed volume container and the top plate is carefully dried and weighed and the weight is recorded, Wa.~~
~~b) The fixed volume container is filled to the top with water. The top plate is carefully slid across the top of the container to exclude all air bubbles. Any excess water is removed to avoid errors. The container, top plate and water are carefully weighed and the weight recorded, Wb.~~
~~c) The fixed volume container is emptied, dried and filled to the top with fluid to be tested. The top plate is carefully slid across the top of the container to exclude all air bubbles. Any excess fluid is removed to avoid errors. The container, top plate and fluid are carefully weighed and the weight recorded, Wc.~~
~~d) The specific gravity of the fluid is calculated as follows :~~

~~specific gravity = $(W_c - W_a)/(W_b - W_a)$~~

~~e) The accuracy of the weighing scales should be checked at least weekly.~~

~~The specific gravity of the Slag CB backfill shall be measured by the use of a fixed volume container and electronic weighing scales such that an accuracy of ±0.002 is achieved.~~

2.6.8.~~6~~5 Bleed

Bleed shall be measured using the following procedures:

Equipment
A glass or similar material vertical measuring cylinder graduated in 20ml increments up to 1000 ml. A membrane, or similar, to seal the top of the measuring cylinder, in order to avoid evaporation.

Procedure
a) Carefully fill the measuring cylinder to the 1000 ml mark with the cementitious slurry, ensuring that no air is entrapped. Seal the top of the measuring cylinder. Leave to stand undisturbed for 24 hours.
b) When the slurry has stood for 24 hours record the volume occupied by the set solids.
c) The bleed is calculated as:

percent bleed = (volume of water above the solids)/(total volume) x 100

Bleed shall be measured at 24 hours after mixing using a 1000ml measuring cylinder. The set cementitious solids shall occupy a volume of at least 980ml. ~~The maximum allowable bleed shall be limited to one (1) percent~~

2.6.8.~~7~~6 Temperature

The temperature of Slag-CB backfill samples taken for purposes of the quality control procedures shall be recorded at the time of testing the samples.

2.6.8.7 Strength

One set (4 samples) of 2-in cube samples shall be collected from each 5,000 SF of the wall section and as directed by the Engineer for strength tests in accordance with ASTM C109 (Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).

2.6.8.8. Permeability

At least 10 cube samples shall be ~~The approved Slag-CB backfill shall be~~ tested for ~~its~~ permeability in accordance with ASTM D5084 - 10 Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter. The approved mix shall have a 28-days coefficient of permeability $1x10^{-7}$cm/s, or less. The Engineer shall select and assign the permeability testing from those cube samples collected and cured at least for 28 days.

2.6.9 Work Platform

Barrier wall trench construction shall be accomplished from the access road previously constructed, as shown on the drawings. If the Contractor's operations require a wider work platform, the reason for the change shall be submitted. If approved, a wider work platform may be constructed at no additional cost to the State.

2.6.10 Barrier wall Trench Excavation

~~The barrier wall trench shall key 3 feet into the lower permeability stratum.~~ The barrier all trench shall be excavated to the elevations shown on the Drawings, or as adjusted by the Engineer in the field to key 3 feet into the lower permeability stratum. The Engineer may direct the Contractor to modify the trench depth based on examination of bucket cuttings or drive samples. The toe of the slope of the trench excavation shall not precede the toe of the Slag-CB backfill slope by less than 30 feet or more than 100 feet. Trench excavation shall begin on the northeastern side of the landfill and progress to the eastern side, then the southern side.

2.6.10.1 Excavation

The Contractor shall submit to the Engineer, at least 14 days prior to commencement of the Barrier wall trench works, all relevant details of the method of construction of the cut-off wall and the proposed plant.

2.6.10.1.1 Excavation Depth

The method of excavation shall be able to obtain the specified maximum depth and accommodate changes in depth while maintaining the required penetration into the aquiclude (i.e. the clay formation).

2.6.10.1.2 Guide Walls

Guide walls shall be used where necessary and/or as directed by the Engineer to provide slurry hydraulic head as well as correct alignment to the wall.

2.6.10.1.3 Barrier Wall Level

The working platform level shall be set such that the barrier wall level at all times can be kept at least five (5) feet above any groundwater level (including perched water table and leachate level). The Contractor shall maintain the level of the fluid barrier wall in the trench excavation sufficiently full to minimize the risk of collapse of the trench sides. Any drop in level of the barrier wall due to filtration, penetration, moisture loss or any other cause shall be made up by the Contractor to ensure the as-cast level of barrier wall is above the required finished trimmed level.

2.6.10.1.4 Ground and Toe Levels

The Contractor shall provide the Engineer with his proposed method for dealing with:

(a) uneven ground surface to achieve the required top level

(b) variable aquiclude (clay formation) elevation and hence changing cut-off wall toe level to achieve the required aquiclude penetration.

2.6.10.2 Wall Location and Dimensions

2.6.10.2.1 Setting Out

The cut-off wall shall be set out to a plan positional tolerance of ±2 inches and constructed to a plan positional tolerance of ~~±6~~ 12 inches measured at the ~~centre~~center line at the top of the trench.

2.6.10.2.2 Width

The width of the wall shall not be less than the specified minimum width specified in this document and as shown on the drawings.

2.6.10.2.3 Verticality

The ~~centre~~center line of the cut-off wall shall be constructed to be within ±1:60 from vertical. The work working platform and / or excavating equipment may be leveled to be plumb within acceptable tolerance.

2.6.10.2.4 Toe Levels - Depths

The required toe level and/or penetration in the aquiclude (clay formation) is specified and shown on the drawings. The depth of the wall toe below working platform level shall be recorded and verified by the Engineer's representative at chainage intervals. The upper surface of the aquiclude (clay) shall be identified and verified by the Engineer's representative by observation of spoil arisings and the depth to this layer as well as the toe level of the trench shall be recorded at chainage intervals as specified.

2.6.10.3 Day joints

Unless the cut-off wall is constructed by continuous excavation in 24 hours and 7 days a week without interruption until completion, the Contractor shall adopt suitable measures to ensure that the wall is continuous across joints resulting from interruption of the excavation (e.g. day joints). A minimum overdig into the previous day's work of two (2) feet throughout the depth of the wall shall be adopted to ensure intermixing at joints. The Contractor shall ensure that his excavation procedure does not cause damage to the material in completed sections of the wall.

Temporary stop-ends if used shall be of the length, thickness and quality of material adequate for the purpose of preventing water and soil from entering the completed excavations or sections of wall. Each temporary stop-end shall be rigid and adequately restrained to minimize horizontal ground movement and shall be straight and true throughout and the external surface shall be clean and smooth i.e., free from defects that could affect the wall integrity during removal of the temporary stop-end.

2.6.10.4 Temporary Protection

The Contractor shall be responsible for maintaining and protecting the completed sections of the barrier wall until handing over the entire construction to the State. No partial handing over is permitted.

2.6.11 Barrier wall Placement and Maintenance

Barrier wall shall be introduced into the trench at the time excavation begins and shall be maintained in the trench during excavation and until hardening.

The Contractor shall deliver the slurry mixture from the material mixing plant to the slag-CB equipment at an adequate flow rate for the trenching process. The Engineer will periodically visually inspect each batch of mixed material to ensure that the slurry has been sufficiently mixed. The Contractor shall continue to mix slurry until it is thoroughly mixed to the satisfaction of the Engineer.

The level of the barrier wall in open trenches shall be maintained a minimum of 5 feet above ground water level and no more than 2 feet below the top of the work platform until the placement of Slag-CB backfill material is complete, or as directed by the Engineer. If ~~the density or sand content of~~ the barrier wall in the trench does not conform to the standards specified herein, the excess solids shall be removed from the barrier wall using approved methods or the barrier wall shall be replaced with fresh barrier wall. Sufficient personnel, equipment, barrier wall storage areas, and prepared barrier

wall materials shall be ready to raise the barrier wall level at any time in the excavated trench. Contractor shall take measures necessary to eliminate the potential of barrier wall becoming diluted by surface water (installation of appropriate run on controls).

Conditioning of the barrier wall may require recirculation through a shaker screen, de-sanding or the addition of approved additives.

2.6.12 Excavated Material

All material excavated from the trench shall be considered contaminated and not used as backfill. Excavated trench material shall be placed in the waste disposal area as described in Section 2.10. The excavated material shall be spread out on the designated landfill disposal area and worked periodically with an excavator to break it up and promote drying, to allow filling over it.

2.6.13 Stability

The Contractor shall be responsible for maintaining the stability of the excavated trench at all times for its full length and depth including maintaining slurry densities and levels within specified limits. In the event of failure of the trench walls (prior to completion of a panel), the Contractor shall re-excavate the trench and remove all material displaced into the trench (at his own expense). Contractor must take immediate action to prevent further deterioration.

Any increase of width of the trench during slag-CB barrier wall installation due to cave in (mainly in top of the trench) will be the responsibility of the Contractor. The NJDEP will not compensate for additional slurry used due to widening of barrier wall trench.

Surcharge from equipment, waste, berm construction, backfill stockpiles, and other loading situations which may affect trench stability shall be controlled. Stockpiles and excavated material shall be placed no closer to the trench than a distance equal to 60 percent of the trench depth, but in no case closer than 30 feet from the trench. Slopes of stockpiles and excavated material shall be no steeper than 1 vertical to 2 horizontal, and no higher than 10 feet above the work platform. The trench shall be re-excavated in the event of failure of the trench walls and any material displaced into the trench shall be removed. Corrective action shall be taken to prevent subsequent collapses, at no additional expense to the State.

For purposes of minimizing global slope movement, the Contractor shall limit the excavated open trench to a length of 200 feet during barrier wall construction.

2.6.14 Trench Cleaning

The Contractor shall clean the trench in a way mixing of soil/waste with slag-CB wall is not permitted and a minimum wall thickness is maintained at all times. ~~As a minimum, unless otherwise approved, the trench bottom shall be cleaned at the start of each shift. If Slag-CB backfill placement operations have ceased for longer than 8 hours, the face of the Slag-CB backfill slope shall be cleaned prior to the placement of additional Slag-CB backfill. The trench bottom shall be cleaned by an air lift pump or other suitable equipment approved by the Engineer to ensure removal of sand, gravel, sediment~~

~~contaminated heavy barrier wall and other material left in the trench during excavation and/or which has settled out of the barrier wall. Cleaning equipment shall not remove material from the walls of the trench. The Contracting Officer may require more frequent cleaning.~~

2.6.15 Slag-CB Backfill Mixing and Placement

Mixing – ~~The Slag-CB backfill material shall be thoroughly mixed into a homogeneous mass, free from large lumps or clods of soil or pockets of fines, sand, or gravel. All particles shall be mixed thoroughly. Sluicing with water is not permitted.~~ The Slag-CB backfill material shall be mixed in a separate mixing location ~~as shown on the drawings~~, as approved by the Engineer.

Placing – Initial Slag-CB backfill placement shall be by one of the following methods: (1) Placement by lowering Slag-CB backfill to the bottom of the trench with crane and clamshell bucket, or tremie until the surface of the Slag-CB backfill rises above the surface of the trench; (2) Construct a lead-in trench at a point outside of the limits of work to allow a Slag-CB backfill face to form prior to reaching the full depth of the required trench. No payments will be made for the portions of trenches which lie outside of the limits of work. Slag-CB backfilling operations shall proceed in such a manner that the slope of the initially placed Slag-CB backfill is maintained. Free dropping of Slag-CB backfill material through the trench is not permitted. The Slag-CB backfill shall be placed so that it will slide down the forward face of the Slag-CB backfill slope. The Slag-CB backfill material shall be placed in the excavated trench so that no pockets of external material are trapped and that a constant slope is maintained. Placement shall be continuous from the beginning of the trench in the direction of the excavation to the end of the trench. If stop ends are used, the stop ends shall be removed within 24 hours to allow bonding of the Slag-CB backfill between the two adjacent panels.

Excavation shall proceed continuously from the starting point to the finishing point and shall be constructed to the extents, depths and elevations shown on the Contract Drawings. The slurry trench shall be constructed using a panel method or other method approved by the Engineer / NJDEP. The Contractor shall plan each day's production to have each panel worked on during the shift completed at the end of the shift and return the slurry levels to within 1 foot of ground surface.

The barrier wall trench shall follow the designed alignment within one foot of the centerline. The barrier wall trench may vary from the designed alignment (i.e. at corners or turns) if approved by the Engineer / State.

Any removed section of completed slurry trench panels (due to day joints overdig or any other reason), shall be refilled with slag-CB slurry at no additional expense to the NJDEP.

In the event that obstructions are encountered during construction of barrier wall, the Contractor shall notify the Engineer / NJDEP and at that point, the Engineer will inform the Contractor on a decision which will include one of the following options:

1. Excavate overlying in an attempt to move obstruction.
2. The obstruction may be deemed unmovable and the station is considered complete at that depth (the Engineer / NJDEP alone will make the determination when refusal is reached and if station can be considered complete).

The Slag-CB slurry shall be placed in the trench in a fluid, stable, colloidal state of suspension meeting the requirements set forth in this specification. In the event the slurry hardens prematurely or exceeds density requirements, the hardened slurry shall be removed to the full depth and re-excavated at the Contractor's expense.

The Contractor shall be aware that there is a potential for loss of slurry / backfill in the waste and existing road material. No additional compensation will be made for loss of slurry / backfill in the waste and existing road material.

Mixing and Placing During Severe Weather – No mixing or placing of the Slag-CB backfill material shall be performed when the mean daily temperature is less than 40 degrees F for more than three (3) consecutive days. Frozen Slag-CB backfill shall not be placed in the trench and backfill material containing frozen lumps shall not be used to mix Slag-CB backfill. Construction will not be permitted when severe weather conditions may comprise the quality of the work.

Contractor may propose a mixing and placement methods in a detailed step-by-step manner for Engineer's review and approval.

2.6.16 Soundings

Excavation and Slag-CB backfill soundings shall be taken every 25 feet along the trench centerline using a weighted tape, cable, or other approved device. Soundings shall be measured to the nearest 0.1 ft. The soundings shall measure the following:

1. Elevation of Top of Key Stratum – The top of the key stratum shall be determined based on examination of bucket cuttings during trench excavation. This elevation shall be subject to approval.

2. Elevation of Bottom of Excavation – The elevation of the bottom of the excavation shall be determined. The elevation of the bottom of excavation shall be subject to approval.

~~3. Elevation of Bottom Prior to Backfilling – This sounding shall be used to monitor for side wall collapse and for any accumulated sediments which may be present at the trench bottom immediately prior to backfilling. This sounding shall not precede the toe of the Slag-CB backfill slope more than 50 feet.~~

~~4.~~3. Profile of Backfill Slope and Trench Bottom – If the Engineer directs, t~~T~~he Slag-CB backfill slope and trench bottom shall be sounded at the beginning and end of each shift, and at additional times as directed. The slope shall also be sounded after each Slag-CB backfill batch is placed.

Trench width measurements shall also be taken at the same 25-foot increments. Sounding data shall be reviewed with the Engineer on a daily basis and documented for the as-built drawings. Engineer shall approve that design depth has been achieved for each station. The Contractor shall provide thorough description of Health and Safety procedures (see Section 3.1) associated with the soundings, this may include items such as fall protection, etc.

2.6.17 As-Built Profile

An as-Built profile of the trench bottom and Slag-CB backfill slopes, including descriptions of materials encountered in the trench bottom, shall be continuously maintained. This profile shall indicate extent of excavation and the Slag-CB backfill profile at the end of each work day and after each Slag-CB backfill material batch is placed in the trench as determined from soundings. The Slag-CB backfill material batch numbers shall appear on the profile with the limits of each batch of material delineated as placed.

2.6.18 Treatment of Top of Barrier Wall Trench

After completion of a panel or at the end of each day, the Slag-CB barrier wall trench shall be filled to within 1-foot of the ground surface. After intial setting of the slurry, any free water or disturbed slurry shall be removed from the top of wall and fresh slurry added to the top of the slurry trench to achieve elevations shown on the Contract Drawings.

Prior to placement of the trench cover, a temporary weighted sheet of plastic (5 mils) shall be anchored over the Slag-CB backfill to minimize drying and cracking during curing, and then directly placing the final cover at a later date. The plastic sheet shall be placed within 1 day after Slag-CB backfill placement is completed over each 100 foot reach. After a minimum two weeks, the plastic sheet shall be removed and replaced by the geomembrane trench cover. If any depression develops within the completed barrier wall trench area, it shall be repaired by placing and compacting additional Slag-CB backfill. Heavy construction equipment and machinery shall only be driven over the barrier wall trench at approved heavy equipment crossing points. In the event desiccation occurs, the Contractor shall excavate and replace with fresh slurry, as directed by the Engineer.

2.6.19 Day Joints

To achieve continuity between sections of wall it is necessary to excavate back into previously placed barrier wall to a distance of typically 2 ft. This cut-back has to be throughout the depth of the wall and across the full width of the previously formed wall. Verticality at day joints is therefore important but may be difficult to measure. The operator of the excavation plant should be instructed regarding these requirements and the formation of day joints should be supervised and controlled until a satisfactory working practice has been confirmed.

The cut-back may be proved through the full depth of the trench by plumbing.

2.6.20 Clean-up

Excavation spoil, and unused Slag-CB backfill shall be removed following completion of Slag-CB backfilling. These materials shall be disposed of in the waste disposal area.

2.6.21 Slag-CB Production Standard Requirements

2.6.21.1 Preparation Plant

Contractor shall provide details of Slag-CB production in Method Statement. Production plant shall be as specified in Section 2.6.6.2~~include the use of a high shear mixer and slow addition of cement and slag to reduce the potential for flash setting, as well capacity of the mixing, preparation and pumping units~~.

2.6.21.2 Accuracy

All parts of the batching plant shall be capable of weighing and/or measuring the quantity of each individual component material to an accuracy of ±3% of the target quantity of that material as given in the approved mix design.

2.6.21.3 Calibration

The Contractor shall ensure that the batching plant measurement systems are fully calibrated prior to commencement of production for the permanent works, and thereafter at least weekly. The Engineer shall be invited to witness the plant calibrations and copies of the record of calibrations shall be forwarded to him. If any part of the plant does not meet the batching accuracy criteria work shall not proceed until it has been adjusted and recalibrated to meet the specified accuracy.

2.6.22 In-situ Testing

2.6.22.1 Sampling for testing for set properties

Samples for later testing of set properties of the Slag-CB backfill shall be made by pouring the unsieved mix sample from the trench into sample tubes prior to the setting. A total of four (4) samples shall be collected from each sampling locations. Additional samples shall also be collected as directed by the Engineer.

2.6.22.1.1 Sample tubes

Sample tubes shall be standard plastic concrete cylinders minimum 4-inch diameter and 12 inch tall with air tight caps can be used for sampling. A total of four (4) samples shall be collected from each sampling location. Additional samples shall be collected as directed by the Engineer. ~~4 inches nominal diameter PVC tubing of minimum length 12 inches. The ends of the sample tubes shall be square and free from burrs and the inside of the tubes shall be clean.~~ Filled sample tubes shall be labeled with the contract name, location, date and depth of sample, and given a unique reference number.

2.6.22.1.2 ~~Frequency~~Location

Sample location points shall be at intervals of chainage along the wall such that there is one sample location point per one days shift or per 2000 square feet of projected wall area in elevation, and not less than one sample location per day's production. Samples must be taken during the same day the backfill is produced.

2.6.22.1.3 ~~Location~~Depth

Representative sample sets of the mix shall be taken from 3 feet below the top and three feet above the bottom of the trench at each sample location point. The means of taking the samples shall ensure that the sample is taken from the zone intended.

2.6.22.1.4. Care of samples

The fluid mix shall be carefully poured into the sample tubes such that air is not entrapped in the Slag-CB Mix. The sample tubes shall be sealed without delay by close-fitting PVC push-on end caps and sealed with duct tape to avoid moisture loss. Samples shall not be transported until at least 14 days old. During storage and later transportation care must be taken to ensure that the samples are not damaged by impact or vibration. Samples shall not be demoulded until required for test.

2.6.22.1.5 Storage and Transportation

The samples shall be stored in an environment where the temperature is $68^{o}F \pm 5^{o}F$. Samples must be stored and transported upright at all times.

2.6.22.2 Laboratory Testing

Testing the set properties of the backfill shall only be carried out by an approved laboratory with suitable equipment and experience in dealing with Slag-CB slurries.

2.6.22.2.1 Approved Laboratory

The Contractor shall submit details of the proposed testing laboratory to the Engineer for his approval at least 14 days prior to the first test commencing.

2.6.22.2.2 Scheduling of Tests

The Contractor shall submit to the Engineer a record of all samples taken giving the chainage/location, date, depth and reference number of the samples within 24 hours of the sampling. The Engineer will provide the Contractor with a testing schedule at least 14 days before the tests are required to be carried out. Unless otherwise required by the Engineer, the minimum testing requirement shall be two unconfined compressive strength and permeability tests for each five days production.

2.6.22.2.3 Preparation and Care of Samples

The samples shall be carefully extruded vertically from the sample tubes and trimmed in a progressive manner to avoid shearing the material. Any hollows in the top or bottom of the sample shall be removed by careful trimming of the surrounding high zones. Material shall not be filled back into hollows. There shall be no sub-sampling of smaller diameter samples from the original sample.

2.6.22.2.4 Tests

2.6.22.2.4.1 Permeability Tests

Specified permeability tests shall be carried out and reported in accordance with the procedures stated in ASTM D5084-00

2.6.22.2.4.2 Unconfined Compression Strength and Consolidated Undrained / Drained Triaxial Compression Tests

Specified unconfined compression strength tests shall be carried out and reported in accordance with the procedures stated in ASTM D 2166. The minimum allowable peak stress shall be 120 psi (pounds square inch). A CD triaxial test shall be conducted and reported in accordance with the procedures stated in ASTM D4767-11. At 28 days the Slag-CB Barrier shall achieve a strain of minimum 5 percent without failure under a deviatory stress of 20 psi.

2.6.22.2.4.3 Reporting of Results

The Contractor shall provide the Engineer with a full copy of each laboratory test result within one week of completion of the test.

~~2.6.22.3 Field Testing~~

~~Post construction testing shall include drilling and collection of one undisturbed sample for each 500 linear feet of wall installed. The Contractor shall assume that 18 sample locations will be used and the average depth of each sample (based on the varying depths of each sample) will be 35 feet. The samples shall be obtained at locations and depths acceptable to Engineer, and to obtain a good representation of overall wall conditions. Samples shall be taken from the wall not less than 14 days after placement of Slag-CB wall. Samples obtained shall be tested for permeability and strength. All test holes shall be backfilled with the same design mix as used in the original backfill.~~

2.6.23 Measurement and Payment

Measurement for Slag-CB Barrier Wall shall be based on the area in square feet of completed barrier wall trench measured in a vertical plane through the centerline of the barrier wall trench, from the top of the work platform to the bottom of the excavated trench. Measurement shall be based on surveys and soundings taken at the site as directed and approved.

The Contractor can submit for an “Or Equal” barrier wall meeting the requirements of these specifications for the review of the Engineer and the State. The Contractor’s costs and time are at his own expense, and no delays / cost claims or Contract time extensions will be considered for associated “Or Equal” barrier wall submissions.

Payment shall be made under:

Pay Item No.	Pay Item	Unit

2.6 Slag-CB Barrier Wall Square Feet

The Contractor will be paid based on the bid unit price of actual square feet of completed Slag-CB Barrier Wall. Payment will include: excavation (3 feet wide), materials, measurement, testing, and placement of barrier wall. Payment also includes placement and compaction of excavated materials on the landfill in accordance with Section 2.4. Payment includes covering the top of the slurry wall with plastic sheeting.

RA Type B material excavated from the barrier wall trench shall be re-used for final grading of perimeter access road in accordance with Section 2.26 of these specifications and details on the Contract Drawings, under the gabion wall, and/or to achieve grades on the southern and eastern portions of the perimeter access road. No separate payment will be made for this work.

END OF SECTION

2.7 Installation of Monitoring Wells

2.7.1 Installation of New Monitoring Wells

The Contractor shall install the following 12 monitoring wells in accordance with this Specification and Contract Drawings.

PROPOSED GROUNDWATER MONITORING WELLS			
MONITORING WELL	**APPROXIMATE GROUND SURFACE ELEVATION (amsl)**	**TOP OF SCREEN ELEVATION (amsl)**	**BOTTOM OF SCREEN ELEVATION (amsl)**
MW-SW1	13.0	-5	-15
MW-SW1A	13.0	-5	-15
MW-SW2	23.0	-5	-15
MW-SW2A	22.0	-5	-15
MW-SW3	10.5	-5	-15
MW-SW3A	14.5	-5	-15
MW-SW4	10.5	-5	-15
MW-SW4A	13.5	-5	-15
MW-SW5	14.0	-5	-15
MW-SW5A	14.5	-5	-15
MW-SW6	24.0	-5	-15
MW-SW6A	24.0	-5	-15

The top ten feet of each monitoring well shall consist of steel casing in accordance with the details on the Contract Drawings. Gravel pack of #1 sand shall be placed around the well to at least 2 feet above the screen. The remainder of the annulus shall be filled with cement/bentonite slurry. Wells shall be developed by pumping and surging until the water discharge is clear. The discharge water shall be allowed to drain back into the landfill. The well shall have a flush mount protective steel casing set in concrete with a locking cap. New monitoring wells to be installed and constructed by the Contractor are depicted on Contract Drawings.

The ground water monitoring wells shall:

1. Be constructed pursuant to N.J.S.A. 58:4A-4.1 et seq. and generally accepted methods. Monitoring well construction requirements, such as those described in the NJDEP Field Sampling Procedures Manual in effect as of the date the wells are to be constructed, may be utilized. The person responsible for conducting the remediation shall obtain the approval of the Department pursuant to N.J.A.C. 7:26E-1.6(d) for variations from the well design specifications outlined in NJDEP Field Sampling Procedures Manual in effect as of the date the wells or piezometers are to be constructed, prior to the issuance of the State monitoring well permits and prior to installation of the wells. Failure to install a well in accordance

with current well construction specifications in the Field Sampling Procedures Manual can result in rejection of results, and requirements to decommission the well;

2. Be installed after the required well drilling permits are obtained pursuant to N.J.S.A. 58:4A et seq.;

3. Be installed by a licensed New Jersey well driller pursuant to N.J.S.A. 58:4A-4.1 et seq.;

4. Have continuous split spoon samples collected during drilling through unconsolidated or overburden material using American Society of Testing Materials (ASTM) Method D1586-84, incorporated herein by reference, if appropriate. The boring shall be logged. Drilling logs shall include all data required pursuant to N.J.A.C. 7:26E-3.6 (Soil Investigations);

5. Be surveyed by a New Jersey licensed surveyor as follows:

   i. The inner well casing must be surveyed to the nearest hundredth (0.01) foot in relation to the permanent, on-site datum and horizontally to an accuracy of one-tenth of a second latitude and longitude.

   ii. A permanent water level measurement mark shall be etched onto the top of the inner well casing to allow for accurate, consistent and comparable water level measurements over time.

6. Be developed to yield a non-turbid discharge, where possible;

7. Have the monitoring well permit number and site specific well identification number prominently displayed and permanently affixed to the monitoring well;

8. Be constructed with a locking cap and generally protected from damage and vandalism. Any damage or vandalism to a monitoring well or piezometer shall be reported to the Department, and the damaged monitoring well or piezometer shall be properly repaired or decommissioned in accordance with N.J.A.C. 7:9-9; and

9. The Contractor shall complete and submit to the State the monitor well record report for the installation of the well. Additionally a Monitoring well certification Form A - As Built and Monitoring well certification Form B - Location Certification shall be submitted.

2.7.2 Submittals

Submittals shall be in accordance with Section 1.3.

Submittals shall include:

- Shop Drawings showing the well construction;
- NJDEP groundwater well construction permits; and,
- NJDEP Form A and Form B reports.

2.7.3 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Unit
2.7	Installation of Monitoring Well	Linear Foot

The Contractor will be paid the Linear Foot bid unit price for Pay Item 2.7 Installation of Monitoring Well measured to the nearest foot. This shall include furnishing all labor, materials, equipment, and reporting requirements associated with this work. Work detailed in this section shall not be considered complete until all permits (including Form A and B reports) are submitted and survey is completed.

END OF SECTION

2.8 Imported Fill

2.8.1 General Description

Imported fill designated as Modified Fill, I-13 shall be used as the 6 inch gas venting / protective cushion layer between the wastefill material and the geomembrane liner and as the 12 inch common fill cover soil over composite drainage net. Imported fill designated as Modified Fill, I-5 shall be used for construction of the Stilling Wells.

Large stockpiles of any material stored on the landfill will not be allowed. The determination as to what constitutes an acceptable amount of fill, and its location, stockpiled on the landfill will be solely at the discretion of the Engineer. Regardless of Engineer approval of any stockpile location, quantity, footprint, shape or the like, the Contractor shall restore the stockpile location to its original pre-construction elevation either by leaving stockpiled material in place or by importing suitable material at no additional cost to the State, and as approved by the Engineer, on a case by case basis. Stockpile replacement material approval will be solely at the discretion of the Engineer.
~~Large stockpiles of fill material stored on top of the Landfill will not be allowed when they could result in slope instability. The determination of what constitutes an acceptable amount of fill, and its location, stockpiled on top of the Landfill will be solely at the discretion of the Engineer.~~

2.8.2 Material

Imported Fill shall consist of natural or prepared mixtures consisting of hard, durable particles of sand and gravel. The composite mixture of any type of soil aggregate shall be free of organic matter, wood, garbage, metal, debris, or lumps of clay. Material from crushing operations will not be allowed. Screened material will be acceptable.

Imported Fill soil aggregates from a single source shall be used in any one construction item, unless otherwise submitted to and approved by the Engineer. Soil aggregates from different sources may be considered, if they are of the same geological classification and have similar specific gravities and color.

All imported fill brought from off-site must meet the following requirements (from NJAC 7:26D):

1. Fill shall be uncontaminated pursuant to the more stringent of DEP's Non-Residential Direct Contact Soil Remediation Standards or DEP's Default Leachate Criteria for Class II Ground Water found in DEP's Guidance for the use of the Synthetic Precipitation Leaching Procedure to Develop Site-Specific Impact to Ground Water Remediation Standards and shall be free of extraneous debris or solid waste (except as noted below). Additional testing, sampling, and laboratory delays will result for all changes of source of imported fill. Fill placed under the geomembrane and within the slurry wall does not need to meet or be tested for Site-Specific Impact to Ground Water Remediation Standards. All fill shall meet the Non-Residential Direct Contact Soil Remediation Standards.

2. Documentation shall be provided by certification stating that it is virgin material from a commercial or noncommercial source or decontaminated recycled soil.

3. All proposed sources of fill must be pre-approved by the Engineer. Bills of lading shall be provided to the Engineer to document the source(s) of fill. The documentation shall include: (1) the name of the affiant and relationship to the source of the fill, (2) location where the fill was obtained, including the street, town, lot, block, county and state and a brief history of the site which is the source of fill, and (3) a statement that to the best of the affiant's knowledge and belief the fill being provided is not contaminated pursuant to #1 above and a description of the steps taken to confirm such.

4. The Engineer will acquire samples for analytical testing for compliance with the NJDEP Standards and Guidance for clean fill as described in Item (1) above. No fill may be brought to the site until the Engineer confirms that it meets the NJDEP Standards and Guidance. The Contractor should allow adequate time in his project schedule for the sampling, analysis, and review of analytical data.

Modified Fill, I-13

The gradation requirements for Modified Fill, I-13 shall apply to material prior to placement. If bank-run or other materials conforming to these requirements are not available, materials that conform thereto may be produced by combining and mixing. Such combining and mixing shall not be performed on-site. Modified Fill, I-13 shall meet requirements of NJDOT Soil Aggregate I-13 modified such that 100% of material passes the 3/8" sieve. Modified Fill, I-13 shall meet the following gradation requirement:

Modified, Fill I-13 Gradation Designation	
Sieve Size	weight passing square mesh sieves
3/8"	100 %
#4	30-100 %
#200	0-12 %

Borrow source testing shall include the following: The Contractor shall perform gradation (ASTM D422) and Modified proctor (ASTM D1557) tests on the Modified Fill, I-13; per Section 1.10. Testing shall be at a frequency of one test per 10,000 Cubic Yards of material imported to the site and one test per borrow source. Results shall be submitted within three days of testing.

Modified Fill, I-5

The gradation requirements for Modified Fill, I-5 shall apply to material prior to placement. If bank-run or other materials conforming to these requirements are not available, materials that conform thereto may be produced by combining and mixing. Such combining and mixing shall not be performed on-site. Modified Fill, I-5 shall meet the requirements of NJDOT Soil Aggregate I-5, modified such that 100% of the material shall pass the 3/8" sieve (also referred to as 'I-5 Modified'). The Drainage soil materials shall be non-angular (ASTM D2488). Modified Fill, I-5 shall meet the following gradation requirement:

Modified, Fill I-5 Gradation Designation

Sieve Size	weight passing square mesh sieves
3/8”	100 %
#4	30-80 %
#50	10-35 %
#200	5-12 %

~~The permeability of Modified Fill, I-5 shall be greater than $1x10^{-2}$ cm/sec when compacted to 90% of the maximum Standard Proctor density, as determined by ASTM D-2434.~~

Borrow source testing shall include the following:

The Contractor shall perform gradation (ASTM D422), Standard proctor (ASTM D698) and permeability (ASTM D2434) tests on the Modified Fill, I-5; per section 1.10. Testing shall be at a frequency of one test per 10,000 Cubic Yards of material imported to the site and one test per borrow source. Results shall be submitted within three days of testing. ~~Permeability testing shall be conducted on material remold to meet 90% of the maximum Standard Proctor density. If permeability is less than $1x10^{-2}$ cm/s for the drainage layer, the material shall be rejected.~~

2.8.3 Submittals

Submittals shall be according to Section 1.3 and shall include the source location, copy of the borrow area permits, and results of analysis indicating material meets the criteria of these Technical Specifications.

2.8.4 Placement and Compaction

The waste surface shall be compacted in accordance with Section 2.5 prior to placement of the cushion/ gas venting layer of Modified Fill, I-13.

Wet areas shall be stabilized by removing water prior to fill placement and compaction. This can be accomplished by either removing the water, or by placement of Coarse Aggregate (#57) fill material, as described in Section 2.20.4, and as determined by the Engineer. Backfill material in wet areas shall be end dumped. The manner of filling and advancing the backfill wedge shall be such as to force all wet material laterally to the sides of the excavation and not to trap it under the fill. Accumulation of wet material at the sides of the embankment shall be removed as the embankment wedge advances, mixed with dry embankment material as necessary for drying, and spread in a thin lift over dry areas to be filled.

2.8.4.1 Modified Fill, I-13

Placement and compaction of Modified Fill, I-13 above and below the liner shall be treated separately.

<u>Below Geomembrane</u>

Modified Fill, I-13 placed below the geomembrane shall be placed as a single lift with a compacted thickness of 6”. Compaction for the Modified Fill, I-13 material placed below the liner shall be

performed using a non-vibratory, non-rubber tire, variable weight roller with a maximum weight of 10 tons to prevent loss of aggregate into the waste. A maximum of 10 passes of the roller will be made for compaction of the Modified Fill, I-13 material below the liner.

Prior to installation of the Modified Fill, I-13 below the geomembrane, a test strip (size of 200% width of roller and 400% length of roller) shall be completed to confirm the compaction technique. Both the NJDEP and the Engineer shall visually evaluate compaction of the test strip and determine an appropriate compaction procedure. In addition, the Engineer shall conduct nuclear density testing on the strips to determine the number of passes required to achieve 90% Standard Proctor maximum dry density. Once a compaction procedure is established for each layer, it will be applied to the rest of its respective layer.

~~The Contractor shall perform nuclear density testing on Modified Fill, I-13 material, at a rate of 1 per 2,500 ft^2, to document the level of compaction achieved. The Engineer may also perform additional nuclear density gauge testing. Any Modified Fill, I-13 material found to be less than 90% of Standard Proctor, shall be recompacted until it meets the compaction requirements, or a maximum of 10 passes of the roller has occurred.~~

Above Geomembrane

Modified Fill, I-13 above the geomembrane (and geocomposite drainage layer) shall be placed as a single lift with a compacted thickness of 12". Compaction of the Modified Fill, I-13 above the geomembrane shall be conducted using a LGP (Low Ground Pressure – less than 6 psi contact pressure) roller. The LGP roller shall be operated on at least 12" of cover above the liner at all times. A maximum of 10 passes will be made for compaction of the Modified Fill, I-13 material above the liner.

Prior to installation of the Modified Fill, I-13 above the liner, a test strip (size of 200% width of roller and 400% length of roller) shall be completed. Both the NJDEP and the Engineer shall visually evaluate compaction of the test strip and determine an appropriate compaction procedure. In addition, the Engineer shall conduct nuclear density testing on the strip to determine the number of passes required to achieve 90% Standard Proctor. Once a compaction procedure is established for each layer, it will be applied to the rest of its respective layer.

The Contractor shall perform nuclear density testing on Modified Fill, I-13 at a rate of 1 test per 2,500 ft^2, to document the level of compaction achieved. The Engineer may also perform additional nuclear density gauge testing. Any Modified Fill, I-13 placed as part of the liner system and found to be less than 90% of Standard Proctor, shall be recompacted until it meets the compaction requirements, or a maximum of 10 passes of the roller has occurred.

Modified Fill, I-13 material placed above the drainage net shall be placed starting at the edge of the drainage net and worked upward, by pushing the material forward in a tumbling motion with a dozer or front end loader (with LGP), and shall not be dumped directly on the drainage net.

Any heavy equipment (except for the LGP roller and spreader) used above the Geomembrane liner shall operate with at least 2' of temporary cover over the liner, and shall be as appropriate and

necessary to meet the placement and compaction criteria and limitations; except the use of pneumatic-tire rollers and vibratory rollers will not be permitted. Placement and compaction of the soil shall be in such a way as to not damage the geomembrane.

2.8.4.2 Modified Fill, I-5

Contractor shall place Modified Fill, I-5~~-~~ in 12" lifts. Compaction of the Modified Fill, I-5 above the geomembrane shall be conducted using a LGP (Low Ground Pressure – less than 6 psi contact pressure) roller. The LGP roller shall be operated on at least 12" of cover above the liner at all times. A maximum of 10 passes will be made for compaction of the Modified Fill, I-5 material above the liner.

Any heavy equipment (except for the LGP roller and spreader) used above the geomembrane liner shall operate with at least 2' of temporary cover over the liner, and shall be as appropriate and necessary to meet the placement and compaction criteria and limitations; except the use of pneumatic-tire rollers and vibratory rollers will not be permitted. Placement and compaction of the soil shall be in such a way as to not damage the geomembrane.

2.8.5 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Unit
2.8.1	Modified Fill, I-13, 6" Thick	Square Yard
2.8.2	Modified Fill, I-13, If and Where Directed	~~Cubic Yard~~Ton

The Contractor will be paid the bid price per square yard for Pay Item 2.8.1 for the purchase, excavation, testing, stockpiling, handling, placement and compaction Modified Fill, I-13, 6" Thick for installation of the gas venting/cushion layer below the geomembrane, as shown on the Drawings. Payment for Pay Item 2.8.1 is based on the horizontal plane.

Separate payment per ~~cubic yard~~Ton, based on certified weigh tickets will be made per Bid Item 2.8.2 for If and Where Directed items. Refer to Section 1.2.29 for addition language regarding if and where directed items.

Payment associated with material and placement of drainage layer (Fill, I-13, 12" thick common fill) will be paid for under Pay Item 2.13.2.

The Contractor will NOT be paid under Item 2.8.1 Modified Fill, I-13, 6" Thick for fill associated with daily cover to cover the relocated waste.

The Contractor will NOT be paid separately for Modified Fill, I-5. Modified Fill, I-5 costs will be considered incidental to the bid item price for Item 2.22.4 Stilling Well as described in Section 2.22.7.

END OF SECTION

2.9 Modification of Monitoring Wells

2.9.1 General

Furnish labor, materials, tools, and equipment to modify existing monitor wells, and inclinometers. The Contractor shall modify existing wells as shown on the drawings. The wells shall be extended according to the final elevations and the detail shown in the drawings.

The Contractor shall protect and modify the following groundwater wells: MW-3S, MW-10S, MW-10D, MW-6S and MW-6D.

The Contractor shall protect and modify the following inclinometers: SD-1, SD-2, SD-3, SD-4, SD-5, and SD-6.

2.9.2 Products/Materials

Monitoring Wells

A. PVC Pipe and Fittings: The pipe shall be Schedule 40 Type 1, Grade 1 polyvinyl chloride conforming to ASTM D-1784. Fittings shall be Schedule 40 conforming to ASTM D-2464 for threaded fittings. Glue and/or solvents shall not be used for extension of groundwater wells/piezometers.

B. A bentonite mix shall be used to seal the annular space between the extended well casing and protective casing. The bentonite mix shall be 5 pounds of high grade bentonite, 94 pounds of cement (Portland Cement Type I or II), and 8.3 gallons of potable water. The target density shall be 13.9 lbs./gal. with an acceptable range of 13.4 to 14.5 lbs./gal.

Inclinometers

A. Inclinometer casing – Large Diameter QC Casing, 3.34 in. O.D. Inclinometer Casing, (Slope Indicator Company or approved equivalent);
B. Borehole grout – Shall meet the following ratios, as provided by Slope Indicator Company:

Material	Ratio by Weight
Portland Cement	1
Water	2.5
Bentonite	0.3

Materials shall also meet the quality and testing requirements of Section 3.5 in addition to the above specification.

Submittals shall be according to Section 1.3. Contractor shall submit a copy of all well permits at the completion of work.

2.9.3 Modifications

The Contractor shall provide all equipment necessary to modify existing wells (including Level B personal protective equipment, if necessary). The Contractor shall also provide means to protect the wells during grading and placement of the liner.

The Contractor shall comply with NJDEP Monitor Well Specifications N.J.S.A. 58:4A et seq., the drawings, and these technical specifications when modifying the wells.

1. The Contractor shall extend the well and protective casing as shown in the detail drawings.
2. The bentonite shall be pumped through a tremie pipe into the annular space between the extended well casing and the protective casing.
3. The protective casing extension shall be equipped with a locking steel cap.
4. The top of the innermost extended casing (excluding cap) must be surveyed to the nearest 0.01 foot by a New Jersey-licensed surveyor. The survey point shall be the highest point of the casing and must be clearly marked on each well.
5. The driller must obtain well logs for the wells to be extended from the Engineer and revise them to their final conditions/elevation. The revised logs including final surveyed locations and elevations of the innermost casing and final ground shall be submitted to the Bureau of Water Allocation.
6. The Contractor shall protect the wells during grading and liner placement operations.

2.9.4 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Unit
2.9	Modification of Monitoring Wells	Linear Foot

Modification of Monitoring Wells will be measured on a linear foot basis from the top of well riser pipe to where the well is cut to perform the modification in accordance with the Contract documents.~~Modification of Monitoring Wells will be measured on a linear foot basis in accordance with the Contract Documents.~~ Payment for modification of wells shall be under Pay Item 2.9. Preservation of monitor wells not requiring modification is considered incidental to this work.

END OF SECTION

2.10 Leachate Collection System

2.10.1 General

The leachate collection system consists of the leachate collection piping system and associated trench, and cleanouts as shown on the drawings. Leachate collection system shall additionally include the force main designed to pump leachate from the south pump station to the north pump station, and from the north pump station to offsite. The leachate collection system shall drain to the pump stations shown on the Contract Plans.

During construction of the leachate collection system, the Contractor shall limit the excavated open trench to a length of 200 feet for purposes of minimizing global slope movement. For trench stability, Contractor shall construct leachate collection trench and backfill excavation prior to constructing slurry wall in the same area.

2.10.2 Materials

The work includes furnishing all the materials, equipment, tools, supervision and testing required to install the leachate collection pipe, and connect the collection pipe to the pumping and metering stations, in accordance to the design drawings and the specifications. This work includes shoring of the trench; if necessary, and surface water diversion. The invert of the proposed pipe will be under the leachate liquid level. Dewatering during installation will not be required, but is the Contractor's option.

Materials/Products

A. Bedding and Backfill: Coarse Aggregate # 3 (CA #3), Washed. CA #3 shall meet the NJDOT standard specification for Coarse Aggregate #3. Coarse Aggregate #57 shall meet requirements in Section 2.20.

B. Leachate Collection Pipe and Fittings: Perforated and non-perforated pipe and fittings shall be manufactured from high density polyethylene conforming to ASTM D 1248. Pipe shall conform to ASTM F 714. Pipe should be delivered in standard laying lengths. All pipe unless otherwise indicated or specified should be SDR 17. Pipe shall be an 8 inch diameter DR17 with 3 rows of 3/8" diameter holes, 120 degrees apart, spaced 6" on center (as per detail on Contract Drawings). Fittings shall conform to ASTM D 3261.

C. Leachate Cleanout Points: Leachate cleanout points will be installed as shown on the contract drawings. Cleanout points shall be 150 millimeters (6 inches) in diameter and consisting of a HDPE 45 degree fitting on end of run, or combination Y fitting and l/8 bend in the run with HDPE pipe extension, water tight plug or cap and cast frame and cover flush with finished grade. Cleanouts shall be constructed as shown on Contract Drawings. Where cleanout is in force main, provide a blind flange top connection. The center of the flange shall be equipped with a 50 mm (2 inches) base

valve to allow the pressure in the line to be relieved prior to removal of the blind flange.

D. Paint: Highly visible, indelible yellow paint with a minimum 15 years wear life to identify the leachate cleanout ports.

E. Force Main Pipe and Fittings: High Density Polyethylene (HDPE) pipe and fittings shall be manufactured from PE 3408, high density, extra high molecular weight polyethylene melting the requirements of ASTM D3350. Pipe shall be manufactured in accordance with ASTM F714, and shall be DR-26 (64 psi WPR). Molded fittings shall be manufactured in accordance with ASTM D3261 and subject to the test required under ASTM D3261. Fabricated fittings shall be made by heat fusion jointing of machined shapes cut from pipe, sheet stock, or molded fittings. Molded and fabricated fittings shall be rated for a minimum working pressure equivalent to the pipe. Joints shall be heat fusion butt joints, flange adapters, or mechanical couplings. As shown on the drawings two force main pipes shall be installed in the leachate collection trench. The second pipe shall be end capped outside of the pump stations. Cleanouts for the secondary leachate force main pipe shall be a capped T-wye in the cleanout vaults.

F. Geotextile: Type A Geotextile (Section 2.14).

G. Combination Sewage Air Valves:

1. Combination sewage air valves shall be of the single body, double orifice design. The combination valve shall allow large volumes of air to escape or re-enter the force main through the large orifice during filling or draining of the line. While the main is under pressure, the combination valve shall automatically release pressurized air, gas or vapor through the small orifice without spillage. The small and large orifices shall act independently of each other.

2. The sewage combination air valve shall have an elongated cast-iron body and cover. The float and internal stem shall be stainless steel supported by a Delrin or cast iron leverage frame. All internals shall be easily removed through the top cover without removing the valve body from the force main.

3. All materials of construction shall be certified in writing to conform to ASTM specifications as follows:

PART	MATERIAL	SPECIFICATION
Body,cover & baffle	Cast Iron	ASTM A126 GR.B
Float	Stainless Steel	ASTM A240 T304
Stem	Stainless Steel	Series T300
Seat	Buna-N	Nitrile Rubber

Plug	Brass or Stainless Steel	ASTM A240 T304
Leverage Frame	Delrin or Cast Iron	ASTM D1233, ASTM A126 GR.B
Exterior Paint	Phenolic Primer / Red Oxide	FDA Approved for Potable Water

4. The valve manufacturer shall furnish installation and maintenance manuals with each valve.

5. An isolating valve shall be installed between the force main and combination sewage air valve. The valve shall be a plug valve. Plug isolation valves shall be equipped with gear actuators and adapters for 2 - inch operating nuts. The valve shall also be equipped with an extension stem bringing the operating nut to within 12 - inches of the ground surface.

6. Combination sewage air valves shall be installed in easily accessible pre-cast manhole vaults. The vault shall be sized to properly house the valve assembly as well as providing sufficient lateral and vertical clearances to facilitate valve removal and maintenance. Where possible, the vault shall be drained to an adjacent sanitary manhole. Vaults shall be adequately vented to meet air release valve requirements.

H. Cleanout Frame and Cover: Frames and covers shall be gray iron casting conforming to ASTM C48. Flush-mounted frames and covers shall be rated for HS20-44 wheel loading. All covers shall have a studded pattern, vent holes, and lifting slots. The cover shall fit firmly on the frame without movement when subject to vehicular traffic. The word “SEWER” shall be cast on the cover.

I. Valve boxes and Covers: The valve box shall be high density, high molecular weight, polyethylene pipe and conform to ASTM D3350 with a minimum cell classification value of 345464C. The fittings supplied shall be made from polyethylene resin which meets this same specification. Fittings shall be as recommended/ provided by the pipe manufacturer.

a. The density shall be no less than 0.955 gms/ccm as referenced in ASTM D1505.
b. The melt index shall be no greater than 0.15 gms/10 minutes when tested in accordance with ASTM D 1238 - Condition 3.2.3.
c. The flexural modulus shall be 110,000 to less than 160,000 psi as referenced in ASTM D 790.
d. The tensile strength shall be 3,200 to less than 3,500 psi as referenced in ASTM D 638.
e. Slow Crack Growth Resistance shall be per ASTM F 1473 (PENT test). The results shall be greater than 100 hours.
f. Hydrostatic Design Basis shall be 1,600 psi at 23 degrees C when tested in accordance with ASTM D 2837.
g. The pipe shall be joined by butt fusion.

h. The manhole supplier shall submit certification that the HDPE material meets the specifications.
    i. The HDPE manholes shall be constructed of HDPE pipe with a nominal ID of 48" available in SDR 17. Calculations must be provided to verify the wall thickness is adequate for burial and loading.
    ii. The fabricator of the manholes shall submit drawings showing the position of the inlets, outlets and the overall dimensions along with any other special features such as manways, ladders, etc.
    iii. The fabricator shall submit data indicating that the manholes meet the requirements of ASTM F1759, "Design of High Density Polyethylene (HDPE) Manholes for Subsurface Applications".

i. Calculations supporting these requirements will be part of the submittal package.
    i. Thickness of the bottom based on depth and groundwater. Thickness should be based on acceptable stress and deflection amounts.
    ii. The manhole should be proven to have acceptable design for Ring Compressive Strain, Combined Ring Compressive and Ring Bending Strain, Ring Buckling, Axial Stain, and Axial Buckling

j. The top cover shall shall be made of gray iron conforming to the requirements of ASTM A 48, Class 30 B and shall be labeled "SEWER".

k. Handling of Manholes. HDPE manholes shall be stored on clean, level, and dry ground to prevent undue scratching or gouging of the pipe. The handling of HDPE manholes shall be done in such a manner that there is no damage. Nylon slings are often used.

l. A total of five (5) - ½"diameter weep holes shall be drilled into the bottom of the manhole to promote drainage out of the manhole.

m. Pipe Joining. HDPE pipe shall be joined using butt fusion. All butt fusion welds shall be made as described in ASTM F 2620. Electrofusion welding can be used for making pipe welds. Hot air and extrusion welding are not permitted for pipe joining. All connections to the structure made butt fusion welds using hydraulically operated butt fusion equipment shall be recorded using a McElroy Manufacturing DataLogger. The contractor shall maintain records of the temperature, pressure, and graph of the fusion cycle.

J. Epoxy Lined Resilient Wedge Gate Valve: Valves shall conform to the latest revision of AWWA standard C-509 covering resilient seated gate valves and be approved by ULFM. Valves shall be either non-rising stem or rising stem, opening by turning stem left or right and provided with 2" square operating nut or handwheel with the word 'open' and an arrow cast in the metal to indicate direction to open.

The wedge shall be of cast iron completely encapsulated with rubber.

The sealing rubber shall be permanently bonded to the cast iron wedge to meet ASTM tests for rubber metal bond ASTM D429.

Valves shall be supplied with o-ring seals at all joints. No flat gaskets allowed.

Stems for NRS assemblies shall be cast bronze with integral collars in full compliance with AWWA. OS&Y stems shall be bronze. The NRS stem stuffing box shall be the o-ring seal type with two o-rings located above thrust collar and one o-ring below. The two o-rings above the thrust collar shall be replaceable with valve fully open and subjected to full rated working pressure.

There shall be two low torque thrust bearings located above and below the thrust collar. The stem nut shall be independent of the wedge and shall be made of solid bronze. There shall be a smooth, unobstructed waterway free of all pockets, cavities and depressions in the seat area.

The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior, complying with AWWA C-550 and be NSF 61 approved. Each valve shall have maker's name, pressure rating and year in which manufactured cast on the body.

K. Floor Stand Assembly with Handwheel Operator: Handwheel Operators shall be of high-strength cast iron provided with extension stems of steel, and have a cast bronze lift nut machined to accurately mate with the operating stem. Bronze bushings shall be provided above and below the flange on the lift nut to take the thrust developed while opening and closing the gate. Bushings shall be housed in an enclosed weatherproof housing and shall be furnished with lubrication fittings. Each unit shall be fitted with a handwheel marked with direction of opening. Handwheels shall be of such diameter that handwheel pull shall not exceed 40 lb. on the rim. Handwheels shall be removable and shall be cast iron or fabricated steel. Stand shall be 34-1/4 inches high with a base diameter of 12 inches. Base shall be provided with four 1-inch mounting holes. Stand shall be CLOW Valve Company Model F-5500T or equal as approved by the Engineer.

L. Tracer Tape: Metal detection tape shall be in accordance with Section 330526, Tracer Tape. The tape shall be furnished with an appropriate message imprinted on a colored background warning of buried sewer line.

M. Butt Fusion Fittings: Molded butt fusion fittings shall be in accordance with ASTM D-3261 and shall be manufactured by injection molding. Fabricated fittings made from HDPE pipe conforming to this specification are also acceptable. All fittings shall be pressure rated to provide a working pressure rating no less than 100 psi (DR-17). A graphic representation of the temperature and pressure data for all fusion joints made producing fittings shall be maintained as part of the quality control. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

N. Electrofusion Fittings: Electrofusion Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D-3350-02 and be the same base resin as the pipe. Fittings shall be DR17 unless otherwise specified on the plans.

O. Flanged and Mechanical Joint Adapters: Flanged and Mechanical Joint Adapters shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D-3350-02 and be the same base resin as the pipe. All flange adapters and back up rings shall be pressure rated to provide a working pressure rating no less than that of the 100 psi (DR-17). The supplier shall be ISCO Industries, LLC, Ferguson Industrial Plasticsor equal as approved by the Engineer.

P. Mechanical Restraint: Mechanical restraint for HDPE pipe may be provided by mechanical means. Bell MJ Adapters and standard MJ adapters may be used.

Materials shall also meet the quality and testing requirements of Section 1.10.

2.10.3 Submittals

Submittals shall be in accordance with Section 1.3.

A. Prior to beginning the work, submit six (6) sets of the following:

1. Qualifications of the firm/personnel who will perform the work.

2. Provide at least five (5) references of different projects in which at least 500 linear feet of HDPE piping have been installed by the firm within the past three (3) years.

B. Shop Drawings and/or brochures shall be submitted for all items furnished in accordance with the provisions of the General Conditions. Submittals required under this section include, but are not limited to, shop drawings or manufacturer's literature for the following:

1. Horizontal joint sealing material

2. Pipe connections and fittings: High density polyethylene (HDPE) pipe and fittings: product information and dimensions; Schedule or SDR/SIDR number; storage, handling, and installation recommendations.

3. Valves: Shut-off, check, anti-siphon, air release valves, combination air/vacuum valves, corporation valves, valve boxes, and miscellaneous appurtenances: product description, parts list, detailed assembly drawings, and maintenance requirements and procedures.

4. Clean Outs: Showing materials and construction of leachate pipeline and forcemain cleanouts.

C. Certificates Of Compliance

1. Certificates of compliance shall be submitted for all pipe and fittings stating the item supplied is in accordance with the requirements specified herein.

D. Certified Test Results

Certified test results shall be submitted for the following:

1. Ductile iron pipe and fittings;
2. HDPE pressure pipe and fittings.

2.10.4 Quality Control Testing

A. Prior to HDPE pipe being installed in the trench, after the Contractor has begun butt fusion of the pipe, the Engineer reserves the right to select at random two butt fusion joints (with a minimum of 18" of pipe on each side of the joint). These samples shall be sent to the HDPE supplier for hydrostatic testing at the Contractor's expense.

B. The testing procedure shall be to Factory Mutual Standards. In no case will the failure be in the butt fusion joint. The test will be recorded and sent to the Contractor and Engineer. Upon failure of any butt fusion weld; Contractor shall be required to cut and re-weld all questionable butt fusion joints as directed by the Engineer.

2.10.5 Warranty

A. The HDPE piping installation work performed shall have a warranty against faulty workmanship and materials in accordance with Section 5.5.9 of the RFP. ~~The HDPE piping installation work performed shall have a warranty against faulty workmanship and materials for a period of one (1) year after the project is accepted by the Engineer.~~

2.10.6 Delivery, Storage and Handling

A. Materials shall be delivered to the site in the Manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. All materials shall be stored properly and in accordance with Manufacturer's instructions.

2.10.7 Installation

2.10.7.1 General

The Contractor shall supply all equipment necessary to construct the leachate collection trench, install the collection pipe, install the cleanouts, and connect the collection pipe to the pump and metering stations as shown on the drawings.

Pipe and Fitting size shall be as indicated on the plans. Install as shown in accordance with manufacturer's recommendations.

2.10.7.2 Joining

A. Butt Fusion: Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400-450 degrees Fahrenheit, alignment, and an interfacial fusion pressure of

75 PSI. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. A data logger shall be used to record all fusion conditions.

1. All on site fusion welds to be performed using McElroy Datalogger and Weld Map as provided by ISCO Industries, LLC, or UPSCO, Inc. or equal as approved by the Engineer.

2. On Site Fusion Technician to have Fusion Welded over 5000ft of 3" or larger Solid Wall HDPE pipe. Qualification letter required.

B. Sidewall Fusion: Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused. Sidewall Fusion Welds shall only be performed by qualified personnel.

C. Mechanical: Bolted joining may be used where the butt fusion method cannot be used. Flange joining will be accomplished by using a HDPE flange adapter with a ductile iron back-up ring. Mechanical joint joining will be accomplished using either a molded mechanical joint adapter or other approved methods. Either mechanical joint joining method will have a ductile iron mechanical joint gland.

D. Other: Socket fusion, hot gas fusion, threading, solvents, and epoxies may not be used to join HDPE pipe.

2.10.7.3 Quality and Workmanship

The pipe and/or fitting manufacturer's production facility shall be open for inspection by the Engineer or his designated agents with a reasonable advance notice. During inspection, the manufacturer shall demonstrate that it has facilities capable of manufacturing and testing the pipe and/or fittings to the standards required by this specification.

2.10.7.4 Pipe Packaging, Handling & Storage

The manufacturer shall package the pipe in a manner designed to deliver the pipe to the project neatly, intact and without physical damage. The transportation carriers shall use appropriate methods and intermittent checks to insure the pipe is properly supported, stacked and restrained during transportation such that the pipe is not nicked, gouged, or physically damaged.

Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment.

Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the heat fusion joining method.

Fused segments of the pipe shall be handled so as to avoid damage to the pipe. Chains or cable type chokers must be avoided when lifting fused sections of pipe. Nylon slings are preferred. Spreader bars are recommended when lifting long fused sections.

2.10.8 Trench Construction

Trenching, including earth excavation, bedding material and backfill, shall be done in accordance with Section 2.4 'Wastefill and Earth Excavation.' As required based on excavation depth and stability, contractor shall select/ use temporary sheeting and shoring (i.e. trench box, sheet pile, etc) for excavation stability construction of leachate trench, in accordance with Section 2.3. As this activity is part of the Contractor's means and methods, no separate payment shall be made for temporary excavation support systems.

2.10.9 Pressure Testing of Pipelines

A. Pressure pipelines shall test in accordance with the specifications and requirements of the Engineer and pipe manufacturer's recommendations. The hydro-test shall be conducted in accordance with the "Inspections, Tests and Safety Considerations" document as available through PPI. If a system component such a fabricated or mechanical fitting has a pressure rating less than that of the pipe, the piping system shall be pressure tested to the manufacturer's guideline on that component.

2.10.10 Video

All installed piping shall be checked for deformation from round upon completion of placement of backfill and fill covering it. The Contractor shall inspect the piping by means of a television camera pulled through the pipe. Engineer shall be present when this testing is accomplished and the Contractor shall provide the State a copy of the video tape in DVD format. Any pipeline section found to have been deformed by 10 percent or more of its original diameter shall be removed and replaced or returned to its original shape, then reinstalled and retested, at no additional cost to the State.

2.10.11 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Unit
2.10.1	Perforated HDPE Leachate Pipe, 8" Diameter	Linear Foot
2.10.2	Leachate Clean Out	Each
2.10.3	Forcemain HDPE	Linear Foot
2.10.4	Forcemain Clean Out	Each
2.10.5	Forcemain Combination ARV and Forcemain Cleanout	Each

The leachate collection pipe (including all labor, materials, leachate handling, and equipment needed for trench excavation, geotextile, pipe placement, connection to tanks, bedding, and backfilling with Coarse Aggregate #3) shall be paid per linear foot under Bid Item 2.10.1. Leachate collection pipe. C ~~c~~leanouts shall be paid for under Bid Item 2.10.2. Forcemain pipe (including all labor, materials, leachate handling, and equipment needed for trench excavation, excavation, geotextile, pipe placement, connection to tanks, bedding, air release valves and backfilling with Coarse Aggregate #3) shall be paid per linear foot under Bid Item 2.10.3 (Note that two pipes shall be installed within the trench per the drawings with one pipe capped at either end). Forcemain cleanouts shall be paid for under Bid Item 2.10.4. There will be one combination air release valve (ARV) and forcemain cleanout as per the Contract Drawings which will be paid for under Bid Item 2.10.5.

Valves adjacent to the pump station manhole shall be paid for as part of Bid Item 2.11. Installation of the 6 inch diameter forcemain connecting north pump station to 6" stub from the ~~eixsting~~existing pump station shall be paid for under Bid Item 2.11.

This RA Type B material excavated from the leachate collection system trench shall be re-used for final grading of perimeter access road in accordance with Section 2.26 of these specifications and details on the Contract Drawings, under the gabion wall, and/or to achieve grades on the southern and eastern portions of the perimeter access road. No separate payment will be made for this work.

END OF SECTION

2.11 Pump Stations

2.11.1 General

A. Work under this section includes, but is not limited to, furnishing and installing factory built duplex pump stations in two locations as indicated on the project drawings, herein specified, as necessary for proper and complete performance.

2.11.2 References

B. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.

1. American National Std. Institute (ANSI) / American Water Works Assoc. (AWWA)

a.	ANSI B16.1	Cast iron pipe flanges and flanged fittings.
b.	ANSI/AWWA C115/A21.51	Cast/ductile iron pipe with threaded flanges.
c.	ANSI 253.1	Safety Color Code for Marking Physical Hazards.
d.	ANSI B40.1	Gauges, Pressure and Vacuum.
e.	AWWA C508	Single Swing Check Valves.
f.	AWWA C504	Plug Valves

2. American Society for Testing and Materials (ASTM)

a.	ASTM A48	Gray Iron Castings.
b.	ASTM A126	Valves, Flanges, and Pipe Fittings.
c.	ASTM A307	Carbon Steel Bolts and Studs.
d.	ASTM A36	Structural Steel.

3. Institute of Electrical and Electronics Engineers (IEEE)

a.	ANSI/IEEE Std 100	Standard Dictionary of Electrical Terms.
b.	ANSI/IEEE Std 112	Test Procedure for Polyphase Induction Motors.
c.	IEEE Std 242	Protection of Industrial and Control Power Systems.

4. National Electric Code (NEC) / National Electrical Manufacturers Assoc. (NEMA)

a.	NEC	National Electric Code.
b.	NEC 701	National Electric Code article 701.
c.	NEMA Std MG1	Motors and Generators.

5. Miscellaneous References
   a. Ten-State Standards Recommended Standards for Sewage Works.
   b. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.
   c. NMTBA and JIC Std National Machine Tool Builders Association and Joint Industrial Council Standards
   d. ISO 9001 International Organization for Standardization.

2.11.3 System Description

A. The contractor shall furnish and install one factory built automatically controlled above ground submersible pump valve package capable of handling raw unscreened industrial waste in each location shown on the Plans.

B. The pumps and mechanical slide rail accessories shall be installed in the wet well as shown on the project plans. The pump control panel, liquid level control, valves and piping shall be installed within a factory built fiberglass enclosure.

C. Factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with requirements listed herein.

2.11.4 Performance Criteria

A. Each pump for the North Station must be designed to handle raw, unscreened, industrial waste. Pumps shall be furnished with a 4" discharge connection. Each pump shall be selected to deliver 150 GPM at a design dynamic discharge head of 28 feet. Motors should be 5 HP.

B. Each pump for the South Station must be designed to handle raw, unscreened, industrial waste. Pumps shall be furnished with a 4" discharge connection. Each pump shall be selected to deliver 100 GPM at a design dynamic discharge head of 57 feet. Motors shall be 7.5 HP.

C. Site power furnished to pump stations shall be 3 phase, 60 hertz, 480 volts, 4 wire, maintained within industry standards. The available fault current provided at the pump station control panel is 12 kA rms symmetrical. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA standard MG-1. Control voltage shall not exceed 132 volts.

2.11.5 Submittals

Submittals shall be in accordance with Section 1.3.

A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit one original and six copies of submittal data for review and approval.

2. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

3. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for slide rail components. Pipe penetrations and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

B. Operation & Maintenance Manuals

1. Installation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied.

2. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:

   a. Functional description of each major component, complete with operating instructions.

   b. Instructions for operating pumps and pump controls in all modes of operation.

   c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.

   d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.

   e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA70. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

   f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, valves and piping.

3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read

portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

4. The Operation and Maintenance Manual shall include a spare parts and maintenance equipment list be developed, consisting of recommended quantities and prices. All spare parts on the list and maintenance equipment shall be purchased by the Contractor and storage provided on-site. This shall include one spare pump of each type.

2.11.6 Quality Assurance

A. The pumps and pump station manufacturer must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. Upon request from the Engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.

C. All pump openings and passages shall be of adequate size to pass 3.15" diameter spheres (minimum) and any trash or stringy material which can pass through an average house collection system.

D. The manufacturer’s technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

2.11.7 Manufacturer’s Warranty

A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

1. In addition to defects in material and workmanship, station enclosures are warranted for sixty (60) months to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.

2. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.

B. Components failing to perform as specified by the Engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.

C. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design or delays in delivery are also beyond the manufacturer's scope of liability.

D. Equipment supplied by others and incorporated into a pump station or enclosure is not covered by this limited warranty. Any warranty applicable to equipment selected or supplied by others will be limited solely to the warranty, if any, provided by the manufacturer of the equipment.

E. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. A start-up report competed by an authorized manufacturer’s representative must be received by manufacturer within thirty (30) days of the initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

2.11.8 Unitary Responsibility

A. In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that all system components are furnished by a single supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

2.11.9 Manufacturer

A. The pump station system integrator must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.

C. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.

D. In event the contractor obtains Engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail

drawings illustrating the substituted equipment shall be submitted to the Engineer prior to acceptance.

E. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

2.11.10 Station Enclosure

A. The station enclosure shall contain and enclose all valves, and associated controls and shall be constructed to enhance serviceability by incorporating the following design characteristics:

1. Two access panels per side of station shall be provided. Panels shall be sized and placed to permit routine maintenance operations through the panel openings of the enclosure. For these purposes, routine maintenance shall include frequently performed adjustments and inspections of the electrical components, controls and valves.

2. The access panels shall be provided with a hinge and latch. Hinge shall be the continuous type. Latch shall engage the enclosure at not less than three places, and shall be protected by a keyed lock.

3. One enclosure side shall contain a screened vent to maximize air flow for enclosure ventilation.

4. Station enclosure, less base, must be removable or able to be disassembled following the removal of reusable hardware.

5. Removal or disassembly of the enclosure shall be accomplished by not more than two maintenance personnel without the use of lifting equipment.

B. The station enclosure shall be manufactured of molded reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Resin fillers or extenders shall not be used.

C. Glass fibers shall have a minimum average length of 1 1/4 inches. Major design considerations shall be given to structural stability, corrosion resistance, and watertight properties. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long life. They must be impervious to micro-organisms, mildew, mold, fungus, corrosive liquids, and gases which can reasonably be expected to be present in the environment surrounding the wet well.

D. All interior surfaces of the housing shall be coated with a polyester resin rich finish. It shall provide:

1. Maintenance free service
2. Abrasion resistance

3. Protection from industrial waste, greases, oils, gasoline, and other common chemicals
4. The outside of the enclosure shall be coated with a suitable pigmented resin, compounded to insure long maintenance free life.

E. An exhaust blower shall be mounted in the roof of the enclosure. Blower capacity shall be sufficient to change station air a minimum of once every two minutes. Blower motor shall be operated automatically and shall be turned on at approximately 70 degrees F and shall be turn off at 55 degrees F. Blower motor and control circuit shall be protected by a thermal magnetic air circuit breaker to provide overcurrent and overload protection. Blower exhaust outlet shall be designed to prevent the entrance of rain, snow, rocks, and foreign material.

2.11.11 Station Base

A. Station base shall be constructed of pre-cast, reinforced concrete bonded inside a fiberglass form covering top and sides, and shall be designed to insure adequate strength to resist deformation of the structure during shipping, lifting, or handling. The enclosure base shall function at the wet well top and incorporate a duplex access lid, sized for the installation and removal of the specified pumps, and shall be of sufficient size to permit access to the wet well. Color used shall de-emphasize the presence of dirt, grease, etc., and shall be provided with a non-skid surface.

B. A static wet well vent shall be mounted in the station base, and be housed in the station enclosure. The station enclosure shall provide a transition area between the wet well and the vent outlet. The vent shall terminate through the station wall with a screened opening which shall be designed to prevent the entrance of rain, snow, rocks and foreign material.

C. The station base shall incorporate a cable transition adapter for the pump cables, level controls, and associated wiring. The adapter shall provide for a vapor tight transition between the wet well and the lift station enclosure. The adapter shall incorporate cable grips for each cable and be provided with a gasket between the adapter and the station for a positive seal. Junction boxes shall not be considered for cable transition.

D. The station base shall be furnished with elastomeric compression sealing devices for all piping penetrations to provide for a vapor tight transition between the wet well and lift station enclosure.

E. Station Heater

1. Pump station shall be provided with a 1300/1500 watt, 115 volt electric heater with cord, thermostat and grounding plug. Ungrounded heaters shall not be acceptable.

F. Insulation Package

1. The pump station shall be furnished with 1" thick spray foam insulation, which shall be applied to the roof, doors, and corner panels.

G. Door Open Notification

1. The station enclosure shall include limit switches with defeater switch alarm circuit and time delay, mounted and wired in the station enclosure to indicate that there has been a door left open or unauthorized entry to the station. There shall be an adjustable time period for the operator to disable alarm with an unmarked pushbutton located inside the station. The notification shall be activated when a station door is opened. Includes dry contacts pre-wired to a terminal strip for remote monitoring. Dry contact shall be connected to the cellular autodialer for alarm notification to owner.

H. Hand Lamp

1. Pump station shall be provided with a 100 watt, 115 volt AC vapor tight hand lamp with 25 feet of cord and grounding plug. Hand lamp shall be constructed of corrosion resistant materials, and shall be equipped with a guard and a clear globe. Ungrounded hand lamps may be supplied if provided with an effective means of double insulation.

I. Discharge Gauge Kit

1. The pump station shall be equipped with a glycerin-filled pressure gauge to monitor discharge pressures. Gauge shall be a minimum of 4 inches in diameter, and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full scale reading. Pressure gauge shall be graduated 0 to 140 feet water column minimum. Gauge kit shall be mounted and complete with all hoses and stainless steel fittings and shall include a shutoff valve installed in each connection to discharge piping and a three way valve to monitor either pump.

J. Portable Hoist and Socket

1. Each pump station shall be provided with a portable hoist with winch assembly. Hoists shall be designed to lift pumps weighing up to 650 pounds. Portable hoist shall not weigh more than 75 pounds. Hoist socket shall be permanently installed on station slab.

K. Compression Couplings

1. Compression couplings shall be provided for each suction and discharge connection to join plain end ductile iron pipe to wet well piping.

2.11.12 Wet Well

The wet well shall be constructed of pre-cast reinforced concrete designed to meet the anticipated loads of the structure. The contractor shall submit signed and sealed engineering drawings and calculations demonstrating that wet well design will withstand the anticipated earth pressures.

The inside of each wet well shall receive a coal tar epoxy waterproof coating. For concrete waterproofing, use epoxy-resin that conforms to ASTM C 881, Type 7, Grade 1, 2, or 3, Class D, E, or F, and is listed on the QPL. Acceptable products include Ameron "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy", or equal as approved by the Engineer.

Prior to installation of the wet well the outside of the structure shall receive asphalt waterproofing. For use below ground level, use an asphalt waterproofing conforming to ASTM D 449, Type I. Use a primer conforming to ASTM D 41. Acceptable products include Carboline "Bitumastic 50" or Tnemec "46-465 H.B. Tnemecol", or approved equal.

Submit material data sheets for precast structural concrete, epoxy waterproofing and asphalt waterproofing. All wet well materials shall be installed in accordance with the manufacturer's recommendations.

All coating materials that will be in contact with wastewater atmosphere shall be guaranteed by the manufacturer to be fumeproof and suitable for wastewater atmospheres that contain hydrogen sulfide. Coatings that cannot be so guaranteed shall not be used. Lead-free and mercury-free coatings shall be used if available, but in no case shall coatings containing lead or mercury be used that become discolored when exposed to a wastewater atmosphere.

Water tight seals, such as Link-Seal, NPC Kor-N-Seal pipe to manhole connector, or approved equal, shall be used for each pipe penetration to the wet well.

The Contractor shall connect and install the PrevEx Flammability Analyzer (made by Control Instruments) that is installed in the Metering Station to the North Pump Station.

2.11.12 Pump Design

The pump(s) for each station must be submersible slide rail type and be properly selected with the necessary characteristics to deliver the capacities previously stated and as shown on the Plans.

A. The manufacturer of the pumps must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. Hydraulic Components and Solids Handling:

1. The pump casing shall be of gray iron, ASTM A-48, Class 30, or ductile iron, Class 65-45-12, with a 125# Flange. Casing shall be easily removable from the motor for full inspection of impeller.

2. All pump openings and passages shall be of adequate size to pass a minimum 3" diameter spheres and any trash or stringy material which can pass through an average house collection system.

3. The impeller shall be a multi-vane vortex type with integral stagger-step winglets on each vane. The winglet shall form a stagger-stepped L-shaped cross section at the face of the vane for improved hydrodynamic efficiency. Impeller shall be of ductile iron and precision balanced. Balancing shall not deform or weaken the impeller. The impeller shall be recessed into the pump casing and shall not require flow of liquid through the impeller. The impeller and seal housing shall incorporate auxiliary vanes to hydraulically reduce pressure on the primary seal and force fibrous materials and solids away from the close axial clearance on the backside of the impeller. The impeller shall be driven by means of a key slotted into the shaft. Impeller fasteners shall be non-corroding. No impeller clearance adjustment or wear rings shall be required.

4. A hoisting bail shall provide for proper balance of pump while it is being lifted.

5. All other major pump components such as motor housing, seal housing, and bearing brackets shall be of gray iron, ASTM A-48, Class 30. All external surfaces coming into contact with pumped media shall be protected by water-based epoxy primer and a waterborne enamel top coat with a minimum 8 mil thickness. All exposed fasteners and lock washers shall be of 300 series stainless steel.

C. Shaft Seal

1. Two separate mechanical seals shall be provided, arranged in tandem. The upper seal shall have a carbon rotating face and ni-resist stationary face. The lower seal shall incorporate silicon carbide on both the rotating and stationary faces. Cage and springs shall be of stainless steel and elastomers of Viton or Buna-N.

2. The rotating seal faces shall be lubricated from an oil filled reservoir between pump and motor; the oil serving as both lubricating and a cooling media. The reservoir shall have two oil fill and drain plugs to insure accuracy when measuring lubricant level and for ease of maintenance.

3. Seal shall require no special maintenance or routine adjustment; however, shall be easily inspected or replaced. No seal damage shall result from operating the pump for short periods of time without liquid.

4. A seal failure electric probe sensor shall be installed in the seal chamber. The sensor shall be capable of sensing leakage into the seal chamber and the sensitivity level shall be set in the control panel.

2.11.13 Pump Motor

A. Motor Description

1. The motor and pump must be connected to form an integral unit. Motor shall be a squirrel cage, induction type in an air filled water tight enclosure, oil-filled motors shall not be acceptable. The motor shall conform to NEMA design standards, and incorporate Class H insulation materials to withstand a continuous operating temperature of 180^0C (356^0F). The pump and motor shall be capable of handling liquids with a maximum temperature of 40^0C (104^0F).

2. Motor shall be capable of sustaining a minimum of 10 starts per hour and shall be inverter duty rated in accordance with NEMA MG1. The motor shall not require a cooling jacket or any other means of auxiliary cooling during normal continuous operation.

3. Motor housing shall be of cast iron. The stator shall consist of copper windings with copper connectors applied to high grade electrical steel laminations. The stator shall be held securely in place by a heat shrink fit into the motor housing. Any other means of securing the stator which would require penetration of the motor housing shall not be considered acceptable.

4. Combined rotor and shaft assembly shall be dynamically balanced for vibration free operation. Rotor end bars and short circuit rings shall be of aluminum. The pump shaft shall be of 17-4 PH series stainless steel. The shaft shall be machined with shoulders or snap ring grooves for positive placement of bearings.

5. The upper and lower bearing shall be of heavy duty design, capable of supporting the shaft and rotor while under maximum radial and thrust loads. The bearings shall be permanently grease lubricated and sealed at the time of installation. The minimum B-10 bearing life shall be 50,000 hours over the normal operating range of the curve.

6. Pump motors shall be variable frequency drive type (VFD).

B. Watertight Integrity

1. All static seals at water tight mating surfaces shall be of Buna-N or Viton rubber O-ring type. Use of auxiliary sealing compounds shall not be required.

2. The power and control cables shall enter the motor through a terminal housing. The entrance shall be sealed with a rubber grommet and clamp set which when compressed longitudinally causes a radial water tight seal. The individual leads of the power and control cables shall be separated by a compressible grommet, which shall provide protection from wicking through the cable. Any other cable entrance design requiring use of epoxies, silicones, or similar caulking materials shall be considered unacceptable.

3. The motor and sensor leads shall be mated to the cable leads through a group of quick-connect, color-coded cable connectors.

4. The pump and electrical cables shall be capable of continuous submergence without loss of waterproof integrity to a depth of 65 feet.

5. The water tight integrity of the motor housing and shaft seal shall be tested during manufacture by vacuum testing the completed pump assembly.

C. Motor Protection

1. The motor shall be protected from thermal damage by a group of three separate thermostatic switches embedded into the stator windings, one per stator phase. Each switch shall open independently and terminate motor operation if temperature of the protected winding reaches the high temperature set point of $160^{O}C$ ($320^{O}F$) and shall automatically reset upon cooling of the winding. The thermal sensing device shall be connected to the pump control panel by the contractor.

2. The pump shall utilize a single probe to monitor both the motor and seal chambers for moisture intrusion. The detection of moisture in either chamber shall send a signal to the control panel which shall be used to notify the user of the need for an inspection.

2.11.14 Automatic Discharge Connection

A. 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 must insure an automatic and firm connection of the pump to the discharge piping when lowered into place.

B. A gray iron or fabricated steel base plate with integral guide rail pilots shall be provided along with all hardware and anchor bolts required for permanent installation to the wet well floor. The base plate shall be designed with an integral 90^{0} elbow, or adapt to a commercially available elbow for connection to the vertical discharge piping utilizing standard ANSI 125 lbs. flanges. The base plate shall be coated with an epoxy coating for corrosion resistance. The manufacturer shall provide all necessary drawings to insure proper installation and alignment of baseplate within the sump.

C. Each pump shall be provided with a replaceable ductile iron slide rail guide shoe attached to pump discharge flange. A replaceable neoprene seal shall be provided as an integral part of the guide shoe to form a seal with the base plate 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. The contractor shall provide two lengths of 1-1/2", schedule 40 stainless steel guide rail pipe for each pump.

E. Upper guide rail pilots, and a lifting cable shall be furnished for each pump. Bottom pilots shall be an integral part of the baseplate for ease of installation and proper alignment.

F. The guide shoe shall direct the pump down two vertical guide rails and onto the discharge connection in a simple lineal movement. The buildup of sludge and grease on guide rails shall not present problems during the lifting operation. The guide shoe shall be designed with integral hooks at the top to transmit full weight of the pump to the base plate flange. No portion of the pump shall be supported directly on the bottom of the wet well, guide rails, or lifting cable.

G. Lifting cable shall consist of a 316 stainless steel braided wire cable attached to the pump lifting bail. A crimped ball end shall be provided at the upper end of this cable for attaching to the wet well access frame.

H. All bolts, machine screws, nuts, washers, and lockwashers for complete assembly of access cover, guide rails, and discharge elbow shall be stainless steel.

2.11.15 Wet Well Access

A. The wet well access shall be fabricated from welded aluminum sections. A hinged aluminum door shall be provided for each pump. The hinged door shall be fabricated from 1/4" thick aluminum with non-skid diamond tread on upper surface. All hardware on access assembly shall be stainless steel with a flush upper surface without protrusions. For safety, the door shall have a 300 lbs/sq.ft. rating and be fitted with a recessed staple for padlock. Door shall be furnished with a flush aluminum drop handle and automatic hold open arm.

2.11.16 Valves and Piping

A. Check Valve: Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional spring. Valve seat shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O-ring, and shall be replaceable. The valve body shall be cast iron incorporating a clean-out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings. Shaft nut shall have double O-rings which shall be shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

B. Each discharge line shall be equipped with a 2-way plug valve to permit isolation of the pumps from the common discharge header. The plug valve shall be non-lubricated type. Valve body shall be cast iron with flanged end connections drilled to 125 pound standard. Valve shall be furnished with a drip-tight shutoff plug mounted in stainless steel or teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface. Valves shall have ports designed to pass 3" spherical solids.

C. Piping

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.

2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.

3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

4. Bolt holes shall be in angular alignment within $1/2^0$ between flanges. Flanges shall be faced and a gasket finish applied.

5. All pipes connected to the pump station shall be supported according to good commercial practice.

D. Discharge Bypass Piping

1. The station header pipe shall incorporate a 2-way plug valve to permit emergency access to the pump station force main after isolation of the pumps. The plug valve shall be non-lubricated, tapered type. Valve body shall be cast iron with flanged end connections drilled to 125 pound standard. Valve shall be furnished with a drip-tight shutoff plug mounted in stainless steel or teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface.

2. The header pipe shall penetrate the station side wall and terminate with a male OPW type quick connect fitting.

E. Suction Bypass Piping

1. The station shall incorporate piping to permit emergency access to the pump station wet well.

2. The pipe shall penetrate the station side wall and terminate with a male OPW type quick connect fitting.

F. Vacuum Break / Air Release Valves

1. The header piping shall be equipped with ball type check valves on the discharge side of each pump to allow a vacuum break to occur, as well as assist purging air from the system in the event that there is insufficient atmospheric pressure available to support the resultant water column. A ball valve and PVC line extending through the pump station base for drainage back to the wet well shall be installed in each pump discharge line.

2.11.17 Electrical Control Components

A. The pump station control panel will be tested as an integral unit by the pump station manufacturer.

B. Panel Enclosure

1. The electrical control equipment shall be mounted within a 36"x30"x14" NEMA 1 stainless steel, dead front type control enclosure. The enclosure door shall be hinged and sealed with a neoprene gasket. It shall include a removable plated steel back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Operator controls shall be mounted on the enclosure door. The enclosure shall be mounted within the fiberglass valve enclosure. The control panel shall be equipped with vapor emission type corrosion inhibitors.

2. All control components shall be securely fastened to a removable back panel with screws and lock washers. Switches, indicators and instruments shall be mounted through the control panel door. All control devices and instruments shall be secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; Self-tapping screws shall not be used to mount any components. All connections from the back panel to door mounted or remote devices shall be made through terminal blocks. All control devices shall be clearly labeled to indicate function.

3. A main terminal block and ground bar shall be furnished for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the pump station loads. The main terminal block shall be mounted to allow incoming wire bending space in accordance with Article 373 of the National Electrical Code (NEC).

C. Transient Voltage Surge Suppressor

1. The control panel shall be equipped with a transient voltage surge suppressor to minimize damage to the pump motors and control from transient voltage surges. The suppressor shall utilize thermally protected silicon-oxide varistors encapsulated in a non-conductive housing. Mechanical indicators shall be provided on each phase to indicate protection has been lost. The suppressor shall have a surge current rating of 100,000 Amps per phase and a 100kA interrupting rating.

D. Station Enclosure Low Temperature Alarm:

1. Pump station shall be supplied with a thermostat which shall monitor interior station temperature. The control shall incorporate an unpowered dry contact wired to terminal blocks for field connection to a remote alarm device. The contact will close in the event that the temperature within the enclosure falls below approximately 35 degrees F.

E. Motor Branch Components

1. A properly sized heavy duty air circuit breaker shall be furnished for each pump motor, and shall have a symmetrical RMS interrupting rating of 12,000 amperes at 480 volts. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.

2. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the door, with interlocks which permit the door to be opened only when circuit breakers are in the "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

3. Motor Starter

   a. An open frame, across the line, NEMA rated magnetic motor starter shall be furnished for each pump motor. Starters of NEMA size 1 and above shall be designed for addition of at least two auxiliary contacts. Starters rated "O", "OO", or fractional size shall not be acceptable. Power contacts shall be double-break and made of cadmium oxide silver. Coils shall be epoxy molded for protection from moisture and corrosive atmospheres. The starter assembly shall be equipped with a metal mounting plate for durability. All motor starters shall be equipped to provide under-voltage release and overload protection on all three phases. Motor starter contacts and coils shall be easily replaceable without removing the motor starter from its mounted position.

   b. Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, thus re-establishing a control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection.

   c. A reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the door.

4. All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. The lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating

F. Other Control Components

1. The pump control panel shall be equipped to terminate pump operation due to high motor winding temperature or moisture in the motor housing, utilizing contacts in the pump motor housing. If either event should occur, the motor starter will drop out and a mechanical indicator visible on the door shall indicate that the pump motor has been shut down. The pump motor and the mechanical indicator shall require manual reset. Dry contacts, wired to terminal blocks, shall be furnished for each pump for thermal/moisture shutdown.

2. The control circuit shall be protected by a normal duty thermal- magnetic air circuit breaker which shall be connected in such a manner as to allow control power to be disconnected from all control circuits.

3. Pump mode selector switches shall be connected to permit manual start and manual stop for each pump individually, and to select automatic operation of each pump under control of the liquid level control system. Manual operation shall override the liquid level control system. Selector switches shall be heavy duty, oil tight design, with contacts rated NEMA A300 minimum.

4. Pump alternation shall be integral to the liquid level controller. Provisions for automatic alternation or manual selection shall also be integral to the liquid level controller.

5. Control panel shall be equipped with one oil tight pilot light for each pump motor. Light shall be wired in parallel with the related pump motor starter to indicate that the motor is on or should be running.

6. Six digit elapsed time indicators (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenth of hours".

7. A switch shall be provided to permit the station operator to select automatic alternation of the pumps, to select pump number one to be the lead pump for each pumping cycle or to select pump number two to be the lead pump for each pumping cycle. Selector switch shall be oil-tight design, with contacts rated NEMA A300 minimum.

8. A duplex ground fault indicating utility receptacle providing 115 VAC, 60 Hertz, single phase current, shall be mounted on the door panel of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.

9. The lift station shall be equipped with a 3 KVA (kilovolt-ampere) stepdown transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door and a padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on

the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

10. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, voltage unbalance, high voltage, and low voltage. An adjustable time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart, following an adjustable time delay, when power conditions return to normal.

11. Panel Heater

    a. The control panel shall be equipped with a panel heater to minimize the effects of humidity and condensation. The heater shall include a thermostat.

G. Wiring

1. The control panel, as furnished by the Pump Station Manufacturer, shall be completely wired. The contractor shall field connect the power feeder lines to the main terminal block, final connections to the remote alarm devices, and the connections between the pump and the pump motor control. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electric Code (NEC).

2. All user serviceable wiring shall be type MTW or THW, 600 volts, and shall be color coded as follows:

    a. Line and load circuits, AC or DC power.....Black
    b. AC control circuit less than line voltage.....Red
    c. DC control circuit.....Blue
    d. Interlock control circuit, from external source…….…….Yellow
    e. Equipment grounding conductor.....Green
    f. Current carrying ground.....White
    g. Hot with circuit breaker open.....Orange

3. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be of 16 gauge minimum, type MTW (machine tool wire) or THW (heat resistant, flame retardant, and moisture resistant), 600 volts. Power wiring shall be 14 gauge minimum.

4. Motor branch and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires shall be clearly numbered at each end in accordance with the electrical diagrams. All wires on the sub-plate shall be bundled and tied.

5. Wires connected to components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be provided to allow the door to swing to its full open position without undue stress or abrasion on the wire or insulation. Bundles shall be held in place on each side of the hinge by mechanical fastening devices.

H. Conduit requirements are as follows

1. All conduit and fittings shall be UL listed.

2. Liquid tight flexible metal conduit shall be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight, polyvinyl chloride cover.

3. Conduit shall be supported in accordance with articles 346, 347, and 350 of the National Electric Code.

4. Conduit shall be sized according to the National Electric Code.

I. Grounding

1. The pump control manufacturer shall provide a common ground bar mounted on the enclosure back plate. The mounting surface of the ground bar shall have any paint removed before making final connections.

2. The contractor shall make the field connections to the main ground lug and each pump motor in accordance with the National Electric Code.

J. Identification

1. A permanent corrosion resistant name plate(s) shall be attached to the control and include the following information:

   a. Equipment serial number
   b. Control panel short circuit rating
   c. Supply voltage, phase and frequency
   d. Current rating of the minimum main conductor
   e. Electrical wiring diagram number
   f. Motor horsepower and full load current
   g. Motor overload heater element
   h. Motor circuit breaker trip current rating
   i. Name and location of equipment manufacturer

2. Control components shall be permanently marked using the same identification shown on the electrical diagram. Identification label shall be mounted adjacent to the device.

3. Switches, indicators, and instruments shall be plainly marked to indicate function, position, etc. Marking shall be mounted adjacent to and above the device.

K. Power Cable (going inside wet wells)

1. Incoming power from the pump control panel goes to junction box inside the wet well (up near the top) where it can be serviced without actually entering the wet well.

2. From this junction box, flexible watertight cables go down to the pumps. This shall be a four-conductor 10 gauge rubber covered cable. This cable shall not get secured to the inside of the wet well so that pumps can be winched out of the wet well. This allows removal of pumps for inspection or service without the need for confined-space entry.

3. Weight of cable going down to the pumps shall be supported by strain reliefs provided at the junction box.

2.11.18 Liquid Level Control (Air Bubbler Type)

A. The manufacturer of the liquid level control system must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.

B. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.

C. The level control system shall be an air bubbler type level control system.

D. The level control system shall utilize alternation to select first one pump, then the second pump, then the third pump (if required), to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle, or in the event of excessive run time.

E. The level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second and/or third pump (if required) when the liquid reaches the "lag pump start level", or “standby pump start level” so that all pumps are operating. These levels shall be adjustable as described below.

1. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Comparators shall be solid state, and shall be integrated with other components to perform as described below.

2. The electronic pressure switch shall be capable of operating on a supply voltage of 12VDC in an ambient temperature range of -10^0C (14 degrees F) through 55 degrees C (131 degrees F). Control range shall be 0 to 12.0 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be non-volatile.

3. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators and output relays.

   a. The internal pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0-15 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 0.25% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.

   b. The electronic pressure switch shall incorporate a digital back lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet well, and the preset start and stop level for both lead and lag pump. The display shall include twenty (20), 0.19" high alpha-numeric characters calibrated to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.

   c. Level adjustments shall be electronic comparator set-points to control the levels at which the lead and lag pumps start and stop. Each of the level settings shall be easily adjustable with the use of membrane type switches, and accessible to the operator without opening any cover panel on the electronic pressure switch. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation or introduction of pressure to the electronic pressure switch.

   d. Each output relay in the electronic pressure switch shall be solid state. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. The "ON" state of each relay shall be indicated by illumination of a light emitting diode. The output of each relay shall be individually fused providing overload and short circuit protection. Each output relay shall have an inductive load rating equivalent to one NEMA size 4 contactor. A pilot relay shall be incorporated for loads greater than a size 4 contactor.

4. The electronic pressure switch shall be equipped with an output board which shall include LED status indicators and a connector with cable for connection to the main unit.

5. The electronic pressure switch shall be equipped with pump start delay(s) preset at a fixed delay time of five (5) seconds.

6. Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.

7. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.

8. The electronic pressure switch shall be capable of controlling liquid levels in either a pump up or pump down application.

9. The electronic pressure switch shall have internal capability of providing automatic alternation, manual selection of pump sequence operation, and alternation in the event of 1-199 hours excessive run time.

10. The electronic pressure switch shall be equipped with a security access code to prevent accidental set-up changes and provide liquid level set-point lock-out.

11. The electronic pressure switch shall be equipped with one (1) 0-33 ft. W.C. input, one (1) scalable analog input of either 0-5VDC, 0-10VDC, or 4-20mA, and one (1) 4-20mA scalable output. Output is powered by 10-24VDC supply. Load resistance for 4-20mA output shall be 100-1000 ohms.

12. The electronic pressure switch shall include a DC power supply to convert 120VAC control power to 12 or 24VDC EPS power. The power supply shall be 500 mA (6W) minimum and be UL listed Class II power limited power supply.

13. The electronic pressure switch shall be equipped with an electronic comparator and solid state output relay to alert maintenance personnel to a high liquid level in the wet well. An indicator, visible on the front of the control panel, shall indicate that a high wet well level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.

14. The electronic pressure switch shall be equipped with an electronic comparator and solid state output relay to alert maintenance personnel to a low liquid level in the wet well. An indicator, visible on the front of the control panel, shall indicate that a low wet well level exists. The alarm signal shall be maintained until the cause for the low wet well level has been corrected and the circuit has been manually reset. A low liquid level condition shall disable both pump motors. When the wet well rises above the low level point, both pump motors shall be automatically enabled. Low water alarm shall be furnished with a dry contact wired to terminal blocks.

15. EPS Analog Output circuit will be furnished with transient voltage surge suppression to protect related equipment from induced voltage spike from lighting

F. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are underway. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be oil tight design with contacts rated NEMA A300 minimum.

G. Air Bubbler System

1. The level control system shall be the air bubbler type, containing air bubbler piping which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals for the remainder of the level control system.

2. Two vibrating reed, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour and a pressure not to exceed 7 psi. Liquid level control systems utilizing air compressors delivering greater quantities of air at higher pressures, requiring pressure reducing valves, air storage reservoirs, and other maintenance nuisance items will not be acceptable. A selector switch shall be furnished to provide manual alternation of the air pumps. The switch shall be connected in such a manner that either pump may be selected to operate continuously. The selector switch shall be oil-tight design with contacts rated NEMA A300 minimum.

3. An air bell constructed of PVC 3 inches in diameter shall be provided for installation at the outlet of the air bubbler line in the wet well. The air bell shall have a 3/8" NPT (National Pipe Thread) tapped fitting for connection to the bubbler line.

4. An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.

H. High Water Redundant Float Switch

1. A separate unpowered float switch shall be used to alert maintenance personnel to a high water level in the wet well. Should the wet well level rise to the "high water alarm" level, the float switch assembly shall close a dry contact in the cellular autodialer and contact the owner.

I. Alarm Light

1. Pump station manufacturer will supply one 115 volt AC alarm light fixture with vapor-tight red globe, guard, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the contractor.

J. Alarm Flasher

1. The alarm light circuit shall be equipped with a repeat cycle timer causing the alarm light to flash. Flash rate shall be approximately 1 second. (1/2 second on and off).

K. Alarm Horn

1. Station manufacturer will supply one 115 volt AC weatherproof alarm horn with projector, conduit box, and mounting base. The design must prevent rain water from collecting in any part of the horn. The alarm horn will be shipped loose for installation by the contractor.

L. Wireless Communication

1. Contractor shall supply Wireless Communication System as described in Section 2.42.

2.11.19 Flowmeter

Contractor shall supply Flowmeter as shown on the Contract Drawings.

2.11.20 Examination

A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Pump station manufacturer shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

2.11.21 Installation

A. Install, level, align, and lubricate pump stations as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

C. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure

operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

D. Contractor shall provide temporary support of excavation during pump station installation, in accordance with Section 2.3.

2.11.22 Field Quality Control

A. Operational Test

1. Prior to acceptance by owner, an operational test of all pumps, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

2. After construction debris and foreign material has been removed form the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

3. Contractor shall perform a high volume clean water test to confirm function before pumping leachate through the system during the shakedown period. This will allow the State to shake down south and north pump stations to the main pump station and transfer system to PCSC using water as a test run and allow for repairs. Contractor shall supply clean water at his own expense.

B. Manufacturer’s Start-up Services

1. Coordinate station start-up with Pump Station manufacturer's technical representative. The representative or factory service technician will inspect the completed installation. Calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

2. Coordinate station start-up with Passaic Valley Sewer Commission (PVSC) in accordance with discharge Treatment Works Approval (TWA) permit. Representative of PVSC and Manufacturer shall be at the site for Station start-up.

3. Operation and Maintenance of the Pump Station’s during the project shall be in accordance with Section 4.1.

2.11.23 Cleaning

A. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

2.11.24 Protection

The pump stations should be placed into service immediately. If operation is delayed, station is to be stored and maintained per manufacturer's written instructions.

2.11.25 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Unit
2.11.1	North Pump Station	Lump Sum
2.11.2	South Pump Station	Lump Sum
2.11.3	North Pump Station – Power Connection	Lump Sum
2.11.4	South Pump Station – Power Connection	Lump Sum

The Pump Stations (including all labor, materials and equipment needed) shall be paid for under Bid Item 2.11.1 for the North Pump Station and Bid Item 2.11.2 for the South Pump Station. Payment for these bid items shall include any start up costs, excavation, valves (including isolation valves), flowmeter, pump station backfill and bedding, precast concrete manholes, bollards around pump station for protection, wireless monitoring system and any other appurtenances (except for power connections) associated with Pump Stations installation in accordance with this Specification and the Contract Drawings. Costs for the installation of the 6 inch diameter forcemain from the north pump station to the 6 inch diameter stub connection to previously installed pump station and 2" PVC conduit with sampling tube shall be included in the bid unit price under Bid Item 2.11.1 North Pump Station.

Cost for wireless monitoring system shall (Section 2.42) be incorporated as follows: the cost for the wireless monitoring system installed in the north pump station and the existing MSLA-1D pump station shall be included in Bid Item 2.11.1; the cost for the Wireless monitoring system installed in the south pump station shall be included in Bid Item 2.11.2.

Electrical work associated with supplying power from the power source (the existing pump station) to the North Pump Station shall be paid for under Bid Item 2.11.3 for the North Pump Station – Power Connection and the electrical work associated with supplying power from the power source depicted on the plans to the South Pump Stations control panel shall be paid for under Bid Item 2.11.4 for the South Pump Station – Power Connection.

END OF SECTION

2.12 Geomembrane

2.12.1 General

This Specification is written for use of non-reinforced, textured, linear low density polyethylene (LLDPE) geomembrane which meets the performance criteria as specified. HDPE will not be permitted or considered. The LLDPE material shall be equally textured on both sides and white-surfaced on at least one side and coextruded.

Work covered by this Section shall include supply, preparation, testing, and installation of a minimum 40 mil LLDPE textured geomembrane, or equivalent as approved and as specified herein and shown on the drawings. Geomembrane shall be installed in accordance with the requirements of N.J.A.C. 7:26-2.A and as specified herein.

This work shall also include the supply and installation of fabricated "geosynthetic boots" and or other appurtenances necessary to seal around geomembrane penetrating structures and the attachment of the geomembrane to the Slurry Wall.

2.12.1.1 Geosynthetics Manufacturers: The Geosynthetics Manufacturers shall be able to provide sufficient production capacity and qualified personnel to meet the demands of the project.

The Geosynthetics Manufacturer in particular shall be pre-qualified and approved by the Engineer, and the NJDEP. The qualifications presented by the Geosynthetics Manufacturer shall, at a minimum, include:

a. Manufacturing Capabilities

1. Daily production quantity available for this contract
2. Quality control manual for manufacturing
3. List of material properties including certified test results, to which are attached geomembrane samples.

b. A list of at least 10 completed facilities totaling a minimum of 2,000,000 ft^2, for which the Manufacturer has manufactured a geomembrane of the same material to be used for this project. For each facility, the following information will be provided:

1. Name and purpose of facility, its location and date of installation.
2. Name of owner, project manager, engineer, fabricator (if any) and installer.
3. Thickness of geomembrane, surface area of geomembrane manufactured.

2.12.1.2 Geosynthetics Fabricator: The Geosynthetics Fabricator shall be trained and qualified to fabricate panels from rolls. The Geosynthetics Fabricator shall be a well-established

firm able to provide sufficient fabrication capacity and qualified personnel to meet the demands of the project.

The Geosynthetics Fabricator, in particular, will be approved and/or licensed by the Geosynthetics Manufacturer. A copy of the approval letter or license shall be submitted by the Geosynthetics Fabricator to the Engineer and NJDEP.

Prior to the confirmation of any contractual agreements, the Geosynthetics Fabricator shall provide the Engineer and NJDEP with the following written information:

a. Fabrication Capabilities

1. Daily fabrication quantity available for this contract.
2. Quality control manual for fabrication.
3. Certified test results and samples of fabricated seams.

b. A list of at least 10 completed facilities for which the Geosynthetics Fabricator has fabricated geomembrane panels of the same material to be used for this project, totaling a minimum of 2,000,000 ft^2. For each fabrication, the following information will be provided:

1. Name and purpose of facility, its location and date of installation.
2. Name of owner, project manager, engineer, manufacturer, and installer.
3. Thickness of geomembrane, surface area of geomembrane fabricated.
4. Type of seams and type of seaming apparatus used.

2.12.1.3 Geosynthetics Installer: The Geomembrane Installer shall have current Approved Installation Contractor (AIC) status issued by the International Association of Geosynthetic Installers. A copy of the approval letter / license will be submitted by the Geosynthetics Installer to the Engineer and NJDEP.

Prior to confirmation by any contractual agreements, the Geosynthetics Installer shall provide the Engineer and NJDEP with the following written information:

a. Installation Capabilities

1. Information on equipment and personnel.
2. Anticipated daily production.
3. Quality control manual for installation.
4. Samples of field seams and certified test results.

b. A list of previous projects providing justification that the Installer has installed at least 2,000,000 ft^2 of geomembrane of the same material to be used for this project. The experience shall be available, at a minimum, at the field crew

foreman level. For each installation, the following information will be provided:

1. Name and purpose of facility, its location and date of installation.
2. Name of owner, project manager, engineer, manufacturer, and fabricator (if any).
3. Name and qualifications of the supervisor of the Installer's crew.
4. Thickness of geomembrane, surface area of installed geomembrane.
5. Type of seams and type of seaming apparatus used.
6. Duration of installation.

The Geosynthetics Installer shall provide the Engineer and NJDEP with a list of proposed seaming personnel and their professional records. This document will be reviewed by the NJDEP and the Engineer. Any proposed seaming personnel deemed insufficiently experienced shall not be accepted, or will be required to pass a seaming test.

The Geosynthetics Installer will designate one representative as his Superintendent, who will represent the Installer at all site meetings and be responsible for acting as the Installer's spokesman on site. The Superintendent will be qualified by experience. The Superintendent must have supervised the installation of a minimum of 2,000,000 ft^2 of geomembrane. His appointment must be approved by the NJDEP.

c. In addition, the Superintendent should have minimum training consisting of:

1. Brief instructions on purpose of lining installation.
2. Brief instructions on placement procedures.
3. Knowledge of safety procedures to be observed during liner development and placement including:

    a) Safe methods of removing lining materials from packaging.
    b) Awareness of techniques to use to avoid over-stressing of arms, legs and back during placement operations.

During installation and field seaming, the Installation Superintendent shall complete report forms detailing the liner installation activities.

2.12.1.4 Transporter: All personnel responsible for the loading, transport and unloading of the geosynthetics must be fully aware of the consequences of damage to the geosynthetics, and familiar with handling and transport constraints required by the Manufacturer. The Transporter will ensure that all rolls of geomembrane are shipped on open trailers (no enclosed vans) for ease and safety of unloading the material.

2.12.2 Materials

2.12.2.1 Geomembrane Physical Properties

Geomembrane shall be 40-mil thickness Linear-Low Density Polyethylene (LLDPE) Geomembrane. Geomembrane shall be textured on both sides and shall be white on at least one side. Manufactured Geomembrane shall meet the minimum, maximum, or range of physical, mechanical and endurance properties as provided in the Geosynthetic Institute Specification GRI Test Method 17 (http://www.geosynthetic-institute.org/grispecs/gm17.pdf, attached at the end of this specification section).

A sheet is defined as a manufactured seamless geomembrane unit. Sheets shall be at least 5' in either length or width and white-surfaced on at least one side and coextruded. Textured geomembrane sheets shall be non-reinforced and uniform in color, thickness, and surface texture. The sheets shall also be free of and resistant to fungal or bacterial attack and they shall be free of cuts, abrasions, holes, blisters, contaminants and other imperfections.

Manufacturer's property specifications shall be submitted for approval of the Engineer a minimum of 30 days prior to use and approved by the Engineer prior to delivery of textured geomembrane to the site.

2.12.2.2 Factory Seams

Textured geomembrane sheets shall be manufactured as wide as possible to minimize factory and field seams. Panels are factory or field fabricated geomembrane units which are composed of several geomembrane sheets seamed together. Factory seaming shall be by methods approved by the geomembrane manufacturer and Engineer. Seams shall meet the minimum shear and peel strength requirements shown on Table 2.12-1. Factory seams shall extend to the end of the sheet so that no unbounded edges greater than (3.2mm) 1/8 inch wide are present (top side only). The manufacturer's QA manual is required to be submitted to the Engineer for approval.

The textured geomembrane material shall be manufactured or factory fabricated using special factory bonded seams utilizing dielectric fusion welding or as approved by the manufacturer, into the minimum number of large panels required to fit the jobsite. Factory seams shall have a tensile yield strength of at least 60 percent of the parent material tensile yield strength as determined by peel testing with failure in the Film Tearing Bond (FTB) Mode and 90% as determined by shear testing. After fabrication the geomembrane shall be packed for minimum handling in the field.

Solvent or other materials for cleaning contact surfaces of field joints and for quality assurance testing shall be as recommended by the manufacturer or fabricator of the geomembrane material. Material Safety Data Sheets shall accompany all such materials as delivered to site. Contractor shall be responsible for the storage and handling of any such materials on-site. Copies of all MSDS shall be provided to Engineer.

All field seaming and sealing of the geomembrane shall be as recommended by the manufacturer or accepted fabricator and approved by the Engineer. Seaming items shall be delivered to the site with an indelible label bearing the name and complete directions on their proper use and application.

2.12.2.3 Interface Friction Testing

Laboratory interface friction tests shall be conducted on all cover system interfaces using ASTM D-5321. Samples should be saturated during testing. Normal stresses of 10.0, 20.0, and 40.0 psi along with a displacement rate of 0.04 inches per minute shall be used. The test shall provide a 3-point strength envelope with the noted applied normal stresses. Cover system components shall be remolded in the laboratory to the same moisture-density conditions utilized for full-scale field placement and saturated prior to shear. Geosynthetics shall be oriented such that the shear force is parallel to the downslope orientation of these components in the field. A minimum peak interface friction angle of 27 degrees is required between all wastefill cover system components. Results shall be submitted and approved prior to delivery of wastefill cover system materials.

The Contractor shall submit the results of interface friction tests performed on the proposed landfill cap materials prior to acceptance of the materials for preconstruction testing; and, where specified, at the required frequency specified herein. The friction value (expressed as an angle of friction) shall meet the requirements specified hereinafter.

Test includes interface between each layer of cap at each of the normal stresses specified herein. Contractor shall only test condition representative of the proposed cap.

Soil shall be compacted to a dry density of 90 percent of maximum dry density and a moisture content equal to the optimum value, both as determined from ASTM D 698, both with a respective tolerance of plus/minus 1.0 percent. Aggregate material shall be rodded in the test mold or otherwise compacted to achieve a density of 90 percent of the Maximum Index Density.

The applicable soil or stone product shall be used adjacent to geosynthetic layers when the opposite side of that geosynthetic product is the subject of the interface friction test. In all other cases, a steel plate or equivalent surface shall be used as the anchoring component on the backside of the tested geosynthetic product.

As a minimum, the reported information shall include the peak and residual interface friction values, the strength envelope plotted on a shear stress/normal stress graph with both axes at the same scale, stress-strain curves, and the apparent adhesion corrected for laboratory equipment internal resistance. The Engineer's judgment on interface friction values shall be considered as final.

Geosynthetic samples shall be used only once per shearing event and shall not be re-used for additional testing under any circumstances, unless specifically approved by the Engineer. Soil samples shall not be reused for additional tests unless they are completely removed from the shearing apparatus and remolded back into the apparatus.

Any change in previously approved soil or geosynthetic materials shall require interface friction tests performed on the changed material. The Engineer shall determine if a material is apparently different or suspect in any way from those materials previously approved.

For interfaces involving a bonded geonet/geotextile product, confirmation shall be provided that the bond remained completely intact throughout the duration of the test, as applicable. Where the bond does not remain completely intact, such test will be considered as failing.

Materials shall also meet the quality and testing requirements of Section 1.10.

Submittals shall be in accordance with Section 1.3.

2.12.3 Shipping and Storage

Each factory sheet/panel or roll (fabricated and manufactured) shall be given prominent, unique, indelible identity markings indicating the thickness, length, width, manufacturer's mark number, and proper direction of unrolling and/or unfolding to facilitate layout and positioning in the field. Each factory sheet/panel or roll shall be individually packaged, fully enclosed and protected to prevent damage to it during shipment, prominently identified in the same fashion as the sheet/roll within, and showing the date of shipment.

Until installed, materials shall be stored in their original unopened packages; if outdoors, they shall be stored on pallets and shall be protected from direct sunlight under a light-colored, heat reflective opaque cover in a manner that provides a free-flowing air space between the package and cover. Material packages opened for inspection and sampling shall be re-covered and protected by the Contractor. The geomembrane shall be packaged for minimum handling in the field.

Textured geomembrane shall be stored in a designated area approved by the Engineer and shall not be off-loaded unless the Engineer is present. Damaged geomembrane shall be removed from site.

2.12.4 Preparation

2.12.4.1 Surface Preparation

Material larger than 3/8 inch in diameter and any other debris which could damage the geomembrane shall be removed from the surfaces to be covered with the geomembrane. The subgrade surface shall be observed daily by the Installer to evaluate the surface condition. Any damage to the subgrade caused by the Contractor's operations shall be repaired at no additional cost. Immediately prior to geomembrane placement, the Installer shall certify in writing that the surface on which the geomembrane is to be placed is acceptable.

2.12.4.2 Anchor/Drainage Trenches

Trench corners shall be slightly rounded to avoid sharp bends in the geomembrane. Loose soil, rock larger than 3/8 inch in diameter, and any other debris which could damage the geomembrane shall be removed from the surface of the trench.

2.12.5 Execution

2.12.5.1 Panel/Sheet Deployment

The textured geomembrane shall be placed white side up. The procedures and equipment used shall not damage the geomembrane. Textured geomembrane damaged during installation shall be removed or repaired, at the Engineer's discretion and as specified in paragraph Defects and Repairs, at no additional cost to the State. Only those panels/sheets that can be anchored and seamed together the same day shall be deployed. Adequate ballast (e.g., sand bags) shall be placed on the geomembrane to prevent uplift by wind or landfill gas generation without damaging the geomembrane. No vehicular traffic will be allowed directly on the geomembrane. The method used to unroll the panels/sheets shall not scratch, crimp or excessively elongate the geomembrane and shall not detrimentally rut the subgrade soil as determined by the Engineer. Seams shall be oriented parallel to the line of maximum slope. Where seams can only be oriented across the slope, the upper panel shall be lapped over the lower panel a minimum of 5 feet.

2.12.5.2 Field Seaming

All panel/sheets shall be overlapped a minimum of 4 inches. In corners and odd-shaped geometric locations, the number of field seams shall be minimized. Seaming shall extend to the outside edge of panels/sheets to be placed in anchor and/or drainage trenches. Seaming shall not be conducted in the presence of standing water and/or soft subgrades as determined by the Engineer. Wet surfaces shall be thoroughly dried and soft subgrades compacted and approved by the Installer and Engineer prior to seaming. The seam area shall be cleaned of all dust, dirt, and foreign material prior to and during seaming.

Polyethylene Seams

Polyethylene geomembranes shall be seamed by hot wedge methods. Extrusion welding shall only be allowed for patching and seaming around appurtenances unless otherwise approved by the Engineer. If seam overlap grinding is required, the procedure used shall not damager the geomembrane. Grinding marks shall be oriented perpendicular to the seam direction and no marks shall extend more than 1/8 inch beyond the extrudate after placement. The depth of the grinding marks shall be no greater than 10% of the sheet thickness. Where extrusion fillet welds are temporarily terminated long enough to cool, they shall be ground prior to applying new extrudate over the existing seam.

The method used to place the panels/sheets shall minimize wrinkles; the geomembrane manufacturer and installer shall coordinate efforts to provide the proper amount of slack in the deployed geomembrane so as to compensate for contraction due to local temperature extremes.

2.12.6 Submittal Requirements

The following shall be submitted to the Engineer.

Materials - Manufacturer's certified raw material and sheet material data sheets along with a copy of quality control certificates and the manufacturer's Quality Control/Quality Assurance Manual/Procedures.

Layout and Detail Drawings - Geomembrane panel layout and penetration detail drawings a minimum of 30 days prior to delivery of geomembrane to the site.

Record Drawings - Final record drawings of geomembrane installation showing panel/sheet numbers, seam numbers, and location of patches, destructive seam samples, and penetrations. A reference to manufacturer roll/sheet number per panel/sheet shall also be required.

Instructions - Test, Inspections, and Verifications; Manufacturer's quality control manual. Fabricator's quality control manual.

Field Seaming - Installer's quality control manual.

Statements of Qualifications - Manufacturer's, fabricator's, installer's, inspection personnel, and independent testing agency/laboratory qualification statements including resumes of key personnel involved in the project.

Warranty - Written warranties for geomembrane material and installation workmanship.

Tests, Inspections, and Verifications - Certified laboratory interface friction test results including description of equipment and test method. Manufacturer's certified quality control test results. Fabricator's certified quality control test results. Installer's certified quality control test results.

Samples - Tests, Inspections, and Verifications - One 12 by 12 inch minimum size geomembrane sample cut from each destructive seam sample shall be supplied to the Engineer for QA testing. This testing will be independent and in addition to Contractor's required testing.

Contractor shall submit the proposed quality assurance testing program they will use to check the field seams. This program shall be subject to Engineer's approval, and shall consist of air lance, ultrasonic, and/or vacuum testing of every inch of field seam.

2.12.7 Installation

Gas Venting / Cushion Layer (Modified Fill, I-13, 6” Thick) shall have already been placed and compacted. Prior to installation of the geomembrane, the surface area shall be inspected and accepted by Engineer. The surface upon which the geomembrane is to be placed shall be smooth and free from sharp objects that could puncture or damage the geomembrane.

The textured geomembrane shall be placed over the prepared surface in such a manner as to minimize handling.

The manufacturer shall fabricate "boots" or use other sealing methods acceptable to the manufacturer and Engineer so that the geomembrane will fit snugly and seal easily to any manhole or other penetrations through the geomembrane.

The Contractor shall lay geomembrane over the slurry wall, as shown on the Construction Drawings.

A field seaming method recommended by the manufacturer shall be used to seal the joint between factory sheets. The contact surfaces of the sheets shall be wiped clean to remove all dirt, dust, moisture, or other foreign materials. Any wrinkles shall be smoothed out prior to seaming.

Individual panels of geomembrane material shall be laid out and overlapped by a minimum of 4 inches prior to welding. All sheets shall be bonded together by means recommended by the manufacturer.

Field seams shall have a tensile yield strength of at least 60 percent of the parent material tensile yield strength as determined by peel and FTB testing and 90% as determined by shear testing.

No "fish mouths" (a wrinkle where the geomembrane does not lay flat) shall be allowed within the seam area. Where "fish mouths" occur, the material shall be cut, overlapped and an overlap bonded seam shall be applied.

Any necessary repairs to the geomembrane shall be patched with a piece of the geomembrane itself in a fashion recommended by the manufacturer, and approved by the Engineer.

Any geomembrane surfaces showing injury due to scuffing, penetration by foreign objects, or distress from other causes, shall be replaced or repaired with an additional piece of geomembrane of the proper size at no additional cost to the State.

On completion of project, Contractor shall dispose of all trash, waste, scrap geomembrane material, and equipment used in connection with the work hereunder and shall leave the premises in a neat and acceptable condition.

Textured geomembrane shall be deployed and field-seamed only when the geomembrane is dry and winds are low. In marginal conditions, seaming shall cease unless tests confirm that satisfactory seam strengths are being obtained.

Any textured geomembrane that may be exposed to sunlight longer than recommended by the manufacturer or than stated in the approved manufacturer's QA Manual shall be removed from site and replaced by the Contractor.

Low ground pressure equipment (less than 6 psi ground pressure) shall operate on a minimum of 12” of fill over the geomembrane. All other equipment (greater than 6 psi ground pressure) shall operate on a minimum of 24” of fill over the geomembrane.

2.12.8 Quality Control

During the construction phase, the geomembrane shall be continuously inspected for uniformity, damage, and imperfections (for example, holes, cracks, thin spots, or foreign materials). Immediately after installation, the liner shall be inspected to ensure tight seams and joints. Additionally, the liner shall be inspected to ensure the absence of tears, punctures, or blisters. Any imperfections shall be immediately repaired and reinspected.

All field seams upon completion of work shall be tightly bonded. Contractor shall test every inch of field seaming by a physical nondestructive method acceptable to the Engineer. Any seams that fail shall be resealed and re-tested until they pass. This testing and reworking of unacceptable seams shall be at no additional cost to the State.

Test Seams

Test seams shall be made on test strips of geomembrane to verify that seaming conditions are adequate. They shall be made under the same conditions that exist for seaming and be witnessed by the Engineer. Test seams shall be made each day prior to production seaming, whenever there is a change in seaming personnel or seaming equipment and at least once every four hours, by each seamer and each piece of seaming equipment used that day. One sample shall be obtained from each test seam. This sample shall be at least 36 inches long by 11 inches wide with the seam centered lengthwise. Ten random specimens 1 inch wide shall be cut from the sample. Five (5) seam specimens shall be field tested for shear strength and 5 specimens for peel adhesion using an approved tensiometer. Field testing shall be witnessed by the Engineer. Jaw separation speed shall be 20 inches per minute. Where necessary, accelerated curing of test strip seams made by chemical fusion methods, shall be conducted in accordance with GRI GM-7. To be acceptable, four out of five replicate test specimens must meet specified seam strength requirements of these Specifications. If the field tests fail to meet these requirements, the entire operation shall be repeated. If the additional test seam fails, the seaming apparatus or seamer shall not be accepted or used for seaming until the deficiencies are corrected by the Installer and two consecutive successful test seams are achieved.

Non-Destructive Seam Testing

All field seams shall be quality tested after they have been allowed to develop to full strength. Such testing shall be carried out through the use of an air lance with 50 pounds per square inch of air directed through a 3/16-inch nozzle or equivalent device. The lance shall be held no more than six inches from the seam edge and shall be utilized to detect any imperfections, tunnels or fishmouths. Any such imperfections in a seam shall be repaired and quality tested until a proper seam is achieved.

The Contractor shall non-destructively test all field seams over their full length using visual observation of seaming, air lance, vacuum testing, air pressure testing (for double fusion seams), or other methods in accordance to the fabricator's approved manual. Continual visual observation shall be performed on seams during the seaming process. Continuity testing shall be carried out as seaming work progresses. Non-destructive testing will not be permitted before sunrise or after sunset.

Where non-destructive testing cannot physically be performed such seams shall be extrudated with the same geomembrane. Extrudate operations shall be observed by the Engineer or appointed QA representative. All test equipment will be furnished by the Contractor.

Destructive Seam Testing

A minimum of one destructive test sample per 500 feet of field seam shall be obtained at locations specified by the Engineer. Sample locations shall not be identified prior to seaming. Samples shall

be a minimum of 12 inches wide by 36 inches long with the seam centered lengthwise. Each sample shall be cut into three equal pieces with one piece retained by the Installer, one piece given to the Independent QA Laboratory for quality assurance testing, and the remaining piece given to the Engineer for permanent record. Destructive seam tests shall meet requirements listed in Table 2.12-1.

Each sample shall be numbered and cross referenced to a field log which identifies: (1) panel/sheet number; (2) seam number; (3) top sheet; (4) date and time cut; (5) ambient temperature; (6) seaming unit designation; (7) name of seamer; and (8) seaming apparatus temperature and pressures (where applicable). A minimum of four 1 inch wide replicate specimens shall be cut from the Installer's sample. A minimum of 2 specimens shall be tested for shear strength and 2 for peel adhesion using an approved field tensiometer. Jaw separation speed shall be 20 inches per minute. To be acceptable, all replicate test specimens must meet the specified seam strength requirements. If the field tests pass, 5 specimens shall be tested at the Contractor’s Independent Laboratory for shear strength and 5 for peel adhesion in accordance with ASTM D 4437. To be acceptable, 4 out of 5 replicate test specimens must meet specified seam strength requirements. If the field or laboratory tests fail, the seam shall be repaired in accordance with the Procedure for Destructive Test Failure described below.

Destructive seam sample holes shall be repaired the same day as cut. Certified test results on field seams shall be submitted to and approved by the Engineer prior to acceptance of the seam. The State reserves the right to perform additional testing.

TABLE 2.12-1
MINIMUM STANDARDS AND VALUES

Property	Test Method (Note 1)	Minimum Test Value	Number of Replicates	Frequency of Tests
Seam Shear Strength, (ppi) Note 1	ASTM D6392	90% of yield strength of parent material	5	Lab: 1/500' of seam or minimum of one test/seam Field Trial Seams •morning start •afternoon start
Seam Peel Adhesion, (ppi) (minimum) Note 2	ASTM D6392	60% of yield strength of parent material	5	Lab: 1/500' of seam or minimum of one test/seam Field Trial Seams •morning start •afternoon start

Note 1: Test results shall be considered passing if the minimum shear strength value is reached or the geomembrane elongates greater than 30.5 cm without failing regardless of the shear strength value.

Note 2: Seams tested for peel adhesion must fail in the Film Tear Bond (FTB) mode. This is a failure in the ductile mode of one of the bonded sheets by tearing or breaking prior to complete separation of the bonded area. Where applicable, both tracks of a double hot wedge seam shall be tested for peel adhesion.

2.12.8.1 Procedures for Destructive Test Failure

The following procedures shall apply whenever a sample fails the field destructive test:

A. Contractor shall cap strip the seam between the failed location and any passed test location. Cap strips shall have a minimum of 4" overlap in all directions from repair point or as recommended by the manufacturer and approved by the engineer.

B. Contractor can retrace the welding path to an intermediate location (at a minimum of 10 feet from the location of the failed test), at Engineer's discretion, and take a small sample for an additional field test. If this test passes, then the seam shall be cap stripped between that location and the original location. If the test fails, then the process is repeated.

C. Over the length of seam failure, Contractor shall either cut out the old seam, reposition the panel and re-seam, or add a cap strip, as required by Engineer.

D. After re-seaming or placement of the cap strip, additional destructive field test(s) shall be taken within the re-seamed area. The re-seamed sample shall be found acceptable if test results are approved by Engineer. If test results are not acceptable, this process shall be repeated until the re-seamed length is judged satisfactory by Engineer.

In the event that a sample fails a laboratory destructive test, then the above procedure shall be followed, considering laboratory tests exclusively.

2.12.8.2 Defects and Repairs

Identification

Immediately prior to covering the geomembrane, seams and non-seam areas shall be visually inspected by the Engineer for defects, holes, or damage due to weather conditions or construction activities. At the Engineer's discretion, the surface of the geomembrane shall be brushed, blown, or washed by the Installer if the amount of dust, mud, or foreign material inhibits inspection or functioning of the overlying material.

Evaluation

Each suspect location shall be non-destructively tested. Each location that fails non-destructive testing shall be repaired and re-tested by the Installer until it passes.

Repair Procedures

Defective seam areas and destructive testing sampling locations shall be overlaid with a strip of new material and seamed (cap stripped). Alternatively, the seam path shall be retraced to an intermediate location a minimum of 10 feet on each side of the failed seam location. Destructive tests sample location repairs shall have a minimum of 4" overlap. At each location 12 by 12 inch minimum size seam sample shall be taken for 2 additional shear strength and 2 additional peel adhesion tests using

an approved quantitative field tensiometer. If these tests pass, then the remaining seam sample portion shall be sent to the Independent Laboratory for 2 shear strength and 2 peel adhesion tests in accordance with ASTM D4437. If these laboratory tests pass, then the seam shall be cap stripped between that location and the original failed location. If field or laboratory tests fail, then the process is repeated. After cap stripping, the entire cap stripped seam shall be non-destructively tested. Destructive test sample repairs shall be nondestructively tested. Certified test results on all repaired seams shall be submitted and approved by the Engineer prior to covering the seamed areas.

2.12.2.9 Warranty

The manufacturer's warranty shall state that the installed material meets all requirements of the contract documents and that under typical local atmospheric conditions, and conditions set forth by this specification, the sheet material is warranted for 5 years. The Geomembrane Installer (or Contractor) shall warranty that the geomembrane field seams will not fail within 5 years of installation.

Warranties shall cover the labor and material cost of repairs or replacement. Such costs shall be the responsibility of warrantor.

2.12.10 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Unit
2.12	Geomembrane	Square Yard

Measurement will be made of the total horizontal surface area in square yards covered by the textured geomembrane. Final quantities will be based on completed conditions. No allowance will be made for waste or overlap.

Payment will be made to the neat line geomembrane liner limit shown on the drawings. Pay limits will be to the center of the barrier wall. Separate payment will not be made for geomembrane beyond the barrier wall centerline. Separate payment will not be made for test strips, patches, boots at penetrations, geomembrane anchor, waste or overlap. Payment includes supply and installation of the geomembrane, including seaming, anchoring, testing (field and laboratory), geomembrane anchor, fabrication of boots and sleeves at penetrations upon approval by NJDEP. Geomembrane installed as accepted by the Engineer will be paid for at the respective contract unit price in the bidding schedule.

END OF SECTION

2.13 Drainage Layer

2.13.1 General

The Contractor shall install the Drainage Layer as described herein and as shown on the Contract Drawings. As shown on the Contract Drawings, the drainage layer shall be constructed above the geomembrane and below the topsoil layer of the landfill cap. The Drainage Layer shall include installation of a Composite Drainage Net above the geomembrane overlain with 12 inches of I-13 Modified Fill. Infiltration drainage piping and Strip Drain shall be installed as shown on the Contract Drawings.

2.13.2 Materials

Modified Fill, I-13 shall be as specified in Section 2.8.

Infiltration strip drain shall be as specified in Section 2.15.

Type A Geotextile shall be as specified in Section 2.14.

Composite Drainage Net shall be as specified below:

The Contractor shall install composite drainage net on top of the geomembrane cap at the locations shown on the Design Drawings.

Composite Drainage Net shall meet the requirements shown in Table 2.13-1. The drainage net shall consist of geonet adhered between two layers of 8 oz./sq. yd. Type A Geotextile. Type A Geotextile fabric shall be non-woven, needle punched geotextile (minimum 8 oz/sq. yd.). However, the Contractor may provide composite drainage net with geonet adhered to only one layer of 8 oz./sq. yd. Type A Geotextile (i.e. on the upper side of the composite drainage net) if the required properties (i.e. interface friction angle, ply adhesion, etc.) in these specifications are satisfied for the bottom side in contact with the geomembrane liner. The Contractor will have to adequately demonstrate this through submittals. This drainage net adhered to one side of geotextile can only be used for the drainage layer component of the cap. However, for Composite Drainge Net, if and where directed, anticipated to be used on leachate seeps under the liner on the side slopes, geonet adhered between two layers of geotextiles is required.

Geotextile on the upper side of the composite drainage net shall have a white color to reduce solar heating of the underlying geomembrane.

The geonet shall be provided as a geocomposite manufactured by heat bonding the geotextiles (both top and bottom) to the geonet. No burn through the geotextiles shall be permitted. Glue and adhesives shall not be used. The bond between the geonet and the geotextile shall exhibit minimum peel strength of 2 pounds per inch and as average of 4 pounds per inch, in accordance with ASTM F904. The manufacturer shall test peel strength once every 500 feet of the geonet composite.

Materials shall meet the quality and testing requirements of Section 1.10.

Submittals shall be in accordance with Section 1.3.

Manufacturing

The Contractor shall provide the Engineer with a list of guaranteed properties for the type of Drainage Net to be supplied. Required submittals shall include manufacturer's installation instructions, proposed layout and material sample. The Contractor shall provide the Engineer with a written certification signed by a responsible party that the Drainage Net actually delivered has properties, which meet or exceed the guaranteed properties.

All manufacturer certifications shall be examined to ensure that the property values listed on the certifications meet or exceed those specified. Any deviations will be reported to the Engineer.

Labeling

The Contractor will identify all rolls of Drainage Net with the following:

a. Manufacturer's name.
b. Product identification.
c. Lot number.
d. Roll number.
e. Roll dimensions.

TABLE 2.13 - 1
COMPOSITE DRAINAGE NET
PROPERTIES / QUALITY CONTROL PLAN / TESTING FREQUENCY

Property/ Component (unit)	**Required Test/ Test Method**	**Sample Size**	**Sample Frequency**	**Acceptance /Rejection Criteria**
Geonet Component				
Mass per Unit Area (lb/sq.ft)	ASTM D5261	N/A	N/A	0.16
Thickness (mils)(min.)	Caliper Measurement at Strand Intersection (ASTM D5199)	3' x Roll Width per roll sampled	One per 100,000 sq. ft. installed	200 to 265
Specific Gravity (g/cm^3) (min.)	ASTM D1505 Condition A	3' x Roll Width per roll sampled	One per 100,000 sq. ft. installed	0.94 min.
Melt Flow Index (g/10 minutes) (max)	ASTM D1238 Condition E	3' x Roll Width per roll sampled	One per 100,000 sq. ft. installed	1.0 max.
Carbon Black Content (%)(min.)	ASTM D1603	3' x Roll Width per roll sampled	One per 100,000 sq. ft. installed	2-3
Tensile Strength @ Yield (psi)	ASTM D5035	3' x Roll Width per roll sampled	One per 100,000 sq. ft. installed	45#/inch in MD
Geocomposite Material				
Ply Adhesion (lb/in) (min)	ASTM D 7005	3' x Roll Width per roll sampled	One per 100,000 sq. ft. installed	1
Transmissivity (minimum) (m^2/sec)	GRI Standard GC8 and ASTM D4716 - 1,000 psf Compressive Load of 0.03 Hydraulic Gradient and 0.33 Hydraulic Gradient Simulate field conditions /layers for 100 hours	3' x Roll Width per roll sampled	One per 500,000 sq. ft. installed	5.0×10^{-3} and 2.0×10^{-3} respectively
Interface Friction Angle (degrees peak)	ASTM D5321	3' x Roll Width per roll sampled	One per interface	27

Notes:
1. The Manufacturer/Supplier shall provide the independent laboratory and the QA Consultant with separate samples of the geonet and the geotextile components prior to bonding the material. These

samples shall be obtained from specific rolls to be delivered to the site. Certification of the sampling from the specific rolls shall include the roll number and shall be notarized and provided with delivery of the samples.
2. See Table 2.14-1 for Geotextile Sampling Frequency and Testing Criteria.

All rolls will be examined upon delivery and any deviation from the above requirements will be reported to the Engineer.

Laboratory interface friction tests shall be conducted on all cover system interfaces using ASTM D5321. Samples should be saturated during testing. Normal stresses of 10.0, 20.0, and 40.0 psi along with a displacement rate of 0.04 inches per minute shall be used. Cover system components shall be compacted to the same moisture-density requirements specified for full scale field placement and saturated prior to shear. Geosynthetics shall be oriented such that the shear force is parallel to the downslope orientation of these components in the field. A minimum interface friction angle of 27 degrees is required between all wastefill cover system components. Results shall be submitted and approved prior to delivery of wastefill cover system materials.

Drainage Net cleanliness is essential to their performance and drainage net rolls shall be wrapped in polyethylene sheets to protect against dust and dirt during shipping and storage. The wrapping should be removed less than one hour before placement. Verify that drainage nets are free of dirt and dust just before installation and report the outcome of this verification to the Engineer. If the drainage nets are judged dirty or dusty, they shall be washed by the installer prior to installation. Washing operations shall be observed by the Engineer.

Conformance Testing

The Contractor shall arrange for samples from the specific rolls of geonet to be used in the finished geocomposite product, to be delivered to the Independent Geosynthetic Laboratory for specific component testing. These samples are to be clearly marked as to the Lot and Roll number of the product, coinciding with the Lot and Roll numbers of the material to be bonded by the manufacturer for the geocomposite product.

The Geonet samples will be collected at the frequency indicated in Table 2.13-1, and shipped to the Independent Geosynthetic Laboratory to document conformance to both the Specifications and the list of guaranteed properties.

Samples will be taken across the entire width of the roll and will not include the first three feet. Unless otherwise specified, samples will be 3 ft long by the roll width. Mark the machine direction on the samples with an arrow.

Unless otherwise specified, samples will be taken at a rate of one per lot or one per 50 rolls, whichever is least.

Handling and Placement

The Installer will handle all drainage nets in such a manner as to ensure they are not damaged in any way, and the following will be complied with:

a. On slopes, the drainage net will be secured in the anchor trench and then rolled down the slope in such a manner as to continually keep the drainage net sheet in tension. If necessary, the drainage net will be positioned by hand after being unrolled to minimize wrinkles. Drainage nets can be placed in the horizontal direction (i.e., across the slope) in some special locations (e.g., at the toe of a slope, if an extra layer of drainage net is required, this extra layer of drainage net can be placed in the horizontal direction). Such locations are to be identified by the Contractor in shop drawings.

b. In the presence of wind all drainage net will be weighted with sandbags or the equivalent. Such sandbags will be installed during placement and will remain until replaced with overlying material.

c. Unless otherwise specified, drainage net will not be welded to geomembranes. Geonet will be heat-bonded by the Manufacturer to Type A geotextiles.

d. The Installer will take any necessary precautions to prevent damage to the underlying layers during placement of the drainage net.

e. During placement of drainage net care will be taken not to entrap in the drainage net dirt or excessive dust that could cause clogging of the system and/or stones that could damage the adjacent geomembrane. If dirt or excessive dust is entrapped in the drainage net, it shall be hosed clean prior to placement of the next material on top of it. In this regard, care shall be taken with the handling of sandbags to prevent rupture or damage of the sandbag.

f. If composite drainage net with geotextile only on one side is used, Contractor shall install drainage net with the adhered geotextile on the upper side of the geonet. The side with no geotextile shall be on the bottom side of the geonet, in contact with the underlying geomembrane.

Care should be taken not to leave tools on or in the drainage net.

The Contractor shall note any non-compliance and report it to the Engineer.

When several layers of drainage net are stacked, care should be taken to prevent strands from one layer from penetrating the channels of the next layer, thereby significantly reducing the transmissivity. This cannot happen if stacked drainage net are placed in the same direction. A stacked drainage net will never be laid in perpendicular directions to the underlying drainage net (unless otherwise specified by the Engineer). In the corners of side slopes of rectangular landfills, adjacent overlapping drainage nets are usually perpendicular and special precautions will be taken as discussed below.

Adjacent drainage nets will be joined at a minimum, in accordance with the following requirements:

a. Adjacent rolls will be overlapped by at least 3 inches.

b. These overlaps will be secured by tying.

c. Tying will be achieved by nylon cable or high density polyethylene fasteners. Tying devices will be white or yellow for easy observation. Metallic devices are not allowed.

d. Tying will be every 5 ft along the slope, every 2 ft across the slope, and every 6 in. in the anchor trench. When installing drainage nets horizontally, follow the manufacturer's installation requirements with no overlapping of drainage net cores.

e. In the corners of the side slopes of rectangular landfills, where overlaps between perpendicular drainage net strips are required, an extra layer of drainage net will be unrolled along the slope, on top of the previously installed drainage net, from top to bottom of the slope.

f. When more than one layer of drainage net is installed, joints will be staggered.

The Contractor shall note any non-compliance and report it to the Engineer.

Any holes or tears in the drainage net will be repaired by placing a patch extending 2 feet beyond the edges of the hole or tear. The patch will be secured to the original drainage net by tying every 6 inches. Tying devices will be as indicated in Subsection 2.13.1. If the hole or tear width across the roll is more than 50% the width of the roll, the damaged area will be cut out and the two portions of the Geonet will be joined as indicated in this Section.

Locations of repairs shall be noted in the documentation of the Daily Activities.

2.13.3 Measurement and Payment

The Contractor shall be paid based as described in the pay items below.
Payment will be made under:

Pay Item No.	Pay Item	Unit
2.13.1	Composite Drainage Net	Square Yard
2.13.2	Modified Fill I-13, 12" Thick	Square Yard
2.13.3	Infiltration Strip Drain, 18" Wide	Linear Foot
2.13.4	Composite Drainage Net, If and Where Directed	Square Yard

Pay Item 2.13.1, Composite Drainage Net will be measured in the horizontal plane by the number of square yards installed in accordance with the Contract Documents, and paid at the bid unit price per square yard of drainage net installed. Separate payment will not be made for patches, waste or overlap.

The Contractor will be paid the bid price per square yard for Pay Item 2.13.2 for the purchase, delivery, Proctor and particle size testing, stockpiling, handling, placement, compaction, and

compaction testing of Modified Fill I-13. The Contractor will NOT be paid under Item 2.13.2 Modified Fill I-13, 12" Thick for fill associated with daily cover to cover the relocated waste.

The Contractor will be paid the bid unit price for the actual number of linear foot of Bid Item 2.13.3, Infiltration Strip Drain (18" wide) installed and accepted, which shall include excavation, dewatering, placement, strip drain installation including all appurtenances, 6 inch diameter solid pipes (i.e. relief pipes connected strip drain to swales), fittings (wye fittings and adapter fittings converting from strip drain to 6 inch diameter solid pipe), and any testing associated with installation. No separate payment shall be made for 6 inch diameter solid pipes. The cost of these relief pipes and their associated fittings shall be included in the bid unit price for Pay Item 2.13.3. Strip drain shall be measured according to Section 1.2.16. Payment will not be made to the Contractor until installation is deemed satisfactory by the Engineer.

The Contractor will be paid the bid unit price per square yard for Bid Item 2.13.4, Composite Drainage Net, If and Where Directed. Such payments shall include purchase, delivery, installation, testing, and protection. Composite Drainage Net, if and where directed, shall be measured off the roll and paid by actual quantity used. ~~Composite Drainage Net shall be measured in the horizontal plane. Payments will not be made for waste or overlap.~~ This item is not associated with Drainage Layer and all bidders shall provide a unit cost for this item. Drainage net is anticipated to be used on Leachate seeps under the liner on the side slopes. The drainage net required by this item shall consist of geonet adhered between two layers of geotextiles as described in section 2.13.2.

Refer to Section 1.2.29 for additional language regarding if and where directed items.

END OF SECTION

2.14 Geotextiles

Geotextiles shall include the purchase, delivery, and installation of Type A geotextile (separation/stabilization/filter) and Type B geotextile (heavy weight geotextile), as shown on the drawings.

Materials shall meet the quality and testing requirements of Section 1.10.

Submittals shall be in accordance with Section 1.3.

2.14.1 Type A Geotextile

Type A geotextiles shall be used as separation / filter fabric as shown on the Contract Drawings, to separate/stabilize roadway and to wrap pipes and stones in the Leachate Collection System (LCS). Perforated pipe shall not be wrapped with geotextile, perforated pipe shall be surrounded by granular fill wrapped in geotextile (as shown on Contract Drawings). The requirements of Type A geotextile are provided in Table 2.14-1.

2.14.2 Type B Geotextile

Type B geotextiles shall be utilized as cushion layer under and around gabion wall/mattress and as separation layer between drainage layer and RA Type B roadway aggregate for access roads over landfill cap as indicated in Sections 2.23 and 2.26. Type B Geotextile shall meet the requirements in Table 2.14-1.

2.14.3 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Unit
2.14.1	Geotextiles, Type A, If and where directed	Square Yard
2.14.2	Geotextiles, Type B, If and where directed	Square Yard

The Contractor will be paid the bid unit price per square yard for Bid Item 2.14.1, Geotextiles, Type A if and where directed and Bid Item 2.14.2, Geotextiles, Type B if and where directed. Such payments shall include purchase, delivery, installation, testing, and protection. Geotextiles, if and where directed, shall be measured off the roll and paid by actual quantity used. ~~Geotextiles shall be measured in the horizontal plane. Payments will not be made for waste or overlap.~~ Refer to Section 1.2.29 for addition language regarding if and where directed items. Payment for Geotextile, Type A and Geotextile, Type B used as shown on the drawings shall be paid for as a part of the item associated with the geotextile. Geotextile Type B used above the geomembrane as shown to build up the Southern Perimeter Road (estimated 10,500 SY) shall be paid under Bid Item 2.14.2.

TABLE 2.14 - 1
QUALITY ASSURANCE PLAN
GEOTEXTILES
TESTING FREQUENCY

COMPONENT	REQUIRED TEST/ TEST METHOD	SAMPLE SIZE	SAMPLE FREQUENCY	ACCEPTANCE/REJECTION CRITERIA (Minimum)	
				Type A	Type B
Grab Strength (lbs/percent elongation)	ASTM D4632	3' x Roll Width per roll sampled	1/lot	160/50	320/50
Puncture Strength (lbs)	CBR Puncture ASTM D6241~~ASTM D4833~~	3' x Roll Width per roll sampled	1/lot	90	190
Trapazoidal Tear (lbs)	ASTM D4533	3' x Roll Width per roll sampled	1/lot	65	125
Apparent Opening Size (Less than US sieve)	ASTM D4751	3' x Roll Width per roll sampled	1/lot	#40-70	#100
Permittivity (sec^{-1})	ASTM D4491	3' x Roll Width per roll sampled	1/lot	1.50 □	0.8
Mass Per Unit Area (oz/yd^2)	ASTM D5261	3' x Roll Width per roll sampled	1 per 100,000 ft^2	6	12

MD – Machine Direction (longitudinal to the roll)
TD – Transverse Direction (across roll width)

END OF SECTION

2.15 Infiltration Strip Drain

2.15.1 General

Infiltration Strip Drain shall include the purchase, delivery, and installation of the 18" wide infiltration strip drain as shown on the drawings.

2.15.2 Materials

Infiltration Strip Drain shall be ADS AdvanEDGE (oblong corrugated pipe), "Multiflow" by Multiflow Co. ,or equal as approved by the Engineer, in accordance with ASTM D7001. The Infiltration Strip Drain outside dimensions shall be 1.5” thick by 18” wide. The Infiltration Strip Drain shall have internal bracing adjoining each long wall to prevent crushing under typical loading. The Infiltration Strip Drain shall have an external geotextile (sock) wrap.

All pipe and fittings shall be made of polyethylene with minimum cell classification of 424420C as defined and described in ASTM D3350.

Materials shall meet the quality and testing requirements of Section 1.10.

Submittals shall be according to Section 1.3.

2.15.3 Installation

Infiltration Strip Drain installation shall be as indicated on Drawings. Special care as to not damage the liner shall be taken during installation and cover placement. Any damage to the liner shall be the Contractor’s responsibility to repair at no additional cost to the State.

Infiltration Strip Drain shall be installed directly over top of geomembrane liner at locations shown on Contract Drawings. Strip Drains shall be installed along 2 foot wide, 3 inch deep depressions with composite drainage net laid directly over top, as shown on the Contract Drawings. Strip Drains shall also be installed along landfill side slope swales centerline directly over top geomembrane liner as shown on Contract Drawings.

No construction equipment (dozers, excavators, rollers) shall drive over top of Strip Drains after installation unless a minimum of 12” thick cushion layer fill (I-13 Modified Fill) has been placed over top of Strip Drains. Dump trucks (off-road and on-road) are NOT permitted to drive over Strip Drains.

Positive drainage pitch must be maintained on all Strip Drain as depicted on Contract Drawings.

Joints shall be made using appropriate fittings provided by manufacturer of Strip Drain, including couplers, wyes, tees, end caps, and round pipe adapters. If a sock wrap is used, pull sock back to make joint connections then replace the sock over the joint and secure with ADS tape. The split couplers should be secured with metal pins.

The Strip Drain shall be anchored to the geomembrane liner every 15 feet using adhesive tape as recommended by manufacturer to prevent movement during the installation of subsequent layers.

Every 400 feet along strip drains, the Contractor shall connect the Strip Drains to 6 inch diameter HDPE solid “strip drain relief” pipes via appropriate fittings provided by manufacturer (wye fitting and strip drain-to-pipe adapter), and daylight the solid pipe into the side of the swale, as shown on the Contract Plans and Details.

Prior to Strip Drains daylighting into the side of swales, strip drains shall transition to a minimum 5 foot segment of 6 inch diameter HDPE solid pipe, then the pipe shall daylight into the side of the swale, as shown on the details on the Contract Drawings.

2.15.4 Measurement and Payment

Payment for Infiltration Strip Drain will be made as described in Section 2.13.

END OF SECTION

2.16 Gas Collection System

2.16.1 General

The work described in this section includes furnishing, handling, and installation of the gas collection system. The gas collection system includes the gas extraction wells, gas pipe, valves, and condensate traps.

2.16.2 Submittals

Submittals shall be in accordance with Section 1.3.

A. Product Data:

1. Manufacturer's specifications and catalog literature for the plastic gas piping including:
    a. Table of pipe dimensions.
    b. Physical properties of the pipe.
    c. Design strengths of the pipe.
    d. Brochure of available pipefittings and appurtenances.
2. Manufacturer's specifications and catalog literature for the following appurtenances:
    a. HDPE gas valves.
    b. HDPE gas valve service boxes.
    c. Mechanical link seals.
    d. Steel pipe sleeves.
    e. Underground marking tape.

B. Verification of compliance with the NJDEP Well Specifications N.J.S.A. 58:4A et seq.

C. Welding Certificates.

2.16.3 Materials/Products

1. Flexible, perforated, HDPE Pipe and Fittings: Shall conform to the following:

    a. Extra high molecular weight (EHMW) high density polyethylene (HDPE) conforming to ASTM D 1248 and ASTM D 2513. Pipe shall conform to ASTM F 714. Pipe should be delivered in standard laying lengths.

    b. All pipe unless otherwise indicated or specified should be Standard Dimension Ration (SDR 17). Fittings shall conform to ASTM D 3261.

    c. High density polyethylene (HDPE) pipe of type PE3408 resin. All high density polyethylene (HDPE) pipe shall meet ASTM D 3350-80 cell classification PE345434C requirements.

    d. Long-term hydrostatic strength of 1600 psi at 73.4 degrees F.

e. Piping diameters and lengths shall be in accordance with Contract Drawings.

f. Valves and Valves boxes shall be in accordance with Section 2.17 Gas System Valves.

g. All HDPE (butt fusion) pipe fittings shall:

- Match pipe size and pipe SDR rating.
- Molded of EHMW, High Density Polyethylene resin and meeting the requirements of ASTM D 3261, as required by ASTM D 2513.
- PPI Material Designation - PE 3408.
- Design pressure rating of 102.4 psi at 73.4 degrees F.

2. All pipe of any manufacturer may be rejected if more than five unsatisfactory joint assembly operations in 100 consecutive joints, even if they conform to ASTM Specifications. Remove all unsatisfactory pipe of that manufacturer of same shipment from work and furnish from another manufacturer conforming to these specifications. All tests shall be made in accordance with methods prescribed by ASTM specifications, and the acceptance or rejection will be based on the test results and testing.

3. Piping Joining Materials:

a. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

2. AWWA C906-99, neoprene, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

b. Flange Bolts and Nuts: ASME B18.2.1, Type 304 stainless steel, unless otherwise indicated.

4. Transition Fittings:

a. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

b. Transition Couplings NPS 1-1/2 and Smaller:
1. Underground Piping: Manufactured piping coupling or specified piping system fitting.

2. Aboveground Piping: Specified piping system fitting.

c. AWWA Transition Couplings NPS 2 and Larger:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

i. Cascade Waterworks Mfg. Co.
ii. Dresser, Inc.; DMD Div.
iii. Ford Meter Box Company, Inc. (The); PipeProducts Div.
iv. JCM Industries.
v. Smith-Blair, Inc.
vi. Viking Johnson.
vii. Or equal as approved by the Engineer.

5. Identification Devices:

a. General: Products specified are for applications referenced in other Division 2 Sections. If more than single type is specified for listed applications, selection is Installer's option.

b. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
2. Location: Accessible and visible.

c. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is 1-1/4 inches for ducts, and 3/4 inch for access door signs and similar operational instructions.

1. Material: Fiberboard.
2. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

d. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

e. Lettering: Manufacturer's standard preprinted captions as selected by Architect.

f. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.

g. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils (0.08 mm) thick.

1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
2. Color: Comply with ASME A13.1, unless otherwise indicated.

h. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.

1. Material: 0.0375-inch- (1-mm-) thick stainless steel.
2. Size: 1-1/2 inches in diameter, unless otherwise indicated.
3. Shape: As indicated for each piping system.

i. Valve Tag Fasteners: Stainless-steel, wire-link or beaded chain; or stainless-steel S-hooks.

j. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
2. Thickness: [1/16 inch (1.6 mm)] [1/8 inch (3 mm)], unless otherwise indicated.
3. Thickness: 1/16 inch (1.6 mm), for units up to 20 sq. in. (130 sq. cm) or 8 inches (200 mm) in length, and 1/8 inch (3 mm) for larger units.
4. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.

k. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Brown: Energy reclamation equipment and components.
4. Blue: Equipment and components that do not meet criteria above.

5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
6. Terminology: Match schedules as closely as possible. Include the following:

i. Name and plan number.
ii. Equipment service.
iii. Design capacity.
iv. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
v. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

l. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.

1. Size: 3-1/4 by 5-5/8 inches.
2. Fasteners: Brass grommets and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

m. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.

1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

6. Trench Backfill: Shall consist of Coarse Aggregate as specified in Section 2.20.

7. Geotextile: Shall be Type A Geotextile as specified in Section 2.14.

8. Steel Pipe Sleeves:

a. API 5L Grade B seamless or electrically welded steel pipe: ASTM A 53.
- Wall thickness: Standard Weight (Sch. 40).

b. Size: Carrier pipe size plus 4 inches in diameter.

9. Mechanical Link Seals

a. PSI-Thunderline Link-Seal modular seal, Flexicraft PipeSeal, or equal as approved by the Engineer:

i. Interlocking links of solid synthetic rubber connected by rubber-coated corrosion resistant bolts and nuts to form a sealing belt in an annular pipe space.

ii. Link-Seal/Thunderline 400 series, Flexicraft PS 400 series, or equal as approved by the Engineer.
iii. Model LS-425-C for use with Sch. 40, steel pipe sleeves.

10. Underground Marking Tape

a. Detectable Marking Tape: 6-inch width, yellow color-coding, wording - "CAUTION: BURIED GAS LINE BELOW".

2.16.4 Quality Assurance

Materials shall meet the quality and testing requirements of Section 3.5.

1. Provide gas pipe and gas valve products manufactured to Title 49 of the Code of Federal Regulations, Part 192, "Transportation of Natural and Other Gas by Pipeline, Minimum Federal Safety Standards", issued by the Office of Pipeline Safety Operations, Materials Transportation Bureau, Department of Transportation.

2. Workers' Qualifications:

a. Employ only workers personally certified by the gas utility company as being experienced and skilled in actually making fused joints in plastic gas piping and appurtenances.
b. Submit credentials of the workers to be engaged in fusing and/or welding the plastic gas piping and appurtenances to the gas utility company for its review. Obtain the gas utility company's approval of those individuals for performing such work.

2.16.5 Construction

2.16.5.1 General

1. Contractor shall be aware of the present topographic conditions of the project site and of all installation requirements for the Landfill Gas Management System presented and specified in the design plans, prior to performing any work.

2. Contractor shall be aware of the dangers involved with working in the confined space of the excavated header trench and extraction well borehole, and must take appropriate safety measures and adhere to all safety requirements stated in the contract document. All work shall be performed in accordance with the SWANA Landfill Gas Division Health and Safety Task Force, "A Compilation of Landfill Gas Field Practices and Procedures, Health and Safety" dated August 1991 (revised March 2008), and any applicable Federal and State regulations.

3. The NJDEP and Engineer will provide drawings showing approximate locations of utilities. Contractor shall be responsible for locating and verifying all utilities within the construction area. Contractor shall be responsible for repairing any damage to located existing facilities

due to Contractors construction, at no additional cost to the NJDEP. Repair of any damage to unlocated utilities due to Contractors construction, shall be at no additional cost to the NJDEP.

4. Location and installation of gas extraction wells, gas header piping, and condensate knockouts may vary to accommodate landfill surface / subsurface, field conditions, landfill refuse limits, and maintain a minimum required header slope. Contractor shall construction field stake proposed gas well locations and complete header route to ensure all header route locations and elevations will fit actual field conditions, and meet the system design objectives presented in these drawings. Contractor shall prepare header route survey notes to include header stationing, site grid coordinates, header invert elevation, ground elevation, header depth, header slope, construction notes, pipe information, and a complete job pipe summary.

5. Construction field stake notes to be submitted to owner for review, prior to any construction by Contractor of gas extraction wells and header collection piping.

6. The Contractor shall provide all equipment necessary to properly handle, install, and test the pipe. The Contractor shall also furnish all labor and equipment necessary to assist the Engineer in inspecting pipe upon delivery and to remove rejected pipe immediately.

7. Inspection to be performed and/or witnessed by Engineer, includes, but is not limited to, the following:

   A. Examine excavation before pipe placement to ensure:
      - Excavated complete to elevations and slopes indicated.
      - No obstruction exists to interfere with installation.
      - Bottom firm and dry.

   B. Inspect each pipe and fittings before installation. Remove defective pipe. Replace with sound pipe.

2.16.5.2 Pipe Handling

1. High Density Polyethylene pipe shall be stored or stacked so as to prevent damage by marring, crushing or puncture. Maximum stacking height shall be limited to six (6) feet.
2. Store until installation, as acceptable to Engineer; keep place at ambient outdoor temperature:
   - Provide temporary shading.
   - Covering causing temperature build-up NOT ACCEPTABLE.
3. Handle into position to avoid damage in manner acceptable to Engineer.
4. Cleaning solutions, detergents, or solvents, when required, shall be used in accordance with the manufacturer's recommendations. Care shall be taken to protect the pipe from excessive heat or harmful chemicals.
5. Care shall be taken to avoid imposing strains that will over stress or buckle the piping or impose excessive stress on the joints. Pipe shall not be bent under the minimum radius recommended by the manufacturer for type and grade.
6. Butt fusions shall be made in accordance with manufacturer's recommendations and procedures. Fusion equipment and a qualified operator will be provided by contractor. All

fusion equipment operators shall have been certified by the HDPE manufacturer within the last 12 months.

7. Branch saddle fusions shall be made in accordance with manufacturer's recommendations and procedures. Branch saddle fusion equipment will be of the size to facilitate saddle fusion within the trench.
8. Prior to butt fusing pipe, each section of pipe or fittings shall be inspected and cleaned of all dirt, sand, mud, shavings and other debris or animals.
9. At the end of each day, all open ends of fused pipe shall be capped or covered to prevent entry by animals, debris and water.
10. Maximum lengths of fused pipe to be handled as one section will be field determined by contractor according to pipe size, SDR and topography, to prevent any excessive gauging or surface abrasion, and shall not exceed 1,000 feet at any given time.

2.16.5.3 Piping and Pipe Fittings Installation

Only molded HDPE pipe fittings for tee and elbow connections shall be used. Fittings formed of fused mitered pipe sections will not be acceptable.

Contractor responsibilities for installation of gas collection piping include, but are not limited to, the following:

1. Install piping at indicated slopes.
2. Install fittings for changes in direction and branch connections.
3. Install piping in accordance with the trenching detail and layout indicated on the Drawings. Avoid interference with existing utilities.
4. Install the HDPE gas valves as indicated on the Drawings. As part of each installation, provide the specially molded and formed valve support for the specified gas valve.
5. Connect the new gas service to the gas utility company’s system, or metering and pressure regulating station in accordance with the gas utility company’s requirements.
6. Make transitions to steel piping with molded plastic flange adapters equipped with steel slip-on flanges. Butt fuse adapters to the plastic gas line terminal ends and connect to the flanged ends of the steel lines with Type 317 stainless steel bolts and nuts.
7. Installing non-straight pipe NOT ALLOWED.
8. Support pipe on compacted material. Permanently supporting on saddles, blocking or stone is NOT ALLOWED.
9. Excavate holes for fittings such as flanges and valves so that only pipe barrel receives bearing pressure.
10. Clear pipe units of debris, dirt, etc. before installation and keep clean until acceptance.
11. Install to lines and grades indicated or required by Engineer.

11A. Pipe sections should be covered with at least 12" of approved fill for a minimum period of 4 hours prior to final connection to minimize temperature variations and to reach a stable length. The installation temperature of the pipe should be within 15 degrees Fahrenheit of the service temperature.

12. Maintain close joint with previously installed pipe. Match with adjoining pipe.
13. Driving pipe down to required grade by striking with shovel handle, timber, or the like will NOT BE ALLOWED.

14. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
15. Flanged Joints: Select appropriate gasket material, size type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
16. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
17. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
18. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
    a. Plain-End PE Pipe and Socket Fittings. Use socket fusion.
19. Butt Fusion Joining:
    a. Clean joint surfaces: Prepare joint surfaces according to manufacturer's recommendation. Use devices to force pipes together with minimum open recess inside and outside and tightly sealed joints. Avoid force that could wedge apart and split ends.
    b. Do not pull or cramp joints without permission of Engineer.
    c. Remove unfittable pipes and replace with sound units.
    d. Follow directions of joint material and pipe manufacturers when installing gaskets and joints to render them fluid tight flexible.
20. HDPE piping including HDPE gas valves shall be joined into a homogenous union by butt fusion using equipment employing temperature and pressure to complete the fused joints.
21. Make connections according to the following, unless otherwise indicated:
    a. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
    b. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
22. Close open ends of pipe and branches with HDPE stoppers secured in place.
23. After bedding pipe, place approved fill between pipe and sides of trench. Use extra care to compact fill under lower half of pipe. Fill fitting holes and compact. Place and compact approved fill as indicated.
24. Install the HDPE pipe in steel sleeves at the locations indicated on the Drawings.
25. Blow sand fill into the annular space within the sleeves to firmly cushion the plastic gas pipe. Close both ends of the sleeves with mechanical link seals.
26. Prevent storm water run-off from entering the trenches.
27. Make open ends of pipe and branches fluid tight with temporary plugs when pipe installation endangers cleanliness of the interior of the pipes and before any work stoppage.
28. If water in trench, do not remove plug until provisions made to prevent water, earth, or other substances from entering pipe; then resume work.
29. Cleaning:
    - Prevent earth, water, and other materials entering pipeline.
    - Clean inside of pipeline upon completion.
30. Install condensate traps as noted on the Drawings.

2.16.5.4 Piping Trench Installation

1. Excavated soil cover material shall be separated from excavated refuse. Any materials not suitable for trench backfill will be removed by contractor and disposed at a location as designated on the drawings or as directed by the Engineer.
2. During trench excavation and piping installation, proper side slope or benching is required per OSHA standards for any trench of the depth of four (4) feet or more.
3. A laser level or equivalent method shall be used to maintain grades of five percent or less during excavation and bedding grading for installation of gas collection header piping. Grade settings utilized for each pipe section shall be noted accordingly on "Record Drawings".
4. Clean coarse aggregate #57 shall be used for granular bedding purposes.
5. Prior to any pipe being installed in the trench, the following items should be inspected, and any irregularities corrected, before lowering piping into the trench.
    a. Butt and saddle fusions.
    b. Pipe integrity.
    c. Trench excavation for rocks, foreign material and bedding. The trench shall be continuous, smooth and free of water, rocks, foreign material.
    d. Proper trench slope as per header route survey note layout.
    e. Trench contour to ensure the pipe will have uniform and continuous support.
6. Any pipe section longer than a single joint (usually 40 feet) shall be capped on both ends during placement.
7. Tie-ins for tees and reducers shall be made out of the trench whenever possible. When tie-ins can only be made in the trench, a bell hole shall be excavated large enough to ensure adequate and safe work area.
8. All branch saddle connections will be made within the trench, a bell hole shall be excavated large enough to ensure an adequate and safe work area.
9. To reduce tee and/or branch saddle stress, tees and branch saddles will be installed at an in-place slope equal to and continuous with the lateral piping.
10. Pipe shall be allowed sufficient time to adjust to trench temperature prior to any testing, segment tie-ins and/or backfilling activity. Untested segment tie-ins shall remain unbackfilled and clearly marked or as directed by the Engineer for easy access and inspection until the system final pressure test is complete.
11. Granular bedding backfill shall be placed in the trench ensuring material is placed under the haunches of the pipe. The bedding shall be placed and compacted using a mechanical compaction device such as a walk behind vibratory compactor or equal, in a loose lift not to exceed nine (9) inches above the top of the pipe. Compaction shall be to a density where subsequent passes with the mechanical compaction device will not reduce the surface elevation of the backfill by more than three-quarters of an inch.
12. Excavated trench material (soil cover) will be used as general backfill to the lower depth of the existing landfill cover, provided it is free of refuse, rocks and foreign material. The remaining trench shall be backfilled with landfill cover soil material to equal landfill cover type, compaction, and thickness. Backfilled areas shall be graded to match original landfill grade unless specified otherwise in the design drawings.
13. All header pipe installed below a road surface or traffic area shall be encased in a corrugated metal (aluminum or steel) pipe (CMP) to ensure HDPE pipe structural integrity. CMP shall

meet NJDOT standard specifications for CMP. Road casings are to be field located with the construction field stake notes. The inner diameter of the CMP shall be a minimum of two (2) inches larger than the outside diameter of the header pipe.

14. Install underground marking tape as indicated on the Drawing.
15. Gas pipeline shall not be installed under water.

2.16.5.5 Flange Connections

1. All flanges to meet the American National Standards Institute (A.N.S.I.) 150 pound bolt hole circle diameter, number of bolts and bolt sizing requirements. All bolts, nuts, and washers to be cadmium plated. All flanged connections to use full face neoprene flange gasket.

2. In making flanged joints, the following precautions should be observed:

    a. When a PVC flange is installed, the pipe ends shall be cut square and fully bottomed out in the flange socket.
    b. Insert the appropriate size neoprene flange gasket between the flanges, the flange/valve/flange spacer connection or orifice plate.
    c. Use U.S. Standard round washers on plastic flanges (trimming of washers may be required on some flanges). Cadmium plated bolts should be well lubricated per manufacturer's recommendations.
    d. To prevent leaky gaskets, tighten the flange bolts in accordance with manufacturer's recommended sequence. CAUTION: Do not over-torque bolts.

        4"Flange - 20 to 30 ft/lbs
        6"Flange - 33 to 50 ft/lbs
        8"Flange - 33 to 50 ft/lbs
        10"Flange - 53 to 75 ft/lbs
        12"Flange - 53 to 75 ft/lbs

        All sizes greater than 12" shall be torqued in accordance manufacturer's recommendations.

3. All below grade steel flanges/pipe and bolts to be corrosion protected with Tapecoat Mastic and tape, or equal as approved by the Engineer.

2.16.5.6 Identification

1. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

    a. Stenciled Markers: According to ASME A13.1.
    b. Retain subparagraph above or below.

c. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
d. Edit subparagraph and associated subparagraphs below to suit Project.
e. Locate pipe markers on exposed piping according to the following:

i. Near each valve and control device.
ii. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
iii. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
iv. At manholes and similar access points that permit view of concealed piping.
v. Near major equipment items and other points of origination and termination.

2. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.

a. Lettering Size: Minimum 1/4 inch high for name of unit if viewing distance is less than 24 inches 1/2 inch high for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
b. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

2.16.6 Gas Piping Testing

The NJDEP shall be notified before the Contractor performs any pressure testing procedure, shall have the option of being present during the test, and must approve with signature all pressure testing reports.

Piping shall be clean of all dirt, dust, oil, grease and other foreign material, before pressure and leakage testing.

2.16.6.1 Pressure and Leakage Testing

Contractor shall conduct combined pressure and leakage test for pressure pipe in accordance with American Society of Mechanical Engineers code for pressure piping B31.8, Appendix N.

1. Prior to piping installation, similar sizes of polyethylene piping shall be butt welded together into testing segments not to exceed 500 feet, or as recommended by the manufacturer, and pressure tested. Afterwards, completed manifold legs shall be pressure tested, followed by pressure testing of isolated sections upon completion. Segments shall be fitted with a temporary cap on one end and testing apparatus on the other. The segment to be tested should be laid in excavation before completing backfill. However, the pipe should be covered at

intervals, especially at curves to hold the pipe in place during pressure tests. Flange connections shall not be covered. The pressure test should be performed during a period when the pipe segment will be out of direct sunlight when possible, i.e., early morning, late evening, or cloudy days. This procedure will minimize the pressure changes which will occur during temperature fluctuations.

2. Fill section of pipe with water and expel air. If blowoffs not available, taps can be made at high points to enable air release. The pipe shall be plugged after test completion.
3. Pressure and leakage test consists of first raising fluid pressure (based on elevation of lowest point of section under test and corrected to gage location) to 10 psi. The initial pressure test shall be applied and allowed to stand without makeup pressure for a sufficient time to allow for diametric expansion or pipe stretching to stabilize. This usually takes 2-3 hours. After this time period, the test section can be returned to 10 psi, the pump turned off and a final test pressure held for 2 hours. Contractor shall submit verification and results of gauge calibration prior to final acceptance by the Engineer.
4. Pressure drop will occur due to pressure expansion and fluctuations due to temperature change during test. Refer to manufacturer literature for allowable amounts of makeup water due to expansion. The allowable pressure drop observed during the test shall not exceed one percent of the testing gauge pressure over a period of one (1) hour. This pressure drop shall be corrected for temperature changes before determining pass or failure.
5. Equipment required to complete the pressure testing procedure shall consist of a HDPE flange adaptor with a PVC blind flange equal in size to the blower inlet valve. Tapped and threaded into the blind flange will be a temperature gauge zero to one-hundred degrees centigrade, a pressure gauge zero to fifteen psig, a "tire-valve" to facilitate an air compressor hose, and a ball valve to release pipe pressure at completion of test. Polyethylene reducers shall be utilized to adapt test flange to size of pipe being tested.
6. Pressure and Leakage testing acceptable results: a) No significant pressure drop during the final test period b) No visible leakage in joints, as measured by air bubbles in sap solution applied to 100% of the pipe.
7. An entire manifold leg shall be constructed, tested, and approved prior to making well and condensate trap connections to the manifold. Valves at the well heads shall be left in the closed position until ready to test the gas collection and flare system.

2.16.6.2 Pressure Test Failure

The following steps shall be performed when a pipe segment fails the one (1) percent - one hour test.

a. The pipe and all fusions shall be inspected for cracks, pinholes or perforations.
b. All flanged connections and capped ends shall be inspected for leaks.
c. Leaks shall be verified by applying a soap water solution and observing soap bubble formation.
d. All pipe and fused joint leaks shall be repaired by cutting out the entire pipe section leaking area, and refusing the pipe.
e. After all leaks are repaired, a retest shall be performed. Additional tests shall be conducted until section passes test. Repairs shall be made at no additional cost to the State.

2.16.6.3 Final System Pressure Test

1. A final test shall be made on the completed pipeline. Procedures outlined above shall be utilized.
2. To facilitate the system final pressure test, all open pipe ends will be temporarily capped with a fused polyethylene cap or be fitted with a blind flange and gasket. Do not pressure test against wellhead or header line valves.
3. The completed system should be in its proper trench location and allowed time to reach constant and/or ambient temperature before initiating the test.
4. Testing apparatus can be placed at location of the valve inlet before the blower.

2.16.6.4 Pressure Test Reporting

1. All testing shall be reported in writing to the NJDEP and shall include the following information:
    a. Date and time of each test/retest
    b. Person performing test
    c. Name of Engineer's representative
    d. Pipe length, size(s) and location
    e. Test pressure measurements at ten (10) minute intervals
    f. Ambient temperature at ten (10) minute intervals (measured in trench for final test)
    g. Signature of Contractor and Resident Project Representative approving "pass" of segment pressure test.
    h. Pressure test reporting forms are available from the Project Design Engineer.

2. The following information shall be reported in writing if a failure occurs:
    a. Nature of all leaks found
    b. Details of repair
    c. Retest results

2.16.6.5 System-Start Up

1. Contractor shall start-up the active landfill gas management system with flare manufacture's personnel and owner's representative, and ensure construction completion and proper operation of the system.

2. Any material substitutions or design modifications must be approved by the Project Design Engineer.

2.16.7 Gas Extraction Wells

1. A well driller licensed in New Jersey shall be used to drill all wells. Permits are required for all gas wells prior to installation, per NJDEP Monitor Well Specifications N.J.S.A. 58:4A et seq. The Contractor shall be present during all well boring and construction activities to log the refuse profile including refuse temperature, dates, degree of decomposition, moisture content, liquid levels, and record construction well materials and dimensions. All field changes regarding extraction well locations and construction dimensions specified in the

design gas extraction well schedule shall be properly recorded and documented by the Contractor as "Record Drawing" conditions.

2. No extraction well boring shall extend into or through the clay below the landfill. If a well boring cannot be completed to the specified depth due to boring refusal or encountered excessive liquids, the Contractor shall immediately notify the Engineer, who will make the decision if the well can be completed at the achieved depth, or must be relocated. Well refusals (abandoned well borehole) will be backfilled with spoil material taken from the well bore, to the landfill cover/refuse interface; remaining refusal borehole to be backfilled with soil to equal landfill cover type, compaction, and thickness.

3. Gas Extraction Wells shall be constructed in accordance with Gas Extraction Well detail, in Contract Drawings.

4. Boreholes drilled for gas extraction well installation shall be 24 inches in diameter.

5. Typical configuration of wells shall consist of screen (4 inch diameter PVC schedule 80, 0.~~1~~2" slotted pipe), extending to depth shown on detail, and riser (4-inch diameter PVC schedule 80 solid pipe) extended from top of screen to above proposed finish grades, as shown on detail on Contract Drawings.

6. Gas Extraction wells and condensate traps will require 48" diameter x 24" high, corrugated metal rings around them, where they stick up. The rings will have a clearly scribed mark on the top rim that a surveyor can locate and obtain an elevation.

7. Wellhead: Contractor shall provide a premanufactured wellhead assembly supplied as a complete manufactured unit (such as Accu-Flo Wellhead, as manufactured by Landtec, or equal) which meets the requirements of the Contract Drawings and the description below:
    a. Wellheads shall be compatible with the gas extraction well and connections to the gas header pipe (via corrugated HDPE flex hose secured with clamps).
    b. Wellhead assembly shall include wellhead piping with gas flow measurement device, flow control mechanism (flow control gate valve, orifice plate or other), gas temperature gauge port, quick connect gas sampling port, static and impact pressure ports, flexible hose connector, PVC union disconnect and dust cap. Wellhead piping and fittings shall be Schedule 80 PVC. Adapters shall be Elastomeric Polyvinyl Chloride.
    c. Wellhead shall be tight and leak free and shall be height adjustable in the field using adapter bushings.
    d. Nominal flow capacity of the well head shall be 5 cubic feet per minute (CFM) minimum and 150 CFM maximum.
    e. The wellhead shall be designed to withstand a vacuum of 80 inches of water.
    f. Contractor shall install wellhead in accordance with Manufacturer's Instructions.
    g. After installation Contractor shall test static and impact pressure ports and test valve for proper operation. Contractor shall verify well head is installed per manufacturer instructions and submit required documentation.

8. Construction of gas extraction wells shall include a lablock valve, ¼" NPT x hose (for gas sampling and pressure readings) and a 5/8" diameter access port to measure gas flow.

9. Coarse Aggregate (No. 57) shall be used around the perforated portion of the pipe. The top 2 feet of borehole shall be soil backfilled to equal landfill cover type, compaction, and thickness.

10. Permits: Contractor shall obtain well drilling permits. Copies of the permits shall be provided to the Engineer at the end of well installation.

2.16.8 Gas Monitoring Probes

The Contractor shall install 17 gas monitoring probes around the perimeter of the landfill on the outboard side of the barrier wall in accordance with the Contract Drawings. The gas monitoring probes shall be monitored by the Contractor quarterly during the post construction operation and maintenance, in accordance with Section 4.2.

2.16.9 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Unit
2.16.1	Gas Pipe, 4" Diameter	Linear Foot
2.16.2	Gas Pipe, 6" Diameter	Linear Foot
2.16.3	Gas Pipe, 8" Diameter	Linear Foot
2.16.4	Gas Extraction Wells	Linear Foot
2.16.5	Gas Well Borehole Abandonment	Linear Foot
2.16.6	Condensate Traps	Each
2.16.7	Gas Monitoring Probes	Each

Payment for Bid Items 2.16.1 through 2.16.3 shall be made based on linear feet of gas collection pipe installed as measured in the horizontal projection. Payment shall include all labor, equipment, testing, and materials necessary for trenching, installing the pipe, geotextiles, stone, bedding, and backfilling with Coarse Aggregate, connections between laterals, header branches and header lines as shown on Contract Drawings. Payment for Bid Items 2.16.1 through 2.16.3 includes all fittings, valves, and appurtenances necessary to complete installation of the gas collection system within the landfill and up to the connection point of the blower and flare system, as identified on the Contract Drawings. Payment also includes corrugated metal piping encasements for any gas piping crossing roadway in accordance with section 2.16.5.4 (item number 13) of these specifications. Payment for Bid Items 2.16.1 through 2.16.3 does not include any piping/fittings/valves associated with the blower and flare system.

Payment for Bid Item 2.16.4 Gas Extraction Wells shall be measured based on linear feet of gas extraction well installed below the final grade, items above grade and continuing to the connection with the gas collection lateral are considered incidental to the gas extraction well. This pay item includes all aspects of gas extraction well installation, including: permits, drilling of well borehole,

installing PVC screen and riser, sampling ports, valves, fittings, corrugated HDPE flexible hose, slotted PVC wing extensions, vertical PVC pipe connecting to 4 inch HDPE lateral line, protective steel rings, and appropriate backfill as shown on Contract Drawings details. Payment for Bid Item 2.16.4 ends at the point of connection between vertical 4 inch HDPE pipe and 4 inch HDPE lateral line.

Payment for Bid Item 2.16.5 Gas Well Borehole Abandonment shall be made based on linear feet of gas well borehole abandoned as directed by the Engineer in the event that refusal is encountered before the planned depth is reached. This pay item includes all labor, equipment, material and documentation needed to abandon each borehole. The Contractor is alerted that any borehole abandoned due to negligence or fault of the Contractor during construction operations shall be provided by the Contractor at no additional cost to the NJDEP.

Payment for Bid Item 2.16.6 Condensate Traps shall be made based on each condensate trap installed. This pay item includes all labor, materials, protective steel rings, and equipment required to install the condensate traps.

Payment for Bid Item 2.16.7 Gas Monitoring Probes shall be made based on each monitoring probe installed in accordance with the Contract Drawings. This pay item includes all labor, materials, equipment required to install the probes.

END OF SECTION

2.17 Gas System Valves

2.17.1 General

The intent of this section is to describe valves required during installation of the gas collection system.

2.17.2 Submittals

A. Valve Schedule: Submit the valve schedule listing type of valve, manufacturer's model number and size, for each valve type required.

B. Product Data: Catalog sheets and specifications for each valve type and size and all other items required by this Section.

2.17.3 Quality Assurance

A. Identification: In addition to body markings, furnish each valve with an attached nameplate with markings in accordance with the MSS Standard Marking System No. SP-25. On valves under 3 inches in size a metal tag securely attached to the valve is acceptable and on larger size valves the tag shall be mounted on the yoke arm, bonnet or other location where the tag information will be readily visible after the valve is installed.

B. Provide valves and indicator posts for fireline service that are UL or FM approved and bear visible body markings indicating such approval.

2.17.4 Products

2.17.4.1 Manufacturers

A. Asahi/America, 35 Green St, Malden, MA 02148, 800-343-3618

B. Apco Willamette Valve and Primer Corp., 1420 S. Wright Blvd., Schaumburg, IL 60193, (847) 524-9000.

C. Crane Valve Co., 2129 3rd Ave., S.E., Cullman, AL 35055, (800) 323-3679.

D. Clow Valve Co., 902 South 2nd St., Oskaloosa, IA 52577, (515) 673-8611.

E. DeZurik Corp., 250 Riverside Ave. N., Sartell, MN 56377, (320) 259-2000.

F. Grinnell Corp. (Tyco Valves and Controls Group), 3 Tyco Pk., Exeter, NH 03833, (603) 778-9200.

G. Hammond Valve Corp., 210 Tower St., Prairie Du Sac, WI 53578, (608) 643-2977.

H. Hayward Industrial Products, Inc., Plastics Division, 900 Fairmount Ave., Elizabeth, NJ 07207, (908) 351-5400.

I. Hydra-Stop, Inc., 12601 South Homan Ave., Blue Island, IL 60406, (708) 389-5111.

J. "IPSCO" International Piping Services Co., 2424 Wisconsin Ave., Downers Grove, IL 60515, (630) 435-9500.

K. Jenkins Valve Co., 45 E. Winsor Pkwy., Oceanside, NY 11572, (516) 536-1517.

L. Kennedy Valve Co., 1021 E. Water St., Elmira, NY 14901, (607) 734-2211.

M. L&M/Technaflow Valve Co., (Tyco Valves and Controls Group), 9025 Maya Blvd., Reno, NV 89506, (775) 350-4100.

N. Ludlow-Rensselaer Div., Patterson Pump Co., P. O. Box 790-TR, Toccoa, GA 30577, (706) 886-2101.

O. M&H Valve Co., P. O. Box 2088, Anniston, AL 36202, (256) 237-3521.

P. Milwaukee Valve Co., 2375 S. Burrell St., Milwaukee, WI 53207, (414) 744-5240.

Q. Mueller Valve Co., 500 W. Eldorado St., Decatur, IL 62525, (217) 423-4471.

R. NIBCO, Inc. (Northern Indiana Brass Co.), 1516 Middlebury St., Elkhart, IN 46516, (219) 295-3000.

S. Henry Pratt Co., 401 S. Highland Ave., Aurora, IL 60506, (630) 844-4000.

T. Red Valve Co., Inc., 700 N. Bell Ave., Carnegie, PA 15106, (412) 279-0044.

U. Rodney Hunt Co., 46 Mill St., Orange, MA 01364, (978) 544-2511.

V. Ross Valve Mfg. Co., 6 Oakwood Ave., Troy, NY 12181, (518) 274-0961.

W. Stockham Valve Co. (Crane Valve Group), 2129 3rd Ave. S.E., Cullman, AL 35055, (800) 786-2542.

X. Tyco Valves and Controls, Inc., 9700 W. Gulf Bank Rd., Houston, TX 77040, (713) 466-1176.

Y. U. S. Pipe and Foundry Co., Plano, TX 75026, (972) 423-3881.

Z. Victaulic Company, P. O. Box 31, Easton, PA 18044, (610) 559-3300.

AA. Walworth Co., 8383 Commerce Park Dr., Houston, TX 77036, (713) 777-7788.

BB. Or approved equal.

2.17.4.2 Valves – Basic Construction

A. Provide valves of first quality, free from all imperfections and defects, with body markings indicating manufacturer and rating. Valve parts of the same manufacturer, size and type shall be interchangeable. Manually operated valves shall open in a counter-clockwise direction, and in general, round ventilated type handwheels shall be provided. All valves that use packing (except butterfly, cone, and ball valves) shall be capable of being packed when wide open and under full working pressure.

B. Provide valves of each type from a single manufacturer.

C. Unless otherwise indicated, provide valves having a minimum operating pressure of 150 psig OWG, factory tested at double the working pressure.

D. Valves less than 3 inches in size shall be all bronze unless otherwise indicated.

E. Valves 3 inches and larger in size shall have iron bodies and bronze trim unless otherwise indicated.

F. Valve ends, unless otherwise indicated, shall be:
1. Threaded or flanged ends in steel and brass piping under 4 inches in size; flanged ends in steel and brass piping 4 inches and larger in size.
2. Brazing or screwed ends with adapters in threadless copper pipe (Type TP).
3. Solder or screwed ends with adapters in copper water tubing.
4. Mechanical joint, rubber ring joint, or flanged joint in cast iron/ductile iron piping to match joints of pipe furnished.
5. Grooved ends to match joints of pipe furnished.

G. Valve flanges shall be of a class to mate with pipe flanges.

2.17.4.3 Materials

A. Body:
1. Cast Iron: ASTM A-126 Class B, higher strength cast iron.

2. Ductile Iron: ASTM A-536 Grade 65-45-12.
3. Bronze: For use up to 150 WSP, ASTM B-62; over 150 to 300 psig WSP, ASTM B-61.

B. Stem:
1. Cast Manganese Bronze: ASTM B-584.
2. Cast Silicon Brass: ASTM B-584.
3. Rolled Silicon Brass: ASTM B-98 Alloy D.
4. Rolled Aluminum Bronze: ASTM B-150 Alloy 1.
5. Rolled Manganese Bronze: ASTM B-138 Alloy A (half hard).
6. Naval Brass: ASTM B-21 Alloy A or Alloy C (hard).
7. Silicon Bronze: ASTM B-371 Alloy C69400.
8. Stainless steel, Type 304.

2.17.4.4 Gate Valves

A. Gate valves 2 inches and under in size installed in copper tubing water lines inside buildings and pits:
1. All bronze exclusive of the handwheel and nut.
2. Pressure Ratings: 200 psig OWG; 300 psig hydrostatic test.
3. Solder ends.
4. Rising stem.
5. Acceptable Valves: Crane 1334, Grinnell 3010 SJ, Jenkins 1242, Kennedy 425 SJ, Nibco/Scott S121 & S111, Stockham B109 and Walworth 36.

B. Gate Valves 3 Inches and Larger in Size:
1. Design Standard: ANSI/AWWA C509 or ANSI/AWWA C515.
a. Comply fully with either Standard and the following additional requirements.
b. Resilient wedge type with ductile iron body, epoxy coated in conformance with ANSI/AWWA C550, bronze spindle and nut in which the screw operates.
c. Handwheel operators or 2-inch square operating nuts as required.
d. Valves installed inside buildings and pits shall be outside screw and yoke type, unless otherwise noted.
e. Valves buried in the ground shall be non-rising stem.
f. Provide extension stems and guides as required by the location.
2. Acceptable Manufacturers: Clow, Ludlow-Rensselaer, M & H, and Stockham.

2.17.4.5 Globe and Angle Valves

A. Valves 2 inches and under in size installed in copper tubing water lines inside buildings:
   1. All bronze exclusive of the handwheel and handwheel nut.
   2. Pressure Ratings: 200 psig OWG; 300 psig hydrostatic test.
   3. Solder ends.
   4. Rising or non-rising stem.
   5. Acceptable Valves: Crane 1310 & 1311, Grinnell 3210 SJ, Jenkins 1200 & 1202, Kennedy 89 SJ, Nibco/Scott S211 & S311, Stockham B14 and Walworth 3058 SJ.

2.17.4.6 Check Valves

A. Valves 2 inches and under in size installed in copper tubing water lines:
   1. Bronze body, brass or bronze trim.
   2. Pressure Ratings: 200 psig OWG; 300 psig hydrostatic test.
   3. Regrindable and renewable disc.
   4. Rubber-faced disc for cold water service.
   5. Solder ends.
   6. Acceptable Valves: Crane 1342, Grinnell 3315 SJ, Jenkins 1222, Stockham B309 and B320B, and Walworth 3406 SJ.

B. IBBM Swing Gate Type installed in cast iron/ductile iron piping:
   1. Design Standard: ANSI/AWWA C508.
   2. Bronze disc and body seating surfaces.
   3. Stainless steel hinge pins.
   4. Acceptable Manufacturers: Clow, Kennedy, M & H and Stockham.

C. IBBM Globe-Style Silent Check:
   1. Pressure Ratings: 175 psig OWG; 300 psig shell hydrostatic test.
   2. Disc and Seat Ring: Bronze; ASTM B-62.
   3. Spring: Stainless steel; ASTM A-276, Type 316.
   4. Flanged ends.
      a. Provide solder-end companion flanges for valves under 3 inches in size installed in copper tubing water lines.
   5. Acceptable Manufacturers: Apco, Clow Williams-Hager.

2.17.4.7 Butterfly Valves, 3 inches and Larger

A. Butterfly valves used in the landfill gas collection system shall be Asahi/America Type 57 Butterfly Valves or approved Equal. Butterfly valves shall be lined body design and bubble-tight seal (meeting or exceeding Class VI as defined by American National Standard Institute) with only the liner and disc as parts exposed to the landfill gas. Gear operators shall be worm gear design. The spherical disc design for higher Cv values shall be of solid, abrasion resistant plastic. Liner shall be molded and formed around the body, functioning as gasket seals with convex ring design of each side of the valve for lower bolt tightening torque and valve body shall have molded body stops and seat relief

area to prevent over tightening torque and valve body shall have molded body stops and seat relief area to prevent over tightening of mating flanges. Stem shall be 316/403 stainless steel, non wetted, have engagement over the full length of the disc and be locked into valve body by PP stem retainer. Valves shall have a molded ISO bolt pattern on top flange for actuator mount. PVC shall conform to ASTM D1784 Cell Classification 12454-A, PP conforming to ASTM D4101 Cell Classification PP0210B67272, and PVDF conforming to ASTM D3222 Cell Classification Type II. All PVC PP and PVDF body valves shall be rated to 150 psi at 70 degrees F, sizes 1.5" to 10". Butterfly valves shall be wafer style.

B. HDPE Butterfly Valve Stem Extension:
   1. Contractor shall furnish and install 6 inch HDPE butterfly valve stem extension at locations shown on Contract Drawings and in accordance with Butterfly Valve Stem Extension Detail in Contract Drawings. Butterfly valve stem extension shall be Thermoplastic Valves, Inc. Item No. BVSE or Approved Equal.
   2. Contractor shall install 48" Corrugated Metal Pipe protective ring around butterfly valve stem extension as shown on contract drawings and details.

2.17.4.8 Plastic Ball Valves, 2 inches and Under in Size

A. Construction:
   1. Body, Ball and Stem: Type 1, Grade 1 PVC; ASTM D-1784.
   2. Pressure Rating: 225 psi at 70 degrees F, non shock.
   3. Union end connections.
   4. Reversible Teflon valve seats.
   5. Viton-A O-ring stem seal.
   6. Full port design.

B. Acceptable Manufacturer: Hayward Industrial Products, Inc., or equal as approved by the Engineer.

2.17.4.9 Ball Valves, 4 inches and Larger

A. Design Standard: ANSI/AWWA C507, Pressure Class 150.
   1. Comply fully with this Standard except as modified below.
   2. Bi-directional drip-tight shutoff at rated pressure.
   3. Manufacturer shall be prepared to show that the valves proposed meet the proof-of-design requirements of AWWA Standard C504, Section 5.2.4.

B. Construction:
   1. Body:
      a. Cast iron; ASTM A126, Class B.
      b. Three-piece design O-ring sealed.

2. Ball:
   a. Cast iron; ASTM A48, Class 40.
   b. Full port.
   c. Type 316 stainless steel or nickel-chrome spherical seating surfaces mating with rubber seating rings in the body end-pieces.
3. Body Seats: Buna-N secured to the body end-pieces by epoxy retainers injected-in-place in dovetail grooves.
4. Shafts: Two piece stub type; 18-8 Type 304 stainless steel.
5. Bearings: Teflon-lined with fiberglass backing.
6. Packing: Self-adjusting Chevron type.

C. Operators: Manual compound lever traveling nut type with handwheel.
1. Mechanical stop-limiting means to prevent over travel of the ball in the open and closed positions.
2. Designed to produce required torque at a maximum pull of 80 lbs on the handwheel and to withstand an input torque of 450 ft lbs at extreme operator positions without damage.

D. Shop Painting:
1. Interior Ferrous Surfaces: Two coats (3 to 5 mils dry film thickness each) of a two part epoxy; Tnemec Series 20 Pota-Pox or Keysite 740, or equal as approved by the Engineer..

2. Exterior Ferrous Surfaces: Two coats (3 to 5 mils dry film thickness each) primer; Tnemec Series 37 H Chem Prime H.S., or equal as approved by the Engineer.

E. Certified Test: Bi-directional leak test at 150 psig; no leakage allowed.

2.17.4.10 Pressure Relief Valves

A. Designed to open when inlet pressure exceeds its pre-adjusted setting.

B. Pilot Operated Type:
1. Internal pilot control.
2. Acceptable Valve: Ross 20 WR, or equal as approved by the Engineer.

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C. Valve Construction:
1. Pressure Ratings: 150 psig working pressure; 300 psig hydrostatic test.
2. All internal parts replaceable without removing the valve body from the line.
3. Replaceable seat and seals.

D. Shop Painting:
1. Interior Ferrous Surfaces: Two coats (3 to 5 mils dry film thickness each) of a two part epoxy; Tnemec Series 20 Pota-Pox or Keysite 740, or equal as approved by the Engineer..

2. Exterior Ferrous Surfaces: Two coats (3 to 5 mils dry film thickness each) primer; Tnemec Series 37 H Chem Prime H.S, or equal as approved by the Engineer.2.17.4.11 Automatic Control

A. Pressure Reducing Valves:
   1. Designed to maintain a pre-adjusted downstream pressure regardless of changes in flow rate.
   2. External pilot control comprising an external strainer, needle valve, position indicator, gauge cocks, and control piping isolation valves.
   3. Acceptable Valve: Ross 40 WR or equal as approved by the Engineer.

B. Altitude Valves:
   1. Single Acting: Designed to prevent overflow of the tank, and to fully open for refilling when the stored water level lowers.
      a. External pilot control comprising an external strainer, needle valve, position indicator, gauge cocks, and control piping isolation valves.
      b. Acceptable Valve: Ross 30 AWR or equal as approved by the Engineer.
   2. Double Acting: Designed to fully close to prevent overflow of the tank and to fully open to permit flow from storage to the distribution system when distribution pressure is less than that from the tank.
      a. External pilot control comprising an external strainer, needle valve, position indicator, gauge cocks, and control piping isolation valves.
      b. Acceptable Valve: Ross 40 DAWR or equal as approved by the Engineer.

C. Relief, Surge Control and Back Pressure Sustaining Valves:
   1. Relief Valves: Designed to open rapidly when the line pressure exceeds the pilot valve setting and to close slowly when line pressure returns to normal.
      a. External pilot control comprising an external strainer, needle valve, position indicator, gauge cocks, and control piping isolation valves.
      b. Acceptable Valve: Ross 50 RWR or equal as approved by the Engineer.
   2. Surge Control Valves: Designed to anticipate the surge wave by monitoring the line pressure and opening when an unusual drop in pressure occurs, or on loss of electric power while pumping.
      a. Valve operation shall be purely hydraulic requiring no electrical power.
      b. Relief pilot having over-riding control at all times.
      c. External pilot control comprising an external strainer, needle valve, position indicator, gauge cocks, and control piping isolation valves.
      d. Acceptable Valve: Ross 50 RWR-E or equal as approved by the Engineer.

3. Back Pressure Sustaining Valves: Designed to prevent the incoming pressure from falling below a pre-selected minimum.
    a. External pilot control comprising an external strainer, needle valve, position indicator, gauge cocks, and control piping isolation valves.
    b. Acceptable Valve: Ross 50 RWR or equal as approved by the Engineer.

D. Pump Control Valves: Designed to minimize pump starting and stopping surges.
1. Opening and closing speeds controlled independently.
2. Adjustable fast closure, at a controlled rate, upon power failure.
3. External pilot control comprising an external strainer, needle valves, position indicator, gauge cocks, and control piping isolation valves. Solenoid pilot valves to be equipped with manual operators.
4. Pre-wired NEMA 4X control panel utilizing mechanical relay style components or PLC based logic.
5. Acceptable Valve: Ross 42 WR-S or equal as approved by the Engineer.

E. Electrically Controlled Throttling Valves: Designed to control flow, level or pressure by comparing a signal from a set point controller with an electronic feedback signal.
1. Opening and closing speeds controlled independently.
2. Opening and closing solenoids energized independently by the controller.
3. External pilot control comprising an external strainer, needle valves, position indicator, gauge cocks, and control piping isolation valves.
4. Acceptable Valve: Ross 42 AFCV or equal as approved by the Engineer.F. Valve Construction:
1. Pressure Ratings: 150 psig working pressure; 300 psig hydrostatic test.
2. All internal parts replaceable without removing the valve body from the line.
3. Replaceable seat and seals.
4. Diameter of seat opening equal to or greater than the diameter of the piping in which the valve is installed.
5. Control Piping: Red brass; ASTM B43.
6. Pilot Control Valves: Bronze; ASTM B62.
7. Shop Painting:
    a. Interior Ferrous Surfaces: Two coats (3 to 5 mils dry film thickness each) of a two part epoxy; Tnemec Series 20 Pota-Pox, Keysite 740, or equal as approved by the Engineer.
    b. Exterior Ferrous Surfaces: Two coats (3 to 5 mils dry film thickness each) primer; Tnemec Series 37 H Chem Prime H.S., Sherman Williams Kem Kromik Universal Metal Primer, or equal as approved by the Engineer.

2.17.4.12 Pressure Gages

A. Four-inch dial type, with a micrometer type pointer or an external recalibration device, bronze bourdon tube, bronze bushed rotary movement; cast aluminum, brass or black finished phenol case, with a guaranteed accuracy of within one percent in the middle third of the dial range. Provide case with a white enameled background, with bold black graduations, numerals and pointer. Scale range shall be as required by the service application.

B. Pressure Sensors: Full flange design for insertion between standard ANSI B16.1/6.5 Class 150 pipeline flanges.
   1. Flow-thru design with flexible elastomer sensing ring rigidly clamped between metal end cover flanges.
   2. Sensing ring detecting pressure around the full inside circumference of the pipeline and transmitting that pressure to a mineral oil filled cavity at the outer side of the ring.
   3. Outside diameter of entire sensor matching that of the mating pipeline flanges.
      a. Flange bolts shall pass thru sensor body and flanges.
   4. Maximum face-to-face dimension of entire sensor no greater than that specified for flangeless butterfly valves in MSS-SP67.
   5. Acceptable Pressure Sensor: Series 40 by Red Valve Co., Inc. or equal as approved by the Engineer

2.17.4.13 Valve Keys

A. Furnish one steel socket key for each five valves of the same size or less. For each additional five valves of one size or multiple thereof, furnish one additional key. Provide service box keys, for valves less than 3 inches in size with stationary rod, where required by the service or noted. Acceptable Manufacturer: Mueller.

2.17.5 Measurement and Payment

Payment for HDPE gas valves boxes shall be made under:

Pay Item No.	Pay Item	Unit
2.17	HDPE Butterfly Valve	Each

Payment for Bid Item 2.17 shall be made for EACH HDPE butterfly valve (including: butterfly valve, stem extension, and 48” protective CMP) furnished and installed at the locations shown on the Drawingsor as approved by the Engineer. Butterfly valves and stem extension shall be in accordance with subsection 2.17.4.7 of this specification. Separate Payment will not be made for other valves installed throughout the gas collection system; costs for installation of those valves shall be included in appropriate Bid Items. Gas system valves are incidental to installation of gas collection system and blower and flare system.

END OF SECTION

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Revision 12: November 4, 2015
Revision schedule on pg. 11

GRI Test Method GM17*

Standard Specification for

"Test Methods, Test Properties and Testing Frequency for
Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes"

This specification was developed by the Geosynthetic Research Institute (GRI), with the cooperation of the member organizations for general use by the public. It is completely optional in this regard and can be superseded by other existing or new specifications on the subject matter in whole or in part. Neither GRI, the Geosynthetic Institute, nor any of its related institutes, warrant or indemnifies any materials produced according to this specification either at this time or in the future.

1. Scope

1.1 This specification covers linear low density polyethylene (LLDPE) geomembranes with a formulated sheet density of 0.939 g/ml, or lower, in the thickness range of 0.50 mm (20 mils) to 3.0 mm (120 mils). Both smooth and textured geomembrane surfaces are included.

1.2 This specification sets forth a set of minimum, maximum, or range of physical, mechanical and endurance properties that must be met, or exceeded by the geomembrane being manufactured.

1.3 In the context of quality systems and management, this specification represents manufacturing quality control (MQC).

Note 1: Manufacturing quality control represents those actions taken by a manufacturer to ensure that the product represents the stated objective and properties set forth in this specification.

*This GRI standard is developed by the Geosynthetic Research Institute through consultation and review by the member organizations. This specification will be reviewed at least every 2-years, or on an as-required basis. In this regard it is subject to change at any time. The most recent revision date is the effective version.

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1.4 This standard specification is intended to ensure good uniform quality LLDPE geomembranes for use in general applications.

Note 2: Additional tests, or more restrictive values for the tests indicated, may be necessary under conditions of a particular application. In this situation, interactions with the manufacturers are required.

Note 3: For information on installation techniques, users of this standard are referred to the geosynthetics literature, which is abundant on the subject.

2. Referenced Documents

2.1 ASTM Standards

D 792 Specific Gravity (Relative Density) and Density of Plastics by Displacement
D 1004 Test Method for Initial Tear Resistance of Plastics Film and Sheeting
D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
D 1603 Test Method for Carbon Black in Olefin Plastics
D 3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis
D 4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
D 4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
D 5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
D 5323 Practice for Determination of 2% Secant Modulus for Polyethylene Geomembranes
D 5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
D 5617 Test Method for Multi-Axial Tension Test for Geosynthetics
D 5721 Practice for Air-Oven Aging of Polyolefin Geomembranes
D 5885 Test method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
D 5994 Test Method for Measuring the Core Thickness of Textured Geomembranes
D 6370 Standard Test Method for Rubber-Compositional Analysis by Thermogravimetry (TGA)
D 6693 Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
D 7238 Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent Condensation Device

D 7466 Test Method for Measuring the Asperity Height of Textured Geomembranes

2.2 U. S. Environmental Protection Agency Technical Guidance Document "Quality Control Assurance and Quality Control for Waste Containment Facilities," EPA/600/R-93/182, September 1993, 305 pgs.

3. Definitions

Manufacturing Quality Control (MQC) - A planned system of inspections that is used to directly monitor and control the manufacture of a material which is factory originated. MQC is normally performed by the manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the manufacturer to determine compliance with the requirements for materials and workmanship as stated in certification documents and contract specifications.
ref. EPA/600/R-93/182

Manufacturing Quality Assurance (MQA) - A planned system of activities that provides assurance that the materials were constructed as specified in the certification documents and contract specifications. MQA includes manufacturing facility inspections, verifications, audits and evaluation of the raw materials (resins and additives) and geosynthetic products to assess the quality of the manufactured materials. MQA refers to measures taken by the MQA organization to determine if the manufacturer is in compliance with the product certification and contract specifications for the project.
ref. EPA/600/R-93/182

Linear Low Density Polyethylene (LLDPE), n – A ethylene/α-olefin copolymer having a linear molecular structure. The comonomers used to produce the resin can include 1-butene, 1-hexene, 1-octene or 4-methyl-1-pentene. LLDPE resins have a natural density in the range of 0.915 to 0.926 g/ml (ref. Pate, T. J. Chapter 29 in Handbook of Plastic Materials and Technology, I.I. Rubin Ed., Wiley, 1990).

Formulation, n - The mixture of a unique combination of ingredients identified by type, properties and quantity. For linear low density polyethylene geomembranes, a formulation is defined as the exact percentages and types of resin(s), additives and carbon black.

4. Material Classification and Formulation

4.1 This specification covers linear low density polyethylene geomembranes with a formulated sheet density of 0.939 g/ml, or lower. Density can be measured by ASTM D1505 or ASTM D792. If the latter, Method B is recommended.

4.2 The polyethylene resin from which the geomembrane is made will generally be in the density range of 0.926 g/ml or lower, and have a melt index value per ASTM D1238 of less than 1.0 g/10 min. This refers to the natural, i.e., nonformulated, resin.

4.3 The resin shall be virgin material with no more than 10% rework. If rework is used, it must be of the same formulation (or other approved formulation) as the parent material.

4.4 No post consumer resin (PCR) of any type shall be added to the formulation.

5. Physical, Mechanical and Chemical Property Requirements

5.1 The geomembrane shall conform to the test property requirements prescribed in Tables 1 and 2. Table 1 is for smooth LLDPE geomembranes and Table 2 is for single and double sided textured LLDPE geomembranes. Each of the tables are given in English and SI (metric) units. The conversion from English to SI (metric) is "soft". It is to be understood that the tables refer to the latest revision of the referenced test methods and practices.

Note 4: The tensile strength properties in this specification were originally based on ASTM D 638 which uses a laboratory testing temperature of 23°C ± 2°C. Since ASTM Committee D35 on Geosynthetics adopted ASTM D 6693 (in place of D 638), this GRI Specification followed accordingly. The difference is that D 6693 uses a testing temperature of 21°C ± 2°C. The numeric values of strength and elongation were not changed in this specification. If a dispute arises in this regard, the original temperature of 23°C ± 2°C should be utilized for testing purposes.

Note 5: There are several tests sometimes included in other LLDPE geomembrane specifications which are omitted from this standard because they are outdated, irrelevant or generate information that is not necessary to evaluate on a routine MQC basis. The following tests have been purposely omitted:

- Volatile Loss
- Dimensional Stability
- Coeff. of Linear Expansion
- Resistance to Soil Burial
- Low Temperature Impact
- ESCR Test (D 1693 and D 5397)
- Wide Width Tensile
- Water Vapor Transmission
- Solvent Vapor Transmission
- Water Absorption
- Ozone Resistance
- Hydrostatic Resistance
- Tensile Impact
- Small Scale Burst
- Various Toxicity Tests
- Field Seam Strength

Note 6: There are several tests which are included in this standard (that are not customarily required in other LLDPE geomembrane specifications) because they are relevant and important in the context of current manufacturing processes. The following tests have been purposely added:

- Oxidative Induction Time

- Oven Aging
- Ultraviolet Resistance
- Asperity Height of Textured Sheet

Note 7: There are other tests in this standard, focused on a particular property, which are updated to current standards. The following are in this category:

- Thickness of Textured Sheet
- Tensile Properties, incl. 2% Secant Modulus
- Puncture Resistance
- Axi-Symmetric Break Resistance Strain
- Carbon Black Dispersion (In the viewing and subsequent quantitative interpretation of ASTM D 5596 only near spherical agglomerates shall be included in the assessment).

Note 8: The minimum average value of asperity height does not represent an expected value of interface shear strength. Shear strength associated with geomembranes is both site-specific and product-specific and should be determined by direct shear testing using ASTM D5321/ASTM D6243 as prescribed. This testing should be included in the particular site's CQA conformance testing protocol for the geosynthetic materials involved, or formally waived by the Design Engineer, with concurrence from the Owner prior to the deployment of the geosynthetic materials.

5.2 The values listed in the tables of this specification are to be interpreted according to the designated test method. In this respect they are neither minimum average roll values (MARV) nor maximum average roll values (MaxARV).

5.3 The various properties of the LLDPE geomembrane shall be tested at the minimum frequencies shown in Tables 1 and 2. If the specific manufacturer's quality control guide is more stringent, it must be followed in like manner.

Note 9: This specification is focused on manufacturing quality control (MQC). Conformance testing and manufacturing quality assurance (MQA) testing are at the discretion of the purchaser and/or quality assurance engineer, respectively. Communication and interaction with the manufacturer is strongly suggested.

6. Workmanship and Appearance

6.1 Smooth geomembrane shall have good appearance qualities. It shall be free from such defects that would affect the specified properties and hydraulic integrity of the geomembrane.

6.2 Textured geomembrane shall generally have uniform texturing appearance. It shall be free from such defects that would affect the specified properties and hydraulic integrity of the geomembrane.

6.3 General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide and/or documents.

7. MQC Sampling

7.1 Sampling shall be in accordance with the specific test methods listed in Tables 1 and 2. If no sampling protocol is stipulated in the particular test method, then test specimens shall be taken evenly spaced across the entire roll width.

7.2 The number of tests shall be in accordance with the appropriate test methods listed in Tables 1 and 2.

7.3 The average of the test results should be calculated per the particular standard cited and compared to the minimum value listed in these tables, hence the values listed are the minimum average values and are designated as "min. ave."

8. MQC Retest and Rejection

8.1 If the results of any test do not conform to the requirements of this specification, retesting to determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.

9. Packaging and Marketing

9.1 The geomembrane shall be rolled onto a substantial core or core segments and held firm by dedicated straps/slings, or other suitable means. The rolls must be adequate for safe transportation to the point of delivery, unless otherwise specified in the contract or order.

9.2 Marking of the geomembrane rolls shall be done in accordance with the manufacturers accepted procedure as set forth in their quality manual.

10. Certification

10.1 Upon request of the purchaser in the contract or order, a manufacturer's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment.

English Units

Table 1(a) – Linear Low Density Polyethylene (LLDPE) Geomembrane (SMOOTH)

Properties	Test Method	Test Value								Testing Frequency (minimum)
		20 mils	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness - mils (min. ave.)	D5199	nom.	nom.	nom.	nom.	nom.	nom.	nom.	nom.	per roll
• lowest individual of 10 values		-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	
Density g/ml (max.)	D 1505/D 792	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	200,00 lb
Tensile Properties *(1)* (min. ave.)	D 6693									20,000 lb
• break strength - lb/in.	Type IV	76	114	152	190	228	304	380	456	
• break elongation - %		800	800	800	800	800	800	800	800	
2% Modulus – lb/in. (max.)	D 5323	1200	1800	2400	3000	3600	4800	6000	7200	per formulation
Tear Resistance - lb (min. ave.)	D 1004	11	16	22	27	33	44	55	66	45,000 lb
Puncture Resistance - lb (min. ave.)	D 4833	28	42	56	70	84	112	140	168	45,000 lb
Axi-Symmetric Break Resistance Strain - % (min.)	D 5617	30	30	30	30	30	30	30	30	per formulation
Carbon Black Content - %	D 4218 *(2)*	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	45,000 lb
Carbon Black Dispersion	D 5596	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	45,000 lb
Oxidative Induction Time (OIT) *(4)*										
(a) Standard OIT (min. ave.)	D 3895	100	100	100	100	100	100	100	100	200,000 lb
— or —										
(b) High Pressure OIT (min. ave.)	D 5885	400	400	400	400	400	400	400	400	
Oven Aging at 85°C *(5)*	D 5721									
(a) Standard OIT (min. ave.) - % retained after 90 days	D 3895	35	35	35	35	35	35	35	35	per formulation
— or —										
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	60	60	60	60	60	60	60	60	
UV Resistance *(6)*	D 7238									
(a) Standard OIT (min. ave.)	D 3895	N. R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	per formulation
— or —										
(b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(8)*	D 5885	35	35	35	35	35	35	35	35	

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Break elongation is calculated using a gage length of 2.0 in. at 2.0 in./min.

(2) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.

(3) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
- 9 in Categories 1 or 2 and 1 in Category 3

(4) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(5) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(6) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(7) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(8) UV resistance is based on percent retained value regardless of the original HP-OIT value.

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SI (Metric) Units

Table 1(b) – Linear Low Density Polyethylene (LLDPE) Geomembrane (SMOOTH)

Properties	Test Method	Test Value								Testing Frequency (minimum)
		0.50 mm	0.75 mm	1.0 mm	1.25 mm	1.50 mm	2.00 mm	2.5 mm	3.0 mm	
Thickness - mm (min. ave.)	D5199	nom.	nom.	nom.	nom.	nom.	nom.	nom.	nom.	per roll
• lowest individual of 10 values		-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	
Density g/ml (max.)	D 1505/D 792	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	90,000 kg
Tensile Properties *(1)* (min. ave.)	D 6693									9,000 kg
• break strength – N/mm	Type IV	13	20	27	33	40	53	66	80	
• break elongation - %		800	800	800	800	800	800	800	800	
2% Modulus – N/mm (max.)	D 5323	210	315	420	520	630	840	1050	1260	per formulation
Tear Resistance - N (min. ave.)	D 1004	50	70	100	120	150	200	250	300	20,000 kg
Puncture Resistance - N (min. ave.)	D 4833	120	190	250	310	370	500	620	750	20,000 kg
Axi-Symmetric Break Resistance Strain - % (min.)	D 5617	30	30	30	30	30	30	30	30	per formulation
Carbon Black Content - %	D 4218 *(3)*	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	20,000 kg
Carbon Black Dispersion	D 5596	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	note *(3)*	20,000 kg
Oxidative Induction Time (OIT) *(4)*										90,000 kg
(c) Standard OIT (min. ave.)	D 3895	100	100	100	100	100	100	100	100	
— or —										
(d) High Pressure OIT (min. ave.)	D 5885	400	400	400	400	400	400	400	400	
Oven Aging at 85°C *(5)*	D 5721									
(a) Standard OIT (min. ave.) - % retained after 90 days	D 3895	35	35	35	35	35	35	35	35	per formulation
— or —										
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	60	60	60	60	60	60	60	60	
UV Resistance *(6)*	D 7238									
(a) Standard OIT (min. ave.)	D 3895	N. R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	N.R. *(7)*	per formulation
— or —										
(b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(8)*	D 5885	35	35	35	35	35	35	35	35	

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Break elongation is calculated using a gage length of 50 mm at 50 mm/min.

(2) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.

(3) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
- 9 in Categories 1 or 2 and 1 in Category 3

(4) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(5) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(6) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(7) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(8) UV resistance is based on percent retained value regardless of the original HP-OIT value.

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English Units

Table 2(a) – Linear Low Density Polyethylene (LLDPE) Geomembrane (TEXTURED)

Properties	Test Method	Test Value								Testing Frequency (minimum)
		20 mils	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness mils (min. ave.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values	D 5994	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	per roll
Asperity Height mils (min. ave.)	D 7466	16	16	16	16	16	16	16	16	Every 2nd roll *(1)*
Density g/ml (max.)	D 1505/D 792	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	200,000 lb
Tensile Properties *(2)* (min. ave.) • break strength – lb/in. • break elongation - %	D 6693 Type IV	 30 250	 45 250	 60 250	 75 250	 90 250	 120 250	 150 250	 180 250	20,000 lb
2% Modulus – lb/in. (max.)	D 5323	1200	1800	2400	3000	3600	4800	6000	7200	per formulation
Tear Resistance – lb (min. ave.)	D 1004	11	16	22	27	33	44	55	66	45,000 lb
Puncture Resistance – lb (min. ave.)	D 4833	22	33	44	55	66	88	110	132	45,000 lb
Axi-Symmetric Break Resistance Strain - % (min.)	D 5617	30	30	30	30	30	30	30	30	per formulation
Carbon Black Content - %	D 4218 *(3)*	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	45,000 lb
Carbon Black Dispersion	D 5596	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	45,000 lb
Oxidative Induction Time (OIT) *(5)* (e) Standard OIT (min. ave.) — or — (f) High Pressure OIT (min. ave.)	 D 3895 D 5885	 100 400	 100 400	 100 400	 100 400	 100 400	 100 400	 100 400	 100 400	200,000 lb
Oven Aging at 85°C *(6)* (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	 35 60	 35 60	 35 60	 35 60	 35 60	 35 60	 35 60	 35 60	per formulation
UV Resistance *(7)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(9)*	D 7238 D 3895 D 5885	 N. R. *(8)* 35	 N.R. *(8)* 35	 N.R. *(8)* 35	 N.R. *(8)* 35	 N.R. *(8)* 35	 N.R. *(8)* 35	 N.R. *(8)* 35	 N.R. *(8)* 35	per formulation

(1) Alternate the measurement side for double sided textured sheet

(2) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Break elongation is calculated using a gage length of 2.0 in. at 2.0 in./min.

(3) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.

(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
- 9 in Categories 1 or 2 and 1 in Category 3

(5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(7) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(8) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(9) UV resistance is based on percent retained value regardless of the original HP-OIT value.

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SI (Metric) Units

Table 2(b) – Linear Low Density Polyethylene (LLDPE) Geomembrane (TEXTURED)

Properties	Test Method	Test Value								Testing Frequency (minimum)
		0.50 mm	0.75 mm	1.0 mm	1.25 mm	1.50 mm	2.00 mm	2.5 mm	3.0 mm	
Thickness mils (min. ave.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values	D 5994	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	per roll
Asperity Height mm (min. ave.)	D 7466	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	Every 2nd roll *(1)*
Density g/ml (max.)	D 1505/D 792	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	90,000 kg
Tensile Properties *(2)* (min. ave.) • break strength – N/mm • break elongation - %	D 6693 Type IV	 5 250	 9 250	 11 250	 13 250	 16 250	 21 250	 26 250	 31 250	9,000 kg
2% Modulus – N/mm (max.)	D 5323	210	315	420	520	630	840	1050	1260	per formulation
Tear Resistance – N (min. ave.)	D 1004	50	70	100	120	150	200	250	300	20,000 kg
Puncture Resistance – N (min. ave.)	D 4833	100	150	200	250	300	400	500	600	20,000 kg
Axi-Symmetric Break Resistance Strain - % (min.)	D 5617	30	30	30	30	30	30	30	30	per formulation
Carbon Black Content - %	D 4218 *(3)*	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	20,000 kg
Carbon Black Dispersion	D 5596	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	20,000 kg
Oxidative Induction Time (OIT) *(5)* (g) Standard OIT (min. ave.) — or — (h) High Pressure OIT (min. ave.)	 D 3895 D 5885	 100 400	 100 400	 100 400	 100 400	 100 400	 100 400	 100 400	 100 400	90,000 kg
Oven Aging at 85°C *(6)* (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	 35 60	 35 60	 35 60	 35 60	 35 60	 35 60	 35 60	 35 60	per formulation
UV Resistance *(7)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(9)*	D 7238 D 3895 D 5885	 N. R. *(8)* 35	 N.R. *(8)* 35	 N.R. *(8)* 35	 N.R. *(8)* 35	 N.R. *(8)* 35	 N.R. *(8)* 35	 N.R. *(8)* 35	 N.R. *(8)* 35	per formulation

(1) Alternate the measurement side for double sided textured sheet

(2) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Break elongation is calculated using a gage length of 50 mm at 50 mm/min.

(3) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.

(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
- 9 in Categories 1 or 2 and 1 in Category 3

(5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(7) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(8) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(9) UV resistance is based on percent retained value regardless of the original HP-OIT value.

Revised 9/19/16

Adoption and Revision Schedule
for
GRI Test Method GM17

"Test Methods, Test Properties and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes"

Adopted: April 3, 2000

Revision 1: June 28, 2000: added a new Section 5.2 that the numeric tables values are neither MARV nor MaxARV. They are to be interpreted per the designated test method. Also, corrected typographical error of textured sheet thickness test method designation from D5199 to D5994.

Revision 2: December 13, 2000: added one Category 3 is allowed for carbon black dispersion. Also, unified terminology to "strength" and "elongation".

Revision 3: June 23, 2003: Adopted ASTM D 6693, in place of ASTM D 638, for tensile strength testing. Also, added Note 4.

Revision 4: February 20, 2006: Added Note 9 on Asperity Height clarification with respect to shear strength.

Revision 5: Removed recommended warranty from specification.

Revision 6: June 1, 2009: Replaced GRI-GM12 test method for asperity height of textured geomembranes with ASTM D 7466.

Revision 7: April 11, 2011: Added alternative carbon black test methods.

Revision 8: October 3, 2011: Expanded types of comonomers in the definition of LLDPE.

Revision 9: December 14, 2012: Replaced GRI-GM12 with the equivalent ASTM D7238.

Revision 10: November 14, 2014: Increased asperity height of textured sheet from 10 to 16 mils (0.25 to 0.40 mm).

Revision 11: April 13, 2015: Unit conversion error was corrected for 0.75 mm (30 mil) thickness for the property of 2% modulus. The test value was changed from 370 N/mm to 315 N/mm in the SI (Metric) units tables to agree with the English units tables.

Revision 12: November 4, 2015: Removed Footnote (1) on asperity height from tables.

2.18 Gas Blowers Handling System

2.18.1 General

A. Under this section, the contractor shall provide all labor, equipment and material necessary to furnish, install, test and place in operation the landfill gas blowers handling system and associated components for the moving of landfill gas from the well field to the flare enclosure, as shown in the plans and as specified herein. Information within this specification describes a landfill gas blowers handling system designed specifically for the extraction of landfill gas and combustion of landfill gas in the gas flare system described Section 2.19. The landfill gas blower system shall exhibit industrial quality and be designed specifically for use in landfill gas service. The supplier shall have a minimum 10 years experience in the design and manufacture of this particular equipment and shall have a minimum of fifteen (15) blower skids operating successfully in the United States.

B. The landfill gas blowers system supplied shall be complete and operable as specified within. In the interest of total system compatibility, reliability, quality, cost and single source responsibility, the systems and assemblies furnished under this section and Section 2.19 Gas Flare System shall be designed, manufactured and/or supplied by a single vendor.

C. These specifications are intended to be specific in nature such that gas blowers and accessories will be a complete pre-assembled unit such as to minimize the installation and start-up time. The blower skid assembly is to be completely fabricated, assembled, pre-wired, and thoroughly tested before the unit is to ship.

D. The gas blower skid shall be a stand-alone skid, equipped with the components describes in this specification section, including all piping and valves for a complete and operational system.

E. The contractor shall perform equipment and system testing, and demonstrate compliance with performance requirements as specified herein. The contractor shall provide initial system start-up, including operational start-up and training. The contractor shall prepare and deliver eight copies of submittals and operation and maintenance manuals. Operation and maintenance during construction will be paid under Item 4.1.1.

F. There is an existing concrete pad for the flare (15’ x 15’) and another for the blowers and controls (18.5’ x 34.5’)

2.18.2 Performance Requirements

A. All tests shall conform to ASME Power Code and shall extend from surge to 120% of design volume.

B. Project Altitude: Base blower performance ratings on 25 feet sea level.

C. Operating Limits: Classify according to AMCA 99.

2.18.3 Quality Assurance

A. Qualifications of manufacturer: Products used in the Work of this section shall be produced by manufacturers regularly engaged in the manufacture of LFG handling, processing and combustion systems and with a history of successful production as approved by the Engineer.

B. Qualifications of installers: Use an adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work in this section.

C. Basis of acceptance: The manufacturer's recommended installation procedures, or equal as approved by the Engineer, will become the basis for inspecting and accepting or rejecting actual installation procedures used for Work specified in this section.

D. All equipment shall be designed and shall perform in accordance with these specifications, as a minimum.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

2.18.4 Delivery, Storage and Handling

A. Deliver blowers as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering. The contractor shall use all means necessary to protect the condition and integrity of the equipment provided under this section both during and after receipt of said equipment, and to protect the installed work and all other trades. Deliver materials in manufacturer's original packaging with all tags and labels intact and legible.

B. Store and handle material in such a manner as to avoid damage; store at Site under cover if required to meet the conditions of this section.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. In the event of damage during installation, the contractor shall immediately make all repairs and/or replacements necessary as approved by the Engineer and at no additional cost to the NJDEP.

2.18.5 Coordination

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Do not interrupt utilities serving facility occupied by owner or others without engineer's written permission.

2.18.6 Submittals

A. Submittals shall be in accordance with Section 1.3.

B. Before any materials of this section are delivered to the job site, the contractor shall submit complete shop drawings to the Engineer in accordance with Section 1.3 of these specifications. Shop drawings shall show all details of:

1. Equipment dimensions, layout plan and profile drawings showing various equipment orientation on skid and existing concrete pad, component parts and list of materials.

2. Installation and mounting details.

3. Electrical wiring diagram and details.

C. Submit complete list of materials and equipment proposed to be furnished and installed under this portion of the work, including materials required for electrical tie-in, giving manufacturer's name, catalog number, and catalog cut for each item, where applicable.

D. Following installation, the contractor shall provide to the Engineer the equipment supplier's written report certifying that equipment has been properly installed and connected, is in accurate alignment and is free from undue stress imposed by piping or mounting bolts.

E. Submit warranties as specified in accordance with these specifications.

F. Three (3) operation and maintenance manuals with essential instructions, appropriate vendor literature, and submittal drawings shall be supplied.

G. Provide gas blowers system for landfill application. Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified blower performance curves with system operating conditions indicated.
2. Certified blower sound-power ratings.
3. Electrical info including: motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Wiring Diagrams: Power, signal, and control wiring.

5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Model number of blower(s).
9. Flow rate (SCFM).
10. Maximum vacuum pressure (in W.G.)
11. Maximum working temperature (degree F)
12. Blower HP.
13. Operating weight (Lbs)
14. Overall dimensions, arrangement of blower accessories and clearances
15. Blower structural supports.
16. Pipe connection sizes.
17. Operation and Maintenance Manual.
18. Test Reports.

H. Provide gas blower accessories for landfill application, to include the following:

1. Galvanized structural steel supports.
2. HDPE piping.
3. Manual valves, check valves, and expansion joints.
4. Moisture separator.
5. Thermometers, Gauges, Flow meters.
6. Flanged Reducers.
7. Non-sparking grating support for compressed gas cylinder.
8. Heat trace HDPE drain piping from moisture separator.
9. Control panel, motor starters, and fail-closed valve.

2.18.7 Products

A. Centrifugal Gas Blowers: Performance and Design Requirements:

1. Each blower shall be of multi-stage centrifugal design as manufactured by National Turbine Corporation, HSI, Gardner Denver, or equal as approved by the Engineer. Manufacturers shall have a minimum five years experience in the design and manufacture of this type of equipment and have a minimum of 25 successfully operating installations in the United States.

2. The blower impellers shall be mounted on one shaft supported on each end by bearings mounted in outboard bearing housings. The blower shall be built from parts cast in patterns from which previous units have been built and tested. The blower shall be the manufacturers' standard design. The blowers shall be non-sparking type. All internal surfaces (other than aluminum or stainless steel) must be coated with a phenolic coating.

3. Individual blower shall be rated for a performance of 1,300 SCFM of gas (0.9 specific gravity) at a discharge pressure of 0.50 PSIG, when operated with an inlet vacuum of 50 inches of water gauge, 100 degrees Fahrenheit, and 100% relative humidity. The blowers shall be capable of delivering sufficient pressure to service the LFG flare, including all system parasitic restrictions, throughout the full design range of this specification.

4. Blower Housing:

    a. The blower housing shall consist of cast iron sections held securely between cast iron inlet and outlet heads with steel tie rods. Two-piece fabricated construction with rope packing is not acceptable. All wetted cast iron internals to be protected for corrosion resistance through use of a baked phenolic coating.

    b. No contact shall be made between the shaft rotor and the housings, other than through the bearings. Where the blower shaft passes through the outlet head, a non-contact labyrinth seal shall be provided to prevent air leakage.

    c. The inlet and outlet connections shall be ASA 125 drilled and tapped flange pattern, and will be an integral part of the heads.

5. Impellers: The impellers shall be one-piece cast aluminum, with spacing hubs an integral part of the impeller casting.

    a. The impellers shall be keyed to the shaft with one-piece key, which extends the entire length of the impeller hub.

    b. Impellers shall be individually machine balanced, and shall be individually replaceable without requiring dynamic rebalancing of the entire rotating assembly to maintain factory vibration specifications. Vibration shall not exceed 1.25 mils in the vertical plane when measured at the blower bearing housing.

6. Diffusers: Diffuser sections, which receive air from the impeller and guide the air into the next impeller, shall be provided. Diffusing vanes shall be an integral part of the section casting.

7. Baffle Rings: Units incorporating baffle rings at the intermediate sections and inlet head shall be one-piece stainless steel and mounted directly on a machined area of the casting. The use of mounting brackets shall not be acceptable.

8. Shaft: Each shaft shall be of sufficient diameter to operate below the first critical speed, constructed of precision-machined AISI 4045 carbon steel. Shaft shall not exceed 3,600 RPM.

9. Bearing Housings: Bearings shall be mounted in cast iron outboard bearing housings designed to isolate the bearings from blower temperature. The housings shall have a bronze labyrinth type insert in the area inboard of the bearing, to serve as a backup bearing and protect the bearing from external contamination. Bearing housings shall be of closed construction, specifically designed for gas handling.

    a. The drive end bearing shall include a gland type packing arrangement utilizing a style 387- I John Crane seal or equal as approved by the Engineer, which can be adjusted and/or replaced without removal of the bearing housing.

    b. The use of open bearing housings with carbon ring seal assemblies is not acceptable due to increased maintenance considerations and potential leakage.

10. Bearings: Each blower shall be provided with two (2) grease lubricated anti-friction bearings. It shall be possible to replace the bearings without disconnecting any piping or disassembling the blower casing. Both inlet and outlet bearings shall be sized for a minimum expected life of 10 years as defined by AFBMA B-10 standards. Grease lubricated units shall incorporate a grease slinger mounted inboard of the bearing to insure a constant flow of lubricant to the bearing. Oil lubricated units requiring carbon ring assemblies are not acceptable due to additional maintenance requirements on the seals.

11. Flexible Couplings: The blower shall be connected to the driver with a suitable flexible coupling. The installing contractor shall check, and if necessary, adjust the alignment of the coupling(s) in accordance with the blower manufacturer's instructions, to a tolerance as specified by the coupling manufacturer. The couplings shall be covered with a base mounted metal coupling guard.

12. Base: Each blower, motor and /or driver shall be mounted on one full-length steel base, set on suitable rubber vibration isolation pads.

13. Motor: The motor driver shall be a squirrel cage design with constant speed, in accordance with NEMA and IEEE standards. Totally enclosed fan cooled (TEFC-EPACT) enclosures must be furnished. Bearings shall be anti-friction ball bearing type. The motor horsepower rating shall be in excess of the

maximum load that will be imposed under the design requirements; overload capacity of the motor may not be utilized. The motor horsepower shall be sufficient to operate the blower throughout its design range. The motor shall be rated for service with a variable frequency drive. Each motor shall have a 1.15 service factor minimum at jobsite conditions. Electrical characteristics shall be 230/460 volt, 3 phase and 60 hertz.

14. Variable Frequency Drive (VFD): A VFD suitable for control of each blower/motor assembly shall be provided. The VFD shall be capable of controlling the blower motor by either a manually selected speed control or by a 4-20 mADC signal provided by the flow rate or landfill vacuum monitoring system(s). The operator shall be able to select a desired LFG flow rate or landfill vacuum at the operator interface touchscreen console, and the VFD shall automatically control the blower speed to maintain discharge pressure.

15. Galvanized structural steel supports, heavy duty AISC designed structural steel. Support to be completely galvanized after fabrication.

B. Blower Accessories and Piping

1. All landfill gas piping to be HDPE, PE3408 DR17 or 304 SS Schedule 10S.

2. Gaskets shall be a synthetic fiber type with an NBR binder, Donex 660 or equal as approved by the Engineer for stainless steel piping or neoprene for HDPE piping.

3. All stainless steel reinforced flanges to be 150# RFSO,

    a. Flanged reducer shall be fabricated of stainless steel. See Site plan lay out for size.

    b. Flanged increaser shall be fabricated of stainless steel. See Site plan lay out for size.

4. All piping to be fully assembled, mounted, and supported from the outlet of the moisture separator to the skid edge.

5. Expansion joints: hypalon material flexible expansion joints to be provided at the inlet and outlet of each blower.

6. Manual valves, check valves: Butterfly valves in the gas piping shall be gear operated, lug type, cast iron-bodied valves with viton resilient seats and stainless steel disc and shaft. No part of the cast iron body shall be in contact with the landfill gas. The shaft seals shall be designed for LFG (landfill gas) service. Valves shall be selected for a minimum pressure of 50 PSIG. At a minimum, appropriately sized butterfly valves shall be installed on the system skid at the inlet of the system (for isolation from the landfill) and in the suction and

discharge piping to each blower and in the recirculation line. For valves above 6", a gear operator to be provided. For valves 6" and less, lever handles to be provided. Check valves shall be flanged, wafer type, double door, aluminum bodied, with viton seats, provided at the outlet of each blower. Install a stainless steel or brass ¼" threaded ball valve upstream of the butterfly valve for use as a landfill gas sampling port.

7. Moisture separator: One moisture separator shall be provided for the gas blower pair. Moisture separator manufacturers shall have a minimum five years experience in the design and manufacture of this type of equipment and have a minimum of 10 units successfully operating in the United States. The moisture separator assembly shall be located, installed and pre-plumbed on the gas handling system skid. Moisture removed and collected by the moisture separator shall be discharged back into the landfill via a discharge pipe. Moisture separator shall be sized to separate 99% of all liquid droplets 10 microns and larger complete with the following:

    a. Flanged inlet and outlet
    b. Drain connection
    c. Level gauge
    d. Stainless steel mesh pad for moisture collection
    e. Flanged top for accessibility and maintenance
    f. HDPE or carbon steel construction. Carbon steel to be internally coated with two (2) coats of a phenolic painting system
    g. The carbon steel exterior shall be prepared with an SSPC-SP-6 blast and primed with an epoxy primer
    h. A differential pressure gauge to be mounted on the vessel and connected to taps on the upstream and downstream side of the mesh pad
    i. Two (2) 1" FNPT connections with plugs for optional addition of level switches.

8. One (1) 8"x12" flanged fabricated reducer shall be furnished for reducing from the 12" header to the 8" blower inlet piping.

9. One (1) 8"x12" flanged fabricated increaser shall be furnished for increasing from the 8" blower outlet piping to the 12" piping.

10. One (1) 10" wafer style rubber-lined butterfly valve with gearbox operator shall be furnished for installation in the blower inlet and outlet piping where the blower piping is either increased and/or reduced. Valve body to be cast iron with an EPDM seat, stainless steel shaft and disc, and Teflon inboard bushing.

11. A bimetal thermometer, 3" dial, dual scale, +/- 1% F.S. accuracy, with external reset will be furnished for mounting in the blower inlet and outlet piping system. Thermometers to be back connection style, with temperature range of 0 to 250^0 F (-20 to 120 ^{0}C)

12. A pressure gauge, 2.5” diameter, 0-50” W.C., shall be furnished for mounting in the blower discharge piping system.

13. A vacuum gauge, 3” diameter, 0-100” W.C., shall be furnished for mounting in the blower inlet piping system.

14. A NEMA 7/9, Explosion Proof, non-fused disconnect switch shall be furnished with each blower.

15. A gas flow meter: 0-3000 SCFM, explosion-proof.

16. A 4 foot long, 16” diameter (where 16” is the diameter of the braided hose segment), flanged braided metal hose flexible connector (Flexicraft Industries Model FF or equal as approved by the Engineer) shall be provided along the 16” diameter HDPE gas header prior to connection to the condensate knockout tank. The HDPE pipe shall be connected to the flanged flexible connector via 16” diameter HDPE flange adapters (IPP DeltaFlex Flange Product No. PESE-SDR17-16 or Approved Equal) on either side of the flanged connector.

C. Control Panel, motor starters, and fail-closed valve

1. The control panel and motor starters as specified in the Landfill Gas Flare System specification are to be mounted to the blower skid and completely wired in rigid conduit from the panels to each appropriate instrument and or control item on the blower skid.

2. One (1) high performance butterfly valve with carbon steel body, 316 stainless steel disk, PTFE seat with pneumatic fail-closed actuator, three-way solenoid valve, speed control valve, and auxiliary switches is to be mounted between the moisture separator and the blowers.

D. Gauges and Instrumentation Transmitters/Transducers

1. Where direct read-out pressure gauges are required, Dwyer Capsuhelic or equal as approved by the Engineer shall be employed and shall be selected in appropriate ranges and/or scales. Where analog transmitters/transducers are required for installation on the sytem process piping or in the control panel(s) for comliant control, such transducers shall be provided and installed as 2-wire, 2-40 madc devices. Pressure, vacuum and differential pressure transducers shall be provided as ITT/Barton, Rosemount, or equal as approved by the Engineer. For temperature signals, thermocouple type sensing devices selected for the appropriate temperature ranges are acceptable, with the thermocouple EMF signals processing the system PLC. The minimum required list of devices for this system is:

a. Landfill vacuum gauge, Dwyer Capsuhelic or equal as approved by the Engineer
b. LFG temperature gauge, Reotemp 4-1/2" dial or equal as approved by the Engineer
c. Landfill vacuum transmitter
d. LFG temperature thermocouple
e. Demister differential pressure gauge, Dwyer Capsuhelic or equal as approved by the Engineer
f. Blower discharge pressure gauge, Dwyer Capsuhelic or equal as approved by the Engineer
g. Blower discharge temperature gauge, Reotemp 4-1/2 dial or equal as approved by the Engineer
h. Blower discharge temperature thermocouple
i. Blower inlet bearing vibration transmitter (one on each blower)
j. Flame arrester pressure gauge, Dwyer Capsuhelic or equal as approved by the Engineer

E. Packaging

1. The complete gas handling system shall be designed and manufactured as a pre-packaged, pre-plumbed, pre-conduited, pre-wired, and factory pre-tested system. In areas where field installation requires connection to piping systems or wiring systems, flanged connections and terminal/junction boxes shall be provided. The intent is to have as fully pre-assembled system delivered to the job site as possible.

F. Lighting

Lighting shall be pole mounted outdoor solar lighting capable of providing a minimum of 4200 lumens.

Install solar lighting in accordance with manufacturer instructions. Solar lighting system shall meet or exceeds NEC 2005 code requirements. Provide factory-certified field service engineer to a site visit to ensure proper installation and operation

Provide manufacturer's warranty covering 5 years on solar lighting system from date of purchase. Provide Solar Voltaic Panel warranty covers 15 years.

A. Solar Powered Light System consists of six (6) components and assemblies: Photovoltaic (PV) Modules, Solar Light Controllers, Light Fittings, LED lamps, Batteries, Battery Enclosures, Mounting and Support Hardware.

1. Photovoltaic (PV) Module
a. Construction:

1) Crystalline silicon solar cells
2) Framed in an all-aluminum structure
3) Sealed behind UV stabilized tempered glass
4) Covered by a 20 year power warranty
5) Meet or exceed IEC61215, IEEE1262 or UL1703 standard
6) RoHS compliant
7) Harnessing and cabling is 12 AWG THHN stranded wire with over molded insulated rated for exterior usage

b. Performance: PV power rating generates adequate power to fully recharge system batteries within two (2) days at the installation location's expected minimum insolation as defined by NREL.

2. Light Fixture Assembly

a. Construction:

1) Cobrahead, Shoebox or GreenwayTM style or equal as approved by the Engineer
2) UV stabilized powder coated gray
3) Glass or Polycarbonate with clear sag or prismatic refraction lens finish
4) Sealed and rain-proof
5) Dark Sky Certified
6) Tilt from 0 to 15 degrees above horizontal for better light dispersion
7) Designed and factory-installed LED light source only

b. Performance:

1) LED source designed for a minimum of 100,000 hour performance with over 70% initial lumen maintenance
2) LED junction temperature does not exceed 120° C in worst-case site temperature conditions
3) High brightness LEDs only (>80 lumens/Watt) per LED. 5 mm type LEDs are not acceptable
4) Bright white LEDs with a color temperature greater than 5000 K (> 5000 K) 5) Manufacturer provides relevant .ies files to indicate light dispersion and intensity of LED source

3. System Electronics – consist of battery charge controller and LED driver

a. Construction:

1) Enclosed within the light system with touch-proof covers to prevent damage
2) Conformal coated to prevent corrosion and failure due to water
3) Charge controller and LED driver are designed without electrolytic capacitors. All other capacitor devices are de-rated by at least 20° C below the capacitor's maximum temperature rating under fully-loaded conditions and ambient temperature of 30° C
4) Minimum 10 year operational life when operating at minimum or maximum rated system environmental specifications (10° C to 50° C at 0 – 100% relative humidity, non condensing)
5) Designed and tested to withstand electrostatic discharges up to 15,000 V without impairmentper IEC 801-2.

6) Withstand up to a 6,000 Volt surge without impairment of performance as defined by ANSI C62.41 Category A.

7) Manufactured in a facility that employ ESD reduction practices in compliance with ANSI/ESD S20.20.

b. Performance

1) Operates in the following mode Dusk to Dawn

2) Perform Power Management to increase a system's run-time even with inclement weather conditions

3) Charge Controller operates with temperature compensated limits ensuring battery charging algorithm protects battery(ies) from over and under voltage stress

a) Charge controller adapts maximum (charged) voltage based on temperature (14V maximum at 21° C)

b) Charge controller prevents discharge below temperature compensated battery Low Voltage Disconnect (LVD) limit (11.5V at 21° C)

4) Operate the light for five (5) nights without adequate insolation during the day to charge the batteries

5) Charge controller never discharges more than 20% depth of discharge per night

6) Charge Controller differentiates between actual sunlight and solar panel illumination from the system's own LED light

4. Batteries

a. Construction:

1) Sealed valve regulated Gel cell type

2) Maintenance free

3) Air shippable

4) 100% recyclable

b. Performance

1) Capable of over 2000 cycles

2) Deep cycle technology

3) Maintains over 80% of charge after 2 months if left disconnected

5. Battery Enclosure

a. Construction:

1) All aluminum vented enclosure

2) Aluminum doors with keyed notches for securing the door during service

3) NEMA 3RX rated

4) Holds up to 2 large-size (100 Ah) batteries or 4 small-size (55 Ah) batteries to a maximum enclosure weight of 200 lbs.

5) All battery wire terminals and harnessing connect via quick-connect type with keyed connections to prevent miswires

b. Performance:

1) Access provided for battery service via four (4) bolts

2) Wire harness is 12AWG THHN wire and finished to prevent accidental shorts

3) Terminal covers, ring washers, terminals, etc. are non-corrosive non-rusting

4) Warranted for a minimum of two (2) years, and an additional pro-rated warranty to cover five (5) years.

6. Mounting and Support Hardware

a. Construction:

1) All aluminum bracing and support struts

2) Aluminum or stainless steel hardware for rust-proof and corrosion resistant mounting equipment

3) All field serviceable cabling is quick connect plug-in type and designed to prevent miswires.

b. Performance:

1) PV, Battery, and Fixture mounting hardware rated for 110 mph wind conditions

2) PV support structure adjustable to set angles of 45 degrees for ideal solar harvesting

3) PV support structure does not allow complete horizontal mounting to avoid soil, dust, dirt and debris collection that impedes solar harvesting

Submit the following:

Product Data: Catalog cut sheets with performance specifications demonstrating compliance with specified requirements.

IES electronic files of lamp output or Photometric Plots on a surface from a defined lamp height

Calculation of Effective Projected Area (EPA) of the solar lighting system, with associated AASHTO reference for design wind speed for the area and EPA rating of the pole (if provided)

2.18.8 Execution

A. Installation

1. Install centrifugal blowers and associated valves, piping, fittings, controls with level and plumb.

2. Support floor-mounting units using spring isolators or restrained spring isolators having a static deflection of 1 inch.

3. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

4. Install floor-mounting units on concrete bases.

5. Install gas blowers in accordance with manufacturer recommendations.

6. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.

7. Install 4 foot long, 16” diameter, flanged braided metal flexible connector (Flexicraft Model FF or equal as approved by the Engineer) along the 16” diameter HDPE gas header prior to connection to the condensate knockout tank (as shown on the Contract Drawings) and in accordance with manufacturer recommendations. The HDPE pipe shall be connected to the flanged flexible connector via 16” diameter HDPE flange adapters (IPP DeltaFlex Flange Product No. PESE-SDR17-16 or equal as approved by the Engineer) on either side of the flanged connector.

B. Field Quality Control

Perform the following field tests and inspections and prepare test reports,

1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

3. Verify that cleaning and adjusting are complete.

4. Leak test after installation.

5. Verify lubrication for bearings and other moving parts.

6. Remove and replace malfunctioning units and retest as specified above.

7. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Demonstrations

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal blowers.

2.18.9 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Unit
2.18.1	Gas Blower and Flare System	Lump Sum
2.18.2	Gas Blower and Flare System - Power Connection	Lump Sum

Payment for Bid Items 2.18.1 shall be made on a lump sum basis. Payment includes all labor, equipment, materials, appurtenances, and components required for full installation of the gas blower and flare system, in accordance with this specification and Section 2.19 Gas Flare System.

Payment for Bid Items 2.18.1 shall include all piping, valves, fittings, bedding, two light poles and lights and components identified as part of the blower skid and flare system. Payment shall also include costs associated for the installation of the 16" diameter pipeline which will connect to the 8" diameter header lines. Payment shall also include all costs associated with the installation of the moisture separator collection runoff pipe in accordance with the Contract Drawings.

Electrical work associated with supplying power from the power source (the transformer pad) to the Gas Blower and Flare System control panel shall be paid for under Bid Item 2.18.2 Gas Blower and Flare System – Power Connection.

Payment for installation of the combustion air blower foundation (concrete pad and micropiles) shall be paid for under Bid Item 2.25 and Bid Item 2.28.

END OF SECTION

2.19 Gas Flare System

2.19.1 General

A. Under this section, the contractor shall provide all labor, equipment and material necessary to furnish, install, test and place in operation the landfill gas flare system as shown in the plans and as specified herein. Information within this specification describes an enclosed flare system designed specifically for the combustion of landfill gas. The flare system shall exhibit industrial quality and be designed specifically for use in landfill gas service. The supplier shall have a minimum 10 years experience in the design and manufacture of this particular equipment and shall have a minimum of 5 enclosed flares operating successfully in the United States.

B. The landfill gas flare system supplied shall be complete and operable as specified within. In the interest of total system compatibility, reliability, quality, cost and single source responsibility, the systems and assemblies furnished under this section and Section 2.18 Gas Blowers Handling System shall be designed, manufactured and/or supplied by a single vendor.

C. The contractor shall perform equipment and system testing, and demonstrate compliance with performance requirements as specified herein. The contractor shall provide initial system start-up, including operational start-up and training. The contractor shall prepare and deliver three (3) copies of submittals and operation and maintenance manuals.

D. There is an existing concrete pad for the flare (15’ x 15’).

2.19.2 Design Criteria

A. The enclosed flare shall be designed to operate continuously with landfill gas as the primary fuel source.

B. The landfill gas stream is characterized by the following parameters.

Flow Rate:	1,300 SCFM (maximum)
Composition:	30% to 50% CH_4 remainder CO_2, air, and inert gases
Lower Heating Value (LHV):	500 BTU/SCF (maximum)
Temperature:	100 °F
Moisture Content:	saturated
Heat Release:	39 MMBTU/hr (maximum) (1,300 SCFM @ 50% CH_4 of LFG)

C. The flare system shall satisfy the following site conditions.

Wind Speed:	110 mph (maximum)
Seismic Classification:	Zone 4

Site Elevation:	25 ft above sea level (design condition)
Electrical Area Classification:	non-hazardous (unclassified)

D. The enclosed flare shall satisfy the following process conditions.

Smokeless Capacity:	100%
Operating Temperature:	1,200 °F to 1,800 °F (2,000 °F shutdown)
Retention Time:	0.7 seconds (minimum) at 1,800 °F
Inlet Pressure:	15" H_2O

E. The following utilities are required to support operation of the flare system.

Pilot Gas (intermittent):	22 SCFH of propane at 10 psig and/or 50 SCFH of natural gas at 15 psig
Electricity:	480 V, three phase, 60 Hz

2.19.3 Quality Assurance

A. Qualifications of manufacturer: Products used in the Work of this section shall be produced by manufacturers regularly engaged in the manufacture of LFG handling, processing and combustion systems and with a history of successful production as approved by the Engineer.

B. Qualifications of installers: Use an adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work in this section as approved by the Engineer.

C. Basis of acceptance: The manufacturer's recommended installation procedures, or equal as approved by the Engineer, will become the basis for inspecting and accepting or rejecting actual installation procedures used for Work specified in this section.

2.19.4 Performance Requirement

A. The enclosed flare must be capable of achieving the following performance requirements.

1. The flare shall sustain stable combustion with 10% to 50% methane concentrations at the maximum flow rate, while maintaining the operating temperature, without requiring any burner adjustment.

2. Considering a 50% methane concentration, flare must achieve a 5:1 instantaneous heat release turndown minimum. Achieving the specified turndown must not require any burner adjustment or flare modification.

3. The flare shall sustain stable combustion with methane concentrations of at least 10% at reduced flow rates without any burner adjustments or flare modification.

4. The pressure loss through the flare, from the inlet flange through the flare enclosure, shall be less than 15" H_2O.

5. The flare shall operate free of pulsation and vibration with at most 5% oxygen concentration in the landfill gas stream.

6. Emissions from the flare shall not exceed the following.

Nitrogen Oxide (NOx):	~~0.025~~ 0.038 lb. per million BTU fired
Carbon Monoxide (CO):	~~0.06~~ 0.045 lb. per million BTU fired

7. The flare system shall achieve a destruction efficiency greater than 99% of total non-methane organic compounds (NMOC) throughout the entire flare operating range, without any burner adjustments or flare modification.

8. The flare system shall be capable of operating at a LFG flow rate and a LFG heat flow rate of 20% maximum load rating through 100% maximum load rating described earlier in this section.

2.19.5 Submittals

A. Submittals shall be in accordance with Section 1.3.

B. Before any materials of this section are delivered to the job site, the contractor shall submit complete shop drawings to the Engineer in accordance with Section 1.3 of these specifications. Shop drawings shall show all details of:

1. Equipment dimensions, layout plan and profile drawings showing various equipment orientation on skid and existing concrete pad, component parts and list of materials.

2. Installation and mounting details.

3. Electrical wiring diagram and details.

C. Submit complete list of materials and equipment proposed to be furnished and installed under this portion of the work, including materials required for electrical tie-in, giving manufacturer's name, catalog number, and catalog cut for each item, where applicable.

D. Following installation, the contractor shall provide to the Engineer the equipment supplier's written report certifying that equipment has been properly installed and connected, is in accurate alignment and is free from undue stress imposed by piping or mounting bolts.

E. Submit warranties as specified in accordance with these specifications.

2.19.6 Product Handling

A. The contractor shall use all means necessary to protect the condition and integrity of the equipment provided under this section both during and after receipt of said equipment, and to protect the installed work and all other trades.

B. In the event of damage during installation, the contractor shall immediately make all repairs and/or replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

C. Deliver materials in manufacturer's original packaging with all tags and labels intact and legible.

D. Store and handle material in such a manner as to avoid damage; store at Site under cover if required to meet the conditions of this section.

2.19.7 Products

A. All equipment shall be designed and shall perform in accordance with these specifications, as a minimum.

B. The content of these specifications is intended to describe an enclosed flare requiring no burner adjustment to accommodate varying flow rates or gas concentrations.

C. Three (3) operation and maintenance manuals with essential instructions, appropriate vendor literature, and submittal drawings shall be supplied.

2.19.8 Equipment

A. The flare system shall include the following items, as a minimum.

1. Anti-flashback burners

2. Flare stack

3. Externally removable spark ignited pilot

4. Ignition and control station

5. Wireless Monitoring System

6. Ancillary equipment

B. The equipment provided shall be designed specifically for use in landfill gas service and manufactured by the flare supplier at the supplier's own fabrication facility. All components directly supporting combustion, such as burners and pilots, must be manufactured by the flare supplier. Only ancillary equipment, such as gas blowers, flame arrestors, and instrumentation shall be manufactured by others.

C. The control system shall be completely assembled and tested prior to shipment by the flare supplier at the supplier's own fabrication facility.

2.19.9 Equipment Description

A. Anti-flashback burners

1. All burners furnished within the enclosed flare shall be anti-flashback type, with an internal stainless steel flame arresting seal, a stainless steel diverter plate, and no adjustable, or moving parts.

2. All burners shall be individually flanged for easy removal through the damper opening.

3. All burner material within 6" of the burner flame zone shall be made of high temperature material.

B. Flare stack

1. Stacks shall be constructed of carbon steel with a 1/4" minimum thickness.

2. The internal portion of the stack requires a 2" thickness minimum of ceramic fiber blanket refractory. The surface layer, exposed to flame, shall be 1" thick, 8 lb density backed by 1" thick, 6 lb density, both with a 2,300 °F temperature rating minimum. The surface layer shall be overlapped horizontally for additional heat protection.

3. Refractory shall be attached using Inconel 601 pins and keepers, with 8-3/4" horizontal spacing maximum and 10-1/2" vertical spacing maximum.

4. The stack shall contain a burner manifold with flanged inlet connection, and individual flanged burner connections, allowing proper gas distribution.

5. The external portion of the stack requires SSPC-SP-6 surface preparation and one coat of Sherwin Williams "Zinc Clad II" coating system, or equal as approved by the Engineer, 3-4 mils DFT, gray-green color.

6. Two (2) 4" diameter FNPT sample ports and plugs minimum shall be located 90° apart and one-half stack diameter from the stack top for emissions testing. Each of the 4" diameter plugs shall be insulated with ceramic fiber refractory.

7. Connections for combustion air dampers shall be supplied on the stack.

8. Three (3) connections minimum shall be supplied on the stack for installing temperature control thermocouples.

9. One (1) connection shall be located in the lower one-third of the stack for installing the high temperature thermocouple.

10. The stack shall contain thermocouple conduit mounting brackets.

11. A stainless steel rain guard shall be provided at the stack top, covering the exposed edge of refractory, to prevent water damage. This rain guard shall consist of overlapping segments and not a continuous ring, to minimize thermal expansion affects.

12. The stack shall include an AISC designed, continuous baseplate for mounting and high wind stability.

13. Two (2) lifting lugs shall be located 180° apart for use during installation.

C. Externally removable spark ignited pilot

1. The pilot shall be mounted to the outside of the stack such that the assembly is externally removable.

2. The pilot shall be spark ignited.

3. The pilot shall be capable of firing on either propane or natural gas at pressures ranging from 3 to 15 psig.

D. Ignition and control station

Provide a complete and functional control system designed for 480 V, three phase, 60 Hz incoming power, including transformer conversion as required for operating the flare system.

The control panel for the system shall be compliant with NEMA 12/3R specifications at a minimum. The panel shall be equipped with a sun/rain shield that extends 3 feet from the panel on the door side and 2 feet from each end of the panel. The control panel shall be sized 72"H x 36"W x 24" D at a minimum. The control panel shall be fully pre-wired to the extent possible by the system manufacturer. The complete control system and instrumentation shall be manufactured, wired and functionally

tested prior to shipment in a UL 508A approved panel shop simulating actual operation, and shall be specifically designed for the performance of the electrical and logical control requirements of this project. The control panel shall bear the official UL label confirming UL classifications as "Flame Control Panel". The control panel shall be equipped with an emergency alarm beacon to be activated upon emergency shutdown.

The control panel shall include a load center for all the motors, fixtures, controls and devices included with the system. The electrical system shall include voltage transformer(s), disconnects, main and bran circuit protectors and any other protection and/or control devices required for complete operation of the system based on a single electrical service supply of 480 VAC, three phase, 60 Hz power.

The electrical motor control panel(s) and/or the logical control panels shall be provided with thermostatically controlled hearing and cooling systems as required to ensure proper operation of all motor control and logical supervisory control sub-systems.

The control panel shall include a PLC-based control center to receive all the signals from the various safeties, controls and monitoring equipment, and to automatically control all the various components of the system. The PLC system shall include an installed modem system and Ethernet capability such that authorized personnel who have access to the required PC, modem and appropriate software can contact the control system remotely. One licensed copy of the appropriate software shall be provided to the NJDEP as a part of this scope of work and supply.

The control panel shall include an operator interface panel to allow either manual or automatic selection for the control of the operation components of the system. Such operator interface shall be provided as a touchscreen, shall have Ethernet capabilities, and shall be fully compatible with the PLC (Programmable Logic Circuit) and shall be designed for industrial duty applications.

The control panel shall record continuous temperature and flow rate data in accordance with the Air Permit. Temperature and flow rate data shall be available in electronic format for download a/or reproduction.

The automatic flare control system shall include a pilot gas control systems, including pilot temperature controller, pilot timer, pilot failure indicator and shut down. The system shall include igniter timer, purge timer and down time timer, which shall be manually adjustable.

The following items for ignition and controls shall be completely mounted, assembled, and wired on a structural steel rack:

1. One (1) weatherproof single phase power transformer to convert electrical service from 480 V to 120 V.

2. One (1) weatherproof Flare Control Panel including the following instrumentation for safe, overall system operation and control.

    - Programmable logic controller manufactured by Allen Bradley, General Electric, or equal as approved by the Engineer
    - 10" minimum color touch screen display for all control, alarms, troubleshooting, indication, and history
    - Indicator lights for operating and alarm conditions
    - High temperature shutdown switch
    - Emergency shutdown switch
    - Flame scanner amplifier and relay
    - Yokogawa DXAdvanced DX100T or Engineer approved equal, digital process recorder, capable of collecting, accumulating, storing and presenting digital records of monitored systems. The device shall also have Ethernet capability for remote monitoring and a data storage card at least 1 GB in size
    - Three position thermocouple selector switch
    - Ammeter for each gas blower motor (200% scale)
    - Hourmeter for each gas blower motor
    - One (1) 10 A duplex outlet

    The following switch and pushbuttons are required, as a minimum:

    - Panel power (On/Off) switch
    - System control (Local/Off/Remote) switch
    - Gas blower (Hand/Off/Automatic) switch(es)
    - Reset pushbutton
    - Lamp test pushbutton

    The following flare system indications are required on the color touch screen display, as a minimum:

    - Panel power on
    - Purging
    - Ignition sequence
    - Flame proved
    - Gas blower(s) ON
    - Gas blower(s) failure
    - Purge failure
    - Automatic block valve failure
    - Flame failure
    - Flare low temperature
    - Flare high temperature
    - Burner flashback

- Low combustion air flow
- Landfill gas flow rate

3. Weatherproof combination motor starters for each gas blower.

4. Variable frequency drive for the combustion air blower.

5. One (1) Pilot Gas Control System including pressure regulator, fail-closed shutdown valve, manual block valve, and pressure gauge.

The following components for ignition and controls shall be installed on or mounted to the flare stack:

6. One (1) weatherproof Ignition Panel with 6000 V transformer mounted to the stack for intermittent pilot ignition.

7. One (1) self-checking, ultraviolet flame scanner to monitor the main flame.

8. Three (3) temperature control thermocouples.

9. One (1) high temperature thermocouple.

10. Combustion air dampers with opposed, bolted blade design, galvanized finish, and stainless steel press-fit bearings.

E. Wireless Monitoring System

1. Complete wireless monitoring system using alarm notification technology for remote monitoring of landfill gas flare and blower handling system, including field RTU for wireless communications through cellular data transmission, computer based software, and website access.

2. System shall provide hourly reporting of LFG flow rate and flare temperature, and real time monitoring/alarm status of gas flare and key blower system operational components.

3. System shall be field mounted to the flare control system rack in a NEMA 4X enclosure and shall include antenna with mounting bracket and 11’ of cable for connection to monitoring box.

4. System shall be Mission Communication M-110 Series, FleetZOOM FZ400, or equal as approved by the Engineer.

5. System shall be connected to thermocouple at exit of the combustion section and monitor temperature continuously. The alarm shall sound at any time flare temperature is detected to be less than the permitted operating temperature.

6. System shall monitor and record the landfill gas flow rate to the enclosed flare in scfm. The flow rate monitoring shall: (1) correct and report from actual to standard cubic feet; (2) have an overall accuracy of not less than 0.5% or the best accuracy available; (3) be installed and operated in accordance with the instructions of the manufacturer; and, (4) be equipped with a totalizer to continuously monitor the cumulative amount of landfill gas directed to the flare in scfm.

F. Ancillary Equipment

1. A flame arrester with aluminum body and removable, internal aluminum element shall be installed at the flare inlet flange.

2. A mixing chamber with static mixer for landfill gas and combustion air.

3. An automatic block valve assembly consisting of a high performance butterfly valve with 316 stainless steel disc and Teflon seal, and a fail-closed pneumatic actuator shall be supplied.

4. Gas blowers with totally enclosed, fan cooled motors (TEFC) shall supply the enclosed flare with landfill gas.

5. A moisture separator vessel with flanged inlet and outlet connections, stainless steel demister element capable of removing 99% of water droplets 10 micron and larger from landfill gas, and level gauge shall be supplied.

6. A suitable amount of thermocouple and ignition wire shall be supplied.

7. A combustion air blower with totally enclosed, fan cooled (TEFC) motor shall supply the required combustion air for proper dilution.

8. A commercially available 10 gallon propane tank with OPD (overfill protection device) for storage of propane gas valve shall be supplied. The tank shall meet all applicable requirements as set forth by ASME Code for Pressure Vessels, National Propane Gas Association and NFP. The tank shall be constructed of galvanized steel with powder coated finish. The tank shall be located within the footprint of the flare pad and suitably fastened to the flare pad structure.

2.19.10 System Operation

A. The flare system shall operate with automatic temperature control and shall safely destroy organic compounds generated by solid waste.

B. The system shall be controlled by a programmable logic controller (PLC) which receives and transmits signals with respect to operating conditions. If an unacceptable operating

condition occurs, the system shall either adjust the operating parameters to correct the problem or discontinue operation.

C. System operation shall include an initial purge cycle, timed ignition sequence, and fail-safe controls.

D. System shutdown shall result from low purge air flow, pilot flame failure, main flame failure, flare low temperature, flare high temperature, low combustion air flow, and burner flash back.

E. Both local and remote operating modes shall be available.

F. A self-checking flame scanner main flame. The pilot flame shall be monitored by either a self-checking flame scanner or thermocouple.

G. System Control Selection

1. System operation shall begin automatically by selecting either local or remote system control. Local control requires interaction at the control panel to start and stop operation. Remote control allows starting and stopping operation without interaction at the control panel.

H. Operating Permissives

1. System operation shall be permitted only after confirming two safety conditions exist. The closed limit switch for the automatic block valve must be satisfied, proving a closed valve position. Additionally, the flame scanner must not detect the presence of flame inside the flare enclosure.

I. Purge Cycle

1. Prior to beginning the ignition sequence, the combustion chamber and flare enclosure must be purged with ambient air to ensure no potentially explosive gas mixture exists inside. To create a safe condition for pilot ignition, the combustion air blower operates and the air damper louvers shall be maintained fully open for five minutes prior to each ignition attempt and “Purging” will be indicated. If the purge air blower operation fails, or the purge air is not satisfied, “Purge Failure” will be indicated and system operation discontinues.

J. Ignition Sequence

1. The ignition sequence shall begin immediately after the purge cycle is complete. The pilot gas solenoid valve opens automatically, supplying gas to the pilot, the “Ignition Sequence” is indicated, and the ignition transformer energizes. The ignition transformer continues for ten seconds and then the pilot thermocouple

verifies flame is present. “Flame Proved” is indicated and the pilot gas solenoid valve remains open.

K. Gas Supply

1. Once the thermocouple detects pilot flame, the combustion air flow increase to a pre-determined rate, the automatic block valve opens, operation of the selected gas blower begins, supplying gas to the flare. After the gas blower has been on for a pre-determined time, the combustion air flow will decrease to the corrected flow rate. If the open limit switch for the automatic block valve is not achieved within twenty seconds, the “Automatic Block Valve Failure” status is indicated and system operation discontinues.

L. Automatic Temperature Control

1. The operating temperature, or temperature maintained inside the flare enclosure, is controlled by varying the ambient air available through the air damper louvers. The elevation of the temperature control thermocouple is selected depending on the gas flow rate and methane concentration. The operating temperature is maintained by adjusting automatically the position of the louvers. Closing the louvers reduces the amount of air available and increases the operating temperature, while opening the louvers increases the amount of air available and decreases the operating temperature. The louvers are maintained open initially, before beginning automatic temperature control modulation, which introduces air inside the flare enclosure while the enclosure is cold and lacking draft, to minimize smoke during initial operation.

2.19.11 System Failure

A. Purge Failure

1. A purge air flow meter shall monitor positive pressure during the purge cycle. If positive pressure is not detected during the purge cycle, the “Purge Failure” alarm will be indicated and system operation discontinues.

B. Automatic Block Valve Failure

1. If either the open or closed limit switch for the automatic block valve indicates improper valve position any moment during operation, the “Automatic Block Valve” light flashes and system operation discontinues.

C. Pilot Flame Failure

1. During the ignition sequence, pilot flame failure shall occur when the thermocouple is unable to detect the presence of flame inside the flare enclosure.

If the thermocouple is unable to detect flame, the entire purge cycle and ignition sequence is repeated. "Flame Failure" is indicated and system operation discontinues only after three consecutive, unsuccessful attempts occur.

D. Main Flame Failure

1. Main Flame Failure occurs, once the ignition sequence is complete, when the flame scanner is unable to detect flame is present inside the flare enclosure. When Main Flame Failure occurs, system operation is interrupted momentarily. Then the entire purge cycle and ignition sequence are repeated automatically. A Shutdown occurs only after three consecutive Failures, or unsuccessful attempts. Once Main Flame Shutdown occurs, the "Flame Failure" status is indicated and system operation discontinues.

E. Flare Low Temperature

1. Flare low temperature shall occur when a temperature below 1,200 °F is detected inside the flare enclosure by the selected controlling thermocouple and exists for ten minutes consecutively. The corresponding "Flare Low Temperature" alarm is indicated and system operation discontinues. The low temperature timer resets the moment a temperature above 1,200 °F is detected during normal operation.

F. Flare High Temperature

1. Flare high temperature shall occur the moment a 2,000 °F temperature is detected inside the flare enclosure by a dedicated high temperature thermocouple. The "Flare High Temperature" alarm is indicated and system operation discontinues immediately.

G. Low Combustion Air Flow

1. Low combustion air flow shall occur the moment the measured air flow is determined to be an incorrect flow ratio with the given landfill gas flow rate and methane concentration, as determined by the PLC. "Low Combustion Air Flow" will be indicated and system operation discontinues immediately.

H. Burner Flashback

1. Burner flashback shall occur when a temperature above the desired set point is detected on the burner thermocouples. "Burner Flashback" is indicated and system operation discontinues immediately.

2.19.12 Existing Conditions

A. Inspection

1. Prior to all work of this section, the Contractor and the flare and gas handlingskid manufacturer's representative in charge shall carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.

2. Verify that the Work of this section may be installed in accordance with all pertinent codes and regulations, the original design, and the referenced standards.

B. Discrepancies

1. In the event of discrepancy, the contractor shall immediately notify the Engineer.

2. The contractor shall not permit the manufacturer's representative in charge of system startup to proceed with commissioning in areas of discrepancy until such discrepancy has been resolved.

2.19.13 Installation

A. General: Install the Work of this section in strict accordance with the manufacturer's recommendations as approved by the Engineer.

B. Installation shall proceed in compliance with the submitted installation schedule, as approved by the Engineer.

C. Contractor shall install all foundations and surface treatments in accordance with the specifications and drawings of this project.

D. The Work of this section shall be installed plumb and perpendicular to piping where required on the Construction Plans.

E. Painting: Marred or abraded surfaces shall be cleaned and refinished in accordance with the manufacturer's recommendations.

2.19.14 Start-up and Testing

A. Factory Test: The entire system, including all controls shall be tested at the manufacturer's plant before shipment. Complete test reports shall be made available to the Engineer which shall show all system controls operate correctly prior to shipment.

B. Start Up: System start-up shall be performed by the manufacturer's factory-trained representative for a minimum of 3 days start-up demonstration and testing and one day of personnel training. The representative will remain on site until start-up of the system has been completed as approved by the Engineer.

C. Functional and Validation Tests: Upon completion of the installation, functional and validation tests shall be performed by the contractor with the assistance of the

manufacturer's representative. The manufacturer's representative will demonstrate compliant operation of the system to the Engineer's satisfaction. Should the system NOT perform to the requirements of this section, the expense of any re-testing, if required, will be borne by the system manufacturer, unless failure to achieve successful operation is neither the fault or cause of the manufacturer.

2.19.15 Instructions

A. When all required approvals of this portion of the Work have been obtained, and at time designated by the NJDEP and/or Engineer, the contractor and/or the manufacturer's representative in charge of start-up and testing shall thoroughly demonstrate to the NJDEP's operation and maintenance personnel, the operation and maintenance of all items installed under this work and Section 2.18.

B. The instructions shall be separate from the installation, start-up and equipment adjustment services.

2.19.16 Cleaning

A. Clean exposed surfaces of all grease, dirt and other foreign materials.

B. touch up all marred or abraded surfaces as specified herein.

2.19.17 Measurement and Payment

Payment for the Gas Flare System shall be included in the lump sum cost for Gas Blower and Flare System under Bid ~~i~~Item 2.18.

END OF SECTION

2.20 Coarse Aggregate

2.20.1 Description

Coarse aggregate shall be used for a variety of applications for this project, as shown on the Contract Drawings, including; pipe bedding, structure foundations, and general fill in wet areas. Coarse aggregate is not permitted to be in contact with the geomembrane. Aggregates from a single source shall be used in any one construction item, unless otherwise authorized. Aggregates from different sources may be permitted, if they are of the same geological classification and have similar specific gravities and color. The coarse aggregate shall include purchase, stockpiling, hauling, and placement of pre-qualified material from off-site.

2.20.2 Material

Unless specified otherwise Coarse aggregate shall comply with NJDOT Specification (latest edition) for Coarse Aggregate #57, and these specifications. Coarse aggregate shall be broken stone or washed gravel. Broken stone shall be uniform in texture and quality and shall be free of organic matter, wood, garbage, metal, debris, or lumps of clay. Coarse aggregate may be produced from recycled concrete aggregate in areas other than the Leachate Collection System (LCS). Coarse Aggregate used in the LCS shall be non-calcareous. Slag will not be permitted.

Requirements for Clean Fill

All material brought from off-site must meet the following requirements (from NJAC 7:26E-6.4):

1. Fill shall be uncontaminated pursuant to the more stringent of DEP's Non-Residential Direct Contact Soil Remediation Standards or DEP's Default Leachate Criteria for Class II Ground Water found in DEP's Guidance for the use of the Synthetic Precipitation Leaching Procedure to Develop Site-Specific Impact to Ground Water Remediation Standards and shall be free of extraneous debris or solid waste. Additional testing, sampling, and laboratory delays will result for all changes of source of imported fill. Fill placed under the geomembrane does not need to be tested for Site-Specific Impact to Ground Water Remediation Standards. All fill shall meet the Non-Residential Direct Contact Soil Remediation Standards.

2. Documentation shall be provided by certification by the supplier stating that it is virgin material from a commercial or noncommercial source or decontaminated recycled soil.

3. All proposed sources of fill must be pre-approved by the Engineer. Bills of lading shall be provided to the Engineer to document the source(s) of fill. The documentation shall include: (1) the name of the affiant and relationship to the source of the fill, (2) location where the fill was obtained, including the street, town, lot, block, county and state and a brief history of the site which is the source of fill, and (3) a statement that to the best of the affiant's knowledge and belief the fill being provided is not contaminated pursuant to #1 above and a description of the steps taken to confirm such.

4. The Engineer will acquire samples for analytical testing for compliance with the NJDEP Standards and Guidance for clean fill as described in Item (1) above. No fill may be brought to the site until the Engineer confirms that it meets the NJDEP Standards and Guidance. The Contractor should allow adequate time in his project schedule for the sampling, analysis, and review of analytical data.

2.20.3 Submittals

Submittals shall be according to Section 1.3 and shall include the source location, and results of analysis indicating material meets the criteria of these Technical Specifications.

2.20.4 Placement and Compaction

Placement and compaction of the Coarse Aggregate within the waste material below the liner system, and as directed by the Engineer, shall be accomplished as follows. Material shall be placed in lifts not exceeding 8 inches, and compacted by a series of at least 6 passes of the same compaction equipment used for compaction of the waste material.

Coarse Aggregate placed underwater or on wet/unstable ground shall be constructed by end-dumping methods. Care will be taken not to damage geotextiles. When backfilling is interrupted for a period of 24 hours or more, dumping shall not resume until the excavation has been inspected and approved by the Engineer. End dumping shall be used only to an elevation that permits compaction equipment. The remainder of the Coarse Aggregate fill shall be placed and compacted as specified herein.

Material used for structure foundations within the waste material shall be placed in lifts not exceeding 8 inches, and compacted using hand tampers to a minimum of 95% of the Standard Proctor maximum density (ASTM D698), or 67% of the Relative Density (ASTM D4253 and D4254), or as specified by the Engineer.

Hand tamping equipment shall be used for compaction of Coarse Aggregate material within the gas collection trenches (Sections 2.16), the infiltration collection trenches (Section 2.16), and the Storm Piping trenches (Section 2.22). Coarse Aggregate in pipe trenches shall be placed in lifts not exceeding 4 inches loose depth and compacted using hand tampers to a minimum of 95% of the Standard Proctor maximum density (ASTM D698), or 67% of the Relative Density (ASTM D4253 and D4254), or as specified by the Engineer.

2.20.5 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Unit
2.20	Coarse Aggregate, If and where directed	Cubic Yard

The Contractor will be paid the bid price per cubic yard pertaining to the use and placement of Coarse Aggregate material if and where directed by the Engineer. Costs for obtaining off-site material, labor and equipment shall be included in the Contractor's unit price(s) for the specific use proposed.

Separate payment will not be made for Coarse Aggregate paid under other pay items. Instead, payment for the use and placement of the Coarse Aggregate will be included in the unit pricing for those items.

END OF SECTION

2.21 Riprap

2.21.1 General

This work is construction of riprap lining installed in the stomwater swales and at stomwater outfall locations, as shown on the Contract Drawings.

2.21.2 Material

Riprap stone shall conform to the NJDOT Standard Specifications (latest edition) requirement for Riprap Stones, and these specifications.

Acceptable quality; sound; free from structural defects and foreign substances, such as soil, shale, and organic materials. Recycled aggregate may be acceptable as determined by the Engineer. Slag will not be permitted.

Geotextile, Type A shall be in accordance with Section 2.14.

Submittals shall be in accordance with Section 1.3.

Use rock meeting the following requirements:

- No shale seams.
- Hard and angular shaped rock with neither width nor thickness less than one-third its length.
- Minimum specific gravity of 2.5, bulk-saturated, but surface-dry basis.
- Each load of rock well-graded, from the smallest to the largest size.

Riprap to be used as the riprap apron at the outfall of the discharge pipes from the northern and southern detention basins and as riprap lining within the east swale) between stilling well 7 and the southern detention basin), as indicated on the Contract Drawings, shall have a median stone diameter size (d_{50}) of 4".

Riprap to be used at the flared end section of the culverts near the junkyard in the west end of the Site shall have a median stone diameter size (d_{50}) of 7".

The stone gradation shall comply with the following tables:

4" Riprap Percent Passing (Square Opening)	
Rock Size (Inches)	**Percent Passing (%)**
6	100
5	50-75
4	15-50
2	0-15

7" Riprap Percent Passing (Square Opening)	
Rock Size (Inches)	**Percent Passing (%)**
10.5	100
8.75	50-75
7	15-50
3.5	0-15

Acceptance of gradation will be based upon certification data provided by the supplier.

Requirements for Clean Fill

All imported fill brought from off-site must meet the following requirements (from NJAC 7:26D):

1. Fill shall meet the clean fill requirements as specified in the NJDEP "Alternative and Clean Fill Guidance for SRP Sites, Updated December 29, 2011, Version 2.0". Additional testing, sampling, and laboratory delays will result for all changes of source of imported fill.

2. All proposed sources of fill must be pre-approved by the Engineer. Bills of lading / affidavit shall be provided to the Engineer to document the source(s) of fill. The documentation shall include: (1) the name of the affiant and relationship to the source of the fill, (2) location where the fill was obtained, including the street, town, lot, block, county and state and a brief history of the site which is the source of fill, and (3) a statement that to the best of the affiant's knowledge and belief the fill being provided is not contaminated pursuant to #1 above and a description of the steps taken to confirm such.

~~3. The Engineer will acquire samples for analytical testing for compliance with the NJDEP Standards and Guidance for clean fill as described in Item (1) above. No fill may be brought to the site until the Engineer confirms that it meets the NJDEP Standards and Guidance. The Contractor should allow adequate time in his project schedule for the sampling, analysis, and review of analytical data.~~

2.21.3 Construction

Riprap shall be installed on a prepared surface as shown on the Contract Drawings. The surface for receiving Riprap shall be approved by the Engineer prior to installation of Riprap.

Riprap shall be installed in accordance with NJDOT Standard Specifications (2007) Section 603.03.03 'Riprap Stone Slope or Channel Protection.'

Rearrange individual rocks, if necessary, to ensure uniform distribution.

2.21.4 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Unit
2.21.1	4" Riprap, If and Where Directed	~~Cubic Yard~~Ton
2.21.2	7" Riprap, If and Where Directed	~~Cubic Yard~~Ton

Riprap shall be measured by the ~~Cubic Yard~~Ton of Riprap delivered and installed in accordance with the Contract Plans. Measurement shall be based upon certified weigh tickets. Riprap shall be installed at the thicknesses indicated herein and on the Contract Drawings and/or as directed. Installation shall include bedding preparation, ~~installation of Geotextile, Type A~~ and placement of Riprap stone. Installation of Geotextile, Type A shall be paid on If and Where Directed basis under item 2.14.1. Payment shall be based upon the Unit Price of Riprap completed, installed and accepted by the Engineer. The Unit Price for Riprap shall include materials (Riprap stone ~~and Geotextile, Type A~~), labor, and testing to complete the work described herein. Refer to Section 1.2.29 for addition language regarding if and where directed items.

END OF SECTION

2.22 Storm Piping

2.22.1 Description

Work within this Section shall include the storm drainage piping, associated fittings and accessories, and bedding.

The following reference standards shall be adhered to:

HDPE Pipe Specification –

NJDOT Standard Specifications (2007) Section 909.02.02 – Standard Specification for HDPE Pipe
NJDOT Standard Specifications (2007) Section 601 – Standard Specification for Pipe
ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
AASTHO M294 Type S – Standard Specification for Corrugated Polyethylene Pipe (12” to 36”).

Joint Certification –

ASTM D 3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

Gasket Specification –

ASTM D 1056 – Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber,
ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

Submittals

Submittals shall be in accordance with Section 1.3.

Product Data: The Contractor shall provide catalog materials / cut sheets / shop drawings for all drainage structures described herein including but not limited to pipe, pipe joints / fittings, stormwater inlets, stilling well, stormwater overflow structures, stormwater outfalls, concrete thrust blocks, HDPE flared end sections, HDPE anti-seep collar, check valves.

Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.

Manufacturer's Certificate: Certify that products meet or exceed ASTM designations.

Project Record Documents

Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.

Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

2.22.2 Storm Pipe Materials and Accessories

2.22.2.1 Downpipe

Downpipe shall be 12" or 18" diameter (as shown on the Drawings) Corrugated Plastic Pipe (CPP). CPP shall be Corrugated High Density Polyethylene (HDPE) Pipe with a Smooth Interior (SLCPP): Only permitted when specifically indicated on Drawings and conform to AASHTO Designation M294 Type S with gasketed silt-tight joints. Pipe joints shall be watertight and conform to ASTM D 3212 (10.8 psi water) laboratory certification. Use HDPE pipe from a manufacturer who is qualified by the Department of Transportation's National Transportation Product Evaluation Program (NTPEP).~~Use HDPE pipe from a manufacturer who is an Eastern States Consortium (ESC0 qualified manufacturer of HDPE.~~ The Contractor shall submit a certification of compliance as specified in Section 106.07 of the NJDOT Standard Specifications.

CPP HDPE pipe shall have an integral bell and spigot gasket, or equivalent as approved by the Engineer. Pipe shall have smooth interior and annular exterior corrugations. Pipe diameter shall be as shown on the Contract Drawings. Pipe must be installed in accordance with pipe manufacturer's installation guidelines for storm water drainage applications. See Section 2.22.2.7 for pipe joints.

2.22.2.2 Stormwater Inlet

Stormwater Inlets are located swales to collect stormwater and transfer the flow to downpipes. Refer to Contract plans for location and details.

Storm Rack

Material

The Storm Rack shall be light weight and may be constructed of ~~resin used for s~~Structural p~~P~~lastic or other materials suitable to withstand the elements (range of weather conditions) and loadings (flow conditions and worker entry to inlet) required at the site. ~~Storm Racks shall be glass reinforced HDPE (High Density Polyethylene). Virgin material must be used to insure that all of the expected mechanical properties are maintained throughout the life of the Storm Rack. The added rigidity provided by the glass fill must meet maximum deflection values as shown below. In addition, the glass content must not cause the material to become brittle even in cold temperatures (-0 degrees F). The grid used to manufacture Storm Racks must conform to the following mechanical properties:~~

~~Load Rating: 1,500 lbs./sq. ft.~~
~~Ultimate Yield Strength: 1855 lbs./sq. ft.~~
~~Maximum Deflection (@90 degrees F): < 2.00 inches~~

UV Considerations

~~Due to the fact that~~ Storm Racks are continually exposed to radiation and shall be able to suitably withstanding UV degradation.~~, UV protection must be incorporated into the resin to prevent premature degradation of the plastic material. Therefore, the UV protection must meet or exceed ASTM D2565-99.~~

Colorant Considerations

The colorant (if used) must be homogenous and must not fade, run, discolor or deteriorate when exposed to sunlight and/or the elements for the life of the Storm Rack.

Mounting Considerations

Each Storm Rack design must account for both the physical and hydraulic factors that the Storm Rack is expected to see during its intended product life. Mounting locations must be determined by taking into account the hydraulic dynamic force factors for each individual application. ~~Failure to use the pre-drilled holes (as supplied by the manufacturer) which are calculated to meet these requirements could result in product breakdown, malfunction and/or collapse. All mounting hardware (3/8" X 3" anchor bolts) is included with each Storm Rack.~~ It is the Contractor's responsibility to mount the storm rack in accordance with manufacturer's recommendations.

Physical Properties

Grid Material ~~is 1 1/2" thick with 5/8" webbing 6" on center~~shall be as recommended by the manufacturer and suitable for blocking debris (leaves, grass clippings etc) while allowing flow into the Catch Basin. ~~Anti-vortex plates must be available for whenever hydraulic calculations dictate their use.~~ Storm Rack shall be removable ~~Access door(s) must be available~~ for ~~easier~~ access ~~to larger structures/stairs~~ to the Catch Basin. All metal stiffeners must be made from 316 stainless steel to prevent corrosion. ~~Stainless steel anchor bolts (for mounting the Storm Rack to the concrete structure), should be utilized to eliminate corrosion concerns as well as provide easy future access/removal.~~

Catch Basin

Catch Basin shall be 36" diameter (as shown on the Drawings) Corrugated Plastic Pipe (CPP). CPP shall be Corrugated High Density Polyethylene (HDPE) Pipe with a Smooth Interior (SLCPP): Only permitted when specifically indicated on Drawings and conform to AASHTO Designation M294 Type S with gasketed silt-tight joints. Joints shall be watertight and conform to ASTM D 3212 (10.8

psi water) laboratory certification. Use HDPE pipe from a manufacturer who is an Eastern States Consortium (ESC) qualified manufacturer of HDPE. The Contractor shall submit a certification of compliance as specified in Section 106.07 of the NJDOT Standard Specifications.

Catch basin shall match the dimensions shown on the Contract Drawings. Catch basin shall be welded to a 1" thick HDPE board with dimensions shown on the drawings. The board shall be used for securing the catch basin to the underlying concrete slab. The catch basin and concrete slab shall be secured as depicted on the plans..

Concrete Slab

Concrete slab shall be constructed of concrete in accordance with Section 2.25. Concrete slab shall be placed at locations of catch basin as shown on the Contract Drawings. Concrete slab shall match the dimensions shown on the Contract Drawings.

2.22.2.3 Stilling Well

Stilling Wells are located where downpipes outlet to perimeter swales or basin. Refer to Contract plans for location and details. Stilling well construction shall meet the requirements of NJDOT pre-cast inlet basin (NJDOT Standard Construction Detail Sheet CD-602-1) for concrete, reinforcement, wall thickness and structure bedding requirements. Stilling Wells shall be pre-cast concrete and have the following minimum reinforcement: Horizontal Reinforcement #13 @ 10" O.C. and Vertical Reinforcement #13 @ 18" O.C. (note that reinforcement steel is given in metric units).

Thrust Blocks

Thrust Blocks shall be constructed of concrete in accordance with Section 2.25. Thrust blocks shall be placed at locations where downpipes connect to stilling wells as shown on the Contract Drawings. Thrust blocks shall match the dimensions shown on the Contract Drawings.

2.22.2.4 Stormwater Overflow Structure

Stormwater Overflow Structures are located at drainage culvert inlets where stormwater flows from basins flows into culverts. Refer to Contract plans for location and details.

2.22.2.5 Stormwater Discharge Pipe

Stormwater Discharge Pipe shall be 24" Diameter Corrugated HDPE Pipe meeting the requirements described above under Section 2.22.2.1.

Stormwater Discharge Pipes are located at locations where stormwater discharges from detention basins. Discharge pipes shall cross the perimeter roadway and slurry wall. Refer to the Contract Drawings for locations and details. See Section 2.22.2.7 for pipe joints.

HDPE Anti-seep Collar

HDPE anti-seep collars shall be for 24" HDPE pipe and shall be as manufactured by Scheib or Approved Equal. Anti-seep collars shall be installed at locations where stormwater discharge pipes cross slurry wall for outlet of storm water detention basins and shall be constructed in accordance with details on the Contract Drawings.

Check Valve

Check valves shall be installed at storm water outfall where stormwater discharge pipes outlet for backflow prevention. Check valves shall match the dimensions and properties indicated on the Contract Drawings. Check valves shall be Series TF-1, as manufactured by Tideflex Technologies, or Approved Equal.

The valve shall be installed onto the pipe by means of sliding the cuff portion of the valve over the pipe outlet at a minimum 9 inch depth and compressing the valve cuff portion against the exterior surface of the pipe by using a metallic compression clamp. The compression clamps and bolting hardware shall be constructed of 304 stainless steel for Hose Clamps and 304L stainless steel for Fabricated Clamps and provided as an ancillary component with each valve. The Contractor shall install the valve through 2 bolted fabricated band clamp. The bolts shall be driven through the valve, clamp and pipe to prevent losing the valve during high flow through the pipe.

The Contractor shall adhere to the manufacturer's delivery, storage and material handling and installation requirements.

2.22.2.6 Drainage Culvert

Drainage Culvert shall be 18" Diameter Corrugated HDPE Pipe meeting the requirements described above under Section 2.22.2.1.

Two 18 inch diameter culvert pipes shall connect swales located in western portion of the Site as shown on Contract Plans. See Section 2.22.2.7 for joining pipe segments.

HDPE Flared End Section

The HDPE Flared End Section shown on the Contract Drawings shall be high density polyethylene meeting ASTM D3350 minimum cell classification 213320C as manufactured by ADS or Approved Equal. The HDPE flared end section shall be installed at the outlet of the two 18 inch diameter drainage culverts connecting the two swales located in the west of the Site.

2.22.2.7 Pipe Joints / Fittings / Couplers

Pipe shall be joined with a gasketed integral bell and spigot joint meeting the requirements of NJDOT Standard Specifications 601.03.01. Pipe shall be watertight according to the requirements of ASTM D3212. Spigots shall have gaskets meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufactures and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufactures shall be used on the gasket and

bell during assembly. Pipe shall have a reinforced bell with a polymer composite band installed by the manufacturer.

Bell & spigot connections shall utilize a spun-on, welded or integral bell and spigot with gaskets meeting ASTM F477. Bell & spigot fittings joint shall meet the watertight joint performance requirements of ASTM D3212.

To assure water tightness, field performance verification may be accomplished by testing in accordance with ASTM F1417 or ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. The Contractor shall coordinate with the manufacturer for recommended leakage rates.

Watertight field couplers shall conform to ASTM D 1056. Couplers must be installed in accordance with the manufactures installation guidelines for storm water drainage applications. Provide a manufacturer recommended locking mechanism for adjacent pipe sections to prevent pipe separation due to gravity, water flow, and settlement.

2.22.2.8 Concrete Water Channel

Contractor shall furnish and install precast concrete water channels within northern and southern detention basins at the locations shown on the Contract Drawings. Minimum dimensions of the concrete water channel shall be in accordance with the details on the Contract Drawings. The intent of the concrete channels is to assist water flow from downpipe outlets to inlets of stormwater discharge pipes.

2.22.3 Construction

The Contractor shall verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on Contract Drawings. Wastefill and Earth Excavation required for the items in this Section shall be conducted in accordance with Section 2.4.

Hand trim excavations to required elevations. Replace over-excavated material with common fill, as noted in Section 2.26. Required over-excavation will be incidental to the pipe placement and will not be paid for separately.

The Contractor shall remove large stones or other hard matter, which could damage piping or impede consistent backfilling or compaction.

The Contractor shall excavate pipe trench and bedding material as shown on the Contract Drawings and in accordance with these specifications.

Contractor shall verify that pipe sections are lowered into the trench without damage to the pipe or pipe ends where couplings are to be made.

All joints of drainage pipes shall be water tight.

During handling, placement, and joining bell and spigot joints, and gaskets, must be free of mud, grit, and other foreign material in order to enable effecting joining and sealing. After the joint is aligned, it is necessary to drive the spigot end of one pipe to its proper distance into the receiving bell of an adjoining pipe. Pipe shall be laid with bells upstream. A bar and block may be used to provide the levered action. This consists of vertical bar driven into the ground, bearing against a horizontal wood block that protects the upstream end of the pipe to be moved. Avoid sudden thrusts of force, which can damage the pipe.

2.22.4 Pipe Installation

1. The Contractor shall confirm that pipe storing and handling, excavation, placement of bedding, pipe installation, joining pipe joints, and backfilling activities are in accordance with Specification Section 601.03 of the NJDOT Standard Specifications.
2. Install pipe, fittings, and accessories in accordance with ASTM D2321 and manufacturer's instructions and state or local requirements. Watertight joints shall be used to connect the sections of pipes.
2. Install pipe on pipe bedding in accordance with the Construction Details, and the placement and compaction guidelines defined in Section 2.28.4.
3. Lay pipe to slope gradients noted on construction drawings.
4. Connect pipe joints in accordance with the manufacture’s instruction. Apply watertight field couplers and secondary seal to all joints in accordance with the manufacturer’s specifications.
5. Backfill pipe with in accordance with the Construction Details and the manufacturer’s specifications. Do not displace or damage pipe when compacting.

2.22.5 Field Quality Control

1. Bedding Tests: As indicated in Section 3.5, but not less than one test per lift, per 200 linear feet of trench, when backfilling trenches.
2. After backfilling trench with minimum 1 foot over top of pipe, the Contractor shall inspect the piping by means of a television camera pulled through the pipe. Engineer shall be present when this testing is accomplished and the Contractor shall provide the State a copy of the recording in DVD format. Any pipeline section found to have been deformed by 10 percent or more of its original diameter shall be removed and replaced or returned to its original shape, then reinstalled and retested, at no additional cost to the State.

2.22.6 Protection

Protect pipe and aggregate cover from damage or displacement.

2.22.7 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Unit
2.22.1	Downpipe, 12” Diameter	Linear Feet

2.22.2	Downpipe, 18" Diameter	Linear Feet
2.22.3	Stormwater Inlet	Each
2.22.4	Stilling Well	Each
2.22.5	Stormwater Discharge Pipe	Linear Feet
2.22.6	North Basin - Stormwater Overflow Structure	Each
2.22.7	South Basin - Stormwater Overflow Structure	Each
2.22.8	Drainage Culvert	Linear Foot
2.22.9	Concrete Water Channel	Linear Foot

Downpipe, 12" Diameter shall be measured by the Linear Foot of 12" Diameter CPP installed in place measured in the horizontal plane. Payment shall be based upon the Unit Price of 12" Diameter pipe completed and installed in place, for materials, labor, and testing, including wastefill and earth excavation, bedding, pipe collars and backfilling shall be included in the unit cost for Pay Item 2.22.1.

Downpipe, 18" Diameter shall be measured by the Linear Foot of 18" Diameter CPP installed in place measured in the horizontal plane. Payment shall be based upon the Unit Price of 18" Diameter pipe completed and installed in place, for materials, labor, and testing, including excavation, bedding, pipe collars and backfilling shall be included in the unit cost for Pay Item 2.22.2.

The bid item price for Item 2.22.3 Stormwater Inlets shall include materials, labor, installation, and testing and shall be measured as Each stormwater inlet installed.

The bid item price for Item 2.22.4 Stilling Well shall include materials, labor, installation, and testing and shall be measured as Each stilling well installed. Costs for excavation for stilling well installation, concrete thrust block, stilling well structure, coarse aggregate between stilling well and gabions, and 24" thick I-5 Fill bedding directly under stilling well (as shown on the Contract Drawings) shall be included in the unit bid price for Bid Item 2.22.4.

The bid item price for Item 2.22.5 Stormwater Discharge Pipe shall include materials, labor, installation, and testing and shall be measured by the Linear Foot of 24" Diameter CPP HDPE pipe installed in place measured in the horizontal plane. The Linear Foot unit cost for Stormwater Discharge Pipe shall include materials and installation of pipe, coarse aggregate #57 bedding (under and over discharge pipes), HDPE anti-seep collar at slurry wall crossing, and check valves at outlet ends of discharge pipes.

The bid item price for Items 2.22.6 and 2.22.7 shall include any materials, labor, installation, and testing costs associated with the installation of the Stormwater Overflow Structures at the northern and southern detention basins and shall be measured as Each Stormwater Overflow Structure installed.

Drainage Culvert shall be measured by the Linear Foot of 18" Diameter CPP HDPE pipe installed in place measured in the horizontal plane. This includes any materials, labor, and testing, associated with the installation of the Drainage Culvert including, but not limited to, excavation, bedding, pipe collars, HDPE flared end section, and backfilling shall be included in the unit cost for Pay Item 2.22.8.

Concrete Water Channel shall be measured by the Linear Foot of precast channel installed in place measured in the horizontal plane. This includes any materials, labor, and equipment, associated with the installation of the concrete channel including excavation and I-5 fill bedding required for the installation of the concrete channel. Payment for the unit price for concrete water channel shall be paid under Pay Item 2.22.9.

Wastefill and Earth Excavation required for the items in this Section shall be conducted in accordance with Section 2.4. Payment for Wastefill and Earth Excavation shall be made via Pay Item 2.4.

END OF SECTION

2.23 Wire Mesh Gabions

2.23.1 General

This specification is for the procurement and installation of steel wire mesh gabion and mattress units (see Section 2.23.3 for description) used as a measure of protection against erosion forces of stream flow in water courses and slope instability.

The work under this specification includes furnishing, assembling, filling and tying open wire mesh rectangular compartmented gabions and mattress placed on a prepared surface of geotextile and common fill, as specified, and in accordance with the lines, grades, and dimensions shown in the drawings or otherwise established in the field.

2.23.2 Submittals

The following shall be submitted in accordance with Section 1.3:

A. Samples

Samples of the materials, used to fabricate the gabions or mattresses, shall be furnished to the Engineer 60 days prior to assembly of units onsite so that testing may be performed by the Engineer in accordance with either ASTM A 974 or ASTM A 975 depending on which system is being furnished by the Contractor. Samples shall include:

Gabions;
Alternative Wire Fasteners

B. Test Reports

For each shipment of wire gabions or mattresses delivered to the site, the Contractor shall furnish the Engineer, in duplicate, test reports or records that have been performed during the last year. All material contained within the shipment shall meet the composition, physical, and manufacturing requirements stated in this specification.

C. Certificates

A certificate or affidavit signed by a legally authorized Principal of the Supplier, who is providing the stone fill and the geotextile, stating that it meets the specifications.

2.23.3 Description

Gabions and mattress are wire mesh containers of variable sizes, uniformly partitioned into internal cells, interconnected with other similar units, and filled with stone at the project site to form flexible, permeable, monolithic structures. Gabions and mattress shall be manufactured with all components mechanically connected at the production facility with the exception of the mattress lid, which is produced separately from the base. The supply to the jobsite of unassembled individual

wire mesh components (panels) forming gabions and mattress will not be permitted. Definitions of terms specific to this specification and to all materials furnished on the jobsite, with the exception of the rock to fill the baskets and the filter material, shall refer and be in compliance with ASTM A 975 for double twisted wire mesh Gabions and Revet mattresses. For ease of reference, the term "mattress" will be used in this specification in place of Revet mattress and/or Gabion mattress, where the statement is of general nature and it is not specific to the double twisted mesh wire products.

2.23.4 Definitions

Double twisted wire mesh Gabions - Double twisted wire mesh Gabions consisting of wire mesh made from wire which is coated with Zn-5Al-MM before being double twisted into mesh. Fasteners, lacing wire, and stiffeners are also produced from Zn-5Al-MM coated wire.

2.23.5 Testing

Samples of materials used to fabricate the Gabions shall be furnished to the Engineer 60 days prior to start of installation.

Copies of the manufacture’s quality control test results shall be furnished to the Engineer.

2.23.6 Materials

A. Double twisted wire mesh Gabions

Double twisted wire mesh Gabions shall be as defined and manufactured with a non-raveling mesh made by twisting continuous pairs of wires through three half turns (commonly called double twisted) to form a hexagonal-shaped opening. Gabion sizes, wire diameters, mesh opening sizes, and tolerances shall comply with the requirements of ASTM A 975. Gabions shall meet the following test requirements:

Metallic coating - The coating weights shall conform to the requirements of ASTM A 856 and ASTM A 90 as applicable.

Wire Tensile Strength - The tensile strength of the wire used for the double twisted mesh, lacing wire, and stiffener, when tested in accordance with Test Methods and definitions ASTM A 370, shall be in accordance with the requirements of ASTM A 856, for soft temper wire. Galvanized hog rings may be substituted for lacing wire if manufactured by Spenax Corporation or equivalent, as approved by the Engineer.

Zinc Coating (Galvanizing) –

a. All wire used in fabrication of the gabions during construction shall be coated to ASTM A641-89 Zinc Coated (galvanized) carbon steel wire. The minimum weight of the zinc coating shall be in accordance to the following when tested in accordance with ASTM A90-81:

Nominal Diameter of Wire	Minimum Weight of Coating
0.0866 inches	0.70 ozs/sq. ft.
0.1063 inches	0.80 ozs/sq. ft.
0.1338 inches	0.80 ozs/sq ft.

b. The adhesion of the zinc coating to the wire shall be such that when the wire is wrapped six turns around a mandrel of 4 times the diameter of the wire, it does not flake or crack to an extent that any zinc can be removed by rubbing with bare fingers.

Mesh strength and panel to panel joint strength - The minimum strength requirements of the mesh, selvedge wire to mesh connection, panel to panel connection, and punch test, when tested in accordance with ASTM A 975 Section 13.1, shall be as shown in Table 2.23-1. The strength values reported in lb/ft are referred to the unitary width of the specimen. The panel to panel test shall demonstrate the ability of the fastening system to achieve the required strength, and indicate the number of wire revolutions for the lacing wire or the ring spacing for ring fasteners used. The same number of wire revolutions or ring spacing shall be used in the field installation.

TABLE 2.23-1
Minimum Strength Requirements of Mesh and Connections

Test description	Gabions, metallic coated lb/ft	Revet mattresses lb/ft
Tensile strength parallel to twist	3500	2300
Tensile strength perpendicular to twist	1800	900
Connection to selvedges	1400	700
Panel to panel (using lacing wire or ring fasteners	1400	700
Punch Test	6000	4000

B. Testing

Test records made within one year by certified laboratories and State agencies will be used to determine the acceptability of the fastening system. Samples of wire fasteners and samples of material for fabricating the gabions and mattresses with their certified test records shall be submitted at least 60 days in advance to the Engineer for approval. The State reserves the right to test additional samples to verify the submitted test records at the State's expense. When the first test results indicate that the fasteners do not meet the specified requirements, the additional test will be at the Contractor's expense. The fasteners will be rejected after two tests failing to meet the requirements.

C. Stone Fill

For gabions and mattress, the ability to function properly depends upon their stability, which is partly dependant upon the rocks filling them. Rock sizes should be chosen to prevent them from falling through the mesh of the gabions or mattresses. The rock has also to withstand natural weathering processes during the life of the project that would cause it to breakdown to sizes smaller than the wire mesh opening dimensions. Rock to fill gabions and mattress shall be durable and of suitable quality to ensure permanence in the structure and climate in which it is to be used.

Requirements for Clean Fill

All material brought from off-site must meet the following requirements (from NJAC 7:26E-6.4):

1. Fill shall be uncontaminated pursuant to the more stringent of DEP's Non-Residential Direct Contact Soil Remediation Standards or DEP's Default Leachate Criteria for Class II Ground Water found in DEP's Guidance for the use of the Synthetic Precipitation Leaching Procedure to Develop Site-Specific Impact to Ground Water Remediation Standards and shall be free of extraneous debris or solid waste. Additional testing, sampling, and laboratory delays will result for all changes of source of imported fill. Fill placed under the geomembrane does not need to be tested for Site-Specific Impact to Ground Water Remediation Standards. All fill shall meet the Non-Residential Direct Contact Soil Remediation Standards.

2. Documentation shall be provided by certification by the supplier stating that it is virgin material from a commercial or noncommercial source or decontaminated recycled soil.

3. All proposed sources of fill must be pre-approved by the Engineer. Bills of lading shall be provided to the Engineer to document the source(s) of fill. The documentation shall include: (1) the name of the affiant and relationship to the source of the fill, (2) location where the fill was obtained, including the street, town, lot, block, county and state and a brief history of the site which is the source of fill, and (3) a statement that to the best of the affiant's knowledge and belief the fill being provided is not contaminated pursuant to #1 above and a description of the steps taken to confirm such.

4. The Engineer will acquire samples for analytical testing for compliance with the NJDEP Standards and Guidance for clean fill as described in Item (1) above. No fill may be brought to the site until the Engineer confirms that it meets the NJDEP Standards and Guidance. The Contractor should allow adequate time in his project schedule for the sampling, analysis, and review of analytical data.

1. Delivery - Rock shall be delivered to the work site in a manner to minimize its reduction in sizes (breakdown) during the handling of the rock, and be placed and secured within the assembled and interconnected gabion and mattress.

2. Sources - The sources from which the Contractor proposes to obtain the material shall be selected well in advance of the time when the material will be required in the work. The inclusion of more than 5% by weight of dirt, sand, clay, and rock fines will not be permitted. Rock may be of a natural deposit of the required sizes, or may be crushed rock produced by any suitable method and by the use of any device that yields the required size limits chosen in TABLE 2.23-2.

3. Properties - Rocks shall be hard, angular to round, durable and of such quality that they shall not disintegrate on exposure to water or weathering during the life of the structure.

Stone fill, crushed stone, shall meet the quality requirements of ASTM C 33, and freezing and thawing requirements of ASTM D 5312 for the region of the United States in which the structure will be constructed.

Gradation tests of stone for gabions shall be performed every 1,000 tons placed under this contract in accordance with ASTM C 136. Sizes of rock to fill gabions and mattresses are chosen on the basis of the mesh sizes, the structure's thickness, and within the limits shown in TABLE 2.23-2. Within each range of sizes, the rock shall be large enough to prevent individual pieces from passing through the mesh openings. Each range of sizes may allow for a variation of 5% oversize rock by weight, or 5% undersize rock by weight, or both.

4. Oversize Rock - In all cases, the sizes of any oversize rock shall allow for the placement of three or more layers of rock within each gabion compartment and two or more layers of rock within each mattress compartment dependent upon the height of the mattress.

5. Undersize Rock - In all cases, undersize rock shall be placed within the interior of the gabion or mattress compartment and shall not be placed on the exposed surface of the structure. There shall be a maximum limit of 5% undersize or 5% oversize rock, or both, within each gabion and mattress compartment. The required rock gradation is reported in Table 2.23-2.

TABLE 2.23-2
Required rock gradation for gabions

Type of structure	Thickness (height) inch	Rock sizes inch
Gabions	12	4 - 8
Gabions	18 or higher	4 - 8

6. Filter Geotextile - Filter fabrics shall be heavy weight geotextile and meet the provisions of Type B geotextile.

2.23.7 Material Delivery

Gabions shall be delivered with all components mechanically connected at the production facility with the exception of the mattress lid, which is produced separately from the base. All gabions are supplied in the collapsed form, either folded or bundled or rolled, for shipping. Bundles are banded together at the factory for ease of shipping and handling. Bases and lids may be packed in separate bundles.

- Gabions shall be delivered to the jobsite labeled in bundles. Labels shall show the dimensions of the gabions including the number of pieces and the color code.

2.23.8 Foundation Preparation

Foundation preparation shall not take place on frozen or snow-covered ground immediately prior to placing the material, the Engineer shall inspect the prepared foundation surface, and no material shall be placed thereon until that area has been approved.

2.23.9 Filter Placement

Filter fabric shall be placed uniformly on the prepared foundation surface in a manner satisfactory to the Engineer, and as indicated on the drawings or as directed any damage to the foundation surface during the filter placement shall be repaired before proceeding with the work.

2.23.10 Assembly

Double twisted wire mesh gabions shall be assembled per manufacturer directions.

2.23.11 Lacing Operations

When using lacing wire, a piece of wire 1.2 to 1.5 times the length of the edge to be laced shall be cut off. If the edge of the basket is 3 foot long, no more than 4 to 5 feet of wire should be uses at a time to lace. For vertical joints, starting at the bottom end of the panel, the lacing wire shall be twisted and wrapped two times around the bottom selvedge and double and single loops shall be alternated through at intervals not bigger than 4 to 6 inches. The operation shall be finished by looping around the top selvedge wire.

2.23.12 Installation and Filling

Empty gabion units shall be assembled individually and placed on the approved surface to the lines and grades as shown or as directed, with the sides, ends, and diaphragms erected in such a manner to ensure the correct position of all creases and that the tops of all sides are level. All gabion units shall be properly staggered horizontally and vertically as shown in the construction drawings. Finished gabion structures shall have no gaps along the perimeter of the contact surfaces between adjoining units. All adjoining empty gabion units shall be connected along the perimeter of their contact surfaces in order to obtain a monolithic structure. All lacing wire terminals shall be securely fastened. All joining shall be made through selvedge-to-selvedge or selvedge-to-edge wire connection; mesh-to-mesh or selvedge-to-mesh wire connection is prohibited except in the case where baskets are offset or stacked and selvedge-to-mesh or mesh-to-mesh wire connection would be necessary. As a minimum, a fastener shall be installed at each mesh opening at the location where mesh wire meets selvedge or edge wire.

- The initial line of basket units shall be placed on the prepared filter layer surface and adjoining empty baskets set to line and grade, and common sides with adjacent units thoroughly laced or fastened. They shall be placed in a manner to remove any kinks from the mesh and to a uniform alignment. The basket units then shall be partially filled to provide anchorage against deformation and displacement during the filling operation. The stone shall be placed in the units as specified in paragraph Stone Fill.

- Undue deformation and bulging of the mesh shall be corrected prior to further stone filling. All visible faces shall be filled with some hand placement to ensure a neat and compact appearance and that the void ratio is kept to a minimum.

- Gabions shall be uniformly overfilled by about 1 to 2 inches to compensate for future rock settlements. Gabions can be filled by any kind of earth-filling equipment, such as a backhoe, gradall, crane, etc. The maximum height from which the stones may be dropped into the baskets shall be 3 to 4 feet.

A. Double twisted wire mesh Gabions

After the foundation has been prepared, the pre-assembled gabions shall be placed in their proper location to form the structure. Gabions shall be connected together and aligned before filling the baskets with rock. All connections (panel-to-panel) and basket-to-basket shall be already carried out as described in paragraph ASSEMBLY. Stone fill shall have a gradation as described in paragraph GRADATION, and shall be placed in 1 foot lifts. Cells shall be filled to a depth not exceeding 1 foot at a time. The fill layer should never be more than 1 foot higher than any adjoining cell. Stiffeners or internal cross ties shall be installed in all front and side of the gabions at 1/3 and 2/3 of the height for 3 feet or higher gabions, as the cell is being filled. Stiffeners shall be installed in the center of the cells. In 1.5 foot high units, stiffeners or internal crossties are not required. Internal cross ties, or alternatively the preformed stiffeners, shall be looped around three twisted wire mesh openings at each basket face and the wire terminals shall be securely twisted to prevent their loosening. The number of voids shall be minimized by using a well-graded stone in

order to achieve a dense, compact stone fill. All corners shall be securely connected to the neighboring baskets of the same layer before filling the units. When more than one layer of gabions is required, in order for the individual units to become incorporated into one continuous structure, the next layer of gabions shall be connected to the layer underneath after this layer has been securely closed. Gabions shall be uniformly overfilled by about 1 to 2 inches to compensate for future rock settlements.

B. Non-rectangular Shapes

Gabion and mattress units can conform to bends up to a radius of curvature of 60 to 70 feet without alterations. Units shall be securely connected together first, and be placed to the required curvature, holding them in position by bracing such that the underlying geomembrane liner is not damaged. For other shapes, bevels and miters can be easily formed by cutting and folding the panels to the required angles.

2.23.13 Closing

Lids shall be tightly secured along all edges, ends and diaphragms in the same manner as described for assembling. Adjacent lids may be securely attached simultaneously. The panel edges shall be pulled to be connected using the appropriate closing tools where necessary. Single point leverage tools, such as crowbars, may damage the wire mesh and shall not be used. All end wires shall then be turned in.

2.23.14 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Unit
2.23	Gabions	Cubic Yard

Payment includes costs associated with gabion protection, including the costs of furnishing, assembling, and placing the wire baskets, the stone fill, geotextile (Type B) and all other materials, labor, equipment, tools, supplies, and incidental costs in connection with completing this item of work. No separate payment will be made for preparation of subgrade under gabions. Cost for this work shall be included in the unit cost for this item.

Gabions meeting the requirements of these specifications and acceptably placed within the limits indicated on the drawings or otherwise established in the field, will be measured for payment by the cubic yard of stone filled gabions.

END OF SECTION

2.24 Revegetation

2.24.1 General

Contractor shall be responsible to re-vegetate all areas disturbed (including cap) during construction and as noted on the drawings.

2.24.2 Materials

A. Topsoil: Topsoil shall be imported from off-site, be certified by the Supplier to the Contractor as clean and meet the standards provided in this specification. ~~Topsoil shall not contain stones, lumps, roots, or similar objects larger than 50 millimeters in any dimension and shall have not less than a 6.5 pH value.~~ Topsoil shall not contain stones, lumps, roots, or similar objects larger than 50 millimeters in any dimension and shall have a pH value in the range of 5.5 to 6.5 pH. Topsoil shall have a minimum organic content of not less than 2.75 percent by weight. Materials from the following sources shall not be considered suitable for use as topsoil:

1. ~~Soils having less than a 4.1 pH value.~~ Soils having less than a 5.5 pH value or greater than a 6.5 pH value.
2. Chemically contaminated soils (all on-site topsoil).
3. Areas from which the original surface has been stripped and/or covered over such as borrow pits, open mines, demolition sites, dumps, and sanitary landfills.
4. Wet excavation.
5. Soils containing invasive plant seeds.

All imported fill brought from off-site must meet the following requirements (from NJAC 7:26D):

1. The topsoil material shall be uncontaminated prior to emplacement.

2. All proposed sources of fill must be pre-approved by the Engineer. Bills of lading / affidavit shall be provided to the Engineer to document the source(s) of fill. The documentation shall include: (1) the name of the affiant and relationship to the source of the fill, (2) location where the fill was obtained, including the street, town, lot, block, county and state and a brief history of the site which is the source of fill, and (3) a statement that to the best of the affiant's knowledge and belief the fill being provided is not contaminated pursuant to #1 above and a description of the steps taken to confirm such.

3. The Engineer will acquire samples for analytical testing for compliance as described in Item (1) above. No fill may be brought to the site until the Engineer confirms that it meets the NJDEP Standards and Guidance. The Contractor should allow adequate time in his project schedule for the sampling, analysis, and review of analytical data.

When the organic content of the topsoil is less than 2.75 percent, it shall be increased by adding marketable residual product or another product approved by the Engineer, at a rate necessary to attain this minimum organic content. The organic content of soils will be determined in accordance with

AASHTO T194 except that the sample is to be taken from oven-dried soil passing a #10 sieve. Shipments of marketable residual product, if used, shall be accompanied by delivery slips with the certified weight and the name of the producer or supplier.

The gradation of the topsoil will be determined using ASTM D422. The gradation of the topsoil shall be within the following:

1. Not more than 20 percent of the material submitted from an off-site sample shall be retained on a #10 sieve.
2. If more than one-half of the sand is smaller than #35 sieve:

	Percent
Sand (2.000 to 0.050 mm)	40 - 80
Silt (0.050 to 0.005 mm)	0 - 30
Clay (0.005 mm and smaller)	0 - 30

3. If more than one-half of the sand is larger than 0.5 millimeters:

	Percent		**Percent**
Sand (2.000 to 0.050 mm)	40 - 80	or	40 - 75
Silt (0.050 to 0.005 mm)	0 - 30	or	0 - 30
Clay (0.005 mm and smaller)	15 - 30	or	0 - 30

B. Marketable Residual Product: Stabilized sewage sludge commonly called Marketable Residuals Products (MRP) which means any residual or material derived from a residual which has been prepared for land application of residual in accordance with a permit issued pursuant to N.J.A.C. 7:14A-20. This includes composted, alkaline stabilized and/or heat dried sewage sludge and certain Water Treatment Residuals (WTR). These products, when blended as proposed by the Contractor with soils above the geomembrane, must meet the Non-Residential Direct Contact Soil Standards and Default Leaching Criteria for Impact to Groundwater for Class IIA Aquifers. Marketable Residual Products must be licensed by the New Jersey Department of Agriculture pursuant to the New Jersey Commercial Fertilizer and Soil Conditioner Act, N.J.S.A. 4:9-15.1 et seq., or the New Jersey Agricultural Liming Materials Act, N.J.S.A. 4:9-21.1 et seq., unless permit conditions for distribution are otherwise established by the Department in accordance with N.J.A.C. 7:14A-20. The average water content of the MRP shall not exceed 55% by weight. The MRP shall have a minimum organic content of 50% by weight, and a pH of not less than 6.0.

C. Lime: Ground limestone (Dolomite) containing not less than 85% total carbonates as determined by ASTM C602. Lime will be ground to a fineness that will pass through the following sieves:

Sieve No:	Percent Passing:
#20	90%
#100	50%

D. Fertilizer and Seed Requirements

Fertilizer: No fertilizer is required nor is the application of fertilizer acceptable.

Seed: All areas will be seeded with oats at a rate of one bushel/acre. The native seed mix will consist of the following:

Seed Mix Species	Gentle Slope Mix (< 15% slopes)	Steep Slope Mix (> 15% slopes)
Orchard grass (*Dactylis glomerata*)	8lbs/acre	8lbs/acre
Red Clover (*Trifolium pratense*)	4lbs/acre	4lbs/acre
Big Bluestem 'Niagara' (*Andropogon gerardii*)	6lbs/acre	2lb/acre
Switchgrass 'Shelter' (*Panicum virgatum*)	3lbs/acre	2lb/acre
Little Bluestem, CT Ecotype, (*Schizachyrium scoparium*)	2lb/acre	3lbs/acre
Indiangrass, Long Island, NY Ecotype (*Sorghastrum nutans*)	2lb/acre	6lbs/acre
Butterfly Milkweed (*Asclepias tuberosa*)	0.2 lb/acre	0.2 lb/acre
New England Aster (*Aster novae-angliae*)	0.2 lb/acre	0.2 lb/acre
Perrenial Sweetpea (*Lathyrus latifolius*)	0.2 lb/acre	0.2 lb/acre
White Beard Tounge (*Penstemon digitalis*)	0.2 lb/acre	0.2 lb/acre
Black Eyed Susan (*Rudbeckia hirta*)	0.2 lb/acre	0.2 lb/acre

Seed germination shall have been tested within 12 months of the planting date. No seed shall be accepted with a germination test date more than 12 months old unless retested.

E. Interim Crop Cover: Includes Red clover (*Trifolium pretense)* at 4lbs per acre and Annual rye – (*Lolium multiflorum)* at 30 lbs per acre.

Prior to installation of the permanaent seed, the Contractor shall mow the temporary vegeataive cover to a maximum height of 4 inches (4”). All cuttings shall be collected and disposed offsite at the Contractor’s expense.

F. Mulch: Cereal straw free of objectionable weeds or other deleterious materials.

G. Erosion Control Matting: Erosion Control Matting shall be North American Green S150, North American Green S150BN or approved equal and shall be used on landfill side slopes greater than 15% slope. Erosion Control matting shall meet New Jersey Soil Erosion Control Standards for Stabilization Matting (Appendix A5) which adopts Texas DOT Approved Product List for “Soil Retention Blanket -> Slopes greater than 3H:1V Sandy Soils”

(http://ftp.dot.state.tx.us/pub/txdot-info/mnt/erosion/product_evaluation/approved.pdf) shall be used to evaluate suitability.

H. Tackifier: Vegetable based, biodegradable polymer tackifier shall be Chemstar StarTak 600 or approved equal.

I. Swale Reinforcement Matting: Swale Reinforcement Matting shall be North American Green C350, SI Geosolutions Pyramat, or equal as approved by the Engineer. Swale Reinforcement Matting is to be installed at locations shown on the Contract drawings, i.e. within vegetated swales and at stilling wells located within basins (still well 1, 4, and 5). Swale Reinforcement matting shall meet New Jersey Soil Erosion Control Standards for Stabilization Matting (Appendix A5) which adopts Texas DOT Approved Product List for "Soil Retention Blanket" (http://ftp.dot.state.tx.us/pub/txdot-info/mnt/erosion/product_evaluation/approved.pdf) shall be used to evaluate suitability.

J. Water: Meeting the standards for drinking, and free of substances harmful to plant growth.

Materials shall meet the quality and testing requirements of Section 3.5.

Submittals shall be according to Section 1.3.

2.24.3 Application

The Contractor shall apply topsoil to all areas disturbed by construction and as noted on the drawings, other than permanent roads and structures. Six inches of topsoil shall be applied to the wastefill cap and to other disturbed or designated areas. Topsoil stripped from on-site waste fill construction areas and re-grading/excavation areas is considered contaminated and will not be reused. This on-site topsoil will be disposed of under the cap.

Equipment used for placement of material above the cap liner shall be light ground pressure (less than 6 psi contact pressure) equipment, operated on at least 12" of cover above the liner at all times. Any other heavy equipment used above the liner shall operate with at least 2' of temporary cover over the liner, and shall be as appropriate and necessary to meet the placement and compaction criteria and limitations; except the use of pneumatic-tire rollers and vibratory rollers will not be permitted.

~~A minimum of 2 tons lime per acre is to be applied.~~ Apply lime if the soil test shows the pH is below 5.5, and then at a rate sufficient to achieve no more than 6.5. Incorporate the lime and fertilizer into the soil to a depth of 4" by discing across the slope to minimize erosion and runoff. Apply additional soil amendments according to soil test recommendations such as offered by Rutgers Cooperative Extension. Soil tests should be conducted at a rate of 1 test per 2,500 square yards. A leveling device (wooden utility pole, steel beam or train rail) must be dragged behind the discs to level the soil for seedbed preparation.

Mulching or Erosion Control Matting placement must be completed within 7 days after seeding on all seeded areas. All slopes of less than 15% must be covered with straw mulch which will be anchored by overspraying with a tackifier. Mulch shall be applied at a rate of 1.5 tons per acre and

spread such that approximately 85% of the soil surface is covered. The tackifier shall be applied at a rate of 194 gallons per acre and applied uniformly across the site. Erosion Control Matting shall be placed on slopes greater than 15%.

Following applications of mulch, the seed bed shall be moistened by the Contractor. A muddy soil condition is not acceptable. Seeded areas shall be watered by the Contractor at no additional expense to the State as often as required to obtain and maintain a satisfactory stand of grass, and containing plants in reasonable proportion to the various kinds of seed in the grass seed mixture. Deficient areas shall be reseeded and remulched at no cost to the State until a satisfactory stand of grass is established. Seeded areas shall be maintained until final acceptance of construction. Deficient, damaged or otherwise unsatisfactory areas shall be re-seeded, and re-mulched at no additional cost to the State.

Contractor shall be responsible for stabilizing areas while waiting for the allowable Seeding time period. Contractor may use Interim Crop Cover to stabilize areas waiting for Seeding. No separate payment will be made. Should the Contractor installing Erosion Control Matting after applying interim crop cover, the Erosion Control Matting must be removed prior to Seeding.

Erosion Control Matting and Swale Reinforcement Matting shall be installed in accordance with NJ Soil Erosion Standards. Swale Reinforcement Matting shall be anchored in trench (per manufacturer recommendations) on the upgradient side of swales where water will be flowing into the swale. On the downgradient side of the swale (slurry wall side) the Swale Reinforcement Matting can be spliced with the erosion control matting.

~~———~~2.24.3.1 Application Requirements

Prior to installation of the ~~permanaent~~permanent seed, the Contractor shall mow the temporary ~~vegetaative~~vegetative cover to a maximum height of 4 inches (4”). All cuttings shall be collected and disposed offsite.

Permanent seeding shall only occur between April 15th and June 1st using a mechanical power drawn native warm season grass drill with a cultipacker. Seed should be planted l/8" to 1/4" deep. Seeding during any other time is not acceptable. Seeding operation shall be kept as close as possible to the contours and not up and down slopes. Interim crop cover may be installed during other times to stabilize areas waiting for seeding. The Contractor shall protect his work at all times. The Contractor is alerted that the yearly seeding window for permanent seed is very short. The Contractor needs to coordinate his work to complete the permanent seeding within this timeframe.

All seeding equipment, seed boxes, compartments and seed tubes will be cleaned and vacuumed of previous seeding residues before being used. Oats shall be broadcast over all seedbeds at a rate of one bushel per acre. Broadcasting oats with a spinner type seeder or a cultipacker type seeder are the only acceptable seeding methods. Thereafter; oat seed shall be tracked into the soil with tracked equipment. Install the specified native seed mixes, after equipment tracking, with a warm season grass drill and cultipacker before erosion control matting is installed. Installing native seed mixes with a warm season grass drill and cultipacker type seeder is the only acceptable method. There are two native seed mixes which are seeded depending on slope as specified under 2.24.2.D. Grass seed types and non-grass seed types shall not be mixed together. Grass type seeds shall be seeded from a grass seed box.

Non-grass seed types shall be seeded from a standard seed box. The native seed mixes require the warm season grass drill seeder to have, at a minimum, a standard seed box and a warm-season grass seed box. Due to the differences in seed types used in the mixes; sand, sawdust, oat hulls or another biodegradable medium, as approved by the Engineer, shall be used to help the seed to mix and flow uniformly. The Contractor shall perform a test seeding on-site to demonstrate that the seed drill and cultipacker are calibrated correctly and operating properly, subject to approval by the Engineer.

Contractor shall establish permanent seeding through two growing seasons, as judged by the Soil Conservation District, and seeding should be placed in accordance with NJ Soil Erosion Control Standards (including recommended timeframes). Good seed to soil contact must be obtained. All seeding shall be suspended when wind velocities exceed 5 miles per hour or as directed by the Engineer. Seeding on all areas shall be accomplished within 5 days after final grading and topsoil placement has been completed.

2.24.4 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Unit
2.24.1	Revegetation	Square Yard
2.24.2	Topsoil 6” Thick	Square Yard
2.24.3	Erosion Control Matting	Square Yard
2.24.4	Swale Reinforcement Matting	Square Yard

The Contractor shall be paid under Bid Item No. 2.24.1 at the unit price per square yard for amending soil, seeding, mulching, and watering as measured in the horizontal plane per Section 1.2.16. Separate nor additional payment will not be made for areas of seeding disturbed by the Contractor, outside of the construction operations area or areas of deficient stands of grass. Seeding shall include purchase, delivery, and application of lime, and seed to all areas where topsoil has been placed in accordance with the Soil Erosion and Sediment Control Plan. Straw Mulching shall consist of purchase, delivery, and placement of straw mulching on all areas to be seeded in accordance to these Specifications and the Soil Erosion and Sediment Control Plan. Watering shall include purchase, delivery, and application of water as needed to sustain vegetation. Contractor will not be paid separately for watering but is included in the cost of Revegetation.

The Contractor shall be paid the Bid Item No. 2.24.2 at the unit price per square yard of topsoil installed (6”), as measured in the horizontal plane, according to 1.2.16. Such price shall be considered full payment for excavation and/or delivery, stockpiling and installation of topsoil.

Bid Item 2.24.3, Erosion Control Matting, shall include purchase, delivery and installation. Bid Item 2.24.3 shall be measured in the horizontal plane per Section 1.2.16. Refer to Section 1.2.29 for addition language regarding if and where directed items.

Bid Item 2.24.4, Swale Reinforcement Matting, shall include purchase, delivery and installation. Bid Item 2.24.4 shall be measured in the horizontal plane per Section 1.2.16.

No additional payment will be made for Interim Crop Cover or other measures implemented by the Contractor to stabilize areas waiting for Seeding. If the Contractor chooses to install erosion control matting prior to Seeding, Contractor will be responsible for removing Erosion Control Matting prior to Seeding. No additional payment will be made for removal and replacement of Erosion Control Matting.

END OF SECTION

2.25 Site Concrete

2.25.1 General

This section applies to the Concrete Pad for Combustion Blower (Pay Item 2.25) and miscellaneous concrete to be used throughout the project.

The combustion air blower concrete pad shall be constructed in accordance with the Drawings and these specifications. The pad is to be built on the piles (Section 2.29). Construction of the concrete pad should be completed in the following general steps: preparation of subgrade, installation of piles, placement of base course, and finally construction of reinforced concrete pad.

2.25.2 Submittals

Mix Design: Submit proposed mix design and obtain approval by Engineer prior to commencement of work.

Ready-Mix Delivery Tickets: ANSI/ASTM C94.

Shop Drawings: Prior to fabrication and delivery, submit shop drawings clearly indicating:

1. Reinforcing bar sizes, spacing, location and quantities of reinforcing steel and wire fabric, bending and cutting schedules, and supporting and spacing devices.

2. Reinforcement Details: Details, splices, and lengths of laps shall be in accordance with ACI 315; CRSI - Manual of Standard Practice, and in accordance with Contract Drawing requirements.

3. Construction and control joints not shown on drawings.

4. The shop drawings are interpretations of and are supplemental to the Contract Drawings and Specifications. Their intent shall demonstrate that this Contractor understands the design concept, and to provide the detailed information necessary for the fabrication, assembly, and installation of the products or materials specified. Neither the shop drawings nor comments placed on them by the Engineer shall be construed as being "Change Orders". If any deviations, discrepancies or conflicts between the Shop Drawings and the Contract Drawings and Specifications are discovered, either "prior to" or "after" the shop drawings have been reviewed, the Contract Drawings and Specifications shall have control and shall be implemented.

Product Data: Submit manufacturer's descriptive literature and application/installation instructions and recommended procedures.

2.25.3 Environmental Requirements

Allowable Concrete Temperatures:

1. Cold Weather: Conform to maximum and minimum requirements of ANSI/ASTM C94 and ACI 306.

    a. Do not use frozen materials or materials containing ice or snow.
    b. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

    Note: Use only specified non-corrosive, non-chloride accelerator. Calcium chloride, Thicyanates or admixtures containing more than 0.05% chloride ions are not permitted.

2. Hot Weather: Maximum concrete temperature of 90° F, conform to requirements of ANSI/ASTM C94 and ACI 305.

    a. Prevent rapid drying during hot weather.

Do not place concrete during rain, sleet, or snow unless protection is provided.

2.25.4 Form Materials

Form work: Conform with requirements of ACI 347, Chapter 3, Materials and Form Work.

1. Material:

    a. Use either steel forms, designed specifically for the purpose, or wood forms of plywood or lumber not less than $^{3}/_{4}$" thick.
    b. Non-Architectural Concrete: Unlined lumber or plywood may be used.

Tubular Column Type Forms: Round, spirally wound laminated fiber material; inside surface treated with release agent.

Corner Forms (when Applicable): $^{3}/_{4}$" chamfer or profile indicated, made of plastic, rubber, or wood.

Ties: Snap type, carbon steel where not exposed and stainless steel for exterior or exposed concrete.

Nails, Spikes, Lag Bolts, Through Bolts, Anchors: Sized as required; of sufficient strength and character to maintain formwork in place while placing and curing concrete.

Form Release Agent: Colorless mineral oil which will not stain concrete or impair natural bonding, or color characteristics, or other coating intended for use on concrete.

1. Coating must be applied prior to placement of reinforcement.

2.25.5 Reinforcing

Fabrication: In accordance with CRSI - Manual of Standard Practice, ACI 315, and the drawings.

Reinforcing Steel: ANSI/ASTM A615, ANSI/ASTM A616, ANSI/ASTM A617, 60 ksi yield grade steel bars; uncoated finish, sizes as indicated.

Tie Wire: FS QQ-W-46G, annealed black steel, 16 gauge minimum.

Chairs, Bolsters, Bar Supports, Spacers: Adequately sized and shaped for strength and support of reinforcing during concrete operations.

No welding of reinforcing bars will be permitted without approval of Engineer.

All reinforcement shall be continued across joints, except for slabs-on-grade.

2.25.6 Concrete Materials

Concrete (Ready-mixed): Shall conform to requirements of ACI 301, ACI 318, and ANSI/ASTM C94.

Cement: ANSI/ASTM C150, normal Type I or II, Portland, gray color. Cement for concrete exposed to view shall be of one manufacturer.

Coarse Aggregate: ANSI/ASTM C33, with a maximum size limited to requirements of ACI 318.

Fine Aggregate: ANSI/ASTM C33, washed, hard sand.

Water: Fresh, clean, potable, and not detrimental to concrete.

2.25.7 Admixtures

Water Reducing Admixture: ANSI/ASTM C494, Type A, containing no more chloride ions than present in municipal drinking water, "Eucon WR-75", as manufactured by the Euclid Chemical Company, Cleveland, OH; "Pozzolith 200" by Master Builders; "Plastocrete 160" by Sika Chemical Corp, or equal as approved by the Engineer.

Water Reducing, Retarding Admixture: ANSI/ASTM C494, Type D, containing no more chloride ions than present in municipal drinking water, "Eucon Retarder-75" as manufactured by the Euclid Chemical Company; "Pozzolith 100XR" by Master Builders; "Plastiment" by Sika Chemical Corporation, or equal as approved by the Engineer.

High Range Water Reducing Admixture (Superplasticizer): ANSI/ASTM C494, Type F or G, containing no more chloride ions than present in municipal drinking water, "Eucon 37" as manufactured by the Euclid Chemical Company; "Sikament" by Sika chemical Co.; "Melment L10 A" by American Admixtures, or equal as approved by the Engineer.

Non-Corrosive, Non-Choride Accelerator: ANSI/ASTM C494, Type C or E, containing no more choride ions than present in municipal drinking water, "Accelguard 80" as manufactured by the Euclid Chemical Company, Cleveland, OH; Polarset as manufactured by W.R. Grace, Cambridge, MA; Pozzutec 20 as manufactured by Masterbuilders, Cleveland, OH; or equal as approved by Engineer. The admixture manufacturer must have long-term non-corrosive test data from a independent testing laboratory (of at least 1 year duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures.

Air Entrainment Admixture: ANSI/ASTM C260.

Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions are not permitted.

Certification: Written conformance with the above mentioned requirements, and the chloride ion content of the admixture will be required from the admixture manufacturer prior to mix design review by the Engineer.

2.25.7 Curing Materials

Liquid Membrane Forming Compound Type: Do not use curing and sealing compounds which are not compatible with adhesives and cements for finish materials when scheduled to go over concrete substrates, and where concrete is scheduled to receive special coatings or toppings.

1. Type: Clear styrene acrylate type, 30% solids content minimum. Sodium Silicate compounds are prohibited.
2. Moisture Loss: Test data from independent testing laboratory indicating a maximum moisture loss of 0.030 grams per sq. cm. when applied at a coverage rate of 300 sq.ft. per gallon.
3. Manufacturer: "Super Rez Seal" as manufactured by The Euclid Chemical Co.; "Vulkem 2101" by Mameco International, Inc.; "Masterkure 30" by Master Builders, or equal as approved by the Engineer.
4. Certificate: Manufacturer’s certification required.

Non-Liquid Membrane Type: When Liquid Membrane Type curing compounds are not compatible, or specified not to be used, use one of the following materials.

1. Regular concrete "CURING PAPER", ANSI/ASTM C171.
2. Polyethylene film, ANSI/ASTM D2103, 6 mil thick, "WHITE" opaque type.
   a. Black or Clear-type polyethylene-type films will not be acceptable.

2.25.8 Accessories

Expansion Joint Material: Preformed asphalt, ANSI/ASTM D994; or FS HH-F-341F, Type II, $^1/_4$" thick by full depth of concrete.

Non-Shrink Cement Grout: Non-staining, positive expansion, flowable and self-leveling, high strength, conforming to CRD C-621-83, Corps of Engineers Specification for Non-Shrink Grout, "Euco-NS" by Euclid Chemical Co.; "Masterflow 713" by Master Builders; "Five Star Grout" by U.S. Grout Corp, or equal as approved by the Engineer.

1. Use: For grouting of structural column bases, heavy machinery and equipment, securing dowels and anchors not cast-in-place, for setting of steel grid floors and bearing plates, as indicated or required.

2. Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 9,000 PSI in 28 days.

Control Joint Materials: Use for exterior sawed control joints.

1. Joint Sealant: ASTM C290, Type M, Grade NS, Class 25, two component type, urethane sealant, requiring no primer, "Eucolastic II" by Euclid Chemical Co., "Vulkem - 922" by Mameco International, or equal as approved by the Engineer.

2. Joint Filler: Compatible with sealant, closed cell polyethylene foam, PVC foam or other fillers not containing asphalt or tar, as approved by Engineer.

Waterstops (as applicable): Rubber or polyvinylchloride; type and width as indicated by maximum possible lengths, with electrically welded splice joints.

Splash blocks (as applicable): Precast concrete type, of size(s) indicated and as required to properly collect and remove storm water.

2.25.9 Concrete Mix

Mix concrete only in quantities for immediate use, and in accordance with ANSI/ASTM C94.

Mix Proportioning: Concrete design mixes are based on a minimum 28 day compressive strength as follows:

Location	Req'd 28 day Compressive Strength P.S.I.	Max. Water Cem. Ratio	Air Content
Exterior site concrete unless noted otherwise on the Drawings	4,000	0.40	4.0%-6.0%

Notes: All coarse aggregate size shall be AASHTO #57.

Proportions for concrete mixes shall be selected by ACI 301, Section 3.9. All mixes will be permitted without prior approval of the Engineer.

Where the concrete production facility can establish the uniformity of its production for concrete of similar strength and materials based on recent test data, the average strength and materials based on recent test data, the average strength used as a basis for determining mix design proportions shall exceed the specified strength by the requirements of ACI-318-83, Section 4.3 or ACI-301-84, Section 3.9.

When a concrete production facility does not have test records for calculation of standard deviation, the required average strength shall be at least 1200 psi greater than the specified design strength.

All concrete containing a high-range water-reducing admixture (superplasticizer) shall have a maximum slump of 8" (after the addition of the admixture) unless otherwise approved by the Engineer. The concrete shall arrive at the job site at a slump of 2" plus or minus 1", be verified, then the high-range water-reducing admixture added to increase the slump to the approved level. After adding the high-range water reducing admixture operate the mixer at mixing speed as directed by the admixture supplier. All other concrete shall have a maximum of 3" for slabs and 4" for other members. This maximum slump may not be exceeded except by the job-site addition of the specified high-range water-reducing admixture (superplasticizer). In those portions of the structure where member dimensions and/or congestion due to reinforcing steel prevent the proper placement and consolidation of the concrete at the maximum slump specified, superplasticizer shall be used by the Contractor in lieu of increasing the slump of non-superplasticizer concrete by the addition of water.

All concrete shall contain the specified water-reducing retarding admixture and/or high-range water-reducing admixture (superplasticizer). All concrete slabs, placed at air temperatures below 50° F shall contain the specified non-corrosive non-chloride accelerator. All concrete for industrial slabs, concrete required to be watertight and concrete with a water-cement ratio below 0.50 shall contain the specified high-range water-reducing admixture (superplasticizer).

2.25.10 Subgrade Preparation

The Contractor shall grade the area where concrete combustion air blower pad is to be installed to provide flat subgrade for pad installation, and maintain grades shown on Contract Drawings. Area shall be compacted in accordance with compaction method described in Section 2.26, before placement of base course. Place and compact 6” coarse aggregate #57 base course over prepared subgrade. Unsuitable areas identified during compaction shall be repaired before placement of concrete. All compaction testing must be completed before pouring base course.

Proof-roll prepared base material surface to check for unstable areas. The work shall begin after the unsuitable areas have been corrected and are ready to receive paving. Compaction testing for the base material shall be completed prior to the placement of the concrete.

Remove loose material from compacted base material surface to produce a firm, smooth surface immediately before placing concrete.

2.25.11 Formwork Erection

Placement: Conform to requirements of ACI-347

Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

Construct formwork, shoring and bracing to meet design and code requirements accurately so that resultant finished concrete conforms to shapes, lines and dimensions indicated on drawings.

Arrange and assemble formwork so as to permit easy dismantling and stripping, so that concrete is not damaged during form removal.

Align form joints and make watertight, to prevent leakage of mortar and disfigured appearance of concrete. Keep form joints to minimum.

Obtain Engineer's approval for use of earth forms. When using earth forms, hand-trim sides and bottoms, and remove loose dirt prior to placing concrete. Keep form joints to minimum.

Arrange forms to allow stripping without removal of principal shores, where these are required to remain in place.

Provide bracing to ensure stability of formwork as a whole. Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.

Apply form release agent on formwork in accordance with manufacturer's recommendations. Apply prior to placing reinforcing steel, anchoring devices and embedded parts. Do not apply form release agent where concrete surfaces are to receive special finishes or applied coverings which are affected by agent.

2.25.12 Inserts/Embedded Parts/Openings

Provide formed openings where required for pipes, conduits, sleeves and other work to be embedded in and passing through concrete members.

Accurately locate and set in place items which are to be cast directly into concrete.

Coordinate work of other sections and cooperate with trade involved in forms and/or setting openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts. Do not perform work unless specifically indicated on drawings or approved prior to installation.

Install all concrete accessories in accordance with drawings and manufacturer's recommendations; straight, level, and plumb. Ensure items are not disturbed during concrete placement.

Install waterstops, when appropriate to project, continuous without displacing reinforcement. Heat weld all joints watertight.

Provide temporary ports or openings in formwork where required to facilitate cleaning and

inspection. Locate openings at bottom of forms to allow flushing water to drain. Close temporary ports or openings with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.

2.25.13 Cleaning Forms

Clean forms as erection proceeds, to remove foreign matter. Remove cuttings, shavings and debris from within forms. Flush completely with water to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within a heated enclosure. Use compressed air or other means to remove foreign matter.

2.25.14 Reinforcing Placement

Placement of Steel Bar Reinforcing:

1. Conform to CRSI - Manual of Standard Practice.
2. Place reinforcing as indicated on drawings, adequately supported and secured against deplacement.
3. Do not deviate from true alignment.

Adjustment:

1. Move within allowable tolerances to avoid interference with other reinforcing steel, conduits, or other embedded items.
2. Do not move bars beyond allowable tolerances without approval by Engineer.
3. Do not heat, bend, or cut bars in the field without approval by Engineer.

Splices:

1. Lap Splices: Tie securely with wire to prevent displacement of splices during placement of concrete.
2. Splice Devices: Install in accordance with manufacturer's instructions.
3. Do not splice bars except at locations shown on approved shop drawings.
    a. If splice locations are not shown, then only at locations and types as directed by Engineer.

Placement of Welded Wire Fabric:

1. Install in longest practicable lengths.
2. Lap adjoining pieces one full mesh minimum, and tie splices with 16 gauge wire.
3. Do not make end laps midway between supporting beams, or directly over beams of continuous structures.
4. Offset end laps in adjacent widths to prevent continuous laps.

Cleaning:

1. Remove all dirt, grease, oil, loose mill scale, excessive rust, and foreign matter that will reduce bond with concrete.

Protection:

1. Keep reinforcing steel in proper position during concrete placement and operations.

2.25.15 Placing Concrete

Place concrete in accordance with lines and levels indicated on drawings and in accordance with requirements of ACI 304.

Ensure all expansion joint material, anchors, sets, plates, and other items to be cast into concrete are in place and held securely.

Ensure reinforcements, inserts, embedded parts, formed expansion and contraction joints, and other items are not disturbed during concrete placement.

Convey concrete from mixer or transporting vehicle to place of final deposit as rapidly as practical by methods which will prevent separation or loss of the material.

Regulate rate of placement so concrete remains plastic and flows into position.

Do not deposit concrete that has partially hardened.

Deposit concrete in continuous operation until panel or section is completed.

Place concrete in continuous horizontal layers.

Slabs-On-Grade: Place slabs in "long strip pattern", in accordance with ACI 302.1R, Chapter 6. Pattern shall be formed by use of prefabricated tongue and grooved metal key joints. Divide placed concrete strips into approximate square sections by making transverse "control joints" as specified below.

2.25.16 Concrete Joints

Control (contraction) Joints: Provide control joints for sectioning concrete into areas to eliminate shrinkage and thermal cracking.

1. Form weakened-plane control joints to a depth equal to a minimum of $^1/_4$ the concrete thickness, using one of the following methods:
   a. Tooled Joints: Form joints in fresh concrete by hand grooving top portion of

surface.

b. Insert Joints: Form joints by inserting preformed plastic or metal control joint strips into the top surface of freshly placed concrete.

c. Sawed Joints: Form joints by using power saw equipped with shatterproof or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by the cutting action.

1) Soft-Cut Saw: Shall be used immediately after final finishing and to a depth of 1 1/4".

2) Conventional Saw: Shall be used as soon as possible without dislodging aggregate, to a depth of 1/4 slab thickness.

3) Immediately after saw cutting, clean and dry joints, place joint filler and apply sealant in accordance with manufacturer's instructions.

2. At all construction joints of slabs on grade, discontinue slab reinforcement.

3. Place control (shrinkage) joints, whether shown on Drawings or not, at column centerlines and/or at the following maximum spacing.

4" slab thickness, maximum spacing = 12' each way.
5" slab thickness, maximum spacing = 15' each way.
6" slab thickness, maximum spacing = 18' each way.
7" slab thickness, maximum spacing = 21' each way.
8" slab thickness, maximum spacing = 24' each way.

4. Place vertical wall construction joints at 20' intervals for walls over 30' in length.

Isolation Joints:

1. Separate floor slabs from vertical surfaces with 15 lb. roofing felt paper.
2. Isolate structural columns, when applicable, by forming diamond-shaped isolation joints.
   a. Install joint filler around diamond shaped formwork, placing floor slab before placing diamond around column.
   b. Extend joint filler from bottom of slab to within 1/4" of finished slab surface.
3. Install isolation joints at all locations as may be indicated on drawings.

Construction Joints (Bonding):

1. Clean and roughen surface of hardened concrete, and remove laitance.
2. Dampen surface, if required. Surface shall be prepared in accordance with the bonding material manufacturer's directions.
3. Bonding compound, bonding admixture, or epoxy adhesive shall be used in strict accordance with the directions of the manufacturer.
   a. Type shall be as approved by Engineer.
4. Fresh concrete shall be placed after bonding compound has dried and while bonding admixture grout or epoxy adhesive is still tacky.

2.25.17 Consolidating Concrete

During and immediately after depositing, all concrete shall be thoroughly consolidated by means of suitable tools, as recommend by ACI.

2.25.18 Concrete Finishing

Formed Concrete:

1. Tops of Forms:

    a. Strike off concrete smooth at tops of forms.
    b. Float to texture comparable to formed surfaces.

2. Formed Surfaces:

    a. Spade Finish: Surfaces not exposed to view shall be given a spade finish.
        1) Patch tie holes and other defects after form removal.
        2) During placement of concrete, force spade or similar device into concrete adjacent to form and then pulling away from form, to bring mortar to form surface.
        3) Remove fins from finish surface.
    b. Rubbed Finish: Surfaces exposed to view shall be given a rubbed finish.
        1) On patched surface specified above, rub surface with carborundum stone to eliminate fins and irregularities, but not to cut the general surface of the concrete.
        2) Brush finishing or painting with grout or neat cement will not be permitted.
        3) Corners or edges shall be slightly rounded by use of the carborundum stone.

Flatwork:

1. Tolerances: Place, consolidate, strike off level, float and trowel smooth, and maintain surface flatness with maximum variation of $^1/_8$" in 10'. Pitch to drains $^1/_4$" per ft. unless noted otherwise on drawings.
2. General:
    a. Place, consolidate, strike off and level concrete.
    b. Do not work surface until ready for floating.
    c. Power float surface on disappearance of water sheen.
    d. Hand float areas inaccessible to power float.

2.25.19 Curing and Protection

Beginning immediately after placement, and final finishing, cure and protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

Liquid Membrane Curing Compounds: Curing shall be by application of specified curing and sealing compound, the specified dissipating resin-type compound, or by application of waterproof

sheet materials conforming to ASTM C171. Liquid membrane-forming curing and sealing compounds shall be applied in accordance with the manufacturer's recommendations. Curing compounds must be applied immediately after final finishing. For curing by the waterproof sheet material, the concrete must be continually moist-cured for a minimum of seven days. The curing process must begin immediately after final finishing.

The curing period shall be continuous for a minimum duration of seven days when the ambient temperature exceeds 50° F.

When concrete slab placement is subject to high temperatures, wind and/or low humidity the Engineer may require the use of the specified evaporation retarder to minimize plastic cracking. The compound may be required to be applied one or more times during the finishing operation. The initial application is usually made after the strike-off operation.

2.25.20 Final Sealing

Sealer Finish: Apply a coat of the specified water-based acrylic emulsion compound to all new slabs which are scheduled to be left exposed. The compound shall be applied just prior to completion of project.

2.25.21 Form Removal

Do not remove forms, shores and bracing for a minimum of 12 hours, and until concrete has gained sufficient strength to carry its own weight, construction loads, and design loads which are liable to be imposed upon it. Verify strength of concrete by field cured compressive test results.

Remove formwork progressively and in accordance with code requirements and so that no shock loads or unbalanced loads are imposed on structure.

Loosen forms carefully. Do not wedge pry bars, hammers or tools against concrete surfaces.

Reshore structural members where required due to design requirements or construction conditions and as required to permit progressive construction. Remove load supporting forms only after concrete has attained 75% of required 28 day compressive strength, provided construction is reshored.

Remove forms not directly supporting weight of concrete as soon as stripping operations will not damage concrete.

Backfilling: Do not backfill against concrete walls for a minimum of seven days, or until the concrete has attained 70% of its design strength.

2.25.22 Defective Concrete

With prior approval of Engineer, as to method and procedures, all repair of defective areas shall conform to ACI 301, Chapter 9, except bond shall be achieved by use of one of the specified

bonding materials.

All structural repairs, with prior approval of Engineer, as to method and procedures, shall be made by use of the specified epoxy adhesive and/or epoxy mortar.

2.25.23 Concrete Testing

The Contractor will take a minimum of one set of four cylinders per 50 Cubic Yards, with at least one cylinder collected for each day that concrete is placed. Test one cylinder in compression at 7 days and two at 28 days in accordance with ASTM C 39; keep one cylinder in reserve for additional testing.

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing by the Contractor to the Engineer and concrete manufacturer within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

2.25.24 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Unit
2.25	Concrete Pad for Combustion Air Blower	Lump Sum

The Contractor shall be paid Lump Sum for the Bid Item No. 2.25 - Concrete Pad for Combustion Air Blower. This includes all labor and materials for the concrete pad for the combustion air blower. This also includes the installation of bedding, reinforcing steel, and formwork as shown on the Contract Drawings.

Separate payment will not be made for any other site concrete work. Payment for concrete used for other portions of the project shall be included in the payment for the respective item.

END OF SECTION

2.26 Access Road

2.26.1 General Description

The Contractor shall furnish all material, labor equipment, and incidentals necessary for final grading of the existing perimeter roadway and the construction of permanent access roads going across the landfill as depicted on the Contract Drawings and accordance with this specification section.

This work shall consist of building up the perimeter access road to achieve final grades by utilizing Recycled Aggregate (RA) Type B aggregate excavated and stockpiled during wastefill excavation, excavation for barrier wall construction, down pipe trenching, gas collection pipe trenching, and leachate collection piping trenching activities.

This work shall also include subgrade preparation and construction of permanent access roads on top of the landfill cap by installing geotextile type A and placing 8" of imported RA Type B aggregate over the geotextile.

2.26.2 Applicable Publications

American Society for Testing of Materials (ASTM)

- ASTM C 136 Test Method for Sieve analysis for Fine and Coarse Aggregate

American Association of State Highway and Transportation Officials (AASHTO)

- M288-96 Geotextile Specification for Paving Fabrics

2.26.3 Materials

Recycled aggregate can be produced by crushing concrete, pieces of concrete blocks, brick, tile, masonry material, and glass to reclaim the aggregate. RA, Type B shall be free from reinforcing bars, both plastic and metal pipes, tires, paper and cardboard, insulation, foam, windows, plumbing fixtures, cabinets, carpets, and other material of compressible nature. The longest dimension of any recycled material shall not exceed three times its shortest dimension. Acceptability of recycled aggregate will be determined by the recycling agency gradation/weight reports. The engineer reserves the right to require the contractor to retest the RA material if it appears to be in noncompliance with the specification during installation. If materials do not meet specifications they will be rejected and the contractor shall remove the RA from the site at no cost to the State. The minimum testing frequency shall be one (1) sample per 3,000 tons of recycle aggregate as per Section 1.10. The Contractor shall submit source and test reports for approval.

Recycled aggregate must be obtained from a NJDEP certified Class B recycling facility. The Contractor may substitute natural earth and rock materials of the same gradation for Recycled Aggregate, as approved by the Engineer.

A. Recycled Aggregate Fill Type B: RA Type B roadway aggregate to be used for perimeter road grading or construction of permanent access roads (whether excavated / stockpiled aggregate for reuse or imported from offsite sources) shall conform to the following gradation:

Sieve Size in Inches	Percent Passing
4	100
3	75-90
2-1/2	40-60
1-3/4	10-20
1	0-5

Testing frequency shall be in accordance to Section 1.10.

B. Separation Fabric, Geotextile Type B

On permanent access roads to be constructed on top of the landfill cap, separation Fabric (Geotextile Type B) shall be placed as shown on the Contract Drawings between the 12" drainage layer and the RA Type B roadway aggregate. Refer to Section 2.14 for additional information and guidance.

2.26.4 Material Sources

All imported recycled aggregate shall be from DEP licensed or approved recycling facilities. All material shall be selected from a commercial recycling center and shall meet the material description above.

2.26.5 Requirements for Clean Fill

Recycled aggregate shall come from a NJDEP Certified Class B recycling facility. Prior to the acceptance onsite of any recycled aggregate the Contractor shall allow the Engineer to visit the proposed source of the material.

Natural earth and rock materials, if substituted for recycled aggregate, will be subject to the chemical testing requirements for clean fill specified in Section 2.8. Testing frequency will be one sample per 3,000 tons. The Contractor shall allow the Engineer to visit the proposed source of the material and, if requested, obtain samples of the material for chemical analysis. Natural earth and rock materials shall not be brought to the site until the Engineer's analysis of the material is complete and contaminant levels are found not to exceed requirements for clean fill in Section 2.8.

2.26.6 Documentation

The Contractor shall provide a Quantity Control Officer to document all material delivered to the site. The Quantity Control Officer shall provide the Engineer a copy of all certified scale tickets, and time of material delivery on site at the end of each work day. The cost associated with this work shall be included in the per Ton price bid for the recycled aggregate material.

2.26.7 Execution

2.26.7.1 Permanent Access Roads On Top of Landfill Cap

Prior to placement of gas venting layer, geomembrane, drainage layer, geotextile, and recycled aggregate for access road construction, the contractor shall clear the site in accordance with Section 2.1.

Following re-grading of the site to achieve access road subgrades, Contractor shall proof roll the exposed subgrade using a maximum 10 ton smooth roller, as directed by the Engineer. Any soft, wet, organic or unsuitable materials identified during proof rolling shall be excavated and backfilled with RA Type B, as directed by the Engineer, at no additional cost.

Following installation of the 12" layer, separation fabric (Geotextile Type B) shall be placed between the drainage layer and the RA type B roadway aggregate, as shown on the Contract Drawings. Geotextile shall be placed longitudinally in runs from top of slope to toe, with downstream edge of the upstream run overlapping the upstream edge of the downstream run. Geoxtextile rolls shall be laid so there is 2 feet of overlap on all sides adjacent with another roll. Equipment is not allowed on unprotected Geotextile Type B. To protect the geotextile and prevent degradation due to exposure, the geotextile shall be covered with roadway material within 21 days of placement.

RA Type B shall be placed on the ground in front of the deployed geotextile, no material shall be dumped directly on the geotextile. Then the RA Type B shall be spread over the geotextile to a thickness of 8 inches to the neat lines shown on the Contract Drawings using equipment having a ground pressure that minimizes damage to the underlying geotextile and as approved by the Engineer.

In general, Recycled Aggregate shall be placed from the lower elevations to the higher elevations.

Each lift of the RA Type B roadway aggregate shall be compacted using a 10 ton dynamic smooth roller compactor with 2 to 6 overlapping passes, as directed by the Engineer.

The Contractor shall be responsible for any temporary access roads during construction activities. A minimum of 2 feet of material over geomembrane is required for temporary access roads needed for construction. Any change in grading or rutting shall be repaired by the Contractor at no additional cost to the NJDEP.

Access roads shall be maintained throughout the course of the construction.

2.26.7.2 Perimeter Road Final Grading

As needed to install landfill structures and achieve final grades, the Contractor shall segregate and temporarily stockpile previously installed RA Type B aggregate during wastefill excavation and excavation for barrier wall construction, storm downpipe trench, gas collection piping trenches, and leachate collection trenches. The Contractor shall segregate and temporarily stockpile approximately 13,000 cubic yards of previously installed RA type B aggregate for reuse during perimeter access road final grading (see section 2.4 of these specifications). During final grading of perimeter roadway, Contractor shall reuse the temporarily stockpiled RA Type B aggregate to meet neat lines shown on

the Contract Drawings. This stockpiled RA type B aggregate shall be placed as the top 12" layer of perimeter roadway (following placement of the 12" drainage layer) and as fill beyond the barrier wall up to the drainage layer subgrade and towards the perimeter road outer side slope as depicted on the details on the Contract Drawings.

Contractor shall place wastefill generated during wastefill excavation / relocation activities between gabion wall and barrier wall limit, and up to drainage layer subgrade as shown on the details on the Contract Drawings. Wastefill shall be placed in accordance with section 2.5 of these specifications.

2.26.8 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Unit
2.26.1	Access Road, 8" Thick	Square Yard
2.26.2	Perimeter Access Road (RA Type B reuse)	Square Yard
2.26.3	RA Type B, If and Where Directed	Ton

The Contractor will be paid the bid unit price per square yard ~~(SY)~~ amount for Pay Items 2.26.1 and 2.26.2. The bid unit price for item 2.26.1 shall include any material, labor, and equipment costs for the construction of the permanent access roads on top of the landfill, as depicted on the Contract Drawings. This cost shall include excavation, subgrade preparation (including subgrade compaction), relocation, storage, any potential double handling, separation, and installation of geotextile Type B and 8" thick RA Type B (measured in the horizontal plane).

Re-location of waste material will be paid under Item 2.4.1. Separate payment will not be made for any haul or temporary roads.

The Contractor shall be paid the bid unit price for item 2.26.2 per square yard ~~(SY)~~ of perimeter road final grading, by utilizing excavated RA Type B soil aggregate, to achieve neat lines for perimeter access road, as depicted on Contract Drawings and described in this specification section. Work included in pay item 2.26.2 shall include excavation; subgrade preparation; installation of ~~geotextiles~~Geotextile, Type B below the geomembrane; relocation, storage, replacement/ placement, and potential double handling ~~or~~ of RA Type B on the existing access road. Payment shall include excavation and stockpiling of the RA Type B material, and maintaining the material before its final installation during construction of the Perimeter Access Road.

The Contractor shall be paid the bid unit price for item 2.26.3 RA Type B, If and Where Directed per Ton delivered to the site and installed. Item 2.26.3 will be utilized for building up the eastern and southern roadways (between, approximate, stations 41+25 to 67+00 and 73+00 to 80+00).

Work associated with the installation of cap and fill shall be paid for under the appropriate bid items.

END OF SECTION

2.27 Inclinometers

2.27.1 General

Contractor shall install inclinometers as shown on the Contract Drawings prior to starting the slurry wall construction. Inclinometers shall be monitored as described in Section 4.1 for a minimum period of 1 month prior to start of slurry wall construction. If inclinometers indicate that there is movement in the subsurface that can be attributed to construction activities precautionary measures may be required to protect existing features around the site, including the various gas pipelines.

Vertical inclinometers will be installed within borings to monitor the movement of ground slopes pre-, during, and post-construction of landfill closure. Installed inclinometer components shall include:

- Inclinometer casing;
- Corrugated plastic tube;
- Borehole grout;
- Vibrating Wire Piezometers; and,
- Vertical In-Place Inclinometer Sensors and Dataloggers.

Additional inclinometer components shall include:

- Automatic Data Acquisition System and Software.

Components of the inclinometers and piezometers shall meet the specifications of the products listed below.

Inclinometer casing and grout will extend for the entire length of each boring, approximately 60 feet in each boring. The inclinometers shall be installed to the depth at which the bedrock is encountered or 60 feet, whichever is less. Inclinometers should be completed with stickup well casing.

The Contractor shall obtain well permits from the NJDEP for each inclinometer (N.J.A.C. 7:9D).

Inclinometers shall be surveyed by a New Jersey licensed surveyor as follows:

i. The inner well casing must be surveyed to the nearest hundredth (0.01) foot in relation to the permanent, on-site datum and horizontally to an accuracy of one-tenth of a second latitude and longitude.

ii. A permanent water level measurement mark shall be etched onto the top of the inner well casing to allow for accurate, consistent and comparable water level measurements over time.

Inclinometers shall have the well permit number and site specific well identification number prominently displayed and permanently affixed to the monitoring well;

Inclinometers shall be constructed with a locking cap and generally protected from damage and vandalism. Any damage or vandalism to a monitoring well or piezometer shall be reported to the Department, and the damaged monitoring well or piezometer shall be properly repaired or decommissioned in accordance with N.J.A.C. 7:9-9; and

The Contractor shall complete and submit to the State the monitor well record report for the installation of the well. Additionally a Monitoring well certification Form A - As Built and Monitoring well certification Form B - Location Certification shall be submitted.

Inclinometer construction shall be as approved by the Engineer.

Inclinometers shall be maintained throughout construction and for the first year of operation and maintenance. After that, Contractor may remove the inclinometer probes and data loggers.

2.27.2 Materials

Materials for each inclinometer will include:

- **Inclinometer casing** – Large Diameter QC Casing, 3.34 in. O.D. Inclinometer Casing, (Slope Indicator Company or equal as approved by the Engineer);
- **Borehole grout** – Shall meet the following ratios, as provided by Slope Indicator Company:

Material	Ratio by Weight
Portland Cement	1
Water	2.5
Bentonite	0.3

- **Vibrating Wire Piezometers** – As manufactured by Slope Indicator or equal as approved by the Engineer. One VW Piezometer shall be installed in each inclinometer casing and connected to the data logger. VW Piezometers shall be installed at the depth of the top of clay.
- **Vertical In-Place Inclinometer Sensors and Dataloggers** – As manufactured by Slope Indicator, or equal as approved by the Engineer. Inclinometer Sensors will be installed in each Inclinometer hole at the following depths: at the toe of wall depth, 3 ft above bottom of clay layer with approximately 2 more in between those points, as directed by the Engineer. Inclinometer Sensors shall be connected to Datalogger system capable of providing wireless data retrieval.
- **Existing Inclinometers** – Existing inclinometers will have vertical, in-place, inclinometer probes and data loggers installed. Depths are as follows:

Inclinometer #	Depths of probes below existing ground surface (ft)
SD1	105, 110, 115, 118
SD2	89, 95, 100, 107
SD3	100, 105, 110, 115, 124
SD4	110, 115, 120, 124
SD5	120, 130, 135, 145
SD6	105, 109, 120, 130, 140

One of each of the following items will be purchased and used for collecting readings from the inclinometer:

- **Automatic Data Acquisition System and Software [ADASS]** – As provided by manufacturer of Vertical In-Place Inclinometer Sensors and Dataloggers. ADASS shall be capable of collecting data logger information and presenting the following views: Plan Views, Plots, Tabular Data, Reports and Alarms. A copy of ADASS shall be provided to the Engineer and NJDEP on a weekly basis for monitoring of inclinometer data.

2.27.3 Unitary Responsibility

In order to unify responsibility for proper operation of the complete inclinometers, it is the intent of these Specifications that all system components are furnished by a single supplier (unitary source). The inclinometers must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted. Only those inclinometer probes that are capable of installation and functioning in the existing Slope Indicator Company's QC inclinometer casing, in Inclinometers Nos. SD-1 to SD-6, shall be acceptable.

2.27.3 Submittals

Contractor shall submit shop drawings showing proposed inclinometer construction. Contractor to provide cut sheet data from manufacturer of inclinometer equipment.

Contractor shall submit copies of all permit applications and approvals.

Submittals shall be in accordance with Section 1.3.

2.27.4 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Unit
2.27.1	New Inclinometers	Linear Foot
2.27.2	Existing Inclinometers	Each

The Contractor will be paid the Linear Foot bid unit price for Pay Item 2.27.1 New Inclinometers, measured to the nearest foot. The Contractor will be paid the bid unit price for Pay Item 2.27.2 Existing Inclinometers for each existing inclinometer in which vertical, in-place, inclinometer probes and data loggers are installed.

This shall include furnishing all labor, materials, equipment, and reporting requirements associated with this work. Work detailed in this section shall not be considered complete until all permits (including Form A and B reports) are submitted and survey is completed.

END OF SECTION

2.28 Micropiles

2.28.1 Description

Under this contract, the Contractor shall design and install micropiles to support the new combustion air blower equipment and pump stations shown on the Contract Drawings. The work shall include furnishing all labor and materials and performing all operations necessary to install micropiles at the locations shown on the plans, to a service load of minimum 15 tons per pile. The micropiles are to be steel central core filled and encased with grout, transmitting the structural load to the sand and silty clay layers indicated on the borings. All work shall conform to the Micropile Design and Construction Guidelines (FHWA-SA-97-070) with applicable Interim revisions. Reinforcing core shall be covered with grout to form at least an outer grout core diameter of eight (8) inches with minimum grout thickness/cover of 3 inches.

The spacing of micropiles (center-to-center) shall be at least 3 times the outside diameter of the micropiles.

If the Contractor provides an alternative micropile design, the revised design calculations shall be submitted for review.

2.28.2 Site Conditions

The work shall be performed at the abutment locations of the new combustion air blower equipment in the vicinity of MSLA project location. Contractor shall fully examine the existing site conditions to ensure that equipment can operate without damage to any existing utilities, structures or structural members. The Contractor shall provide all required equipment, modified if needed to accommodate site conditions. Boring logs showing site conditions as encountered are included in Louis Berger & Associates, March 2000, Final Site Sampling and Investigation Plan which are available on file at the NJDEP.

2.28.3 Design Criteria

a. The micropiles shall be designed to provide a service load of 15 tons per pile.

b. Steel core element shall incorporate an additional 1/8-inch thickness of sacrificial steel for corrosion protection.

c. The allowable stresses at working load shall not exceed those allowed by the latest version of AFHWA SA-97-070 with applicable Interim Revisions, if any.

d. Working Drawings. The working drawings shall include all information required for the construction and quality control of the micropiles. Working drawings shall include, but not be limited to, the following items:

   (1) A plan view identifying the locations of all micropiles.

(2) Elevation view showing micropiles elevations; vertical and horizontal spacing.
(3) Design parameters and applicable codes.
(4) General notes for constructing the micropiles structure including construction sequencing or other special construction requirements.

The working drawings and design calculations shall be signed and sealed by the Contractor's Professional Engineer licensed in New Jersey.

2.28.4 Qualifications

The Contractor performing the work described in this specification shall submit proof of:

1) Two projects on which he has successfully designed, tested and installed micropiles,

2) The foreman for this work having supervised the successful testing and installation of Micropiles on at least two projects in the past two years.

A Registered Professional Engineer licensed in New Jersey, employed by the Contractor and having experience in the construction of at least 5 completed micropiles projects over the past 3 years of similar scope to this project, and shall directly be responsible for the work. The Contractor shall not use consultants or manufacturers' representatives to satisfy the responsible Engineer requirements of this section.

2.28.5 Materials

Furnish materials new and without defects. Remove defective materials from the jobsite at no additional cost. Materials for micropiles shall consist of the following:

Cement - All cement shall be Portland cement conforming to ASTM C150/AASHTOM85, Types I, II, III or V. Cement shall be free from lumps and other deleterious matter and shall be otherwise undamaged when used. Cement shall be protected from exposure to moisture: Immediately upon receipt at the jobsite the grout shall be stored in a dry and ventilated storage. Grout delivery shall be accompanied by shipping documents containing the following:

- Certification that material meets all applicable requirements of the project
- Cement strength uniformity for all test ages in accordance with ASTM C917
- Type or class of material shipped
- Manufacturing locations and dates
- Lot number
- Date of shipment
- Quantity of material shipped

Water - Water used in the grout mix shall conform to AASHTO T26 and shall be potable, clean, and free from substances that may be injurious to cement and steel.

Grout - Neat cement or sand/cement mixture within a minimum 28-day compressive strength of 5,000 psi per AASHTO T106/ASTM C109.

Admixtures for Grout - Admixtures shall conform to the requirements of ASTM C494/AASHTO M194. Admixtures that control bleed, improve flowability, reduce water content and retard set may be used in the grout, subject to the review and acceptance of the Engineer. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations. Expansive admixtures shall only be added to the grout used for filling sealed encapsulations and anchorage covers. Accelerators are not permitted. Admixtures containing chlorides are not permitted.

Reinforcing Steel Core - Reinforcing steel shall be deformed bars in accordance with ASTM A615/AASHTO M31, Grade 420 or Grade 520 or ASTM A722/AASHTO M275, Grade 1035. The threading may be continuous spiral deformed ribbing provided by the bar deformations (e.g., Titan, Dywidag or Williams continuous threaded bars or equivalent) or may be cut into a reinforcing bar. If threads are cut into a reinforcing bar, the next larger bar number designation from that shown on the Plans shall be provided, at no additional cost. Bar couplers, if required, shall develop the ultimate tensile strength of the bars without evidence of any failure. Overlapping of deformed bars is not permitted. Allowance of 12 inches will be added for the exposed portion for each micropiles installed for connection to the concrete platform.

The manufacturer or fabricator of special steel elements (i.e. Titan, Dywidag, Williams, or equivalent) shall furnish a certificate of compliance stating that the steel core being supplied conforms to these specifications. The certificate of compliance shall include test reports for tensile and chemical tests. The certificate of compliance shall be in English units.

Plates and Shapes - Structural steel plates and shapes for micropiles top attachments shall conform to ASTM A36/AASHTO M183, OR ASTM A 572/AASHTO M233, Grade 350. Bearing plate and nut shall be used, and be threaded onto the top end of steel core as load transfer elements from the concrete platform.

2.28.6 Execution

Contractor shall fully examine the existing site conditions to ensure that his equipment can operate without damage to or relocation of existing utilities, structures or structural members. Contractor shall provide all required equipment, modified if needed to accommodate site conditions.

The structural design does not allow for any eccentricity. Therefore, the contractor’s micropile rig shall be capable of drilling and installing the micropiles at locations as shown on the drawings without any deviation in horizontal plane. Also, the Contractor’s drill rig shall have a plum line attached on its mast to ensure that the micropiles will not deviate from verticality.

2.28.7 Construction Submittals

The Contractor shall prepare and submit to the Engineer, for review of completeness, five copies of the following for the micropiles system or systems to be installed:

(1) Detailed step-by-step description of the proposed micropiles construction procedure, including personnel, testing and equipment to assure quality control. This step-by-step procedure shall be shown on the working drawings in sufficient detail to allow the Engineer to monitor the construction and quality of the micropiles.

(2) Proposed start date and time schedule and micropiles
- Micropile number
- Micropile design load
- Type and size of reinforcing steel core, and casing, if any
- Total micropiles length
- Micropile top footing attachment

(3) Manufacturer's information, model, size, and type of equipment to be used for installing micropiles, with appropriate manufacturer's literature for review. Include detailed description of the drilling equipment and methods proposed to be used to provide drill hole support and prevent detrimental ground movements.

(4) Information on space requirements for installation equipment that verify the proposed equipment can perform at the site. Plan describing how drilling fluids and excess waste grout will be controlled and disposed.

(5) Certified mill test reports for the steel. The ultimate strength, yield strength, elongation, and material properties composition shall be included.

(6) Proposed Concrete Foundation Design. The concrete foundation design shall be performed by a NJ licensed professional engineer with signed and sealed drawings.

(7) Proposed Grouting Plan. The grouting plan shall include complete descriptions, details, and supporting calculations for the following:

a) Grout mix design and type of materials to be used in the grout including certified test data and trial batch reports.

b) Grouting equipment, including capacity and relation to the grouting demand and working conditions as well as provisions for back-up equipment and spare parts.

c) Types and sizes of grout hoses, connections, and grout delivery systems.

d) Methods and equipment for placing, positioning, and supporting the steel reinforcing core, or casings, if any.

e) Methods and equipment for accurately monitoring and recording the grout depth, grout volume and grout pressure as the grout is being placed.

f) Procedures and schedules for grout batching, mixing, and pumping including provisions for handling drilling fluid and for post grouting (if directed by the Engineer).

g) Grouting rate calculations, when requested by the Engineer. The calculations shall be based on the initial pump pressures or static head on the grout and losses throughout the placing system, including anticipated head of drilling fluid (if applicable) to be displace.

h) Contingency procedures for handling blockage of ducts or equipment breakdowns.

i) Estimated curing time for grout to achieve specified strength. Previous test results for the proposed grout mix completed within one year of the start of grouting may be submitted for initial verification and acceptance and start of production work. During production, grout shall be tested in accord with Section 3.3.4.

j) Procedure and equipment for Contractor monitoring of grout quality.

Work shall not begin until the construction submittals have been received, reviewed, and accepted in writing by the Engineer. Provide submittal at least 5 calendar days prior to initiating micropiles installation. The Contractor shall allow the Engineer 5 calendar days to review the construction submittals after a complete set has been received. Additional time required due to incomplete or unacceptable submittals shall not be cause for delay or impact claims. All costs associated with incomplete or unacceptable Contractor submittals shall be the responsibility of the Contractor.

2.28.8 Micropiles Installation

The Contractor shall select the drilling method, the grouting procedure, and the grouting pressure used for the installation of the micropiles. The Contractor shall also determine the steel core section or size, final drill hole diameter and bond length, and reinforcement steel sizing necessary to develop the specified load capacities. The Contractor is also responsible for estimating the grout intake. There will be no extra payment for grout overruns. The Contractor is also responsible for locating existing underground structures and maintaining the integrity of the existing both underground and above ground structures.

Drilling - The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, without causing damage to any overlying, adjacent or buried structures or services. Drilling shall be performed using rotary drilling techniques with clean water or grout circulation. The use of percussion, down-the-hole, or top drive drilling techniques, is not allowed. The drill hole must be open along its full-length to at least the design minimum drill hole diameter prior to placing steel core, and pumping grout. The steel core and casing shall have a required minimum allowance as required by the design for the exposed portion for connection to the concrete pile cape. Lengths of steel cores to be spliced shall be secured in proper alignment and in a manner to avoid eccentricity of angle between the axes of the two lengths to be spliced.

Micropiles drill hole support will be required to permit the micropiles to be formed to the minimum design drill hole diameter. The Contractor's proposed method(s) to provide drill hole support and to prevent detrimental ground movements shall be reviewed by the Engineer. Detrimental ground movement is defined as movement, which requires remedial repair measures.

Ground Heave or Subsidence - During installation of micropiles, the Contractor shall observe the conditions in the vicinity of the micropiles construction site on a daily basis for signs of ground heave or subsidence. He is to immediately notify the Engineer if signs of movements are observed. Contractor shall immediately suspend or modify drilling or grouting operations of ground heave or subsidence is observed, if the mini- micropile

structure is adversely affected, or if adjacent structures are damaged from the drilling or grouting. If the Engineer determines that the movements require corrective action, the Contractor shall take corrective actions necessary to stop the movement or perform repairs. When due to the Contractor's methods, operations, or failure to follow the specified/approved construction sequence, as determined by the Engineer, the costs of providing corrective actions will be borne by the Contractor. When due to differing site conditions, as determined by the Engineer, the costs of providing corrective actions will be paid as Extra Work.

Grouting - The Contractor shall use a stable, neat cement grout or a sand/cement grout with a minimum 28-day unconfined compressive strength of 5,000 psi. Water/cement ratio of the grout shall always remain at or below 0.4. Admixtures, if used, shall be mixed in accordance with manufacturer's recommendations. The grouting equipment used shall produce a colloidally-mixed grout, free of lumps and undispersed cement. Contractor shall have means and methods of measuring the grout quantity and pumping pressure during the grouting operations. The grout pump shall be equipped with a pressure gauge to monitor grout pressures. A second pressure gauge shall be placed at the point of injection into the mini- micropile top. The pressure gauges shall be capable of measuring pressure of at least 500 psi or twice the actual grout pressures used, whichever is greater. The grout shall be kept in agitation prior to mixing. Grout shall be placed within 30 minutes of mixing. The grouting equipment shall be sized to enable each micropile to be grouted in one continuous operation. The grout shall be injected from the lowest point of the drill hole and injection shall continue until uncontaminated grout flows from the top of the micropiles (i.e. by tremie grouting techniques). The grout may be pumped through grout tubes or other approved methods. Once the clean grout displaces the drilling fluid and reaches the top, a packer shall be mounted on the pile cap for pressure grouting. Grout shall be pumped to the bottom of the micropiles by means of plastic tremie pipes, continuously, until 150-psi pressure is attained for a period of 5 minutes, after which, the grouting work shall be considered completed. Temporary casing, if used, shall be extracted in stages ensuring that, after each length of casing is removed the grout level is brought back up to the ground level before the next length is removed. The removal of temporary casing shall be completed prior to 5 minute hold pressure. Additional grout shall be placed by the use of the tremie pipe at all times. The tremie pipe shall always extend below the level of the existing grout in the drillhole. The grout pressures and grout takes shall be controlled to prevent excessive heave or fracturing of rock or soil formations. Upon completion of grouting, the grout tube may remain in the hole, but must be filled with grout.

Grout Testing - During production, mini- micropile grout shall be tested by the Contractor for compressive strength in accordance with AASHTO T106/ASTM C109 at a frequency of no less than one set of three 2- inch grout cubes from each micropile, The compressive strength shall be the average of the 3 cubes tested.

Grout composition, as reflected by grout density, shall be determined by the Contractor per ASTM C188/AASHTO T133 at a frequency of at least one test per pile, conducted just prior to start of mini- micropile grouting. The Baroid Mud Balance is an approved

device for determining the grout density. The measured grout density shall be within 2% of the theoretical value.

Grout samples shall be taken directly from the grout plant. Provide grout cube compressive strength and grout density test results to the Engineer within 24 hours of testing.

Micropiles Installation Records - Contractor shall prepare and submit to the Engineer full installation records for each micropiles installed. The records shall be submitted within the same work shift that micropiles installation is completed. The data shall be recorded on the micropile installation log and as a minimum shall include the following information:

- Project name and number.
- Name of Contractor.
- Pile location, number and date installed.
- Computed pile capacity.
- Type and length of steel core.
- Type and length of casing, if used.
- Grout mix design.
- Grout water/cement ratio.
- Grout density.
- Grout volume.
- Grout pressures; hold pressure, and the hold time.
- Secondary grout pressures and volume, if any.
- Number of grout cube samples.
- Type and size of drill rig used.
- Rate of operation of drilling equipment.
- Micropiles dimensions.
- Tip elevation .
- Butt elevation before and after cut-off.
- Ground elevation.
- Pile deviation.
- Unusual occurrences during micropiles installation.

2.28.9 Construction Tolerance

The Contractor shall take all necessary measures to ensure that the top of the mini- micropile is at the plan location (within 1 inch).

2.28.10 Pile Load Tests

If required, perform pull out load and lateral load testing in accordance with ASTM Standards.

If the load test fails to meet the acceptance criteria, the Contractor shall propose modifications to the design, the construction procedure, or both. These proposed modifications may include modifying the installation methods, increasing the mini- micropile length, or changing the

micropiles type. Any modification that necessitates changes to the structure shall require the Engineer's prior review and acceptance. Any modifications of design or construction procedures or cost of additional Test piles and load testing shall be at the Contractor's expense. At the completion of load testing, test piles shall be removed down to the elevation specified by the Engineer.

2.28.11 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Unit
2.28	Micropiles	Linear Foot

The Contractor shall be paid the Linear Foot unit bid price for the Bid Item No. 2.28 - Micropiles. This includes all labor, materials and equipment for the installation of five (5) micropiles for the combustion air blower concrete pad and five (5) at each pump station, as shown on the Contract Drawings. Micropile Load Tests, if and where directed by the Engineer, shall be included in the Bid Item No. 2.28 – Micropiles.

END OF SECTION

2.29 Fencing, Gates, and Bollards

2.29.1 General Description

Fencing, gates, and bollards shall consist of the installation of a temporary and permanent chain link fence, including post holes, concrete, and posts, gates, and bollards furnished and installed in accordance with the plans and these specifications. Temporary fencing shall be installed around the trailers, as detailed in Section 1.4. Permanent fencing shall be installed around the gas blower and flare system, as shown on the plans.

2.29.2 Materials

Materials shall meet the requirements of ASTM A491 for aluminum coated steel chain link fencing (9 gauge wire with 2 inch mesh); ASTM F900 or F1184 for gates; ASTM F1083 for posts; ASTM A824 for tension wire (9 gauge); and ASTM F626 for accessories.

Fence shall consist of aluminum-coated 8' high chain link fence.

Gate shall include aluminum-coated 8' high chain link fence gate having a width of 10’. Gate shall be the same height as the fence to which the gates are attached. Contractor shall provide gate locks and six sets of keys which fit all gate locks. All locks should be keyed alike.

Bollards shall consist of 8” diameter steel pipe, extend 3’-6” above grade and be filled with 4,000 psi concrete and shall be installed to a depth of 4’and shall include post holes, concrete, pipe, primer, and paint (two coats of yellow exterior grade epoxy paint). Bollard footing holes shall have a 3 foot minimum diameter. Four bollards shall be installed around the North Pump Station and three bollards around the South Pump Station as depicted on the Contract Drawings.

Submittals shall be according to Section 1.3.

2.29.3 Installation

The chain link fence shall conform to The American Association of State Highway and Transportation Officials (AASHTO) M181 and shall include, the following requirements:

1. The fence shall be installed along lines and/or locations as specified by NJDEP.

2. Installation of fence will include any alterations or modifications to the ground surface which must be performed and all necessary tools normally used in fence installation. These alterations may require the use of hand tools as well as hand-held power equipment such as chain saws, power augers, powered brush cleaning devices, etc.

   Alterations will also include the removal to ground level of stumps, rocks, etc. protruding above the ground surface and in the line of the fence. The Contractor is to perform the required work in such a manner as to minimize erosion that would occur as a result.

3. The height of the fence shall be eight feet (8’). The 8' fencing shall be all metal, constructed of wire fabric fastened to vertical line posts.

4. The entire fence shall be installed within site boundary lines, and the fabric shall be installed on the side of the posts facing away from the area enclosed by said lines.

5. All posts, frames and rails shall be round, hot dipped galvanized, Schedule 40, steel pipe per ASTM F 1083 with strength requirements in accordance with ASTM F 669. In addition, the fencing shall conform, at a minimum to the following sizes and lengths:

	Outside Diameter	Length
Line Posts	2- ½ inches	11 feet
Corner Posts	3 inches	11 feet, 6 inches
Gate Posts for gate leaves less than 8 feet	3 inches	11 feet, 6 inches
Gate Posts for gate leaves 8 feet or larger	4 inches	12 feet
Top Rail	1-5/8 inches	
Gate Frame	2 inches	

Note:

1) Additional lengths for the above posts may be required when fencing is installed over channel crossings and other surface irregularities, and when fencing is installed with drive anchors. and for barbed wire installations.

2) Posts shall be 2 feet shorter where 6 foot fence is required.

6. Line posts shall be spaced not more than ten (10) feet on centers. Line post footings shall have a minimum diameter of ten (10) inches and shall extend at least six (6) inches below the bottom of the posts. Corner and gate post footings shall have a minimum diameter of fifteen (15) inches and shall extend at least six (6) inches below the bottom of the posts.

7. The bottom of the corner posts shall be a minimum of three and one-half (3-1/2) feet below finished grade; and the bottom of the line posts shall be at least three (3) feet below grade. Gate posts shall extend at least four (4) feet below grade level.

8. All posts shall be plumbed vertical before holes are filled with concrete, and held vertical while concrete is installed so that finished posts shall be plumb.

9. Concrete shall have aggregate no larger than one and one-half (1-1/2) inches and have minimum compressive strength of no less than two thousand (2,000) psi at twenty-eight (28) days.

10. Post holes shall be completely filled with concrete which shall extend not more than three (3) inches above grade, and will be neatly crowned to shed water.

11. When conditions require, and NJDEP personnel directs, drive anchors will be used in lieu of concrete filled post holes. The installation will require the complete assembly of the anchor shoes, fastening hardware and blades. Each drive anchor assembly will be complete for each post.

12. Pull shall not be applied to posts set in concrete foundations until concrete has cured a minimum of seventy-two (72) hours.

13. All parts of the fence shall be galvanized steel, except that fittings may be of galvanized malleable iron, wrought iron or steel. Posts, rails, braces, and gate frames shall be zinc coated at 1.8 oz. per square foot.

14. Tops of posts shall be provided with caps to exclude moisture. Tension wire shall connect post tops and bottoms. Tension wire shall be seven gauge coil spring steel wire and shall be galvanized.

15. Wire fabric shall be of No. 9 gauge wire helical wound and interwoven with a mesh of two inches (2"). The fabric shall conform to Fed. Spec. RR-F-191, Type 11, 1.2 ounce per square foot coating. Top of fabric shall have knuckled selvage, bottom shall have barbed selvage.

16. Wire fabric shall be fastened to line posts with preformed clips of 9-gauge, zinc coated steel wire, spaced not more than twelve (12) inches on center. Fabric shall be fastened to top and bottom tension wires with wire ties or hog rings spaced at eighteen (18) inches.

17. Wire fabric shall be installed in gate frames by means of high carbon steel stretcher bars.

18. Wire fabric shall be securely fastened to all terminal posts using one-quarter (1/4) inch by three-quarter (3/4) inch tension bars and 11 gauge pressed steel bands spaced at twelve (12) inches.

19. Barbed wire shall be furnished along the top of the fence, and shall be supported at the posts by arms inclining away from the area enclosed at an angle of forty-five degrees. Arms shall be strong enough to support a weight of two hundred pounds (200 lbs.) applied at outer strand of the bared wire. The arms shall have tongues to receive three (3) strands of double twisted 4-point thickest barbed wire, the barbs spaced about four (4) inches apart. The barbed wire shall conform to ASTM A2 1.

20. End and corner panels, and panels adjacent to gates shall have intermediate horizontal rails and diagonal bracing rods which shall be at least three-eighths (3/8) inch in diameter and shall be provided with turnbuckles. Straight runs between braced posts (posts that have attached hardware including the intermediate horizontal rails and diagonal bracing rods) shall not exceed five hundred (500) feet.

21. All gate frames shall be of welded construction. All rails used for gate construction shall be factory galvanized with 1.8 ounce zinc coating per square foot. Gate frames shall be galvanized after fabrication where possible or painted with suitable rust-preventative. Gate

leaves more than eight (8) feet wide shall have either intermediate members as necessary to provide rigid construction, free from sag or twist. Diagonal bracing shall be at least three eighths (3/8) of an inch in diameter and shall be provided with turnbuckles.

22. One (1) ten (10) foot wide gate shall be provided at the location shown on the Drawings. See plans and details for locations and additional dimensions.

23. Gate hinges shall be of the double clamping offset type. Gates shall swing through ninety degrees from closed to open. To hold the gate in open or closed positions, each gate shall be provided with a keeper which automatically engages a gate shoe set in concrete. Gates shall have a drop bolt latch with provision for a padlock. Latches shall be arranged so that the padlock will be accessible from both sides of the gate regardless of the latching arrangement.

24. Each gate shall be provided with a brass body padlock suitable for outdoor use. The lock shall have a hardened shackle, and shall be of the five (5) pin tumbler type, Master Lock No Pro Series 6321KA or 6125KALJ or equal as approved by the Engineer. Die cast locks are not acceptable.

    All locks on a site must be keyed alike and six (6) copies of the key must be provided to NJDEP. Chain of the appropriate gauge and length for site-specific conditions may be specified for use with the locks by the NJDEP.

25. In the event unusual digging conditions such as rubble, cement covered areas, etc. are encountered, existing mechanical means must be used to dig holes for footings of the same dimensions as described in paragraphs 6 and 7 above. Core drilling of holes and embedding posts in pourable concrete or the use of bolted on plates will not be permitted without the express written approval of NJDEP.

2.29.4 Temporary Fence

Refer to Section 1.4.5 for Temporary Fencing requirements

~~In accordance with Section 1.4 Mobilization, temporary chain-link fence and pedestrian access gates will be required around the trailer staging area. The temporary fencing shall be erected before construction activity in the staging area. Temporary fence shall be constructed according to the requirements for permanent fence except used materials may be used. The fence shall be installed on stands made of hot dipped galvanized steel pipe at grade. This stand is intended to go on the ends of the fence. Temporary fence shall be maintained as directed during construction and shall be removed and disposed of/ recycled when no longer required on the Project.~~

2.29.5 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Unit
2.29.1	Chain Link Fence with Barbed Wire, 8’ high	Linear Feet
2.29.2	Chain Link Gate with Barbed Wire, 10’ wide	Each

The Contractor will be paid the bid unit price per linear foot of permanent fencing installed per Bid Item 2.29.1, Chain Link Fence with Barbed Wire, 8’ high. These bid unit prices shall include the complete installation of fencing as specified.

The Contractor will be paid the bid unit price per each of gates installed per Bid Item 2.29.2, Chain Link Gate with Barbed Wire, 10’ wide. This bid unit price shall include the complete installation of gates as specified.

Payment for bollards shall be incidental to the North and South Pump Station installation and shall be included in Pay Items 2.11.1 and 2.11.2.

END OF SECTION

2.30 Low-Voltage Electrical Power Conductors and Cables

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.
B. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.
B. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100and marked for intended use.
C. Comply with NFPA 70.

PART 2 – PRODUCTS

2.1 CONDUCTORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.
6. Or equal as approved by the Engineer.

C. Copper Conductors: Comply with NEMA WC 70.

D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.

2.2 CONNECTORS AND SPLICES

A. A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Power Systems, Inc.
2. O-Z/Gedney; EGS Electrical Group LLC.
3. 3M; Electrical Products Division.
4. Tyco Electronics Corp.
5. Or equal as approved by the Engineer

C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 – EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND WIRING METHODS

A. Service Entrance: Type XHHW, single conductors in raceway.
B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.
D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
E Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
G. Class 1 Control Circuits: Type THHN-THWN, in raceway.
H. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS

A. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
C. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 2.35 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to applicable electrical codes.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
B. Perform tests and inspections and prepare test reports.
C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

    a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

4.1 Measurement and Payment

No separate payment will be made for work conducted as per this section. The cost of this work shall be included in the respective Pay Items.

END OF SECTION

2.31 Grounding and Bonding for Electrical Systems

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section Includes: Grounding systems and equipment.
B. Section includes grounding systems and equipment, plus the following special applications:

1. Overhead-line grounding.
2. Underground distribution grounding.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Ground rods.
2. Ground rings.
3. Grounding arrangements and connections for separately derived systems.
4. Grounding for sensitive electronic equipment.

B. Qualification Data: For qualified testing agency and testing agency's field supervisor.
C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Instructions for periodic testing and inspection of grounding features at ground rings based on NFPA 70B.

a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
b. Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 – PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:

1. No. 4 AWG minimum, soft-drawn copper.
2. Conductor Protector: Half-round PVC or wood molding; if wood, use pressure-treated fir, cypress, or cedar.

D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 5/8 by 96 inches (16 by 2400 mm) in diameter.

1. Backfill Material: Electrode manufacturer's recommended material.

PART 3 – EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. as shown AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING OVERHEAD LINES

A. Comply with IEEE C2 grounding requirements.
B. Install two parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.
C. Drive ground rods until tops are 12 inches below finished grade in undisturbed earth.
D. Ground-Rod Connections: Install bolted connectors for underground connections and connections to rods.
E. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.
F. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.
G. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.
B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.
B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Ground Ring: Install a grounding conductor, electrically connected to each ground rod and to each piece of equipment, extending around the perimeter of area.

1. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.

3.6 LABELING

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.
B. Install labels at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.
F. Prepare test and inspection reports.
G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

4.1 MEASUREMENT AND PAYMENT

No separate payment will be made for work conducted as per this section. The cost of this work shall be included in the respective Pay Items.

END OF SECTION

2.32 Hangers and Supports for Electrical Systems

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.
B. IMC: Intermediate metal conduit.
C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

2. Nonmetallic slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.
h. Or equal as approved by the Engineer

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. Fabco Plastics Wholesale Limited.
   d. Seasafe, Inc.
   e. Or equal as approved by the Engineer.

3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
4. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
5. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hilti Inc.
2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
3) MKT Fastening, LLC.
4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
5) Or equal as approved by the Engineer.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cooper B-Line, Inc.; a division of Cooper Industries.
2) Empire Tool and Manufacturing Co., Inc.
3) Hilti Inc.
4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
5) MKT Fastening, LLC.
6) Or equal as approved by the Engineer.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
B. Materials: Comply with building code requirements for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
B. Raceway Support Methods: In addition to methods described in NECA 1, RMC may be supported by openings through structure members, as permitted in NFPA 70.
C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements as per building applicable building code requirements for site-fabricated metal supports.
B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 2.25 Site Concrete.
C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

4.1 MEASUREMENT AND PAYMENT

No separate payment will be made for work conducted as per this section. The cost of this work shall be included in the respective Pay Items.

END OF SECTION

2.33 Raceways and Boxes for Electrical Systems

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Metal wireways and auxiliary gutters.
3. Surface raceways.
4. Boxes, enclosures, and cabinets.
5. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 2.34 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

D. Samples: For wireways and surface raceways and for each color and texture specified, 12 inches (300 mm) long.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. Anamet Electrical, Inc.
3. Electri-Flex Company.
4. O-Z/Gedney; a brand of EGS Electrical Group.
5. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
6. Republic Conduit.
7. Robroy Industries.
8. Southwire Company.
9. Thomas & Betts Corporation.
10. Western Tube and Conduit Corporation.
11. Wheatland Tube Company; a division of John Maneely Company.
12. Or equal as approved by the Engineer.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

G. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anamet Electrical, Inc.
2. Arnco Corporation.
3. CANTEX Inc.
4. CertainTeed Corp.
5. Condux International, Inc.
6. Electri-Flex Company.
7. Kraloy.
8. Lamson & Sessions; Carlon Electrical Products.
9. Niedax-Kleinhuis USA, Inc.
10. RACO; a Hubbell company.
11. Thomas & Betts Corporation.
12. Or equal as approved by the Engineer.

B. Listing and Labeling: fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. LFMC: Comply with UL 1660.
E. Rigid HDPE: Comply with UL 651A.
F. Continuous HDPE: Comply with UL 651B.
G. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
H. RTRC: Comply with UL 1684A and NEMA TC 14.
I. Fittings for LFMC: Comply with UL 514B.
J. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
K. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman; a Pentair company.
3. Mono-Systems, Inc.
4. Square D; a brand of Schneider Electric.
5. Or equal as approved by the Engineer.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 4X unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
D. Wireway Covers: Hinged type unless otherwise indicated.
E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Engineer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Mono-Systems, Inc.
    b. Panduit Corp.
    c. Wiremold / Legrand.
    d. Or equal as approved by the Engineer.

C. Tele-Power Poles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Mono-Systems, Inc.
    b. Panduit Corp.
    c. Wiremold / Legrand.
    d. Or equal as approved by the Engineer.

2. Material: Galvanized steel with ivory baked-enamel finish.
3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman; a Pentair company.
7. Hubbell Incorporated; Killark Division.
8. Kraloy.
9. Milbank Manufacturing Co.
10. Mono-Systems, Inc.
11. O-Z/Gedney; a brand of EGS Electrical Group.
12. RACO; a Hubbell Company.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.
18. Or equal as approved by the Engineer.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
H. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 4X with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

I. Cabinets:

1. NEMA 250, Type 4X galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. CDR Systems Corporation; Hubbell Power Systems.
d. NewBasis.
e. Oldcastle Precast, Inc.; Christy Concrete Products.
f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
g. Or equal as approved by the Engineer.

3. Standard: Comply with SCTE 77.
4. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, "ELECTRIC.".
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes as shown on the drawings and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete and/or reinforced concrete.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. CDR Systems Corporation; Hubbell Power Systems.
d. NewBasis.
e. Nordic Fiberglass, Inc.
f. Oldcastle Precast, Inc.; Christy Concrete Products.
g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
h. A.C. Miller Concrete product.
i. Or equal as approved by the Engineer.

3. Standard: Comply with SCTE 77.
4. Color of Frame and Cover: Gray.
5. Configuration: Designed for flush burial with [open] [closed] [integral closed] bottom unless otherwise indicated.
6. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
7. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

8. Cover Legend: Molded lettering, "ELECTRIC."
9. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
10. Handholes as shown on the drawings and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.7 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC, Type EPC-80-PVC, or concrete encased.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: GRC.
2. Exposed, Not Subject to Severe Physical Damage: GRC.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

   a. Mechanical rooms.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: GRC.

6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
F. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
C. Complete raceway installation before starting conductor installation.
D. Comply with requirements in Section 2.32 "Hangers and Supports for Electrical Systems" for hangers and supports.
E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
G. Support conduit within 12 inches (300 mm) of enclosures to which attached.
H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum10-foot (3-m) intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

O. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

Q. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

R. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

S. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

T. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

U. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

V. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

W. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Y. Locate boxes so that cover or plate will not span different building finishes.

Z. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

BB. Set metal floor boxes level and flush with finished floor surface.

CC. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Contract plans for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in in contract plans.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 2.36 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
D. Install handholes with bottom below frost line.
E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 2.35 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with all applicable code requirements.

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

4.1 MEASUREMENT AND PAYMENT

No separate payment will be made for work conducted as per this section. The cost of this work shall be included in the respective Pay Items.

END OF SECTION

2.34 Underground Ducts and Raceways for Electrical Systems

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks.
2. Handholes and boxes.

1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.
2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Accessories for handholes and boxes.
4. Warning tape.
5. Warning planks.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Reinforcement details.
3. Grounding details.
4. Joint details.

C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design.
3. Grounding details.
4. Dimensioned locations of pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
2. Drawings shall be signed and sealed by a qualified professional engineer.

B. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C 858.

C. Qualification Data: For professional engineer and testing agency.

D. Source quality-control test reports.

E. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Engineer no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Engineers written permission.

1.9 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 PRECAST CONCRETE HANDHOLES AND BOXES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.
9. A.C. Miller Concrete Product.
10. Or equal as approved by the Engineer.

C. Comply with ASTM C 858 for design and manufacturing processes.

D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
3. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.

    a. Cover Hinges: Concealed, with hold-open ratchet assembly.
    b. Cover Handle: Recessed.

4. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.

    a. Cover Hinges: Concealed, with hold-open ratchet assembly.
    b. Cover Handle: Recessed.

5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC."
7. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
8. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

    a. Extension shall provide increased depth of 12 inches (300 mm).
    b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

9. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.

    a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
    b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
    c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

10. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

    a. Type and size shall match fittings to duct or conduit to be terminated.
    b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

11. Handholes as shown on the Drawings and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.3 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.

1. Color: Gray.
2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC."
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes as shown on the Drawings and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. CDR Systems Corporation.
    d. NewBasis.
    e. Or equal as approved by the Engineer.

C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. Christy Concrete Products.

d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
e. Or equal as approved by the Engineer.

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of cast iron.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Carson Industries LLC.
b. Christy Concrete Products.
c. Nordic Fiberglass, Inc.
d. Or equal as approved by the Engineer.

2.4 PRECAST MANHOLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.
9. A.C. Miller Concrete Products
10. Or equal as approved by the Engineer.

C. Comply with ASTM C 858 and with interlocking mating sections, complete with accessories, hardware, and features.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.

a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.

c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

a. Type and size shall match fittings to duct or conduit to be terminated.
b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

D. Concrete Knockout Panels: 1-1/2 to 2 inches (38 to 50 mm) thick, for future conduit entrance and sleeve for ground rod.

E. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-80 or EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

3.2 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.

3.3 EARTHWORK

A. Excavation and Backfill: Do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation as per Contract plans and specifications.

3.4 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1220 mm), both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 50 feet (3 m) outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 2.35 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

G. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.

H. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than **4** spacers per 20 feet (6 m) of duct. Secure separators to earth

and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.

10. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

I. Direct-Buried Duct Banks (for GRC only):

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than **4** spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified.
4. Install backfill as specified.
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified.
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

11. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried ducts and duct banks, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional planks 12 inches (300 mm) apart, horizontally.

3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-Place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.
2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches (38 to 50 mm) thick, arranged as indicated.
3. Cast-in-place concrete, formwork, and reinforcement as specified.

B. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches (380 mm) below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
3. Install handholes with bottom below the frost line.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

E. Waterproofing: Apply waterproofing to exterior surfaces of handholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

F. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, **and** cable arms, as required for installation and support of cables and conductors and as indicated.

H. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (98 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

I. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with applicable Specification Sections.

3.7 GROUNDING

A. Ground underground ducts and utility structures according to Section 2.31 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 2.31 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

4.1 MEASUREMENT AND PAYMENT

No separate payment will be made for work conducted as per this section. The cost of this work shall be included in the respective Pay Items.

END OF SECTION

2.35 Sleeves and Sleeve Seals for Electrical Raceways and Cabling

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

C. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

D. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.
e. Proco Products, Inc.
f. Or equal as approved by the Engineer.

3. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Stainless steel.
5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

a. Presealed Systems.
b. Pipeline Seal & Insulator, Inc.
c. Emerson Industrial Automation/O-Z Gedney

d. Or equal as approved by the Engineer.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

E. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

4.1 MEASUREMENT AND PAYMENT

No separate payment will be made for work conducted as per this section. The cost of this work shall be included in the respective Pay Items.

END OF SECTION

2.36 Identification for Electrical Systems

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high letters on 20-inch (500-mm) centers.

D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers diagonally over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stop stripes at legends.

H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

I. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) or 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

D. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

F. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.4 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.

C. Tag: Type I:

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 4 mils (0.1 mm).
3. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).
4. 3-Inch (75-mm) Tensile According to ASTM D 882: 30 lbf (133.4 N), and 2500 psi (17.2 MPa).

D. Tag: Type II:

1. Multilayer laminate consisting of high-density polyethylene scrim coated with pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 12 mils (0.3 mm).

3. Weight: 36.1 lb/1000 sq. ft. (17.6 kg/100 sq. m).
4. 3-Inch (75-mm) Tensile According to ASTM D 882: 400 lbf (1780 N), and 11,500 psi (79.2 MPa).

E. Tag: Type ID:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils (0.125 mm).
3. Foil Core Thickness: 0.35 mil (0.00889 mm).
4. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
5. 3-Inch (75-mm) Tensile According to ASTM D 882: 70 lbf (311.3 N), and 4600 psi (31.7 MPa).

F. Tag: Type IID:

1. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 8 mils (0.2 mm).
3. Foil Core Thickness: 0.35 mil (0.00889 mm).
4. Weight: 34 lb/1000 sq. ft. (16.6 kg/100 sq. m).
5. 3-Inch (75-mm) Tensile According to ASTM D 882: 300 lbf (1334 N), and 12,500 psi (86.1 MPa).

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with **black letters on white face**.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in

contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

a. Color shall be factory applied.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

D. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

G. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.
b. Controls with external control power connections.

I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be **engraved**, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Enclosed switches.
e. Enclosed circuit breakers.
f. Variable-speed controllers.
g. Push-button stations.
h. Contactors.

4.1 MEASUREMENT AND PAYMENT

No separate payment will be made for work conducted as per this section. The cost of this work shall be included in the respective Pay Items.

END OF SECTION

2.37 Overcurrent Protective Device Coordination Study

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.

1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and Equipment Evaluation Reports.
3. Coordination-Study Report.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For coordination-study specialist.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

B. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

1. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.
4. Operation Technology, Inc.
5. SKM Systems Analysis, Inc.
6. Or equal as approved by the Engineer.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

    a. Circuit-breaker and fuse-current ratings and types.
    b. Relays and associated power and current transformer ratings and ratios.
    c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    d. Generator kilovolt amperes, size, voltage, and source impedance.
    e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
    f. Busway ampacity and impedance.
    g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.

h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Distribution equipment.
2. Branch circuit panelboard.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 and IEEE 242.
1. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
2. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 141 recommendations for fault currents and time intervals.

C. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

D. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

a. Device tag.
b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
d. Fuse-current rating and type.
e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

a. Device tag.
b. Voltage and current ratio for curves.
c. Three-phase and single-phase damage points for each transformer.
d. No damage, melting, and clearing curves for fuses.
e. Cable damage curves.
f. Transformer inrush points.
g. Maximum fault-current cutoff point.

E. Completed data sheets for setting of overcurrent protective devices.

4.1 MEASUREMENT AND PAYMENT

No separate payment will be made for work conducted as per this section. The cost of this work shall be included in the respective Pay Items.

END OF SECTION

2.38 Electricity Metering

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section includes equipment for electricity metering by utility company.

1.3 DEFINITIONS

A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.

B. PC: Personal computer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For electricity-metering equipment.

1. Dimensioned plans and sections or elevation layouts.
2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data. In addition to items specified elsewhere, include the following:

1. Application and operating software documentation.
2. Software licenses.
3. Software service agreement.

4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and handle modular meter center according to NECA 400.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.10 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power services.
2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

1.11 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to the Engineer and NJDEP to allow scheduling and access to system and to allow the Engineer and NJDEP to upgrade their computer equipment if necessary.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Meters will be furnished by utility company.

B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.

C. Meter Sockets: Comply with requirements of electrical-power utility company.

D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

1. Comply with requirements of utility company for meter center.
2. Housing: NEMA 250, Type 3R enclosure.
3. Minimum Short-Circuit Rating: SECTION TO BE UPDATED BASED ON MEETING WITH PSE&G A symmetrical at rated voltage.
4. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers.
5. Main Disconnect Device: Fusible switch, series-combination rated by circuit-breaker manufacturer to protect downstream feeder and branch circuit breakers.
6. Tenant Feeder Circuit Breakers: Series-combination-rated molded-case units, rated to protect circuit breakers in downstream tenant and to house loadcenters and panelboards that have 10,000-A interrupting capacity.

    a. Identification: Complying with requirements in Section 2.36 "Identification for Electrical Systems" with legend identifying tenant's address.
    b. Physical Protection: Tamper resistant, with hasp for padlock.

7. Meter Socket: Rating coordinated with indicated tenant feeder circuit rating.
8. Surge Protection: For main disconnect device, comply with requirements in Section 2.41 "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install modular meter center according to NECA 400 switchboard installation requirements.

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Section 2.36 "Identification for Electrical Systems."

1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
2. Equipment Identification Labels: Adhesive film labels with clear protective overlay. For residential meters, provide an additional card holder suitable for printed, weather-resistant card with occupant's name.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
2. Turn off circuits supplied by metered feeder and secure them in off condition.
3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

B. Electricity metering will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

4.1 MEASUREMENT AND PAYMENT

No separate payment will be made for work conducted as per this section. The cost of this work shall be included in the respective Pay Items.

END OF SECTION

2.39 Fuses

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in enclosed switches panelboards.
2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches fuseholders.
3. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.
4. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

    a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
5. Coordination charts and tables and related data.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified elsewhere, include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.

3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.7 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.8 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.

3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.
5. Or equal as approved by the Engineer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

2.5 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, time delay.
2. Feeders: Class L, time delay.
3. Motor Branch Circuits: Class RK1, time delay.
4. Other Branch Circuits: Class RK1, time delay Class RK5, time delay.

B. Plug Fuses:

1. Motor Branch Circuits: Edison-base type, dual Edison-base type, single-element time delay.
2. Other Branch Circuits: Edison-base type, dual-element time delay Edison-base type, single-element time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.

C. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 2.36 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

4.1 MEASUREMENT AND PAYMENT

No separate payment will be made for work conducted as per this section. The cost of this work shall be included in the respective Pay Items.

END OF SECTION

2.40 Enclosed Switches and Circuit Breakers

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).

4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified elsewhere, include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Construction Manager's written permission.
4. Comply with NFPA 70E.

1.11 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. Or equal as approved by the Engineer.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Compression type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. Or equal as approved by the Engineer.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Compression type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. Or equal as approved by the Engineer.

C. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

D. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

E. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

F. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

G. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

H. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

I. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

J. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

K. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1
2. Outdoor Locations: NEMA 250, NEMA 4X.
3. Other Wet or Damp, Indoor Locations: NEMA 250, NEMA 4X.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements as per applicable codes.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 2.36 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 2.37 "Overcurrent Protective Device Coordination Study".

4.1 MEASUREMENT AND PAYMENT

No separate payment will be made for work conducted as per this section. The cost of this work shall be included in the respective Pay Items.

END OF SECTION

2.41 Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section includes field-mounted TVSS for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed voltage rating.

C. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Certificates: For TVSS devices, from manufacturer.

C. Field quality-control reports.

D. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For TVSS devices to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replaceable Protection Modules: One of each size and type installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

D. Comply with NEMA LS 1.

E. Comply with UL 1283 and UL 1449.

F. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Property Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Engineer no fewer than two days in advance of proposed electrical service interruptions.
2. Do not proceed with interruption of electrical service without NJDEP written permission.

B. Service Conditions: Rate TVSS devices for continuous operation under the following conditions unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet (6090 m) above sea level.

1.10 COORDINATION

A. Coordinate location of field-mounted TVSS devices to allow adequate clearances for maintenance.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Warranty for Cord-Connected, Plug-in Surge Suppressors: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic equipment connected to circuits protected by surge suppressors.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. ABB USA.
2. AC Data Solutions.
3. Advanced Protection Technologies Inc. (APT).
4. Atlantic Scientific.
5. Current Technology Inc.; Danaher Power Solutions.
6. Danaher Power Solutions; United Power Products.
7. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
8. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
9. Intermatic, Inc.
10. LEA International.
11. Leviton Mfg. Company Inc.
12. Liebert Corporation; a division of Emerson Network Power.
13. Northern Technologies, Inc.; a division of Emerson Network Power.
14. Siemens Energy & Automation, Inc.
15. Square D; a brand of Schneider Electric.
16. Surge Suppression Incorporated.
17. Or equal as approved by the Engineer.

C. Surge Protection Devices:

1. Non-modular.
2. LED indicator lights for power and protection status.
3. Audible alarm, with silencing switch, to indicate when protection has failed.
4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

D. Surge Protection Devices:

1. Comply with UL 1449.
2. Non-modular design.
3. Fuses, rated at 200-kA interrupting capacity.
4. Fabrication using bolted compression lugs for internal wiring.
5. Integral disconnect switch.
6. Redundant suppression circuits.
7. Redundant replaceable modules.
8. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
9. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
13. Four-digit transient-event counter set to totalize transient surges.

E. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.

F. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

G. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 V, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 V.
2. Line to Ground: 800 V for 480Y/277 V.
3. Neutral to Ground: 800 V for 480Y/277 V.

H. Protection modes and UL 1449 SVR for 240/120 V, single-phase, 3-wire circuits shall be as follows:

1. Line to Neutral: 400 V.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

I. Protection modes and UL 1449 SVR for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:

1. Line to Neutral: 400 V, 800 V from high leg.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

J. Protection modes and UL 1449 SVR for 240 V, 480 V, or 600 V, 3-phase, 3-wire, delta circuits shall be as follows:

1. Line to Line: 2000 V for 480 V.
2. Line to Ground: 2000 V for 480 V.

2.2 PANELBOARD SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. ABB USA.
2. AC Data Solutions.
3. Advanced Protection Technologies Inc. (APT).
4. Atlantic Scientific.
5. Current Technology Inc.; Danaher Power Solutions.
6. Danaher Power Solutions; United Power Products.
7. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
8. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
9. Intermatic, Inc.
10. LEA International.
11. Leviton Mfg. Company Inc.
12. Liebert Corporation; a division of Emerson Network Power.
13. Northern Technologies, Inc.; a division of Emerson Network Power.
14. Siemens Energy & Automation, Inc.
15. Square D; a brand of Schneider Electric.
16. Surge Suppression Incorporated.
17. Or equal as approved by the Engineer.

C. Surge Protection Devices:

1. Non-modular.
2. LED indicator lights for power and protection status.

3. Audible alarm, with silencing switch, to indicate when protection has failed.
4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

D. Surge Protection Devices:

1. Comply with UL 1449.
2. Non-modular design.
3. Short-circuit current rating complying with UL 1449, and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with individually fused metal-oxide varistors.
4. Fuses, rated at 200-kA interrupting capacity.
5. Fabrication using bolted compression lugs for internal wiring.
6. Integral disconnect switch.
7. Redundant suppression circuits.
8. Redundant replaceable modules.
9. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
13. [**Four**]-digit transient-event counter set to totalize transient surges.

E. Peak Single-Impulse Surge Current Rating: 80 kA per mode/160 kA per phase.

F. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2:

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

G. Protection modes and UL 1449 SVR for grounded wye circuits with [480Y/277 V], 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 V.
2. Line to Ground: 800 V for 480Y/277 V.
3. Neutral to Ground: 800 V for 480Y/277 V.

H. Protection modes and UL 1449 SVR for 240/120-V, single-phase, 3-wire circuits shall be as follows:

1. Line to Neutral: 400 V.
2. Line to Ground: 400 V.

3. Neutral to Ground: 400 V.

I. Protection modes and UL 1449 SVR for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:

1. Line to Neutral: 400 V, 800 V from high leg.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

J. Protection modes and UL 1449 SVR for 240 V, 480 V, or 600 V, 3-phase, 3-wire, delta circuits shall be as follows:

1. Line to Line: 2000 V for 480 V.
2. Line to Ground: 1500 V for 480 V.

2.3 ENCLOSURES

A. Indoor Enclosures: NEMA 250 Type 12.

B. Outdoor Enclosures: NEMA 250 Type 4X.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install TVSS devices at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install TVSS devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

1. Provide multiple, circuit breaker as a dedicated disconnecting means for TVSS per manufacturer recommendations.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
2. After installing TVSS devices but before electrical circuitry has been energized, test for compliance with requirements.
3. Complete startup checks according to manufacturer's written instructions.

E. TVSS device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Do not energize or connect service entrance equipment to their sources until TVSS devices are installed and connected.

B. Do not perform insulation resistance tests of the distribution wiring equipment with the TVSS installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train NJDEP's maintenance personnel to maintain TVSS devices.

4.1 MEASUREMENT AND PAYMENT

No separate payment will be made for work conducted as per this section. The cost of this work shall be included in the respective Pay Items.

END OF SECTION

2.42 Wireless Monitoring and Control System

2.42.1 General

Furnish and install a factory wireless data cellular based communication system for the purpose of monitoring and controlling various equipment operations related to the leachate collection system and gas management system. The supplier of the communication system shall be responsible for coordination required to insure equipment compatibility. The communication system shall be provided complete, in place, as shown on the Drawings, specified herein and needed for a complete, proper installation.

Related work:

- Documents affecting work of this Section include, but are not necessarily limited to General Conditions, Supplementary Conditions, and sections in Division 1 of these Specifications.
- Electrical
- Sewage Pumps
- Gas Flare System

2.42.2 Submittals and Substitutions

The following product data shall be submitted in accordance with the approved Construction Schedule:

1. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades;
2. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work;
3. Test data required elsewhere in this Section.

Upon completion of this Portion of the Work, and as a condition of its acceptance, deliver to the Engineer three copies of an operation and maintenance manual compiled.

2.42.3 Equipment Compatibility

The Contractor shall be responsible for coordinating the instrumentation equipment, communication equipment and other related equipment so that all elements are compatible and form a complete working system. Shop drawing submittals shall include sufficient information regarding component compatibility to demonstrate compliance with this requirement.

2.42.4 Products

Qualifications of Manufacturers: Products used in the work of this Section shall be produced by manufacturers regularly engaged in the manufacture of similar items and with a history of satisfactory production acceptable to the Engineer.

1. The submitting Company shall provide evidence of, and warrant compliance with, substantially all below listed requirements.
2. The submitting Company shall have been in business providing remote facility monitoring and control services through the data side of the cellular system to the water distribution / wastewater collection industry or a substantially similar industry for at least six years.
3. The submitting Company shall be the actual manufacturer and operator, or a duly authorized and trained agent of the manufacturing company or a combination of both, who will actually provide, maintain, and warranty the proposed system.
4. The Manufacturing Company of the field equipment shall also be the provider of all monitoring related services associated with the field equipment and all ongoing service agreements will be with the actual company providing the monitoring service, not a subcontractor or agent.
5. The submitting company shall have a primary central monitoring and control center and a fully redundant, physically separate, backup-computer monitoring center. Either center shall have the capability of operating all the remote monitoring and control field RTU's.
6. The submitting Company shall offer and provide 24 X 7 technical support.

2.42.5 Monitoring and Control System

A. Microprocessor Based Field RTU

1. Data Cellular Radio
   a. The Remote Terminal Unit (RTU) shall incorporate a radio that utilizes the data side of any cellular system to transmit the data and alarms monitored, as well as receive manual or automated control commands.
   b. Cellular radios from all cellular carriers shall be able to mount in the same mounting port on the motherboard and consequently be interchangeable in no more than 10 minutes.

2. Enclosure Options
   The RTU shall be offered in at least the following three enclosure options:
   a. NEMA1 with battery inside the enclosure
   b. NEMA1 "FlatPak" with a depth of less than 1.5 inches so it is able to fit between the inner and outer door of a double door control panel.
   c. NEMA4X with the battery inside and which has front door and top "sun shades" to reduce internal temperatures when placed in the sun.

3. Microprocessor Feature Updates

Microprocessor features like data transmission rates shall be able to be adjusted through the cellular system without any site visits necessary.

4. RTU Inputs and Outputs

a. RTU shall have eight (8) digital inputs. These eight (8) inputs must have end of line resistor supervision, or similar supervision, that can detect normal alarm trip inputs and detect input wiring disconnection/shorting as a distinctly different signal and report.
b. RTU shall have an optional expansion board of an additional eight (8) digital inputs
c. The digital inputs shall be user selectable as normally open (NO) or normally closed (NC).
d. Eight of the RTU digital inputs on main board must be capable of being programmed to record and report pump run times in one minute increments or less as indicated by a relay opening and closing. If only two pumps are monitored then the unit shall also be capable of recording and reporting simultaneous pump run times.
e. RTU shall have built-in alarms for input wiring fault, AC failure, communication failure and low battery detection.
f. RTU shall have two (2) analog inputs measuring 4-20mA or 1-5 VDC at 10 bit resolution with four (4) alarm thresholds per input.
g. RTU shall have an optional expansion board of an additional four (4) analog inputs
h. RTU shall have an optional expansion board of an additional eight (8) digital inputs
i. RTU shall have an optional expansion board of an additional two (2) analog outputs.
j. RTU shall have an optional expansion board of two (2) pulse counter inputs
k. RTU shall have an electronic key reader input to monitor on-site personnel. The RTU shall utilize an audible tone to verify key reading. Each key in the system shall provide unique identification of the key holder when they are on site vs. “someone” is on site.
l. RTU shall have three (3) digital normally open or closed output relays rated at ½ ampere@ 120VAC

5. Status LED’s on Motherboard

a. LED’s above each digital input shall visually display the status of the digital input
b. Radio signal strength shall be displayed by at least 8 LED’s in 5db increments between -75db and -110db to facilitate accurate antenna placement
c. Operational and diagnostic status of at least 8 criteria shall be displayed by individual LED’s.

6. Power Requirements
   a. The RTU shall be powered by 12 volts AC and have a built in battery backup capable of keeping the RTU powered for 30 hours in case of primary AC failure.
   b. All terminations inside the RTU enclosure shall be low voltage AC or DC (28 volts or less).

B. Communication Links

1. Communication System
   a. Wireless communication links shall be through the data side of the cellular system. The voice side of the cellular system and satellite based links are not acceptable.

2. Cellular Carriers
   a. The submitting company shall have direct relationships with the cellular companies and shall not use third parties to affect data transport through the cellular companies.
   b. The RTU will have interchangeable data cellular radios that will communicate through third generation GPRS (ATT), CDMA (Verizon) or iDEN (Nextel) to maximize the likelihood of reliable communication.
   c. If a GPRS (ATT) radio is used, the submitting company shall have PTCRB approval from ATT to use the radio, contract and product acceptance with ATT. If an iDEN radio is used the submitting company shall be have certified partner status, contract and product acceptance with Sprint/ Nextel.
   d. The Customer will not have or have to purchase cellular data contracts direct with the carrier(s).

3. Security Protocols
   a. All the cellular radios shall all make continuous, secure socket connections (SSL) from the radio, through the cellular system, to the submitting company's servers and web pages.
   b. The RTU shall utilize a transmission scheme that encrypts the transmitted data utilizing a 128 bit encryption method that meets or exceeds the advanced encryption standard (AES). The 128 bit AES encryption shall be at all stages of data transfer and storage
   c. The cellular radios shall all have private IP addresses
   d. The submitting company shall have established multiple, private gateways through the cellular system, completely behind firewalls, with at least one of the cellular providers.

4. RTU Data Transmission Rates
   a. All alarms regardless of unit type will be transmitted immediately upon occurrence; delays can be added by the customer at the RTU or the supplier's website.

b. The RTU shall continuously transmit all digital state changes on an as occurs basis; analog and pulse inputs will be transmitted at least once every two minutes on RTU models.
c. The RTU will have an effective, continuous, transfer rate of at least 19,200 baud.

5. Communication Link Structure and Performance Criteria
   a. The communication link structure shall be a secure socket connection from the RTU through the cellular system to the supplier's servers, and it shall be a continuous connection, 24 x 7, 365.
   b. Receipt of all data sent from the RTU to the server center shall be acknowledged by the server center back to the RTU in real time for every data packet sent. Such structure is called end-to-end data acknowledgement.
   c. The secure socket connection shall be from the RTU through the cellular system direct to the system supplier; no third parties shall receive the data from the cellular carrier and then pass it to the system supplier.
   d. The above mentioned secure socket connection shall be monitored for end-to-end uptime with interruptions as small as 15 seconds being captured.
   e. Both end-to-end uptime and the number of times the link was disconnected/reconnected shall be reported for each RTU continuously with daily summary statistics posted on the customer website. All the end-to-end uptime history of each RTU shall be available on the customer web site from when it first powered up to the present. Weekly management summaries of each RTUs end-to-end uptime shall be automatically emailed to the customer.

C. Centralized Server Centers: Hardware and Software Requirements

1. Server Center Physical Structure
   a. The server center housing shall be able to withstand a direct hit from at least a F-3 tornado and continue operations.
   b. The server center housing shall have at least six (6) separate and redundant, on-site power generating facilities to backup the local utility power such that there can be stand-alone operation of the center for at least 24 hours.

2. Server Center Redundancy Structure
   a. The server center shall house the manufacturers completely redundant and hot linked:
      i. Servers
      ii. Interconnects
      iii. Databases
      iv. Power supplies

v. Inbound cellular connections
vi. Outbound internet hubs and providers

3. Database Structure
   a. All data from the RTU's shall be held for customer access forever.
   b. All databases shall be backed up and archived daily
   c. The databases shall be capable of interfacing and transferring, on a continuous basis, all RTU data to an OPC compliant database for access by other OPC compliant HMI software packages.
      i. Client side OPC software will run as an executable or NT service.
      ii. Client side OPC software will, on a user definable interval, establish a socket connection to static IP address(s) at providers' server center.
      iii. OPC software shall retrieve all changed OPC tag values and close the socket. OPC software shall be set up so as customers OPC computers firewalls may be programmed to only allow Internet traffic to/from the designated service providers IP addresses and port numbers.
      iv. OPC software will allow for multiple customer OPC software packages to establish, concurrently, OPC connections so as to provide for redundant HMI database operation at customers locations.
      v. Customer's firewalls will not be programmed to accept socket connections.

4. System Security
   a. All data links shall be behind firewalls, 128 bit encrypted and never accessible, addressable or viewable via the general public Internet, Private IP's are required, pooled public IP's will not be accepted.

5. System Software
   a. The system software shall collect and display:
      i. Alarms including individuals accepting alarms,
      ii. RTU electronic key reads with user names, time of read, and site name
      iii. pump running status,
      iv. pump run times with historical graphs,
      v. individual pump flow estimates,
      vi. automatic daily analysis of pump runtimes for abnormalities with automatic customer notification of such abnormalities,
      vii. pump starts with hourly analysis of excess pump starts with automatic notifications of excess pump starts,
      viii. minute-by-minute radio health checks with automatic notification of non-reporting or poorly reporting RTU's,

ix. scaled and labeled pulse totalizations and if rainfall gauges are used, inter-day rainfall graphs and run time verses rain fall based on either rain gauges installed as part of the system or as run time verses a reporting airport rain gauge;
x. Performing and displaying volumetric inflow/outflow calculations from RTU supplied data for each pump cycle as they occur. Such volumetric calculations will utilize real-time pump start/stop data with simultaneously gathered level transducer data to perform the inflow/outflow and pump GPM calculations.
xi. Utilizing real-time data collection have the ability to based on digital input closure, open or close digital output relay on the same or another real-time unit (Intertie),
xii. Gas flare mass flowrate,
xiii. Gas flare stack temperature

D. Alarm System Structure and Software

1. Alarm Delivery Formats
   a. Alarms shall be delivered in the following formats:
      i. Phone (voice call), fax, pager (numeric or alphanumeric (short alpha or long alpha format), text message, email, or any combination of the above simultaneously.
   b. Alarms shall be able to be acknowledged by phone, text message, 2-way pager, email or on the customer web site.
   c. Voice alarm acknowledgement shall be adjustable to be able to mimic the format of dialers.
   d. Alarms will be called out on alarm and upon return to normal conditions.
      i. Return to normal alarms can be adjusted to call the alarm callout group or a different callout group.

2. Alarm Callout Formats
   a. Alarm callout groups shall be able to be setup to automatically switch between callout groups at different hours of the day and/or different days of the week.
   b. Alarm callout groups shall be able to have multiple teams within each group to easily facilitate rotation of teams of on-call personnel.

3. Alarm Message Formats
   a. All alarms shall have the alarm condition, time, alarm location and pump status at the time of the alarm in each message.
   b. Alarm message format shall be adjustable to include just the above information when calling a phone where it is known who will answer the phone, or be adjustable to add an introductory message asking for a specific person when calling a phone where it is not known who will answer the phone (like a home phone).

c. Alarms shall be able to be delivered individually or be able to be grouped into one message so that multiple, simultaneous alarms (like AC Fail at multiple sites) can be delivered and acknowledged in one phone call.

4. Alarm Dispatch Logs
   a. Each alarm shall have a full log of each notification attempt of that alarm documenting the following:
      i. Date, time, and alarm condition
      ii. If each notification attempt was a success or failure and the reason for each failure if an attempt was a failure (like line busy, call dropped, etc)
      iii. A recording of each voice notification attempt so the specific reason for a notification failure can be known.
      iv. Date, time, and name of person who acknowledged the alarm.

5. Voice Alarm Delivery Capacity
   a. Manufacturer shall provide at least 20 outbound lines to deliver voice alarms so as not delay delivery of current alarms.

E. Remote Data Access

1. Remote Data Access Format
   a. Data collected by the system shall be able to be remotely accessed by simple web browser. The system shall provide individual web pages for the User to access via any web browser.
   b. To access the web pages, the User will have to enter a User Name and Password.
      i. The User can set up any of three levels of access to the web pages:
         1. Read only…can see but cannot make any changes
         2. Read/Write…can see and can make changes
         3. Read/Write/Control…can see, make changes and effect control functions, also add or remove logins/ passwords.
   c. The system supplier will provide at least two separate web sites for the NJDEP. One shall be designed to be viewed on a traditional laptop or desktop computer. The other shall be designed to be viewed on a web enabled cell phone or PDA. This web site will still have graphs showing trending of data, and will be designed to minimize the data sent so as to minimize the page loading times and size of the data plans necessary to view the site on a web enabled cell phone or PDA.
   d. The system supplier will provide secure access through a specified phone without the need for web access (Voice SCADA). This will require login to system via numeric 5 digit code and must be set up

in the system to an associated login for that site to a specific phone number to maintain site security.

2. Remote Access Security
   a. In addition to the Username and Password structure described above, all access of the User web site shall be logged. Such logging data to included date, time and duration of access, User Name and Password of user to access the site and IP address of the accessing computer. The log will be accessible through the User web site.

3. Automated Administrative Reports and Alerts
   a. The User web site shall produce and automatically deliver weekly reports which summarize alarms and responses, pump runtimes and flow estimates, weekly end-to-end uptime percentages of each RTU, and all electronic key uses at the RTU sites.
   b. The web site shall be capable of sending two (2) different categories of notifications, Alarms and Alerts. Alarms are for conditions that the User decides they want to be notified immediately about. Alerts are conditions that need attention, but are not so time sensitive that they cannot wait till the next morning.
      i. The Alarms callout list and the Alert callout list shall be able to be separate and distinctly different.
   c. The User web site shall analyze daily pump run times at compared to a moving 30 day average of that pumps most recent runtimes and automatically Alert the User is the pump runs outside the normal runtime variation pattern.
   d. The User web site shall analyze hourly pump runtimes and automatically compare it to two (2) User set thresholds. If the Alert threshold is exceeded, an Alert will be sent the following morning. If the Alarm threshold is exceeded, an alarm will send immediately.
   e. The User web site shall send an Alert the first morning that units are in Communications fail even though Alarms have been sent at the time the RTUs went off-line. Such Alerts are a reminder to Management that they still have units that are off line.

2.42.6 RTU Locations

A. RTUs shall be located at the North Pump Station, the South Pump Station, at the existing MSLA 1-D Pump Station, and at the gas flare as shown on construction drawings. The exact location shall be approved by the Engineer, KMUA, and NJDEP. Both the North and South Pump Station RTUs shall be Mission Communication Model M-800, or approved equivalent, in flat-pack enclosures, furnished and installed by the pump station Manufacturer. The gas flare RTU shall be Mission Communication Model M-110, or approved equivalent, in flat-pack enclosures, furnished and installed by the pump station Manufacturer. The RTU at the existing MSLA 1-D Pump Station shall be furnished in a NEMA 4 enclosure.

B. RTUs at each location shall be furnished with an omnidirectional antenna at grade, plus 8 ft.

2.42.7 Monitoring and Output Points Per RTU

A. The inputs to be monitored at the sites described in Section 2.03A are shown on the Process Control and Instrumentation (PC&I) drawing(s).

B. The relay outputs at the sites described in Section 2.03A are shown on the Process Control and Instrumentation (PCI) drawing(s).

2.42.8 Other Materials

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

2.42.9 Execution

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

B. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

C. Additional coordination with the supplier's information here.

2.42.9.1 Installation

. A. Install the work of this Section in strict accordance with the manufacturer's recommendations and shop drawings as approved by the Engineer.

B. Upon completion of the installation, carefully inspect each component and verify that all items have been installed in their proper location, adequately anchored, and adjusted to achieve optimum operation.
- If required, the contractor shall adjust the antenna placement or elevation to obtain consistent, stable operation of the system.

C. Delineate timing of RTU installation and commissioning.

2.42.10 Service

A. Demonstrate to the Owner's operation and maintenance personnel the proper methods for operating and maintaining the equipment, and the contents of the operation and maintenance manual required to be submitted.

B. The Contractor shall furnish to the Construction Manager, through the Engineer, a written report prepared by the instrumentation equipment manufacturer's field service technician certifying that:

1. The equipment has been properly installed in accordance with manufacturer's recommendations;

2. The equipment check out and initial start-up activities have been completed in accordance with manufacturer's recommendations and under the technician's supervision;

3. Antenna placement has been optimized;

4. The equipment is free from any undue stress imposed by connecting conduit or anchor bolts;

5. The equipment operates satisfactorily and in compliance with the requirements of this Section.

C. If applicable, delineate whether or not the Contractor shall include with his bid, the on-site services of the instrumentation equipment manufacturer's field service technician, and for what period. This service shall be for the purpose of instruction of plant personnel and testing of the system.

2.42.11 Measurement and Payment

No additional payment shall be made for Wireless Monitoring and Control System. The work described herein shall be incidental to the Pump Stations installed as described in Section 2.11.

END OF SECTION

MSLA 1-D LANDFILL CLOSURE PROJECT
TECHNICAL SPECIFICATIONS
NJSTART BID NO. 17DPP00036

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3.1 Health and Safety Plan

3.1.1 General Description

General: This Section describes the minimum safety, health and emergency response requirements for remedial activities at the MSLA 1-D Landfill Site. Requirements of the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, and applicable publications of this Section provide the basic safety program for this project. The responsibility of development, implementation, and enforcement of the Health and Safety Plan (HASP) lies with the Contractor and his health and safety personnel. The HASP developed by the Contractor shall include programs for accident prevention, personnel protection, emergency response/contingency planning, and air monitoring. The Contractor's HASP must include contingency plans for alerting the adjacent occupants of the surrounding buildings and evacuating them if necessary.

Documents to be Supplied by Contractor:

- Site-specific Health and Safety Plan. The site-specific HASP shall be furnished as a separate document and shall pertain only to the named site activity. A corporate safety and health manual may be furnished along with the HASP but this shall not satisfy the site-specific HASP requirement. The Contractor shall supply four (4) copies of the Health and Safety Plan to NJDEP for comment and approval and one (1) copy to the Engineer in accordance with Specification Section 1.3.

The NJDEP will not “Approve” a Contractor’s Health and Safety Plan, only provide comments and acceptance.

3.1.2 Applicable Publications

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities: NIOSH, 85-115.

OSHA Safety and Health Standards: 29 CFR 1910 and 1926.

USEPA Standard Operating Safety Guides: November 1984.

NJDEP: Health and Safety Plan - Minimum Requirements (see Volume 4)

3.1.3 Health and Safety Plan Minimum Requirements

The Contractor shall follow the Health and Safety Plan Minimum Requirements provided in Volume 4, Appendices, for preparation of the Health and Safety Plan.

3.1.4 Health and Safety Plan (HASP) Closeout Report

At the completion of the project, the Contractor shall provide the NJDEP and the Engineer with a HASP Closeout Report, as per specification section 1.3. The HASP Closeout report presents the NJDEP and the Engineer with an overall safety summary. In this report, the Contractor shall provide

documentation confirming adherence to the HASP requirements set forth in section 3.1.3. At a minimum, the HASP Closeout Report shall include, but not be limited, to the following.

1. Health and Safety Officer's (HSO) Daily Report.
2. During potentially hazardous work, such as hazardous substance container removal and staging, Contractor is to provide health and safety field notes and a write-up summary. This shall include:
    a) Contaminants encountered, conditions present, and practices applied in the specific operation.
    b) Confirming proper adherence to HASP and proper protection equipment.
    c) Affirmation that proper decontamination methods, as required by the HASP, have been met, refer to section 3.1.3. (decontamination certificates if applicable).
    d) Summary of the necessary engineering and/or work practice controls incorporated to reduce and maintain employee exposures during potentially hazardous tasks.
    e) The PPE program incorporated by Contractor shall be included.
3. Copies of employee Healthy and Safety training records and safety program certifications shall be included. This also includes respirator fit testing certificates.
4. OSHA Occupational Sampling Results
5. Daily air monitoring report/results.
6. Medical Clearance Forms for each worker involved in on-site operations shall be included.
7. If any incidents, accidents, injuries, or other emergencies occurred on site, OSHA 300 logs (accident and exposure reports), and the implemented emergency response plan are to be included in the HASP closeout report. The implemented emergency response plan in HASP closeout report should be consistent with the approved HASP.

3.1.5 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Pay Unit
3.1.1	Health and Safety Plan	Lump Sum
3.1.2	Implementation of Health and Safety Plan	Month

Payment for the development and final approval of the Health & Safety Plan (HASP) shall be made on a lump sum basis under Bid Item 3.1.1. Payment for the implementing of the Health & Safety Plan (HASP) shall be made under Bid Item 3.1.2 on a monthly basis for each month or fraction thereof, measured to the nearest week from Notice to Proceed with mobilization until substantial completion. **No change** in price will be allowed for changes in level of protection required for field personnel during construction. Bid Item 3.1.2 also includes payment for the collection and analysis of all air quality samples and production of the Health and Safety Closeout Report.

The Contractor will not be paid for Bid Item 3.1.1 until the Health and Safety Plan is complete and approved by the NJDEP. No field work can begin until the HASP is approved.

END OF SECTION

3.2 Construction Plan

The Construction Plan shall address, at a minimum, the following items: site operations plan and schedule, environmental pollution control, dust and vapor control, stormwater pollution prevention plan, security, traffic control, contact water management, and construction quality control.

3.2.1 Site Operations Plan and Schedule

The Contractor shall provide a schedule for the tasks needed to complete the remedial construction. The Construction Schedule shall be submitted in accordance with RFP Section 5.5.4 – Before Starting Construction. Separate payment for this task will not be made.

3.2.1.1 Work Included

This item includes the preparation of the Project Construction Schedule and the Site Operations Plan. The Contractor shall perform all work to complete the job within the approved construction schedule. Also, construction operations shall be sequenced and scheduled to give consideration to site conditions, disposal of contaminated material, seasonal effects and any other factors considered relevant by the Contractor.

3.2.1.2 Site Operations Plan

The Contractor shall develop and submit a Site Operations Plan, describing all major site construction activities and showing the sequence of the activities in accordance with the Project Construction Schedule. This Plan shall describe all major construction activities including preparation and submittals of plans, permit applications, shop drawings, materials testing, product data sheets, and operating and maintenance instructions in accordance with Section 1.3 – Submittals.

The Site Operations Plan shall include provisions for daily pre-work safety/progress meetings with the NJDEP Construction Manager and/or the Engineer and the Project Construction Schedule.

Drawings, diagrams, and sketches should be included in the Site Operations Plan as well as references to the Plans (Health and Safety Plan, etc.) in Section 3 to convey how construction will be coordinated with site operations.

3.2.1.3 Project Construction Schedule

1. The Project Construction Schedule developed as part of this contract shall be included in the Site Operations Plan. The schedule shall be prepared by the Critical Path Method. The Contractor shall provide with the project schedule submission a written narrative explaining the schedule and the Contractor's general approach for achieving Substantial Completion and Completion as specified in this Contract, including an explanation of calendars used in the schedule. The Contractor shall also provide with the project schedule submission a resource plan indicating the quantity and type of equipment that will be employed and the size and character of the proposed labor force for each operation.

2. The Contractor shall provide the Engineer with two copies of the Project Management Software used to develop the Project Construction Schedule.

3. Provide one (1) activity for each discrete component of each Item scheduled in the Proposal. The Engineer may allow grouping of similar Items into one (1) activity. For certain Items, the Engineer may require the Contractor to provide additional detail for each component to be included in the progress schedule. The system shall consist of network diagrams and accompanying mathematical tabulations as described hereinafter.

4. Diagrams shall show the order and interdependence of activities and the sequence and quantities in which the work is to be accomplished. The basic concept of network scheduling shall be followed to show how the start of an activity is dependent on the completion of preceding activities and how its completion may affect the start of following activities. No activity duration shall be less than one (1) workday. No activity duration shall be longer than 30 working days without prior approval by the Engineer. The critical path shall be distinguished from other paths on the network.

5. Ensure that activity logic and durations are consistent with the Contract.

6. Ensure that all activities, except the project start milestone and project completion milestone, have predecessors and successors. The start of an activity shall have a start-to-start or finish-to-start relationship with preceding activities. The completion of an activity shall have a finish-to-start or finish-to-finish relationship with a succeeding activity. Do not use start-to-finish relationships.

7. Indicate time frames when work is restricted in time sensitive areas, (such as seeding), to ensure that appropriate staging and seasonal constraints are reflected.

8. Ensure that seasonal constraints are reflected for Items of work such as stripping, seeding, and planting.

9. Indicate time frames when work is restricted by work performed by Utilities or by Others.

10. Indicate time frames, as specified for the Engineer to review working drawings.

11. Identify the start and finish dates of stages with Finish Milestones.

12. Calculate the CPM schedule in working days. Ensure that the working day to calendar date relationship is based upon the Contractors proposed work week with allowance for weekends, legal holidays and any special requirements of the Contract.

13. Do not use resource loaded schedules.

14. In addition to construction activities, network activities shall include the submittal and approval of samples of materials and drawings. It shall include all documents and proofs

of compliance required by the Plans or Specifications needed for completion.

15. The mathematical tabulation of the network diagram shall include a tabulation of each activity shown on the detailed network diagram. The following information shall be furnished as a minimum for each activity on this tabulation.

    a. event nodes numbered
    b. activity description
    c. estimated duration
    d. earliest start date (calendar date)
    e. earliest finish date (calendar date)
    f. latest start date (calendar date)
    g. latest finish date (calendar date)
    h. percentages of activity completed
    i. critical path activities

16. This mathematical tabulation can be either a computer printout or one manually prepared with a column for each of the above requirements. The Contractor shall update the mathematical tabulation on a monthly basis and shall provide the Engineer with updated copies along with any revisions to the network diagrams on the day the monthly Engineer's Estimate is prepared. The updated tabulations shall reflect the current status of activities as outlined on the network diagram. If any delays have occurred, these shall be noted for time consideration. The updated tabulation sheet shall reflect all changes in dates, durations and float times.

Conditions may develop which require network logic revisions to the original diagram. If during the process of the work, major changes develop which necessitate changes in the original plan, the Contractor shall make such changes so as to depict the current mode of operation and shall provide the Engineer with a revised network diagram.

The Project Construction Schedule shall be reviewed monthly and updated monthly as needed, by the Contractor. Updates (hardcopy and electronic versions) shall be included in the Monthly Invoice.

17. The Project Construction Schedule shall take into consideration the effect of any physical constraints or time constraints posed by the Contract Documents or regulatory permits including, but not limited to, the requirements of Temporary Erosion and Sediment Control Plan; Construction Water Management Plan.

18. Provide a progress narrative with each update submission that includes the following:

    a) A description of schedule status.

    b) A discussion of current and anticipated delaying problem areas and their estimated schedule effect.

    c) A discussion of all intermediate milestones specified in the Contract that are behind schedule.

d) A discussion of schedule slippage, pay revisions, and progress along the critical path in terms of days ahead or behind previously established dates.

Submission of the Project Schedule does not constitute notice to proceed. Approval of the Schedule by the Engineer does not modify the Contract or constitute Acceptance of the feasibility of the Contractor's logic, activity durations, or assumptions used in creating the schedule. If the schedule reflects a completion date different than that specified in the RFB, this does not change the specified completion date. If the Engineer approves a schedule that reflects a completion date earlier than that specified as the Contract Time, the NJDEP will not accept claims for additional Contract Time or compensation as the result of failure to complete the Work by the earlier date shown on the CPM schedule. Float is the amount of time that an activity may be delayed from its early start without delaying Completion. Float belongs to the Project and is not for the exclusive use of the Contractor or the Department.

3.2.1.4 Major Construction Activities

The Contractor shall describe all major construction activities. Sequencing, crews, size and type of major equipment, and special considerations or conditions shall be described.

3.2.1.5 Permits

The Contractor shall show a schedule for obtaining all necessary permits including those to be obtained by others, in accordance with Section 1.2.23 and Section 3. This schedule shall be reflected in the Project Construction Schedule.

3.2.2 Environmental Pollution Control

The Contractor shall prepare an Environmental Pollution Control Plan and comply with its provisions. The Contractor shall prepare an Environmental Pollution Control Plan describing how environmental pollution from the construction activities will be prevented. The Contractor shall perform all work in such manner as to minimize the pollution of air, water, soil, or land, and shall, control noise, the disposal of trash and debris, as well as other pollutants. The Contractor shall comply with all applicable federal, state, and local laws, rules, and regulations pertaining to environmental pollution control.

Prior to commencement of the work at the site, the Contractor shall submit in writing a detailed plan in accordance with Section 1.3 for implementing the requirements for environmental pollution control specified herein, and meet with representatives of the Engineer to review and alter the proposal as needed for compliance with the environmental pollution control requirements.

3.2.2.1 Implementation

Prior to the start of any on-site construction activity, the Contractor and the Engineer shall make a joint condition survey after which the Contractor shall prepare a section of his Work Plan indicating on a layout plan the arrangement he proposes in using areas immediately adjacent to the site of the

work and adjacent to the designated storage area and access route(s), as applicable.

The land areas outside the limits of clearing under this Contract shall be preserved to allow restoration to their present condition. The Contractor shall confine construction activities to areas defined for work on the Drawings or specifically assigned for his use. Where, in the opinion of the Engineer, trees and/or shrubs may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's equipment or by his other operations, the Engineer may direct the Contractor to provide temporary protection of such trees/shrubs by placing orange snow fence or silt fence.

The Contractor shall assure the proper disposal of fuels, oils, bitumens, calcium chlorides, acids, alkalis, or other potentially harmful construction-related materials, both on and off the site premises at no additional cost to the State. Special measures shall be taken to prevent such materials from entering public waters.

As part of the Environmental Pollution Control Plan and prior to on-site construction, the Contractor shall submit a description of his scheme for controlling and disposing of trash and debris generated as a result of the work under this Contract. The Contractor is responsible for disposal of garbage generated by the State and the Engineer. Provision of a dumpster, if needed, shall be addressed in the Plan.

The Contractor shall maintain all excavations, backfill areas, stockpiles, and all other work areas free from excess dust as in accordance with the Dust and Vapor Migration Control Plan. Approved temporary methods consisting of sprinkling, approved dust palliatives, or similar methods will be permitted to control dust. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard is imminent in accordance with the Dust Control Plan.

The Contractor shall, upon receipt of notice in writing of any non-compliance with the foregoing provisions, take immediate corrective action. If the Contractor fails or refuses to comply promptly, the NJDEP may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop order shall be claimed as damages by the Contractor unless it was later determined that the Contractor was in compliance.

3.2.3 Dust and Vapor Migration Control Plan

The Contractor shall conduct all site operations in such a way to minimize dust and vapor generation. The Contractor's attention is directed to the fact that the site contains contaminated soils, explosive and malodorous gases, and possibly asbestos.

The Contractor shall prepare and submit for approval by the Engineer a Dust and Vapor Migration Control Plan in accordance with Section 1.3 which will present the Contractor's procedures for control of dust and vapor generation and measures to prevent off-site dispersion.

3.2.3.1 Implementation

The Contractor shall conduct his operations to minimize the generation of dust or vapors. In general, action is required to control dust whenever the three (3) hour average concentration in air exceeds 5 mg/m^3, as measured at the property boundary. At a minimum the Contractor shall also conduct dust suppression actions at least twice a day during excavation and regrading activities. Additional actions

may be needed if dust reduces site visibility or if directed, by the Engineer.

During excavation and regrading operations, the Contractor shall sample the air as specified in the H&S plan to determine the dust and explosive vapors concentration. Monitoring for asbestos fibers will be conducted when work in Construction and Demolition waste is conducted. When the dust or vapor concentration exceeds the action level identified in the HASP, the Contractor shall reduce the concentration by changing his operations to control or minimize the production of dust and vapors. The dust may be controlled by water or non-toxic chemical spray, or similar means. The Contractor shall cease operations if he is unable to control the dust or explosive or malodorous content of the site air.

After the site excavation has commenced, and the site soils or waste is exposed, dust may be lifted and carried by the wind. The Contractor shall develop a plan to reduce such wind entrainment, by covering the exposed soils or waste, or coating them to reduce the hazard.

The Contractor shall maintain the vehicles and equipment necessary for control of dust at or near the site of the work, so that minimum delay occurs when dust control operations become necessary.

The Contractor shall also observe the dust, explosive gases, and malodorous gases concentrations at the perimeter of the site, to avoid creating hazards on neighboring properties. The Contractor shall report the results of the Air Sampling data to the Engineer within 24 hours of obtaining results. Any action level results shall be reported verbally immediately.

3.2.4 Stormwater Pollution Prevention Plan (SPPP)

The SPPP shall include the preparation and implementation of a Stormwater Pollution Prevention Plan and compliance with its provisions. The Contractor shall develop a SPPP prior to the start of any site activities. The Plan shall include contingency measures for potential spills of construction-related materials such as diesel fuel and discharges from dewatering of contaminated surface water pits or ponds on or surrounding the site.

3.2.4.1 Implementation

The Contractor shall implement, maintain, supervise, and be responsible for the SPPP. The Contractor shall provide methods, means, and facilities required to prevent contamination of soil, water, atmosphere, equipment, or material by the discharge of materials from spills due to Contractor's operations.

The Contractor shall provide equipment and personnel to perform emergency measures required to contain any spillage and to remove spilled materials and soils or liquids that become contaminated due to spillage. This collected spill material shall be disposed properly at the Contractor's expense.

The Contractor shall provide equipment and personnel to perform decontamination measures that may be required to remove spillage from previously uncontaminated structures, equipment, or material. Decontamination residues shall be disposed properly at the Contractor's expense.

The Contractor shall submit a SPPP in accordance with Section 2.2.5.2 and the following:

1. Procedures for Containing Dry and Liquid Spills.

2. Discharge locations for dewatering activities (to be located on the top of the landfill).

3. Listing of Absorbent Material available on-site.

4. Procedures for Storage of Spilled Materials.

5. Decontamination Procedures. Decontamination procedures may be required after cleanup to eliminate traces of the substance spilled or reduce it to an acceptable level. Acceptable level shall be determined by the Engineer. Complete cleanup may require removal of contaminated soils. Personnel decontamination shall include showers and cleansing or disposing of clothing and equipment. All contaminated materials such as soil and wood that cannot be decontaminated or disposed on top of the wastefill must be containerized properly, labeled, and disposed properly as soon as possible, at no additional cost to the State.

6. Spill Incident Report. A written report detailing the spill or discharge shall include, at a minimum, the cause and resolution of the incident, outside agencies involved, and date the incident occurred. The report shall be submitted to the Engineer within 48 hours of the incident. The Contractor shall document the location of all spills on the Site Drawings and submit the Drawings to NJDEP at project completion.

7. Notification. The State shall be notified immediately of a spill or discharge that impacts the environment by contacting the NJDEP 24-hour Hotline (1-877-WARNDEP). The US Environmental Protection Agency, Region II shall be notified if the spill exceeds the designated reportable quantity.

3.2.5 Security Plan

Security Plan shall consist of preparation and implementation of a plan for site security during the construction. The Contractor shall prepare a Security Plan that describes the security measures to be employed during the construction to prevent site entry by unauthorized persons. The Security Plan shall include at least the following items and be submitted in accordance with Section 1.3:

1. Identification. Procedures for identifying those persons authorized to enter the site.

2. Personnel List. A list, kept current throughout the project that identifies personnel authorized to enter the site.

3. Entrance Procedure. Proper procedures for granting access to the site and providing for proper training if required.

4. Vehicles. A plan for maintaining a list of vehicles entering and leaving the site.

5. Visitors. Identify procedures to be followed in maintaining a visitor log, escorting visitors to the site, and providing for prior approval by the Engineer.

6. Liability Releases. Explain procedures for obtaining signed liability releases from visitors to the site.

7. Access Control. Outline the procedures to be implemented to ensure that all site access is through the main gate, unless authorized otherwise by the Engineer.

8. Non-Working Hours Security. Provide explanation of non-working hours security measures. ~~An alarm system with motion detection and video recording shall be included in the security measures.~~

The Contractor shall be responsible for maintaining security. The security of stockpiled materials is the responsibility of the Contractor. The Contractor shall provide sufficient security personnel to accomplish the work outlined in the Security Plan. The Engineer or NJDEP shall have the right to approve or reject security personnel assigned to the project site at any time during Contractor activities. Designated security personnel must have access to a telephone 24 hours a day. The State's review and approval with regard to the security plan will be limited to public safety and control of waste.

The Contractor shall ensure that all security personnel entering exclusion/ contamination or contamination/ reduction zone, as defined by the Health and Safety Plan, have received the OSHA 40 hour health and safety training for hazardous site operations.

The Contractor shall furnish and install the security fence, including gates, at mobilization for the project in accordance with the appropriate sections of these specifications and the drawings.

The Contractor shall provide trained security personnel 24 hours a day, with a minimum staff of one (1) person at all times, whether work is being done or the project is idle.

3.2.6 Traffic Control Plan

This work shall consist of the planning for and the carrying out of maintenance and protection of vehicular or pedestrian traffic and to provide for the safe and convenient passage of such traffic, within the scope of the Project. Maintenance and protection of traffic includes furnishing, assembling, placing, and relocating traffic control devices, including pavement markers, and removing them when they are no longer required. The Contractor shall prepare and implement a Traffic Control Plan.

Traffic control devices need not be new but must be in good condition as approved. Traffic control devices, other than those shown on the Plans, or as directed by the Engineer, shall conform to the Manual on Uniform Traffic Control Devices. The traffic control devices will be placed as per the approved Traffic Control Plan.

A Pass Through has been provided in Bid Item 1.4.1 for Town of Kearny Police to assist with traffic control. With the consent of the Engineer and NJDEP, the Contractor may request assistance from the police with traffic control. This in no way is meant to relieve the Contractor from the responsibility for traffic control.

The number and location of traffic signage shall conform to the "Manual for Uniform Traffic Control

Devices." When construction signs conflict with existing signs, the existing signs shall be covered. When construction signs are no longer required, they shall be removed. If they are temporarily not required, such as overnight, they shall be either temporarily removed or covered. Signs covered from view of the traveling public shall be completely covered with opaque material securely fastened so that it does not blow in the wind. Burlap shall not be used.

Prior to beginning construction, traffic control devices shall be placed where shown on the Plans or directed by the Engineer. Traffic control devices shall be kept clean and maintained in good condition until no longer required for the Project, at which time they shall be disposed of.

Traffic control devices shall also be placed as directed to provide traffic control for personnel doing inspections, sampling, testing, or taking measurements required for the Project.

When the construction involves improvement of an existing roadway, the roadway shall be kept open to traffic unless otherwise approved or shown on the Plans. The portion of the Project which is opened to traffic shall be kept in such condition that traffic is adequately accommodated. Temporary approaches or crossings and intersections, and access to trails, roadways, businesses, and parking lots shall be provided and maintained in a safe condition. The owners of adjoining properties shall be given a written notice at least three days prior to the beginning of any Work which interferes with the owners' normal passage.

Equipment or machinery having crawler tracks or other treads that may mar or damage pavements shall not move over or operate from newly constructed or existing pavements unless precautions are taken to prevent such damage.

Any damage to newly constructed or existing pavements within the limits of the Project or adjacent thereto, which in the opinion of the Engineer was caused by the Contractor's operations, shall be repaired as directed, at the Contractor's expense, or the repairs will be made by the NJDEP and the cost of such repairs will be deducted from any monies due or that may become due the Contractor.

Any restrictions of required traffic lane widths or diversion of traffic at any time are subject to approval. Except as necessary during actual working hours, and then only with approval, equipment, materials, personnel, or employee vehicles shall not occupy any traveled way, shoulder, median, or sidewalk area within or adjacent to the Project that is open to traffic.

The Engineer shall be notified one month in advance of a tentative date for establishing new traffic patterns. This date shall be finalized ten working days prior to the establishment of the new traffic patterns resulting from stage construction, and 15 working days prior to the establishment of a detour for the closing of any roadways.

Removable pavement marking tape shall be applied at designated locations. The tape shall be white or yellow and shall be applied in single or double lines, as designated.

The Contractor shall remove, immediately prior to striping or marking the pavement surface, all dirt, oil, grease, existing types of traffic stripes or traffic markings, and other foreign material, including curing compound on new portland cement concrete, from the surface areas on which the various traffic stripes or traffic markings are to be placed. The pavement shall be cleaned one inch beyond the perimeter of where the stripe or marking is to be placed.

The Contractor shall apply a primer-sealer conforming to NJDEP volatile organic content (VOC) requirements to the areas of bituminous concrete surfaces, when recommended by the manufacturer, and to the areas of portland cement concrete surfaces where long-life thermoplastic traffic markings are to be placed.

Marking tape shall be applied on dry surfaces, when the surface temperature is between 10 and 66^{o}C and when the ambient temperature is 10^{o}C and rising, and when the weather is otherwise favorable as determined by the Engineer. The tape shall not be overlapped, and only butt splices shall be used.

To ensure maximum adhesion, the tape shall be tamped and a truck shall be driven slowly over the tape several times. The tape shall be removed when no longer required for traffic control.

Tape that has become damaged and is no longer serviceable shall be replaced. Tape that is damaged by construction operations shall be replaced without additional compensation.

Work which closes or alters the use of existing roadways shall not be undertaken until adequate temporary or permanent provisions for traffic have been approved.

Where it is necessary for pedestrians to cross or walk within the limits of the Project, temporary sidewalks shall be provided, maintained, and removed as directed.

Construction above vehicular or pedestrian traffic shall not be performed unless there is explicit provision made in the Special Provisions or specific written permission given. Subject to such provision or permission, necessary devices and means to protect such traffic from falling construction materials or other objects and from painting operations shall be provided at no cost to the State during the time that construction is performed above traffic. The precautions to be taken for the protection of traffic are subject to approval.

The traffic control plan provides for the treatment of conditions caused by or encountered during the Work on the Project. The Work shall be performed in accordance with the traffic control plan.

3.2.6.1 Traffic Control Coordinator

Prior to the start of construction operations, the Contractor shall assign a supervisory-level employee to be the traffic control coordinator. The Engineer shall be notified as to the name and method of contacting the traffic control coordinator on a 24-hour basis.

The duties of the traffic control coordinator shall include, but shall not be limited to, the responsibility for ensuring the following:

1. Set-up and removal of all traffic control devices in accordance with the Contract Documents.
2. Correction of deficiencies of traffic control devices within two hours of discovery or notification by the Engineer.
3. Repositioning traffic control devices displaced by traffic or construction equipment.
4. Covering or uncovering signs as appropriate.
5. Repairing or replacing damaged traffic control devices.

6. Replacing batteries, light bulbs, control panels, and other electrical components.
7. Keeping all traffic control devices clean.
8. Adding fuel and oil to power units for traffic control devices.
9. That all Contractor equipment and vehicles are properly stored and packed so as not to create a traffic hazard.
10. Properly storing traffic control devices when not in use.

Trained flaggers shall be in good physical condition, including sight and hearing, mentally alert, and shall have a courteous but firm manner, neat appearance, and a sense of responsibility for the safety of the public. Trained flaggers shall wear an orange or fluorescent orange garment such as a shirt, jacket, or vest. This garment shall be reflectorized for nighttime operations with reflective material that shall be orange in color. When controlling traffic, trained flaggers shall be equipped with STOP/SLOW paddles, and shall follow the procedures stipulated for flaggers in the Manual on Uniform Traffic Control Devices. The Traffic Control Plan will also include traffic control personnel and devices, as needed.

3.2.7 Construction Water Management Plan

The Contractor shall manage and dispose of water generated during construction. The Erosion and Sediment Control Plan requires prevention of run off from the site, and prevention of run on from areas adjacent to the site. The Contractor shall continue to maintain that separation of the site from adjacent areas under storm conditions. Contaminated water and non-contaminated water shall be managed separately.

Construction water generated during activities at the MSLA 1-D Landfill shall consist of:

Contact Water - Stormwater runoff that has been in contact with solid waste materials. Leachate is included in this category.

Decontamination Water - Water from personal and equipment decontamination activities.

Non-contaminated Water - Water not in contact with contaminated material, or may be run-on from clean areas adjacent to the site or run-off from non-contaminated areas.

Measures shall be taken to minimize generation of contact water. Contact water shall be re-routed to the top of the waste mound which is encircled by the perimeter access road.

1. Contact Water - Contact water generation shall be limited to prevent contamination of "clean areas" from run-off and to reduce the quantity of contact water for disposal. Measures to limit, control, and manage contact water include, but are not limited to the following:

    a. All surfaces with exposed waste shall be covered with six (6) inches of imported soil when excavation operations are halted for periods in excess of eight (8) hours. An intermediate cover of up to twelve (12) inches of cover material shall be applied when work is halted for one month or more.

    b. Non-contaminated surface water shall be prevented from entering areas of exposed refuse or other known areas of contaminated material for all flows up to peak

discharges from at least a 25-year, 24-hour storm.

c. For areas of exposed refuse or MSLA 1-D-type waste, the contact water management system shall be designed to collect and control the water volume resulting from a 25-year, 24-hour storm. Contact water shall be collected prior to leaving the contaminated area.

d. Contact water collected from a contaminated area shall be discharged back onto the landfill. Contact water shall not be allowed to enter gas collection manifold piping.

e. In the event, surface run-off is the cause of existing clean areas or subsequently clean areas becoming contaminated above cleanup standards, the affected areas shall be cleaned. Unless the Contractor can demonstrate that the applicable design storm was exceeded, the cost of cleanup will be at the Contractor's expense.

2. Disposal - Contact water shall be disposed within the waste mound encompassed by the perimeter access road. No separate payment will be made for on-site disposal of the contact water since this disposal cost is incidental to the work and its cost should be included in the price of work associated with the generation of contact water.

3. Non-contaminated water shall be prevented from entering areas of open excavation or suspected contaminated materials.

Prior to mobilization to the site, a Construction Water Management Plan shall be submitted to the NJDEP for approval in accordance with Section 1.3 showing complete details of systems to be implemented pursuant to the requirements of this section. No work will be permitted until this Plan has been approved. Modifications to the Plan which may become necessary as a result of the Contractor's method of work or which may be required by other agencies shall be submitted to the NJDEP for approval.

The Construction Water Management Plan shall include a plan of the site showing sub areas and the sequences of construction activities. Based on these sequences, the Plan shall indicate construction water routes, collection and diversion features, and disposal or discharge locations for each phase of construction. The Construction Water Management Plan submittal shall be in accordance with Section 1.3.

The Plan shall show or describe measures to control decontamination water, control the origin of construction water and to maintain separation of contact (potentially contaminated) water from uncontaminated water during each phase of construction.

3.2.7.1 Decontamination Water Management

Decontamination water shall be managed separately. Decontamination water generated during activities at the MSLA 1D Landfill shall consist of water from personnel and equipment decontamination activities.

Decontamination Water shall be considered to be a regulated wastewater. Measures shall be taken to minimize generation of decontamination water.

Decontamination water shall be collected and disposed back into the landfill under the cap.

1. Decontamination Water - Generated from decontamination of personnel and equipment shall be collected and stored separately from other contaminated water. A tank will be included at the equipment decontamination pad for this use. The Contractor must provide a storage tank for personnel decontamination water where appropriate.

2. Disposal - Decontamination water shall be disposed under the cap. An adequate area is to be provided and maintained on-site for the storage of decontamination water, as long as decontamination activities are occurring and until the water is disposed under the cap. No decontamination water will leave the site; all water will be disposed of under the cap. The number of gallons disposed shall be reported to the NJDEP on a monthly basis. The Contractor is responsible for the disposal of decontamination water generated after the landfill is capped. No separate payment will be made for off-site disposal of the decontamination water. However, this disposal cost is incidental to the work and its cost should be included in the price of work associated with the generation of contaminated water.

3.2.8 Decontamination Facilities

Decontamination Facilities shall include the provision, installation, and operation of decontamination facilities for equipment, and materials. The Contractor shall dispose of all decontamination liquids. Contaminated and/or uncontaminated liquids are anticipated to result from decontamination of equipment and personnel working on-site within the exclusion zone.

Rinsate Water - Water resulting from decontamination of equipment shall be collected and disposed on-site under the cap except for chemical decontamination of sampling equipment using acetone, in which case the acetone shall be separated from the other decontamination water, drummed, and disposed of in accordance with appropriate regulations at no additional cost to the State.

Equipment Decontamination Stations: The Contractor shall provide equipment decontamination stations within the Contamination Reduction Zones for removing soil from all vehicles and equipment leaving the working area. As a minimum, these stations shall include a high pressure water wash area for equipment and vehicles and a steam-cleaning system for use after the mud has been cleaned from the equipment. A designated clean area shall be established within the Reduction Zone for performing equipment maintenance. This area shall be used when personnel are required to come in contact with ground soil, i.e., crawling under a vehicle to change engine oil. A temporary pad constructed of an impermeable and chemical resistant material such as the decontamination concrete pad shown on the drawings shall be acceptable. The pad shall be capable of handling on- and off-site vehicles without loss of integrity and shall include a sump for collection of decon water. All equipment within the Exclusion or Contamination Reduction Zones shall be decontaminated prior to maintenance work.

General: Any item taken into an Exclusion Zone must be assumed to be contaminated and must be carefully inspected and/or decontaminated before the item leaves the area. Vehicles, equipment, and materials brought into the Exclusion Zone shall remain in the Exclusion Zone until no longer necessary to the project. All contaminated vehicles, equipment and materials shall be cleaned and decontaminated to the satisfaction of the NJDEP on-site coordinator prior to leaving the site. All construction material shall be handled and brought on-site in such a way as to minimize the potential

for contaminants being carried off-site. Separate, clearly marked parking and delivery areas shall be established in the Support Zone.

3.2.9 Construction Quality Control Plan

The Contractor shall prepare a Construction Quality Control Plan that will include the following:

- Identify the project organization
- Responsibilities
- Construction Quality Assurance (CQA) officer
- CQA Support personnel
- Personnel qualifications
- Project meetings
- Inspections
- Testing
- Daily Record keeping
- Inspection documentation
- Final Documentation
- Storage of records

The Contractor shall ensure that Construction Quality Plan conforms to the requirements of the plans and specification.

3.2.10 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Pay Unit
3.2.1	Construction Plan	Lump Sum
3.2.2	Adherence to Construction Plan	Month (or fraction of, to the nearest week)

The Contractor will be paid on a lump sum basis and will not be paid until the Construction Plans are complete and accepted by the NJDEP and no payments for any line item work will be processed until these plans are completed and the Notice to Proceed has been issued. Project Management Software (2 copies), to be provided to the Engineer, shall be included in the price for Pay Item 3.2.1.

Payment for Implementation of Construction Plan, shall be paid under Bid Item 3.2.2. The Contractor shall be paid on a monthly basis as per Bid Item 3.2.2 for each month, or fraction thereof, measured to the nearest week, from notice to proceed with mobilization until substantial completion. The Contractor will not be paid for any month or fraction thereof that liquidated damages are assessed. The contractor shall be responsible for any fines incurred for spills due to their work.

END OF SECTION

3.3 Hazardous Substance Container Removal & Staging

3.3.1 Description

Hazardous Substance Container Removal & Staging shall consist of excavation, removing, staging and transporting containers discovered during site excavation operations. These actions shall occur at the direction of the Construction Manager/Engineer after the Contractor has notified the Construction Manager/Engineer that a hazardous substance container may have been encountered. A hazardous substance container shall be defined as drums, cans, cylinders, and lab packs suspected to contain hazardous substances, hereafter referred to as containers. This also includes backfilling and compaction after removing the container. Empty drums or carcasses are not included in this line item. Any empty drums or carcasses encountered will be replaced in the landfill as part of the work for which it was encountered.

Drum disposal is not included within this Contract, and this task will be handled as a change order.

3.3.2 Excavation of Hazardous Substance Containers

Containers encountered during fill/refuse relocation and other construction operations shall be removed if directed by the Construction Manager/Engineer. The container shall be classified a hazardous substance container for the purpose of this contract. If directed to remove the container(s), the Contractor shall take all steps necessary to remove the container(s) intact to preserve any evidence of ownership. Only containers identified for removal by the Construction Manager/Engineer will be paid under this item.

Following inspection and testing of contents, the containers shall be overpacked, if necessary, and staged at suitable locations on site. Subsequent to removal of containers from the area of excavation, the Contractor shall backfill the excavation to grade.

A. Hazardous Substance Container Handling, Removal, and Opening

Manual handling of hazardous substance containers shall be minimized. Handling shall be by suitable mechanical equipment such as a grappler-equipped backhoe or front end loader. Manual handling of hazardous substance containers in locations other than designated storage areas will not be permitted.

Prior to handling, the condition of each container shall be determined by the Drum Inspector (designated by the Contractor) and categorized as either open, leaking, bulging, empty, a combination, or intact. Containers shall not be moved or opened unless an external/gross gamma scan is negative. The Contractor will not be allowed to move the container until the Contractor contacts the NJDEP and the Engineer and allows the NJDEP and / or Engineer to document the container. The containers shall be removed to the designated lined drum staging area as shown on the Contract Initial Site Operations Plan. See Section 3.4 for hazardous substance container staging area requirements description.

Hazardous substance containers which the Drum Inspector determines cannot be moved to the initial staging area or opened without risk of explosion, fire or spilling of contents shall be designated as unsound containers. Unsound non-bulging containers shall either be overpacked or the contents shall be transferred to a DOT approved container using hand-operated non-sparking drum pumps. Containers which are bulging or appear to be under pressure shall be remotely sampled in place. Openings shall be plugged and bung holes shall be fitted with pressure venting caps set at 5 psi release. After overpacking or relieving pressure via sampling, the containers may be moved to the initial staging area.

Hazardous substance containers which are not the subject of special handling and removal procedures shall be exposed fully by carefully removing surrounding material and placed in the initial staging area. Hazardous substance containers which the Drum Inspector determines can be opened safely manually shall be placed upright in the initial staging area and the top opened using non-sparking tools.

B. Hazardous Substance Container Inventory

As subsurface containers are exposed, each container shall be subject to the following inventory procedures:

- The location of each container shall be temporarily staked and permanently located by GPS and plotted accurately on a reproducible copy of a topographic plan of the site.

- An information sheet shall be developed upon which the Contractor shall record information such as container size, condition, type of materials, and any identifying characteristics of the container.

- Each inventoried item will be indelibly marked on top and two opposite sides with a numeric code corresponding to the information sheet prepared for that item.

- Copies of the information sheets and location plan shall be provided to the Engineer.

3.3.3 Hazardous Substance Container Staging

The containers may be staged temporarily on-site in the drum staging area until the State completes additional analyses and arranges for off-site disposal. The cost of additional analyses and disposal is not a part of this contract and shall be handled under a change order.

3.3.4 Measurement and Payment

Payment shall be made under:

Pay Item No.	Pay Item	Unit
3.3	Hazardous Substance Container Removal and Staging	Each

The Contractor shall be paid the bid unit price for Hazardous Substance Container Removal for each hazardous substance container removed, over packed (if needed), and staged in the designated area. Bid Item 3.3 allows for handling of twenty-five hazardous substance containers. For purposes of the work, hazardous substance container is defined as a container with a volume capacity greater than 35 gallons including drums, cans, cylinders, and lab packs.

END OF SECTION

3.4 Hazardous Substance Container Staging Area

3.4.1 Description

Hazardous Substance Container Staging Area shall include rehabilitating the existing hazardous substance container staging area and maintenance of a hazardous substance container staging area. A hazardous substance container area (meeting the requirements in this Section) shall be available for use at all times during this project.

If the Contractor elects to relocate the existing hazardous substance container area, to facilitate his work, the area shall consist of the following:

The Contractor shall restore the 10’ x 50’ hazardous substance container staging area upon mobilization. This staging area shall consist of 12 inches of Common Fill, Type I-13 (reference Section 2.10) over Geotextile Type B (reference Section 2.9) and 40 mil HDPE geomembrane. It shall be located at least 100' from any active working areas or underground utilities and protected with at least a 2.5' high earthen berm, constructed of Common Fill, Type I-13, to help contain any leakage. The perimeter berm shall have a maximum 1:1 sideslope and shall begin at the edge of the 10 foot by 50 foot area. The Contractor shall remove all stagnant stormwater water when the area is not in use.

The geomembrane shall be GSE HD Smooth Geomembrane, 40 mil, Poly-Flex Inc. Smooth HDPE 40 mil, or equal, as approved by the Engineer, and shall be welded using the hot wedge method, and extend under the entire staging area and containment berm.

3.4.2 Measurement & Payment

Payment will be made under:

Pay Item No.	Pay Item	Unit
3.4	Hazardous Substance Staging Area	Month

All material, equipment and labor required to complete this work shall be included in the Month bid price of Pay Item 3.4 – Hazardous Substance Staging Area. The price bid shall include any hazardous staging area relocation work that the Contractor may perform.

END OF SECTION

3.5 Hazardous Substance Container Sampling and Analysis

3.5.1 Description

Hazardous Substance Container Sampling and Analysis shall consist of sampling and analysis of containers discovered during site excavation operations. These actions shall be completed by the Engineer after the Contractor has notified the Construction Manager/Engineer that a hazardous substance container may have been encountered. These tasks will be completed in accordance with the Engineer's pre-approved Quality Assurance Plan. A hazardous substance container shall be defined as drums, cans, and lab packs suspected to contain hazardous substances, hereafter referred to as containers. This also includes backfilling and compaction after removing the container. Sampling and analysis of cylinders will be handled through a Change Order.

3.5.2 Hazardous Substance Container Sampling and Analysis

Manual handling of hazardous substance containers shall be minimized. Handling shall be by suitable mechanical equipment such as a grappler-equipped backhoe or front end loader. Manual handling of hazardous substance containers in locations other than designated storage areas will not be permitted. The Contractor will be responsible for opening the containers to provide access to the Engineer for sampling.

One sample will be collected by the Engineer for each container and analyzed for TCL/TAL Metals, TCLP on a 4 week turnaround, and RCRA Disposal Parameters (ignitability, corrosivity, sulfides, and cyanide reactivity) by a New Jersey Certified Laboratory.

Temporary storage of the containers on site in the drum staging area until the State completes any additional analyses and arranges for off-site disposal. The cost of additional analyses and disposal is not a part of this contract and shall be handled under a change order.

3.5.3 Measurement and Payment

Separate payment will not be made for Sampling and Analysis. The Contractor shall accommodate the Engineer who will conduct the Sampling and Analysis. Contractor will be required to open the containers to provide access for the Engineer.

END OF SECTION

3.6 Construction Erosion and Sediment Control Plan

3.6.1 Description

Construction Erosion Sediment Control Plan shall consist of preparation of a phased construction erosion and sediment control plan that meets the requirements of the Hudson-Essex-Passaic Soil Conservation District. The Contractor shall prepare a Construction Erosion Sediment Control Plan that describes the temporary measures to be employed to provide control of sediment and prevent erosion during the construction project. The proposed Erosion Sediment Plan shall be in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey and signed and sealed construction drawings shall be submitted to the Hudson-Essex-Passaic Soil Conservation District for review and certification approval prior to the start of any construction activities.

This Erosion and Sediment Plan shall take into consideration the proposed detentions basins and any other erosion control measures necessary to avoid damage and/or contamination to the bodies of water receiving run-off from the site during construction. The Erosion and Sediment Plan shall outline the various construction stages and discuss in detail the proposed engineering controls in each stage and an appropriate contingency plan for critical scenarios. Critical scenarios shall take into account a low return period precipitation event during a vulnerable construction stage (e.g., open slopes).

The Contractor will be required to make provisions for a Temporary Sediment Basin [TSB] to be installed early in the sequence of construction to collect sediment during the construction period. The first completion item will be to install temporary soil erosion controls and the second completion item will be to install the TSB.

The Contractor shall remove accumulated sediment from the TSB upon permanent stabilization.

The Contractor shall install the TSB prior to performing grading or clearing and grubbing activities. In addition, the Contractor will be required to seed and mulch (or blanket) the TSB, side slopes, berms, inlets, and downstream outlet channels immediately after construction of the TSB. The Contractor will also be required to have a continually functioning TSB and coordinate construction of the permanent basin features.

The Contractor shall address in their Construction Erosion Sediment Control Plan their means and methods to installing the sediment basin and how they will coordinate their capping installation while maintaining the sediment basin.

The Contractor shall provide temporary diversion berms in their Construction Erosion Sediment Control Plan and incorporate into their construction activities.

~~Construction Erosion and Sediment Control Plan shall consist of preparation of a phased construction erosion and sediment control plan that meets the requirements of the Hudson County Soil Conservation District. The Contractor shall prepare a Construction Erosion and Sediment Control Plan that describes the temporary measures to be employed to provide control of sediment and prevent erosion during the construction project. The proposed Erosion and Sediment Plan shall be in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey and signed and sealed construction drawings shall be submitted to the Hudson County Soil Conservation District for review and certification approval prior to the start of any construction activities.~~

~~This Erosion and Sediment Plan shall take into consideration the proposed detentions basins and any other erosion control measures necessary to avoid damage and/or contamination to the wetlands and other bodies of water receiving run-off from the site during construction. The Erosion and Sediment Plan shall outline the various construction stages and discuss in detail the proposed engineering controls in each stage and an appropriate contingency plan for critical scenarios. Critical scenarios shall take into account a low return period precipitation event during a vulnerable construction stage (e.g., open slopes).~~

3.6.2 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Pay Unit
3.6	Construction Erosion Sediment Control Plan	Lump Sum

The Contractor will be paid on a Lump Sum basis as per Bid Item 3.6 for preparation and approval of the Construction Erosion and Sediment Control Plan. Pay Item 3.6 shall include all costs for obtaining the Construction Erosion and Sediment Control Plan approval, including costs for revisions and resubmissions.

END OF SECTION

MSLA 1-D LANDFILL CLOSURE PROJECT
TECHNICAL SPECIFICATIONS
NJSTART BID NO. 17DPP00036

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4.1 Operations and Maintenance – During Construction

Operation and maintenance (O&M) during construction shall consist of O&M of the landfill flare, gas collection system, leachate collection system (including the metering / pump stations); and stormwater management structures. The Contractor is responsible for inspecting, operating and maintaining all aspects of the site and associated equipment as directed by the O&M Manual and Manufacturer's literature.

A. The Contractor shall create an O&M Manual to reflect the gas collection and flare system installed during this project. The O&M Manual shall be submitted to the NJDEP and Engineer during construction, and shall be approved by the Engineer before final acceptance and operation of the system. The Manual must include, at a minimum: all manufacturer's recommended maintenance, including frequency for inspections, oil changes, etc.; drawings, schematics, details, etc.; a description of how the item operates; a description of how the item operates in the process where applicable; an item spare parts list, including specified lubricants, gaskets, tools, etc.; and technical specifications. Additionally, the O&M manual shall include a detailed sampling, monitoring and reporting program in accordance with the permits.

B. After completing the gas flare system, the Contractor shall make available the personnel scheduled to operate the gas flare system and at least two dates to attend training sessions at the site provided by the Engineer and manufacturer representatives.

C. The Contractor shall operate the gas flare in accordance with Section 4.2; the O&M Manual; manufacturer's recommendations; and within compliance with the air permit. The system shall be operated as necessary to prevent methane migration off the property and accumulation of methane in under the geomembrane. The Contractor shall maintain the landfill gas collection and flare system equipment as required by the O&M Manual and manufacturer recommendations. This shall include lubrication, cleaning, testing, and repairs, as necessary. The Contractor shall respond to flare system alarms. The contractor shall perform sampling, analysis, record keeping and reporting as required by the NJDEP Air Permit and as described in Section 4.2.

E. The Contractor shall maintain the leachate collection system equipment and KMUA-MSLA 1-D metering station (built by others) as required by the O&M Manual and manufacturer recommendations. This shall include lubrication, cleaning, testing, and repairs, as necessary.

F. The Contractor shall operate the Leachate Collection System in accordance with Section 4.2. Contractor shall perform sampling, analysis, record keeping and reporting as required by the Treatment Works Approval; and the KMUA and PVSC Sewer Service Agreements.

G. The Contractor shall maintain all erosion and sediment control and Stormwater Management Structures, including but not limited to removing blockages due to ice, snow, sediment, and straw. Excavated material may be placed on the wastefill, under the cap unless otherwise approved by the Engineer.

H. Materials shall meet the quality requirements of the specifications. Submittals shall be in accordance with Section 1.3.

I. Contractor shall perform all inspections, reporting, record keeping, collect certifications and make submissions as required by the NJPDES Stormwater Permit (NJPDES Stormwater – Individual Construction Permit).

J. Operation and Maintenance during construction shall begin with startup of the leachate collection system pump station (and pumping to the PVSC) or landfill gas flare, whichever begins operation first. Operation and Maintenance during construction will continue until substantial completion.

K. The hydrostatic pressure of the cut-off wall shall be monitored on a monthly basis and the results shall be submitted to the Solid & Hazardous Waste Management Program. [N.J.A.C. 7:26-2A.8(h)8].

The Contractor is required to provide all labor and overhead, materials, equipment, transportation, etc. necessary in performing the tasks listed in this section. The Contractor will be responsible for all costs during construction.

4.1.1 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Pay Unit
4.1.1	Operation and Maintenance During Construction	Month
4.1.2	PVSC and KMUA Disposal Fees	Pass Through
4.1.3	PVSC Testing and Reporting	Each

Bid Item 4.1.1 will be measured per month of operation and maintenance during construction. This period shall start after equipment has been installed and the O&M manual has been approved. Payment shall be per month or fraction thereof for operation and maintenance during construction under pay item 4.1.1, except for leachate disposal. This task terminates when O&M transferred to Operation and Maintenance, Post-Construction, as described in Section 4.2.

For off-site Leachate disposal during construction, the Contractor shall be paid the bid unit prices for handling leachate, and the bid unit price for quarterly testing according to the PVSC Service Agreement. The Contractor will pay the disposal bill directly based on the gallons measured at the MSLA 1D Landfill Pump Station and be reimbursed by NJDEP from the Pass Through in Item 4.1.2. The Contractor is allowed a 2% markup on the PVSC and KMUA disposal costs for management fees including costs of any utilities during the O&M period (i.e. electricity). After construction, only leachate from the leachate collection system will be produced and the costs for testing and reporting shall be included in the lump sum yearly O&M bid price (disposal at PVSC will still be paid direct by the Contractor and reimbursed by NJDEP with a 2% markup allowed, based on the gallons measured at the MSLA 1D Landfill Pump Station). The "Initial Reporting"

required in the Service Agreement includes 12 sampling events within the first 3 months of operation and will be paid under Item 4.1.3 per each test and associated report. PVSC testing and reporting will be conducted quarterly thereafter.

END OF SECTION

4.2 Operations and Maintenance – Post-Construction

Operations and maintenance of the MSLA Landfill Closure project shall be performed by the Contractor for a period of one year following Substantial Completion, with an optional additional year (on a month by month basis). O&M under this contract consists of all operation and maintenance activities associated with landfill closure, which includes, but is not limited to, gas flare and leachate collection system operation, compliance with KMUA and PVSC Service Agreements operations, mowing, herbicide application, snowplowing, monitoring, inspecting, and reporting services associated with erosion and sediment control and stormwater management structures, fencing, bollards, signs, erosion on regraded areas, vegetation establishment and invasive species control, concrete pads and all roads and parking areas. Contractor can perform additional O&M work if needed.

A. The Contractor shall maintain all erosion and sediment control and stormwater management structures, including but not limited to removing blockages due to ice, snow, sediment, and straw. Excavated material will be graded into the site adjacent to the areas it is removed from.

B. The Contractor shall maintain fences, gates and locks in good condition so that the site is secure from trespassing.

C. Materials shall meet the quality requirements of its applicable specification section. Submittals shall be in accordance with Section 1.3.

D. Operations and Maintenance shall begin upon written notice of substantial completion of the construction phase from NJDEP.

The Contractor is required to provide <u>all</u> labor and overhead, materials, equipment, transportation, etc. necessary in performing the tasks listed in this section. The Contractor will be responsible for all costs for the first year. The NJDEP may elect to use the Contractor on a monthly basis for a second year of O&M services.

Any fines from PVSC and KMUA due to the Contractor's lack of timely response will be the responsibility of the Contractor to pay.

4.2.1 General

<u>Occupying Private Land</u>

The Contractor shall not (except after written consent from the NJDEP) enter or occupy with personnel, tools, materials, or equipment, any land outside of the landfill properties.

<u>Catastrophe or Vandalism Repairs</u>

Repairs of damage caused by catastrophe or vandalism shall be accomplished by the Contractor either:

- At Contractor's expense if covered under his warranty, or caused by his negligence, or
- The Contractor will prepare Change Order request documents for major repairs which shall be paid for by the State.

Documentation

The Contractor shall be responsible for documenting all operation and maintenance activities performed during the course of the work. Documentation shall include the following:

- Maintain an operation and maintenance log book, recording all data generated at the facility (i.e., meteorological readings, names and hours for all personnel used in operation and maintenance efforts and tasks performed, security problems, and communications with agencies and/or personnel).
- The Contractor will be required to submit a completed daily inspection/ maintenance log after each site visit. Site inspections shall occur on a weekly basis. All inspection efforts are to be documented in detail in the daily log. The daily log (reports) shall break out what was inspected that day (including security fencing). The daily log shall list potential future problems with the system. The daily log is to be filled out after every site inspection and is to be submitted and received by the NJDEP either via mail or telefacsimile no later than two (2) working days after a site inspection. Delays in meeting this submittal schedule shall be the basis for a Contractor Complaint, filed by NJDEP with the Department of Treasury.
- Prepare and submit to the State, semiannually, a report consolidating data into charts and graphs providing an overview of all aspects of the operation and maintenance effort. A written report summary shall also be included in this report.
- Prepare report of the annual cost of operation and maintenance of the MSLA landfill facility, upon completion of the 12-month operation period. The annual cost report should be summarized by month to show seasonal differences.
- Provide a record of all personnel utilized in the annual operation and maintenance of the site. Include baseline and annual medical records for each person working on the site.
- The Contractor shall be responsible to perform all the monitoring and/or reporting required for the following permits and/or plans:
    - NJDEP Landfill Closure Plan Approval
    - Air Quality Permit
    - Passaic Valley Sewage Commission (PVSC) Requirements
    - NJPDES Stormwater Discharge Permit

NOTE: It is the Contractor's obligation to contact the Regulatory Enforcement Officer to determine the procedures required in maintaining/processing logs/reports.

Materials shall meet the quality requirements of its applicable specification section. Submittals shall be in accordance with Section 1.3.

4.2.1.1 Management and Administration

The Contractor shall be responsible for management and administration of the operation services and activities specified to be conducted at the MSLA Landfill. The Contractor shall provide supervisory and management staff to direct the daily activities of its work force and establish and update work schedule and assignments. The Contractor shall provide all site communications to the appropriate NJDEP staff and other entities as directed by the NJDEP. NJDEP shall have full access to all records of the Contractor pertaining to operation and maintenance.

4.2.1.2 Staffing

A. The Contractor shall provide management, operations, and maintenance personnel required to operate, maintain, and administer all necessary facilities and programs. The Project shall be staffed as necessary to ensure continuous compliance with all specified permits, rules, and regulations in addition to the performance of all necessary related tasks (maintenance, repair, process monitoring, etc.) to effect the proper operation of the project.

4.2.1.3 Materials and Supplies

Acceptance of Specified Materials

Only new materials and equipment shall be incorporated in the work (as specified in the appropriate technical specification sections of the Contract relating to construction). All materials and equipment furnished by the Contractor to be incorporated in the work shall be subject to the inspection of the NJDEP. No material shall be processed or fabricated for the work or delivered to the work site without prior acceptance by the NJDEP.

Prior to the commencement of the work, the Contractor shall submit samples of materials necessary to demonstrate that they conform to the Specifications. Such samples shall be furnished, taken, stored, packed, and shipped by the Contractor.

The Contractor shall submit samples sufficiently early to permit inspection before the materials and equipment are needed for incorporation in the work. The consequences of his failure to do so shall be the Contractor's sole responsibility.

Storage of Materials and Equipment

All material and equipment to be incorporated in the work shall be placed so as not to damage any part of the work or existing facilities and so that free access can be had at all times to all parts of the site and to all public utility installations in the vicinity of the site. Materials and equipment shall be kept neatly piled and compactly stored in such locations as will cause a minimum of inconvenience to public travel and adjoining owners, tenants, and occupants, and as approved by NJDEP.

Any and all Contractor owned materials and/or equipment stored on the site is stored at the Contractor's risk. The State is not liable for any damage to or theft of the Contractor's equipment, material, etc.
Material shall meet the quality requirements of its applicable specification section. Submittals shall be in accordance with Section 1.3.

4.2.1.4 Operation and Maintenance Tasks

This section summarizes the tasks to be performed under the O&M portion of this Contract. In general, the tasks are organized as general tasks to be performed for the entire site.

Task 1 - Project Plans

Several plans are required to be prepared for the O&M portion of this Contract. They include a Work Plan specific to O&M tasks, a HASP for post-construction O&M, and 6-Month Reports. Costs for this work shall be included in the 1st Year lump sum O&M bid item and/or the 2nd Year monthly O&M fee as identified below.

Work Plan (1st Year)

The Contractor shall submit a detailed Work Plan for the completion of all the O&M elements which shall consist of a schedule for the implementation of the O&M program. Included in the work plan shall be an estimate of manpower and equipment which may be necessary to complete each task. Any other considerations necessary to ensure the completion of each element shall also be included in the work plan. The work plan shall describe in detail how work tasks will be completed.

In addition, the schedule within the work plan must be evaluated and updated every 6 months and be included in the 6 month report (described below).

Health and Safety Plan (1st Year)

The Contractor shall submit a detailed Health and Safety Plan for Post-Construction O&M that assures compliance with all applicable OSHA standards under 29 CFR parts 1910 and 1926 and the NJDEP minimum requirements for Health and Safety Plans and Section 3.1 of these specifications. The HASP shall include a listing of all Contractor or subcontractor personnel scheduled to work on the project for Post-Construction O&M. The Contractor or subcontractor shall also provide proof that appropriate employee training and medical surveillance physical examinations are current for employees assigned to the project prior to their initiating any work under the Contract.

O&M Manual (1st Year, 2nd Year - Update)

The Contractor shall prepare an O&M Manual for this construction project. Thereafter, the Contractor shall provide updates and revisions to the O&M Manual every year based on field changes, future needs and recommendations.

The O&M Manual shall include at a minimum: recommended maintenance procedures and manufacturer spare parts list. The parts list shall also include the name, address, and phone number of local suppliers, from which the original equipment/material was purchased. Materials can be designated by construction specifications or by a substitute approved by NJDEP.

The activities report (described below under "6 Month Report") shall be incorporated into a separate section of the O&M Manual, in order to maintain a historical account of the entire project and in order to keep the revision of the original O&M Manual to minimal level of work for the Contractor.

6 Month Report (1st and 2nd Years)

A 6 month report shall be submitted to the NJDEP no later than 15 days after each 6 month period, which commences with the Construction Final Acceptance Conference. This report will include an updated Work Plan schedule, an activity report, and photographs of the current site conditions.

The activity report shall consist of documentation all site activities during a 6 month period. The documentation of the activity report shall include at a minimum: routine O&M activities, any emergency response activities, equipment replacement, changes or upgrades made during the reporting period, and a narrative describing the effectiveness of the systems. In addition, the activity report shall evaluate the O&M program and recommend modifications as needed. Also, the activity report shall include information regarding how permit requirements were met, include copies of any reports the Contractor was required to file per permit requirements, all sampling data, etc.

Photographs of the current site conditions shall be taken at locations and frequencies sufficient to document the entire site. Photographs shall document material or system failures, equipment changes, or other important events.

Any recommendations that will result in an increase of effectiveness or represents a saving to the State shall also be included in this report.

Deliverables

1. The draft O&M Work Plan and HASP shall be prepared and submitted before the first year of O&M, at least 15 days prior to obtaining a Certificate of Substantial Completion. Three (3) copies of each of these documents shall be submitted for the Draft and Final Copy. NJDEP shall have ten (10) working days to review and make comments on the Work Plan and HASP. The Contractor shall have five (5) working days to submit a Final Copy of the above documents which will incorporate NJDEP's comments. These documents must be completed, and approved by the

NJDEP, prior to issuance of the Certificate of Substantial Completion. The payment for these items will be made on a lump sum basis, upon NJDEP approval of the deliverables.

2. The Contractor shall submit a draft revised/updated O&M Manual at the Construction Final Acceptance Conference. Three (3) copies are to be submitted for both draft and final copies. Revisions of the draft by NJDEP will be incorporated into the final copy. The final copy of the revised O&M Manual is to be delivered to NJDEP within 30 days of the date that the Contractor received draft comments.

Task 2 - Repair of Roadways (1st and 2nd Years)

The Contractor is required to maintain all roadways to allow access to the site for operations and maintenance. The NJDEP expects that these roadways will incur damage as a result of use and/or erosion.

Work under this task will be done on an as needed basis, as determined by NJDEP.

If road repairs are required, as determined by NJDEP, the Contractor shall supply and install the same type aggregate gravel material (Recycled Aggregate Type B, Dense Graded Aggregate Base Course, and Hot Mix Asphalt) which will be installed for the access road surface under the site improvements construction, and Type B Geotextile if needed.

Delivered material will be installed at agreed upon areas. Any repairs containing an area to be filled which is greater than either 3' wide or greater than 1,000 square feet shall be compacted to meet the specifications in this RFB for that particular material using a small drum roller. Any other repair for areas smaller than those outlined above may be performed using a non-vibratory plate compactor.

The material will not be placed until the area has been shaped and dressed and approved by the NJDEP Construction Manager. Shaping and dressing shall include grading to the required lines and elevations, and the removal of all debris or unsuitable material. Debris will be spread on the landfill in an area designated by NJDEP.

Task 3 - Erosion Control (1st and 2nd Years)

The Contractor shall inspect erosion control structures monthly. The Contractor shall provide aggregate or topsoil, as necessary, to stabilize the slopes and fill in eroded areas, in those sections of the landfill that were disturbed and/or created during this Contract. The access road aggregate used shall be as specified in Section 2.26 of the construction specifications and designated by the NJDEP.

Topsoil shall be in accordance with Construction Specification Sections 2.24. Areas not covered with Recycled Aggregate shall be revegetated as specified in O&M Task 9. Wetlands areas are not to be cleaned of sediment or disrupted.

Costs for this work shall be included in the 1st Year lump sum O&M bid item and in the 2nd Year monthly O&M bid item.

Task 4 - Sediment Excavation (1st and 2nd Years)

The Contractor shall inspect the run-on, run-off control channels, the culverts, the inlets, pond, and the access road monthly for accumulation of sediments/foreign materials. Accumulated sediment shall be excavated to restore the required erosion and sediment control and stormwater management capacities. The excavated sediment shall be dewatered to increase the solids content to at least 20% solids by weight and placed in low spots or on high spots on top of the wastefill or as directed by NJDEP.

Costs for sediment excavation shall be included in the 1st Year lump sum O&M bid item and in the 2nd Year monthly O&M bid item.

Task 5 - Snow Plowing (1st and 2nd Years)

To ensure access for site operations, the Contractor may be required to plow the site access roads. The Contractor may also plow roads for his convenience. However, the Contractor must plow the roads when sample collection is scheduled or an emergency condition exists, as determined by NJDEP.

The Contractor shall include the costs for this task in the 1st Year lump sum bid item for O&M and in the 2nd Year monthly O&M bid item. NJDEP anticipates that the Contractor will have to plow the roads a maximum of four (4) times/year.

NOTE: Plowed snow shall not be deposited on/across any private property or emergency or regular exit/entrance.

Task 6 - Security Fence (1st and 2nd Years)

A well maintained security fence is integral in assuring that the site is not vandalized or used for illegal dumping. The fence, gates, bollards, and signs shall be inspected weekly. Damage shall be repaired within 24 hours of discovery. Repair materials shall be in accordance with appropriate specification sections.

Costs for this shall be included in the 1st year lump sump bid item for O&M and in the 2nd Year monthly O&M bid item.

Task 7 - Vegetative Control (1st and 2nd Years)

To ensure clear access to the work areas, the Contractor will be required to perform cutting around structures using a weed-whacker (including the use of handsaws, gas powered chainsaws or pruning shears) and pruning of trees and shrubs around roadways and access points. This shall include cutting and pruning the areas listed below:

1. Clear a 4' swatch around all fencing and gates.
2. Maintain existing road width.

3. Clear any other areas where access to mowing is limited.
4. Maintain the access road from the landfill gas plant to the top of the landfill.
5. Clear a 4' swatch around all gas wells and provide access to each gas well.
6. Clear any tree or shrub growth on the landfill.

Mowing will also be performed, as needed, along the perimeter access road and access road from the gas plant to the top of the landfill to maintain it weed free.

General

The Contractor, as part of his operations, shall not be responsible for picking up and removing the cut vegetation except along the entrance gate area. Vegetation removed from the entrance gate area shall be removed offsite. The NJDEP anticipates that the above areas will require mowing/pruning a maximum of six (6) times/growing season.

Vegetation Work

The Contractor shall employ a NJDEP licensed commercial pesticide operator trained in general vegetation management (N.J.A.C. 7:30-5-2). The Contractor will be required to conduct between 6 and 8 herbicide applications during each establishment year (12 to 16 applications for the establishment period) to control the following invasive or noxious species; *Ampelopsis brevipedunculata* (Porecelain berry), *Artemisia vulgaris* (Mugwort), *Lespedeza cuneata* (Chinese brush-clover), *Phalaris arundinacea* (common reed), *Pologonum cuspidatum* (Japanese knotweed), *Pologomun perfoliatum* (Mile-a-minute), *Pueraria montana* (Kudzu) and *Rosa multiflora* (multiflora rose). The herbicicde shall be applied using backpack type sprayers on foot. Mechanized spraying from equipment or ATVs shall not occur. Mowing or weed whacking invasive species is not an approved or acceptable method of control.

The Contractor shall ensure that persons applying herbicide are able to correctly identify invasive species in the field. Judicious, repeated and timely use of herbicide is required to avoid, to the greatest extent possible, non-target plants and apply herbicide to individual invasive plants to prevent them from spreading roots and/or producing seed. The herbicide / surfactants and the application plan or strategy chosen by the licensed commercial pesticide operator shall be approved by the Engineer before application begins. Application is on uplands only so no aquatic pesticide permit is required.

The Contractor shall include all costs for this work in the 1st Year monthly O&M bid price and 2nd Year monthly O&M bid price, as appropriate.

Task 8 - Erosion Repair and Regrading (1st And 2nd Years)

The Contractor shall inspect the access road and landfill areas disturbed by waste relocation monthly for erosion rills and gullies, ponded water, and other damage.

Various types of material are required to perform the necessary erosion repairs including: top soil as specified in Construction Specification Section 2.24, off-site fill as specified in Section 2.8, and

Type B geotextile as specified in Section 2.14. The soil shall be prepared as in Section 2.24 prior to placing repair materials. Soil shall be placed in 6 inch lifts and shall be compacted between layers. Compaction with a non-vibratory plate compactor shall be adequate. The area shall be revegetated as specified in O&M Task 9.

Costs for this work shall be included in the 1st Year lump sum O&M bid item and in the 2nd Year monthly O&M bid item, as appropriate.

Task 9 - Revegetation (1st and 2nd Years)

Revegetation is necessary in order to maintain the vegetative cover which protects the cap system from erosion. It shall be accomplished by putting down lime, fertilizer, seed, and mulch twice a year in areas which are bare or damaged.

Soil shall be shaped and prepared as described in Section 2.24 of these specifications. Fertilizing, seeding and mulching shall be performed in accordance with Section 2.24.

The finished seeded area shall be smooth and shall conform to the prescribed lines and elevations. Seeded areas shall be protected and maintained until final acceptance of the work. Any damage to the seeded area caused by the Contractor shall be repaired at no additional cost.

All costs for this work shall be included in the 1st Year lump sum O&M bid item and in the 2nd Year O&M monthly bid item.

Task 10 - Leachate Collection (1st and 2nd Years)

The proposed leachate collection system is a gravity drain built with perforated HDPE pipe within a filter pack. The gravity drain will be constructed in four pipe runs around the landfill perimeter within the contained area. Two runs will direct flow to a pump station on the south side of the landfill, which will subsequently pump the leachate to a metering and pump station on the northeastern side of the site. The other two runs will flow directly to the metering and pump station on the northeastern side of the Site. The collected leachate will finally be pumped to the previously installed KMUA MSLA 1-D pump/metering station.

Contractor shall perform sampling, analysis, record keeping and reporting as required by the Treatment Works Approval; and the KMUA and PVSC Sewer Service Agreements.

Emergency Response – Contractor to provide round the clock response for alarm conditions as reported by the RTU system.

The collection system piping shall be cleaned annually.

Pipe Jetting

High pressure water-jet pipe cleaning shall be performed to achieve the following:

- Remove biomass accumulations in the piping, facilitating leachate flow;
- Open blocked perforations, facilitating leachate flow;
- It may be able to establish the existence and approximate location of collapsed or damaged sections of pipe; and

It is recommended that jet cleaning be performed against the normal flow—i.e., from downstream to upstream- in order to ensure debris is pulled back into the header system where it may be further jetted back to the pump station and removed. If jetting is carried out in the same direction as the flow, the system cleaning has to rely on gravity to convey debris downstream. This is method is considerably less effective in removing debris.

Pump Station Maintenance

Wet Well Isolation Valves: Wet well isolation valves shall be adjusted on a monthly basis, or as needed, to regulate the flow of leachate into the wet wells. Adjust isolation valves such that wet well fill time is 19 minutes +/- 1 minute for North Pump Station and 19 minutes +/- 1 minute for South Pump Station.

Lock-out/Tag-out Procedure: Never perform any maintenance work when the pump motor is connected to electrical power. Always follow lock-out/tag-out procedures by locking the electrical disconnect, located at the pump control panel, in the OPEN position.

Overheated Pumps: Do not attempt to remove plates, covers, gauges, pipe plugs, or fittings from an overheated pump. Vapor pressure within the pump can cause parts being disengaged to be ejected with great force. Allow pump to cool completely before attempting service.

Metering Station: Maintain supply of bottled hydrogen for the Metering Station; maintain Metering Station and equipment including Flammability Analyzer and Automated Sampler; empty sample containers in Automated Sampler at least every other day; and respond promptly to alarms to avoid fines by PVSC.

The pump stations require little service due to their simple and minimum-maintenance design. Routine maintenance is limited to the tasks described below. In the event of pump failure, the failed pump shall be replaced with a spare pump, and the failed pump returned to the manufacturer for rebuilding.

Pump Lubrication:

Drain and replace the oil in the seal cavity after the first 200 hours of operation. Following this, check the oil level in the seal cavity after the first two weeks of operation, and every month thereafter. Perform work in accordance with Pump Operation and Maintenance Manual.

Valve Exercising:

All manual valves in the above-ground valve housing should be exercised (manually cycled between open/closed positions) at least once every three months. The wetwell isolation valves

should be exercised annually. Note that these valves have multi-turn gear reducer actuators requiring between three and four complete turns to close. These valves should never be forced against their stops.

Monitoring and maintenance shall be conducted as listed in the following table:

Site Equipment Maintenance Intervals V=Visual Inspection, C=Change, R=Relubricate, T=test, A=Adjust, X=Clean, Ca=Calibration						
Equipment	**Maintenance Item**	**Every Month**	**Every Three Months**	**Once Per Year**	**Once / 2 years**	**Maintenance Free Item**
North Pump Station	Submersible Pumps-Check Seal Cavity Oil Level	**V**				
	Submersible Pumps-HIPOT Test Motor Windings				**T**	
	Bubbler Tube Level Sensor Air Pumps	**V**				
	Pump Air Release Valves	**V**				
	Pump Check Valves	**V**				
South Pump Station	Submersible Pumps-Check Seal Cavity Oil Level	**V**				
	Submersible Pumps-HIPOT Test Motor Windings				**T**	
	Bubbler Tube Level Sensor Air Pumps	**V**				
	Pump Air Release Valves	**V**				
	Pump Check Valves	**V**				
Collection System & Appurtenances						
	Air Release Valves (Force Mains)			**V**		
	Flowmeters				**Ca**	
	Exercise/Test Valves			**T**		

The hydrostatic pressure of the cut-off wall shall be monitored on a monthly basis and the results shall be submitted to the Solid & Hazardous Waste Management Program. [N.J.A.C. 7:26-2A.8(h)8].

All costs for the operation and maintenance tasks described above shall be included in the 1st Year lump sum O&M bid item and in the 2nd Year monthly O&M fee.

Task 11 - Gas Collection and Monitoring System (1st and 2nd Years)

The proposed gas collection system is comprised of a HDPE piping system consisting of 3 main headers (one 8- inch header along the southern toe of slope, one 8- inch head along the northern toe of slope, and one 8- inch header which transverses the middle of the landfill). The south and north headers each connect to five 6- inch diameter header branches extending to the center of landfill. The headers and header line branches connect to 64 wells, via 4- inch diameter HDPE laterals, as shown on the Contract Drawings. The middle header line connects all header branches along the center of the landfill as shown in the Contract Drawings. Condensate traps are installed at low points in the gas collection manifold to drain condensate back into the landfill. All headers connect to a flare stack through a condensate knockout tank, blower, and flame arrestor.

The gas extraction wells consist of 4-inch diameter schedule 80 PVC pipe. A total of 64 gas extraction wells are required to withdraw gas generated from the landfill. Forty (40) gas wells are proposed in the middle portion of the landfill and are proposed to be 40 feet deep. The remaining twenty-four (24) gas wells will be constructed closer to the perimeter of the landfill and are proposed to be of 30 feet maximum depth. The design depth of the gas wells is primarily based on the leachate levels in the subsurface. The design is to avoid screening gas wells within leachate. All gas collection pipes will be installed at a minimum slope of 2% in direction of gas flow and 4% opposite direction of gas flow towards condensate traps. Generally, condensate traps have been spaced at 300 foot intervals along header mains. Condensate traps will also be located at points where header mains cross stormwater swales and at the end of branch lines at the toe of the landfill side slope prior to connecting to header mains, as shown on the details in the Contract Drawings.

The manifold system will be constructed with access ports to allow for video surveys of the lines and for venting the lines during maintenance work.

The gas collection and monitoring system will consist of seventeen (17) gas monitoring probes.

The Contractor shall operate the gas collection system to maintain a high methane content and low oxygen content and prevent migration of landfill gas off of the property. To accomplish this, the Contractor shall perform the following tasks:

• Initial System Balance (Year 1 only) - The Contractor shall completely balance the gas collection and combustion system. To obtain stabilized and balanced operation, the Contractor shall complete initial well header and header valve adjustments to obtain a vacuum on each well. It is expected that a considerable amount of subsequent well header and header valve adjustment will be required to complete the system balance. The Contractor is required to use like equipment as specified in Gas System Balance Maintenance.

Contractor shall analyze the composition of the gas prior to beginning system operation. The two primary components are methane and carbon dioxide. The presence of oxygen above 3 percent in a landfill gas well indicates a potential break in the gas well piping or a breach in the nearby liner system. Wells showing oxygen at these levels shall be inspected for damage and either taken off line or used at reduced flow to limit the quantity of oxygen drawn into the system.

To prevent migration of gas off the property, the gas shall be extracted at a rate equivalent to the gas production in that area of the landfill. The system shall initially be started pulling a low vacuum (2 to 4 inches H_2O) on each landfill gas well. Vacuum pressure and methane, carbon dioxide and oxygen concentrations being drawn from each well and manifold leg shall be monitored and recorded. Higher vacuums may be pulled on wells showing no oxygen intrusion and methane concentrations in excess of 50 percent. Wells that show a decrease in methane concentration shall be operated at a lower vacuum. Oxygen concentration in the gas extracted from the landfill gas wells must be less than 3% under vacuum.

• Gas System Balance Maintenance (years 1 & 2) - Once the system has been started and balanced, monitoring and adjustment can be carried out on a weekly to alternate weekly schedule, depending upon site specific conditions. Most of the adjustments made on the balanced system are anticipated to be account for the variations in air infiltration and anaerobic decomposition caused by seasonal weather changes.

The Contractor shall perform all monitoring and adjustment of the extraction wells and associated header/manifold system in accordance with site specific requirements and conditions. Data to be taken will include: vacuums, temperatures, gas velocities/flow, gas composition (methane and oxygen), and barometric conditions. The Contractor is required to use equipment comparable to the GEM 500 for gas monitoring, vacuum and temperature and ADM-870 Airdata Multimeter for flow readings. Based upon the monitoring data, necessary valve adjustments will be made and recorded.

The data will be graphed to analyze the stabilization process and swings due to seasonal changes. The degree of variations will be used to establish the monitoring and adjustment schedules.

In addition to the gas extraction wells, the Contractor shall monitor the vacuums/pressures, temperatures, gas velocity/flow and composition at the flare station.

Under any site specific condition, for both the Gas System Balance task and the Gas System Balance Maintenance task, the Contractor shall operate the system to meet the requirements of the current NJDEP air permit.

The Contractor shall perform the following preventative maintenance and repair tasks to maintain the landfill gas wells, gas condensate traps, gas manifold, and perimeter condensate tanks in workable condition. No repair work shall be performed on the gas system unless the work area has been isolated from gas supply and been purged. These tasks shall be performed for years 1 and 2.

• Quarterly, the Contractor shall inspect the landfill gas wells and perimeter wells. The valves shall be manipulated through their entire range of operation and lubricated per manufacturer

recommendations. Replace valves, when necessary. The wells shall be inspected for odor. If odor is noted, the actions outlined above in the case of high oxygen content shall be performed. Inspect the flexible hose. Replace as necessary.

• Quarterly, the Contractor shall walk along the gas manifold pipes and inspect for odor. If odor is detected, check for damaged HDPE pipe and repair. Likely locations for damaged pipe are areas of significant landfill settling or collapse and welded or flanged connections.

• Quarterly, the Contractor shall monitor the 17 gas monitoring probes to be installed around the perimeter of the landfill during this phase of construction. Results shall be provided to the State within 2 weeks of completion of monitoring.

Task 12 - Gas Blower / Flare System

The flare shall be operated according to manufacturer recommendations and in accordance with the requirements of the air permit (Appendix 4). The flare system shall operate automatically after the modifications made during construction. The Contractor shall monitor the gas flare operation during each site visit to confirm that the system is performing in compliance with the air permit. Also, the Contractor shall record temperature, pressure, etc., during each inspection of the gas flare. The Contractor shall also perform preventative and repair maintenance, as described below and in accordance with manufacturer recommendations:

• Blowers - Check the blowers and motors weekly. Lubricate and perform other maintenance monthly as recommended by the manufacturer. Monthly, adjust motor couplings/ belt tension. Visually inspect and change, as necessary, Air filters on a monthly basis. Perform electrical maintenance annually.

• Condensate Knockout Tank – Inspect visually on a monthly basis. Make repairs and adjustments as per manufacturer's recommendations.

• Electrical - The contractor shall inspect and maintain the electrical components of the system to include motors, electric operators, the control panels, the electrical wireway, level controls, and switches. Electrical maintenance shall be performed quarterly and annually according to manufacturer recommendations. Electrical maintenance shall be performed by a licensed electrician.

• Gas Flare - Maintenance items include dampers and motors, spark-plug/ ignitor assembly, thermocouples, UV flame sensor, stack temperature gauges, switches, spark-plug/ignitor assemblies, etc. The gas flare shall be inspected weekly. Maintenance shall be performed monthly or as recommended by the manufacturer, and electrical maintenance shall be performed semi-annually.

• Natural Gas Connection - The propane gas system shall be inspected monthly. The inspections shall be performed by a mechanic and an electrician.

• Valves - Maintenance on valves shall be performed quarterly. Maintenance on the electrical operators and motors shall be as recommended above.

• Sediment Traps/Flame Arrestors - These units shall be inspected weekly for accumulation of liquids and solids. Sediments shall be removed as required.

• Piping - The piping shall be inspected for physical damage including cracking, chipping of paint, and rust. Defective sections shall be repaired. Chipping paint and rust shall be repaired immediately.

• Pilot Gas - The Contractor shall supply the pilot gas needed to operate the flare system pilot for the duration of the contract. The Contractor shall inspect the pilot gas level, on a regular basis and when necessary schedule and be present for propane deliveries.

• Wireless Monitoring Response - When the gas collection and combustion system is in operation, the Contractor shall be connected to the wireless monitoring system and be ready to respond upon receiving approval from the State. The Contractor shall contact the State in the event of an alarm. The Contractor shall be available immediately during business hours or the next business morning following non-business hours non-emergency alarms.

• Permit Compliance Sampling - Within 45 calendar days after initial startup of the gas venting system and quarterly thereafter, contractor shall perform sampling and reporting as required by the NJDEP Air Permit.

Costs for these activities including sampling and analysis for permit compliance shall be included in the year 1 O&M lump sum bid price and the year 2 monthly fee.

Task 13 - Final Lockout Inspection (2nd Year)

Thirty (30) days before contract expiration, the Contractor and NJDEP shall have a joint inspection of the site to prepare a punch list of items that shall be completed prior to the Contractor's departure. In general, the Contractor shall, unless otherwise directed or permitted in writing, tear down and remove all temporary buildings and structures built by him; shall remove all temporary work, tools, and machinery or other equipment furnished by him; shall remove all rubbish from any grounds which he has occupied; and shall leave the roads and all parts of the premises and adjacent property affected by his operations in a neat and satisfactory condition.

The Contractor shall thoroughly clean all materials installed by him and his subcontractors, and on completion of the contract shall deliver it undamaged and in fresh and new-appearing condition.

The Contractor shall restore or replace, when and as directed, any public or private property damaged by his work, equipment, or employees, to a condition at least equal to that existing immediately prior to the beginning of operations. To this end the Contractor shall do as required all necessary highway or driveway, walk, and landscaping work. Suitable materials, equipment, and methods shall be used for such restoration. The restoration of existing property or structures shall be done as promptly as practicable prior to contract expiration.

Task 14 – Settlement Monitoring (1st and 2nd Years)

During the final month of the first year, settlement monitoring shall be performed by a licensed surveyor. The elevations of survey marks on protective CMP rings at each gas well, condensate trap, and valve box shall be determined with respect to NAVD88 MSL to an accuracy of ± 0.01 ft. During the second year DEP shall have the option of directing the Contractor to repeat the settlement monitoring. In each instance, data will be reported by the Contractor in a spreadsheet to DEP including location, elevation, date surveyed, and comparison with previous elevations measured on the same mark.

Task 15 – Settlement Monitoring (1st Year)

Inclinometers shall be maintained throughout construction and for the first year of operation and maintenance. After that, Contractor may remove the inclinometer probes and data loggers.

During the first year of operation and mainatenace, the Contractor shall provide a copy of ADASS to the Engineer and NJDEP on a weekly basis for monitoring of inclinometer data.

4.2.2 Measurement and Payment

Payment will be made under:

Pay Item No.	Pay Item	Pay Unit
4.2.1	Operation and Maintenance-Post Construction, Year 1	Lump Sum
4.2.2	Operation and Maintenance-Post Construction, Year 2	Month
4.2.3	Settlement Monitoring, Year 1	Lump Sum
4.2.4	Settlement Monitoring, Year 2	Lump Sum
4.2.5	PVSC and KMUA Disposal Fees	Pass Through

For Operation and Maintenance – Post Construction, 1st Year payment shall be a lump sum bid price paid out in 12 monthly payments. For Operation and Maintenance-Post-Construction, 2nd Year, payment shall be on a per month basis. For Settlement Monitoring, Year 1, and Settlement Monitoring, Year 2, shall be a lump sum bid price paid out in one payment.

Thirty (30) days prior to contract expiration, NJDEP will perform an inspection of the site and adjacent property. Based on the inspection, the Contractor will be informed of any deficiencies. The deficiencies must be corrected prior to issuance of final payment.

For leachate disposal at KMUA and PVSC, the Contractor shall pay the disposal bills directly based on gallons measured at the MSLA 1D Landfill Metering Station, and shall be reimbursed by DEP from the Pass Through in Pay Item 4.2.5. The Contractor is allowed a 2% markup on the PVSC and KMUA disposal costs for management fees including costs of any utilities during the O&M period (i.e. electricity). After construction, only leachate from the leachate collection system will be produced and the costs for testing and reporting shall be included in the lump sum yearly

O&M bid price (disposal at PVSC will still be paid direct by the Contractor and reimbursed by NJDEP with a 2% markup allowed, based on the gallons measured at the MSLA 1D Landfill Pump Station). PVSC testing and reporting will be conducted by the Contractor in accordance with the PVSC/DEP Service Agreement (attached). It is noted that the PVSC/DEP Service Agreement language may be modified when the DEP receives the Service Agreement. The Contractor will be reimbursed by DEP for PVSC testing and reporting conducted quarterly as part of the O&M and will be paid for as part of Bid Item 4.2.1 and 4.2.2 after the initial reporting period.

END OF SECTION