APPENDIX O
TECHNICAL SPECIFICATIONS

APPENDIX O.1	PHASE III SPECIFICATIONS
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APPENDIX O.1
PHASE III SPECIFICATIONS

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TECHNICAL SPECIFICATIONS
LANDFILL UNIT B-18 PHASE III
KETTLEMAN HILLS FACILITY
KETTLEMAN CITY, CALIFORNIA

Prepared for:

Chemical Waste Management, Inc.
Kettleman Hills Facility
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SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

A. The section describes the general requirements for the construction of Phase III of Landfill Unit B-18 at the Kettleman Hills Facility located outside of Kettleman City, California. The Work will consist of excavation, engineered fill placement, subgrade preparation, installation of a double-composite geosynthetic sideslope liner system, placement of operations layer soil, extending sideslope riser pipes, and installing surface water drainage structures.

1.02 CONTRACTOR'S RESPONSIBILITIES:

A. Start, lay out, construct, and complete the Project in accordance with the Contract Documents;

B. Provide a competent superintendent, capable of reading and understanding the Contract Documents, who shall receive instructions from the OWNER or his authorized representative. The superintendent shall have full authority to execute the Work in accordance with the Contract Documents;

C. The CONTRACTOR shall be responsible for transporting, permitting, and/or conveying all required construction water.

D. Pay costs of legally required sales, consumer, and use taxes, and governmental fees.

E. Forward submittals and communications to the CONSTRUCTION MANAGER. Where applicable, the CONSTRUCTION MANAGER will coordinate submittals and communications with the representatives who will give approvals and directions through the CONSTRUCTION MANAGER.

F. Maintain order, safe practices and proper conduct at all times among CONTRACTOR's employees. The OWNER, and its authorized representative, may require that disciplinary action be taken against an employee of the CONTRACTOR for disorderly, improper, and unsafe conduct. Should an employee of the CONTRACTOR be dismissed from his duties for misconduct, incompetence, or unsafe practice, or combination thereof, that employee should not be rehired for the duration of the Work.

G. Coordinate prosecution of the Work with the utilities, private utilities, or OWNER performing work on or adjacent to the work site; either eliminate, or minimize as far as possible, delays in the Work and conflicts with those utilities or contractors. Coordinate utility activities, and activities of OWNER, with the CONSTRUCTION MANAGER. Schedule private utility and public utility work relying on survey points, lines, and grades established by the CONTRACTOR to occur immediately after those points, lines and grades have been established. Confirm coordinate

measures for each individual case with the CONSTRUCTION MANAGER by memorandum.

J. Coordinate activities of the several trades, suppliers, and subcontractors, if any, performing the Work.

K. Obtain all necessary building and construction permits. Permit fees will be paid by the OWNER.

1.03 RESERVED

1.04 CONFORMANCE

A. Work shall conform to the following Drawings that form a part of these Contract Documents.

SHEET NO.	TITLE
T-1	TITLE SHEET
C-1	SITE PLAN
C-2	EXISTING CONDITIONS (AS OF MARCH 28, 2008)
C-3	BASE LINER PLAN
C-4	FINAL CLOSURE PLAN
C-5	CROSS-SECTIONS A TO D
C-6	CROSS-SECTIONS E TO I
C-7	PHASE III BASE LINER CONSTRUCTION DETAILS
C-8	PHASE III LCRS DETAILS
C-9	DRAINAGE DETAILS
C-10	CLOSURE DETAILS

1.05 DEFINITIONS

OWNER — The term OWNER means Kettleman Hills Facility with whom the CONTRACTOR has entered into the Agreement and for whom the Work is to be provided.

CONSTRUCTION MANAGER — The term CONSTRUCTION MANAGER means the representative of the OWNER for the purpose of administration and inspection of the Work. The CONSTRUCTION MANAGER may be a member or group of the staff or may be an external firm. The OWNER will inform the CONTRACTOR in writing at the start of the Work who the CONSTRUCTION MANAGER will be. During the period of Work the CONSTRUCTION MANAGER will act as an authorized representative of the OWNER.

DESIGN ENGINEER — The term DESIGN ENGINEER means Golder Associates Inc., the firm responsible for the design and preparation of the construction drawings and specifications. The

	DESIGN ENGINEER is responsible for approving all design changes, modifications, or clarifications encountered during construction.
CQA CONSULTANT	The term CQA CONSULTANT means the representative of the OWNER for the purpose of conducting CQA testing, monitoring, documenting, and reporting.
CONTRACTOR	The term CONTRACTOR means the firm that is responsible prosecuting the Work. The CONTRACTOR's responsibilities include the Work of any and all subcontractors and suppliers.
Geosynthetics CONTRACTOR	The term Geosynthetics CONTRACTOR means the firm that is responsible for the supply and installation of all geosynthetics including the Work of all of the subcontractors and suppliers. The Geosynthetics Installer may work directly for the OWNER or as a subcontractor to the CONTRACTOR. The Geosynthetics CONTRACTOR is also referred to as the CONTRACTOR.
Work	The term Work means the entire completed construction or various separately identifiable parts, thereof, required to be furnished under the Contract Documents. Work includes any and all labor, services, materials, equipment, tools, supplies, and facilities required by the Contract Documents and necessary for the completion of the project. Work is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.
Working day	A calendar day, exclusive of Saturdays, Sundays, and OWNER's recognized legal holidays, on which weather and other conditions not under the control of the CONTRACTOR will permit construction operations to proceed for the major part of the day with the normal working force engaged in performing the controlling item or items of work which would be in progress at that time. The working day is subject to the conditions and work restrictions outlined in these Specifications.
Regular Working Hours	Between 6:30 a.m. and 6:00 p.m. on allowable work days.

Calendar Days	Each day of the year including all OWNER approved holidays.

1.06 CONTRACT TIMES

A. The CONTRACTOR shall commence Work in accordance with Section 18 of the General Conditions and Section 7 of the Standard Contract.

1.07 CONTRACTOR USE OF WORK SITE

A. Confine work site operations to areas permitted by law, ordinances, permits, and the Contract Documents. The CONTRACTOR shall ensure that all persons under his control (including Subcontractors, their workers and agents) are kept within the boundaries of the Site and shall be responsible for any acts of trespass or damage to property by persons who are under his control. Consider the safety of the Work, and that of people and property on and adjacent to work site, when determining amount, location, movement, and use of materials and equipment on work site.

B. The CONTRACTOR shall be responsible for protecting private and public property including pavements, drainage culverts, electricity, highway, telephone and similar property and making good of, or paying for, all damage caused thereto. Control of erosion throughout the project is of prime importance and is the responsibility of the CONTRACTOR. The CONTRACTOR shall comply with the requirements of the Storm Water Pollution Prevention Plan (SWPPP) provided by the OWNER for the Kettleman Hills Facility and prepare and submit a SWPPP specific to the Work in accordance with requirements of local or state agencies (see Section 01300). The CONTRACTOR shall provide and maintain all necessary measures to control erosion during progress of the Work to the satisfaction of the CONSTRUCTION MANAGER and all applicable Laws and Regulations and remove such measures and debris upon completion of the project. All provisions for erosion and sedimentation control apply equally to all areas of the Work.

C. CONTRACTOR shall promptly notify OWNER and CONSTRUCTION MANAGER in writing of any subsurface or latent physical conditions at the Site which differ materially from those indicated or referred to in the Contract Documents. CONSTRUCTION MANAGER will promptly review those conditions and advise OWNER in writing if further investigations or tests are necessary. Promptly thereafter, OWNER shall obtain the necessary additional investigations and tests and furnish copies to the CONSTRUCTION MANAGER and CONTRACTOR. If CONSTRUCTION MANAGER finds that the results of such investigations or tests indicate that there are subsurface and latent physical conditions which differ materially from those intended in the Contract Documents, and which could not reasonably have been anticipated by CONTRACTOR, a Change Order shall be issued incorporating the necessary revisions.

1.08 PRESERVATION OF SCIENTIFIC INFORMATION

A. Federal and State legislation provides for the protection, preservation, and collection of data having scientific, prehistoric, historical, or archaeological value (including relics and specimens) which might otherwise be lost due to alteration of the terrain as a result of any construction work.

B. If evidence of such information is discovered during the course of the Work, the CONTRACTOR shall notify the CONSTRUCTION MANAGER immediately, giving the location and nature of the findings. Written confirmation shall be forwarded within two (2) working days. The CONTRACTOR shall exercise care so as not to damage artifacts uncovered during excavation operations, and shall provide such cooperation and assistance as may be necessary to preserve the findings for removal or other disposition by the OWNER's representative or Government agency.

C. Where appropriate, by reason of a discovery, the OWNER may order delays in the time of performance, or changes in the Work, or both. If such delays, or changes, or both, are ordered, the time of performance and contract price shall be adjusted in accordance with the applicable clauses of the Contract.

1.09 EXISTING UTILITIES

A. The CONTRACTOR shall be responsible for locating, protecting, flagging, and identifying all existing utilities. The CONTRACTOR shall request that Underground Service Alert (USA) locate and identify the existing utilities. The request shall be made 48 hours in advance.

B. Costs resulting from damage to utilities shall be borne by the CONTRACTOR. Costs of damage shall include repair and incidental costs resulting from the unscheduled loss of utility service to affected parties.

C. The CONTRACTOR shall immediately stop work and notify the CONSTRUCTION MANAGER of all utilities encountered or damaged. The CONTRACTOR shall also provide the CONSTRUCTION MANAGER with the exact location of any utilities encountered during construction.

D. If specified by the CONSTRUCTION MANAGER, utility pot holes shall be carefully dug by the CONTRACTOR to identify the presence of underground utilities.

E. Damage to utilities by the CONTRACTOR during pothole operations shall be born by the CONTRACTOR.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

SECTION 01032

INTENT OF DRAWINGS AND SPECIFICATIONS

PART 1 GENERAL

1.01 CONTRACT DRAWINGS ASND SPECIFICATIONS

A. The intent of the Drawings and Specifications is to prescribe a complete work which the CONTRACTOR shall perform in a manner acceptable to the OWNER and in full compliance with the terms of the Contract.

B. The Drawings show general arrangements for the work which shall be used by the CONTRACTOR in the preparation of shop and field drawings. Particular care shall be given to all layouts to make sure all equipment is accessible for operation.

C. The CONTRACTOR shall provide the OWNER with a complete and operable system, even though the Drawings and Specifications may not specifically call out all items of work required of the CONTRACTOR to complete his tasks, incidental appurtenances, materials, and the like and maintenance.

D. The CONTRACTOR is to perform the Work in accordance with the cross-sections, thickness, gradients and dimensions shown on the Drawings. Any deviations must be approved by the DESIGN ENGINEER prior to doing the work.

E. The dimensions on the Drawings are presumed to be correct, but the CONTRACTOR shall be required to check carefully all dimensions prior to beginning the Work. If errors or omissions are discovered by the CONTRACTOR, the CONTRACTOR shall immediately notify the CONSTRUCTION MANAGER in writing and await the CONSTRUCTION MANAGER's notification before proceeding.

1.02 PRECENDENCE OF CONTRACT DOCUMENTS

A. If there is a conflict between Contract Documents, the document highest in precedence shall control. The precedence, unless otherwise stipulated by the OWNER, shall be:

1. Permits.
2. Special Provisions.
3. General Terms and Conditions.
4. Construction Drawings.
5. Technical Specifications.
6. Construction Quality Assurance (CQA) Plan.

1.03 CHANGES TO DRAWINGS, SPECIFICATIONS AND CQA PLAN

A. It is inherent in the nature of construction that some changes in the Drawings, Specifications, and/or CQA Plan may be necessary during the course of construction to adjust them to field conditions, and it is the essence of the Contract to recognize a normal and expected margin of change. The CONSTRUCTION MANAGER shall have the right to make such changes, from time to time, in the Drawings, in the character of the Work as may be necessary or desirable to insure the completion of the Work in the most satisfactory manner without invalidating the Contract.

B. Design and specification changes will only be made with written agreement of the Design Engineer, Owner and Contractor. Design and specification changes which affect the containment or environmental controls shall also require approval of the Regional Water Quality Control Board (RWQCB).

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.01 SUBMITTAL PROCEDURES

A. Transmit each submittal with cover letter to the OWNER.

B. Each submittal shall have a unique submittal number.

C. Submittals shall be numbered sequentially. Re-submittals shall have original number with an alphabetic suffix (A, B, C, etc.) to indicate the sequence of the re-submittal.

D. Identify Project, CONTRACTOR, Subcontractor or supplier; pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.

E. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

F. Provide space for DESIGN ENGINEER and/or CQA CONSULTANT review stamps.

G. Revise and resubmit submittals as required, identify all changes made since previous submittal.

H. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

I. When catalog pages are submitted, applicable items shall be clearly identified.

J. An electronic copy (preferred) or three (3) hard copies of each submittal shall be provided to the OWNER. The OWNER will not accept submittals from anyone other than the CONTRACTOR.

K. The CONTRACTOR shall review all submittal packages prior to transmittal to OWNER for completeness and accuracy.

1.02 CHECK OF RETURNED SUBMITTALS AND WAIVER OF CLAIMS

A. The CONTRACTOR shall check and review the submittals returned for correction and ascertain whether the required corrections result in extra cost above that included in the Contract, and shall give written notice to the CONSTRUCTION MANAGER within five (5) working days if, in the CONTRACTOR's estimation, extra costs result from the corrections. The CONTRACTOR's failure to give such written notice before the starting of the Work covered by returned submittal constitutes a waiver by the CONTRACTOR of claims for extra costs resulting from required corrections. Payment based on such written notice is not approved until authorized by the OWNER.

1.03 PRODUCT DATA SUBMISSION

A. For each product item included in the Work, include the manufacturer's name and address, the trade or brand name, all conditions of manufacturer's guarantee and warranty, information to fully describe each item, and supplementary information as may be required for approval. Mark catalog cuts, brochures, and data to indicate the items proposed and the intended use. Clearly mark product parameters which were specifically called out on the original specifications.

1.04 EQUIPMENT DATA SUBMISSION

A. Submit complete technical, performance, and catalog information for every item of civil, mechanical, and electrical equipment and machinery proposed for installation in the Work. Include information on performance and operating curves, ratings, capacities, characteristics, power efficiencies, manufacturers' standard guarantees and warranties with the terms and conditions fully described, and all other information to fully illustrate and describe the items as may be specified or required for approval.

1.05 SUBMITTAL REVIEW AND ACCEPTANCE

A. The submittal review period shall be ten (10) consecutive work days in length and shall commence on the first working day immediately following the date of arrival of the submittal or re-submittal in the OWNER's office. The time required for mail delivery of the submittal or re-submittal back to the CONTRACTOR shall not be considered a part of the submittal review period.

B. The acceptance of drawings and data submitted by the CONTRACTOR will cover only general conformity to the Drawings and Specifications, external connections, and dimensions which affect the layout. The DESIGN ENGINEER's and/or CQA CONSULTANT's review of submittals shall not relieve the CONTRACTOR from responsibility for errors, omissions, or deviations, nor responsibility for compliance with the contract documents.

1.06 RE-SUBMITTALS

A. When the drawings and data are returned marked "AMEND AND RESUBMIT" or "REJECTED, SEE REMARKS," the corrections shall be made as noted thereon and as instructed by the DESIGN ENGINEER's and/or CQA CONSULTANT's and shall be resubmitted.

B. When corrected copies are resubmitted, the CONTRACTOR shall highlight or otherwise direct specific attention to all revisions and shall list separately those revisions made other than those called for on previous submissions.

C. The need for more than one resubmission shall not entitle the CONTRACTOR to extension of the Contract Time.

1.07 COSTS FOR SUBMITTALS

A. All costs for the preparation, correction, and delivery of the submittals are considered incidental to the contract and shall be included in CONTRACTOR's costs.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 MATERIALS REQUIRING SUBMITTALS

A. The following materials shall require submittals.

1. Material certifications and product data for all geosynthetics;
2. Material quality control data for all geosynthetics;
3. Material certifications and product data for piping;
4. Material quality control data for piping; and
5. Items not fully detailed and specified in the Contract Drawings or these Specifications.

3.02 ITEMS NOT REQUIRING SUBMITTALS

A. A submittal is not required for products and equipment completely specified or salvaged on-site. A submittal is required if the product has not been completely specified or when the specified product is not available within the construction schedule. Substitutions requested by the CONTRACTOR require a submittal.

3.03 CONSTRUCTION SCHEDULE

A. At the pre-construction meeting, the CONTRACTOR shall submit to the CONSTRUCTION MANAGER for review a schedule of the proposed construction operations. The construction schedule shall indicate the sequence of the Work indicating the time of completion of each component of the Work.

B. Submit initial progress schedule in duplicate within ten (10) days after Effective Date of Agreement for CONSTRUCTION MANAGER to review.

C. Revise and resubmit as required.

D. Submit revised schedules with each Application for Payment, identifying changes since previous version.

E. Submit a horizontal bar chart with separate line for each major section of Work or operation, identifying first work day of each week. Include on the bar chart construction/placement rates for all the major items of Work. CONTRACTOR shall develop proposed Construction Schedule on basis of a five or six day working week. Sufficient labor, equipment, and materials shall be provided by CONTRACTOR to complete the Work on a five or six day per week basis. Night work and work on Sundays will only be approved by the OWNER if the Work falls behind the approved Construction Schedule.

F. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the start date, finish date, and duration. At a minimum, the following activities must be shown on the project schedule:

1. Mobilization;
2. Excavation;
3. Subgrade preparation;
4. Placement of the clay liner;
5. Installation of the geomembranes;
6. Installation of the geocomposites;
7. Placement of the operations layer soil;
8. Construction of surface water controls;
9. Construction of new riser pipes and pads; and
10. Demobilization and site clean-up.

G. Indicate estimated percentage of completion for each item of Work at each submission with Application for Payment.

H. Indicate submittal dates required for shop drawings, product data, samples and product delivery dates.

I. The Construction Schedule as approved by the OWNER will be an integral part of the Contract, and will establish interim Contract completion dates for various activities. Should an activity not be completed within ten (10) days after the stated Schedule date, the CONSTRUCTION MANAGER shall have the option to recommend to the CONTRACTOR to expedite completion of the activity by whatever means deemed appropriate and necessary, without additional compensation to the CONTRACTOR.

J. Should any activity be twenty (20) or more working days behind Schedule, the OWNER shall have the right to perform the activity or to have the activity performed by whatever method the OWNER deems appropriate. Costs incurred by the OWNER in connection with expediting construction activities under this Paragraph shall be reimbursed to the OWNER by the CONTRACTOR.

K. It is expressly understood and agreed that failure by the OWNER to exercise the option to either order the CONTRACTOR to expedite an activity or to expedite the activity by other means shall not be considered precedent-setting for any other activities. The Work shall be executed in strict accordance with the Construction Schedule unless a variance has been received by the CONSTRUCTION MANAGER and approved by the OWNER.

3.04 PROGRESS REPORTS

A. The CONTRACTOR shall submit progress reports as requested indicating work performed and completed that week, quantity of material used, and equipment used to perform the Work.

B. A progress report shall also be furnished to the ENGINEER with each application for progress payment. If the Work falls behind schedule, the CONTRACTOR shall submit additional progress reports at such intervals as the CONSTRUCTION MANAGER may request.

C. Each progress report shall include sufficient narrative to describe current and anticipated delaying factors, their effect on the construction schedule, and proposed corrective actions.

Work reported complete, but which is not readily apparent as complete to the CONSTRUCTION MANAGER, must be substantiated with satisfactory evidence.

D. Each progress report shall also include a graphic schedule marked to indicate actual progress. Revised schedules shall be included when warranted.

3.05 MANUFACTURER'S CERTIFICATES

A. When specified in individual Specification Sections, submit manufacturers' certificate to the CQA CONSULTANT for review, in quantities specified for Product Data.

B. Indicate whether material or product conforms to or exceeds specified requirements. Submit supporting reference date, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to the CONSTRUCTION MANAGER.

3.06 RECORD SURVEY AND DRAWINGS

A. The CONTRACTOR shall keep a set of construction drawings on the job and mark in red pencil the as-built conditions.

B. A complete and accurate set of record drawings shall be signed and dated by the CONTRACTOR and shall be labeled with the following, "These record drawings completely and truly represent the contract work as installed."

C. Record drawings shall be delivered to the CONSTRUCTION MANAGER prior to final acceptance of the work by the CONSTRUCTION MANAGER.

D. Record drawings shall show all changes in "clouds" to clearly identify any deviations from the plans.

E. Any utilities uncovered during construction shall be identified on the record drawings.

F. The record survey shall be performed by the CONTRACTOR in accordance with Section 01400, Part 1.04 and shall meet the requirements of these Specifications and the CQA Plan and include, but not be limited to:

1. edges, bottom, and limits of anchor trenches;
2. limits of excavation and fill;
3. final subgrades (including geologic mapping developed by CQA Consultant);
4. top of compacted clay liner;
5. HDPE geomembrane panel layouts and intersections;
6. destructive seam test locations on HDPE geomembranes;
7. location and crown elevations of piping;
8. top of operations layer soil;
9. grade breaks;
10. appurtenant structures (e.g., riser pads); and
11. layout and flow line elevations of surface water control structures.

G. Survey of the excavated subgrades (including geologic mapping), Clay Liner, and Operations Layer surfaces shall be on a grid with a maximum spacing of 50 feet or an equivalent method approved by the CQA CONSULTANT, with additional elevations at slope change locations. The elevations for the subgrade, top of Clay Liner, and top of Operations Layer shall be at the same grid locations and shall be used to document thickness conformance. The record survey shall include locations and elevations of all other work as directed by the CONSTRUCTION MANAGER.

H. Record drawings shall be prepared to scale, with the scale clearly marked. Record drawings of details may not be to scale, but all dimensions shall be clearly identified. Record drawings shall be submitted to the CQA CONSULTANT for review and approval. Record drawings shall be provided on Bond and electronically in AutoCAD 2005 format or more recent. The DESIGN ENGINEER will provide the base AutoCAD file map. Different elements of the work shall be presented on different layers in the base AutoCAD file provided by the DESIGN ENGINEER.

3.07 HEALTH AND SAFETY PLAN

A. The CONTRACTOR shall submit a Health and Safety Plan in accordance with Section 01810 of these Specifications.

3.08 STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

A. The CONTRACTOR shall prepare and submit a SWPPP specific to the work to the OWNER for approval. The SWPPP shall be consistent with the provisions of the "California Construction Best Management Practice Handbook," the site National Pollutant Discharge Elimination System (NPDES) site permit, and the Kettleman Hills Facility SWPPP. The SWPPP shall include specific measures to protect the Work and comply with the regulations, including specific erosion and sediment controls. The CONTRACTOR is responsible to control storm water run-on, run-off, erosion, and sediment to such an extent as needed to maintain compliance with the SWPPP and protect the Work, protect adjacent landfill operations, and adjacent structures.

END OF SECTION

SECTION 01400

CONSTRUCTION QUALITY CONTROL

PART 1 GENERAL

1.01 CONSTRUCTION QUALITY CONTROL

A. The CONTRACTOR shall be responsible for construction quality control of the Work and all appurtenances as described in these Specifications.

B. The CONTRACTOR shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

C. The CONTRACTOR shall comply fully with manufacturers' instructions, including each step in sequence.

D. Should manufacturers' instructions conflict with Contract Documents, the CONTRACTOR shall request clarification from CONSTRUCTION MANAGER before proceeding.

E. The CONTRACTOR shall comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

F. The CONTRACTOR shall perform work using persons qualified to produce workmanship of specified quality.

G. The CONTRACTOR shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

H. The CONSTRUCTION MANAGER shall determine and decide all questions which may arise as to the quality and acceptability of materials and Work performed; the manner of performance and the rate of progress of said Work; the interpretations of the Contract Documents relating to the Work; the acceptable fulfillment of the Contract Documents on the part of the CONTRACTOR; and the amount and quantity of the several kinds of Work performed and materials which are to be paid for under the Contract.

I. All materials and equipment shall be new and of the specified quality and equal to the samples found to be acceptable by the CQA CONSULTANT, if samples have been submitted.

J. The Work shall be done and completed in a thorough, workmanlike manner, notwithstanding omissions in the Contract Documents; and it shall be the duty of the CONTRACTOR to call the CONSTRUCTION MANAGER's attention to apparent errors or omissions and request instructions in writing before proceeding with the Work.

K. The CONSTRUCTION MANAGER may, by appropriate written instructions, correct errors and omissions. Instructions and corrections shall be as binding upon the CONTRACTOR as though contained in the original Contract Documents.

1.02 CONSTRUCTION QUALITY ASSURANCE

A. Materials, equipment, methods of construction and workmanship shall be subject to the inspection of the CQA CONSULTANT as outlined in the CQA Plan. Defective materials, equipment, or work shall be replaced, corrected or otherwise made good by the CONTRACTOR at the CONTRACTOR's own expense.

B. On all questions concerning the acceptability of materials or equipment, execution of the Work, and the determination of costs, the decision of the CONSTRUCTION MANAGER shall be final and binding upon all parties.

C. The CONTRACTOR shall at all times maintain proper facilities and provide safe access to all parts of the Work, to the shops wherein the Work is in preparation, and to all warehouses and storage yards wherein materials and equipment are stored, for purposes of inspection by the CQA CONSULTANT.

D. The CONTRACTOR shall provide incidental labor and facilities to provide access to 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.

E. Notify CQA CONSULTANT 24 hours prior to expected time for operations requiring inspection services.

F. Retesting required because of non-conformance to specified requirements shall be performed by the CQA CONSULTANT on instructions by the CONSTRUCTION MANAGER. Payment for retesting will be charged to the CONTRACTOR by deducting inspection or testing charges from the Contract Price.

G. Employment of CQA CONSULTANT by OWNER shall in no way relieve the CONTRACTOR of obligations to perform Work in accordance with requirements of Contract Documents.

1.03 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual Specification Sections, required material or Product suppliers or manufacturers shall provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, and quality of workmanship as applicable, and to initiate instructions when necessary.

B. Individuals shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

1.04 SURVEYING

A. At least two control monuments shall be established by the CONTRACTOR at locations convenient for daily tie-in. The vertical and horizontal controls for these

control points shall be established within normal land surveying standards. The CONTRACTOR shall use these control points in laying out and providing ongoing geometric control of the work. The control monuments shall be shown on all record drawings.

B. Surveying shall be performed under the direct supervision of a licensed land surveyor or registered civil engineer authorized to practice land surveying under Chapter 15, Article 3, Section 8731 of the Professional Engineering Act of California, as amended January 1, 1992 who may also be the senior surveyor on site. The survey crew shall consist of the senior surveyor and as many surveying assistants as required to satisfactorily undertake the work. Personnel shall be experienced in all aspects of surveying, including detailed, accurate documentation.

C. The survey instruments used for this work shall be sufficiently precise and accurate to meet the needs of the project. Survey instruments shall be capable of reading to a precision of 0.01 feet and with a setting accuracy of 10 seconds. Calibration certificates for survey instruments shall be submitted on request to the CQA CONSULTANT prior to the initiation of surveying activities.

D. It shall be the CONTRACTOR's sole responsibility to control the Work so that all of the geometric requirements of the project are met. The CONTRACTOR shall immediately notify the CONSTRUCTION MANAGER and the CQA CONSULTANT of any discrepancy found in the Work. It will be the CONSTRUCTION MANAGER's sole prerogative to approve or reject work which does not meet the requirements contained in these Specifications and the Drawings, but which, in the CONSTRUCTION MANAGER's sole opinion, may nevertheless meet the intention of the Contract Documents.

E. The CONTRACTOR shall be responsible for the accuracy of all work and shall maintain all reference points, stakes, etc., throughout the life of the project. Damaged or destroyed points, bench marks or stakes, or any reference points made inaccessible by the progress of the construction shall be replaced or transferred by the CONTRACTOR. Any of the above points shall be referenced by ties to acceptable objects and recorded. Any alternations or revisions in the ties shall be so noted and the information furnished to the CONSTRUCTION MANAGER immediately. All computations necessary to establish the exact position of the work from control points shall be made and preserved by the CONTRACTOR. All computations, survey notes and other records necessary to accomplish the work shall be neatly made and shall be made available onsite for review by the CQA CONSULTANT.

F. During the progress of the construction work, the CONTRACTOR shall be required to furnish all of the surveying and state-out incidental to the proper location by line and grade for each phase of the work. For any operation requiring extreme accuracy, the CONTRACTOR shall restake with pins or other acceptable hubs located directly adjacent to the work at a spacing approved by the CONSTRUCTION MANAGER.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

SECTION 01402

CONTROL OF WORK

PART 1 GENERAL

1.01 AUTHORITY OF THE CONSTRUCTION MANAGER

A. The CONSTRUCTION MANAGER will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed; all questions which may arise as to the interpretation of the Drawings and Specifications; and all questions as to the satisfactory and acceptable fulfillment of the Contract on the part of the CONTRACTOR.

B. The OWNER shall have the authority to stop the Work if odor or dust becomes a nuisance.

1.02 AUTHORITY OF THE CQA CONSULTANT

A. The CQA CONSULTANT employed by the OWNER shall be authorized to monitor all work done and materials and equipment furnished. Such monitoring may extend to all or part of the Work, and to the preparation, fabrication, or manufacture of the materials and equipment to be used. The CQA CONSULTANT will not alter or waive the provisions of the Contract Documents.

B. The CQA CONSULTANT will keep the CONSTRUCTION MANAGER informed as to the progress of the Work and the manner in which it is being done; also, the CQA CONSULTANT will call the CONTRACTOR's attention to non-conformance with the Contract Documents that the CQA CONSULTANT may have observed. The CQA CONSULTANT will not approve or accept any portion of the Work, issue instructions contrary to the Contract Documents, or act as foreman for the CONTRACTOR. The CQA CONSULTANT may reject defective materials, equipment, or work subject to final decision of the CONSTRUCTION MANAGER.

C. The CONSTRUCTION MANAGER may delegate additional authority to the CQA CONSULTANT. In such cases, the CONSTRUCTION MANAGER will notify the CONTRACTOR of such action.

1.03 COORDINATION AND INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. The Specifications, General Conditions, Special Conditions, CQA Plan, Contract Change Orders, and all supplementary documents are essential parts of the Contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be coordinated and to describe and provide for a complete work.

B. Should it appear that the Work or other matters relative thereto are not sufficiently detailed or explained in the Contract Documents, the CONTRACTOR shall apply to the CONSTRUCTION MANAGER for such further explanations as may be necessary and shall conform to them as part of the Contract.

C. In the event of a doubt or question arising regarding the true meaning of the Contract Document, reference shall be made to the CONSTRUCTION MANAGER, whose decision thereon shall be final.

D. In the event of a discrepancy between a drawing and the figures written thereon, and/or the Drawings and the Specifications, the CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing and wait for approval before proceeding. Scaled dimensions shall not be used in the performance of the Work.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 PERFORMANCE REQUIREMENTS

A. The CONTRACTOR shall furnish the CONSTRUCTION MANAGER with every reasonable facility for ascertaining whether or not the Work as performed is in accordance with the requirements and intent of the Specifications and Contract.

B. Should a work be covered before acceptance or consent of the CONSTRUCTION MANAGER, it must, if required by the CONSTRUCTION MANAGER, be uncovered for examination at the CONTRACTOR's expense.

END OF SECTION

SECTION 01565

TEMPORARY FACILITIES

PART 1 GENERAL

1.01 SUMMARY

A. The CONTRACTOR shall provide all temporary facilities and utilities required for prosecuting the Work, protection of employees and the public, protection of the Work from damage by fire, weather or vandalism, and such other facilities as may be specified or required by an applicable law, ordinance, rule, or regulation.

B. The CONTRACTOR must provide their own office space for their needs if necessary. The location of the office shall be approved by the OWNER.

1.02 ELECTRICAL SERVICE

A. Electrical power is not available at the site. The CONTRACTOR shall arrange for temporary electric connection or supply a generator capable of providing the power required to operate tools or equipment or to provide area lighting as needed. Temporary power whether supplied by a utility company or by a generator shall conform to the requirements of the 1993 National Electrical Code, the 1993 National Electrical Safety Code, and all applicable national standards, local regulations and ordinances.

B. The allowable hours of generator operation is the same as the regular working hours for the project. All generators shall be fitted with a residential quality muffler.

1.03 FIRST AID

A. First aid kits meeting the minimum requirements of the Occupational Safety and Health Administration shall be provided in a readily accessible location or locations indicated in the CONTRACTOR's Health and Safety Plan as outlined in Section 01810 of these Specifications.

1.04 CONSTRUCTION FACILITIES

A. Construction hoists, elevators, scaffolds, stages, shoring and. similar temporary facilities shall be of ample size and capacity to adequately support and move the loads to which they will be subjected. Railings, enclosures, safety devices, and controls required by law or for adequate protection of life and property shall be provided.

1.05 STAGING AND SHORING

A. Temporary supports shall be designed with an adequate safety factor to assure stability and adequate load bearing capacity.

B. Trenches greater in depth than four (4) feet shall be shored or sloped according to OSHA requirements.

1.06 TEMPORARY ENCLOSURES

A. When any activity hazardous to property or the health of employees and the public is in progress, the area of activity shall be enclosed adequately to contain the dust, overspray, or other hazard. In the event there are not permanent enclosures in the area, or such enclosures are incomplete or inadequate, the CONTRACTOR shall provide suitable temporary enclosures.

1.07 WARNING DEVICES AND BARRICADES

A. The CONTRACTORs shall adequately identify and guard all hazardous areas, holes, pits, and conditions by visual warning devices and physical barriers. Such devices shall, as a minimum, conform to the requirements of OSHA and Cal-OSHA.

1.08 HAZARDS IN PUBLIC ACCESS AREAS

A. Trenches and other essentially continuous excavations in public access areas, running parallel to the general flow of traffic, shall be marked at reasonable intervals by traffic cones, barricades, or other suitable visual markers during daylight hours. During hours of darkness, these markers shall be provided with either torches, flashers or other adequate lights.

1.09 FIRE EXTINGUISHERS

A. A sufficient number of fire extinguishers of the type and capacity required to protect the site and ancillary facilities shall be provided in readily accessible locations.

1.10 ODOR CONTROL

A. The CONTRACTOR shall comply with the provisions for control of odor and emissions as required by the MDAQMD or the OWNER.

1.11 SANITATION FACILITIES

A. CONTRACTOR shall provide and maintain ample field latrines and ablution accommodations in accordance with OSHA requirements for all workers employed on the project under the contract. Field latrines and ablution accommodations shall be provided and maintained in a sanitary condition at all times during the work on this project.

1.12 MATERIAL STORAGE

A. A materials storage area shall be designated to the CONTRACTOR by the CONSTRUCTION MANAGER. The CONTRACTOR is responsible for security of all of his materials and equipment.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

SECTION 01810

SAFETY PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. This section establishes minimum safety requirements and guidelines for the performance of the Work.

B. The CONTRACTOR is advised that decomposing waste produces landfill gas which is potentially flammable or explosive.

C. The CONTRACTOR shall submit a Health and Safety Plan and a copy of their Injury and Illness Prevention Program to the OWNER for review prior to beginning work.

D. The CONTRACTOR shall hold mandatory daily tailgate safety meetings on the site, as well as formal weekly safety meetings.

1.02 GENERAL REQUIREMENTS

A. The CONTRACTOR shall have sole responsibility and liability for the safety, efficiency, and adequacy of the CONTRACTOR's personnel, equipment and methods, and for any damage or injury resulting from their failure, or improper maintenance, use, or operation.

B. The CONTRACTOR shall be solely and completely responsible for the conditions at the Work area arising from the CONTRACTOR's execution of the Work. This requirement shall apply continuously and not be limited to normal working hours.

C. The CONTRACTOR shall provide all personnel working on the project with orientation and training on the potential hazards anticipated and the appropriate use of safety equipment.

D. Neither the OWNER nor the CONSTRUCTION MANAGER shall have liability resulting from injury or death to CONTRACTOR's employees or subcontractors and their employees.

E. A health and safety officer, employed by the CONTRACTOR, shall be present at all times during construction of underground facilities. The health and safety officer may be the site superintendent or other responsible regular employee of the CONTRACTOR provided he has had special health and safety training, and shall have responsibility for the enforcement of the Health and Safety Plan, particularly as it applies to drilling activities. The health and safety officer shall be identified by name in the Health and Safety Plan.

F. Many gases are heavier than air and settle in low areas such as trenches and excavations, therefore additional precautions shall be observed in these areas. Specifically, the need for constant O_2 monitoring, forced ventilation, combustible gas monitoring, VOC monitoring, respiratory protective equipment, etc. shall be

determined by the CONTRACTOR. The CONSTRUCTION MANAGER may impose additional requirements when deemed necessary for worker safety.

1.03 HEALTH AND SAFETY PLAN

A. The CONTRACTOR shall develop and maintain for the duration of work activities at the site, a written, site specific Health and Safety Plan for landfill operations that will effectively incorporate and implement all applicable requirements. The plan will meet the requirements of CCR Title 8 Section 5192.

B. In addition to requirements set forth in other sections, the CONTRACTOR's Health and Safety Plan shall contain provisions for aspects of protection against bodily injury from heavy construction equipment, tools and equipment required to construct the system.

C. The Health and Safety Plan shall include the location and route to the nearest hospital or emergency facility. All CONTRACTOR employees and subcontractors working on the project shall be thoroughly familiar with the emergency route.

D. In the event the Health and Safety Plan is determined by the CONSTRUCTION MANAGER, OWNER or the State or Federal Regulatory Agencies to be inadequate to protect the employees and the public, the plan shall be modified prior to the beginning of the Work to meet the minimum requirements of the OWNER or the State or Federal Regulatory Agencies at no additional cost to the OWNER.

E. Acceptance of the CONTRACTOR's Health and Safety Plan by the OWNER does not release the CONTRACTOR of liability in the event of an accident or injury, nor does it place any liability on the CONSTRUCTION MANAGER or OWNER.

F. Provisions shall be made to protect against ingestion, absorption or inhalation of hazardous compounds and for the handling of refuse in a safe, sanitary, and proper manner.

G. The CONTRACTOR's Health and Safety Plan shall contain trenching and excavation safety guidelines particular to landfill work.

1.04 REGULATORY REQUIREMENTS

A. The CONTRACTOR shall comply with provisions of safety regulatory bodies including, but not necessarily limited to:

1. OSHA/Cal-OSHA regulations for construction
2. 29 Code of Federal Regulations (CFR) 1926/1910 and CFR 1910.120
3. Title 8 California Code of Regulations, in particular Section 5192.
4. All other applicable federal, state, county and local laws, ordinances, codes, the requirements

B. If any of these requirements are in conflict, the more stringent requirement shall apply. The CONTRACTOR's failure to be thoroughly familiarized with the aforementioned safety and health provisions shall not relieve the CONTRACTOR of

responsibility for full compliance with the obligations and requirements set forth herein.

C. The CONTRACTOR shall conform to the rules and regulations of the State Construction Safety regulations pertaining to excavations and trenches. A copy of the regulations is available at the OWNER.

1.05 SPECIAL SAFETY CONSIDERATION RELATED TO LANDFILL WORK

A. Portions of the Work involve excavation and removal of and construction near hazardous waste.

B. The landfill may contain leachate water contaminated with substances found in the landfill which may be corrosive, toxic, carcinogenic, mutanogenic or otherwise hazardous.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. The CONTRACTOR shall assume full responsibility to assure that during construction his employees, subcontractors and their employees follow the Health and Safety Plan.

B. The CONTRACTOR shall hold mandatory weekly safety meetings on the site. The CONTRACTOR shall notify the CONSTRUCTION MANAGER of the time and place of all meetings and allow the CONSTRUCTION MANAGER to participate. Meetings should reiterate safety measures to be taken and discuss any violations committed and preventive measures to avoid future violations.

C. The CONTRACTOR shall require all personnel on the site to wear the appropriate personnel protective equipment such as steel toe boots, hard hats, orange safety vests, safety belts and lanyards, and others.

D. The CONTRACTOR shall provide appropriate fall protection (i.e., harness and shock absorbing lanyard) that must be worn and secured to a stationary object when working within a distance of ten 10 feet of an excavation greater than eight (8) inches in diameter or deeper than four (4) feet.

E. No smoking or consumption of alcohol or any drug which could impair sight, balance or judgment is permitted on the job.

3.02 TRENCHING SAFETY

A. The CONTRACTOR shall complete each excavated trench prior to the end of the working day. A trench shall be considered complete if it has been backfilled to the landfill surface.

B. Any time excavations and trenching exceed four (4) feet in depth, shoring, bracing or sloping of the side walls is required prior to entry. If sloping is the method used, side walls of the trench shall be sloped at a 2H:1V slope (Cal-OSHA requirement).

C. Welding is to be avoided within the barricaded area. If HDPE pipe welding is performed in the trench, continuous methane monitoring shall be performed.

D. Solvent cleaning, gluing or bonding of pipe shall be done, to the extent practicable, outside the trench.

E. All trenches shall be backfilled as soon as practical after excavation, and under no circumstances shall a trench remain open after the crew has left the vicinity of the trench. A maximum of 300 feet of trench may be exposed at any one time. All exposed refuse must be covered at the end of each day using cover soil or a tarp.

F. Electric motors shall not be used in trenches. Pneumatic operated tools shall be used in the trench.

3.03 VIOLATIONS

A. Should any health and safety violations be called to the CONTRACTOR's attention by anyone, the CONTRACTOR shall immediately correct the violations.

B. If the CONTRACTOR violates any health and safety rule or regulation, the OWNER may issue an order to stop all work until the violations are remedied. The CONTRACTOR shall not be entitled to any extension of the time or any claim for damage or to any compensation for either the directive or the work suspension order. A decision by the OWNER not to order discontinuance of any or all of the CONTRACTOR's operations shall not relieve the CONTRACTOR of responsibility for safety.

END OF SECTION

SECTION 02105

EROSION CONTROL

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes the general requirements for erosion control measures associated with lining materials for drainage channels.

PART 2 PRODUCTS

2.01 EROSION CONTROL BLANKET

Permanent Turf Reinforcement Mat shall be Propex Landlok 407, or equivalent. To be used in drainage channels at the locations shown on the Plans.

PART 3 EXECUTION

3.01 GENERAL

A. Grade and compact area of installation and remove all rocks, clods, vegetation or other obstructions so that the installed mat will have direct contact with soil surface. Prepare seedbed by loosening 2-3 inches of topsoil. Incorporate amendments such as fertilizer into soil.

B. For temporary erosion control mat, apply seed to soil surface before installing blanket/mat. For permanent erosion control mat, apply seeding after installation and prior to filling mat with soil.

C. The CONTRACTOR shall install the permanent and temporary control mats in accordance with the manufacturer's recommendations. In general the installation should include:

1. Anchor trenches or check slots (6-inches deep) at 30 foot intervals along the trench.

2. Longitudinal anchor trenches (4-inches deep) to secure outside edges.

3. Anchor erosion control mat with U-shaped wire staples. Staples shall be a minimum of 6-inches in length and have sufficient ground penetration to resist pullout. Longer anchors may be required. Anchors for the permanent erosion control mat shall be installed with a minimum of 2 anchors per square yard. Temporary erosion control mats shall be installed with a minimum of 1.5 anchors per square yard.

4. After installation of permanent erosion control mat, apply seed and apply ½ to ¾ inches of fine soil into the mat to completely fill the voids. Use backside of rake, or similar, to smooth soil fill in order to just expose the top netting.

END OF SECTION

SECTION 02110

SITE CLEARING, GRUBBING AND STRIPPING

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes the general requirements for site clearing, grubbing and stripping associated with the construction of Phase III of Landfill B-18 at the Kettleman Hills Facility.

B. Clearing, grubbing and stripping shall be performed to remove organic, soft, loose, and deleterious materials and expose a firm, unyielding subgrade.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02751 - HDPE Geomembranes

PART 2 PRODUCTS

A. Organic, soft, loose and deleterious materials includes, but is not limited to, vegetative growth, non-engineered fills, alluvial deposits, soft, loose, or saturated subgrade soils, refuse, and construction debris.

PART 3 EXECUTION

3.01 PROTECTION

A. Locate, identify, and protect utilities that remain from damage.

B. Protect existing groundwater monitoring wells and piezometers from damage or displacement.

3.02 CLEARING

A. Clear areas required for access to site and execution of work.

B. Earthwork CONTRACTOR shall remove all organic and deleterious material, and trash from the subgrade surface. Vegetative growth greater than 1 inch in dimension shall be removed to a depth of 6 inches below the subgrade surface.

C. The Earthwork CONTRACTOR shall consider that clearing, grubbing, and stripping will necessitate the use of manual labor to remove all organic and deleterious material from the subgrade surface.

D. The Earthwork CONTRACTOR shall remove soft, loose, or saturated materials as approved by the CQA CONSULTANT. The materials shall be removed until a firm, unyielding subgrade, approved by the CQA CONSULTANT, is exposed.

E. All removed materials shall be disposed of onsite in an area designated by the PROJECT MANAGER. No accumulation of flammable material shall remain on or adjacent to the construction area.

F. The Earthwork CONTRACTOR shall expose existing liner terminations as required on the Drawings. The Work may require hand excavation to avoid damage to the existing liner. Any damage to the existing liner shall be repaired by the Earthwork CONTRACTOR at no additional cost to the OWNER.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. The Earthwork CONTRACTOR shall furnish all labor, materials, equipment and incidentals necessary to perform all excavation, backfilling, compaction and grading required to complete the work shown on the Drawings and specified herein. The Work shall include, but not necessarily be limited to, survey and staking, borrow excavation and hauling, excavation for trenches, fill placement and compaction, grading, and all related work.

B. The Earthwork CONTRACTOR shall comply with the safety procedures given in Section 01810 of these Specifications.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 01400 - Construction Quality Control

C. Section 02110 - Site Clearing, Grubbing and Stripping.

D. Section 02220 - Compacted Clay Liner

E. Section 02751 - HDPE Geomembranes

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM), latest editions:

1. ASTM D422 - Test Method for Particle Size Analysis of Soils.
2. ASTM D1556 - Test Method for Density of Soil In-Place by the Sand Cone Method.
3. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb. Rammer and 18-inch Drop.
4. ASTM D2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
5. ASTM D2419 - Test Method for Sand Equivalent Value of Soil/Fine Aggregate.
6. ASTM D2497 - Standard Test Method for Classification of Soils for Engineering Purposes.
7. ASTM D2937 - Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
8. ASTM D6938 – In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

B. Standard Specifications for Public Works Construction (SSPWC).

1.04 QUALITY ASSURANCE/CONTROL

A. The Earthwork CONTRACTOR shall adhere to the requirements of Section 01400 of these Specifications.

B. Compaction testing of engineered fill and backfill shall be performed by the CQA CONSULTANT. Testing shall be performed at locations to be determined by the CQA CONSULTANT, in order to determine if the soils meet the compaction requirements. Costs for testing to verify compaction and soil moisture content will be assumed by the OWNER. The cost of retesting, should corrections to construction be required, shall be the responsibility of the Earthwork CONTRACTOR.

C. The OWNER shall have complete authority to order immediate stoppage of work due to use of improper construction procedures, or for any reason that in his sole opinion, may result in a defective work.

1.05 DEFINITIONS

A. Excavation: Consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.

B. Subgrade: The surface upon which structures/systems/fills are constructed.

C. Borrow: Soil material obtained from other than the excavation.

D. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the PROJECT MANAGER. Unauthorized excavation, as well as remedial work directed by the PROJECT MANAGER, shall solely be at the Earthwork CONTRACTOR's expense.

E. Utilities include on-site above ground and underground pipes, conduits, ducts, and cables, as well as underground services.

1.06 SAFETY

A. CONTRACTOR is solely responsible for performing work in a safe manner and complying with all applicable local, state and federal codes, ordinances, laws, and regulations.

B. CONTRACTOR shall comply with the requirements of the Health and Safety Plan.

PART 2 PRODUCTS

2.01 MATERIALS

A. Structural Fill

1. Structural Fill shall be removed from the on-site borrow area(s) designated by the OWNER. Material shall be predominantly free from roots, wood, organic matter,

refuse or other deleterious matter, and shall not contain particles over 6 inches in greatest dimension.

2. The OWNER has designated on-site borrow source(s) for the CONTRACTOR. The CONTRACTOR shall be responsible for excavating, loading, hauling, placing and compacting the material from the designated borrow source(s).

B. Clay Liner (see Section 02220)

C. Operations Layer (see Section 02228)

D. Trench Backfill

1. Trench Backfill shall be removed from the on-site borrow area(s) designated by the OWNER. Material shall be predominantly free from roots, wood, organic matter, refuse or other deleterious matter, and shall not contain particles over 1 inch in greatest dimension.

2. The OWNER has designated on-site borrow source(s) for the CONTRACTOR. The CONTRACTOR shall be responsible for excavating, loading, hauling, placing and compacting the material from the designated borrow source(s).

E. Water

1. Water shall be potable water or reclaimed water approved for use by OWNER.

2. The OWNER will provide water for dust control and soil preparation to the Earthwork CONTRACTOR at no cost to the Earthwork CONTRACTOR.

3. The CONTRACTOR shall only obtain water from sources designated by the OWNER.

PART 3 EXECUTION

3.01 GENERAL

A. The Earthwork CONTRACTOR shall be solely responsible for the satisfactory completion of all earthwork in accordance with the Drawings and Specifications.

B. Equipment used in the excavation, transport, placement and compaction of all materials used in construction will be standard of practice grading machinery of known specifications suitable for performing the required work in a timely and efficient manner.

C. All material considered by the CQA CONSULTANT to be unsuitable for use in the construction of the earthwork shall be removed. All materials incorporated as part of engineered fill must be inspected and placement must be observed by the CQA CONSULTANT. Unsuitable material shall be disposed of in the designated area.

D. Where work is interrupted by heavy rains, earthwork operations shall not be resumed until observations and field tests by the CQA CONSULTANT indicate the moisture

content and density of the in-place fills and/or materials intended for placement are within the specified requirements.

E. If any unanticipated earth conditions of an adverse or potentially adverse nature are encountered during grading, the Earthwork CONTRACTOR shall immediately notify the CQA CONSULTANT. The CQA CONSULTANT and DESIGN ENGINEER shall investigate, analyze, and make recommendations to mitigate these conditions.

F. Throughout construction, all excavated and/or fill areas shall be graded to provide positive drainage and prevent ponding of water. Surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site.

G. No heavy equipment shall be permitted to operate within 3 feet of existing wellheads or piping. Compaction of material within these limits shall be completed with hand equipment.

H. The Earthwork CONTRACTOR shall apply water to any exposed earthen areas during construction to minimize airborne dust. This shall include active and inactive excavation areas, haul roads, and any non-vegetated stockpiles. The Earthwork CONTRACTOR shall be responsible for complying with all state and local regulations regarding dust and/or air quality.

I. Earthwork CONTRACTOR **shall not** use "paddle-wheel" (i.e., Caterpillar 613 or equivalent) equipment to excavate soils.

J. Earthwork CONTRACTOR shall provide manned traffic control (e.g., flagman) at locations identified by Owner and/or Contractor as being a potential safety hazard.

3.02 CONTROL OF WATER

A. The Earthwork CONTRACTOR shall excavate and backfill in a manner and sequence that will provide proper drainage at all times. The Earthwork CONTRACTOR shall remove all water, including runoff and run-on collected from rainwater encountered during excavation, to a location approved by the PROJECT MANAGER, by pumps, drains, and other approved methods.

B. The Earthwork CONTRACTOR shall take all necessary precautions to preclude the accidental discharge of fuel, oil, etc. and to prevent such accidents that may endanger the environment. The Earthwork CONTRACTOR will be responsible for the cost of remediating the results of any such discharges or accidents.

3.03 BORROW

A. CONTRACTOR shall submit the proposed limits of the borrow area to the OWNER for approval prior to the commencement of the Work. The maximum limits of the borrow area are shown on the Drawings.

B. The gradients of the borrow slopes and the depth of the borrow excavation should not exceed those specified on the Drawings. If the slopes are constructed steeper or the depth of the borrow excavation is greater than that specified on the Drawings, the CONTRACTOR shall reconstruct the slopes/refill the bottom to the gradients/depth

specified by backfilling and compacting material in accordance with the requirements for engineered fill in this Section. The cost to reconstruct the slopes/refill the bottom will be borne solely by the CONTRACTOR.

C. The CONTRACTOR shall maintain a secure work site at all times.

3.04 STRUCTURAL FILL

A. Prior to placing structural fill, CONTRACTOR shall clear and grub the area in accordance with Section 02110 of these Specifications. CONTRACTOR shall also remove uncertified existing fills, disturbed soils and deleterious materials from the area to the satisfaction of the CQA CONSULTANT.

B. The ground surface (i.e. areas with less than 10% slope) to receive fill shall be over excavated a minimum of 2 feet. The base of the excavation shall be scarified to a depth of 8 inches. The scarified ground surface shall then be brought to within 3 percent of optimum moisture content, mixed as required, and compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557. Excavated soil may be used for filling the excavation if placed in accordance with the structural fill requirements. If the scarified zone is greater than 12 inches in depth, the excess shall be removed, placed in loose lifts not to exceed 8 inches in loose thickness. Prior to fill placement, the ground surface to receive fill shall be stabilized and inspected by the CQA CONSULTANT.

C. Fill placed against existing slopes (i.e., areas with greater than 10% slope) shall be keyed into the slope. Keys shall extend a minimum of 6 feet horizontally into the existing slope. The keys shall form a series of steps in the existing fill.

D. Fill shall be placed in loose lifts not to exceed 8-inches thick, brought to a uniform moisture content within 3 percent of optimum, and compacted to 90 percent of the maximum dry density as determined by ASTM D1557.

E. Where tests indicate the moisture content or density of any layer of fill or portion thereof is below the Project requirements, the particular layer or portion thereof shall be reworked until the required moisture or density has been attained. No additional fill shall be placed over an area until the prior fill lift has been tested and meets the present requirements to the satisfaction of the CQA CONSULTANT.

F. In the event of rain or other reason, if the moisture content of previously placed fill material or processed soils intended for placement is more than 3 percent above optimum as determined by ASTM D1557, the fill material shall be aerated by blading, disking, or other satisfactory method until the moisture content complies with the requirements of this Section. Any previously compacted materials which are disturbed (aerated, bladed, etc.) to reduce or increase the moisture content must be recompacted to the Specifications and to the satisfaction of the CQA CONSULTANT once specified moisture contents are attained.

3.05 SURFACE PREPARATION

A. All surfaces to be overlain by geosynthetics shall be smooth, uniformly sloped (minimum 5%), firm, and free of rocks, protrusions, or depressions greater than 0.5-

inch in maximum dimension. The Earthwork CONTRACTOR shall consider that manual removal/repair of unacceptable areas may be required and shall be considered inherent to the work described herein.

3.06 TRENCH EXCAVATION AND BACKFILL

A. All trenches shall be excavated to lines and grades and dimensions indicated on the Drawings. All trench excavation, backfill, and compaction shall be in accordance with pertinent provisions of this Section.

B. All pipe work placed inside the trenches shall have a minimum of 8-inch clearance from any protrusions from the trench side walls or bottom.

C. The Earthwork CONTRACTOR shall backfill excavated trenches as promptly as progress of the work permits and immediately after the pipe has been laid, jointed, and tested.

D. The trench bottom shall be compacted to provide a uniform bed for the pipe. Backfill material shall be placed around the pipe and shall be compacted by hand-tamping, or methods acceptable to the CQA CONSULTANT.

E. The Earthwork CONTRACTOR shall compact the select engineered fill for trench backfill to at least 90 percent of the maximum dry density and within 3 percent of the optimum moisture content as determined in accordance with ASTM D1557.

F. Trench backfill shall be placed as shown on the Drawings. The backfill shall not be placed at ambient temperatures below 41°F nor above 100°F unless otherwise specified. The material shall be placed in a manner that does not cause movement or excessive wrinkling of, or induce excessive wrinkling of the geosynthetics. The CONTACTOR shall not operate equipment directly on any geosynthetics.

3.07 TOLERANCES

A. All material limits shall be constructed within a tolerance of ±1.0 ft for horizontal State Plane coordinates, 0 to +0.1 ft vertical for reference to mean sea level (MSL), and 0 to +0.1 ft where dimensions are shown or specified as a minimum. The plane of the surface shall not vary more than 0.10 feet when measured with a 10-foot straight edge.

3.08 EXCAVATION BELOW GRADE

A. All excavation shall be performed within the limits of the work to the lines, grades, and elevations indicated and specified herein. The Earthwork CONTRACTOR shall not excavate or remove materials beyond indicated subgrade elevations or dimensions without the approval of the PROJECT MANAGER. The Earthwork CONTRACTOR shall backfill and compact any unauthorized excavation to the satisfaction of the PROJECT MANAGER at no additional cost to the OWNER.

B. When acceptable to the PROJECT MANAGER, lean concrete may be used to bring the bottom elevation of excavations under footings or trenches to correct elevations.

END OF SECTION

SECTION 02220

COMPACTED CLAY LINER

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the construction of the Compacted Clay Liner (CCL), as specified herein, as shown on the Construction Drawings, and in accordance with the Construction Quality Assurance (CQA) Plan.

B. Contractor shall construct the CCL to the elevations, lines, grades, and dimensions as shown on the Plans and described in the Specifications, unless otherwise directed by the Engineer.

C. Process, moisture condition, and transport clay from stockpiled low permeability clay source.

D. Construct the CCL in conjunction with the installation and construction of the other components of the liner system.

E. Contractor shall use clay from the approved Pecten claystone borrow source shown on the Construction Drawings. Alternate clay sources which meet the requirements of this Section may be used if approved by the Owner and Engineer, the Regional Water Quality Control Board (RWQCB), and the Department of Toxic Substances Control (DTSC).

F. The clay borrow source may contain some gypsum debris. The Contractor shall remove large and easily recognizable pieces of gypsum and debris. Gypsum and debris must be removed prior to clay placement. Removal is considered part of the cost of clay placement.

1.02 RELATED SECTIONS

A. Section 01300 – Submittals.

B. Section 01402 – Control of the Work.

C. Section 02200 – Earthwork.

D. Section 02751 – HDPE Geomembranes.

1.03 REFERENCES

A. ASTM D422 - Standard Test Method for Particle Size Analysis of Soils.

B. ASTM D854 - Standard Test Methods for Specific Gravity of Soils.

C. ASTM D1140 - Standard Test Methods for Amount of Material in Soils Finer than the No. 200 Sieve.

D. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.

E. ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

F. ASTM D1587 - Standard Practice for Thin-Walled Tube Geotechnical Sampling of Soils.

G. ASTM D2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures.

H. ASTM D2487 - Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

I. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

J. ASTM D5084 - Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

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

1.04 REGULATORY REQUIREMENTS

Permits: Contractor shall obtain and comply with the appropriate local, state, and federal permits and licenses required for all Work performed on the site.

1.05 QUALITY ASSURANCE

A. Construction Quality Assurance (CQA) monitoring shall be the responsibility of the Owner or Owner's Representative in accordance with the approved CQA Plan.

B. Quality control testing associated with filling and compaction operations shall be performed by the Owner or Owner's Representative in compliance with the CQA Plan and this Specification. The Contractor shall assist the Owner or Owner's Representative in obtaining clay samples at the frequencies provided in the CQA Plan.

C. Contractor shall give advance notice of at least 24 hours to the Owner or Owner's Representative when ready for compaction or subgrade testing and inspection.

D. Contractor shall give advance notice of at least 24 hours to the Owner or Owner's Representative prior to commencement of proof rolling.

1.06 TOLERANCES

A. The final surface of the finished clay liner shall be within +0.0 feet to +0.2 feet of the design thickness. The Contractor shall not be reimbursed for material that exceeds +0.2 feet.

PART 2 PRODUCTS

2.01 CLAY

A. The clay liner material shall be obtained from the Pecten Claystone borrow source as shown on the Construction Drawings. Based on field permeability testing completed by Geosyntec in 2008, the Pecten Claystone, when processed, has a field permeability of less than 1×10^{-7} cm/sec.

B. Clay liner material shall:

1. Be clean soil free of debris, rocks, any particles greater than 1 inch in maximum dimension, and other deleterious material.

2. Be classified as CH, CL, ML, SM, or SC in accordance with ASTM D2487.

3. Have a minimum of 30 percent passing the #200 sieve.

C. The in-situ Pecten Claystone may not meet the requirements of this Specification for moisture content. Processing of this material shall be required prior to its placement. At a minimum, the Contractor shall process and moisture condition the clay in accordance with the "Test Fill and Infiltrometer Test Results" report for the Phases I and II clay liner (Environmental Solutions, Inc.; 1992). The Contractor may elect to use alternative processing and moisture conditioning methods. Alternative methods may require a test pad and field permeability test (i.e., Sealed Double-Ring Infiltrometer) to demonstrate that this Specification is met as well as to evaluate the appropriate compaction specification and associated correction factor.

D. If another clay source (other than the Pecten Claystone) is required to complete the work, that alternative clay source shall be approved by the Owner, Engineer, RWQCB, and DTSC. In order to obtain said approval, clay material obtained from the alternative source shall be laboratory and field tested to demonstrate that the clay meets the requirements in items 2.01 A and B of this Section. It should be noted that the field permeability test requires a minimum of 8 weeks to complete.

2.02 EQUIPMENT

A. Provide equipment to transport clay from borrow source to project site.

B. Provide heavy compaction equipment sufficient to obtain the densities specified. Equipment shall be similar to that used for the Phases I and II clay liner test pad construction (reference Environmental Solutions, Inc. 1992 report).

C. Locations inaccessible to heavy equipment shall be compacted by means of manually controlled pneumatic or vibrating tampers or by Owner-approved equivalent methods to achieve specified densities.

D. Operate compaction equipment in strict accordance with the manufacturer's instructions and recommendations. If inadequate densities are obtained, provide larger and/or different types of additional equipment at no cost to the Owner.

E. Provide water application equipment free of leaks and equipped with a distributor bar or other accepted device to ensure uniform application.

F. Provide processing equipment suitable for providing a material that has uniform moisture content.

PART 3 EXECUTION

3.01 GENERAL

The Contractor shall:

A. Excavate, process for size and moisture content, and stockpile clay from the approved borrow source.

B. Transport processed and moisture conditioned clay from stockpile to the project area.

C. Verify that the survey control system is installed and properly protected from construction operations prior to all earthwork, including clay placement.

D. Placement of successive clay layers shall not begin until the Owner or CQA Consultant has accepted the previous layer. Any damage to the previous layer or deterioration subsequent to acceptance shall be repaired by the Contractor to the satisfaction of the Owner or CQA Consultant at the expense of the Contractor.

E. Fill and compact all holes and other depressions prior to placement of clay.

F. Fill areas to contours and elevations shown on the Drawings.

G. Maintain surface of clay at the minimum grades for drainage shown on the Drawings.

H. Place and compact clay in continuous layers not exceeding 6 inches in compacted thickness. The CONTRACTOR shall implement a systematic method to ensure lift thickness is in compliance with this Specification. Preferred systems include laser levels and global positioning system (GPS). If lath stakes are utilized in the control of grades / thickness then the CONTRACTOR shall ensure recovery of all stakes by implementing a control numbering system. Grade control systems shall be approved by the CQA CONSULTANT.

I. Material incorporated into clay, determined by the OWNER or CQA CONSULTANT to be in violation of Specification requirements, shall be removed by the CONTRACTOR at the CONTRACTOR’s expense.

J. Protect stockpiles so that stockpiled material remains in a condition suitable for use on the project.

K. Transport borrow materials over land or roads designated by the OWNER or CQA CONSULTANT. Perform perimeter/access road maintenance including dust control by sprinkling with water as needed or by other suitable means accepted by the Owner or CQA CONSULTANT. Additionally, road maintenance shall include periodic grading, as necessary, to remove ruts and to maintain construction access roads in a safe and sound condition.

L. Obey all applicable laws where borrow materials are transported along public roads, including but not limited to, laws relating to vehicle speed, vehicle weight, and covering of loads.

3.02 COMPACTED CLAY LINER

A. Work associated with construction of the CCL includes: processing and moisture conditioning clay from borrow sources, any supplementary processing and moisture conditioning of clay at the area of placement to achieve the required moisture content and texture, spreading and compaction of clay layers, and protection of the completed work. The work also includes supplying of all labor and equipment necessary to achieve the construction in accordance with the Drawings and Specifications or as directed by the OWNER or CQA CONSULTANT.

B. The CONTRACTOR shall be responsible for verification that material that does not meet the Specifications is removed from the clay prior to placement.

C. The clay material shall be compacted to a dry density and moisture content that lies within the compaction window bounded by the following 4 points on a moisture content-dry density plot (where optimum moisture and maximum dry density are obtained using the ASTM D1557 test method):

   a. 2 percent above the optimum moisture content for a relative compaction of 90 percent.

   b. 5 percent above the optimum moisture content for a relative compaction of 90 percent.

   c. 3 percent above the optimum moisture content for a relative compaction of 97 percent.

   d. 1 percent above the optimum moisture content for a relative compaction of 98 percent.

   Up to 20 percent of the moisture content-dry density compaction tests per equipment spread per day are allowed to lie slightly outside of the compaction window defined above if the following conditions are met:

   a. The moisture content is within ±0.5 percent of the specified compaction window.

   b. The relative compaction is within -0.5 percent of the specified compaction window.

c. The average for all acceptable tests per equipment spread per day falls within the compaction window described above.

Moisture content and dry density shall be used as an indicator, but the primary requirement for the clay liner is a maximum permeability of 1×10^{-7} cm/sec.

D. Changes to the above compaction specification shall require approval of the Owner, Engineer, CQA Consultant, RWQCB, and DTSC. Modifications will likely require demonstration through a test pad and field permeability test that the modified procedures are acceptable.

E. Clay shall be compacted with a Caterpillar 825 Sheepsfoot Compactor or Rex 3-35 Pad Foot Compactor (or heavier equipment) with a minimum of four complete passes.

F. CONTRACTOR shall take adequate measurements to prevent moisture loss from and desiccation of the CCL.

G. CONTRACTOR shall scarify the top of each lift and confirm the moisture content is acceptable prior to placement of the overlying lift.

H. Clay shall not be placed and compacted if the ambient air temperature drops below 32°F.

I. CONTRACTOR shall seal the last and uppermost layer of CCL, after achieving the compaction and permeability requirements, with two passes of a single drum smooth roller. The final lift shall be suitable for placement of the geomembrane liner (Section 02751).

J. Where test results indicate that the lift thickness, maximum particle size, in-place density/moisture content, and/or permeability of any portion of the clay does not meet the specified requirements, that particular portion shall be re-tested by the OWNER or CQA CONSULTANT and/or re-worked or replaced by the CONTRACTOR at his expense until the required condition has been attained and the resulting product meets or exceeds the Specification requirements. No additional fill shall be placed over an area until the existing fill has been tested horizontally and vertically and determined by the OWNER or CQA CONSULTANT to meet the requirements of this Specification.

K. Upon placement, if test results indicate densities or moisture contents outside the specified compaction window, then two additional field density/moisture content tests shall be conducted in the immediate area. If either of these tests fail to meet the compaction requirements, the area shall be considered inadequate and shall be reworked by the CONTRACTOR. Any reworked areas shall be re-tested by the OWNER or CQA CONSULTANT to assure the reworked area meets the density and moisture content requirements.

L. If the laboratory permeability value exceeds 1.0×10^{-7} cm/sec, then two (2) additional tests of the same type shall be taken by the OWNER or CQA CONSULTANT in the immediate vicinity. If either of the additional tests fails to meet the minimum requirements, the area represented by the test shall be considered inadequate and shall be removed or reprocessed and recompacted by the CONTRACTOR at his expense.

M. If at any time the OWNER or CQA CONSULTANT observes an uncompacted lift thickness in excess of eight inches or observes materials being placed without the required mixing, processing, or stockpiling, the CONTRACTOR shall immediately discontinue placing additional fills in that area. For an over-thick lift, the CONTRACTOR shall immediately blade the surface to reduce the lift to an acceptable thickness at his expense.

N. Prior to placement of the geomembrane liner, all clay surfaces shall be observed for any particles greater than 1 inch in size, and oversize materials shall be removed. The final surface shall be rolled smooth to remove protrusions of ½ inch or greater, to the satisfaction of the CQA Consultant and the Geosynthetics CONTRACTOR.

END OF SECTION

SECTION 02228

OPERATIONS LAYER

PART 1: GENERAL

1.01 DESCRIPTION

A. This section describes the requirements for placement of operations layer material associated with the performance of the Work.

1.02 SUBMITTALS

A. An earthwork operations plan and schedule shall be submitted to the Owner.

1.03 QUALITY ASSURANCE

A. The Contractor shall make allowances for sampling and testing by the CQA Engineer in both his production operations and schedule.

1.04 TOLERANCES

A. The final surface of the finished operations layer shall be within +0.0 feet to +0.2 feet of the design thickness. The Contractor shall not be reimbursed for material that exceeds +0.2 feet.

PART 2: PRODUCTS

2.01 OPERATIONS LAYER MATERIAL

A. Materials shall consist of on-site soil materials meeting the requirements for Structural Fill in Section 02200 of these Specifications with the additional particle size requirements in Articles 2.01.B and 2.01.C below.

B. The maximum particle size for the operations layer material shall be as follows:

- Material to be placed on or within 0.5-feet of the geosynthetic liner: 1-inch in largest dimension;
- Material to be placed at a distance greater than 0.5 feet of geosynthetic liner: 2-inches in largest dimension.

C. Material shall form a firm and stable base when placed.

PART 3: EXECUTION

3.01 PLACEMENT OF OPERATIONS LAYER

A. Operations layer shall be placed over the geocomposite across the base area to the extent and thicknesses shown on the drawings. On the sideslopes, operations layer shall be placed up the slopes a maximum of 10 vertical feet ahead of the rising waste mass. The final elevation of the operations layer shall be approximately 2 feet above the permitted waste level.

B. Prior to placement of operations layer material, final inspection of the geocomposite by the CQA Engineer will be made to verify integrity.

C. Hauling and placing equipment shall operate on a minimum of 3 feet of material over any geosynthetic layer. Equipment with maximum ground pressure of 6 psi may operate on a minimum of 1 foot of material.

D. The Contractor shall take steps to minimize wrinkle generation in the geosynthetic materials during placement of the operations layer. These measures may include placing material in the early morning hours when the geosynthetic materials are cool and monitoring and walking out wrinkles in the geosynthetic materials that appear at the face of the placement operation. Wrinkles which may fold and or crease shall be removed and repaired in accordance with the specifications.

E. There is no compaction requirement for operations layer placement.

END OF SECTION

SECTION 02725

HDPE PIPE

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes the requirements for the manufacture, supply, installation, and quality control (QC) of high density polyethylene (HDPE) pipes, fittings and connections.

1.02 SUBMITTALS

A. Prior to the delivery of any HDPE pipe to the site, Earthwork CONTRACTOR shall submit to ENGINEER for review and approval complete, detailed shop drawings of all HDPE pipe and fittings, a list of materials to be furnished, the name of the pipe manufacturer, and the manufacturer's recommendations for handling, storage, and installation.

B. Earthwork CONTRACTOR shall also submit the pipe manufacturer's certification of compliance with the Specifications, including certification that stress regression testing has been performed in accordance with ASTM D2837, for all HDPE pipe materials delivered to the site.

C. In addition to the certification cited above, Earthwork CONTRACTOR shall submit in writing the following documentation of the pipe manufacturer on the raw materials used to manufacture the pipe and fittings:

1. certificate of compliance stating the specific resin, its source, and the information required by ASTM D3350; if in-plant blending of the resin is performed, the pipe manufacturer shall provide a certificate of compliance stating that the blended resin meets the requirements of ASTM D3350; and
2. certificate of compliance stating that no recycled resin was used in manufacturing the pipe except for a small percentage (i.e., less than 10 percent) of resin generated in the pipe manufacturer's own plan from production using the same resin as the recycled material.

1.03 REFERENCES

A. The American Society for Testing and Materials (ASTM), latest editions:

1. ASTM D1603 – Standard Test Method for Carbon Black in Olefin Plastics
2. ASTM D1693 – Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
3. ASTM D2657 – Standard Practice for Heat-Joining for Polyolefin Pie and Fittings
4. ASTM D2837 – Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials

5. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

6. ASTM F714 – Standard Specification for Polyethylene (PE) Plastics Pipe (SDR-PR) Based on Outside Diameter

1.04 RELATED SECTIONS

A. Section 02200 - Earthwork

PART 2 PRODUCTS

2.01 MATERIALS

A. HDPE pipe shall be of the diameter and SDR rating (per ASTM F714) as indicated on the plans.

B. The HDPE pipe and fittings shall be manufactured from new, high molecular weight, high density polyethylene (HDPE) resin conforming to ASTM D3350 (Type III, Class C Category 5, Grade P 64), pipe cell classification PE 345464C according to ASTM D3350, and having a Plastic Pipe Institute (PPI) Rating of PE 3408. The resin shall be pre-compounded. In plant blending of non-compounded resins shall be permitted if the manufacturer provides a certificate of compliance that the blended resin conforms to the requirements of the Specifications. Pipe and fittings shall be manufactured from the same resin and by the same manufacturer.

C. The polyethylene compound shall contain a minimum of 2 percent carbon black (per ASTM D1603) to withstand outdoor exposure without loss of properties.

D. The polyethylene compound shall have a minimum resistance of 5,000 hours when tested for environmental stress crack in accordance with requirements of ASTM D1693.

2.02 HDPE PIPE AND PIPE FITTINGS

A. Earthwork CONTRACTOR shall provide HDPE pipe having the nominal diameters specified herein and shown on the Drawings.

B. HDPE pipe and fittings shall have a minimum hydrostatic design basis (HDB) of 1,600 pounds per square inch (psi) when determined in accordance with ASTM D2837 unless otherwise indicated herein or on the Drawings.

C. HDPE pipe shall be supplied in standard laying lengths not exceeding 50 feet.

D. HDPE pipes and fittings shall be homogeneous throughout and free of visible cracks, holes, (i.e., other than intentional manufactured perforations), foreign inclusions, or other deleterious effects, and shall be uniform in color, density, melt index, and other physical properties.

E. Fittings at each end of pipes shall consist of HDPE end caps unless indicated otherwise herein or on the Drawings.

2.03 LABELING

A. The following shall be continuously indent-printed on the HDPE pipe, or spaced at intervals not exceeding 5 feet:

1. name and/or trademark of the pipe manufacturer;
2. nominal pipe size;
3. pipe stiffness;
4. the letters PE followed by the polyethylene grade per ASTM D3350, and by the Hydrostatic Design Basis in 100's of psi (e.g., PE 3408);
5. test method references (e.g., ASTM D2412); and
6. a production code from which the date and place of manufacture can be determined.

PART 3 EXECUTION

3.01 GENERAL

A. Transportation of HDPE pipe and fittings shall be the responsibility of Earthwork CONTRACTOR. Earthwork CONTRACTOR shall be liable for all damage incurred prior to and during transportation to the site.

B. Handling, storage, and care of the HDPE pipe and fittings prior to and following installation at the site is the responsibility of Earthwork CONTRACTOR. Earthwork CONTRACTOR shall be liable for all damage to the material incurred prior to final acceptance of the project by OWNER.

C. Earthwork CONTRACTOR shall be responsible for storage of HDPE pipe and fittings at the site. Pipe and fittings shall be stored on clean level ground, preferable turf or sand, free of sharp objects which could damage the pipe. Stacking shall be limited to a height that will not cause excessive deformation of the bottom layers of pipe under anticipated temperature conditions. Where necessary, due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitable and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports. The pipe shall be stored out of direct sunlight (i.e., to minimize pipe bowing). Earthwork CONTRACTOR shall also comply with the pipe manufacturer's recommendations for handling, storage, and installation of HDPE pipe and fittings.

D. Earthwork CONTRACTOR shall exercise care when transporting, handling and placing HDPE pipe and fittings such that they will not be cut, kinked, twisted, or otherwise damaged. Ropes, fabric, or rubber-protected slings and straps shall be used when handling pipe. Slings, straps, etc., shall not be positioned at butt-fused joints. Chains, cables or hooks shall not be inserted into the pipe ends as a means of handling pipe. Pipe or fittings shall not be dropped onto rocky or unprepared ground. Under no circumstances shall pipe or fittings be dropped into trenches, or dragged over sharp objects.

E. Earthwork CONTRACTOR shall carefully examine all pipe and fittings for cracks, damage, or defects before installation. Defective or damaged materials shall be immediately removed from the site and replaced at no additional cost to OWNER.

F. The maximum allowable depth of cuts, gouges or scratches on the exterior surface of pipe or fittings is 10 percent of the wall thickness. The interior of the pipe and fittings shall be

free of cuts, gouges and scratches. CQA CONSULTANT will inspect all pipes. Sections of pipe with excessive cuts, gouges or scratches will be rejected and Earthwork CONTRACTOR shall be required to remove and replace the rejected pipe, at no additional cost to OWNER.

G. Whenever pipe laying is not actively in progress, the open end of pipe that has been placed shall be closed using a watertight cap.

H. The interior of all pipe and fittings shall be inspected and any foreign material shall be completely removed from the pipe interior before it is moved into final position.

I. Field-cutting of pipes, when required, shall be made with a machine specifically designed for cutting pipe. Cuts shall be carefully made, without damage to pipe or lining, so as to leave a smooth end at right angles to the axis of pipe. Cutter ends shall be tapered and sharp edges filed off smooth. Flame cutting will not be allowed.

J. No pipe shall be laid until CQA CONSULTANT has observed the condition of the pipe.

K. No pipe shall be brought into position until the preceding length has been bedded and secured in its final position.

L. Blocking under piping shall not be permitted unless specifically accepted by PROJECT MANAGER for special conditions or as indicated on the Drawings.

M. Pipe will be inspected in the field before and after placement in the trench. If upon inspection, pipe is found not to be in compliance with the Specifications, it shall be subject to rejection. Any corrective work shall be approved by CQA CONSULTANT. The costs for the corrective work shall be at Earthwork CONTRACTOR's sole expense. Pipe shall be laid to the line and grade shown on the Drawings, with uniform bearing under the full length of the barrel of the pipe. Any pipe which is not in true alignment or shows any undue settlement after laying shall be taken up and relaid at Earthwork CONTRACTOR's sole expense. The joining of the pipe shall be in accordance with the manufacturer's written instructions and the Specifications, as approved by PROJECT MANAGER.

N. All placed pipes shall be surveyed along the top of the pipe to complete the record drawings prior to backfilling. All start points, angle joints, junctions, connections, and end points of the pipe shall be surveyed. All survey work shall conform to the quality and practice required by CQA CONSULTANT, specified herein, and in the CQA Plan.

O. Both during the construction period and immediately prior to acceptance of the construction work by OWNER, Earthwork CONTRACTOR shall keep the pipe free-draining and free of rocks, soil, and debris.

P. Earthwork CONTRACTOR shall provide all necessary adapters and/or pipe connection pieces required when connecting different types and sizes of pipe or when connecting pipe made by different manufacturers. Earthwork CONTRACTOR shall weld flanges to existing Stainless Steel pipes in Phase II for connection of new HDPE pipe.

Q. HDPE pipe shall be jointed with butt fusion joints or eletro-fusion couplers. All joints shall be made in strict compliance with the pipe manufacturer's recommendations and ASTM D2657. Use of adhesives or solvents in the joints will not be allowed.

R. Testing of the HDPE pipe after backfilling and compaction shall be required. Testing shall be performed by Earthwork CONTRACTOR and shall include pulling a test mandrel through the pipe, as specified in Section 306-1.2.12 of the SSPWC. This test will be used to ensure that the pipe has not been excessively deformed, crushed, or blocked during backfilling. Alternative test procedures will require approval by PROJECT MANAGER. Any corrections required due to test failure as evaluated by CQA CONSULTANT, shall be at Earthwork CONTRACTOR's sole expense.

END OF SECTION

SECTION 02751

HDPE GEOMEMBRANES

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the requirements for the manufacture, supply, installation, and quality assurance/quality control (QA/QC) of high density polyethylene (HDPE) geomembranes associated with the construction of Phase III of Landfill Unit B-18 at the Kettleman Hills Facility.

B. The following two types of HDPE geomembranes shall be used for the Project:

1. 60-mil double-sided textured HDPE geomembrane shall be used for the primary and secondary geomembranes in the Phase III composite sideslope base liner system.

2. 40-mil smooth HDPE geomembrane for the protective cover shall be used for:

i. White protective liner for the Phase III composite sideslope liner system.

ii. The liner for the South Stormwater Containment Basin.

1.02 RELATED SECTIONS

A. Section 1300 - Submittals.

B. Section 02200 - Earthworks.

C. Section 02752 - Geotextiles.

D. Section 02774 - Geocomposite.

1.03 REFERENCES

A. "Construction Quality Assurance (CQA) Plan for Landfill Unit B-18, Phase III Construction, Kettleman Hills Facility, Kettleman City, California," prepared by Golder Associates Inc., Revision 1, dated February 2010.

B. Latest version of the following American Society for Testing and Materials (ASTM) standards:

1. ASTM D792 - Specific Gravity (Relative Density) and Density of Plastics by Displacement.

2. ASTM D1004 - Test Method for Initial Tear Resistance of Plastic Film and Sheeting.

3. ASTM D1238 - Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
4. ASTM D1505 - Test Method for Density of Plastics by the Density-Gradient Technique.
5. ASTM D1603 - Test Method for Carbon Black in Olefin Plastics.
6. ASTM D3895 - Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.
7. ASTM D4218 - Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
8. ASTM D4833 - Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
9. ASTM D5199 - Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
10. ASTM D5321 - Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
11. ASTM D5397 - Procedure to Perform a Single Point Notched Constant Tensile Load – (SP-NCTL) Test: Appendix.
12. ASTM D5596 - Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
13. ASTM D5721 - Practice for Air-Oven Aging of Polyolefin Geomembranes.
14. ASTM D5885 - Test Method of Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.
15. ASTM D5994 - Test Method for Measuring the Core Thickness of Textured Geomembranes.
16. ASTM D6693 - Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.
17. ASTM D7238 - Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.
18. ASTM D7466 - Test Method for Measuring the Asperity Height of Textured Geomembranes.

C. Latest version of the following Geosynthetic Research Institute (GRI) standards:

1. GM10 - The Stress Crack Resistance of HDPE Geomembrane Sheet.
2. GM13 - Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes.

1.04 PRE-QUALIFICATION

A. The Geosynthetic CONTRACTOR shall pre-qualify for geomembrane installation by providing the following documentation:

1. The Geosynthetic CONTRACTOR shall have a minimum of 10,000,000 square feet (sf) of polyethylene geomembrane cumulative installation experience.
2. The Geosynthetic CONTRACTOR shall provide at least three references from prior geomembrane installation projects in excess of 500,000 sf including the following information:
   a. Client's name, address, phone number, and contact/representative's name.
   b. Project site name, location, and description.
   c. Geomembrane type and quantity installed.

1.05 SUBMITTALS

A. Submittals shall be provided in general accordance with Section 01300.

B. HDPE Resin: Furnish the following in writing to the CQA CONSULTANT a minimum of 7 calendar days prior to geomembrane shipment to the site:

1. Statement of production dates and origin of resin used to manufacture the geomembrane for the Project.
2. Certification stating all resin is from the same Manufacturer and that no reclaimed polymer was added to the resin during the manufacturing of the geomembrane and that recycled polymer does not exceed 2 percent by weight.
3. Copies of the quality control certificates issued by the Manufacturer and resin supplier indicating that the resin used to manufacture the geomembrane meets the requirements of these Specifications. These certifications shall contain manufacturing quality control test results, including specific gravity (ASTM D792 or D1505) and melt index (ASTM D1238, Condition E).

C. Manufacturing Quality Control: A copy of the Manufacturer's quality control program shall be submitted to the CQA CONSULTANT a minimum of 7 calendar days prior to geomembrane shipment to the site. Quality control testing shall be performed by the Manufacturer in accordance with GRI-GM13 and as approved by the CQA CONSULTANT. Prior to delivery, the following shall be submitted to the CQA CONSULTANT for review:

1. Certificates for each shift's production of geomembrane.
2. Copies of quality control certificates issued by the Manufacturer. The quality control certificates shall include:
   a. Roll numbers, lot numbers, and identification;
   b. Sampling procedures; and
   c. Results of quality control tests, including descriptions of the test methods used.
3. The results of the manufacturing quality control tests shall meet or exceed the property values listed in Table 02751-1.

4. Geomembrane delivery, storage, handling, and installation instructions.
5. Extrudate Beads and/or Rod:
   a. Statement of production dates.
   b. Certification stating all extrudate is from one Manufacturer, is the same resin type, and was obtained from the same resin supplier as the resin used to manufacture the geomembrane rolls.
   c. Copies of quality control certificates issued by the Manufacturer including test results for specific gravity (ASTM D792 or D1505) and melt index (ASTM D1238, Condition E).

D. Geomembrane Installer: Prior to mobilization of the Geosynthetic CONTRACTOR to the site, the following information shall be submitted:

1. Shop drawings indicating panel layout and field seams at least 14 calendar days prior to installation of geomembrane.
2. Installation schedule.
3. Copy of Geosynthetic CONTRACTOR's letter of approval or license by the geomembrane Manufacturer.
4. Installation capabilities, including:
   a. Information on equipment proposed for the Project;
   b. Average daily production anticipated for the Project; and
   c. Quality control procedures.
5. Copy of the geomembrane Manufacturer's quality control/quality assurance program.
6. Resume of the Field Superintendent to be assigned to the Project, including dates and duration of employment.
7. Resumes of all personnel who will perform seaming operations on the Project, including dates and duration of employment.
8. The geomembrane installation crew shall have the following experience:
   a. The Field Superintendent shall have supervised the installation of a minimum of 2,000,000 sf of polyethylene geomembrane.
   b. The Master Seamer shall have seamed a minimum of 1,000,000 sf of polyethylene geomembrane using the same type of seaming apparatus to be used for the Project.
   c. All other seaming personnel shall have seamed at least 100,000 sf of polyethylene geomembrane using the same type of seaming apparatus to be used for the Project. Personnel who have seamed less than 100,000 sf of polyethylene geomembrane shall be allowed to seam only under the direct supervision of the Master Seamer or Field Superintendent.

E. During the installation, the Geosynthetic CONTRACTOR shall be responsible for the timely submission to the CQA CONSULTANT of subgrade acceptance certificates, signed by the Geosynthetic CONTRACTOR, for each area to be covered by geomembrane.

F. The Geosynthetic CONTRACTOR shall furnish the OWNER upon completion of the Project:

1. A warranty provided by the Manufacturer against defects in material. Warranty conditions concerning limits of liability shall be evaluated and must be acceptable to the OWNER.

2. A 1-year warranty provided by the Geosynthetic CONTRACTOR against defects in workmanship. Warranty conditions concerning limits of liability shall be evaluated and must be acceptable to the OWNER.

3. As-built panel drawings in compliance with Section 01052.

G. Certificate of calibration less than 12 months old shall be submitted prior to installation for all field tensiometers to be used for the Project.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with Section 01400, Section 01410, the Geosynthetic CONTRACTOR'S Quality Control Program, and the Project's CQA Plan.

PART 2 PRODUCTS

2.01 MATERIALS

A. The geomembrane shall be comprised of high density polyethylene (HDPE) material as indicated on the Drawings, manufactured of new, first-quality products designed and manufactured specifically for the purpose of liquid containment in hydraulic structures.

B. The geomembrane shall be produced free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. Any such defect shall be repaired in accordance with the repair procedures in Item 3.06 of this Section.

C. The geomembrane shall be manufactured with a minimum 15.0-foot seamless width. There shall be no factory seams.

D. The geomembrane shall be either HDPE 60-mils thick and textured on both sides or HDPE 40-mils thick and smooth on both sides, as indicated on the Drawings. White liner shall be provided for the protective cover.

E. The geomembrane shall be supplied in rolls. Folds shall not be permitted.

F. Requirements for the HDPE geomembrane properties are presented in Table 02751-1..

G. Resin:

1. Shall be HDPE, new, first-quality, compounded and manufactured specifically for producing HDPE geomembrane.
2. Do not intermix resin types.
3. Shall meet the following additional requirements:

Property	Test Method	Minimum Test Frequency	Required
Specific Gravity(1)	ASTM D792, Method B or ASTM D1505	1 per resin batch	≥ 0.932
Melt Index	ASTM D1238, Condition E	1 per resin batch	≤ 1.0 g per 10 minutes
Note: (1) Resin without carbon black			

H. Extrudate Rod or Bead:

1. Shall be made from same resin as the geomembrane.
2. Additives shall be thoroughly dispersed.
3. Shall be free of contamination by moisture or foreign matter.
4. Shall meet the following requirements:

Property	Test Method	Minimum Test Frequency	Required
Specific Gravity	ASTM D792, Method B or ASTM D1505	1 per resin batch	≥ 0.940
Carbon Black Content	ASTM D1603	1 per resin batch	2.0 - 3.0%
Melt Index	ASTM D1238, Condition E	1 per resin batch	≤ 1.0 g per 10 minutes

2.02 DELIVERY, STORAGE, AND HANDLING

A. Handling, storage, and care of the geomembrane following transportation to the site shall be the responsibility of the Geosynthetic CONTRACTOR. The Geosynthetic CONTRACTOR shall be liable for all damage to the materials incurred prior to final acceptance of the liner system by the CQA CONSULTANT and OWNER.

B. Conform to the Manufacturer's requirements to prevent damage to the geomembrane.

C. Delivery:

1. Deliver materials to the site only after the CQA CONSULTANT and the OWNER approve all of the required submittals.
2. All rolls of geomembrane delivered to the site shall be identified at the factory with the following:
   a. Manufacturer's name.

b. Product identification and thickness.

c. Lot number.

d. Roll number.

e. Roll dimensions and weight.

3. Separate damaged rolls from undamaged rolls and store at locations designated by the OWNER until proper disposition of material is determined by the OWNER and CQA CONSULTANT.

4. The OWNER shall be the final authority regarding damage.

5. Separate rolls without proper documentation and store until CQA CONSULTANT and OWNER approval is received.

D. On-Site Storage:

1. Store in space allocated by the OWNER.

2. Protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, and any other damage.

3. Store on a level prepared surface (not on wooden pallets).

4. Stack per Manufacturer's recommendations but no more than three rolls high.

E. On-Site Handling:

1. Use appropriate handling equipment to load, move, or deploy geomembrane rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading and spreader and roll bars for deployment. Dragging panels on the ground surface shall not be permitted.

2. Do not fold geomembrane material; folded material shall be rejected.

3. The Geosynthetic CONTRACTOR is responsible for storage and transporting material from the storage area to the work area.

F. Damaged Geomembrane:

1. Geomembrane damage shall be documented by the CQA CONSULTANT.

2. Damaged geomembrane shall be repaired, if possible, in accordance with this Section or shall be replaced at no additional cost to the OWNER.

2.03 EQUIPMENT

A. Welding equipment and accessories shall meet the following requirements:

1. Equipped with gauges showing temperatures both in apparatus and at nozzle (extrusion welders) or at wedge (fusion welders).

2. Maintain adequate number of welding machines to avoid delaying the Work.

3. Use power source(s) capable of providing constant voltage under combined-line load.

4. Provide secondary containment to catch spilled fuel under electric generators, if located on geomembrane.

B. Provide calibrated tensiometer(s) capable of quantitatively measuring geomembrane seam strength:

1. Equipped with gauge accurate to ± 2 lbs per inch of geomembrane width and capable of pulling at 2 inches per minute and 20 inches per minute.
2. Provide one-inch wide die for cutting test specimens.
3. Provide a certificate of calibration for each tensiometer showing that each tensiometer has been calibrated within the past 12 months.

PART 3 EXECUTION

3.01 EXAMINATION

A. The Geosynthetic CONTRACTOR shall document in writing that the surface upon which the geomembrane will be installed is acceptable. In so doing, the Geosynthetic CONTRACTOR shall assume full liability for the accepted surface.

B. The beginning of geomembrane installation means acceptance of existing conditions. The Geosynthetic CONTRACTOR shall be responsible for maintenance of the geomembrane-covered subgrade once installation of geomembrane begins.

3.02 PREPARATION

A. Maintain the surface suitability and integrity until the lining installation is completed and accepted.

B. Repair rough areas and any damage to the subgrade caused by installation of the lining and fill any ruts in subgrade caused by equipment prior to geomembrane deployment.

C. To avoid sharp bends in the geomembrane, bevel the leading edges of the anchor trenches.

D. Subgrade shall be smooth, uniform, firm, and free of rocks or other debris. For deployment over soil subgrade, the subgrade shall not contain any protrusions that are greater than 0.25 inches in height from the finished subgrade surface.

3.03 DEPLOYMENT

A. Geomembrane shall not be deployed:

1. During precipitation.
2. In the presence of excessive moisture.
3. In areas of ponded water.
4. In the presence of excessive winds (i.e., greater than 20 mph).
5. In excessive heat (i.e., greater than 110° F) or cold (i.e., less than 40°F), unless the Geosynthetic CONTRACTOR is able to demonstrate (i.e., through trial

seams) to the satisfaction of the CQA CONSULTANT that acceptable welds can be made in these temperatures. See Items 3.04.O and 3.04.P of this Section for cold weather and hot weather seaming procedures, respectively.

B. Each panel shall be marked with an "identification code" (number and/or letter) consistent with the layout plan. The identification code shall be simple and logical. The number of panels deployed in one day shall be limited by the number of panels which can be seamed on that same day. All deployed panels shall be seamed to adjacent panels by the end of each day.

C. The following is the acceptable method of deployment:

1. Use equipment which will not damage geomembrane by handling, trafficking, leakage of hydrocarbons, or any other means.
2. Do not allow personnel working on geomembrane to wear damaging shoes or engage in activities that could damage geomembrane.
3. Smoking on the geomembrane is prohibited.
4. Round sharp corners of clamps and other metal tools used in the work area.
5. Do not allow clamps and other metal tools to be tossed or thrown.
6. Unroll panels using a method that protects geomembrane from scratches and crimps and protects the soil surface and any underlying geosynthetics from damage.
7. Use a method to minimize geomembrane wrinkles, especially differential wrinkles between adjacent panels.
8. Place adequate hold-downs to prevent uplift by wind.
9. Use hold-downs that will not damage geomembrane (such as sandbags).
10. Use continuous hold-downs along leading edges to minimize risk of wind flow under panels.
11. Panels shall be deployed perpendicular to slope elevation contours and the number of seams shall be minimized.
12. Protect geomembrane in heavy traffic areas by geotextile, extra geomembrane, or other suitable materials.
13. Vehicular traffic shall not be allowed on the geomembrane.
14. Panels deployed on grades steeper than 12% shall extend a minimum of 3 feet beyond the crest or toe of that grade.
15. Shingle or overlap panels in a downward direction to facilitate drainage.
16. Rub sheets used during installation shall be removed prior to placement of subsequent panels.

D. Visually inspect sheet surface during unrolling of geomembrane and mark faulty or suspect areas for repair or testing. Replace faulty (requires more than one patch per 200 square feet) geomembrane stock at no additional cost to the OWNER.

3.04 FIELD SEAMING

A. Orient seams perpendicular to slope elevation contours, i.e., orient down (not across) slope and use seam numbering system compatible with panel number system.

B. Minimize the number of field seams, especially in corners, odd-shaped geometric locations, sumps, and outside corners.

C. Overlap panels by a minimum of 3 inches for extrusion welding and 4 inches for fusion welding. Use procedures to temporarily bond adjacent panels together that do not damage the geomembrane and that are not detrimental to the material to be seamed.

D. Do not use solvents or adhesives unless product is approved in writing by the OWNER.

E. For the base liners, no horizontal seams shall be allowed on grades steeper than 12% or within 3 feet of the crest or toe of slopes. A horizontal seam is defined as more than half of the panel width.

F. Clean geomembrane surface of grease, moisture, dust, dirt, debris, or other foreign material prior to welding.

G. Prior to any extrusion welding, the geomembrane seam or repair shall be prepared as follows:

1. Clean surface of oxidation by disc grinder or equivalent not more than ½ hour before seaming; use number 80 grit sandpaper for the disc grinder. Bevel edges of geomembrane before bonding and provide continuous tacking in repair areas.
2. Repair area where excessive grinding substantially reduces sheet thickness by more than 4 mils beyond extent of weld.
3. Clean grinding dust around weld area after grinding.
4. The following procedure shall be followed for wrinkles and fishmouths:
   a. Cut along the ridge of the wrinkle or fishmouth.
   b. Overlap a minimum of 3 inches and weld.
   c. Any portion where the overlap is less than 3 inches shall be patched with an oval or round patch of geomembrane that extends a minimum of 6 inches beyond the cut in all directions.
5. If required, a firm, dry substrate (piece of geomembrane or other material) may be placed directly under the seam overlap to achieve proper support.
6. Keep water from intercepting the weld during and immediately after welding the seam.
7. For existing welds, or welds that are over 3 minutes old, grind the existing weld two inches back from point of termination and restart welding on ground weld.

H. At least one spare operable seaming apparatus shall be maintained for every three seaming teams. Place protective fabric or piece of geomembrane beneath hot welding apparatus when resting on geomembrane lining and use an electric generator capable of providing constant voltage under combined line load. The electric generator shall generally be located outside of the lined area. Provide protective lining and secondary containment large enough to catch spilled fuel under electric generators when located on the geomembrane. The welding apparatus shall be equipped with gauges giving temperatures in apparatus and at nozzle/wedge.

I. For extrusion welding, purge welding apparatus of heat-degraded extrudate before welding if extruder is stopped for longer than two minutes. All purged extrudate shall be disposed of off the geomembrane. Each extruder shoe shall be inspected daily for wear to assure that its offset is the same as the geomembrane thickness. Repair or replace worn shoes, damaged or misaligned armature brushes, nozzle contamination, or other worn or damaged parts. Avoid stop-start welding. Remove extrudate rod from welder when not using welder for long periods (over two hours). No welding may commence on the liner until the field trial seam sample made by that equipment and seamer passes destructive testing.

J. Test and set "hot air system" using scrap material at least each day prior to commencing seaming and adjust hot air velocity to preclude wind effects. Adjust contact pressure rollers to prevent surface ripples in sheet. No equipment shall be used for welding the geomembrane until a field trial seam sample made by that equipment and seamer has passed destructive testing.

K. In performing hot wedge welding, the welding machines shall be dual-tracked automated vehicular mounted devices equipped with gauges giving applicable temperatures and pressures. The edge of cross seams shall be ground to a smooth incline (top and bottom) prior to welding. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after usage. Protect against moisture buildup between sheets. If welding across cross seams, conduct field trial seams at least every two hours.

L. Field trial seams shall be performed, per seaming apparatus and per seamer, on pieces of geomembrane to verify adequate seaming conditions at the following frequency:

1. At the beginning of each seaming period.
2. At least once every five hours.
3. At the discretion of the CQA CONSULTANT.

M. Make the trial seams at the work area and in contact with the soil subgrade or the geosynthetic component that the geomembrane will be deployed over (i.e., the same condition as the geomembrane to be seamed). The trial seam sample shall be at least 42-inches long and 12-inches wide with the seam centered lengthwise. A one-foot length of each trial seam sample shall be submitted to the CQA CONSULTANT for archive. Cut 1-inch wide specimens and test at least three for peel adhesion and two for bonded seam strength (shear). Specimens that will be subjected to peel and shear tests shall be selected alternately from the trial weld sample. Each double wedge welded seam specimen shall be tested for peel on both sides of the weld. A specimen passes when:

1. The break is film-tear bond (FTB), as defined in publication EPA/600/2-88/052 ("Lining of Waste Containment and Other Impoundment Facilities"), Appendix N.
2. The break is ductile.
3. The strength of breaks for the trial seam testing shall conform to the values listed in Table 02751-1, included at the end of this Section.

N. A trial seam sample passes when all specimens have passing results in peel and shear tests. If a specimen fails (one of the specimens fails in either peel or shear mode), the trial seam procedure shall be repeated in its entirety. If the repeated trial seam fails, the seaming apparatus or operator may not weld until the deficiencies or conditions are corrected and two consecutive passing field trial seams are achieved.

O. The following procedures shall by followed during cold weather conditions.

1. Geomembrane surface temperatures shall be determined by the CQA CONSULTANT at intervals of at lease once per 100 feet of seam length to determine if preheating is required. For extrusion welding, preheating is required if the surface temperature of the geomembrane is below 32°F.
2. For fusion welding, preheating may be waived by the OWNER based upon a recommendation by the CQA CONSULTANT, if the Geosynthetic CONTRACTOR demonstrates to the CQA CONSULTANT'S satisfaction that welds of equivalent quality may be obtained without preheating at the expected temperature of installation.
3. If preheating is required, the CQA CONSULTANT shall observe all areas of geomembrane that have been preheated by a hot air device prior to seaming to ensure that they have not been overheated.
4. Care shall be taken to confirm that the surface temperatures are not lowered below the minimum surface temperatures specified for welding due to winds or other adverse conditions. It may be necessary to provide wind protection for the seam area.
5. All preheating devices shall receive approval by the CQA CONSULTANT prior to use.
6. Additional destructive tests shall be taken at an interval between 250 and 500 feet of seam length, at the discretion of the CQA CONSULTANT.
7. Sheet grinding may be performed before preheating, if applicable.
8. Trial seaming shall be conducted under the same ambient temperature and preheating conditions as the production seams. Under cold weather conditions, new trial seams shall be conducted if the ambient temperature drops by more than 10°F from the initial trial seam test conditions. Such new trial seams shall be conducted upon completion of seams in progress during the temperature drop.

P. The following procedures shall be followed during hot weather conditions.

1. At ambient temperatures above 110°F, no seaming of the geomembrane shall be permitted unless the Geosynthetic CONTRACTOR can demonstrate to the satisfaction of the CQA CONSULTANT that the geomembrane seam quality is not compromised. Trial seaming shall be conducted under the same ambient

temperature conditions as the production seams. At the option of the CQA CONSULTANT, additional destructive testing may be required for any suspect areas.

3.05 FIELD QUALITY CONTROL

A. The Geosynthetic CONTRACTOR shall designate a full-time Quality Control (QC) Technician who shall be responsible for supervising and/or conducting the field quality control program. The QC Technician shall not be replaced without written authorization by the OWNER.

B. Non-Destructive Seam Testing

1. The Geosynthetic CONTRACTOR shall non-destructively test field welds for continuity over their full length. The non-destructive testing shall be performed concurrently with seaming work progress, not at the completion of all seaming. Any defects located in the seam shall be repaired in accordance with Item 3.06 of this Section. The following non-destructive testing procedures shall be used to test the field seams for continuity.

   a. Vacuum box testing for extrusion welds.

   b. Air pressure testing for dual-wedge fusion seams.

2. Vacuum Box Testing

   a. The vacuum box testing equipment shall consist of the following:

      i. Rigid housing; transparent viewing window; a soft rubber gasket attached to the bottom of the housing; porthole or valve assembly; and a vacuum gauge.
      ii. A vacuum pump capable of applying 5 psi gage pressure of vacuum to the box.
      iii. A bucket of soapy solution and applicator.

   b. The procedure for vacuum testing shall be as follows:

      i. Clean window, gasket surfaces, and check box assembly for leaks.
      ii. Energize vacuum pump and reduce tank pressure to approximately 5 psi.
      iii. Wet a strip of geomembrane seam approximately 12 inches by 30 inches (length of box) with soapy solution.
      iv. Place box over wetted area and compress.
      v. Close bleed valve and open vacuum valve.
      vi. Ensure that a leak-tight seal is created.
      vii. Examine length of weld through viewing window for presence of soap bubbles for a period of not less than 10 seconds.
      viii. If no bubbles appear after 10 seconds, close vacuum valve and open bleed valve, move box over next adjoining area with minimum three inches overlap from the previous tested area and repeat process.
      ix. Areas where soap bubbles appear shall be marked by the CQA CONSULTANT with a defect code. The Geosynthetic

CONTRACTOR shall then repair these areas in accordance with Item 3.06 of this Section and then retest the repaired area.

3. Air Pressure Testing (Dual-Wedge Fusion Seams Only)

   a. The air pressure testing equipment shall consist of the following:

      i. An air pump, equipped with pressure gauge having an accuracy of 1 psi, capable of generating and sustaining a pressure of 30 psi, and mounted on a cushion to protect the geomembrane.
      ii. Rubber hose with fittings and connections.
      iii. Sharp hollow needle or other pressure feed device approved by the OWNER.

   b. To perform the test:

      i. Seal both ends of the seam to be tested.
      ii. Insert a needle or other approved pressure feed device into air tunnel created by dual-wedge seaming and insert a protective cushion between air pump and underlying geomembrane.
      iii. Energize air pump to 28 to 30 psi, close valve, and sustain pressure for a minimum of 5 minutes.
      iv. If loss of air pressure in the tunnel exceeds 2 psi over 5 minutes or if this pressure does not stabilize, locate the faulty seam area and repair in accordance with Item 3.06 of this Section.
      v. Release pressure at opposite end of seam from gauge (i.e., by cutting the seam) to verify that the seam is not blocked.
      vi. Remove approved pressure feed device and seal penetration holes by extrusion welding.

C. Destructive Seam Testing

1. For destructive seam testing, the CQA CONSULTANT shall be provided with a minimum of one sample per 500 feet of seam length by each welding apparatus. The location shall be selected by the CQA CONSULTANT; the Geosynthetic CONTRACTOR shall not be informed of the destructive sample location in advance. The Geosynthetic CONTRACTOR shall visually observe, mark, and repair suspect welds before release of a section to the CQA CONSULTANT for destructive sample marking. Cut destructive samples as seaming and non-destructive testing progresses, prior to completion of geomembrane installation. The CQA CONSULTANT shall mark destructive samples with consecutive numbering, location, apparatus I.D., technician I.D., Engineer I.D., and apparatus settings and date. Record, in written form, weld and test date, time, location, seam number, ambient temperatures, machine settings, technician I.D., apparatus I.D., and pass or fail description. The Geosynthetic CONTRACTOR shall immediately repair holes in geomembrane resulting from obtaining destructive samples and shall vacuum test the resulting patches. The size of destructive samples shall be 12 inches wide by 44 inches long with the seam centered lengthwise.
2. Two 1-inch wide specimens shall be taken, one at each end of the sample, and tested by the Geosynthetic CONTRACTOR for peel and shear in the field prior

to CQA destructive testing. If any of these specimens fail, the Geosynthetic CONTRACTOR shall track the failure immediately. The remaining sample shall be cut into three 14-inch long by 12-inch wide pieces and distributed as follows:

a. To the CQA CONSULTANT for destructive testing.

b. To the CQA CONSULTANT for archive.

c. To the Geosynthetic CONTRACTOR for its use.

3. Ten 1-inch wide specimens shall be taken from one piece. Five specimens shall be tested for peel and five for shear in accordance with the CQA Plan. Specimens that will be subjected to peel and shear tests shall be selected alternately from the sample. Each fusion wedge welded seam specimen shall be tested for peel on both sides of the weld. A destructive sample shall be considered passing when all 10 specimens meet the following criteria:

   a. The break is FTB.

   b. The break is ductile.

   c. The strength of breaks for the trial seam testing shall conform to the values listed in Table 02751-1, included at the end of this Section.

4. In the event of sample failure, the procedures for failed seam tracking are:

   a. Retrace welding path a minimum of 10 feet in both directions from the failed test location and remove (at these locations) a one inch wide specimen for testing. Repeat tracking procedures until the Geosynthetic CONTRACTOR is confident of seam quality.

   b. Obtain destructive samples from each side of the welding path and give samples to the CQA CONSULTANT for destructive testing.

   c. Repeat process if additional tests fail.

   d. Reconstruct seam between passing test locations to the satisfaction of the CQA CONSULTANT.

   e. Reconstruction may be one of the following:

      i. Cut out old seam, reposition panel and re-seam.
      ii. Add cap strip.

   f. Cut additional destructive samples from reconstruction at discretion of CQA CONSULTANT.

   g. If additional destructive sample results are not acceptable, repeat process until reconstructed seam is judged satisfactory by the CQA CONSULTANT.

D. For final seaming inspection, check the seams and surface of geomembrane for defects, holes, blisters, undispersed raw materials, or signs of contamination by foreign matter. Brush, blow, or wash geomembrane surface if dirt inhibits inspection.

The CQA CONSULTANT shall decide if cleaning of geomembrane surface and welds is needed to facilitate inspection. Distinctively mark repair areas and indicate required type of repair.

E. At the discretion of the OWNER, the 40-mil smooth HDPE geomembrane seams may not require non-destructive or destructive testing.

3.06 REPAIR PROCEDURES

A. The geomembrane shall be inspected before and after seaming for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be swept or washed by the Geosynthetic CONTRACTOR if surface contamination inhibits inspection. The Geosynthetic CONTRACTOR shall ensure that an inspection of the geomembrane precedes any seaming of that section.

B. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

C. Repair, removal, and replacement shall be at the Geosynthetic CONTRACTOR'S expense.

D. Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or non-destructive test. The Geosynthetic CONTRACTOR shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the CQA CONSULTANT and the Geosynthetic CONTRACTOR. Procedures available include:

1. Patching: Used to repair holes (over ¼-inch diameter), tears (over ¼-inch long), undispersed raw materials, and contamination by foreign matter.
2. Grinding and welding: Used to repair pinholes, blemishes, and over-grinding.
3. Capping: Used to repair large lengths of failed seams.
4. Removing the seam and replacing with a strip of new material.

E. In addition, the following procedures shall be observed:

1. Geomembrane surfaces to be repaired shall be abraded (extrusion welds only) no more than ½ hour prior to the repair.
2. All geomembrane surfaces shall be clean and dry at the time of repair.
3. The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the CQA CONSULTANT.
4. Extend patches or caps at least 6 inches beyond the edge of the defect, i.e., be a minimum of 12 inches in diameter, and round all corners of material to be patched.
5. Bevel the edge of the patch and do not cut patch with repair sheet in contact with geomembrane. Temporary bond the patch to the geomembrane with an approved method, extrusion weld the patch, and then vacuum test the repair.

F. Repair Verification:

1. The CQA CONSULTANT shall number and log each repair.
2. Non-destructively test each repair using methods specified in this Section.
3. Provide daily documentation of non-destructive and destructive testing to the CQA CONSULTANT. The documentation shall identify seams that initially failed testing and include any evidence that these seams were repaired and retested successfully.

3.07 ACCEPTANCE

A. The Geosynthetic CONTRACTOR shall retain ownership and responsibility for the geomembrane until acceptance by the OWNER.

B. Acceptance Criteria: The following shall be completed:

1. Verification of adequacy of field seams, repairs, and testing by the CQA CONSULTANT.
2. All submittals.
3. "As-built" drawings approved and final drawings submitted.
4. Construction area cleaned.
5. Final field inspection.
6. Warranty signed over to the OWNER.

C. Field Inspections: Inspect the completed work with the OWNER; defects, wrinkles, suspicious looking welds shall be noted and marked; document, correct, and arrange further field inspections until no further corrective action is necessary.

TABLE 02751-1
REQUIRED PHYSICAL PROPERTIES OF 40- and 60-MIL HDPE GEOMEMBRANE

PROPERTY	METHOD	VALUE	
		60 mil Textured HDPE	40 mil Smooth HDPE
Thickness, mil	ASTM D 5994	- 57 mils minimum average - 54 mils lowest individual value for 8 out of 10 specimens - 51 mils lowest individual value for any of the 10 specimens	- 36 minimum average
Sheet Density (min. avg.)	ASTM D 792 or ASTM D 1505	0.940 g/cc	0.940
Asperity Height, mil(1)	ASTM D7466	- 10 mils minimum average - 8 of 10 readings ≥ 7 mils - lowest individual reading ≥ 5 mils	Not Applicable (N/A)
Tensile Properties (min. avg.)(2) • Tension at Yield (lb/in) • Strain at Yield (%) • Tension at Break (lb/in) • Strain at Break (%)	ASTM D6693 Type IV	 126 lb/in 12% 90 lb/in 100%	 84 lb/in 12% 60 lb/in 100%
Tear Resistance, lbs. (min. avg.)	ASTM D1004, Die C	42 lbs	28 lbs
Oxidative Induction Time (OIT) (min. avg.) • Standard OIT, or • High Pressure OIT	 ASTM D3895 ASTM D5885	 100 minutes 400 minutes	 100 minutes 400 minutes
Oven Aging at 85°C (min. avg.) • Standard OIT (min. avg.), % retained after 90 days, or • High Pressure OIT (min. avg.), % retained after 90 days	 ASTM D5721 ASTM D3895 ASTM D5885	 55% retained after 90 days 80% retained after 90 days	 55% retained after 90 days 80% retained after 90 days
UV Resistance (min. avg.) • High Pressure OIT (min. avg.), retained after 1,600 hr	GRI-GM11 ASTM D5885	50% retained after 1,600 hours	50% retained after 1,600 hours
Stress Crack Resistance (min.)(3)	ASTM D5397 (Appendix)	300 hours with no failures	300 hours with no failures
Puncture Resistance, lbs. (min. avg.)	ASTM D4833	90 lbs	60 lbs
Carbon Black Content (range)	ASTM D1603	2.0 – 3.0%	N/A
Carbon Black Dispersion	ASTM D5596	- min 9 out of 10 specimens in Cat. 1 or 2 - all in Cat. 1, 2, or 3	N/A
Seam Strength (min. avg.) • Peel (lb/in) • Shear (lb/in)	 ASTM D6392	 90 lb/in 120 lb/in	 60 lb/in 80 lb/in

Notes:
(1) Alternate the measurement side for double-sided textured sheets.
(2) Elongation at yield and elongation at break shall be calculated using a gage length of 1.3 inches and 2.0 inches, respectively.
(3) Test is not applicable for textured geomembranes. Test should be performed on the smooth edges of textured rolls or on smooth rolls made from same formulation as textured rolls.

END OF SECTION

SECTION 02752

GEOTEXTILES

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes the general requirements for the manufacture, supply, installation, and quality control (QC) of geotextiles.

1.02 RELATED SECTIONS

A. Section 02200 – Earthwork

B. Section 02751 – HDPE Geomembranes

1.03 REFERENCES

A. Latest version of the following American Society for Testing and Materials (ASTM) standards:

1. ASTM D4355. Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.

2. ASTM D4632. Standard Test Method for Breaking Load and Elongation of Geotextiles (Grab Method).

3. ASTM D4833. Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

4. ASTM D4873. Standard Guide for Identification, Storage, and Handling of Geotextiles.

5. ASTM D5199. Standard Test Method for Measuring Geotextiles.

6. ASTM D5261. Standard Test Method for Measuring Mass Per Unit Area of Geotextiles.

1.04 SUBMITTALS

A. Quality Control Submittals:

1. A copy of the manufacturer's quality control (QC) plan.

2. Manufacturing QC certificates for each production run. The certificates shall identify the origin and the manufacturer of the resin. The certificates shall be signed by responsible parties employed by the manufacturer (such as the production manager). Tests shall be performed at the frequency indicated in the manufacturer's QC Plan.

3. The QC certificates shall include roll numbers and identification, sampling procedures, and results of quality control tests verifying that each of the properties

listed in Table 02752-1 is met. Samples shall be tested at a minimum frequency of once every 100,000 sf. The manufacturer quality control tests to be performed include the tests specified in Article 2.01 of this section.

4. Manufacturer's certification that the geotextile products meet or exceed specified requirements and are 100% free of needles.

B. The Geosynthetic CONTRACTOR shall submit the following.

1. Installation plan; and

2. Proposed seam stitching methods.

C. Submittals shall be in accordance with Section 01300.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with the CQA Plan.

1.06 QUALIFICATIONS

A. Geotextile shall be supplied by a geotextile manufacturer meeting the following qualification requirements:

1. The geotextile manufacturer shall be responsible for the production and delivery of geotextile rolls and shall be a well-established firm with more than two years experience in the manufacture of geotextiles. The geotextile manufacturer shall submit a statement to the CQA CONSULTANT listing:

a. Certified minimum average roll property values of the proposed geotextiles and the test methods used to determine those properties.

b. Projected delivery date of the material for this project.

B. The Geosynthetic CONTRACTOR shall meet the requirements of the CQA Plan.

PART 2 PRODUCTS

2.01 MATERIALS

A. Non-woven geotextiles shall have the following minimum average roll value (MARV) properties:

TABLE 02752-1

REQUIRED PHYSICAL PROPERTIES OF GEOTEXTILE

Fabric Property	ASTM Test Method	Manufacturer QC Test Frequency [1]	Required Test Values
Mass Per Unit Area (min. ave.)	D5261	1 per 100,000 sf	12 oz/sy
Grab Strength (min. ave.)	D4632	1 per 100,000 sf	300 lbs
Puncture Strength (min. ave.)	D4833	1 per 100,000 sf	150 lbs
UV Resistance (min.)	D4355	1 per resin formulation	70 percent [2]

Notes: (1) Manufacturer may elect to provide certification of values for geotextiles.
(2) After 500 hours of exposure.

B. Geotextile shall be non-woven, needle-punched polyester or polypropylene fabric free from needles or other foreign material.

2.02 DELIVERY, STORAGE, AND HANDLING

A. Handling, storage, and care of the geotextiles following transportation to the site shall be the responsibility of the CONTRACTOR. The CONTRACTOR shall be liable for all damage to the materials incurred prior to final acceptance of the liner system by the CQA CONSULTANT.

B. The CONTRACTOR shall be responsible for storage of the geotextile at the site after the material is delivered. The geotextile shall be stored off the ground and out of direct sunlight, and shall be protected from mud, dirt, dust, and any additional storage procedures required by the Geotextile manufacturer.

C. All rolls of geotextile shall be identified at the factory with the following:

1. Manufacturer's name
2. Product identification
3. Lot Number
4. Roll number
5. Roll dimensions

D. Geotextiles shall be handled in a manner as to ensure they are not damaged in any way.

E. Precautions shall be taken to prevent damage to underlying materials during placement of the geotextile.

F. After unwrapping the geotextile from its cover, the geotextile shall not be left exposed for a period in excess of 30 days.

PART 3 EXECUTION

3.01 INSTALLATION

A. Geotextile seams shall be continuously sewn or heat bonded. Geotextile seams shall be overlapped a minimum of 6 inches prior to sewing. No horizontal seams shall be allowed on slopes steeper than 5 horizontal to 1 vertical.

B. Polymeric thread, with chemical resistance properties equal to or exceeding those of the geotextile, shall be used for all sewing. The seams shall be sewn using Stitch Type 401. The seam type shall be Federal Standard Type SSa-1.

C. The CONTRACTOR shall examine the entire geotextile surface after installation to ensure that no potentially harmful foreign objects are present. Such foreign objects shall be removed and damaged geotextile shall be repaired or replaced at no cost to OWNER.

D. Use care not to damage underlying materials during installation.

E. Prevent the geotextile from accumulating excessive dust.

F. The CONTRACTOR shall be responsible for field handling, storing, deploying, seaming or connecting, temporary restraining (against wind), anchoring, and other aspects of geotextile installation. Specifically, the CONTRACTOR shall follow the guidelines in ASTM D4873 regarding the placement, handling and storage or geotextiles.

G. The CONTRACTOR shall accept and retain full responsibility for all materials and installation and shall be held responsible for any defects in the completed system.

H. No equipment shall operate directly on the geotextile.

I. Use sandbags or other acceptable anchorage to prevent wind uplift.

3.02 REPAIRS

A. Any holes or tears in the geotextile shall be repaired using a geotextile patch consisting of the same geotextile.

1. On slopes inclined steeper than 10 horizontal to 1 vertical, patches shall be sewn into place with a minimum 6-inch overlap.

2. On slopes inclined at 10 horizontal to 1 vertical or less, patches may be heat-bonded with a 6-inch overlap in all directions.

END OF SECTION

SECTION 02774

GEOCOMPOSITE

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes the general requirements for the manufacture, supply, installation, and quality control (QC) of geocomposite.

1.02 RELATED SECTIONS

A. Section 02200 - Earthworks

B. Section 02751 - HDPE Geomembranes

C. Section 02752 – Geotextiles

1.03 REFERENCES

A. Latest version of the following American Society for Testing and Materials (ASTM) standards:

1. ASTM D413. Standard Test Method for Rubber Property-Adhesion to Flexible Substrate

2. ASTM D792. Test Method for Specific Gravity and Density of Plastics by Displacement

3. ASTM F904. Standard Test Method for Comparison of Bond Strength or Ply Adhesion of Similar Laminates Made from Flexible Materials

4. ASTM D1238. Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer

5. ASTM D1505. Standard Test Method for Density of Plastics by Density - Gradient Technique

6. ASTM D1603. Test Method for Carbon Black in Olefin Plastics

7. ASTM D3786. Standard Text Method for Hydraulic Bursting Strength of Knitted Goods and Non-woven Fabrics: Diaphragm Bursting Strength Test Method

8. ASTM D4491. Standard Test Methods for Water Permeability of Geotextiles by Permittivity

9. ASTM D4533. Standard Test Method for Trapezoid Testing Strength of Geotextiles

10. ASTM D4632. Standard Test Method for Breaking Load and Elongation of Geotextiles (Grab Method)

11. ASTM D4716. Standard Test Method for Constant Head Hydraulic Transmissivity (in-plane flow) of Geotextiles and Geotextile Related Products

12. ASTM D4751. Standard Test Method for Determining Apparent Opening Size of a Geotextile

13. ASTM D4833. Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

14. ASTM D5199. Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

15. ASTM D5261. Standard Test Method for Weight (Mass) Per Unit Area of Geotextiles

1.04 SUBMITTALS

A. Geosynthetic CONTRACTOR shall submit to the CQA CONSULTANT the following documentation on the raw materials used to manufacture the geocomposite:

1. Quality control certificates issued by the raw material supplier including the production dates of the raw material used to manufacture geocomposite for the project.

2. Results of tests conducted by the manufacturer to verify the quality of the resin used to manufacture the geocomposite rolls assigned to the project and the origin of the resin and quality control certificates issued by the resin supplier.

3. Certification that no reclaimed polymer was used in the manufacturing of the geocomposite to be used for the project and that recycled material reworked from the manufacturing process does not exceed 10 percent by weight.

B. A copy of the manufacturer's Quality Control (QC) Program.

C. Quality control certificates for test results at the sampling frequency indicated by the manufacturer's QC Plan shall be submitted.

1. Manufacturing quality control certificates for each shift's production shall be signed by responsible parties employed by the manufacturer (such as the production manager).

2. The quality control certificates shall include:

a. Roll numbers and identification;

b. Sampling procedures; and

c. Results of the quality control tests verifying each of the properties listed in Table 02774-1.

D. Submittals shall be provided in general accordance with Section 01300.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with manufacturer's instructions and the CQA Plan.

1.06 QUALIFICATIONS

A. Manufacturer shall be a well-established firm with more than two years of experience in the manufacture of geocomposites.

B. Geosynthetic CONTRACTOR shall meet the requirements of the CQA Plan.

PART 2 PRODUCTS

2.01 MATERIALS

A. The geocomposite to be used on the project shall comprise HDPE bi-planar geonet drainage material with a non-woven, needle-punched geotextile bonded to the top and bottom. The geotextile will be thermally bonded to the geonet component of the geocomposite. Chemical bonding is not allowed.

B. Geocomposite shall meet the minimum properties listed in Table 02774-1.

2.02 DELIVERY, STORAGE, AND HANDLING

A. The Geosynthetic CONTRACTOR shall be responsible for handling, storage, and care of the geocomposites following transportation to the site. The Geosynthetic CONTRACTOR shall be liable for all damage to the materials incurred prior to final acceptance of the liner system by the CQA CONSULTANT.

B. The geocomposite shall be stored off the ground and out of direct sunlight, and shall be protected from mud, dirt, dust, and any additional storage procedures required by the manufacturer.

C. All rolls of geocomposite shall be identified at the factory with the following:

1. Manufacturer's name
2. Product identification
3. Lot Number
4. Roll number
5. Roll dimensions

D. The geocomposites shall be handled in such a manner as to ensure they are not damaged in any way.

E. Precautions shall be taken to prevent damage to underlying layers during placement of the geocomposite.

F. After unwrapping the geocomposite from its cover, the geocomposite shall not be left exposed for a period in excess of 30 days.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that other work is complete over the areas where the geocomposite is to be deployed.

3.02 PREPARATION

A. Protect elements surrounding the work of this section from damage.

3.03 INSTALLATION

A. The geocomposite shall be installed in accordance with the manufacturer's recommended procedures and the CQA Plan.

B. The CQA CONSULTANT shall verify that all geocomposite rolls and underlying layers are free from deleterious material or debris prior to the geocomposite deployment. Dirt entrapped in the geocomposite following deployment shall be cleaned or affected geocomposite removed and replaced prior to placement of successive layers.

C. The Geosynthetic CONTRACTOR is responsible for anchoring exposed geocomposite to protect against wind damage until subsequent layers are placed.

D. The geocomposite shall not be welded to the geomembrane unless specified otherwise.

E. The geocomposite shall only be cut utilizing methods and tools (i.e., a hooked utility blade) which will not damage the geocomposite.

F. The geonet component of the geocomposite shall be overlapped a minimum of 4 inches between adjacent panels and shall be fastened by nylon ties. Ties shall be yellow or white for easy inspection. No metallic materials are allowed. Ties shall be placed every 5 feet along the lengths of adjacent panels, every 6 in. across butt-seams, and every 6 in. in any anchor trench.

G. In general, butt-seams will only be allowed on grades less than 15%. Butt-seams shall be overlapped a minimum of two feet and be secured with two rows of ties a minimum of 6 in. apart. Ties shall be spaced at six inch intervals and staggered between rows.

H. The top geotextile component shall be overlapped a minimum of 6 in. and shall be continuously sewn. Leister seaming shall be allowed following a field demonstration of performance and approval by the Design Engineer.

I. Polymeric thread, with chemical resistance properties equal to or exceeding those of the geotextile, shall be used for all sewing. The seams shall be sewn using Stitch Type 401. The seam type shall be Federal Standard Type SSa-1.

J. The Geosynthetic CONTRACTOR shall be responsible for field handling, storing, deploying, seaming or joining, temporary restraining (against wind), anchoring, and other aspects of geocomposite installation.

K. The Geosynthetic CONTRACTOR shall accept and retain full responsibility for all materials and installation and shall be held responsible for any defects in the completed systems.

3.04 REPAIRS

A. Any defects observed in the geocomposite shall be brought to the attention of the CQA CONSULTANT.

B. Holes or tears in the geocomposite shall be repaired with geocomposite patches extending 2 feet beyond the edges of the hole or tear. The patch shall be secured in place by using approved ties spaced at 6 inches. The ties shall extend though the geonet component of the patch and through the geotextile and geonet components of the geocomposite requiring repair. The upper geotextile component of the patch shall be heat bonded to the geotextile component of the geocomposite requiring repair.

C. If only the upper geotextile is damaged, then it may be repaired by heat-bonding a geotextile patch of equal weight.

3.05 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed in accordance with the CQA Plan.

3.06 PROTECTION

A. Do not permit traffic over any of the Products related to this Section.

B. The CONTRACTOR shall place all soil materials in such a manner as to ensure that:

1. The geocomposite and underlying materials are not damaged;

2. Minimal slippage occurs between the geocomposite and the underlying geosynthetic layers; and

3. Excess tensile stresses are not developed in the geocomposite.

TABLE 02774-1
GEOCOMPOSITE PROPERTY VALUES

PROPERTY	UNITS	SPECIFIED VALUES	TEST METHOD
Geonet Component:			
Thickness	mils	200	ASTM D-751 or ASTM D-5199
Density	g/cc	0.940	ASTM D-792 or ASTM D-1505
Carbon Black Content (range)	%	2-3	ASTM D-1603
Geotextile Component:			
Mass	oz/yd^2	8	ASTM D-5261
Grab Tensile	Lb	220	ASTM D-4632
Puncture	Lb	120	ASTM D-4833
AOS	Mm	0.180	ASTM D-4751
Permeability	Sec^{-1}	1.5	ASTM D-4491
UV Resistance)	% retained after 500 hr.	70	ASTM D-4355
Finished Geocomposite:			
Transmissivity	m^2/sec	1×10^{-3} (see notes 1 and 2 below)	ASTM D-4716
Peel Strength	lb/in.	0.75	GRI GC7

Notes:

1. Required value shall be taken from manufacturer's standard material specification sheet for the selected geonet/geocomposite material. Geonet/geocomposite selection shall be based on the material's ability to meet or exceed the transmissivity identified in the site's design.

2. Transmissivity shall be measured in a 12-inch by 12-inch box with the geocomposite between steel plates under a normal stress of 15,000 psf and a hydraulic gradient of 0.1. A seating time of 15 minutes shall be used.

3. The geotextile component shall conform to the requirements contained in Section 02752 of these Specifications, except that the values listed in Table 02774-1 above take precedence over those in Section 02752.

END OF SECTION

APPENDIX O.2
FINAL CLOSURE SPECIFICATIONS

Golder Associates Inc.

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TECHNICAL SPECIFICATIONS
LANDFILL UNIT B-18 FINAL CLOSURE
KETTLEMAN HILLS FACILITY
KETTLEMAN CITY, CALIFORNIA

Prepared for:

Waste Management, Inc.
Kettleman Hills Facility
35251 Old Skyline Road
Kettleman City, California 93239

Prepared by:

Golder Associates Inc.
230 Commerce, Suite 200
Irvine, California 92602

November 2008
Revision 0

Project No.: 083-91887

TABLE OF CONTENTS

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

A. The section describes the general requirements for the final closure construction of Landfill Unit B-18 at the Kettleman Hills Facility located outside of Kettleman City, California. The Work will consist of excavation, engineered fill placement, subgrade preparation, installation of a composite geosynthetic liner system, and placement of a vegetative cover soil layer.

1.02 CONTRACTOR'S RESPONSIBILITIES:

A. Start, lay out, construct, and complete the Project in accordance with the Contract Documents;

B. Provide a competent superintendent, capable of reading and understanding the Contract Documents, who shall receive instructions from the OWNER or his authorized representative. The superintendent shall have full authority to execute the Work in accordance with the Contract Documents;

C. The CONTRACTOR shall be responsible for transporting, permitting, and/or conveying all required construction water.

D. Pay costs of legally required sales, consumer, and use taxes, and governmental fees.

E. Forward submittals and communications to the CONSTRUCTION MANAGER. Where applicable, the CONSTRUCTION MANAGER will coordinate submittals and communications with the representatives who will give approvals and directions through the CONSTRUCTION MANAGER.

F. Maintain order, safe practices and proper conduct at all times among CONTRACTOR's employees. The OWNER, and its authorized representative, may require that disciplinary action be taken against an employee of the CONTRACTOR for disorderly, improper, and unsafe conduct. Should an employee of the CONTRACTOR be dismissed from his duties for misconduct, incompetence, or unsafe practice, or combination thereof, that employee should not be rehired for the duration of the Work.

G. Coordinate prosecution of the Work with the utilities, private utilities, or OWNER performing work on or adjacent to the work site; either eliminate, or minimize as far as possible, delays in the Work and conflicts with those utilities or contractors. Coordinate utility activities, and activities of OWNER, with the CONSTRUCTION MANAGER. Schedule private utility and public utility work relying on survey points, lines, and grades established by the CONTRACTOR to occur immediately after those points, lines and grades have been established. Confirm coordinate measures for each individual case with the CONSTRUCTION MANAGER by memorandum.

J. Coordinate activities of the several trades, suppliers, and subcontractors, if any, performing the Work.

K. Obtain all necessary building and construction permits. Permit fees will be paid by the OWNER.

1.03 RESERVED

1.04 CONFORMANCE

A. Work shall conform to the following Drawings that form a part of these Contract Documents.

SHEET NO.	TITLE
T-1	TITLE SHEET
C-1	SITE PLAN
C-2	EXISTING CONDITIONS (AS OF MARCH 28, 2008)
C-3	BASE LINER PLAN
C-4	FINAL CLOSURE PLAN
C-5	CROSS-SECTIONS A TO D
C-6	CROSS-SECTIONS E TO I
C-7	PHASE III BASE LINER CONSTRUCTION DETAILS
C-8	PHASE III LCRS DETAILS
C-9	DRAINAGE DETAILS
C-10	CLOSURE DETAILS

1.05 DEFINITIONS

OWNER	The term OWNER means Kettleman Hills Facility with whom the CONTRACTOR has entered into the Agreement and for whom the Work is to be provided.
CONSTRUCTION MANAGER	The term CONSTRUCTION MANAGER means the representative of the OWNER for the purpose of administration and inspection of the Work. The CONSTRUCTION MANAGER may be a member or group of the staff or may be an external firm. The OWNER will inform the CONTRACTOR in writing at the start of the Work who the CONSTRUCTION MANAGER will be. During the period of Work the CONSTRUCTION MANAGER will act as an authorized representative of the OWNER.
DESIGN ENGINEER	The term DESIGN ENGINEER means Golder Associates Inc., the firm responsible for the design and preparation of the construction drawings and specifications. The DESIGN ENGINEER is responsible for approving all design changes, modifications, or clarifications encountered during construction.

CQA CONSULTANT	The term CQA CONSULTANT means the representative of the OWNER for the purpose of conducting CQA testing, monitoring, documenting, and reporting.
CONTRACTOR	The term CONTRACTOR means the firm that is responsible prosecuting the Work. The CONTRACTOR's responsibilities include the Work of any and all subcontractors and suppliers.
Geosynthetics CONTRACTOR	The term Geosynthetics CONTRACTOR means the firm that is responsible for the supply and installation of all geosynthetics including the Work of all of the subcontractors and suppliers. The Geosynthetics Installer may work directly for the OWNER or as a subcontractor to the CONTRACTOR. The Geosynthetics CONTRACTOR is also referred to as the CONTRACTOR.
Work	The term Work means the entire completed construction or various separately identifiable parts, thereof, required to be furnished under the Contract Documents. Work includes any and all labor, services, materials, equipment, tools, supplies, and facilities required by the Contract Documents and necessary for the completion of the project. Work is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.
Working day	A calendar day, exclusive of Saturdays, Sundays, and OWNER's recognized legal holidays, on which weather and other conditions not under the control of the CONTRACTOR will permit construction operations to proceed for the major part of the day with the normal working force engaged in performing the controlling item or items of work which would be in progress at that time. The working day is subject to the conditions and work restrictions outlined in these Specifications.
Regular Working Hours	Between 6:30 a.m. and 6:00 p.m. on allowable work days.
Calendar Days	Each day of the year including all OWNER approved holidays.

1.06 CONTRACT TIMES

A. The CONTRACTOR shall commence Work in accordance with Section 18 of the General Conditions and Section 7 of the Standard Contract.

1.07 CONTRACTOR USE OF WORK SITE

A. Confine work site operations to areas permitted by law, ordinances, permits, and the Contract Documents. The CONTRACTOR shall ensure that all persons under his control (including Subcontractors, their workers and agents) are kept within the boundaries of the Site and shall be responsible for any acts of trespass or damage to property by persons who are under his control. Consider the safety of the Work, and that of people and property on and adjacent to work site, when determining amount, location, movement, and use of materials and equipment on work site.

B. The CONTRACTOR shall be responsible for protecting private and public property including pavements, drainage culverts, electricity, highway, telephone and similar property and making good of, or paying for, all damage caused thereto. Control of erosion throughout the project is of prime importance and is the responsibility of the CONTRACTOR. The CONTRACTOR shall comply with the requirements of the Storm Water Pollution Prevention Plan (SWPPP) provided by the OWNER for the Kettleman Hills Facility and prepare and submit a SWPPP specific to the Work in accordance with requirements of local or state agencies (see Section 01300). The CONTRACTOR shall provide and maintain all necessary measures to control erosion during progress of the Work to the satisfaction of the CONSTRUCTION MANAGER and all applicable Laws and Regulations and remove such measures and debris upon completion of the project. All provisions for erosion and sedimentation control apply equally to all areas of the Work.

C. CONTRACTOR shall promptly notify OWNER and CONSTRUCTION MANAGER in writing of any subsurface or latent physical conditions at the Site which differ materially from those indicated or referred to in the Contract Documents. CONSTRUCTION MANAGER will promptly review those conditions and advise OWNER in writing if further investigations or tests are necessary. Promptly thereafter, OWNER shall obtain the necessary additional investigations and tests and furnish copies to the CONSTRUCTION MANAGER and CONTRACTOR. If CONSTRUCTION MANAGER finds that the results of such investigations or tests indicate that there are subsurface and latent physical conditions which differ materially from those intended in the Contract Documents, and which could not reasonably have been anticipated by CONTRACTOR, a Change Order shall be issued incorporating the necessary revisions.

1.08 PRESERVATION OF SCIENTIFIC INFORMATION

A. Federal and State legislation provides for the protection, preservation, and collection of data having scientific, prehistoric, historical, or archaeological value (including relics and specimens) which might otherwise be lost due to alteration of the terrain as a result of any construction work.

B. If evidence of such information is discovered during the course of the Work, the CONTRACTOR shall notify the CONSTRUCTION MANAGER immediately, giving

the location and nature of the findings. Written confirmation shall be forwarded within two (2) working days. The CONTRACTOR shall exercise care so as not to damage artifacts uncovered during excavation operations, and shall provide such cooperation and assistance as may be necessary to preserve the findings for removal or other disposition by the OWNER's representative or Government agency.

C. Where appropriate, by reason of a discovery, the OWNER may order delays in the time of performance, or changes in the Work, or both. If such delays, or changes, or both, are ordered, the time of performance and contract price shall be adjusted in accordance with the applicable clauses of the Contract.

1.09 EXISTING UTILITIES

A. The CONTRACTOR shall be responsible for locating, protecting, flagging, and identifying all existing utilities. The CONTRACTOR shall request that Underground Service Alert (USA) locate and identify the existing utilities. The request shall be made 48 hours in advance.

B. Costs resulting from damage to utilities shall be borne by the CONTRACTOR. Costs of damage shall include repair and incidental costs resulting from the unscheduled loss of utility service to affected parties.

C. The CONTRACTOR shall immediately stop work and notify the CONSTRUCTION MANAGER of all utilities encountered or damaged. The CONTRACTOR shall also provide the CONSTRUCTION MANAGER with the exact location of any utilities encountered during construction.

D. If specified by the CONSTRUCTION MANAGER, utility pot holes shall be carefully dug by the CONTRACTOR to identify the presence of underground utilities.

E. Damage to utilities by the CONTRACTOR during pothole operations shall be born by the CONTRACTOR.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

SECTION 01032

INTENT OF DRAWINGS AND SPECIFICATIONS

PART 1 GENERAL

1.01 CONTRACT DRAWINGS ASND SPECIFICATIONS

A. The intent of the Drawings and Specifications is to prescribe a complete work which the CONTRACTOR shall perform in a manner acceptable to the OWNER and in full compliance with the terms of the Contract.

B. The Drawings show general arrangements for the work which shall be used by the CONTRACTOR in the preparation of shop and field drawings. Particular care shall be given to all layouts to make sure all equipment is accessible for operation.

C. The CONTRACTOR shall provide the OWNER with a complete and operable system, even though the Drawings and Specifications may not specifically call out all items of work required of the CONTRACTOR to complete his tasks, incidental appurtenances, materials, and the like and maintenance.

D. The CONTRACTOR is to perform the Work in accordance with the cross-sections, thickness, gradients and dimensions shown on the Drawings. Any deviations must be approved by the DESIGN ENGINEER prior to doing the work.

E. The dimensions on the Drawings are presumed to be correct, but the CONTRACTOR shall be required to check carefully all dimensions prior to beginning the Work. If errors or omissions are discovered by the CONTRACTOR, the CONTRACTOR shall immediately notify the CONSTRUCTION MANAGER in writing and await the CONSTRUCTION MANAGER's notification before proceeding.

1.02 PRECENDENCE OF CONTRACT DOCUMENTS

A. If there is a conflict between Contract Documents, the document highest in precedence shall control. The precedence shall be:

1. Permits.
2. Special Provisions.
3. General Terms and Conditions.
4. Construction Drawings.
5. Technical Specifications.

1.03 CHANGES TO DRAWINGS

A. It is inherent in the nature of construction that some changes in the Drawings and Specifications may be necessary during the course of construction to adjust them to field conditions, and it is the essence of the Contract to recognize a normal and expected margin of change. The CONSTRUCTION MANAGER shall have the right

to make such changes, from time to time, in the Drawings, in the character of the Work as may be necessary or desirable to insure the completion of the Work in the most satisfactory manner without invalidating the Contract.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.01 SUBMITTAL PROCEDURES

A. Transmit each submittal with cover letter to the OWNER.

B. Each submittal shall have a unique submittal number.

C. Submittals shall be numbered sequentially. Re-submittals shall have original number with an alphabetic suffix (A, B, C, etc.) to indicate the sequence of the re-submittal.

D. Identify Project, CONTRACTOR, Subcontractor or supplier; pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.

E. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

F. Provide space for DESIGN ENGINEER and/or CQA CONSULTANT review stamps.

G. Revise and resubmit submittals as required, identify all changes made since previous submittal.

H. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

I. When catalog pages are submitted, applicable items shall be clearly identified.

J. An electronic copy (preferred) or three (3) hard copies of each submittal shall be provided to the OWNER. The OWNER will not accept submittals from anyone other than the CONTRACTOR.

K. The CONTRACTOR shall review all submittal packages prior to transmittal to OWNER for completeness and accuracy.

1.02 CHECK OF RETURNED SUBMITTALS AND WAIVER OF CLAIMS

A. The CONTRACTOR shall check and review the submittals returned for correction and ascertain whether the required corrections result in extra cost above that included in the Contract, and shall give written notice to the CONSTRUCTION MANAGER within five (5) working days if, in the CONTRACTOR's estimation, extra costs result from the corrections. The CONTRACTOR's failure to give such written notice before the starting of the Work covered by returned submittal constitutes a waiver by the CONTRACTOR of claims for extra costs resulting from required corrections. Payment based on such written notice is not approved until authorized by the OWNER.

1.03 PRODUCT DATA SUBMISSION

A. For each product item included in the Work, include the manufacturer's name and address, the trade or brand name, all conditions of manufacturer's guarantee and warranty, information to fully describe each item, and supplementary information as may be required for approval. Mark catalog cuts, brochures, and data to indicate the items proposed and the intended use. Clearly mark product parameters which were specifically called out on the original specifications.

1.04 EQUIPMENT DATA SUBMISSION

A. Submit complete technical, performance, and catalog information for every item of civil, mechanical, and electrical equipment and machinery proposed for installation in the Work. Include information on performance and operating curves, ratings, capacities, characteristics, power efficiencies, manufacturers' standard guarantees and warranties with the terms and conditions fully described, and all other information to fully illustrate and describe the items as may be specified or required for approval.

1.05 SUBMITTAL REVIEW AND ACCEPTANCE

A. The submittal review period shall be ten (10) consecutive work days in length and shall commence on the first working day immediately following the date of arrival of the submittal or re-submittal in the OWNER's office. The time required for mail delivery of the submittal or re-submittal back to the CONTRACTOR shall not be considered a part of the submittal review period.

B. The acceptance of drawings and data submitted by the CONTRACTOR will cover only general conformity to the Drawings and Specifications, external connections, and dimensions which affect the layout. The DESIGN ENGINEER's and/or CQA CONSULTANT's review of submittals shall not relieve the CONTRACTOR from responsibility for errors, omissions, or deviations, nor responsibility for compliance with the contract documents.

1.06 RE-SUBMITTALS

A. When the drawings and data are returned marked "AMEND AND RESUBMIT" or "REJECTED, SEE REMARKS," the corrections shall be made as noted thereon and as instructed by the DESIGN ENGINEER's and/or CQA CONSULTANT's and shall be resubmitted.

B. When corrected copies are resubmitted, the CONTRACTOR shall highlight or otherwise direct specific attention to all revisions and shall list separately those revisions made other than those called for on previous submissions.

C. The need for more than one resubmission shall not entitle the CONTRACTOR to extension of the Contract Time.

1.07 COSTS FOR SUBMITTALS

A. All costs for the preparation, correction, and delivery of the submittals are considered incidental to the contract and shall be included in CONTRACTOR's costs.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 MATERIALS REQUIRING SUBMITTALS

A. The following materials shall require submittals.

1. Material certifications and product data for all geosynthetics;
2. Material quality control data for all geosynthetics;
3. Material certifications and product data for piping;
4. Material quality control data for piping; and
5. Items not fully detailed and specified in the Contract Drawings or these Specifications.

3.02 ITEMS NOT REQUIRING SUBMITTALS

A. A submittal is not required for products and equipment completely specified or salvaged on-site. A submittal is required if the product has not been completely specified or when the specified product is not available within the construction schedule. Substitutions requested by the CONTRACTOR require a submittal.

3.03 CONSTRUCTION SCHEDULE

A. At the pre-construction meeting, the CONTRACTOR shall submit to the CONSTRUCTION MANAGER for review a schedule of the proposed construction operations. The construction schedule shall indicate the sequence of the Work indicating the time of completion of each component of the Work.

B. Submit initial progress schedule in duplicate within ten (10) days after Effective Date of Agreement for CONSTRUCTION MANAGER to review.

C. Revise and resubmit as required.

D. Submit revised schedules with each Application for Payment, identifying changes since previous version.

E. Submit a horizontal bar chart with separate line for each major section of Work or operation, identifying first work day of each week. Include on the bar chart construction/placement rates for all the major items of Work. CONTRACTOR shall develop proposed Construction Schedule on basis of a five or six day working week. Sufficient labor, equipment, and materials shall be provided by CONTRACTOR to complete the Work on a five or six day per week basis. Night work and work on Sundays will only be approved by the OWNER if the Work falls behind the approved Construction Schedule.

F. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the start date, finish date, and duration. At a minimum, the following activities must be shown on the project schedule:

1. Mobilization;
2. Excavation;
3. Subgrade preparation;
4. Placement of the geomembrane;
5. Installation of the geotextile;
6. Placement of the vegetative cover soil;
7. Hydroseeding of the final cover; and
8. Demobilization and site clean-up.

G. Indicate estimated percentage of completion for each item of Work at each submission with Application for Payment.

H. Indicate submittal dates required for shop drawings, product data, samples and product delivery dates.

I. The Construction Schedule as approved by the OWNER will be an integral part of the Contract, and will establish interim Contract completion dates for various activities. Should an activity not be completed within ten (10) days after the stated Schedule date, the CONSTRUCTION MANAGER shall have the option to recommend to the CONTRACTOR to expedite completion of the activity by whatever means deemed appropriate and necessary, without additional compensation to the CONTRACTOR.

J. Should any activity be twenty (20) or more working days behind Schedule, the OWNER shall have the right to perform the activity or to have the activity performed by whatever method the OWNER deems appropriate. Costs incurred by the OWNER in connection with expediting construction activities under this Paragraph shall be reimbursed to the OWNER by the CONTRACTOR.

K. It is expressly understood and agreed that failure by the OWNER to exercise the option to either order the CONTRACTOR to expedite an activity or to expedite the activity by other means shall not be considered precedent-setting for any other activities. The Work shall be executed in strict accordance with the Construction Schedule unless a variance has been received by the CONSTRUCTION MANAGER and approved by the OWNER.

3.04 PROGRESS REPORTS

A. The CONTRACTOR shall submit progress reports as requested indicating work performed and completed that week, quantity of material used, and equipment used to perform the Work.

B. A progress report shall also be furnished to the ENGINEER with each application for progress payment. If the Work falls behind schedule, the CONTRACTOR shall submit additional progress reports at such intervals as the CONSTRUCTION MANAGER may request.

C. Each progress report shall include sufficient narrative to describe current and anticipated delaying factors, their effect on the construction schedule, and proposed corrective actions. Work reported complete, but which is not readily apparent as complete to the CONSTRUCTION MANAGER, must be substantiated with satisfactory evidence.

D. Each progress report shall also include a graphic schedule marked to indicate actual progress. Revised schedules shall be included when warranted.

3.05 MANUFACTURER'S CERTIFICATES

A. When specified in individual Specification Sections, submit manufacturers' certificate to the CQA CONSULTANT for review, in quantities specified for Product Data.

B. Indicate whether material or product conforms to or exceeds specified requirements. Submit supporting reference date, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to the CONSTRUCTION MANAGER.

3.06 RECORD SURVEY AND DRAWINGS

A. The CONTRACTOR shall keep a set of construction drawings on the job and mark in red pencil the as-built conditions.

B. A complete and accurate set of record drawings shall be signed and dated by the CONTRACTOR and shall be labeled with the following, "These record drawings completely and truly represent the contract work as installed."

C. Record drawings shall be delivered to the CONSTRUCTION MANAGER prior to final acceptance of the work by the CONSTRUCTION MANAGER.

D. Record drawings shall show all changes in "clouds" to clearly identify any deviations from the plans.

E. Any utilities uncovered during construction shall be identified on the record drawings.

F. The record survey shall be performed by the CONTRACTOR in accordance with Section 01400, Part 1.04 and shall meet the requirements of these Specifications and the CQA Plan and include, but not be limited to:

1. edges, bottom, and limits of anchor trenches;
2. limits of excavation and fill;
3. subgrades;
4. HDPE panel layout, intersections;
5. destructive test locations on HDPE geomembrane;
6. location and crown elevations of piping;
7. top of the vegetative cover soil layer;
8. grade breaks; and
9. layout and flow line elevations of surface water control structures.

G. Survey of the excavated subgrades and Operations Layer surfaces shall be on a grid with a maximum spacing of 50 feet or an equivalent method approved by the CQA CONSULTANT, with additional elevations at slope change locations. The elevations for the subgrade and top of the Operations Layer shall be at the same grid locations and shall be used to document thickness conformance. The record survey shall include locations and elevations of all other work as directed by the CONSTRUCTION MANAGER.

H. Record drawings shall be prepared to scale, with the scale clearly marked. Record drawings of details may not be to scale, but all dimensions shall be clearly identified. Record drawings shall be submitted to the CQA CONSULTANT for review and approval. Record drawings shall be provided on Bond and electronically in AutoCAD 2005 format or more recent. The DESIGN ENGINEER will provide the base AutoCAD file map. Different elements of the work shall be presented on different layers in the base AutoCAD file provided by the DESIGN ENGINEER.

3.07 HEALTH AND SAFETY PLAN

A. The CONTRACTOR shall submit a Health and Safety Plan in accordance with Section 01810 of these Specifications.

3.08 STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

A. The CONTRACTOR shall prepare and submit a SWPPP specific to the work to the OWNER for approval. The SWPPP shall be consistent with the provisions of the "California Construction Best Management Practice Handbook," the site National Pollutant Discharge Elimination System (NPDES) site permit, and the Kettleman Hills Facility SWPPP. The SWPPP shall include specific measures to protect the Work and comply with the regulations, including specific erosion and sediment controls. The CONTRACTOR is responsible to control storm water run-on, run-off, erosion, and sediment to such an extent as needed to maintain compliance with the SWPPP and protect the Work, protect adjacent landfill operations, and adjacent structures.

END OF SECTION

SECTION 01400

CONSTRUCTION QUALITY CONTROL

PART 1 GENERAL

1.01 CONSTRUCTION QUALITY CONTROL

A. The CONTRACTOR shall be responsible for construction quality control of the Work and all appurtenances as described in these Specifications.

B. The CONTRACTOR shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

C. The CONTRACTOR shall comply fully with manufacturers' instructions, including each step in sequence.

D. Should manufacturers' instructions conflict with Contract Documents, the CONTRACTOR shall request clarification from CONSTRUCTION MANAGER before proceeding.

E. The CONTRACTOR shall comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

F. The CONTRACTOR shall perform work using persons qualified to produce workmanship of specified quality.

G. The CONTRACTOR shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

H. The CONSTRUCTION MANAGER shall determine and decide all questions which may arise as to the quality and acceptability of materials and Work performed; the manner of performance and the rate of progress of said Work; the interpretations of the Contract Documents relating to the Work; the acceptable fulfillment of the Contract Documents on the part of the CONTRACTOR; and the amount and quantity of the several kinds of Work performed and materials which are to be paid for under the Contract.

I. All materials and equipment shall be new and of the specified quality and equal to the samples found to be acceptable by the CQA CONSULTANT, if samples have been submitted.

J. The Work shall be done and completed in a thorough, workmanlike manner, notwithstanding omissions in the Contract Documents; and it shall be the duty of the CONTRACTOR to call the CONSTRUCTION MANAGER's attention to apparent errors or omissions and request instructions in writing before proceeding with the Work.

K. The CONSTRUCTION MANAGER may, by appropriate written instructions, correct errors and omissions. Instructions and corrections shall be as binding upon the CONTRACTOR as though contained in the original Contract Documents.

1.02 CONSTRUCTION QUALITY ASSURANCE

A. Materials, equipment, methods of construction and workmanship shall be subject to the inspection of the CQA CONSULTANT as outlined in the CQA Plan. Defective materials, equipment, or work shall be replaced, corrected or otherwise made good by the CONTRACTOR at the CONTRACTOR's own expense.

B. On all questions concerning the acceptability of materials or equipment, execution of the Work, and the determination of costs, the decision of the CONSTRUCTION MANAGER shall be final and binding upon all parties.

C. The CONTRACTOR shall at all times maintain proper facilities and provide safe access to all parts of the Work, to the shops wherein the Work is in preparation, and to all warehouses and storage yards wherein materials and equipment are stored, for purposes of inspection by the CQA CONSULTANT.

D. The CONTRACTOR shall provide incidental labor and facilities to provide access to 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.

E. Notify CQA CONSULTANT 24 hours prior to expected time for operations requiring inspection services.

F. Retesting required because of non-conformance to specified requirements shall be performed by the CQA CONSULTANT on instructions by the CONSTRUCTION MANAGER. Payment for retesting will be charged to the CONTRACTOR by deducting inspection or testing charges from the Contract Price.

G. Employment of CQA CONSULTANT by OWNER shall in no way relieve the CONTRACTOR of obligations to perform Work in accordance with requirements of Contract Documents.

1.03 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual Specification Sections, required material or Product suppliers or manufacturers shall provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, and quality of workmanship as applicable, and to initiate instructions when necessary.

B. Individuals shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

1.04 SURVEYING

A. At least two control monuments shall be established by the CONTRACTOR at locations convenient for daily tie-in. The vertical and horizontal controls for these

control points shall be established within normal land surveying standards. The CONTRACTOR shall use these control points in laying out and providing ongoing geometric control of the work. The control monuments shall be shown on all record drawings.

B. Surveying shall be performed under the direct supervision of a licensed land surveyor or registered civil engineer authorized to practice land surveying under Chapter 15, Article 3, Section 8731 of the Professional Engineering Act of California, as amended January 1, 1992 who may also be the senior surveyor on site. The survey crew shall consist of the senior surveyor and as many surveying assistants as required to satisfactorily undertake the work. Personnel shall be experienced in all aspects of surveying, including detailed, accurate documentation.

C. The survey instruments used for this work shall be sufficiently precise and accurate to meet the needs of the project. Survey instruments shall be capable of reading to a precision of 0.01 feet and with a setting accuracy of 10 seconds. Calibration certificates for survey instruments shall be submitted on request to the CQA CONSULTANT prior to the initiation of surveying activities.

D. It shall be the CONTRACTOR's sole responsibility to control the Work so that all of the geometric requirements of the project are met. The CONTRACTOR shall immediately notify the CONSTRUCTION MANAGER and the CQA CONSULTANT of any discrepancy found in the Work. It will be the CONSTRUCTION MANAGER's sole prerogative to approve or reject work which does not meet the requirements contained in these Specifications and the Drawings, but which, in the CONSTRUCTION MANAGER's sole opinion, may nevertheless meet the intention of the Contract Documents.

E. The CONTRACTOR shall be responsible for the accuracy of all work and shall maintain all reference points, stakes, etc., throughout the life of the project. Damaged or destroyed points, bench marks or stakes, or any reference points made inaccessible by the progress of the construction shall be replaced or transferred by the CONTRACTOR. Any of the above points shall be referenced by ties to acceptable objects and recorded. Any alternations or revisions in the ties shall be so noted and the information furnished to the CONSTRUCTION MANAGER immediately. All computations necessary to establish the exact position of the work from control points shall be made and preserved by the CONTRACTOR. All computations, survey notes and other records necessary to accomplish the work shall be neatly made and shall be made available onsite for review by the CQA CONSULTANT.

F. During the progress of the construction work, the CONTRACTOR shall be required to furnish all of the surveying and state-out incidental to the proper location by line and grade for each phase of the work. For any operation requiring extreme accuracy, the CONTRACTOR shall restake with pins or other acceptable hubs located directly adjacent to the work at a spacing approved by the CONSTRUCTION MANAGER.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

SECTION 01402

CONTROL OF WORK

PART 1 GENERAL

1.01 AUTHORITY OF THE CONSTRUCTION MANAGER

A. The CONSTRUCTION MANAGER will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed; all questions which may arise as to the interpretation of the Drawings and Specifications; and all questions as to the satisfactory and acceptable fulfillment of the Contract on the part of the CONTRACTOR.

B. The OWNER shall have the authority to stop the Work if odor or dust becomes a nuisance.

1.02 AUTHORITY OF THE CQA CONSULTANT

A. The CQA CONSULTANT employed by the OWNER shall be authorized to monitor all work done and materials and equipment furnished. Such monitoring may extend to all or part of the Work, and to the preparation, fabrication, or manufacture of the materials and equipment to be used. The CQA CONSULTANT will not alter or waive the provisions of the Contract Documents.

B. The CQA CONSULTANT will keep the CONSTRUCTION MANAGER informed as to the progress of the Work and the manner in which it is being done; also, the CQA CONSULTANT will call the CONTRACTOR's attention to non-conformance with the Contract Documents that the CQA CONSULTANT may have observed. The CQA CONSULTANT will not approve or accept any portion of the Work, issue instructions contrary to the Contract Documents, or act as foreman for the CONTRACTOR. The CQA CONSULTANT may reject defective materials, equipment, or work subject to final decision of the CONSTRUCTION MANAGER.

C. The CONSTRUCTION MANAGER may delegate additional authority to the CQA CONSULTANT. In such cases, the CONSTRUCTION MANAGER will notify the CONTRACTOR of such action.

1.03 COORDINATION AND INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. The Specifications, General Conditions, Special Conditions, CQA Plan, Contract Change Orders, and all supplementary documents are essential parts of the Contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be coordinated and to describe and provide for a complete work.

B. Should it appear that the Work or other matters relative thereto are not sufficiently detailed or explained in the Contract Documents, the CONTRACTOR shall apply to the CONSTRUCTION MANAGER for such further explanations as may be necessary and shall conform to them as part of the Contract.

C. In the event of a doubt or question arising regarding the true meaning of the Contract Document, reference shall be made to the CONSTRUCTION MANAGER, whose decision thereon shall be final.

D. In the event of a discrepancy between a drawing and the figures written thereon, and/or the Drawings and the Specifications, the CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing and wait for approval before proceeding. Scaled dimensions shall not be used in the performance of the Work.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 PERFORMANCE REQUIREMENTS

A. The CONTRACTOR shall furnish the CONSTRUCTION MANAGER with every reasonable facility for ascertaining whether or not the Work as performed is in accordance with the requirements and intent of the Specifications and Contract.

B. Should a work be covered before acceptance or consent of the CONSTRUCTION MANAGER, it must, if required by the CONSTRUCTION MANAGER, be uncovered for examination at the CONTRACTOR's expense.

END OF SECTION

SECTION 01565

TEMPORARY FACILITIES

PART 1 GENERAL

1.01 SUMMARY

A. The CONTRACTOR shall provide all temporary facilities and utilities required for prosecuting the Work, protection of employees and the public, protection of the Work from damage by fire, weather or vandalism, and such other facilities as may be specified or required by an applicable law, ordinance, rule, or regulation.

B. The CONTRACTOR must provide their own office space for their needs if necessary. The location of the office shall be approved by the OWNER.

1.02 ELECTRICAL SERVICE

A. Electrical power is not available at the site. The CONTRACTOR shall arrange for temporary electric connection or supply a generator capable of providing the power required to operate tools or equipment or to provide area lighting as needed. Temporary power whether supplied by a utility company or by a generator shall conform to the requirements of the 1993 National Electrical Code, the 1993 National Electrical Safety Code, and all applicable national standards, local regulations and ordinances.

B. The allowable hours of generator operation is the same as the regular working hours for the project. All generators shall be fitted with a residential quality muffler.

1.03 FIRST AID

A. First aid kits meeting the minimum requirements of the Occupational Safety and Health Administration shall be provided in a readily accessible location or locations indicated in the CONTRACTOR's Health and Safety Plan as outlined in Section 01810 of these Specifications.

1.04 CONSTRUCTION FACILITIES

A. Construction hoists, elevators, scaffolds, stages, shoring and. similar temporary facilities shall be of ample size and capacity to adequately support and move the loads to which they will be subjected. Railings, enclosures, safety devices, and controls required by law or for adequate protection of life and property shall be provided.

1.05 STAGING AND SHORING

A. Temporary supports shall be designed with an adequate safety factor to assure stability and adequate load bearing capacity.

B. Trenches greater in depth than four (4) feet shall be shored or sloped according to OSHA requirements.

1.06 TEMPORARY ENCLOSURES

A. When any activity hazardous to property or the health of employees and the public is in progress, the area of activity shall be enclosed adequately to contain the dust, overspray, or other hazard. In the event there are not permanent enclosures in the area, or such enclosures are incomplete or inadequate, the CONTRACTOR shall provide suitable temporary enclosures.

1.07 WARNING DEVICES AND BARRICADES

A. The CONTRACTORs shall adequately identify and guard all hazardous areas, holes, pits, and conditions by visual warning devices and physical barriers. Such devices shall, as a minimum, conform to the requirements of OSHA and Cal-OSHA.

1.08 HAZARDS IN PUBLIC ACCESS AREAS

A. Trenches and other essentially continuous excavations in public access areas, running parallel to the general flow of traffic, shall be marked at reasonable intervals by traffic cones, barricades, or other suitable visual markers during daylight hours. During hours of darkness, these markers shall be provided with either torches, flashers or other adequate lights.

1.09 FIRE EXTINGUISHERS

A. A sufficient number of fire extinguishers of the type and capacity required to protect the site and ancillary facilities shall be provided in readily accessible locations.

1.10 ODOR CONTROL

A. The CONTRACTOR shall comply with the provisions for control of odor and emissions as required by the MDAQMD or the OWNER.

1.11 SANITATION FACILITIES

A. CONTRACTOR shall provide and maintain ample field latrines and ablution accommodations in accordance with OSHA requirements for all workers employed on the project under the contract. Field latrines and ablution accommodations shall be provided and maintained in a sanitary condition at all times during the work on this project.

1.12 MATERIAL STORAGE

A. A materials storage area shall be designated to the CONTRACTOR by the CONSTRUCTION MANAGER. The CONTRACTOR is responsible for security of all of his materials and equipment.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

SECTION 01810

SAFETY PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. This section establishes minimum safety requirements and guidelines for the performance of the Work.

B. The CONTRACTOR is advised that decomposing refuse produces landfill gas which is approximately 50 percent methane (natural gas) by volume, and is potentially flammable or explosive.

C. The CONTRACTOR shall submit a Health and Safety Plan and a copy of their Injury and Illness Prevention Program to the OWNER for review prior to beginning work.

D. The CONTRACTOR shall hold mandatory daily tailgate safety meetings on the site, as well as formal weekly safety meetings.

1.02 GENERAL REQUIREMENTS

A. The CONTRACTOR shall have sole responsibility and liability for the safety, efficiency, and adequacy of the CONTRACTOR's personnel, equipment and methods, and for any damage or injury resulting from their failure, or improper maintenance, use, or operation.

B. The CONTRACTOR shall be solely and completely responsible for the conditions at the Work area arising from the CONTRACTOR's execution of the Work. This requirement shall apply continuously and not be limited to normal working hours.

C. The CONTRACTOR shall provide all personnel working on the project with orientation and training on the potential hazards anticipated and the appropriate use of safety equipment.

D. Neither the OWNER nor the CONSTRUCTION MANAGER shall have liability resulting from injury or death to CONTRACTOR's employees or subcontractors and their employees.

E. A health and safety officer, employed by the CONTRACTOR, shall be present at all times during construction of underground facilities. The health and safety officer may be the site superintendent or other responsible regular employee of the CONTRACTOR provided he has had special health and safety training, and shall have responsibility for the enforcement of the Health and Safety Plan, particularly as it applies to drilling activities. The health and safety officer shall be identified by name in the Health and Safety Plan.

F. Many gases are heavier than air and settle in low areas such as trenches and excavations, therefore additional precautions shall be observed in these areas. Specifically, the need for constant O_2 monitoring, forced ventilation, combustible gas

monitoring, VOC monitoring, respiratory protective equipment, etc. shall be determined by the CONTRACTOR. The CONSTRUCTION MANAGER may impose additional requirements when deemed necessary for worker safety.

1.03 HEALTH AND SAFETY PLAN

A. The CONTRACTOR shall develop and maintain for the duration of work activities at the site, a written, site specific Health and Safety Plan for landfill operations that will effectively incorporate and implement all applicable requirements. The plan will meet the requirements of CCR Title 8 Section 5192.

B. In addition to requirements set forth in other sections, the CONTRACTOR's Health and Safety Plan shall contain provisions for aspects of protection against bodily injury from heavy construction equipment, tools and equipment required to construct the system.

C. The Health and Safety Plan shall include the location and route to the nearest hospital or emergency facility. All CONTRACTOR employees and subcontractors working on the project shall be thoroughly familiar with the emergency route.

D. In the event the Health and Safety Plan is determined by the CONSTRUCTION MANAGER, OWNER or the State or Federal Regulatory Agencies to be inadequate to protect the employees and the public, the plan shall be modified prior to the beginning of the Work to meet the minimum requirements of the OWNER or the State or Federal Regulatory Agencies at no additional cost to the OWNER.

E. Acceptance of the CONTRACTOR's Health and Safety Plan by the OWNER does not release the CONTRACTOR of liability in the event of an accident or injury, nor does it place any liability on the CONSTRUCTION MANAGER or OWNER.

F. Provisions shall be made to protect against ingestion, absorption or inhalation of hazardous compounds and for the handling of refuse in a safe, sanitary, and proper manner.

G. The CONTRACTOR's Health and Safety Plan shall contain trenching and excavation safety guidelines particular to landfill work.

1.04 REGULATORY REQUIREMENTS

A. The CONTRACTOR shall comply with provisions of safety regulatory bodies including, but not necessarily limited to:

1. OSHA/Cal-OSHA regulations for construction
2. 29 Code of Federal Regulations (CFR) 1926/1910 and CFR 1910.120
3. Title 8 California Code of Regulations, in particular Section 5192.
4. All other applicable federal, state, county and local laws, ordinances, codes, the requirements

B. If any of these requirements are in conflict, the more stringent requirement shall apply. The CONTRACTOR's failure to be thoroughly familiarized with the aforementioned safety and health provisions shall not relieve the CONTRACTOR of

responsibility for full compliance with the obligations and requirements set forth herein.

C. The CONTRACTOR shall conform to the rules and regulations of the State Construction Safety regulations pertaining to excavations and trenches. A copy of the regulations is available at the OWNER.

1.05 SPECIAL SAFETY CONSIDERATION RELATED TO LANDFILL WORK

A. Portions of the Work involve excavation and removal of and construction near hazardous waste.

B. The landfill may contain leachate water contaminated with substances found in the landfill which may be corrosive, toxic, carcinogenic, mutanogenic or otherwise hazardous.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. The CONTRACTOR shall assume full responsibility to assure that during construction his employees, subcontractors and their employees follow the Health and Safety Plan.

B. The CONTRACTOR shall hold mandatory weekly safety meetings on the site. The CONTRACTOR shall notify the CONSTRUCTION MANAGER of the time and place of all meetings and allow the CONSTRUCTION MANAGER to participate. Meetings should reiterate safety measures to be taken and discuss any violations committed and preventive measures to avoid future violations.

C. The CONTRACTOR shall require all personnel on the site to wear the appropriate personnel protective equipment such as steel toe boots, hard hats, orange safety vests, safety belts and lanyards, and others.

D. The CONTRACTOR shall provide appropriate fall protection (i.e., harness and shock absorbing lanyard) that must be worn and secured to a stationary object when working within a distance of ten 10 feet of an excavation greater than eight (8) inches in diameter or deeper than four (4) feet.

E. No smoking or consumption of alcohol or any drug which could impair sight, balance or judgment is permitted on the job.

3.02 TRENCHING SAFETY

A. The CONTRACTOR shall complete each excavated trench prior to the end of the working day. A trench shall be considered complete if it has been backfilled to the landfill surface.

B. Any time excavations and trenching exceed four (4) feet in depth, shoring, bracing or sloping of the side walls is required prior to entry. If sloping is the method used, side walls of the trench shall be sloped at a 2:1 slope (Cal-OSHA requirement).

C. Welding is to be avoided within the barricaded area. If HDPE pipe welding is performed in the trench, continuous methane monitoring shall be performed.

D. Solvent cleaning, gluing or bonding of pipe shall be done, to the extent practicable, outside the trench.

E. All trenches shall be backfilled as soon as practical after excavation, and under no circumstances shall a trench remain open after the crew has left the vicinity of the trench. A maximum of 300 feet of trench may be exposed at any one time. All exposed refuse must be covered at the end of each day using cover soil or a tarp.

F. Electric motors shall not be used in trenches. Pneumatic operated tools shall be used in the trench.

3.03 VIOLATIONS

A. Should any health and safety violations be called to the CONTRACTOR's attention by anyone, the CONTRACTOR shall immediately correct the violations.

B. If the CONTRACTOR violates any health and safety rule or regulation, the OWNER may issue an order to stop all work until the violations are remedied. The CONTRACTOR shall not be entitled to any extension of the time or any claim for damage or to any compensation for either the directive or the work suspension order. A decision by the OWNER not to order discontinuance of any or all of the CONTRACTOR's operations shall not relieve the CONTRACTOR of responsibility for safety.

END OF SECTION

SECTION 02105

EROSION CONTROL

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes the general requirements for erosion control measures associated with lining materials for drainage channels.

PART 2 PRODUCTS

2.01 EROSION CONTROL BLANKET

Permanent Turf Reinforcement Mat shall be Propex Landlok 407, or equivalent. To be used in Type IB, II and IV channels.

Temporary Erosion Control Mat shall be SI Geosolutions ECB CS2, or equivalent. To be used in Type IA channels.

PART 3 EXECUTION

3.01 GENERAL

A. Grade and compact area of installation and remove all rocks, clods, vegetation or other obstructions so that the installed mat will have direct contact with soil surface. Prepare seedbed by loosening 2-3 inches of topsoil. Incorporate amendments such as fertilizer into soil.

B. For temporary erosion control mat, apply seed to soil surface before installing blanket/mat. For permanent erosion control mat, apply seeding after installation and prior to filling mat with soil.

C. The CONTRACTOR shall install the permanent and temporary control mats in accordance with the manufacturer's recommendations. In general the installation should include:

1. Anchor trenches or check slots (6-inches deep) at 30 foot intervals along the trench.

2. Longitudinal anchor trenches (4-inches deep) to secure outside edges.

3. Anchor erosion control mat with U-shaped wire staples. Staples shall be a minimum of 6-inches in length and have sufficient ground penetration to resist pullout. Longer anchors may be required. Anchors for the permanent erosion control mat shall be installed with a minimum of 2 anchors per

square yard. Temporary erosion control mats shall be installed with a minimum of 1.5 anchors per square yard.

4. After installation of permanent erosion control mat, apply seed and apply ½ to ¾ inches of fine soil into the mat to completely fill the voids. Use backside of rake, or similar, to smooth soil fill in order to just expose the top netting.

END OF SECTION

SECTION 02110

SITE CLEARING, GRUBBING AND STRIPPING

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes the general requirements for site clearing, grubbing and stripping associated with final closure construction of Landfill B-18 at the Kettleman Hills Facility.

B. Clearing, grubbing and stripping shall be performed to remove organic, soft, loose, and deleterious materials and expose a firm, unyielding subgrade.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02751 - HDPE Geomembrane

PART 2 PRODUCTS

A. Organic, soft, loose and deleterious materials includes, but is not limited to, vegetative growth, non-engineered fills, alluvial deposits, soft, loose, or saturated subgrade soils, refuse, and construction debris.

PART 3 EXECUTION

3.01 PROTECTION

A. Locate, identify, and protect utilities that remain from damage.

B. Protect groundwater monitoring wells and piezometers, and landfill gas extraction wells and monitoring probes from damage or displacement.

3.02 CLEARING

A. Clear areas required for access to site and execution of work.

B. Earthwork CONTRACTOR shall remove all organic and deleterious material, and trash from the subgrade surface. Vegetative growth greater than 1 inch in dimension shall be removed to a depth of 6 inches below the subgrade surface.

C. The Earthwork CONTRACTOR shall consider that clearing, grubbing, and stripping will necessitate the use of manual labor to remove all organic and deleterious material from the subgrade surface.

D. The Earthwork CONTRACTOR shall remove soft, loose, or saturated materials as approved by the CQA CONSULTANT. The materials shall be removed until a firm, unyielding subgrade, approved by the CQA CONSULTANT, is exposed.

E. All removed materials shall be disposed of onsite in an area designated by the PROJECT MANAGER. No accumulation of flammable material shall remain on or adjacent to the construction area.

F. The Earthwork CONTRACTOR shall expose existing liner terminations as required on the Drawings. The Work may require hand excavation to avoid damage to the existing liner. Any damage to the existing liner shall be repaired by the Earthwork CONTRACTOR at no additional cost to the OWNER.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. This section describes the general requirements for earthworks associated with the final closure construction of Landfill B-18 at the Kettleman Hills Facility.

B. The Earthwork CONTRACTOR shall furnish all labor, materials, equipment and incidentals necessary to perform all excavation, backfilling, compaction and grading required to complete the work shown on the Drawings and specified herein. The Work shall include, but not necessarily be limited to, survey and staking, borrow excavation and hauling, excavation for trenches, fill placement and compaction, grading, and all related work.

C. The Earthwork CONTRACTOR shall comply with the safety procedures given in Section 01810 of these Specifications.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 01400 - Construction Quality Control

C. Section 02110 - Site Clearing, Grubbing and Stripping.

D. Section 02720 – Drainage Facilities

E. Section 02751 - HDPE Geomembranes

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM), latest editions:

1. ASTM D422 - Test Method for Particle Size Analysis of Soils.
2. ASTM D1556 - Test Method for Density of Soil In-Place by the Sand Cone Method.
3. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb. Rammer and 18-inch Drop.
4. ASTM D2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
5. ASTM D2419 - Test Method for Sand Equivalent Value of Soil/Fine Aggregate.
6. ASTM D2497 - Standard Test Method for Classification of Soils for Engineering Purposes.
7. ASTM D2922 - Test Methods for Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).

8. ASTM D2937 - Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
9. ASTM D3017 - Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

B. Standard Specifications for Public Works Construction (SSPWC).

1.04 QUALITY ASSURANCE/CONTROL

A. The Earthwork CONTRACTOR shall adhere to the requirements of Section 01400 of these Specifications.

B. Compaction testing of engineered fill and backfill shall be performed by the CQA CONSULTANT. Testing shall be performed at locations to be determined by the CQA CONSULTANT, in order to determine if the soils meet the compaction requirements. Costs for testing to verify compaction and soil moisture content will be assumed by the OWNER. The cost of retesting, should corrections to construction be required, shall be the responsibility of the Earthwork CONTRACTOR.

C. The OWNER shall have complete authority to order immediate stoppage of work due to use of improper construction procedures, or for any reason that in his sole opinion, may result in a defective work.

1.05 DEFINITIONS

A. Excavation: Consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.

B. Subgrade: The surface upon which structures/systems/fills are constructed.

C. Borrow: Soil material obtained from other than the excavation.

D. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the PROJECT MANAGER. Unauthorized excavation, as well as remedial work directed by the PROJECT MANAGER, shall solely be at the Earthwork CONTRACTOR's expense.

E. Utilities include on-site above ground and underground pipes, conduits, ducts, and cables, as well as underground services.

1.06 SAFETY

A. CONTRACTOR is solely responsible for performing work in a safe manner and complying with all applicable local, state and federal codes, ordinances, laws, and regulations.

B. CONTRACTOR shall comply with the requirements of the Health and Safety Plan.

PART 2 PRODUCTS

2.01 MATERIALS

A. Structural Fill

1. Structural Fill shall be removed from the on-site borrow area(s) designated by the OWNER. Material shall be predominantly free from roots, wood, organic matter, refuse or other deleterious matter, and shall not contain particles over 6 inches in greatest dimension.

2. The OWNER has designated on-site borrow source(s) for the CONTRACTOR. The CONTRACTOR shall be responsible for excavating, loading, hauling, placing and compacting the material from the designated borrow source(s).

B. Foundation Layer

1. Foundation Layer is structural fill placed within 1-foot of HDPE geomembrane.

2. In addition to the structural fill requirements, Foundation layer shall not contain particles over 1 inch in greatest dimension and have a hydraulic conductivity of less than or equal to 1×10^{-5} cm/sec as determined by ASTM D5084.

C. Vegetative Cover

1. Vegetative Cover shall be removed from the on-site borrow area(s) designated by the OWNER. Material shall contain no particles over 3 inches in greatest dimension.

2. The OWNER has designated on-site borrow source(s) for the CONTRACTOR. The CONTRACTOR shall be responsible for excavating, loading, hauling, placing and compacting the material from the designated borrow source(s).

D. Trench Backfill

1. Trench Backfill shall be removed from the on-site borrow area(s) designated by the OWNER. Material shall be predominantly free from roots, wood, organic matter, refuse or other deleterious matter, and shall not contain particles over 1 inch in greatest dimension.

2. The OWNER has designated on-site borrow source(s) for the CONTRACTOR. The CONTRACTOR shall be responsible for excavating, loading, hauling, placing and compacting the material from the designated borrow source(s).

E. Water

1. Water shall be potable water or reclaimed water approved for use by OWNER.

2. The OWNER will provide water for dust control and soil preparation to the Earthwork CONTRACTOR at no cost to the Earthwork CONTRACTOR.

3. The CONTRACTOR shall only obtain water from sources designated by the OWNER.

PART 3 EXECUTION

3.01 GENERAL

A. The Earthwork CONTRACTOR shall be solely responsible for the satisfactory completion of all earthwork in accordance with the Drawings and Specifications.

B. Equipment used in the excavation, transport, placement and compaction of all materials used in construction will be standard of practice grading machinery of known specifications suitable for performing the required work in a timely and efficient manner.

C. All material considered by the CQA CONSULTANT to be unsuitable for use in the construction of the earthwork shall be removed. All materials incorporated as part of engineered fill must be inspected and placement must be observed by the CQA CONSULTANT. Unsuitable material shall be disposed of in the designated area.

D. Where work is interrupted by heavy rains, earthwork operations shall not be resumed until observations and field tests by the CQA CONSULTANT indicate the moisture content and density of the in-place fills and/or materials intended for placement are within the specified requirements.

E. If any unanticipated earth conditions of an adverse or potentially adverse nature are encountered during grading, the Earthwork CONTRACTOR shall immediately notify the CQA CONSULTANT. The CQA CONSULTANT and DESIGN ENGINEER shall investigate, analyze, and make recommendations to mitigate these conditions.

F. Throughout construction, all excavated and/or fill areas shall be graded to provide positive drainage and prevent ponding of water. Surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site.

G. No heavy equipment shall be permitted to operate within 3 feet of existing wellheads or piping. Compaction of material within these limits shall be completed with hand equipment.

H. The Earthwork CONTRACTOR shall apply water to any exposed earthen areas during construction to minimize airborne dust. This shall include active and inactive excavation areas, haul roads, and any nonvegetated stockpiles. The Earthwork CONTRACTOR shall be responsible for complying with all state and local regulations regarding dust and/or air quality.

I. Earthwork CONTRACTOR **shall not** use "paddle-wheel" (i.e., Caterpillar 613 or equivalent) equipment to excavate soils.

J. Earthwork CONTRACTOR shall provide manned traffic control (e.g., flagman) at locations identified by Owner and/or Contractor as being a potential safety hazard.

3.02 CONTROL OF WATER

A. The Earthwork CONTRACTOR shall excavate and backfill in a manner and sequence that will provide proper drainage at all times. The Earthwork CONTRACTOR shall remove all water, including runoff and run-on collected from rainwater encountered during excavation, to a location approved by the PROJECT MANAGER, by pumps, drains, and other approved methods.

B. The Earthwork CONTRACTOR shall take all necessary precautions to preclude the accidental discharge of fuel, oil, etc. and to prevent such accidents that may endanger the environment. The Earthwork CONTRACTOR will be responsible for the cost of remediating the results of any such discharges or accidents.

3.03 BORROW

A. CONTRACTOR shall submit the proposed limits of the borrow area to the OWNER for approval prior to the commencement of the Work. The maximum limits of the borrow area are shown on the Drawings.

B. The gradients of the borrow slopes and the depth of the borrow excavation should not exceed those specified on the Drawings. If the slopes are constructed steeper or the depth of the borrow excavation is greater than that specified on the Drawings, the CONTRACTOR shall reconstruct the slopes/refill the bottom to the gradients/depth specified by backfilling and compacting material in accordance with the requirements for engineered fill in this Section. The cost to reconstruct the slopes/refill the bottom will be borne solely by the CONTRACTOR.

C. The CONTRACTOR shall maintain a secure work site at all times.

3.04 STRUCTURAL FILL

A. Prior to placing structural fill, CONTRACTOR shall clear and grub the area in accordance with Section 02110 of these Specifications. CONTRACTOR shall also remove uncertified existing fills, disturbed soils and deleterious materials from the area to the satisfaction of the CQA CONSULTANT.

B. The ground surface (i.e. areas with less than 10% slope) to receive fill shall be over excavated a minimum of 2 feet. The base of the excavation shall be scarified to a depth of 8 inches. The scarified ground surface shall then be brought to within 3 percent of optimum moisture content, mixed as required, and compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557. Excavated soil may be used for filling the excavation if placed in accordance with the structural fill requirements. If the scarified zone is greater than 12 inches in depth, the excess shall be removed, placed in loose lifts not to exceed 8 inches in loose thickness. Prior to fill placement, the ground surface to receive fill shall be stabilized and inspected by the CQA CONSULTANT.

C. Fill placed against existing slopes (i.e. areas with greater than 10% slope) shall be keyed into the slope. Keys shall extend a minimum of 6 feet horizontally into the existing slope. The keys shall form a series of steps in the existing fill.

D. Fill shall be placed in loose lifts not to exceed 8-inches thick, brought to a uniform moisture content within 4 percent of optimum (3 percent for Foundation Layer), and compacted to 90 percent of the maximum dry density as determined by ASTM D1557.

E. Where tests indicate the moisture content or density of any layer of fill or portion thereof is below the Project requirements, the particular layer or portion thereof shall be reworked until the required moisture or density has been attained. No additional fill shall be placed over an area until the prior fill lift has been tested and meets the present requirements to the satisfaction of the CQA CONSULTANT.

F. In the event of rain or other reason, if the moisture content of previously placed fill material or processed soils intended for placement is more than 4 percent above optimum as determined by ASTM D1557, the fill material shall be aerated by blading, disking, or other satisfactory method until the moisture content complies with the requirements of this Section. Any previously compacted materials which are disturbed (aerated, bladed, etc.) to reduce or increase the moisture content must be recompacted to the Specifications and to the satisfaction of the CQA CONSULTANT once specified moisture contents are attained.

3.05 VEGETATIVE COVER

A. Vegetative cover layer shall be placed as shown on the Drawings. Soils shall not be placed over geosynthetic materials at ambient temperatures below 41 degrees F nor above 100 degrees F unless otherwise specified. The soils shall be placed in a manner which does not cause excessive movement or wrinkling of the geosynthetics.

B. Vegetative cover layer shall be placed and compacted by tracking with the low ground-pressure pressure dozer used for placement or other relatively light-compaction equipment wherever the soil thickness is less than 3 feet. The equipment used to spread and compact the backfill shall not exert a ground pressure in excess of 6 psi on no less than 1 foot of material. Manually operated compaction equipment may be required in constricted locations and directly adjacent to sensitive structures.

C. Hauling and spreading equipment for the vegetative cover layer shall operate on a minimum of 3 feet of soil above a geosynthetic layer. Low-ground pressure (i.e., less than 6 psi) spreading equipment may operate on a minimum of one foot of soil above a geosynthetic layer.

D. Fill shall be placed in loose lifts not to exceed 8-inches thick, brought to a uniform moisture content within 3 percent of optimum, and compacted between 85 to 90 percent of the maximum dry density as determined by ASTM D1557.

E. Where tests indicate the moisture content or density of any layer of fill or portion thereof is below the Project requirements, the particular layer or portion thereof shall be reworked until the required moisture or density has been attained. No additional fill shall be placed over an area until the prior fill lift has been tested and meets the present requirements to the satisfaction of the CQA CONSULTANT.

F. In the event of rain or other reason, if the moisture content of previously placed fill material or processed soils intended for placement is more than 3 percent above

optimum as determined by ASTM D1557, the fill material shall be aerated by blading, disking, or other satisfactory method until the moisture content is within four percent of optimum moisture content as determined by ASTM D1557. Any previously compacted materials which are disturbed (aerated, bladed, etc.) to reduce or increase the moisture content must be recompacted to the Specifications and to the satisfaction of the CQA CONSULTANT once specified moisture contents are attained.

3.06 SURFACE PREPARATION

A. All surfaces to be overlain by geosynthetics shall be smooth, uniformly sloped (minimum 5%), firm, and free of rocks, protrusions, or depressions greater than 0.5-inch in maximum dimension. The Earthwork CONTRACTOR shall consider that manual removal/repair of unacceptable areas may be required and shall be considered inherent to the work described herein.

3.07 TRENCH EXCAVATION AND BACKFILL

A. All trenches shall be excavated to lines and grades and dimensions indicated on the Drawings. All trench excavation, backfill, and compaction shall be in accordance with pertinent provisions of this Section.

B. All pipe work placed inside the trenches shall have a minimum of 8-inch clearance from any protrusions from the trench side walls or bottom.

C. The Earthwork CONTRACTOR shall backfill excavated trenches as promptly as progress of the work permits and immediately after the pipe has been laid, jointed, and tested.

D. The trench bottom shall be compacted to provide a uniform bed for the pipe. Backfill material shall be placed around the pipe and shall be compacted by hand-tamping, or methods acceptable to the CQA CONSULTANT.

E. The Earthwork CONTRACTOR shall compact the select engineered fill for trench backfill to at least 90 percent of the maximum dry density and within 4 percent of the optimum moisture content as determined in accordance with ASTM D1557.

F. Trench backfill shall be placed as shown on the Drawings. The backfill shall not be placed at ambient temperatures below 41°F nor above 100°F unless otherwise specified. The material shall be placed in a manner that does not cause movement or excessive wrinkling of, or induce excessive wrinkling of the geosynthetics. The CONTACTOR shall not operate equipment directly on any geosynthetics.

3.08 TOLERANCES

A. All material limits shall be constructed within a tolerance of ±1.0 ft for horizontal state plan coordinates, 0 to +0.1 ft vertical for reference to mean sea level (MSL), and 0 to +0.1 ft where dimensions are shown or specified as a minimum. The plane of the surface shall not vary more than 0.10 feet when measured with a 10-foot straight edge.

3.09 EXCAVATION BELOW GRADE

A. All excavation shall be performed within the limits of the work to the lines, grades, and elevations indicated and specified herein. The Earthwork CONTRACTOR shall not excavate or remove materials beyond indicated subgrade elevations or dimensions without the approval of the PROJECT MANAGER. The Earthwork CONTRACTOR shall backfill and compact any unauthorized excavation to the satisfaction of the PROJECT MANAGER at no additional cost to the OWNER.

B. When acceptable to the PROJECT MANAGER, lean concrete may be used to bring the bottom elevation of excavations under footings or trenches to correct elevations.

END OF SECTION

SECTION 02751

HDPE GEOMEMBRANES

PART 1 GENERAL

1.01 SUMMARY

A. This section describes the requirements for the manufacture, supply, installation, and quality control (QC) of high density polyethylene (HDPE) geomembrane associated with the final closure construction at the Kettleman Hills Facility, Landfill B-18.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

1.03 REFERENCES

A. Latest Version of American Society for Testing and Materials (ASTM) standards:

1. ASTM D638 - Test Method for Tensile Properties of Plastics
2. ASTM D792 - Specific Gravity (Relative Density) and Density of Plastics
3. ASTM D1004 - Test Method for Initial Tear Resistance of Plastic File and Sheeting
4. ASTM D1238 - Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
5. ASTM D1505 - Test Method for Density of Plastics by Density-Gradient Technique
6. ASTM D1603 - Test Method for Carbon Black in Olefin Plastics
7. ASTM D3895 - Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis
8. ASTM D4218 - Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
9. ASTM D4833 - Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
10. ASTM D5199 - Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
11. ASTM D5321 - Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

12. ASTM D 5397 - Procedure to Perform a Single Point Notched Content Tensile Load – Appendix (SP-NCTL) Test

13. ASTM D5596 - Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics

14. ASTM D5721 - Practice for Air-Oven Aging of Polyolefin Geomembranes

15. ASTM D5885 - Test Method of Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Colorimetry

16. ASTM D5994 - Test Method for Measuring Core Thickness of Textured Geomembranes

B. Geosynthetics Research Institute (GRI):

1. GRI-GM 10 - Specification for the Stress Crack Resistance of Geomembrane Sheet

2. GRI-GM11 - Accelerated Weathering of Geomembranes Using a Fluorescent UVA – Condensation Exposure Device

3. GRI-GM12 - Measurement of the Asparity Height of Textured Geomembranes Using a Depth Gage.

4. GRI-GM13 - Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes

1.04 PRE-QUALIFICATION

A. The Geosynthetic CONTRACTOR shall pre-qualify for geomembrane installation by providing the following documentation:

1. The Geosynthetic CONTRACTOR shall have a minimum of 10,000,000 square feet (sf) of polyethylene geomembrane cumulative installation experience.

2. The Geosynthetic CONTRACTOR shall provide at least three references from prior installation projects in excess of 500,000 sf including the following information:

a. Client's name, address, phone number and contact or representatives name.

b. Project site and description.

c. Geomembrane type and quantity installed.

1.05 SUBMITTALS

A. Submittals shall be provided in general accordance with Section 01300.

B. HDPE Resin: Furnish the following in writing to the CQA CONSULTANT a minimum of seven calendar days prior to geomembrane shipment to the site:

1. Statement of production dates and origin of resin used to manufacture the geomembrane for the project.

2. Certification stating all resin is from the same manufacturer and that no reclaimed polymer was added to the resin during the manufacturing of the geomembrane and that recycled polymer does not exceed 2 percent by weight.

3. Copies of the quality control certificates issued by the manufacturer and resin supplier indicating that the resin used to manufacture the geomembrane meets these specifications. These shall contain manufacturing quality control test results including specific gravity (ASTM D792 or D1505) and melt index (ASTM D1238, Condition E).

C. Manufacturing Quality Control: A copy of the manufacturer's quality control program shall be submitted to the CQA CONSULTANT a minimum of seven calendar days prior to geomembrane shipment to the site. Quality control testing shall be performed by the manufacturer in accordance with GRI-GM13 and as approved by the CQA CONSULTANT. Prior to delivery the following shall be submitted to the CQA CONSULTANT for review:

1. Certificates for each shift's production of geomembrane.

2. Copies of quality control certificates issued by the manufacturer. The quality control certificates shall include:

   a. Roll numbers and identification;

   b. Sampling procedures; and

   c. Results of quality control tests, including descriptions of the test methods used.

3. The results of the manufacturing quality control tests shall meet or exceed the property values listed in Table 02751-1.

4. Geomembrane delivery, storage, handling and installation instructions.

5. Extrudate Beads and/or Rod:

   a. Statement of production dates.

   b. Certification stating all extrudate is from one manufacturer, is the same resin type, and was obtained from the same resin supplier as the resin used to manufacture the geomembrane rolls.

   c. Copies of quality control certificates issued by the manufacturer including test results for specific gravity ASTM D792 and melt index ASTM 1288 Condition E.

D. Geomembrane Installer: Prior to mobilization of the Geosynthetic CONTRACTOR to the site, the following information shall be submitted:

1. Shop drawings indicating panel layout and field seams 14 calendar days prior to installation of geomembrane.

2. Installation schedule.

3. Copy of Geosynthetic CONTRACTOR's letter of approval or license by the geomembrane manufacturer.

4. Installation capabilities, including:

   a. Information on equipment proposed for this project;

   b. Average daily production anticipated for this project; and

   c. Quality control procedures.

5. Provide copies of the quality control/quality assurance program for the manufacturer of the geomembrane liner.

6. Resume of the superintendent to be assigned to this project, including dates and duration of employment.

7. Resumes of all personnel who will perform seaming operations on this project, including dates and duration of employment.

8. The installation crew shall have the following experience.

   a. The superintendent shall have supervised the installation of a minimum of 2,000,000 ft^2 of polyethylene geomembrane and 500,000 ft^2 of geotextile.

   b. The master seamer shall have experience seaming a minimum of 1,000,000 ft^2 of polyethylene geomembrane using the same type of seaming apparatus to be used at this site.

   c. All other seaming personnel shall have seamed at least 100,000 ft^2 of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Personnel who have seamed less than 100,000 ft^2 of polyethylene geomembrane shall be allowed to seam only under the direct supervision of the master seamer or Superintendent.

E. During the installation, the Geosynthetic CONTRACTOR shall be responsible for the timely submission to the CQA CONSULTANT of subgrade acceptance certificates, signed by the Installer, for each area to be covered by geomembrane.

F. The Geosynthetic CONTRACTOR shall furnish the OWNER upon completion of the project:

   1. A warranty provided by the manufacturer in accordance with GRI-GM13 against defects in material. Warranty conditions concerning limits of liability will be evaluated and must be acceptable to the OWNER.

2. A 1-year warranty provided by the Geosynthetic CONTRACTOR against defects in workmanship. Warranty conditions concerning limits of liability will be evaluated and must be acceptable to the OWNER.

3. As-built panel drawings in compliance with Section 01400.

E. Certificate of calibration less than 12 months old shall be submitted prior to installation for all field tensiometers.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with Section 01400, the Geosynthetic CONTRACTOR's Quality Control Program, and CQA Plan.

PART 2 PRODUCTS

2.01 MATERIALS

A. The geomembrane shall be comprised of high density polyethylene (HDPE) material as indicated on the drawings, manufactured of new, first-quality products designed and manufactured specifically for the purpose of liquid containment in hydraulic structures.

B. The geomembrane shall be produced free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. Any such defect shall be repaired in accordance with the repair procedures in Article 3.06.

C. The geomembrane shall be manufactured with a minimum of 15.0 feet seamless width. There shall be no factory seams.

D. The geomembrane shall be HDPE 40-mil thick and textured on both sides as indicated on the Drawings.

E. The geomembrane shall be supplied in rolls. Folds will not be permitted.

F. Specifications for the HDPE geomembrane properties are presented in Table 02751-1.

G. Resin:

1. Shall be HDPE, new, first quality, compounded and manufactured specifically for producing HDPE geomembrane.

2. Do not intermix resin types.

3. Shall meet the following additional requirements:

Test	Test Designation	Minimum Frequency	Requirements
Specific Gravity[1]	ASTM D 792 Method A	(2)	≥ 0.932
Melt Index	ASTM D 1238 Condition E	(2)	≤ 1.0 g per 10 minutes

Notes:
(1) Resin without carbon black
(2) 1 test per resin batch

H. Extrudate Rod or Bead:

1. Shall be made from same resin as the geomembrane.

2. Additives shall be thoroughly dispersed.

3. Shall be free of contamination by moisture or foreign matter.

4. Shall meet the following requirements:

Test	Test Designation	Minimum Frequency	Requirements
Specific Gravity	ASTM D 792 Method A	(1)	≥ 0.940
Carbon Black Content	ASTM D 1603	(1)	2-3%
Melt Index	ASTM D 1238 Condition E	(1)	≤ 1.0 g per 10 minutes
Notes: (1) 1 test per resin batch.			

2.02 DELIVERY, STORAGE AND HANDLING

A. Handling, storage, and care of the geomembrane following transportation to the site shall be the responsibility of the Geosynthetic CONTRACTOR. The Geosynthetic CONTRACTOR shall be liable for all damage to the materials incurred prior to final acceptance of the liner system by the CQA ENGINEER.

B. Conform to the manufacturer's requirements to prevent damage to geomembrane.

C. Delivery:

1. Deliver materials to the site only after the CQA CONSULTANT and the OWNER approve required submittals.

2. All rolls of geomembrane delivered to the site shall be identified at the factory with the following:

a. Manufacturer's name

b. Product identification and thickness

c. Lot number

d. Roll number

e. Roll dimensions

3. Separate damaged rolls from undamaged rolls and store at locations designated by the OWNER until proper disposition of material is determined by the OWNER the CQA CONSULTANT.

4. The OWNER will be the final authority regarding damage.

5. Separate rolls without proper documentation and store until CQA CONSULTANT approval is received.

D. On-Site Storage:

1. Store in space allocated by the OWNER.

2. Protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.

3. Store on level prepared surface (not on wooden pallets).

4. Stack per manufacturer's recommendation but no more than three rolls high.

E. On-Site Handling:

1. Use appropriate handling equipment to load, move or deploy geomembrane rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, spreader and roll bars for deployment. Dragging panels on ground surface will not be permitted.

2. Do not fold geomembrane material; folded material shall be rejected.

3. The Geosynthetic CONTRACTOR is responsible for storage, and transporting material from storage area to liner facility.

F. Damaged Geomembrane:

1. Geomembrane damage will be documented by the CQA CONSULTANT.

2. Damaged geomembrane shall be repaired, if possible, in accordance with these specifications or shall be replaced at no additional cost to the OWNER.

2.03 EQUIPMENT

A. Welding equipment and accessories shall meet the following requirements:

1. Equipped with gauges showing temperatures both in apparatus and at nozzle (extrusion welder) or at wedge (fusion welder).

2. Maintain adequate number of welding apparatus to avoid delaying work.

3. Use power source capable of providing constant voltage under combined-line load.

4. Provide secondary containment to catch spilled fuel under electric generator, if located on geomembrane.

B. Provide calibrated tensiometer capable of quantitatively measuring geomembrane strength:

1. Equipped with gauge accurate to ± 2 lbs per inch of geomembrane width and capable of pulling at 2 inches per minute and 20 inches per minute.

2. Provide one inch die for cutting sample specimens.

3. Provide certificate of tensiometer calibration within the past 12 months.

PART 3 EXECUTION

3.01 EXAMINATION

A. The Geosynthetic CONTRACTOR shall document in writing that the surface on which the geomembrane will be installed is acceptable. In so doing the Geosynthetic CONTRACTOR shall assume full liability for the accepted surface.

B. The beginning of installation means acceptance of existing conditions. The Geosynthetic CONTRACTOR shall be responsible for maintenance of the geomembrane covered subgrade once installation of geomembrane begins.

3.02 PREPARATION

A. Maintain the surface suitability and integrity until the lining installation is completed and accepted.

B. Repair rough areas and any damage to the subgrade caused by installation of the lining and fill any ruts in subgrade caused by equipment prior to geomembrane deployment.

C. To avoid sharp bends in the geomembrane, bevel the leading edges of the anchor trench.

D. Subgrade shall be smooth, uniform, firm and free from rocks or other debris. For deployment over soil subgrade, no rocks or protrusions greater than 0.5 inch in diameter shall be exposed at the subgrade surface.

3.03 DEPLOYMENT

A. Geomembrane shall not be deployed:

1. During precipitation;

2. In the presence of excessive moisture;

3. In areas of ponded water;

4. In the presence of excessive winds (i.e., greater than 20 mph); and

5. In excessive heat (i.e., greater than 110° F) or cold (i.e., less than 40° F).

B. Each panel shall be marked with an "identification code" (number or letter) consistent with the layout plan. The identification code shall be simple and logical. The number of panels deployed in one day shall be limited by the number of panels which can be seamed on the same day. All deployed panels shall be seamed to adjacent panels by the end of each day.

C. The following is the acceptable method of deployment:

1. Use equipment which will not damage geomembrane by handling, trafficking, leakage of hydrocarbons or other means.

2. Do not allow personnel working on geomembrane to wear damaging shoes, or engage in activities that could damage geomembrane.

3. Smoking on the liner is prohibited.

4. Round sharp corners of clamps and other metal tools used in the work area.

5. Do not allow clamps and other metal tools to be tossed or thrown.

6. Unroll panels with a method that protects geomembrane from scratches and crimps and protects soil surface and underlying geotextile from damage.

7. Use a method to minimize wrinkles, especially differential wrinkles between adjacent panels.

8. Place adequate hold-downs to prevent uplift by wind.

9. Use hold-downs that will not damage geomembrane such as sandbags.

10. Use continuous hold-downs along leading edges to minimize risk of wind flow under panels.

11. Panels shall be deployed perpendicular to slope elevation contours and the generation of seams shall be minimized.

12. Protect geomembrane in heavy traffic areas by geotextile, extra geomembrane or other suitable materials.

13. Do not allow vehicular traffic on geomembrane surface.

14. Panels deployed on grades steeper than 12% shall extend a minimum of 3 feet beyond the crest or toe of that grade.

15. Shingles or overlap panels in a downward direction to facilitate drainage.

16. Rub sheets used during installation shall be removed prior to placement of subsequent panels.

D. Visually inspect sheet surface during unrolling of geomembrane and mark faulty or suspect areas for repair or test. Replace faulty (requires more than one patch per 200 square feet) geomembrane stock at no additional cost to the OWNER.

3.04 FIELD SEAMING

A. Orient seams perpendicular to slope elevation contours, i.e., orient down (not across) slope and use seam numbering system compatible with panel number system.

B. Minimize the number of field seams in corners, odd-shaped geometric locations, sumps, and outside corners.

C. Overlap panels by a minimum of 3 inches for extrusion welding and 4 inches for fusion welding. Use procedures to temporarily bond adjacent panels together that do not damage the geomembrane and that are not detrimental to seam weld material for extension welding.

D. Do not use solvent or adhesive unless product is approved in writing by the OWNER.

E. No horizontal seams shall be allowed on grades steeper than 12% or within 3 feet of the crest or toe of slopes. A horizontal seam is defined as more than half of the panel width.

F. Clean surface of grease, moisture, dust, dirt, debris or other foreign material.

G. Prior to any extrusion welding, the geomembrane seam or repair shall be prepared as follows:

1. Clean surface of oxidation by disc grinder or equivalent not more than one hour before seaming; use number 80 grit sandpaper for the disc grinder. Bevel edges of geomembrane before bonding and provide continuous tacking in repair areas.

2. Repair area where excessive grinding substantially reduces sheet thickness by more than 4 mils beyond extent of weld.

3. Clean grinding dust around weld area after grinding.

4. The following procedure shall be followed for wrinkles and fishmouths.

    a. Cut along the ridge of the wrinkle or fishmouth.

    b. Overlap a minimum of 3 inches and seam.

    c. Any portion where the overlap is less than 3 inches shall be patched with an oval or round patch of geomembrane that extends a minimum of 6 inches beyond the cut in all directions.

5. If required, a firm, dry substrate (piece of geomembrane or other material) may be placed directly under the seam overlap to achieve proper support.

6. Keep water from intercepting the weld during and immediately after welding the seam.

7. For existing welds, or welds that are over 3 minutes old, grind the existing weld two inches back from point of termination and restart welding on ground weld.

H. At least one spare operable seaming apparatus shall be maintained for every three seaming teams. Place protective fabric or piece of geomembrane beneath hot welding apparatus when resting on geomembrane lining and use an electric generator capable of providing constant voltage under combined line load. The electric generator shall generally be located outside of liner. Provide protective lining and secondary containment large enough to catch spilled fuel under electric generators when located on the liner. The welding apparatus shall be equipped with gauges giving temperatures in apparatus and at nozzle.

I. For extrusion welding, purge welding apparatus of heat-degraded extrudate before welding if extruder is stopped for longer than five minutes. All purged extrudate shall be disposed of off the geomembrane. Each extruder shoe shall be inspected daily for wear to assure that its offset is the same as the geomembrane thickness. Repair or replace worn shoes, damaged or misaligned armature brushes, nozzle contamination, or other worn or damaged parts. Avoid stop-start welding. Remove extrudate rod from welder when not using welder for long period (over two hours). No welding may commence on the liner until the field trial seam sample, made by that equipment and seamer, passes destructive testing.

J. Test and set "hot air system" using scrap material at least each day prior to commencing seaming and adjust hot air velocity to preclude wind effects. Adjust contact pressure rollers to prevent surface ripples in sheet. No equipment shall be used for welding the geomembrane until a field trial seam sample made by that equipment has passed destructive testing.

K. In performing hot wedge welding, the welding apparatus shall be automated vehicular mounted devices equipped with gauges giving applicable temperatures and pressures. The edge of cross seams shall be ground to a smooth incline (top and bottom) prior to welding. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after usage. Protect against moisture buildup between sheets. If welding across cross seams, conduct field test seams at least every two hours, otherwise once prior to start of work and once at mid-day. No equipment is allowed to commence welding on geomembrane until the field trial seam sample made by that equipment has passed destructive testing.

L. Field trial seams shall be conducted, per seaming apparatus and per seamer, on pieces of geomembrane liner to verify adequate seaming conditions at the following frequency:

1. At beginning of each seaming period.

2. At least once every five hours.

3. At the discretion of the CQA CONSULTANT.

M. Make the trial seams at area of seaming and in contact with subgrade or GCL (same condition as the liner to be seamed). The seam sample shall be at least 42-inches long and 12-inches wide with the seam centered lengthwise. A one foot length of each trial seam sample shall be submitted to the CQA CONSULTANT for archive. Cut three 1-inch wide specimens and test two for peel adhesion, and one for bonded seam strength (shear). Each double wedge fusion seam specimen shall be tested for peel on both sides of the weld. A specimen passes when:

1. The break is film tearing bond (FTB) conforming to National Sanitation Foundation (NSF) Standard 54, Definition 2.15.

2. The break is ductile.

3. The strength of breaks for the trial seam testing shall conform to the values listed in Table 02751-1, included at the end of this section.

N. A trial seam sample passes when all specimens have passing results in peel and shear tests. If a specimen fails (one of the specimens fails in either peel or shear mode), the trial seam procedure shall be repeated in its entirety. If the repeated trial seam fails, the seaming apparatus or operator may not weld until the deficiencies or conditions are corrected and two consecutive passing field trial seams are achieved.

O. The following procedures shall by followed during cold weather conditions.

1. Geomembrane surface temperatures shall be determined by the CQA CONSULTANT at intervals of at lease once per 100 feet of seam length to determine if preheating is required. For extrusion welding, preheating is required if the surface temperature of the geomembrane is below 32° F.

2. For fusion welding, preheating may be waived by the OWNER based upon a recommendation by the CQA CONSULTANT, if the Geosynthetic CONTRACTOR demonstrates to the CQA CONSULTANT's satisfaction that welds of equivalent quality may be obtained without preheating at the expected temperature of installation.

3. If preheating is required, the CQA CONSULTANT will observe all areas of geomembrane that have been preheated by a hot air device prior to seaming, to ensure that they have not been overheated.

4. Care shall be taken to confirm that the surface temperatures are not lowered below the minimum surface temperatures specified for welding due to winds or other adverse conditions. It may be necessary to provide wind protection for the seam area.

5. All preheating devices shall receive approval by the CQA CONSULTANT prior to use.

6. Additional destructive tests will be taken at an interval between 250 and 500 feet of seam length, at the discretion of the CQA CONSULTANT.

7. Sheet grinding may be performed before preheating, if applicable.

8. Trial seaming shall be conducted under the same ambient temperature and preheating conditions as the production seams. Under cold weather conditions, new trial seams shall be conducted if the ambient temperature drops by more than 10° F from the initial trial seam test conditions. Such new trial seams shall be conducted upon completion of seams in progress during the temperature drop.

P. The following procedures shall by followed during warm weather conditions.

1. At ambient temperatures above 104° F, no seaming of the geomembrane shall be permitted unless the Geosynthetic CONTRACTOR can demonstrate to the satisfaction of the CQA CONSULTANT that the geomembrane seam quality is not compromised. Trial seaming shall be conducted under the same ambient temperature conditions as the production seams. At the option of the CQA CONSULTANT, additional destructive testing may be required for any suspected areas.

3.05 FIELD QUALITY CONTROL

A. The Geosynthetic CONTRACTOR shall designate a full-time quality control (QC) technician who shall be responsible for supervising and/or conducting the field quality control program. The QC technician may not be replaced without written authorization by the OWNER.

B. Non-Destructive Seam Testing

1. The Geosynthetic CONTRACTOR shall non-destructively test field welds for continuity over their full length using vacuum test units. The non-destructive testing shall be performed concurrently with seaming work progress, not at the completion of all seaming. Any defects located in the seam shall be repaired in accordance with Article 3.06. The following non-destructive testing procedures shall be used to test the field seams for continuity.

a. Vacuum box testing for extrusion welds.

b. Air pressure testing for double fusion seams.

2. Vacuum Box Testing

a. The vacuum box testing equipment shall comprise the following.

i. Rigid housing; transparent viewing window; a soft rubber gasket attached to bottom of housing; porthole or valve assembly; and a vacuum gauge.
ii. A vacuum pump capable of applying 5 psi gage pressure of vacuum to the box.
iii. A bucket of soapy solution and applicator.

b. The procedure for vacuum testing is as follows:

i. Clean window, gasket surfaces, and check for leaks.

sample marking. Cut destructive samples as seaming and nondestructive testing progresses, prior to completion of liner installation. The CQA CONSULTANT will mark destructive samples with consecutive numbering, location, apparatus I.D., technician I.D., Engineer I.D., and apparatus settings and date. Record, in written form, weld and test date, time, location, seam number, ambient temperatures, machine settings, technician I.D., apparatus I.D., and pass or fail description. The Geosynthetic CONTRACTOR shall immediately repair holes in geomembrane resulting from obtaining destructive samples and vacuum test patches. The size of destructive samples shall be 12 inches wide by 44 inches long with seam centered lengthwise.

2. Two 1-inch wide specimens shall be taken from each side of the sample and tested by the Geosynthetic CONTRACTOR for peel and shear in the field prior to CQA destructive testing. If any of these specimens fail, the Geosynthetic CONTRACTOR shall track the failure immediately. The remaining sample shall be cut into three 14-inch long by 12 inches wide pieces and distributed as follows:

    a. To the CQA CONSULTANT for destructive testing.

    b. To the CQA CONSULTANT for archive.

    c. To the Geosynthetic CONTRACTOR for its use.

3. Ten 1-inch wide specimens shall be taken from one piece. Five specimens shall be tested for peel and five for shear in accordance with the CQA Plan, with test results meeting the requirements of Table 02751-1, included at the end of this section. In the event of failure, the procedures for failed seam tracking are:

    a. Retrace welding path a minimum of 10 feet in both directions from the failed test location and remove (at these locations) a one inch wide specimen for testing. Repeat tracking procedures until the Geosynthetic CONTRACTOR is confident of seam quality.

    b. Obtain destructive samples from each side of the welding path and give samples to the CQA CONSULTANT for destructive testing.

    c. Repeat process if additional tests fail.

    d. Reconstruct seam between passing test locations to satisfaction of the CQA CONSULTANT.

    e. Reconstruction may be one of the following:

        i. Cut out old seam, reposition panel and re-seam.
        ii. Add cap strip.

    f. Cut additional destructive samples from reconstruction at discretion of CQA CONSULTANT.

g. If additional destructive sample results are not acceptable, repeat process until reconstructed seam is judged satisfactory by the CQA CONSULTANT.

D. For final seaming inspection, check the seams and surface of geomembrane for defects, holes, blisters, undispersed raw materials, or signs of contamination by foreign matter. Brush, blow, or wash geomembrane surface if dirt inhibits inspection. The CQA CONSULTANT shall decide if cleaning of geomembrane surface and welds is needed to facilitate inspection. Distinctively mark repair areas and indicate required type of repair.

3.06 REPAIR PROCEDURES

A. The geomembrane will be inspected before and after seaming for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be swept or washed by the Geosynthetic CONTRACTOR if surface contamination inhibits inspection. The Geosynthetic CONTRACTOR shall ensure that an inspection of the geomembrane precedes any seaming of that section.

B. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

C. Repair, removal and replacement shall be at the Geosynthetic CONTRACTOR's expense.

D. Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or non-destructive test. The Geosynthetic CONTRACTOR shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the CQA CONSULTANT and the Geosynthetic CONTRACTOR. Procedures available include:

1. Patching: Used to repair holes (over 1/4-inch diameter), tears (over 1/4 inch long), undispersed raw materials, and contamination by foreign matter.

2. Grinding and welding: Used to repair pinholes, blemishes and over-grinding.

3. Capping: Used to repair large lengths of failed seams.

4. Removing the seam and replacing with a strip of new material.

E. In addition, the following procedures shall be observed.

1. Geomembrane surfaces to be repaired shall be abraded (extrusion welds only) no more than 1/2 hour prior to the repair.

2. All geomembrane surfaces shall be clean and dry at the time of repair.

3. The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the CQA CONSULTANT.

4. Extend patches or caps at least 6 inches beyond the edge of the defect, i.e., be a minimum of 12 inches in diameter, and round all corners of material to be patched.

5. Bevel the edge of the patch and do not cut patch with repair sheet in contact with geomembrane. Temporary bond the patch to the geomembrane with an approved method, extrusion weld the patch and then vacuum test the repair.

F. Repair Verification:

1. Number and log each patch repair (performed by the CQA CONSULTANT).

2. Non-destructively test each repair using methods specified in this Section.

3. Provide daily documentation of non-destructive and destructive testing to the CQA CONSULTANT. The documentation shall identify seams that initially failed the test and include the evidence that these seams were repaired and retested successfully.

3.07 ACCEPTANCE

A. The Geosynthetic CONTRACTOR shall retain OWNERSHIP and responsibility for the geomembrane until acceptance by the OWNER.

B. Acceptance Criteria: The following shall be completed:

1. Verification of adequacy of field seams, repairs and testing by the CQA CONSULTANT.

2. All submittals.

3. "As-built" drawings, approved and final drawings submitted.

4. Construction area cleaned.

5. Final field inspection

6. Warranty signed over to the OWNER.

C. Field Inspections: Inspect the completed work with the OWNER; defects, wrinkles, suspicious looking welds shall be noted and marked; document, correct and arrange further field inspections until no corrective action is necessary.

TABLE 02751-1
REQUIRED PHYSICAL PROPERTIES OF 40-MIL
TEXTURED HDPE GEOMEMBRANE

PROPERTY	METHOD	VALUE
Thickness, mil.	ASTM D 5994	- 38 minimum average - 36 lowest indiv. value for 8 out of 10 specimens - 34 lowest indiv. value for any of the 10 specimens
Sheet Density (min.)	ASTM D 792 or ASTM D 1505	0.940
Asperity Height (min. ave.)	GM12	10 mil
Min. Ave. Tensile Properties [1] • Tension at Yield (lb/in) • Strain at Yield (%) • Tension at Break (lb/in) • Strain at Break (%)	ASTM D 6693	 84 12 60 100
Tear Resistance, lbs. (min. ave.)	ASTM D1004, Die C	28
Oxidative Induction Time (OIT) (min. ave.) • Standard OIT, or • High Pressure OIT	 ASTM D3895 ASTM D5885	 100 minutes 400 minutes
Oven Aging at 85°C • Standard OIT (min. ave.), % retained after 90 days, or • High Pressure OIT (min. ave.), % retained after 90 days	 ASTM D5721 ASTM D3895 ASTM D5885	 55% 80%
UV Resistance • High Pressure OIT (min. ave.)	GRI-GM11 ASTM D5885	 50%
Stress Crack Resistance (min. hours with no failures)	ASTM D5397 (Appendix)	300
Puncture Resistance, lbs. (min. ave.)	ASTM D4833	60
Carbon Black Content (allowable range in percent)	ASTM D1603	2.0 – 3.0
Carbon Black Dispersion	ASTM D5596	- minimum 9 out of 10 specimens in category 1 or 2 - all 10 specimens in Category 1, 2, or 3
Seam Strength • Peel (lb/in) (fusion/ ext.) • Shear (lb/in)	 ASTM D4437	 65 / 52 81

Notes: (1) Elongation at yield and elongation at break shall be calculated using a gage length of 1.3 inches and 2.0 inches, respectively.

END OF SECTION

SECTION 02752

GEOTEXTILES

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes the general requirements for the manufacture, supply, installation, and quality control (QC) of geotextiles.

1.02 RELATED SECTIONS

A. Section 02220 – Earthwork

B. Section 02751 – HDPE Geomembranes

1.03 REFERENCES

A. Latest version of the American Society for Testing and Materials (ASTM) standards:

1. ASTM D4355. Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.

2. ASTM D4632. Standard Test Method for Breaking Load and Elongation of Geotextiles (Grab Method)

3. ASTM D4833. Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

4. ASTM D4873. Standard Guide for Identification, Storage, and Handling of Geotextiles.

5. ASTM D5199. Standard Test Method for Measuring Geotextiles

6. ASTM D5261. Standard Test Method for Measuring Mass Per Unit Area of Geotextiles.

1.04 SUBMITTALS

A. Quality Control Submittals:

1. A copy of the manufacturer's quality control (QC) plan.

2. Manufacturing QC certificates for each production run. The certificates shall identify the origin and the manufacturer of the resin. The certificates shall be signed by responsible parties employed by the manufacturer (such as the production manager). Tests shall be performed at the frequency indicated in the manufacturer's QC Plan.

3. The QC certificates shall include roll numbers and identification, sampling procedures, and results of quality control tests verifying that each of the properties listed in Table 02752-1 is met. Samples shall be tested at a minimum frequency of

once every 100,000 sf. The manufacturer quality control tests to be performed include the tests specified in Article 2.01 of this section.

4. Manufacturer's certification that the geotextile products meet or exceed specified requirements and are 100% free of needles.

B. The Geosynthetic CONTRACTOR shall submit the following.

1. Installation plan; and

2. Proposed seam stitching methods.

C. Submittals shall be in accordance with Section 01300.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with the CQA Plan.

1.06 QUALIFICATIONS

A. Geotextile shall be supplied by a geotextile manufacturer meeting the following qualification requirements:

1. The geotextile manufacturer shall be responsible for the production and delivery of geotextile rolls and shall be a well-established firm with more than two years experience in the manufacture of geotextiles. The geotextile manufacturer shall submit a statement to the CQA CONSULTANT listing:

a. Certified minimum average roll property values of the proposed geotextiles and the test methods used to determine those properties.

b. Projected delivery date of the material for this project.

B. The Geosynthetic CONTRACTOR shall meet the requirements of the CQA Plan.

PART 2 PRODUCTS

2.01 MATERIALS

A. Non-woven geotextiles shall have the following minimum average roll value (MARV) properties:

TABLE 02752-1

REQUIRED PHYSICAL PROPERTIES OF GEOTEXTILE

Fabric Property	ASTM Test Method	Manufacturer QC Test Frequency (1)	Required Test Values
Mass Per Unit Area (min. ave.)	D-5261	1 per 100,000 sf	12 oz/sy
Grab Strength (min. ave.)	D-4632	1 per 100,000 sf	300 lbs
Puncture Strength (min. ave.)	D-4833	1 per 100,000 sf	180 lbs
UV Resistance	D-4355	1 per resin formulation	70 percent (2)

Notes: (1) Manufacturer may elect to provide certification of values for geotextiles.
(2) After 500 hours of exposure.

B. Geotextile shall be non-woven, needle-punched polyester or polypropylene fabric free from needles or other foreign material.

2.02 DELIVERY, STORAGE, AND HANDLING

A. Handling, storage, and care of the geotextiles following transportation to the site shall be the responsibility of the CONTRACTOR. The CONTRACTOR shall be liable for all damage to the materials incurred prior to final acceptance of the liner system by the CQA CONSULTANT.

B. The CONTRACTOR shall be responsible for storage of the geotextile at the site after the material is delivered. The geotextile shall be stored off the ground and out of direct sunlight, and shall be protected from mud, dirt, dust, and any additional storage procedures required by the Geotextile manufacturer.

C. All rolls of geotextile shall be identified at the factory with the following:

1. Manufacturer's name
2. Product identification
3. Lot Number
4. Roll number
5. Roll dimensions

D. Geotextiles shall be handled in a manner as to ensure they are not damaged in any way.

E. Precautions shall be taken to prevent damage to underlying materials during placement of the geotextile.

F. After unwrapping the geotextile from its cover, the geotextile shall not be left exposed for a period in excess of 30 days.

PART 3 EXECUTION

3.01 INSTALLATION

A. Geotextile seams shall be continuously sewn or heat bonded. Geotextile seams shall be overlapped a minimum of 6 inches prior to sewing. No horizontal seams shall be allowed on slopes steeper than 5 horizontal to 1 vertical.

B. Polymeric thread, with chemical resistance properties equal to or exceeding those of the geotextile, shall be used for all sewing. The seams shall be sewn using Stitch Type 401. The seam type shall be Federal Standard Type SSa-1.

C. The CONTRACTOR shall examine the entire geotextile surface after installation to ensure that no potentially harmful foreign objects are present. Such foreign objects shall be removed and damaged geotextile shall be repaired or replaced at no cost to OWNER.

D. Use care not to damage underlying materials during installation.

E. Prevent the geotextile from accumulating excessive dust.

F. The CONTRACTOR shall be responsible for field handling, storing, deploying, seaming or connecting, temporary restraining (against wind), anchoring, and other aspects of geotextile installation. Specifically, the CONTRACTOR shall follow the guidelines in ASTM D 4873 regarding the placement, handling and storage or geotextiles.

G. The CONTRACTOR shall accept and retain full responsibility for all materials and installation and shall be held responsible for any defects in the completed system.

H. No equipment shall operate directly on the geotextile.

I. Use sandbags or other acceptable anchorage to prevent wind uplift.

3.02 REPAIRS

A. Any holes or tears in the geotextile shall be repaired using a geotextile patch consisting of the same geotextile.

1. On slopes inclined steeper than 10 horizontal to 1 vertical, patches shall be sewn into place with a minimum 6-inch overlap.

2. On slopes inclined at 10 horizontal to 1 vertical or less, patches may be heat-bonded with a 6-inch overlap in all directions.

END OF SECTION

SECTION 02932

REVEGETATION

PART 1 GENERAL

1.01 SUMMARY

A. This section describes the general requirements for vegetating areas associated with the final closure construction at the Kettleman Hills Facility Landfill B-18.

B. The CONTRACTOR shall furnish all labor, materials, tools, equipment, supervision, transportation, manufacturing and installation services necessary to vegetate areas of the final cover as required.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 02200 - Earthwork

1.03 REFERENCES

A. State of California Department of Transportation (CALTRANS) Standard Specifications, latest editions.

1.04 SUBMITTALS

A. Submit the seed mix a minimum of 2 weeks prior to starting of vegetation work for review by the CQA Consultant.

B. Submittals shall be in accordance with Section 01300.

1.05 QUALITY ASSURANCE

CQA Consultant to verify adequate seed application.

PART 2 PRODUCTS

2.01 SEED/ FERTILIZER

A. The seed shall be a mixture of Zorro Fescue (Festuca megalura) at a rate of 4.0 lbs/acre and Panoche Red Brome (Bromus rubens) as a rate of 12.0 lbs/acre. Seed shall have been tested for purity and germination not more than 12 months prior to the application of the seed. The test results from seed testing shall be delivered to the Owner prior to applying the seed. Seed labels furnished by the seed vendors supplying the seed shall indicate the purity, germination and pure live seed as determined by testing.

B. Fertilizer shall be either 15-15-15 or 16-20-0 applied at a rate of 500 lbs/acre.

PART 3 EXECUTION

3.01 PREPARATION

A. The area to be seeded should be weed free and have a firm seed bed which has previously been roughened by scarifying, disking, harrowing, or otherwise worked to a depth of two to four inches. The seed bed may be prepared when earth moving work is completed.

B. The vegetated soil layer should be seeded with the seed mix listed in Section 2.01.

C. The vegetated soil layer should be fertilized with the fertilizer listed in Section 2.01. The fertilizer should be distributed uniformly over the seed bed and incorporated into the soil. Incorporation of the fertilizer may be done as part of the seedbed preparation or as part of the seeding operation unless the seed is broadcast. If fertilizing is a part of the seed bed preparation, it should not be performed more than 15 days prior to seeding.

D. If the Contractor elects to Drill/Cultipacker, a straw mulch shall be applied at a rate of 4,000 lbs/acre to stabilize the soil and retain moisture during seed germination. At least 50 percent of the applied straw should be more than six inches in length. The mulch should be applied immediately after seeding. To prevent removal of straw by wind, the mulch shall be anchored using either mulching rollers or disks. If disks are used for anchoring they should be dull and run straight.

E. If the Contractor elects to hydro-seed, a minimum of 525 pounds of fiber per acre shall be mixed and applied with the seed, and fertilizer may be mixed with the seed and fiber and applied in the hydro-seeding operation. The fiber shall be furnished and applied at the Contractor's expense. Mixing of materials for application with hydro-seeding equipment shall be performed in a tank with a built-in continuous agitation system of sufficient operating capacity to produce a homogeneous mixture and a discharge system which will apply the mixture at a continuous and uniform rate. The tank shall have a minimum capacity of 1,000 gallons. A dispersing agent may be added to the mixture provided the Contractor furnishes evidence that the additive is not harmful. Any material considered harmful, as determined by the Engineer, shall not be used. Any mixture containing stabilizing emulsion shall not be applied during rainy weather or when soil temperatures are below 40° F. Pedestrians or equipment shall not be permitted to enter areas where mixtures containing stabilizing emulsion have been applied.

END OF SECTION