



## **Specifications and Drawings Central Disposal Site Sonoma County, California**

Prepared for:

**Keller Canyon Landfill Company Inc.**

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Prepared on behalf of:

**County of Sonoma Department of  
Transportation and Public Works**

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**TECHNICAL SPECIFICATIONS:  
LANDFILL NO. 2 LINER SYSTEM  
SONOMA CENTRAL DISPOSAL SITE  
PETALUMA, CALIFORNIA**

Prepared for:

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These Technical Specifications: Landfill No. 2 Liner System for the Sonoma Central Disposal Site located in Sonoma County, California, dated July 27, 2012 were prepared and reviewed by the following:



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## **DIVISION 1 – GENERAL REQUIREMENTS**

### **SECTION 01010**

#### **SUMMARY OF WORK PHASE III LINER SYSTEM**

##### **PART 1 – GENERAL**

###### **1.1 RELATED DOCUMENTS**

- A. Drawings, Special Provisions, and Technical Specification Divisions 1, 2, and 3 apply to this Section.

###### **1.2 DEFINITIONS**

- A. Construction Quality Assurance (CQA) Consultant: The monitoring firm responsible for implementation of the CQA plan.
- B. Construction Quality Assurance (CQA) Officer: The professional representative of the CQA Consultant responsible for implementation of the CQA program and assuring that the Construction Report is prepared.
- C. Construction Quality Assurance (CQA) Monitor: Site representative of the CQA Consultant responsible for documenting field observations and tests.
- D. Design Engineer: The individual or firm responsible for the design and preparation of the drawings and technical specifications.
- E. County: Sonoma County DOT and Public Works
- F. Owner: Republic Services Inc./Sonoma County

###### **1.3 PROJECT DESCRIPTION**

- A. The Project: The Project consists of the Phase III cell expansion of an approximately 12-acre area at the Sonoma Central Disposal Site, located at 500 Meham Road, Petaluma, California, as specified and shown in the Contract Documents.
- B. Specification sections have not been divided into groups for work of subcontractors or various trades. Questions concerning the applicability or interpretation of a particular section or part of section or drawing should be directed to the Design Engineer.
- C. The Work: The Work to be performed by the Contractor consists of providing all labor, services, tools, machinery, equipment, and materials necessary to complete the project. The Work includes but is not limited to the following items:

- 1. Mobilization and demobilization.

2. Perform survey of the 12 acre Phase III cell expansion area.
  3. Excavate soils from the Phase III cell area to the grades shown on the Drawings and transport to designated stockpiles. Due to the hardness of subsurface soils, it is anticipated that blasting will be required for part of the excavation. Section 02221 defines conditions when blasting is required. Locate roads and benches where indicated.
  4. Compact final excavated surface according to specifications.
  5. Grading for surface water drainage control ditches, and other control features as shown on the Drawings.
  6. Place adequate section of appropriate diameter concrete pipe around any wells, risers, piezometers, etc., located within the project area, to protect these site features during stripping, grading and cover installation operations.
  7. Use stockpile and borrow soils from on-site locations chosen and approved by the Owner. In-place density of soil fill locations must be to Project Specifications for each liner system layer as in Sections 02222 and 02225.
  8. Placement of geosynthetic barriers and drainage layers in accordance with the Drawings and these Specifications.
  9. Furnish and install imported low permeability soil and gravel materials as shown on the Drawings.
  10. Construct access roads to Phase III disposal cell as shown on the Drawings.
  11. Installation of drainage ditch along roadway alignments and benches at locations shown on Drawings.
  12. Installation of erosion mat and V-ditch as shown on Drawings.
  13. Installation of woven geotextile and aggregate base on landfill roads as shown on the Drawings.
  14. Fertilize and broadcast seed on bare areas as described in Section 02820.
  15. Restore the site to pre-construction conditions.
  16. Protect all constructed work until project is accepted by Owner.
- D. The Contractor shall furnish all labor, materials, equipment, tools, facilities, and services necessary for proper execution, testing, and completion of the Work.



- E. The Contractor shall be responsible for all coordination of this work, including coordination between trades, subcontractors, suppliers, public utilities and the landfill operation.
- F. It is in the interest of the Contractor that the Work proceeds in the most expeditious manner possible to meet the construction schedule.

#### 1.4 CONSTRUCTION WATER

- A. Water for construction, moisture-conditioning and dust control shall be provided to the Contractor by Owner. Water is available at the on-site source(s) shown on Drawing No. 2.
- B. The Contractor shall be responsible for transporting and/or conveying all required construction water from the Owner-supplied source to his water truck loading location.

#### 1.5 WORK UNDER OTHER CONTRACTS

- A. Quality Assurance Consultant: A separate contract will be issued between Owner and the Construction Quality Assurance (CQA) Consultant. That contract includes:
  - 1. Construction quality assurance monitoring
  - 2. Construction quality assurance testing
  - 3. Written certification of construction to the California Regional Water Quality Control Board (RWQCB), North Coast Region and other agencies.
- B. Quality Assurance Monitoring and Testing Procedures: The Quality Assurance Monitoring and Testing Procedures which the CQA Consultant will perform are available from the County.

#### 1.6 CONTRACTOR USE OF PREMISES

- A. Work Days: The Contractor shall have equipment and material delivery access to and from the site as noted in the Special Provisions.
- B. Access: No later than 15 days after notice to proceed, the Contractor shall arrange with Owner a sequence of procedures, means of access, space for storage of materials and equipment, and use of approaches and roadways. Contractor's use of the premises shall be confined to the areas approved by the Owner.
- C. Smoking: Smoking is prohibited on the landfill or within 100 feet of the landfill and materials storage area.
- D. Contractor shall not dispose of waste oils, fuels, cleaners or other potentially hazardous substances on-site.

## 1.7 CONTRACTOR USE OF SITE

- A. The Sonoma Central Disposal Site is an active municipal waste disposal site. Additional waste will be placed in other areas during cover closure construction. There are various environmental monitoring and control facilities on-site as shown on Drawing No. 2. The Contractor will conduct its operations to avoid interferences with ongoing landfill operations (including the allowance of water supply for dust control and operational measures), and to prevent damage to existing site infrastructure and utilities. Coordination with Owner will be necessary.
- B. The Contractor shall limit activities to the landfill cover construction areas, stockpiles, staging area and haul roads as identified by Owner.

## 1.8 SITE CONDITIONS

- A. The Project site is a Class III landfill area as defined by Title 27 of the California Code of Regulations. This landfill is capable of producing leachate and landfill gas as a result of the decomposition of waste. It may also be harmful to workers to contact the waste. The Contractor shall enforce safety procedures to minimize hazards to workers, the public, and the environment.
- B. Existing Grades: The existing grades may vary from those indicated on the Drawings. The procedure for adjusting the existing grades is specified in Section 01050, Surveying. The Contractor shall perform a pre-construction survey of the work areas to establish existing grades.
- C. Existing Features: Field verify the elevations and the location of existing features, see Section 01050, Surveying.

## 1.9 SUBMITTALS

- A. Site Health and Safety Plan: The Work at the landfill is within a zone of potential landfill leachate and landfill gas migration. The Contractor is responsible for site health and safety for its employees. Fifteen days prior to starting work at the site, the Contractor shall prepare a Site Health and Safety Plan, and provide a copy of this Plan to the County for informational purposes only. The Site Health and Safety Plan shall be prepared in accordance with applicable provisions of OSHA regulations 29 CFR 1910.120 and 1926, and "A Compilation of Landfill Gas Field Practices and Procedures," prepared by SWANA Landfill Gas Division, dated March 1992. The Contractor shall also comply with Cal OSHA requirements.
- B. Written plan of Contractor's proposed sequence of construction. Submit within fifteen (15) days after the Notice to Proceed and receive Owner approval prior to commencing the Work.
- C. Shop Drawings, Record Drawings, independent quality control laboratory test results, manufacturer's specifications, and literature for various products, and other information

as described herein. Submittals requested herein are intended to match elements of the Work to actual conditions found in the field. All submittals are subject to the approval of the Engineer.

- D. Discrepancies: Should the Contractor discover any discrepancy between actual conditions and those indicated which prevent following good practice or the intent of the Drawings and Specifications, he/she shall notify Owner in writing and request clarification and instructions on how to proceed. The Contractor shall not proceed with work without advance approval from Owner.
- E. No Additional Payment: No claims shall be made for extra payment or extensions of Contract completion time if the Contractor fails to notify Owner of any discrepancy before proceeding with that part of the Work.
- F. Other submittals as specified in these Specifications.

#### 1.10 SUPERINTENDENT

- A. Contractor shall provide a single qualified full-time superintendent for the duration of the project. Contractor shall not change superintendent without Owner's written permission. Contractor's proposal to change personnel must be justifiable to Owner, and must demonstrate that the proposed replacement possesses adequate qualifications.

#### 1.11 LIST OF DRAWINGS

- A. The following Drawings form part of the Contract Documents (SCS Engineers, July 2012):

<u>Sheet Number</u>	<u>Description</u>
1.	Title Sheet – Location Map
2.	Site Plan and Survey Control
3.	Landfill 2 – Phase III Excavation Plan
4.	General Sections – Phase III
5.	Phase III Sections and Details
6.	Phase III Sections and Details
7.	Phase III Sections and Details
8.	Phase III & IV Section
9.	Landfill 2 – Phase IV Excavation Plan
10.	General Sections – Phase IV
11.	Phase III & IV Section
12.	Phase IV Sections and Details
13.	Phase IV Sections and Details
14.	Phase IV Sections
15.	Sump Riser Plan and Details

END OF SECTION

**SECTION 01025****MEASUREMENT AND PAYMENT****PART 1 – GENERAL****1.1 DESCRIPTION**

- A. The bid items will be paid by Unit Prices. They constitute all of the labor and costs for the completion of the work.

No direct or separate payment will be made for providing miscellaneous temporary or accessory works and services, including but not limited to Owner's and Contractor's field offices and sheds, surveys, job signs, sanitary requirements, testing, safety devices, submittals, record drawings, water supplies, dust controls, power, maintaining traffic, removal of Contractor generated waste, watchmen, security, bonds, insurance, cleanup, and all other conditions of the Contract Documents.

- B. Contractor mobilization and demobilization shall be paid for as Lump Sum and shall not exceed 5% of the total bid.
- C. Record drawings, project meetings, and construction quality control shall be included in related bid items.
- D. Siltation and erosion controls including, but not limited to silt fencing, straw bales, erosion control matting, and other measures, and compliance with all stormwater management/sediment control regulations, shall be paid for by Unit Prices listed in the Contractor's Schedule of Values.
- E. All Contractor Health and Safety provisions to perform the work will be included in related bid items.
- F. Contractor Quality Control and associated testing provisions during the progression of the work will be included in the related bid items.
- G. Monthly Payment Applications for Lump Sum and Unit Price Items in progress shall be based on labor and materials expended at the end of each month as documented by the Contractor and approved by Owner. During the last week of each month, the Contractor is responsible for providing Owner with records of construction that has occurred during that month. Owner will consider the information provided by the Contractor and other information as necessary before making a determination on the percent complete on each pay item for the month.

## 1.2 RELATED DOCUMENTS

- A. Drawings, Special Provisions, and Technical Specification Divisions 1, 2, and 3 apply to this Section.

## 1.3 SUMMARY

- A. This Section specifies administrative and procedural requirements for Unit Price, and Lump Sum pay items.

- 1. Bid prices shall be based on labor and material Unit Prices or Lump Sums and include all necessary material, overhead, profit, and applicable taxes and permit fees.
- 2. Refer to individual Technical Specifications sections for construction activities requiring the establishment of bid prices, as applicable.
- 3. Owner reserves the right to reject the Contractor's work-in-place until the work meets the requirements of the Drawings and Specifications.

- B. The Bid Item measurement and payment descriptions for the work follow.

- 1. Mobilization/Demobilization (Bid Item 1)  
Measurement by lump sum (LS), based on mobilizing of equipment and labor to perform work and demobilizing from and cleaning the site after all work and testing has been performed and accepted by Owner.

Payment as follows: 50 percent of lump sum amount upon completion of 10 percent of the work, and 50 percent for demobilization and site cleanup; Payment includes all costs for mobilizing and demobilizing equipment, living expenses, permits, bonds, insurance, office and field overhead, and any other administrative costs necessary to complete the work. Includes work described in Section 01010, 01025, 01050, 01200, 01300, 01500, and 01700. Payment will be limited to 5 percent of the total contract price.

- 2. Construction Surveying (Bid Item 2)  
Measured by the lump sum (LS).

Payment includes all costs for construction surveying needed to perform the work shown on the Drawings. Payment includes all costs to perform construction surveying as described in Section 01050.

3.     Clearing and Stripping                     (Bid Item 3)  
Measured by the acre (AC). Measurement will be based on perimeter survey for clearing and stripping of the construction limits, stockpile area, and roads/benches that has not been previously stripped. This includes replacement of vegetation and soils over denuded areas as shown on the Plans. Sloped areas will be measured based on actual area, not plan area.
- Payment includes all costs to clear areas then load, haul, stockpile, and replace on denuded areas as shown in the Drawings and as described in Section 02110.
4.     Remove and Replace Fence                     (Bid Item 4)  
Measurement based on linear foot (LF) of removed and installed barbed-wire fence as measured by survey.
- Payment will be by the linear foot (LF) removed and installed. Payment includes all costs to remove, furnish, and install the barbed-wire fence as shown on the Drawings.
5.     Excavate Phase III Cell                     (Bid Item 5)  
Measured by the cubic yard (CY). Measurement based on survey of the cell area before and after excavation.
- Payment includes all costs to complete excavation of the cell within the construction limits as shown on the Drawings and as described in Section 02221. Payment includes all costs to excavate, load, haul, and stockpile excavated materials.
6.     Blasting in Phase III Cell Excavation                     (Bid Item 6)  
Measurement by cubic yard (CY) removed by blasting. Measurement based on survey of the cell before and after removal of excavation.
- Payment includes all costs to blast Phase III cell excavation within the construction limits as shown on the Drawings and as described in Section 02221. Payment includes all costs to drill, load, detonate, and safety for excavated materials by blasting.
7.     Placement of Drain Rock                     (Bid Item 7)  
This bid item is placement of drain rock for the capillary break/underdrain layer and the LCRS Granular layer as indicated on the Drawings. Measurement by the cubic yard (CY) based on a survey of the drainage layers before and after placement. No adjustment will be made for uneven surfaces or waste. No measurement will be made for drainage layer lost due to damage resulting from either the fault or the negligence of the Contractor. The minimum thickness of the drainage layers shall be

verified by survey. The volume survey will be conducted by Contractor's surveyor.

Payment will be by the cubic yard (CY). Includes all costs to furnish and install the drainage layer materials including transportation, handling, and placement as shown on the Drawings and described in Sections 02227.

8. Placement of Groundwater Separation Soil Layer (Bid Item 8)

Measurement by the cubic yard (CY) based on a survey of the groundwater separation soil layer before and after placement. No adjustment will be made for uneven surfaces or waste. No measurement will be made for groundwater separation soil layer lost due to damage resulting from either the fault or the negligence of the Contractor. The minimum thickness of the low permeability soil layer shall be verified by survey. The volume survey will be conducted by Contractor's surveyor.

Payment will be by the cubic yard (CY). Includes all costs to furnish and install the groundwater separation soil layer materials including transportation, handling, and placement as shown on the Drawings and described in Sections 02222.

9. Placement of Sand Detection Layer (Bid Item 9)

This bid item is placement of sand for the detection layer as indicated on the Drawings. Measurement by the cubic yard (CY) based on a survey of the sand layer before and after placement. No adjustment will be made for uneven surfaces or waste. No measurement will be made for drainage layer lost due to damage resulting from either the fault or the negligence of the Contractor. The minimum thickness of the sand layers shall be verified by survey. The volume survey will be conducted by Contractor's surveyor.

Payment will be by the cubic yard (CY). Includes all costs to furnish and install the sand layer materials including transportation, handling, and placement as shown on the Drawings and described in Sections 02228.

10. Placement of Low Permeability Soil Layer (Bid Item 10)

Measurement by the cubic yard (CY) based on a survey of the low permeability soil layer before and after placement. No adjustment will be made for uneven surfaces or waste. No measurement will be made for low permeability soil layer lost due to damage resulting from either the fault or the negligence of the Contractor. The minimum thickness of the low permeability soil layer shall be verified by survey. The volume survey will be conducted by Contractor's surveyor.

Payment will be by the cubic yard (CY). Includes all costs to furnish and install the low permeability soil layer materials including transportation,

handling, and placement as shown on the Drawings and described in Sections 02255.

11. Placement of 60 mil HDPE Geomembrane (Bid Item 11)

Measurement by the planimetric square foot (SF) based on a perimeter survey of the completed installation. No measurement will be made for HDPE geomembrane lost due to damage resulting from either the fault or the negligence of the Contractor. The perimeter is defined as the neat line dimension shown on the perimeter details.

Payment will be by the planimetric square foot (SF) for each layer that is furnished and installed. Payment includes all costs to furnish and install the 60 mil HDPE geomembrane as shown on the Drawings and described in Section 02920.

12. Placement of Geocomposite Drainage Layer (Bid Item 12)

Measurement by the planimetric square foot (SF) based on a perimeter survey of the completed installation. No measurement will be made for geocomposite layer lost due to damage resulting from either the fault or the negligence of the Contractor. The perimeter is defined as the neat line dimension shown on the perimeter details.

Payment will be by the planimetric square foot (SF) for each layer that is furnished and installed. Payment includes all costs to furnish and install the geocomposite layer as shown on the Drawings and described in Section 02930.

13. Placement of Geosynthetic Clay Layer (GCL) (Bid Item 13)

Measurement by the planimetric square foot (SF) based on a perimeter survey of the completed installation. No measurement will be made for geosynthetic clay layer lost due to damage resulting from either the fault or the negligence of the Contractor. The perimeter is defined as the neat line dimension shown on the perimeter details.

Payment will be by the planimetric square foot (SF). Payment includes all costs to furnish and install the geosynthetic clay layer as shown on the Drawings and described in Section 02779.

14. Placement of Operations Layer (Bid Item 14)

Measurement by the cubic yard (CY) based on a survey of the compacted clay layer before and after placement. No adjustment will be made for uneven surfaces or waste. No measurement will be made for drainage layer lost due to damage resulting from either the fault or the negligence of the Contractor. The minimum thickness of the clay layer shall be verified by survey. The volume survey will be conducted by Contractor's surveyor.



Payment will be by the cubic yard (CY). Includes all costs to furnish and install the drainage layer materials including transportation, handling, and placement as shown on the Drawings and described in Sections 02222 and 02920.

15. Geotextile Fabric, 10 ounce (Bid Item 15)

Measured by the planimetric square foot (SF) based on a perimeter survey of the installed product.

Payment will be by the planimetric square foot (SF). Payment includes all costs to furnish and install the woven geotextile fabric as shown on the Drawings and described in Section 02226.

16. Geotextile Fabric, 12 ounce (Bid Item 16)

Measured by the planimetric square foot (SF) based on a perimeter survey of the installed product.

Payment will be by the planimetric square foot (SF). Payment includes all costs to furnish and install the woven geotextile fabric as shown on the Drawings and described in Section 02226.

17. Drainage Ditch, Type I (Bid Item 17)

Measured by the linear foot (LF) based on as-built surveys made along the flow line of the installed erosion mat lined ditch at a maximum spacing of 50 feet.

Payment will be by the Linear Foot (LF) installed. Payment includes all costs to construct the full-width of the erosion mat lined ditch including furnishing and installing the erosion mat as shown in the Drawings and described in Sections 02376.

18. Drainage Ditch, Type II (Bid Item 18)

Measured by the linear foot (LF) based on as-built surveys made along the flow line of the installed erosion mat lined ditch at a maximum spacing of 50 feet.

Payment will be by the Linear Foot (LF) installed. Payment includes all costs to construct the full-width of the erosion mat lined ditch including furnishing and installing the erosion mat as shown in the Drawings and described in Sections 02376.

19. 18-inch Buried HDPE Culvert (Bid Item 19)

Measurement based on linear foot (LF) of installed buried 18-inch HDPE pipe as measured by survey.

Payment will be by the linear foot (LF) installed. Payment includes all costs to excavate, backfill, furnish, and install the buried 18-inch HDPE pipe, couplings, and elbows as detailed on the Drawings and described in Section 02720.

20. 6-inch Buried Perforated HDPE Pipe (Bid Item 20)  
Measurement based on linear foot (LF) of installed buried 6-inch buried perforated HDPE pipe as measured by survey.

Payment will be by the linear foot (LF) installed. Payment includes all costs to excavate, backfill, furnish, and install the buried 6-inch HDPE pipe, couplings, and elbows as detailed on the Drawings and described in Section 15012.

21. LCRS/Underdrain Sump and Risers (Bid Item 21)  
Measured by the lump sum (LS).

Payment will be by lump sum (LS) and includes all costs to supply and install the LCRS, leak detection, and underdrain sump components and risers. Payment includes all costs to furnish and install erosion control and protection measures.

22. Fertilizer and Seed (Bid Item 22)  
Measured by the acre (AC). Measurement will be based on perimeter survey for fertilizing and seeding within the construction limits and stockpile areas. Sloped areas will be measured based on actual area, not plan area.

Payment includes all costs to fertilize and seed areas as shown in the Drawings and as described in Section 02820.

23. Erosion Control and Protection (Bid Item 23)  
Measured by the lump sum (LS).

Payment will be by lump sum (LS) and includes all costs for erosion control and protection shown on the Drawings and as described in Section 02250. Payment includes all costs to furnish and install erosion control and protection measures.

24. Road Base (Bid Item 24)  
Measured by the cubic yard (CY).

Payment includes all costs to furnish and install road base as shown on the Drawings. Payment includes all costs to furnish and install the road base as shown on the Drawings and described in Section 02233. Measurement and payment for furnishing and installing geotextile fabric under road base shall be per the bid item for geotextile.

25. Rip Rap (Bid Item 25)  
Measured by the square foot (SF).

Payment will be by the square foot (SF). Payment includes all costs to furnish and install the rip rap as shown on the Drawings and described in Section 02233.

END OF SECTION

## **SECTION 01050**

### **SURVEYING**

#### **PART 1 – GENERAL**

##### **1.1 SUMMARY**

This section includes the requirements for surveying, field Engineering, and record documents.

##### **1.2 CONTRACTOR’S SURVEYOR**

- A. The Contractor shall separately contract with a surveyor licensed in the State of California to provide field Engineering and surveying services as required for layout and construction of the project and to provide as-built Drawings of the completed project. The Surveyor shall:

- locate existing features,
- verify existing grades,
- provide construction stake out,
- create final Record Drawings (as-builts),
- provide survey base maps for Record Drawings.

##### **1.3 CONTRACTOR SUBMITTALS**

The Contractor shall submit the following items to the County for review:

- A. Existing Topographic Map: Within 30 days of commencing work, the Contractor shall perform a site survey and prepare an existing topographic map. The map shall be submitted to the County for review and approval before starting site grading.
- B. Project Record Documents: Upon substantial completion of the Work, deliver record documents to County. Final payments will not be made until satisfactory record documents are received by Owner. Accompany record documents with transmittal letter containing:
1. Date.
  2. Project title and number.
  3. Contractor’s name and address.
  4. Title and number of each record document.
  5. Certification that each document as submitted is complete and accurate.
  6. Signature of Contractor, or its authorized representative.

#### 1.4 MONTHLY INSPECTIONS

To verify the Contractor's monthly progress payment requests, the following items shall be made available for monthly inspection by the CQA Officer:

- A. Record Documents.
- B. Updated construction schedules using Microsoft Project on a CD ROM.

#### 1.5 SITE CONDITIONS

- A. Existing Grades: The Contract Drawings depict surface elevations in January 2007. Maintenance activities, re-grading, excavations, refuse fillings, and routine settlement have occurred since the survey. The Contractor's new topographic map will be used for site grading.
- B. Existing Features: Contractor is required to field-verify the location of existing features, and at points of connection or tie-in to the work. Owner's record drawings are available to the Contractor. The existence and location of features are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and existing features. Owner and the Engineer take no responsibility for the accuracy of these record drawings implied or otherwise.
- C. Field Verification: Prior to construction, coordinate with Owner to verify the elevations of existing features of the landfill and at points of connection or tie-in to the Work.

### **PART 2 – PRODUCTS (Not Applicable)**

### **PART 3 – EXECUTION**

#### 3.1 QUALIFICATIONS OF SURVEYOR

The Contractor shall arrange for the services of a State of California licensed land surveyor.

#### 3.2 FIELD SURVEY WORK

- A. Control Points: The Engineer will provide drawings with control point data for locations shown on the Drawings to the Contractor.
- B. Benchmarks: The Contractor shall establish and maintain a minimum of two permanent benchmarks on the site, referenced to data established by survey control points. Record benchmark locations including horizontal and vertical data on Project Record Documents. Do not change or relocate benchmarks or control

points without prior written approval by Owner. Promptly report lost or destroyed benchmarks and central points or requirements to relocate benchmarks and central points because of necessary changes in grades or locations, as applicable.

- C. Site Improvements: The Contractor shall work from lines and levels established by benchmarks and control points to set lines and levels as needed to properly locate each element of the Project. Locate and lay out site improvements, including stakes for slopes, grading, fill placement, drainage controls, and pipe invert elevations. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale Drawings to determine dimensions.
- D. Relocation of Existing Utilities: The Contractor shall furnish information necessary to adjust, move, or relocate existing features, structures, utility poles, lines, services or other appurtenances located in, or affected by construction. Coordinate with Owner and local authorities having jurisdiction.

### 3.3 TOLERANCES

- A. Inside the Limits of the Landfill: Within the limit of the landfill, elevations and 10-foot contour lines shown on the drawings are approximate. However, minimum and maximum slope requirements shown on the drawings and specified herein must be observed at all times. Slopes and tolerances shall be constructed as indicated.
  - 1. Horizontal and vertical survey tolerances shall be 1.0 feet and 0.1 feet, respectively.
  - 2. Steepest fill slopes are 3:1.
- B. Outside the Limits of the Landfill Closure Area: Outside the limits of the landfill closure area, grades shall be constructed as indicated.
- C. Positive Drainage: Within the limits of the project area, provide positive drainage towards permanent drainage ways. All areas shall be graded to the minimum slopes indicated. No ponding areas are permitted.

### 3.4 RECORD DOCUMENTS

- A. General: Protect new record documentation from deterioration and loss in a secure, fire-resistive location; provide access to record documents for Owner's reference during normal working hours. Electronic documents shall be backed-up at least once per week.

**B. Recording**

1. Label and file record documents and samples in accordance with Specification Section number listings in Table of Contents of this Technical Specification. Label each document "PROJECT RECORD" in neat, large, printed letters.
2. Preparation of project record documents shall be by personnel skilled as a draftsman competent to prepare the required drawings.
3. Record and update daily record information from field notes, on set of blue line prints, and this specification.
4. Record information concurrently (daily) with construction progress. Do not conceal work until required information is recorded.
5. Record deviations from required lines and levels, and advise the Engineer and CQA Officer when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted and not corrected.

**C. Record Drawings:** Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed or below-grade elements that would be difficult to measure and record at a later date.

Mark record sets with red erasable pencil. Mark new information that is important to Owner, but was not shown on Contract Drawings or Shop Drawings. Note related Change Order numbers where applicable. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates, and other identification on the cover of each set. Legibly mark each item to record actual construction, including:

1. Measured horizontal and vertical locations of underground utilities, drain pipe and appurtenances, referenced to permanent surface improvements.
2. Measured locations of internal utilities, and appurtenances concealed in construction, referenced to visible and accessible features of construction.
3. Field changes (dimensions and detail).
4. Changes by Modifications made by the CQA Officer or Owner.
5. Details not on original Contract Drawings.
6. References to related Shop Drawings and Modifications.
7. Depths of various elements of the Work in relation to datum.

8. Record Specifications: Maintain one complete copy of the Specifications, including addenda and one copy of other written construction documents such as Change Orders and Field Order issued in printed form during construction. Mark these documents to show substantial variations in actual work performed in comparison with the text of the Specifications, Change Order, and Field Order. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and product data. Legibly mark up each Section to record:
  - a. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
  - b. Changes made by Change Order or Field Order.
  - c. Other matters not originally specified.

#### **PART 4 – MEASUREMENT AND PAYMENT**

Measurement and payment will be made for surveying under Bid Item No. 2 – Construction Surveying.

END OF SECTION



**SECTION 01200****PROJECT MEETINGS****PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

Drawings and Special Provisions of the Contract, including Division-1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

This Section specifies administrative and procedural requirements for project meetings including but not limited to:

- A. Pre-Construction Conference
- B. Progress Meetings
- C. Coordination Meetings

**1.3 DESCRIPTION**

The CQA Officer will schedule and administer a pre-construction conference, periodic construction progress meetings, and specially called meetings throughout the progress of work. The CQA Officer will be responsible for preparing the agenda, making arrangements, preparing the meeting minutes, and presiding at these meetings.

Representatives of Contractor, Subcontractor(s), and Suppliers attending these meetings shall be qualified and authorized to act on behalf of the entity each represents.

The Contractor shall attend meetings to make sure that work is being performed consistent with Contract Documents and construction schedules.

**1.4 PRECONSTRUCTION CONFERENCE**

Within fifteen (15) days after the Notice to Proceed and before starting the work, a joint meeting shall be held with representatives of the Owner, Engineer, CQA Staff, Contractor's Project Manager and his Superintendent and other invited parties or government agencies which may be affected by or have jurisdiction over the project. This meeting is intended to introduce the various key personnel from each organization and to discuss the Contract Documents, the start of construction, order of work schedule, coordinate with the landfilling operations, labor and legal requirements, approved insurance requirements, names of the major subcontractors, progress payments, shop drawing submittal schedule, protection of existing facilities

and other pertinent items associated with the Project. The Contractor shall bring six (6) copies of a construction schedule to this meeting.

The suggested agenda for the preconstruction meeting:

- A. Introduction of key personnel and roles
- B. Overview of project
  - 1. Project summary
  - 2. Contract completion time
- C. Project schedule
- D. Critical work sequencing
- E. Labor requirements
- F. Relationship and coordination with:
  - 1. Other contracts
  - 2. On-going landfilling operations
- G. Use of premises (SPECIAL PROVISIONS)
  - 1. Right-of-ways and easements
  - 2. Access and traffic control
  - 3. Office, work, and storage areas
  - 4. Temporary facilities/utilities
  - 5. Safety and first aid procedures
  - 6. Security procedures
  - 7. Posting of signs
  - 8. Clean-up procedures
  - 9. County requirements
- H. Procedures and processing of:
  - 1. Field decisions
  - 2. Change orders
  - 3. Applications for payment
  - 4. Partial payments
  - 5. Record documents
  - 6. Shop drawings
  - 7. Request for extension of Contract time
- I. Construction facilities, controls, and aids
- J. Staking of work
- K. Equipment to be used
- L. Material/manufacturers/suppliers to be used
- M. Major equipment/material deliveries
- N. Requirements of railways and highway departments
- O. On-site material storage requirements
- P. Laboratory testing of materials
- Q. Project inspections
- R. Permit requirements

## 1.5 PROGRESS MEETINGS

During the course of the Contract, periodic progress meetings will be organized and conducted by the CQA Officer to discuss the progress of the Contract and for coordination. The Contractor's Project Manager and his construction superintendent shall attend these meetings.

The progress meetings will be held at the Contractor's field office.

The suggested agenda for these meetings:

- A. Review minutes of previous meeting.
- B. Review of work progress since previous meeting.
- C. Field observations, problems, and conflicts.
- D. Problems which impede the construction schedule.
- E. Review of off-site fabrication and delivery schedules.
- F. Corrective measures and procedures to regain projected schedule.
- G. Revisions to construction schedule.
- H. Progress schedule during next work period.
- I. Coordinate with the landfill operations.
- J. Coordination of schedule.
- K. Shop drawing submittals.
- L. Maintenance of quality standards.
- M. Pending changes and substitutions.
- N. Review proposed changes for:
  - 1. Effect on construction schedule and on completion date.
  - 2. Effect on other Contracts of the project.
- O. Other business.
- P. Construction schedule.
- Q. Critical/long-lead items.

## **PART 2 – PRODUCTS (Not Applicable)**

## **PART 3 – EXECUTION (Not Applicable)**

## **PART 4 – MEASUREMENT AND PAYMENT**

No separate measurement and payment will be made for project meetings. Costs shall be included in various bid items for the work.

END OF SECTION

**SECTION 01300**  
**CONTRACTOR SUBMITTALS**

**PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

Drawings, Special Provisions, and Divisions 1 and 2 Specification Sections apply to this Section.

**1.2 SUMMARY**

This section identifies the required project submittals (Table 01300-1) and the process by which they will be reviewed and approved. Unless otherwise specified, 6 copies of submittal information will be provided by the Contractor to the CQA Officer in accordance with specified time frames.

- A. A Summary of Submittals is provided in Table 01300-1 for quick review by the Contractor. It shall be the Contractor's responsibility to review the Specifications to identify the specific requirements for each submittal.

**Table 01300-1.**  
**Summary of Submittals**

<b>Submittal</b>	<b>Time Due</b>	<b>Approval Period</b>	<b>Approver</b>
Health and Safety Plan Construction Schedule	15 Days Before Start	Informational	N.A.
Subcontractor List	5 Days After NTP	10 Days	Owner
Manufacturer's Test Certifications	15 Days Prior to Procurement	10 Days	Engineer
Product Information	Prior to Procurement	10 Days	Engineer
Shop Drawings	10 Days Before Constructing	10 Days	Engineer
Material Samples/Test Results	30 Days before Constructing	10 Days	Engineer
Compaction Equipment Information	5 Days Prior to Intended Use	5 Days	Engineer
As-Built Plans	30 Days After Close of Construction	Informational	Engineer

### 1.3 SUBMITTAL PROCEDURES

- A. The Engineer reserves the right to modify the procedures and requirements for submittals, as necessary, to accomplish the specific purpose of each submittal. Direct inquiries to Engineer regarding the procedure, purpose, or extent of any submittal.
- B. Review, acceptance, or approval of substitutions, schedules, Shop Drawings, lists of materials, and procedures submitted or requested by Contractor shall not add to the Contract amount, and additional costs, which may result therefrom shall be solely the obligation of Contractor.
- C. The Engineer is not responsible for providing engineering or other services to protect Contractor from additional costs accruing from submittals.
- D. Submittals processed by Engineer do not become Contract Documents and are not Change Orders; the purpose of submittal review is to establish a reporting procedure and is intended for Contractor's convenience in organizing the work and to permit Engineer to monitor Contractor's progress and understanding of the design.
- E. Delays caused by the need for re-submittal shall not constitute basis for claim.

### 1.4 ADMINISTRATIVE SUBMITTALS

- A. Provide administrative submittals required by the Bidding Requirements, Special Provisions, and as might be specifically required in other parts of the Contract Documents.
- B. Make required submittals promptly to the applicable federal, state, or local agency, as required by law. Failure to comply with this requirement may result in withholding of progress payments and make Contractor liable for other prescribed action and sanctions.
- C. Submit to the Engineer a copy of letters relative to the Contract including notifications, reports, certifications, payrolls, and the like, that are submitted directly to a federal, state, or other governing agency.

### 1.5 SCHEDULES

- A. General:
  - 1. Submit proposed project schedule and preliminary schedule of submittals in duplicate to County and Engineer.

2. Based on comments received on the original proposed schedule, revise and resubmit as specified.
3. Submit progress schedule weekly showing actual progress in comparison to the original proposed schedule.

B. Schedule of Submittals:

1. Preliminary Schedule of Submittals. Indicate submittals required by Specification section number with brief description, starting and completion dates for respective submittal preparation, and submittal review by Owner and Engineer. Contractor shall submit its Preliminary Schedule of Submittals at least 5 days prior to the Pre-construction Conference.
2. Finalized Schedule of Submittals. Furnish sub-network to the progress schedule indicating respective progress schedule activity, which sequentially follows the submittal activity. Contractor shall submit its Finalized Schedule of Submittals within 5 days after the Pre-construction Conference.

## 1.6 SHOP DRAWINGS

A. General:

1. Shop Drawings, as defined herein, consist of all drawings, diagrams, illustrations, schedules, and other data which are prepared by or for the Contractor to illustrate some portion of the work; and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams, and other information prepared by a manufacturer and submitted by the Contractor to illustrate material or equipment for distinct portions of the work.
2. Submittal of incomplete or unchecked Shop Drawings will not be acceptable. Shop Drawing submittals, which do not clearly show Contractor's review, stamp or specific written indication of Contractor review will be returned to Contractor for resubmission.
3. Submittal of Shop Drawings not required under these Contract Documents and not shown on the schedule of submittals will be returned to the Contractor un-reviewed and unstamped by the Engineer.

B. Procedures:

1. Submit to Engineer for review and approval, in accordance with the accepted schedule of submittals, six (6) copies of Shop Drawings.

2. Transmit each submittal on Engineer-accepted form.
3. Sequentially number the transmittal forms; re-submittals to have original number with an alphabetic suffix.
4. Identify project, Contractor, Specification section number, pertinent drawing sheet and detail number(s), products, units and assemblies, and the system or equipment identification or tag number as shown.
5. Apply Contractor's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction work, and coordination of information, are in accordance with the requirements of the Contract Documents.
6. Transmit submittals in accordance with finalized schedule of submittals, and deliver to the Engineer.
7. Provide space for Engineer review stamps, 2-1/2 inches by 3-1/2 inches.
8. Revise and resubmit submittals as required; identify all changes made since previous submittal.
9. Submittals will be acted upon by Engineer and transmitted to Contractor not later than 10 working days after receipt by Engineer.
10. When Engineer has reviewed Shop Drawings, three (3) copies will be returned to Contractor appropriately annotated.
  - a. If major changes or corrections are necessary, Shop Drawing may be rejected and one set will be returned to Contractor with such changes or corrections indicated.
  - b. Correct and resubmit the Shop Drawings in the same manner and quantity as specified for the original submittal.
11. Foreign Manufacturers. Submit names and addresses of companies within the United States that maintain technical service representatives; include complete inventory of spare parts and accessories for each foreign-made item proposed for incorporation into the work. Failure to prove these capabilities shall be just cause for rejection of foreign-manufactured items.
12. Interfacing Work. Where called for in the Specifications and as determined necessary by the Engineer to provide proper correlation with other work, complete inter-face information shall be submitted. This interface information shall be accurate and contain all information necessary to allow for manufacturing and construction of the interfacing or connecting work.

## 1.7 SAMPLES AND TEST SPECIMENS

- A. Where required in the Specifications, and as determined necessary by the CQA Officer, submit test specimens or samples of material, equipment, and fittings to be used or offered for use in connection with the work. Include information as to their sources, prepay cartage charges, and submit such quantities and sizes for proper examination and tests to establish the quality or equality thereof, as applicable.
- B. Submit samples and tests specimens in ample time to enable CQA Officer to make tests or examinations necessary, without delay to the work.
- C. Submit additional samples as required by CQA Officer to ensure equality with the original approved sample and/or for determination of Specification compliance.
- D. Tests required by the Specifications to be performed by an independent laboratory shall be made by a laboratory licensed or certified in accordance with state statutes.
- E. Submit certified test results of specified tests in duplicate to the CQA Officer.
- F. Samples and laboratory services shall be at the expense of Contractor, unless otherwise specified, and be included in the prices bid for the associated work.
- G. Approved sample items (fixtures, hardware, etc.) may be incorporated into the work upon approval and when no longer needed by CQA Officer for reference.

## 1.8 QUALITY CONTROL SUBMITTALS

- A. Manufacturers' Certification of Proper Installation. Where manufacturer's certification is required in the Specifications, the manufacturer shall provide certification stating the following:
  - 1. The product or system has been installed in accordance with the manufacturer's recommendations.
  - 2. A manufacturer's authorized representative has inspected the product or system.
  - 3. The product or system has been serviced with the proper lubricants.
  - 4. Applicable safety equipment has been properly installed.
  - 5. Proper adjustments have been made, and the product or system is ready for functional testing, and operation.



**B. Certification of Compliance:**

1. Where specified, furnish certification of compliance for products specified to a recognized standard or code or the Specifications prior to the use of such products in the work.
  - a. CQA Officer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by a certification of compliance.
  - b. The manufacturer of the product shall sign certifications; state that the components involved complies in all respects with the requirements of the Specifications.
  - c. Furnish certification of compliance with each lot delivered to the job-site and clearly identify the lot so certified.
2. Products used on the basis of a certification of compliance may be sampled and tested at any time. The fact that a product is used on the basis of a certification of compliance shall not relieve Contractor of responsibility for incorporating products in the work, which conform to requirements of the Contract Documents. Products not conforming to such requirements will be subject to rejection whether in place or not.
3. Engineer reserves the right to refuse permission for use of products on the basis of a certification of compliance.

**1.9 CONTRACT CLOSEOUT SUBMITTALS**

- A. Record Drawings. The Contractor shall prepare and submit to the CQA Officer a clean copy of a marked-up (in red) set of Contract Drawings depicting all changes and modifications made during the construction. The Contractor shall utilize the necessary survey data for all the changes and modifications and shall provide as-built, record drawings of the completed landfill closure and landfill gas system (see page 01050-1).

**PART 2 – PRODUCTS (NOT USED)****PART 3 – EXECUTION (NOT USED)****PART 4 – MEASUREMENT AND PAYMENT**

No separate measurement and payment will be made for Contractor Submittals. Costs shall be included in the respective bid items.

END OF SECTION

**SECTION 01500****TEMPORARY FACILITIES AND CONTROLS****PART 1 – GENERAL****1.1 SUMMARY**

The requirements of this Section apply to, and are a component of, each section of the Specifications. The Contractor is responsible for furnishing all labor, equipment, materials, and provisions to provide temporary facilities and controls, including but not limited to, the Contractor's field office, Contractor's storage area(s), utility connections/hookups and permits for water service, electrical service, telephone service, maintenance of traffic, barricades, fences, damage to existing property, security, access roads, drainage, erosion and sediment control measures, parking, and emergencies.

**1.2 REFERENCES**

Drawings, Special Provisions, and Divisions 1 and 2 Specification Sections apply to this Section.

**1.3 FIELD OFFICE**

- A. The Contractor shall furnish and maintain one temporary field office for its own use, as needed. This office shall be located on-site and so as not to interfere with construction or landfill operations. The Contractor shall provide electrical service to the office. The Contractor shall obtain all permits for the facilities.
- B. A potable water supply is not currently available on-site. The Contractor shall provide potable water supply for its employees and subcontractors.
- C. Sanitary sewers are not available at this location. The Contractor shall provide sanitary facilities for its employees and his subcontractor's employees.
- D. Any communication given to the Contractor's representative or delivered at Contractor's office in his/her absence shall be deemed to have been delivered to Contractor.
- E. Copies of the Drawings and Specifications, and other Contract Documents shall be kept at the site and be available for use by Owner, Engineer, CQA Staff, or Contractor at all times.

**1.4 CONTRACTOR'S STORAGE AREAS**

- A. A storage area will be provided on the project site for use by the Contractor for storage of his materials, tools, equipment, and other items necessary for the

project construction. The exact limits of the storage area will be designated at the preconstruction meeting and in the field by Owner. The Contractor shall be solely responsible for the security of this area, including fencing, watchmen, and other means of security. Under no circumstances will Owner be responsible for the security of any property belonging to the Contractor, its subcontractors, or any of its work forces.

#### 1.5 SANITARY FACILITIES

- A. Contractor shall furnish temporary sanitary facilities at work locations, as provided herein, for the needs of all construction workers and others performing work or furnishing services in connection with the Work.
- B. Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest practical extent. The use of existing toilet facilities at the sanitary landfill by Contractor's personnel is strictly forbidden.

#### 1.6 TRAFFIC PROVISIONS

- A. Maintenance of Traffic: The Contractor shall conduct his/her operations in a manner that will not close any thoroughfare or interfere in any way with site traffic except with written permission of the County. Work shall be conducted so as to minimize obstruction of traffic, and traffic shall be maintained on at least half of the roadway width or 12 feet at all times except as approved by Owner. Approval shall be obtained from Owner prior to starting any activity that will obstruct traffic.

#### 1.7 FENCES

- A. All existing fences affected by the work shall be maintained by Contractor until completion of the work.
- B. On completion of the work, Contractor shall restore all fences to their original or to a better condition and to their original location.

#### 1.8 DAMAGE TO EXISTING PROPERTY

- A. Contractor will be held responsible for any damage to existing structures, environmental control and monitoring facilities, materials or equipment because of his/her operations and shall report any damaged items to Owner upon recognition of such damage. Contractor is responsible for repairs of damaged structures, work, materials or equipment to the satisfaction of, and at no additional cost to Owner. Such repairs or replacements shall be done in a timely manner.

- B. Contractor shall protect all existing structures and property from damage and shall provide bracing, shoring, or other work necessary for such protection.
- C. Contractor shall be responsible for all damage to streets, roads, curbs, sidewalks, highways, shoulders, ditches, embankments, culverts, bridges or other public or private property, which may be caused by transporting equipment, materials, or workers to or from the work. Contractor shall make satisfactory and acceptable arrangements with the agency having jurisdiction over the damaged property concerning its repair or replacement.

#### 1.9 SECURITY

- A. Security measures shall be at least equal to those usually provided by Owner to protect its facilities during normal operation, and shall also include such additional security fencing, barricades, lighting and other measures as required to protect the site.

#### 1.10 ACCESS ROADS

- A. Contractor shall construct, grade, stabilize and maintain temporary access roads to various parts of the site as required to complete the project.

#### 1.11 DRAINAGE

- A. The Contractor shall keep all natural drainage and water courses unobstructed or provide equal courses effectively placed, and prevent accumulations of surface water.

#### 1.12 EROSION AND SEDIMENT CONTROL MEASURES

- A. Adequate control of erosion and siltation of a temporary nature on areas disturbed by the work specified in this Section shall be provided by the Contractor, subject to the approval of Owner. There will be a joint on-site inspection prior to commencing work, with Contractor, State and County Officials and Owner to agree on sediment control measures and temporary drainage pipes, slope drains, gutters etc.
- B. Erosion control shall comply with all applicable State and County Regulations. Contractor shall prepare all necessary documentation for agency approvals and obtain required construction permits.

#### 1.13 PARKING

- A. Contractor shall provide and maintain suitable parking areas for the use of all construction workers and others performing work in connection with the project.

Vehicles shall not be parked where they may interfere with public traffic, Owner, landfill operations, or construction activities.

1.14 EMERGENCIES

- A. The Contractor shall display and update phone numbers of the local police, fire department, hospital, and emergency squad at its office and at all phones on site during the project.

**PART 2 – PRODUCTS (Not Used)**

**PART 3 – EXECUTION (Not Used)**

**PART 4 – MEASUREMENT AND PAYMENT**

Separate payment will not be made for Temporary Facilities and Controls.

END OF SECTION

**SECTION 01700**  
**CONTRACT CLOSEOUT**

**PART 1 – GENERAL**

**1.1 DESCRIPTION**

**A. Work Included:**

1. The work described in this section complies with the requirements stated in General and in Specifications for administrative procedures in closing out the work.

**1.2 SUBSTANTIAL COMPLETION**

**A. When Contractor considers the work as substantially complete, he shall submit to Owner and CQA Officer:**

1. A written notice that the work, or designated portion thereof, is substantially complete.
2. A list of items to be completed or corrected.

**B. Within a reasonable time after receipt of such notice, Owner and CQA Officer shall observe the work to determine the status of completion.**

**C. Should Owner or CQA Officer determine that the work is not substantially complete:**

1. Owner or CQA Officer will promptly notify the Contractor in writing, giving the reasons therefore.
2. The Contractor shall remedy the deficiencies in the work and send another written notice of substantial completion to Owner or CQA Officer.
3. CQA Officer will review the work.

**D. When the CQA Officer or Owner finds that the work is substantially complete, he/she will:**

1. Prepare and deliver to the Contractor a list of items to be completed or corrected before final payment.

2. After consideration of any objections made by Owner as provided in General and Supplementary Conditions of the Contract, and when CQA Officer considers work substantially complete, the CQA Officer will execute and deliver to Owner and the Contractor a definite Certificate of Substantial Completion with a revised list of items to be completed or corrected.

### 1.3 FINAL ACCEPTANCE

- A. When the Contractor considers the work is complete, he/she shall submit written certification that:
  1. Contract Documents have been reviewed.
  2. Work has been inspected for compliance with Contract Documents.
  3. Work has been completed in accordance with Contract Documents.
  4. Equipment and systems have been tested in the presence of the Engineer and CQA Officer and are operational.
  5. Work is completed and ready for final observation.
- B. Engineer will make an observation of the work to verify the status of completion with reasonable promptness after receipt of such certification.
- C. Should CQA Officer consider that the work is incomplete or defective:
  1. CQA Officer will promptly notify the Contractor in writing, listing the incomplete or defective work.
  2. Contractor shall take immediate steps to remedy the stated deficiencies, and send another written certification to the CQA Officer that the work is complete.
  3. CQA Officer will review the work.
- D. When the CQA Officer finds that the work is acceptable under the Contract Documents, he/she shall request the Contractor to make closeout submittals.

### 1.4 CLOSEOUT SUBMITTALS

- A. The Contractor shall provide evidence of compliance with the requirements of the governing authority.

- B. The Contractor shall submit of accurate “as-built” Record Drawings of the project.
- C. The Contractor shall submit of all specified warranties, guarantees, and operation and maintenance manuals as applicable.

#### 1.5 FINAL ADJUSTMENT OF ACCOUNTS

- A. The Contractor shall submit a final statement of accounting to Owner.
- B. Statement shall reflect all adjustments to the Contract Sum:
  - 1. The original Contract Sum.
  - 2. Additions and deductions resulting from:
    - a. Previous change orders or written amendment.
    - b. Allowances.
    - c. Unit prices.
    - d. Work not done.
    - e. Failed test costs.
    - f. Penalties.
    - g. Deductions for liquidated damages.
    - h. Other adjustments.
  - 3. Total Contract Sum, as adjusted.
  - 4. Previous payments.
  - 5. Sum remaining due.
- C. The Contractor shall submit satisfactory evidence of release of all liens or claims.
- D. County will prepare a final Change Order, reflecting approved adjustments to the Contract Sum, which were not previously made by Change Orders.



1.6 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Conditions of the Contract.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**PART 4 – MEASUREMENT AND PAYMENT**

No separate measurement and payment will be made for Contract Closeout.

END OF SECTION

**DIVISION 2 – SITE WORK**

**SECTION 02110**

**CLEARING AND STRIPPING**

**PART 1. GENERAL**

**1.1 DESCRIPTION**

- A. Scope: The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required for site clearing work. The Contractor shall not disturb more than (15) acres of surface area at any one time during the project without prior approval from Owner.
- B. General: Site clearing work shall include removal of surface debris and other plant life required and for bringing the site to final grade. Vegetation in areas to be stripped shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing.
- C. Work Specified Elsewhere:
  - 1. Section 02222 Excavating and Grading

**1.2 DEFINITIONS**

- A. Clearing: Clearing shall consist of removing vegetation, including trees and brush, and debris that exists within the construction limits.
- B. Stripping: Grasses and top soil shall be removed from the work area as shown on the Drawings and as specified herein. This material shall be stockpiled in a designated area and reapplied after completion of the final cover as specified.
- C. Permits: The Contractor shall obtain all permits necessary for removal of vegetative growth within the work area.

**1.3 QUALITY ASSURANCE**

- A. All materials and labor furnished under this section shall comply with ASTM, AA, NEC, ANSI and all other applicable Federal, State and County codes and regulations including revisions to date of contract.
- B. Coordinate Clearing Work with utility companies.

**PART 2. PRODUCTS (Not Applicable)**

**PART 3. EXECUTION****3.1 PREPARATION**

- A. Verify that existing plant life designated to remain is clearly tagged and/or identified.
- B. Identify an appropriate waste/salvage area for placing removed materials. The waste/salvage area shall be approved by Owner prior to placement of materials.

**3.2 PROTECTION**

- A. Locate, identify and protect existing utilities from damage.
- B. Protect trees, plant growth and features designated to remain, as final landscaping by encircling the trees with protective fencing.
- C. Protect bench marks, survey control point, wells, and existing structures from damage or displacement.

**3.3 CLEARING**

- A. Clear areas required for site access and execution of the Work.
- B. Remove trees and shrubs within marked areas. Remove stumps, main root ball and root system to a depth of 12 inches.
- C. Clear undergrowth and deadwood, without disturbing subsoil.

**3.4 TOPSOIL STRIPPING**

- A. Strip approximately 3 inches of topsoil from the work areas, without mixing with foreign materials.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 20 feet and protect from erosion.
- D. Place excess topsoil not intended for reuse on denuded areas at a location on site, as approved by Owner.

**3.5 DUST CONTROL**

The Contractor shall be responsible for controlling objectionable dust by his/her operation of vehicles and equipment during all land disturbing activities. The Contractor shall use methods, subject to the CQA Office's approval, that keep dust in the air to a

minimum and to the satisfaction of Owner. Dust control will be particularly important in controlling the migration of waste particles containing lime, cement, metals, silt, and sand during the re-grading of the landfill slopes and top deck.

END OF SECTION

## **SECTION 02221**

### **EXCAVATION AND GRADING**

#### **PART 1 – GENERAL**

##### **1.1 SUMMARY**

- A. Section includes excavating soil and rock as required.
- B. Related Sections
  - 1. Section 02110 – Clearing and Stripping
  - 2. Section 02222 – Earthfill

##### **1.2 DEFINITIONS**

- A. Construction Quality Assurance (CQA) Consultant: The monitoring firm responsible for implementation of the CQA plan.

#### **PART 2 – PRODUCTS**

##### **2.1 NO PRODUCTS ARE REQUIRED FOR EXCAVATION.**

#### **PART 3 – EXECUTION**

##### **3.1 PREPARATION**

- A. Identify required lines, levels, contours, and datum.
- B. Provide for dust control.
- C. Provide dewatering as necessary.

##### **3.2 EXCAVATION AND GRADING**

- A. Prior to rock excavation and construction of the landfill liner and leachate collection and removal system (LCRS), a Spill Prevention Plan shall be prepared. The plan will identify procedures for refueling equipment, performing equipment maintenance and repair, and storing construction materials that will minimize the potential for spills. The plan will require that any explosives spilled during the loading of the blasting holes can be designed and restricted to locations where spills could be contained. The plan will include contingency measures to be used

to contain and clean up spills and procedures for disposal of used or spilled materials.

- B. Excavation and Grading includes cover, roads, and drainage ditches.
- C. Strip surfaces of work area of vegetation or other organic material prior to grading the foundation layer soil. Place stripped vegetation and soil in designated stockpiles on Drawing No. 2.
- D. Excavate to the limits of work lines and grades shown on the Drawings.
- E. Remove lumped subsoil, boulders, and rock over 6 inches in largest dimension from completed area of the cover surface.
- F. Notify Owner of unexpected subsurface conditions and discontinue work in affected area.
- G. Exercise care to preserve materials below and beyond the lines of grading. Excavation performed for the convenience of the Contractor will be at no additional expense to Owner. Place earthfill in over-excavated areas per Section 02222.
- H. Exercise care to preserve existing environmental control systems by hand digging to expose wells, piezometers, risers, etc., so as not to damage said item, especially during grading operations.

### 3.3 WASTE EXCAVATION AND HANDLING

- A. Rippable excavation is defined as material that can be removed using a D 9 dozer with a single shank ripper. Materials that cannot be removed in this manner will require blasting by a licensed blasting specialist.
  - 1. Blasting shall be limited to the hours of 4:30 p.m. to 5:30 p.m. Monday through Friday, excluding holidays, when the public is not present. A safety setback perimeter, consistent with OSHA and MSHA requirements shall be established around the blast site with cones. Prior to a blast, all access points to the blasting site shall be blocked by signs and sentries to assure a safe clear zone around the blast. The following warning systems, procedures and protection devices shall be established prior to blasting.
    - a. A system of audible signals to warn of impending blast.
    - b. Signboards and flags indicating areas where blasting operations are occurring. These signs shall be clearly visible and legible from all parts of access to the area. The signs shall clearly describe the audible signal system for warning of impending blasts. Blast area signs shall clearly indicate the length and nature of audible blast warnings and all clear signals. All warning systems shall comply

with the most stringent requirements of regulating local, state and federal agencies.

- c. Only the blaster-in-charge will give the signal that it is safe to blast after ensuring that all people, animals and equipment are in safe locations.
  - d. Explosions must be directly supervised by a licensed blaster at all times that they are on the Central Disposal Site. This requirement applies to all explosives that are already located in the ground and to explosives that are yet unloaded or left over after a blast is loaded. Any explosives spilled during the loading of the blasting holes shall be cleaned up prior to detonating the explosives. No explosives will be stored at the Central Disposal Site.
- 2. The bore holes for blasting shall be limited to a maximum diameter of 4 inches and a depth which assures that a maximum bench height of 30 feet is not exceeded. All blasts will be designed so that the maximum weight of explosives per day will not exceed 200 pounds.
  - 3. Prior to placing explosives in the blast holes, methane detecting equipment will be used to determine whether methane gas is present at the collars of at least 15 blast holes that are nearest the areas of the landfill that contain buried refuse. If the monitors detect methane in concentrations exceeding 1.0%, the blasting contractor shall use only explosives especially formulated for safe use in gassy environments. All explosive charges shall be stemmed with at least 8 feet of clean crushed stone with a maximum dimension of 3/8 to 1/2 inch.
  - 4. Contractors working on the Central Disposal Site will be prohibited from blasting simultaneously at two or more locations. Blasting at more than one location may occur on the same day, but blasting will be coordinated so that blasts do not occur within 10 minutes of each other.
  - 5. Blasting will not be allowed closer than 25 feet from the nearest part of the existing Central Disposal Site landfill that contains buried refuse, any monitoring well, landfill gas or leachate collection pipes, landfill liner, or leachate storage pond. The maximum charge weight per delay shall meet the minimum scale distance of 10 at the nearest part of the existing landfill that contains buried refuse, any monitoring well, landfill gas or leachate collection pipe, landfill liner, or leachate storage pond and a minimum scale distance of 60 based on the distance to the nearest privately owned building. The calculation producing the lowest weight shall be used in all cases.

6. In no case shall blasting noise (air blast), measured near residential building, exceed 130 dBL. Peak particle velocity of blast induced ground motion shall not exceed 0.5 inches per second near any private off-site structure. Ground motion at the nearest part of the existing landfill containing buried refuse, any monitoring well, landfill gas or leachate collection pipe, liner, or leachate storage pond shall not exceed 7.5 inches per second.
  7. Blast reports shall be submitted to the County of Sonoma Department of Transportation and Public Works, Integrated Waste Division, within 24 hours after the time of blasting. Reports shall be kept on file and available for LEA review and shall include details about hold loads, maximum charge weight per delay, delay timing, blast time, weather conditions, explosive product names and quantities, and other pertinent information. A copy of the drill log will also be attached to the blast report.
- B. The Contractor may encounter waste during excavation and uncovering of the edge of existing cover system. In the event that waste is encountered, it shall be excavated and disposed at the active working face of the landfill as directed by Owner.
- C. The Contractor shall prepare and utilize a site-specific Health and Safety Plan to prevent associated hazards, as specified in Section 01010.

END OF SECTION



**SECTION 02222****EARTHFILL****PART 1 – GENERAL****1.1 SUMMARY**

- A. Section includes placement of on-site soils as earthfill for the Liner Subgrade and Soil Separation Layers.
- B. Related sections.
  - 1. Section 02221 – Excavation and Grading

**1.2 REFERENCES**

- A. American Society for Testing and Materials.
  - 1. D 422-63 (7/84), Standard Test Method for Particle-Size Analysis of Soils.
  - 2. D 1557-91, Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-LB (4.54 KG) Hammer and 18-in (457-mm) drop.
  - 3. D 2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
  - 4. D 2922-81, Test Method for Density of Soil and Soil Aggregate in Place by Nuclear Methods.
  - 5. D 3017-78, Test Method for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods.

**1.3 DEFINITIONS**

- A. Backfill: Material placed in previously excavated trenches.
- B. Cohesionless Materials: Materials classified by the Unified Soil Classification System (USCS) as GW, GP, SW, and SP.
- C. Cohesive Materials: Materials classified by USCS as GC, SC, ML, CL, MH, and CH.
- D. Earthfill: On-site soil, obtained from on-site excavation, that is placed to specified densities and moisture contents.
- E. Liner Subgrade: The compacted surface that supports the liner system.

- F. Soil Separation Layer: The soil layer placed over the underdrain to create separation with groundwater.
- G. Lift: One single continuous placement of soils, usually measured in inches of depth.
- H. Percent Relative Compaction: Field dry density expressed as a percentage of the maximum dry density obtained by the test procedure presented in ASTM D 1557-91.

## **PART 2 – PRODUCTS**

### **2.1 EARTHFILL**

- A. Sources: On-site stockpiles and on-site borrow areas as shown on the Drawings.
- B. Free of organic or other deleterious material.
- C. Maximum particle size of 4 inches in largest dimension

### **2.2 LINER SUBGRADE**

- A. Source: On-site stockpiles and on-site borrow areas as shown on the Drawings.
- B. Free of organic or other deleterious material.
- C. Maximum particle size of 4-inches in largest dimension

### **2.2 SOIL SEPARATION LAYER**

- A. Source: County-designated onsite stockpiles.
- B. Some organic materials allowed.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Identify required lines, levels, contours, and datum.
- B. Provide for dust control.
- C. Provide for surface water control.

### **3.2 SUBGRADE PREPARATION**

- A. Strip surfaces in the work area of vegetation or other organic material. Stripped material will be stockpiled in a location identified by the County per Section 02221, 3.2B.

- B. Grade the exposed surface per Section 02221. Place and compact additional soil fill per this Section.
- C. CQA Monitor will observe prepared surfaces before earthfill placement.

### 3.3 LINER SUBGRADE

- A. Earthfill shall be placed to smooth existing surfaces to achieve the liner system's Subgrade. The CQA Monitor shall observe the Contractor verify that the liner subgrade is acceptable.
- B. Place soil to the lines and grades shown on the drawings.
- C. Scarify top of each compacted lift before placing subsequent lift, unless sheepsfoot or padfoot compactor is utilized.
- D. Maintain moisture content within specified range.
- E. Moisture condition, recompact, or remove and replace soil not meeting specified requirements as determined by the County or authorized representative.
- F. Place and compact as specified in Tables 02222-1.
- G. Testing will be performed as specified in Table 02222-2.
- H. Density testing will be performed as specified in Table 02222-3.

**Table 02222-1.  
Earthfill Placement and Compaction Requirements**

Fill Type	Loose <sup>(1)</sup> Lift Thickness (inches)	Moisture Content <sup>(2)</sup>	Minimum Subgrade and Lift Density	Method of Test	Finished Grade Tolerance <sup>(3)</sup> (feet)
Liner Subgrade and Soil Separation Layer	8-in maximum	5% below optimum to 5% above optimum	90.0% minimum	ASTM D 1557	-0.1 to +0.1
<sup>(1)</sup> Thinner lifts may be required to obtain adequate compaction. <sup>(2)</sup> Moisture limits may have to be adjusted to obtain required density or to minimize desiccation cracking. <sup>(3)</sup> Provided adequate drainage is maintained.					

**Table 02222-2.  
Testing Frequency**

Test Method ASTM No.	General Fill	Liner Subgrade On-Site	Separation Layer On-Site
Conformance Testing			
D1557		5,000 cy/	
D422		5,000 cy/	5,000 cy/
D2487		5,000 cy/	5,000 cy/

**Table 02222-3.  
Density Testing In Field**

Test Method ASTM No.	General Fill	Liner Subgrade On-Site	Separation Layer On-site
Field Testing			
D2922	1,000 cy	500 cy/	1,000 cy/
D1556	10,000 cy	5,000 cy/	10,000 cy/

NOTES: Frequency/ Number of Tests = Cubic Yards/ Frequency

### 3.4 SOIL SEPARATION LAYER

- A. The soil separation layer shall be placed in 8-inch thick layers on the final surface of the underdrain.
- B. The first lift shall be track walked using a D6 dozer a minimum of 4 passes. All subsequent lifts shall be 8-inches thick and shall be compacted using conventional compaction equipment.

### 3.5 FIELD QUALITY ASSURANCE

- A. Owner will engage and pay for the services of: (1) CQA Consultant; and (2) CQA Laboratory
- B. Contractor shall render assistance as necessary for CQA Consultant to obtain soil and material samples.
- C. CQA Consultant will determine maximum dry density and optimum moisture content.
- D. CQA Consultant will determine in-place density and moisture content.
- E. Cooperate with Owner or authorized representative in scheduling and performing field CQA tests.

END OF SECTION

**SECTION 02226**  
**GEOTEXTILE FABRIC**

**PART 1 – GENERAL**

**1.1 DESCRIPTION**

- A. This section covers the work necessary to furnish and install woven and non-woven geotextile fabric required by the Drawings and Specifications.
- B. The work includes furnishing all labor, supervision, tools, construction equipment, and materials necessary to install the fabrics described by these Drawings and Specifications.

**1.2 GENERAL**

- A. Provide all labor, materials, and equipment necessary to accomplish the work specified in this section.

**1.3 REFERENCES**

- A. Reference Standards: The following standards, including documents references therein, are referenced within this section and form part of this section to the extent designated herein. Unless otherwise specified, the most recent version of the reference standards at the bidding shall apply.
- B. American Society of Testing and Materials:
  - 1. ASTM D4632, Method for grab tensile strength.
  - 2. ASTM D4632, test Method for grab elongation.
  - 3. ASTM D5261, Test Methods for Mass Per Unit Area (Weight) of Woven Fabric.
  - 4. ASTM D4833, Test Method for Puncture Strength.
  - 5. ASTM D4491, Test Methods for Water Permeability of Geotextiles by Permittivity.
  - 6. ASTM D4533, Test Method for Trapezoid Tearing Strength of Geotextiles.

7. ASTM D4751, Test Method for Apparent Opening Size.

1.4 DEFINITIONS

- A. Satisfactory Materials: Materials which comply with the requirements of this Section are satisfactory.
- B. Unsatisfactory Materials: Materials which do not comply with the requirements of satisfactory materials are unsatisfactory.

1.5 SAFETY

- A. The Contractor shall be solely responsible for installing geotextiles in a safe manner. Provide appropriate measures to ensure that persons working on or near the project area are protected.
- B. Contractor shall familiarize themselves with, and comply with, all applicable codes, ordinances, statutes, and bear sole responsibility for the penalties imposed for noncompliance.

1.6 SUBMITTALS

- A. Prior to delivery, submit certificates of compliance with the requirements and testing methods specified.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Geotextile shipped during the wet weather period shall be shipped in a closed trailer.
- B. Geotextile shall be protected from precipitation, inundation, ultraviolet exposure, dirt puncture, cutting, and other damaging or deleterious condition.

**PART 2 – PRODUCTS**

2.1 EQUIPMENT

- A. Furnish all necessary equipment required to accomplish the construction of the road base aggregate and erosion protection layers.

2.2 NON-WOVEN GEOTEXTILES

- A. The non-woven geotextile supplied by the Contractor shall be:

1. A non-woven, needle-punched, staple fiber or continuous filament polyester material, or
2. A non-woven, needle-punched, staple fiber or continuous filament polypropylene material.

Geotextile shall be UV-light resistant.

- B. Geotextile shall meet performance criteria and shall be approved by the CQA Officer.

### PERFORMANCE CRITERIA

Fabric Property	Unit	Test Method	10 OZ Non- Woven	12 OZ Non- Woven
Grab Strength	lb	ASTM D4632	260	320
Trapezoid Tear	lb	ASTM D4533	100	125
Puncture Strength	lb	ASTM D4833	165	190
Permittivity	Sec-1	ASTM D4491	1.0	0.8
Water Flow Rate	gpm/ft <sup>2</sup>	ASTM D4491	75	60
AOS (Apparent Opening Size)	Sieve Size	ASTM D4751	100	100
UV Resistance (500 hr.)	%	ASTM D4355	70	70

- C. The Manufacturer shall mark on each roll the Manufacturer's name, product identification, lot number, roll number, and roll dimensions.
- D. The Manufacturer shall test one sample, consisting of five specimens, per each lot. One random thickness test per roll shall also be performed. The Contractor shall submit all test information and samples prior to the material being received on site.

## PART 3 – EXECUTION

### 3.1 DEVELOPMENT

- A. Geotextile is to be deployed following the Manufacturer's recommendations, standards, and guidelines.
- B. The geotextile is to be secured against movement caused by wind. Securing



mechanism must be left in place on geotextile until replaced with protective soil cover material.

- C. Geotextile laying and subsequent covering with gravel, soil, road base aggregate and erosion layers shall proceed in such a manner as to minimize exposure to light.
- D. The surface to receive the geotextile shall be smooth, free from obstructions, depressions, and sharp objects. Notify the CQA Monitor prior to placing geotextile so that the CQA Monitor may observe the surface to receive the geotextile. Lay geotextile so as to minimize the number of joints and seams.

Lay geotextile loosely, but without creases.

- E. Do not operate machinery directly on the geotextile. When placing material over joints, place in the direction from the overlying geotextile to the underlying geotextile. Prevent puncture, tear, or displacement of geotextile and protect from damage.

### 3.2 SEAMING

- A. Seams for the geotextile shall be overlapped sewn seams for the geotextile shall be overlapped to provide a “prayer” seam, “J” seam, or “butterfly” seam and shall be a two-thread, double-lock stitch, Federal Class No. 1. Heat bonded seams for the non-woven filter geotextile shall be overlapped a minimum of 1 foot. Seams shall be continuous.
- B. Polymeric thread shall be used in sewing with properties equal to or greater than those of the geotextiles.

### 3.3 REPAIRS

- A. Repair holes or tears in the geotextile by fabric patch placed over the repair area overlapping undamaged geotextile by 1 foot. Patch should have dimensions at least 1 foot greater than the tear or hole.
- B. Replace roll when tear exceeds 10 percent of roll width.
- C. Remove materials which may have penetrated torn fabric.
- D. Log any defects, holes, and tears which are identified and repaired.

### 3.4 PROTECTION

- A. Geotextile shall be stored in such a manner to protect it from puncture, dirt, grease, water, mud, or excessive heat.

END OF SECTION

**SECTION 02227**  
**DRAINAGE GRAVEL**

**PART 1 – GENERAL**

**1.1 WORK OF THIS SECTION**

- A. The Work of this section generally includes furnishing, loading, hauling, and placing the drainage materials for the capillary break layer and leachate collection and recovery system (LCRS).

**1.2 RELATED SECTIONS**

- A. Section 02720 – Storm Drainage Structures, Piping, And Fittings
- B. Section 02225 – Geomembrane
- C. Section 02226 – Geotextile
- D. Section 02930 – Geocomposite Drainage Layer

**1.3 REFERENCES**

- A. ASTM D136 – Standard Method for Fine and Coarse Aggregates
- B. ASTM D2434 – Standard Method for Permeability of Granular Soils (Constant Head)
- C. ASTM D2488 – Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

**1.4 SUBMITTALS**

- A. Submit a 50-pound representative sample of the proposed drainage granular material within 10 days after contract award. Include gradation, hydraulic conductivity and carbonate test results for the supplied material prepared by a qualified laboratory and signed by lab representative. Test results shall be submitted by the CONTRACTOR in accordance with Section 01300.

**PART 2 PRODUCTS**

**2.1 DRAINAGE GRAVEL**

- A. Material obtained and imported from off-site.

- B. Free of organic or other deleterious material.
- C. Having a hydraulic conductivity greater than or equal to 1.0 cm/sec when placed in accordance with this specification.
- D. Rounded to sub-rounded gravel.
- E. Required gradations as shown in Table 02227-1.

**TABLE 02227-1.  
LCRS DRAINAGE GRAVEL GRADATION**

U.S. Sieve Size	Percent Passing
1-inch	100
½-inch	0-5
No. 200	0-2

- F. The permeability specification controls over the gradation specification.
- G. Containing no limestone (carbonates) or other material that may adversely react with landfill leachate. Testing shall be performed on the proposed gravel to show that there is less than 10 percent carbonate rock. Testing shall be performed by a qualified lab in accordance with ASTM D3042.
- H. Material must be hard, durable and not subject to grain crushing.

### **PART 3 EXECUTION**

#### **3.1 PLACEMENT**

- A. Place materials only when underlying excavations, foundations, and geosynthetic installations are complete and accepted by Engineer in accordance with Specifications.
- B. Place to lines and grades shown on the Construction Drawings.
- C. Place to the thickness shown on the Construction Drawings.
- D. Place without damaging underlying geosynthetics. Repairs shall be at Contractor sole expense.
- E. Do not cause underlying geosynthetics to bridge across ditch or pipe alignments. If bridging does occur, repairs shall be at Contractor sole expense.

- F. Construct minimum 36-inch thick haul routes over Geomembrane. Use protective soil cover layer soil to construct roads. The 36-inch minimum thickness applies to haul routes, stockpiles, and initial spreading areas. Any loaded scraper or rubber tired equipment with can only be driver over the liner on a haul road consisting of a minimum 36-inch thick protective soil cover.
- G. Spread and place using low ground pressure dozers and graders. Alternative equipment may be used with prior approval of the Engineer. Alternative equipment may require increased thicknesses of haul routes over installed geomembrane.
- H. Place during the cool part of the day when the liner is relatively tight and free of wrinkles.

### 3.2 LEACHATE COLLECTION AND PIPE INSTALLATION

- A. Comply with Section 02227 for assembly of pipe runs.
- B. Install to the lines and grades shown on the Construction Drawings.

### 3.3 FIELD QUALITY CONTROL

- A. Prior to beginning drainage layer material placement, demonstrate that placement techniques will not damage the underlying geomembrane material. Demonstrate this by constructing test fill over all affected geosynthetic types in an area not part of final construction.
- B. Do not use pointed stakes as grade control devices. Only use devises that will not puncture underlying geomembrane.
- C. Grade top perimeter of excavation to prevent surface water from draining into excavation.

### 3.4 FIELD QUALITY ASSURANCE

- A. Sampling and testing of materials to determine material type may be performed by the Engineer at the stockpile, at the material source, or at the place of use in accordance with the CQA Plan.
- B. The Engineer will perform gradation tests of materials before and during placement in accordance with ASTM D422.
- C. The Engineer will perform permeability tests of materials before and during placement operations in accordance with ASTM D2434.
- D. Assist the Engineer as necessary in collecting material samples and conducting tests.

- E. Engineer reserves the option of waving gradation specifications if products submitted by Contractor meet design intent.

END OF SECTION

**SECTION 02228****SAND****PART 1 – GENERAL****1.1 WORK OF THIS SECTION**

- A. The Work of this section generally includes furnishing, loading, hauling, and placing the sand materials for the detection layer above the secondary HDPE liner.

**1.2 RELATED SECTIONS**

- A. Section 02225 – Geomembrane
- B. Section 02226 – Geotextile

**1.3 REFERENCES**

- A. ASTM D136 – Standard Method for Fine and Coarse Aggregates
- B. ASTM D2434 – Standard Method for Permeability of Granular Soils (Constant Head)
- C. ASTM D2488 – Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

**1.4 SUBMITTALS**

- A. Submit a 50-pound representative sample of the proposed sand material within 10 days after contract award. Include gradation, hydraulic conductivity and carbonate test results for the supplied material prepared by a qualified laboratory and signed by lab representative. Test results shall be submitted by the CONTRACTOR in accordance with Section 01300.

**PART 2 PRODUCTS****2.1 SAND**

- A. Material obtained and imported from off-site.
- B. Free of organic or other deleterious material.
- C. Having a hydraulic conductivity greater than or equal to  $1.0 \times 10^{-2}$  cm/sec when placed in accordance with this specification.

- D. Rounded to sub-rounded sand.
- E. Required gradations as shown in Table 02228-1.

**TABLE 02228-1.  
SAND GRADATION**

U.S. Sieve Size	Percent Passing
3/8-inch	100
No. 4	90-100
No. 8	60-90
No. 16	40-60
No. 30	30-40
No. 50	20-30
No. 100	5-20
No. 200	0-5

- F. The permeability specification controls over the gradation specification.
- G. Containing no limestone (carbonates) or other material that may adversely react with landfill leachate. Testing shall be performed on the proposed gravel to show that there is less than 10 percent carbonate rock. Testing shall be performed by a qualified lab in accordance with ASTM D3042.
- H. Material must be hard, durable and not subject to grain crushing.

### **PART 3 EXECUTION**

#### **3.1 PLACEMENT**

- A. Place materials only when underlying excavations, foundations, and geosynthetic installations are complete and accepted by Engineer in accordance with Specifications.
- B. Place to lines and grades shown on the Construction Drawings.
- C. Place to the thickness shown on the Construction Drawings.
- D. Place without damaging underlying geosynthetics. Repairs shall be at Contractor sole expense.
- E. Do not cause underlying geosynthetics to bridge across ditch or pipe alignments. If bridging does occur, repairs shall be at Contractor sole expense.



- F. Construct minimum 36-inch thick haul routes over Geomembrane. Use protective soil cover layer soil to construct roads. The 36-inch minimum thickness applies to haul routes, stockpiles, and initial spreading areas. Any loaded scraper or rubber tired equipment with can only be driver over the liner on a haul road consisting of a minimum 36-inch thick protective soil cover.
- G. Spread and place using low ground pressure dozers and graders. Alternative equipment may be used with prior approval of the Engineer. Alternative equipment may require increased thicknesses of haul routes over installed geomembrane.
- H. Place during the cool part of the day when the liner is relatively tight and free of wrinkles.

### 3.2 LEAK DETECTION LAYER AND PIPE INSTALLATION

- A. Comply with Section 02228 for assembly of pipe runs.
- B. Install to the lines and grades shown on the Construction Drawings.

### 3.3 FIELD QUALITY CONTROL

- A. Prior to beginning drainage layer material placement, demonstrate that placement techniques will not damage the underlying geomembrane material. Demonstrate this by constructing test fill over all affected geosynthetic types in an area not part of final construction.
- B. Do not use pointed stakes as grade control devices. Only use devises that will not puncture underlying geomembrane.
- C. Grade top perimeter of excavation to prevent surface water from draining into excavation.

### 3.4 FIELD QUALITY ASSURANCE

- A. Sampling and testing of materials to determine material type may be performed by the Engineer at the stockpile, at the material source, or at the place of use in accordance with the CQA Plan.
- B. The Engineer will perform gradation tests of materials before and during placement in accordance with ASTM D422.
- C. The Engineer will perform permeability tests of materials before and during placement operations in accordance with ASTM D2434.
- D. Assist the Engineer as necessary in collecting material samples and conducting tests.

- D. Engineer reserves the option of waving gradation specifications if products submitted by Contractor meet design intent.

END OF SECTION

**SECTION 02229**  
**TRENCHING, BACKFILLING, AND**  
**COMPACTING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes exploratory backhoe trenching, backfilling, and compacting as specified herein.
- B. Related sections:
  - 1. Section 02222: Earthfill

**1.2 REFERENCES**

- A. American Society for Testing and Materials.
  - 1. D 422, Method for Particle-Size Analysis of Soils.
  - 2. D 1557, Test Methods for Laboratory Compaction Characteristics of Soil.
  - 3. D 2487, Standard Test Method for Classification of Soils for Engineering Purposes.
- B. Occupational Safety and Health Administration (OSHA).

**1.3 DEFINITIONS**

- A. Backfill: Material placed in previously excavated trenches.
- B. Cohesionless Materials: Materials classified by the Unified Soil Classification System (USCS) as GW, GP, SW, and SP.
- C. Cohesive Materials: Materials classified by USCS as GC, SC, ML, CL, MH, and CH.
- D. Construction Quality Assurance (CQA) Consultant: The monitoring firm responsible for implementation of the CQA plan.
- E. Lift: One single continuous placements of soils.
- F. Soils laboratory: A laboratory capable of conducting the tests required by this specification. Also referred to as the CQA Laboratory.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL (Backfill)**

- A. Sources: Obtained from identified on-site stockpiles.
- B. Free of angular, and other deleterious materials.
- C. Greater than 30 percent fine material (#200 sieve).
- D. Maximum particle size of 4 inches.

### **2.2 OTHER MATERIALS**

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the acceptance of the County.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely, safe, and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

### **3.2 FINISH ELEVATIONS AND LINES**

- A. Comply with pertinent provisions of the Specifications and Construction Drawings.

### **3.3 PROCEDURES**

- A. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
- B. Maintain access to adjacent areas at all times.

### **3.4 TRENCHING**

- A. Trenching:
  - 1. Excavate trenches.
  - 2. Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, backfill the voids remaining after removal of the objects as directed by the CQA Monitor.

3. When the void is below the subgrade for the utility bedding, use suitable earth materials and compact to the relative compaction directed by the CQA Monitor, but in no case to a relative compaction less than 90.0 percent of ASTM D 1557.
  4. When the void is in the side of the trench or open cut, use suitable soil or sand compacted or consolidated as approved by the CQA Monitor, but in no case to a relative compaction less than 90.0 percent of ASTM D 1557.
  5. Remove boulders and other interfering objects, and backfill voids left by such removals, at no additional cost to the County.
- B. Trench to the minimum width necessary for proper installation of the pipe with sides as nearly vertical as possible. Uniformly grade the bottom to provide uniform bearing for the utility.
- C. Depressions:
1. Except where rock is encountered, do not excavate below the depth indicated or specified.
  2. Where rock is encountered, over excavate rock to a minimum overdepth of 4 inches below the trench depth indicated or specified.

### 3.5 BACKFILLING

- A. General:
1. Backfill trenches to the ground surface with materials shown on the Construction Drawings.
  2. Reopen trenches which have been improperly backfilled. Refill and compact as specified, or otherwise correct to the approval of the Design Engineer.
  3. Do not allow or cause any of the Work performed or installed to be covered up or enclosed by work of this Section prior to required inspections, tests, and approvals.
  4. Should any of the Work be so enclosed or covered up before it has been approved, uncover all such Work and, after approvals have been made, refill and compact as specified, all at no additional cost to Owner.
- B. Lower portion of trench:
1. Trench gravel: Take special care in backfilling and bedding operations to not damage pipe and pipe coatings. Place gravel to completely surround pipe without voids. Lightly tamp bedding to compact.

## C. Remainder of trench:

1. Except for special materials for drainage trenches, backfill the remainder of the trench with trench backfill material.
2. General earthfill: Deposit trench backfill material in layers not exceeding 8 inches in thickness, and compact each layer to 90.0 percent relative compaction based on ASTM D 1557. See Table 02229-1.
3. Trench gravel: Place gravel in layers not exceeding 12 inches. Lightly tamp to eliminate voids.

**Table 02229-1.**  
**Backfill Placement and Compaction Requirements**

Fill Type	Loose <sup>(1)</sup> Lift Thickness (inches)	Moisture Content <sup>(2)</sup>	Minimum Backfill Lift Density	Method of Test	Finished Grade Tolerance <sup>(3)</sup> (feet)
Trench Backfill	8-in maximum	5% below optimum to 5% above optimum	90.0% minimum	ASTM D 1557	-0.1 to +0.1
<sup>(1)</sup> Thinner lifts may be required to obtain adequate compaction. <sup>(2)</sup> Moisture limits may have to be adjusted to obtain required density or to minimize desiccation cracking. <sup>(3)</sup> Provided adequate drainage is maintained.					

## 3.6 FIELD QUALITY CONTROL

- A. The CQA Monitor shall inspect open cuts and trenches before installation of pipes, and will make the following tests:
1. Verify that trenches are not backfilled until all tests have been completed.
  2. Check backfilling for proper layer thickness and compaction.
  3. Verify that test results conform to the specified requirements, and that sufficient tests are performed.
  4. Verify that defective work is removed and properly replaced.

END OF SECTION

**SECTION 02233****AGGREGATES AND RIP RAP****PART 1 - GENERAL****1.1 SUMMARY**

The requirements for drainage layer aggregate, gravel road aggregate, and rip rap are specified herein.

**1.2 REFERENCES**

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)  
STANDARD TEST METHODS/PRACTICE

ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 131	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D 75	Sampling Aggregates
ASTM D 422	Particle Size Analysis of Soils
ASTM D 698	Laboratory Compaction Characteristics Soil Using Standard Effort (12,400 ft-lbf/ft <sup>3</sup> [600 Kn-m/m <sup>3</sup> ])
ASTM D 1556	Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2434	Permeability of Granular Soils (Constant Head)
ASTM D 2487	Classification of Soils for Engineering Purposes
ASTM D 2922	Density of Soil and Soil-Aggregate in Place by Nuclear Method (Shallow Depth)
ASTM D 3017	Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

ASTM D 4253 Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

ASTM D 4254 Minimum Index Density and Unit Weight of Soils Using a Vibratory Table

ASTM D 4373 Calcium Carbonate Content of Soils

ASTM E 11 Wire-Cloth Sieves for Testing Purposes

ASTM E 548 Guide for General Criteria Used for Evaluating Laboratory Competence

### 1.3 SUBMITTALS

- A. Prequalification: Contractor shall submit the material source and required tests for drainage layer and road aggregate to the CQA Officer for approval.
- B. Test Reports: The specified test reports shall be submitted to the CQA Monitor.
- C. Approval of Material Source: The source of the material to be used for producing aggregates shall be selected not less than thirty (30) days prior to the time the material will be required in the work. Tentative approval of the source will be based on an inspection by the CQA Monitor. Tentative approval of material will be based on tests of samples for the specific job. Final approval of both the source and the material will be based on tests for gradation performed on samples taken from the completed and compacted work.

## PART 2 - PRODUCTS

### 2.1 AGGREGATES AND RIP RAP

Aggregates shall consist of clean, sound, durable particles of crushed stone or gravel and screenings. The Contractor shall obtain materials that meet the specifications and can be used to meet the grade and smoothness requirements specified herein, after all compaction and proof-rolling operations have been completed. Slag shall not be used. The aggregate shall be free of silt and clay (as defined by ASTM D 2487), vegetable matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing through the No. 4 sieve shall be known as fine aggregate.

- A. Gradation Requirements: Gradation requirements specified herein shall apply to the completed work. The aggregate shall be graded continuously, well within the limits specified in Table 02233-1, Gradation of Aggregates.



## 2.2 SOURCE QUALITY CONTROL

Sampling and testing shall be performed by an approved commercial testing laboratory subject to approval by the CQA Monitor. Approval of testing facilities shall be based on compliance with ASTM E 548, and no work requiring testing will be permitted until the facilities have been inspected and approved. The materials shall be tested to establish compliance with the specified requirements. Copies of test results shall be furnished to the Engineer.

- A. Sampling: Samples for material gradation tests shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the CQA Monitor.
- B. Tests: The following tests shall be performed in conformance with the applicable standards listed.
  - 1. Sieve Analyses: Sieve analyses shall be made in conformance with ASTM D 422.
  - 2. Soundness Test: Soundness shall be tested in conformance with ASTM C 88.
  - 3. Wear Test: Wear tests shall be made according to ASTM C 131.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT

- A. All equipment and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, as well as meeting the grade controls, thickness control, and smoothness requirements as set forth herein.

### 3.2 STOCKPILING MATERIAL

- A. Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in a manner and at locations approved by the CQA Monitor. Aggregates shall be stockpiled on the cleared and leveled areas designated by the CQA Monitor so as to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

### 3.3 PREPARATION OF UNDERLYING COURSE

- A. Prior to constructing the crushed-aggregate course for the road(s), the underlying course shall be cleaned of all foreign substances. At the time of construction of the course, the underlying course shall contain no frozen material. The underlying course shall conform to Section 02222 Earthfill.

### 3.4 GRADE CONTROL

- A. During construction, the lines and grades shall be maintained by the Contractor.

### 3.5 PLACING

- A. Road Base: A woven geotextile shall be placed on the prepared surface of the roadway areas to receive aggregate as shown on the Drawings. The aggregate shall be placed so that it cascades down onto the geotextiles rather than being pushed so that it does not slide across the surface causing slack wrinkles in the geotextile or damage to the roadway subgrade.
- B. Rip rap: Rip rap shall be placed in such a manner to provide a uniform layer with larger rock fragments evenly distributed and smaller rock fragments filling the spaces between the larger fragments.

**Table 02233-1.  
Gradation/Testing of Aggregates**

Use	Size	Tests
Access Road Base	3/4 inch Caltrans Class II	C131/D422
Drainage Rock	4" to 8" rock	C131/D422
Rip rap	Crushed rock fragments, 100 lbs    50 lbs    25 lbs 50-90%   20-65%   0-35%	C131/D422

END OF SECTION

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**SECTION 02250****EROSION CONTROL AND PROTECTION****PART 1. GENERAL****1.1 DESCRIPTION**

- A. Scope: The Contractor shall prepare an erosion control and protection plan for cell construction based on the facility Storm Water Pollution Prevention Plan (SWPPP). The plan will describe sediment and erosion control devices to contain surface drainage from within the construction-site, waste, and storage areas. The CQA Officer may require protection in other areas.
- B. General Description: This work shall consist of the application of measures throughout the life of the project to control erosion and to minimize the siltation of rivers, streams and bay. The measures shall include, but not be limited to, the use of berms, dikes, dams, sediment basins, sediment traps, filters, silt fence, fiber mats, netting, gravel or crushed stone, mulch, grasses, slope drains and other methods approved by Owner or Soil Conservation District. Erosion and siltation control measures as described herein shall be applied to erodible material exposed by any activity on the project.
- C. Related Work Specified Elsewhere:
  - 1. Section 02221 Excavating and Grading
  - 2. Section 02222 Earth Fill
  - 3. Section 02233 Aggregates
  - 4. Section 02820 Fertilize and Seeding

**1.2 QUALITY ASSURANCE**

- A. The U.S. Soil Conservation Service handbook of Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas, adopted by Owner or Soil Conservation District and the State of California Department of Water Resources is to be used.

**1.3 PERMITS**

- A. The Sediment Control Permit will be obtained by the Contractor.
- B. The Contractor shall be responsible for obtaining other necessary permits and approvals from the appropriate governmental agencies. Copies of all permits or approvals shall be provided to the CQA Officer prior to starting any work covered by the permits or approvals.

In the event of conflict between these requirements and pollution control laws, rules or

regulations of other Federal, State or Local agencies, the more restrictive laws, rules or regulations shall apply.

- C. The CQA Officer shall have the right to inspect erosion control measures in off-site borrow pits and waste areas and to report violations of permit requirements to the Sonoma County agencies.
- D. Contractor Compliance:
  - 5. In the event that erosion and pollution control measures are required due to the Contractor's negligence, carelessness or failure to install permanent control as part of the scheduled Work, the CQA Officer may order that Work to be performed by the Contractor at his own expense.
  - 6. Where erosion and sediment control work to be performed is not attributed to the Contractor's negligence, carelessness or failure to install permanent controls and falls within the Specifications for a work item that has a Contract price, the units of work shall be paid for at the proper Contract price.
- E. Work Suspension: The Contractor shall comply with the requirements specified herein and as shown on the Drawings. Any violation of these requirements may result in the issuance of a written Notice of Suspension of the Work. The suspension of Work will not be lifted until the Contractor has completely corrected the violation. Time extensions requested as a result of delays occasioned by such suspensions will not be considered.
- F. Revisions: Should conditions arise in the field that render the Erosion Control and Protection Plans inadequate or inappropriate for Work included in the Contract, the Contractor shall immediately notify the CQA Officer and the County. Where necessary, additional plans or modifications will be furnished by Sonoma County and will become a condition of the Erosion Control Permit and the Contract.

#### 1.4 PREPARATION

- A. Notification by the Contractor: The Contractor shall notify the Sonoma County Construction Inspection Division at least 48 hours before commencing work on the project. The site, work materials, plans specifications and permits shall be available on-site at all times during working hours for inspection by Sonoma County representatives.

#### 1.5 SUBMITTALS

- A. Pre-qualification

Submit the material source, descriptions, and material specifications certified by the supplier to the CQA Officer for approval.

- B. Certificate of Compliance: The Contractor shall submit to the CQA Officer for approval

at least 14 days before procurement a Certificate of Compliance that the supplied materials meet the specifications herein.

## **PART 2. PRODUCTS**

### **2.1 MATERIALS**

- A. Seed, sod, mulch, fertilizer, topsoil, soil conditioner and other materials for seed shall be in accordance with Caltrans Specifications – Section 20.
- B. Temporary slope drains shall be constructed of material acceptable to the CQA Officer, i.e., pipe, fiber mats, rubble, plastic pipe and plastic sheets.
- C. Polyethylene Erosion Control Matting shall be Enkamat type 7010 or other equivalent product as approved by the CQA Officer.
- D. Filter Stone shall conform to the 1998 Caltrans Specifications.
- E. Other materials as required may be specified by the CQA Officer.

### **2.2 SILT FENCE**

- A. Silt fence shall contain net backing for support. Posts shall be galvanized steel or 1-1/2 inch square hardwood. Silt fence shall have the following properties.

<b>Property</b>	<b>Test Method</b>	<b>Unit</b>	<b>Minimum Average Value</b>
Tensile Strength	ASTM D4632	Lbs	120
Water Flow Rate	ASTM D4491	gal/min/ft <sup>2</sup>	3

Silt fence shall be “Mirafi Envirofence” by Mirafi Inc., or equal.

### **2.3 STRAW BALES**

- A. Straw bales shall be bound with wire or nylon.
- B. Steel rebars or 2" x 2" wooden stakes (two per bale) at least 6 feet long (not on the final landfill cover).

## **PART 3. EXECUTION**

### **3.1 CONSTRUCTION REQUIREMENTS**

#### **A. Implementation:**

1. It is the Contractor's responsibility to implement and comply with all applicable regulation pertaining to erosion and sediment control.
2. No work shall be started until the erosion control schedules and methods of operation have been accepted by the CQA Officer and implemented by the Contractor.

#### **B. Clearing:** Clear only those areas that are so designated on the Drawings. Where possible, maintain a vegetative buffer zone between the disturbed working area and any watercourse.

#### **C. Stockpiles:** Protect excavated material from being eroded into any waters or onto any adjacent lands. Stockpile excavated material on the high side of excavated areas.

#### **D. Sediment Control:** When sediment control devices are designated on the Drawings or by the CQA Officer, install during the initial grading and clearing operations and complete their installation before proceeding with any other site work. Maintain all devices until final restabilization and restoration or otherwise directed by the CQA Officer to remove them.

#### **E. Erosion Control:** Provide erosion control measures such as straw bale, earth berm, dike or other diversion devices that will safely convey runoff through disturbed areas to prevent scour or gully erosion. When possible, runoff shall be diverted in a safe manner around disturbed areas using pipes with headwalls and protected outlets.

#### **F. Maintenance and Repairs:** All erosion and sediment control devices that are disturbed during the construction operations shall be fully repaired by the end of the day on which they are disturbed. All erosion and sediment control devices shall be maintained for the winter season and during other times when the project is closed down.

#### **G. Critical Areas:** Critical areas are disturbed areas with a surface gradient exceeding ten (10) percent and shall be immediately stabilized with vegetation after filling and/or backfilling operations and maintained. Those areas that cannot be planted shall be adequately covered with straw mulch, wood chips, matting or other erosion prevention materials. Those disturbed areas that are less than ten (10) percent in surface gradient shall be considered critical after diverting runoff from critical areas.

#### **H. Stone Entrance:** Provide a stone entrance device in accordance with Sonoma County District Standards and Specifications, at all points of egress onto public thoroughfares.

I. Drainage:

1. The Contractor shall shape the graded area in a manner as to permit the run-off of precipitation and shall construct earth berms along the top edges of embankments to intercept runoff water. Earth berms shall be compacted to the satisfaction of the CQA Officer.
2. Temporary slope drains shall be provided to carry runoff from cuts and embankments. The slope drains may be of flexible or rigid construction, but shall be capable of being readily shortened or extended as the cut or fill advances. Pipe end sections shall be provided at the entrance to temporary slope drains. Where necessary, energy dissipaters shall be provided at the outlet. In all cases, temporary slope drains shall be outletted into either a stabilized area or a sediment control measure.

J. Cut Slopes and Fill Slopes:

Cut slopes and fill slopes shall be dressed, prepared and seeded as the Work progresses in accordance with the following sequence:

1. Slopes with a vertical height of 40 feet or greater shall be seeded in three approximately equal increments of height.
2. Slopes with a vertical height of less than 40 feet, but more than 10 feet, shall be seeded in two approximately equal increments of height.
3. Slopes with a vertical height of 10 feet or less may be seeded in one operation.

K. The dressing, preparing and seeding of slopes shall be performed immediately following the completion of each increment of height stated and immediately following the suspension of grading operations.

L. Work Site: The CQA Officer will limit the area of excavation and embankment operations in progress commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding and other pollution control measures current in accordance with the accepted schedule. Should seasonal limitations make coordination unrealistic, erosion control measures shall be taken immediately. All construction shall be confined to the minimum area necessary to accommodate the Contractor, equipment and work force engaged in his work.

M. Grading Unit: A grading unit is defined as a complete grading spread consisting of earthmovers, hauling units, graders, compactors, etc. Each grading unit will be limited to the amount of surface area of erodible earth material exposed at one time not to exceed 100 acres, unless a larger area is approved by the CQA Officer or specified in this

Invitation for Bids/Project Manual. The Contractor shall be prepared to dress and seed behind each grading unit as defined above.

END OF SECTION



**SECTION 02255****LOW-PERMEABILITY SOIL LAYER****PART 1. GENERAL****1.1 WORK OF THIS SECTION**

- A. The work of this section generally includes construction of the low-permeability soil layer of the liner system as shown on the Drawings using site soils amended with bentonite.
- B. Furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the construction of the low-permeability soil layer as specified herein, as shown on the Drawings, and in accordance with the Construction Quality Assurance (CQA) Plan.
- C. Construct a test pad as specified herein to demonstrate that the materials and procedures intended for use in the construction of the low-permeability soil will meet the requirements of this section.

**1.2 RELATED SECTIONS**

- A. Section 02221 – Excavation and Grading.
- B. Section 02222 – Earth Fill.
- C. Section 02779 – Geosynthetic Clay Liner.

**1.3 REFERENCES**

- A. Construction Quality Assurance (CQA) Plan.
- B. Latest version of American Society for Testing and Materials (ASTM) standards:
  - 1. ASTM D 422, Standard Method for Particle-Size Analysis of Soils.
  - 2. ASTM D 1140, Standard Test Method for Amount of Material in Soils Finer than the No. 200 Sieve.
  - 3. ASTM D 1556, Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
  - 4. ASTM D 1557, Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-pound Rammer and 18-inch Drop.
  - 5. ASTM D 2216, Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures.

6. ASTM D 2487, Standard Test Method for Classification of Soils.
  7. ASTM D 2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  8. ASTM D 2937, Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
  9. ASTM D 3017, Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
  10. ASTM D 4220, Standard Practices for Preserving and Transporting Soil Samples.
  11. ASTM D 4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
  12. ASTM D 5084, Standard Test method for Hydraulic Conductivity of Soils Using a Flexible-Wall Permeameter.
- C. Sealed Double-Ring Infiltrometer (SDRI) by Trautwein.
- D. BAT<sup>TM</sup> Permeameter and sealed single ring infiltrometer.
- 1.4 SUBMITTALS
- A. Submit proposed mix design, plant set-up, and procedures including any modifications to the specified methods to the Owner a minimum of 14 days prior to start-up.
- B. Provide proposed modifications (if any) to the test pad procedure. It is the Contractor's responsibility to review the methods of processing and placement described. All recommendations for modifications to the requirements described shall be submitted by the Contractor to the Engineer a minimum of 14 days prior to the start of construction of the low-permeability soil test pad.
- C. Bentonite material proposed for use in admixture.

## **PART 2. PRODUCTS**

### **2.1 GENERAL**

- A. Imported soils meeting these specifications will be used for the low permeability soil layer.
- B. It shall be the responsibility of the Contractor to construct a test pad before installation of the production liner using the on-site borrow materials to ensure that the permeability

requirements can be met. The test pad shall be constructed in accordance with Part 3 of this section. The test pad shall be constructed a maximum of 30 days prior to the construction of the low-permeability soil liner.

- C. Notwithstanding the prequalification of any material sources for the low-permeability soil, the Contractor shall be entirely responsible for meeting the permeability criteria and other requirements of this Section.

## 2.2 SOIL MATERIAL

- A. All laboratory testing to evaluate the suitability or conformance of soil materials for the low-permeability soil shall be carried out in accordance with the test methods indicated in Part 1.03 of this Section.
- B. The low-permeability soil shall consist of relatively homogeneous natural soils which do not have deleterious amounts of gypsum, ferrous, calcareous concretions, roots, debris, foreign objects, and organics.
- C. No particles larger than 1.0 inches shall be allowed. The low-permeability soil shall be classified according to the Unified Soil Classification System as CL, CH, ML, MH, or SC material or shall be an amended soil material capable of meeting the specified hydraulic conductivity requirements. Regardless of the classification requirements, the material shall meet the requirements of Part 2 of this Section.
- D. The borrow soils selected shall not be gap-graded or susceptible to piping. Substandard materials shall be segregated at the source and will not be permitted at the work area.
- E. The Contractor, at no extra cost to the Owner, shall remove any material from the work area, which is found by the CQA consultant to be unacceptable.
- F. The low-permeability soil shall have an *in situ* (i.e., after compaction) **field** hydraulic conductivity less than or equal to  $1.0 \times 10^{-7}$  cm/sec.
- G. Alternative sources of low-permeability material may be submitted by the Contractor and are subject to approval by Engineer.

## 2.3 CONSTRUCTION WATER

- A. Water for construction and dust control shall be supplied by the Contractor. The Contractor shall determine his construction water requirements prior to bidding and shall be responsible for supplying an adequate amount of water.

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**PART 3. EXECUTION****3.1 FAMILIARIZATION**

- A. Prior to implementing any work of this Section, the Contractor shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this Section and the CQA Plan.
- B. Inspection:
  - 1. Prior to implementing any work of this Section, the Contractor shall carefully inspect the installed work of all other Sections and verify that all such work is complete to the point where the installation of this Section may properly commence without adverse impact.
  - 2. If the Contractor has any concerns regarding the installed work of other Sections or the site, he shall notify the Engineer in writing within 48 hours after his site inspection and before the proposed commencement of the Work described in this Section. Failure to notify the Engineer of installation of the low-permeability soil will be construed as Contractor's acceptance of the related work of all other Sections.

**3.2 TEST PAD CONSTRUCTION**

- A. A test pad for the low-permeability soil liner shall be constructed, as specified in this section, by the Contractor to determine acceptable placement and compaction methods to produce a low-permeability soil that satisfies the requirements of this section. The Engineer must approve the location of the test pad prior to construction.
- B. The Contractor will prepare a sufficient quantity of admix test pad material for the test pad construction in accordance with the requirements of this section. All specified procedures for mixing, conditioning, and stockpiling of the admix soil material will be followed.
- C. The test pad will be constructed within the borrow area (outside the lined area of the cell) to evaluate compaction methods.
- D. So that the test pad will accurately represent the performance of the full-scale facility, the following guidelines will be followed:
  - 1. Construction of the test pad will use the same soil mixture, design specifications, equipment, and procedures as proposed for the full-scale facility.
  - 2. The test pad will be constructed at least four times wider than the widest piece of construction equipment to be used for the full-scale facility or 40 feet minimum (whichever is greater). This is required to ensure a sufficient representative area

for testing avoids the edges of the test pad. The test pad may be subdivided into “lanes” to facilitate evaluation of different compaction methods; however, the width of any individual lane shall be no less than twice the width of the widest piece of construction equipment.

3. The test pad will be long enough to allow construction equipment to achieve normal operating speed before reaching the area that will be used for testing or 80 feet minimum (whichever is less).
4. The test pad will be constructed in at least 4 lifts to evaluate the methodology used to tie lifts together. Lift thickness is described below in this section, and the total thickness of the test pad will be at least 24 inches.
5. Minimum testing frequencies for the test pad construction quality control are listed in the CQA Plan.

E. The following will be demonstrated during the test pad construction:

1. The speed of compaction equipment travelling over the pad.
2. Moisture content of the admixed soil at time of compaction.
3. Lift thickness (compacted), compaction procedures, and number of passes for proposed compaction equipment.
4. Dry unit weight achieved and measured by field density testing.

F. No low-permeability soil liner shall be placed in the main section of the facility until the associated test pad has been constructed and the results from all the test methods indicate that the soil admix will satisfy the required specifications of this section.

G. After all testing has been completed and approved, the material in the test pad can be used by the Contractor for liner construction, provided that the material satisfies the requirements of these Specifications.

H. The results from the test pad may alter the low-permeability soil placement requirements, as approved by the Engineer.

### 3.3 LOW-PERMEABILITY SOIL PLACEMENT

- A. Notify the Engineer and/or CQA Consultant in writing a minimum of 7 days prior to starting construction of the low-permeability soil. The notice shall state the material to be used, the equipment to be used, processing methods, the results of the test pad, the date and time that placement operations will start, and the name of the person in the field who will be in charge of the construction of the low-permeability soil.
- B. If work is interrupted for reasons other than inclement weather, notify the Engineer a minimum of 24 hours prior to the resumption of work.

- C. Once the test pad has been constructed and approved by the Engineer and the CQA Consultant, the Contractor may proceed with liner installation. The remaining portions of low-permeability liner installation shall be tested in accordance with the CQA Plan.
- D. The Contractor shall construct the low-permeability soil to the grades, slopes, thickness, and elevations shown on the Construction Drawings and as specified in this Section.
- E. The Contractor shall construct the low-permeability soil on a compacted subgrade that meets the requirements of Section 02222. The *in situ* dry density of the subgrade shall be greater than 90% of the laboratory maximum dry density as determined by ASTM D 1557.
- F. Standing water, ground water, and/or saturated, unstable soil conditions shall not be tolerated in areas to subsequently receive low-permeability soil.
- G. The low-permeability soil material shall be spread and compacted in lifts not to exceed a compacted thickness of 6 inches.
- H. Prior to compaction when utilizing an admixture material, the Contractor shall mix the low-permeability soil with a pug mill.
- I. Each lift shall be compacted to a dry density of 90% of the laboratory maximum dry density as determined by ASTM D 1557, at or above the optimum moisture content.
- J. Equipment or truck traffic on the surface will not be permitted during the period between scarifying and placement of the following lift.
- K. At the beginning of each day's work, the previously placed low-permeability soil shall be inspected by the CQA Consultant. The Engineer may specify scarifying, moisture conditioning and/or recompaction of the top surface of soil, as necessary in the judgment of the CQA Consultant, to obtain the compaction criteria and provide a suitable surface for the next lift. This work will be performed at no cost to Owner.
- L. No low-permeability soil shall be placed over a lift, which has not been tested and approved by the CQA Consultant. Should the field tests indicate that the density or the permeability of any layer of low-permeability soil, or portion thereof, is below the required dry density or permeability, the particular layer, or portion thereof, shall be reworked or replaced with new material at no extra cost to Owner.
- M. Compaction of lifts shall be performed with an appropriately heavy, properly ballasted, penetrating-foot compactor (such as a CAT 815, 825, or equivalent) subject to approval from the CQA inspection personnel. The number of passes required by the compactor to achieve the specified density shall be determined during the evaluation of the soil liner test pad prior to the installation of the production liner.

- N. The surface of each lift of low-permeability soil shall be scarified approximately 2 inches immediately prior to placement of the next lift so as to promote proper bonding between lifts.
- O. The daily work area will extend a distance no greater than necessary to maintain moist soil conditions (facilitate bonding) and continuous operations. Desiccation and crusting of the lift surface will be avoided as much as possible. If deemed necessary by the CQA Consultant, at the end of the work shift, low-permeability soil shall be covered with visqueen for moisture retention. To minimize desiccation and cracking of the low perm layer, the completed surface of the low permeability layer shall be covered with the secondary geomembrane as soon as practicable.
- P. If desiccation and crusting of the lift surface occurs before placement of the next lift, this area will be sprinkled with water and then scarified and tested for water content to ensure uniform moisture before placement of a subsequent lift.
- Q. Transition from full depth liner to beginning of adjacent new section will be accomplished by sloping (cutting back) the end of a full depth section at 3:1 (horizontal to vertical) or flatter for tying in a new lift. Alternatively, each new lift will be benched into the previously constructed liner at 2-ft horizontal intervals.
- R. The cell bottom will be constructed initially and completed over the width of the base before beginning the slope. The transition between the bottom and side slopes will be accomplished by compacting parallel to the slope and by running up and down the slope.
- S. Dozer or scraper equipment will not be used for primary compaction efforts.
- T. Hand compaction at the proper moisture content shall be used in all locations around penetrations, corners, appurtenances, etc., in order to achieve the specified dry density and moisture content. Care shall be taken to protect piping, geomembranes and other structures. Damage to any materials or work caused by hand compaction shall be repaired by the Contractor at no additional cost to the Owner.
- U. The same material and compaction methods as outlined in this Section shall be used to replace unacceptable zones detected by the CQA Consultant.
- V. The low-permeability soil surface shall be made smooth and free from ruts or indentations at the end of every working day when precipitation is forecast and/or at the completion of the compaction operations in that area.
- W. The Contractor shall furnish each day's work with a smooth roller to create a smooth surface, which will promote surface-water runoff and minimize moisture penetration.
- X. The entire area shall be left in a manner to promote runoff at the end of each day.

- Y. After completion of a segment of low-permeability soil liner, but before installation of the geomembrane liner, the top of the low-permeability soil will be surveyed to ensure that (i) the specified thickness has been achieved; (ii) the top of the liner slopes across the cell at the grades specified on the permitted plans; and (iii) the top of the liner in the collection sump area is at the grades and elevations specified on the permitted plans.
- Z. After completion of a segment of low-permeability soil liner, but before installation of the geomembrane liner, any drying, cracking, rutting, saturation, or unevenness of the low permeability layer shall be repaired and re-compacted to the satisfaction of the CQA Consultant.

### 3.4 SURVEY CONTROL

- A. The Contractor shall survey the location and elevation of the excavation at a 50-foot grid spacing and at all key hinge lines. He shall also survey the location and elevation of the top of low-permeability soil shown on the Drawings the same point-on-point locations. Surveying shall be performed in general accordance with the CQA Plan.
- B. The Contractor shall excavate and/or place fill to the approximate low-permeability soil elevations shown on the Drawings within a tolerance of -0.0 to +0.2 feet or as specified by the Engineer.
- C. The Contractor shall provide Record Drawings of the location and elevation of the excavation and the top of low-permeability soil, in accordance with the requirements of the CQA Plan. The Contractor shall submit this drawing to the Engineer at least 48 hours prior to the start of fill placement. The Contractor may submit a partial Record Drawing to obtain approval for a portion of work. The Engineer will define the minimum requirements for a partial submittal.
- D. The Owner may supply surveying for QA purposes and record drawings. The Contractor provides surveying for QC purposes.

### 3.5 FIELD QUALITY CONTROL AND TESTING

- A. Frequency:
  - 1. The frequency of quality control testing is outlined in the CQA Plan. The Contractor shall take this testing frequency into account in planning his construction schedule.
    - a. The minimum testing frequencies for material evaluation and construction quality evaluation are presented in the CQA Plan.
    - b. Sampling locations shall be selected by the CQA Consultant. If necessary, the location of routine in-place moisture content and dry density tests shall be determined using a non-biased sampling plan.



- c. Undisturbed low-permeability soil material samples for laboratory hydraulic conductivity testing shall be taken with the assistance of the Contractor such that the sample tube is inserted vertically into the material with a continuous smooth stroke from the construction equipment used to drive the sampler.
- d. A special testing frequency shall be used at the discretion of the Engineer and/or the CQA Consultant when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas shall be considered when:
  - 1. the rollers slip during rolling operation;
  - 2. the lift thickness is greater than specified;
  - 3. the low-permeability soil is at improper and/or variable moisture content;
  - 4. fewer than the specified number of roller passes are made;
  - 5. dirt-clogged rollers are used to compact the material;
  - 6. the rollers do not have optimum ballast; or
  - 7. the degree of compaction is doubtful.
- e. During construction, the frequency of testing may also be increased in the following situations:
  - 1. adverse weather conditions;
  - 2. breakdown of equipment;
  - 3. at the start and finish of grading;
  - 4. if the material fails to meet specifications; or
  - 5. the work area is reduced.

**B. Perforations:**

- 1. Perforations in the low-permeability soil that must be filled shall include, but not be limited to, the following:
  - a. nuclear density test probe locations;
  - b. hydraulic conductivity sampling locations; and
  - c. test pit locations.
- 2. Perforations in the low-permeability soil shall be backfilled with a mixture of low-permeability soil and bentonite and compacted to achieve a hydraulic conductivity less than  $1 \times 10^{-7}$  cm/s.

C. Defective Areas:

1. If a defective area is discovered, the CQA Consultant shall immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA Consultant shall determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA Consultant deems appropriate. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQA Consultant shall define the limits and nature of the defect.
2. After determining the extent and nature of a defect, the CQA Consultant shall notify the Contractor and schedule appropriate retests when the work deficiency has been corrected.
3. The Contractor shall correct the deficiency to the satisfaction of the CQA Consultant. The cost of corrective actions shall be borne by the Contractor.
4. All retests recommended by the CQA Consultant must verify that the defect has been corrected before the Contractor performs any additional work in the area of the deficiency. The CQA Consultant shall also verify that all installation requirements are met and that all submittals are provided.

3.6 FIELD QUALITY ASSURANCE

- A. Field quality assurance (QA) will be performed in accordance with the CQA Plan.
- B. The Engineer will determine optimum moisture content and maximum density for all engineered fills in accordance with ASTM D 1557.
- C. The Engineer will determine in-place density and moisture content by one or more of the following methods or approved equal: ASTM D 2922, ASTM D 1556, ASTM D 2216, and ASTM D 3017.
- D. Additional testing may be provided by the Owner to determine the conformance of the materials with these Specifications and the Construction Drawings.
- E. The Owner may perform sampling and testing of excavated materials as they are stockpiled.
- F. The Contractor shall cooperate fully with the Owner in performance of sampling and testing. Include costs for assistance in unit or lump sum prices.

3.7 PRODUCT PROTECTION

- A. The Contractor shall use all means necessary to protect all prior work, including all materials and completed work of other Sections.

- B. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the CQA Consultant and at no additional cost to the Owner.

END OF SECTION

**SECTION 02376**

**FLEXIBLE CHANNEL LINING**

**PART 1. GENERAL**

**1.1 SECTION INCLUDES**

- A. Erosion control material as a flexible channel liner for newly constructed and rehabilitated stormwater channels to be seeded and vegetated.

**1.2 RELATED SECTIONS**

- A. Section 02222 – Earthfill
- B. Section 02820 – Fertilize and Seed

**1.3 REFERENCES**

- A. American Society of Testing and Materials (ASTM):
  - 1. D 570 - Standard Test Methods for Water Absorption of Plastics.
  - 2. D 5199 - Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
  - 3. D 1907 - Test Method for Yarn Number by Skein Method.
  - 4. D 1388 - Test Method for Stiffness of Fabrics.
  - 5. D 2256 - Test Method for Breaking Strength and Elongation of Yarn by Single Strand Method.
  - 6. D 3786 - Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics.
  - 7. D 4354 - Practice for Sampling of Geosynthetics for Testing.
  - 8. D 4355 - Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
  - 9. D 4439 - Terminology for Geotextiles.
  - 10. D 4595 - Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.

11. D 4632 - Test Method for Grab Breaking Load and Elongation of Geotextiles.
  12. D 4759 - Practice for Determining the Specification Conformance of Geosynthetics.
  13. D 4873 - Guide for Identification, Storage, and Handling of Geotextiles.
  14. D 5035 - Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Force).
  15. D 5261 - Test Method for Measuring Mass Per Unit Area of Geotextiles.
- B. Federal Test Method of America (FTMA) CCC-5-191B - Smolder Resistance of Textile Materials.
- C. Geosynthetic Accreditation Institute - Laboratory Accreditation Program (GAI-LAP).
- D. International Standards Organization (ISO) 9002 - Quality System Certification.
- E. Light Projection Analysis - Lumite Test Method for Measuring Light Projection Through Fabric.

#### 1.4 DEFINITIONS

- A. Minimum Average Roll Value (MARV): Property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.
- B. Typical Roll Value: Property value calculated from average or mean obtained from test data.
- C. Rolled Erosion Control Product (RECP) – A temporary degradable or long-term non-degradable material manufactured or fabricated into rolls designed to reduce soil erosion and assist in the growth, establishment, and protection of vegetation.
- D. Turf Reinforcement Mat (TRM) – A long-term, non-degradable RECP composed of UV-stabilized, non-degradable, synthetic fibers, nettings and/or filaments processed into three-dimensional reinforcement matrices designed for permanent and critical hydraulic applications where design discharges exert velocities and shear stresses that exceed the limits of mature natural vegetation. TRMs provide sufficient thickness, strength and void space to permit soil filling and/or retention and the development of vegetation within the matrix.

## 1.5 SUBMITTALS

### A. Submit under provisions of Section 01300:

#### 1. Certification:

- a. The Contractor shall provide the Engineer a certificate stating the name of the RECP manufacturer, product name, style, chemical compositions of filaments or yarns and other pertinent information to fully describe the geotextile.
- b. The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request.
- c. The manufacturer's certificate shall state that the furnished RECP meets MARV requirements of the specification as evaluated under the manufacturer's quality control program. The certificate shall be attested to by a person having legal authority to bind the Manufacturer.

2. Manufacturing Quality Control (MQC) test results shall be provided upon request.

3. Independent Performance Test Results shall be provided upon request.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. RECP labeling, shipment and storage shall follow ASTM D 4873.
- B. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number.
- C. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer's certificate.
- D. Each RECP roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight, and contaminants.
- E. The protective wrapping shall be maintained during periods of shipment and storage.
- F. During storage, RECP rolls shall be elevated off the ground and adequately covered to protect them from the following: Site construction damage, extended exposure to ultraviolet (UV) radiation, precipitation, chemicals that are strong acids or strong bases, flames, sparks, temperatures in excess of 71 deg C (160 deg F) and any other environmental condition that might damage the RECP.

1.7 QUALITY ASSURANCE SAMPLING, TESTING, AND ACCEPTANCE

- A. RECP shall be subject to sampling and testing to verify conformance with this specification. Sampling for testing shall be in accordance with ASTM D 4354.
- B. Acceptance shall be in accordance with ASTM D 4759 based on testing of either conformance samples obtained using Procedure A of ASTM D 4354, or based on manufacturer's certifications and testing of quality control samples obtained using Procedure B of ASTM D 4354.
- C. Quality Assurance Sampling and Testing will be waived for ISO 9002 Certified Manufacturing Facilities. Documentation of ISO 9002 Certification shall be provided upon request.

PART 2. PRODUCTS

2.1 MANUFACTURERS

- A. Synthetic Industries, Inc., Chattanooga, Tennessee, USA, Phone (423) 899-0444, or equal.

2.2 MATERIALS

- A. Type IV RECP:
  - 1. Three-dimensional, lofty woven polypropylene geosynthetic specially designed for erosion control applications on steep slopes and vegetated waterways.
  - 2. Matrix composed of monofilament yarns woven into uniform configuration of resilient pyramid-like projections.
  - 3. Material to exhibit very high interlock and reinforcement capacity with both soil and root systems and demonstrate high tensile modulus.
  - 4. Minimum Average Roll Values:

Property	Test Method	Units	Property Requirement
Thickness	ASTM D-5199	mm (in)	12.7 (0.50)
Resiliency	ASTM D-5199	percent	80
Mass Per Unit Area	ASTM D-5261	G/sq m (oz/sy)	475 (14.0)
Tensile Strength	ASTM D-5035	kN/m (lbs/ft)	45.2 x 29.2 (3,100 x 2,000)
Tensile Elongation	ASTM D-5035	percent	55 (max)
Secant Modulus @ 10% Elongation	ASTM D-4595	kN/m (lb/ft)	109.5 x 98.5 (7,500 x 6,750)
Ground Cover Factor	Light Projection	percent	75
UV Resistance	ASTM D-4355	percent	80 at 1000 hrs

5. Performance Properties: In a vegetated state, the RECP must demonstrate acceptable performance (as defined by the Engineer) when subjected to at least 0.5 hrs of continuous flow producing the following conditions.
- a. Permissible velocity: 7.6 m/sec (25 ft/sec)
  - b. Permissible tractive force (shear stress): 4.80 kPa (10 psf)
  - c. Performance may be demonstrated by:
    1. Flume testing at an independent facility under conditions similar to this project provided that the manufacturer can demonstrate that the material tested is functionally equivalent to the material being supplied. This may be demonstrated by providing index property test results (listed in 2.2.A.4) from a GAI-LAP accredited laboratory for both the tested and supplied materials.
    2. A documented case history of successful performance (as defined by the Engineer) at an installation similar to this project where (documented) hydraulic forces met or exceeded the requirements listed above provided that the manufacturer can demonstrate that the case history material is functionally equivalent to the material being supplied. This may be demonstrated by providing index property test results (listed in 2.2.A.4) from a GAI-LAP accredited laboratory for both the case history and supplied materials.
6. Manufacturing Quality Control: Testing shall be performed at a laboratory accredited by GAI-LAP for tests required for the geosynthetic, at frequency exceeding ASTM D 4354, with following minimum acceptable testing frequency:



Property	Test Frequency sq m (sq yd)
Mass Per Unit Area	1/20,000 (1/24,000)
Tensile Strength	1/20,000 (1/24,000)
Tensile Elongation	1/20,000 (1/24,000)
Ground Cover Factor	1/20,000 (1/24,000)

## 2.2 ACCESSORIES

### A. Ground Anchoring Devices:

1. Length: 200 to 450 mm (8 to 18 inches); sufficient ground penetration to resist pullout. Use longer anchors for loose soils.
2. U-shaped wire staples or metal pins.
3. Wire staples: Minimum 8 gauge.
4. Metal pins: Steel, minimum 5 mm (0.20 in) in diameter with 40 mm (1.5 in) steel washer.

## PART 3. EXECUTION

### 3.1 PREPARATION

- A. Grade and compact areas to be treated with RECP and compacted as indicated or as directed by Engineer.
- B. Remove large rocks, soil clods, vegetation, and other sharp objects that could keep RECP from intimate contact with subgrade.
- C. Prepare seedbed by loosening 50 to 75 mm (2 to 3 in) of soil above final grade.
- D. Select and apply soil amendments, fertilizer, and seed in accordance with Section 02820 – Fertilize and seed to scarified surface prior to installation of RECP.
- E. Construct 150 x 300 mm (6 in x 12 in) anchor trench at upgrade end of installation to inhibit undermining from stray surface water. Excavate 150 x 150 mm (6 in x 6 in) check slots at 7.6 to 9.1 meter (25 to 30 foot) intervals along length of channel. Cut longitudinal anchor slots 100 x 100 mm (4 in x 4 in) at top of each side slope.

### 3.2 INSTALLATION

- A. Install RECP at elevation and alignment indicated.
- B. Beginning at downstream end in center of channel, place initial end of first roll of RECP in anchor trench and secure with ground anchor devices at 300 mm (12 in) intervals.
- C. Position adjacent rolls in anchor trench in same manner, overlapping preceding roll minimum 75 mm (3 in).
- D. Secure RECP at 300 mm (12 in) intervals along the trench, backfill and compact with specified soil or as directed by Engineer.
- E. Unroll center strip of RECP upstream over compacted trench. Unroll adjacent rolls of RECPs upstream in similar fashion, maintaining 75 mm (3 in) overlap.
- F. Fold and secure rolls of RECP snugly into transverse check slots. Lay material in bottom of slot, then fold back against itself as indicated. Anchor through both layers of RECP at 300 mm (12 in) intervals. Backfill with soil and compact. Continue unrolling RECP widths upstream over compacted slot to next check slot or terminal anchor trench.
- G. Secure RECP to channel bottom with ground anchoring devices at a frequency of 3 anchors per square meter (2 ½ anchors per square yard). Increased anchoring frequency may be required if site conditions are such that the Engineer determines it necessary.
- H. Alternate installation methods must be approved by Engineer prior to execution.
- I. Soil fill and seed the RECP:
  - 1. Spread and lightly rake 12 to 20 mm (0.5 to 0.8 in) of fine topsoil into RECP to completely fill its thickness.
  - 2. When using lightweight power equipment to fill RECP, avoid sharp turns. Do not drive tracked or heavy equipment over RECP.
  - 3. Smooth out soil by barely exposing top portion of RECP. Do not place excessive soil above material.
  - 4. Broadcast additional seed and fertilizer above soil-filled mat and water.

END OF SECTION

**SECTION 02720****STORM DRAINAGE STRUCTURES, PIPING, AND FITTINGS****PART 1 - GENERAL****1.1 DESCRIPTION**

- A. Scope of Work: The work in this Section includes all the labor, materials, equipment and incidentals required to construct storm drainage channels, pipe downchutes, pipe gutters, pipe inlet and outlet structures, rip rap, endwalls, and other drainage structures as shown on the Drawings, specified herein.
- B. Related Work Specified Elsewhere:
  - 1. Section 02110 - Site Clearing, Grubbing, And Stripping
  - 2. Section 02221 - Excavation and Grading
  - 3. Section 02222 - Earthfill
  - 4. Section 02233 - Aggregates
  - 5. Section 03300 - Concrete
- C. References:
  - 1. Caltrans Standard Specifications for Construction Materials, October, 1998.

**1.2 SUBMITTALS**

- A. Supplier information and product specifications shall be submitted to the CQA Officer for review and approval at least 30 days before product procurements. The Contractor shall be fully responsible for any construction delays due to failure to obtain submittal approval in a timely manner.
- B. Shop Drawings: Shop drawings for the following items shall be submitted for approval at least 15 days before installation.
  - 1. Corrugated High Density Polyethylene (HDPE) downchutes and all related details.
  - 2. HDPE Compression Release Joints.
  - 3. Concrete endwalls, headwalls, and corrugated HDPE pipe to endwall connections.

4. Centerline cross-sections/profiles of basin outfall pipes through basin embankments, depicting embankments, principal spillway structures, headwalls, endwalls, pipes, anti-seep collars, rip rap aprons, etc., including vertical elevations and pipe slopes and horizontal locations.
  5. Centerline cross-sections/profiles of HDPE, depicting locations of pipes, fittings, risers, headwalls, compression release joints, and rip rap outfalls.
- C. Certificate of Compliance for HDPE pipes; pipe cradles, anti-seep collars, valves, HDPE compression release joints, risers, and manhole inlets shall be submitted to the CQA Officer for approval at least 15 days before installation.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Rip Rap: Refer to Section 02233 – Aggregates and Rip Rap.
- B. Caltrans Aggregates: Refer to the State of California Department of Transportation Standard Specifications, Section 26 - Aggregates.
- C. Corrugated HDPE Storm Drain Pipes:
1. Shall be of Class 100 or 63 for ring stiffness constant (RSC) as defined in ASTM F 894-89 - "Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe".
  2. Pipe material shall be Type III, Class C, Category 5, Grade P34 according to ASTM D 1248 - "Standard Specification for Polyethylene Plastics Molding and Extrusion Materials".
  3. Manufactured by Plexco/Spirolite or approved equal.
  4. Joints: Pipes shall be produced with Bell and Spigot end construction. Joints shall be accompanied by rubber gaskets meeting all ASTM F 477 requirements and as shown on the Drawings.
  5. Perforations shall be per Manufacturer's standards.
  6. Visible defects such as cracks, creases, splits, obstructions to flow in perforations or in tube, uncolored or "pale" tubing, and obvious thin spots are not permissible.
- D. HDPE Pipes, Risers, and Fittings: Shall be as shown on the Details and manufactured by Plexco/Spirolite, or approved equal.

- E. Gaskets: Rubber gaskets shall comply with all ASTM F 477 requirements and shall have a minimum internal and external hydrostatic pressure rating of 10 psi gage.
- F. Lubricants: The lubricant used for assembly shall have no detrimental effect on the gaskets or on the pipes.
- G. Compression Release Joints: Compression Release Joint shall be designed and fabricated by the pipe Manufacturer. The Joint shall be capable of withstanding an internal and external hydrostatic pressure of 5 psi gauge. The design of the joint shall be approved by the CQA Officer prior to fabrication.
- H. HDPE Pipe Embedments for Concrete Structures: HDPE Embedments shall be a standard product of the pipe manufacturer. Installation and casting of HDPE embedment into concrete structures shall be in accordance with pipe Manufacturer's instructions.

### **PART 3 – EXECUTION**

- A. Pipe Trenches:
  - 1. Pipe trenches shall be excavated as specified in Section 02229 – Trenching, Backfilling, and compaction.
- B. Drainage Structures:
  - 1. Drop inlets shall be constructed in conformity with the Drawings, Section 03300 of these Specifications, and the 1998 Caltrans Specification Road and Bridge Standards. The HDPE pipe to endwall connection shall be per the Drawings, the pipe Manufacturer's standard details and recommendations.
- C. Pipe Bedding and Backfilling for Pipes and Drainage Structures:
  - 1. Bedding and backfilling for buried culverts shall comply with the specifications in Section 02229 – Trenching and Backfilling, and Compacting.
  - 2. Backfill for drainage structures shall be placed and compacted in the same manner as specified above the pipe, except the concrete shall be permitted to cure at an outside temperature at or above 50°F for not less than 5 days before the backfill is placed.

D. HDPE Pipes, Fittings, and Accessories Installation:

1. Pipes, fittings and accessories shall be handled in a manner that will ensure installation in sound, undamaged condition. Equipment, tools, and methods used in unloading, storage, reloading, hauling, and laying shall be such that the pipes, risers, fittings and accessories are not damaged. The Contractor shall repair or replace any damaged pipes, fittings and accessories due to mishandling before and during installations at no additional cost to the County.
2. Pipes, fittings and accessories shall be installed in accordance with the Manufacturer's recommendations and with lines and grades and details shown on the Drawings. Manufacturer's recommendations for installation shall be the minimum requirements.
3. Where culvert pipe is to be laid on existing ground and on or under fill the Contractor shall construct the embankment to a height to the top of pipe and then excavate a trench to receive the pipe. Trench shall be no wider than necessary to permit proper compaction of embankment around the pipe.
4. The interior of all pipes, fittings, and accessories shall be thoroughly cleaned of all foreign matter prior to being installed. Before jointing, all joint contact surfaces shall be cleaned, if necessary, and kept clean until jointing is completed.
5. Whenever the pipe laying is discontinued, such as end of workday or weekend, the unfinished work shall be protected from displacement due to caving of the banks, runoff, or other damages.

END OF SECTION

**SECTION 02779**

**GEOSYNTHETIC CLAY LINER**

**PART 1 GENERAL**

**1.1 WORK OF THIS SECTION**

- A. Furnish and install reinforced and un-reinforced geosynthetic clay liner.

**1.2 RELATED SECTIONS**

- A. Section 02221 – Excavation
- B. Section 02222 – Engineered Fill and Backfill
- C. Section 02223 – Subgrade Preparation
- D. Section 02778 – Geomembrane

**1.3 REFERENCES**

- A. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ASTM D422 – Standard Test Method for Particle-Size Analysis of Soil.
- C. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> [600 kN-m/m<sup>3</sup>]).
- D. ASTM D1004 – Standard Test Method For Initial Tear Resistance of Plastic Film or Sheeting.
- E. ASTM D2216 – Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-aggregate Mixtures.
- F. ASTM D4354 – Standard Practice for Sampling of Geosynthetics for Testing.
- G. ASTM D4632 – Standard Test Method for Breaking Load and Elongation of Geotextiles.
- H. ASTM D4643 – Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
- I. ASTM D4759 – Standard Practice for Determining the Specification Conformance of Geosynthetics.

- J. ASTM D5199 – Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
- K. ASTM D5084 – Standard Test Method of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
- L. ASTM D5199 – Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
- M. ASTM D5261 – Standard Test Method for Measuring Mass Per Unit Area of Geotextiles.
- N. ASTM D5887 – Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter.
- O. ASTM D5888 – Standard Guide for Storage and Handling of Geosynthetic Clay Liners.
- P. ASTM D5890 – Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners.
- Q. ASTM D5891 – Standard Test Method for Fluid Loss of Clay Components of Geosynthetic Clay Liners.
- R. ASTM D5993 – Standard Test Method for Measuring Mass per Unit of Geosynthetic Clay Liners.
- S. ASTM D6243 – Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method.
- T. ASTM D6693 – Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.

#### 1.4 DEFINITIONS

- A. Bentonite: Clay soil, comprised primarily of sodium montmorillonite, characterized by high-swelling potential and low-hydraulic conductivity.
- B. Geosynthetic Clay Line (GCL): Relatively thin factory-manufactured liner material consisting of bentonite supported by textile backing or geomembrane held together by needling, stitching, or chemical adhesives.
- C. Installer: The party responsible for field handling, transporting, storing, deploying, and temporary restraining (against wind) of the GCL.



- D. Lot: Group of consecutively numbered rolls from the same manufacturing line.
- E. GCL Manufacturer (Manufacturer): The party responsible for the production and quality of the GCL.
- F. Minimum Average Roll Value (MARV): Minimum value of a limited series of tests that represents a value two standard deviations lower than the overall average value. Ninety-five percent of any individual samples will have values greater than the MARV for any given property.
- G. Textile Backing (textile or Geotextile): Geosynthetic support material consisting of woven slit film, needle-punched nonwoven, or spun-laced polymer fabric, used for supporting bentonite in a GCL.

## 1.5 PRE-CONSTRUCTION MATERIALS

- A. Product Data (Manufacturer): Submit the following 7 days prior to shipping material to the site.
  - 1. Textile Backing:
    - a. Certification stating that the textiles meet the product requirements (Table 02779-1).
    - b. Copy of quality control tests performed by textile supplier (if different from GCL Manufacturer).
    - c. Copy of quality control tests performed by GCL Manufacturer.
  - 2. Bentonite:
    - a. Certification stating that the bentonite meets the product requirements (Table 02779-1).
    - b. Copy of quality control tests performed by bentonite suppliers.
    - c. Copy of quality control tests performed by GCL Manufacturer.
  - 3. GCL:
    - a. Certification stating that the GCL meets the product requirements (Table 02779-1).
    - b. Copy of quality control tests performed by GCL Manufacturer.

- c. Permeability testing on typical product by independent laboratory (not necessarily for product delivered to site).
  - d. Laboratory test data on typical product for:
    - 1) Swell.
    - 2) Permeability of overlapped GCL.
    - 3) Freeze-thaw behavior of GCL.
  - e. The Contractor shall submit a certificate of compliance for the GCL to the Engineer for approval at least 14 days before he intends to import this material. If the asperity height of the geomembrane is proposed to be less than the specified value, the certificate of compliance shall include the test results conducted by a third-party soils laboratory for the following ASTM D6243 (GCL – geomembrane shear strength). The shear strengths must meet or exceed the minimum shear strength parameters presented in Table 02779-1.
  - f. The direct shear strength tests to determine the GCL-Clay interface shear strengths will be performed by consolidating the fabricated specimens under normal loads of 4,000, 8,000, and 16,000 psf, respectively, in a flooded condition for a period of 24 hours prior to applying the shear loads. The direct shear strength tests to determine the GCL-Clay interface shear strengths will be performed by consolidating the fabricated specimens under normal loads of 4,000, 8,000 and 16,000 psf, respectively, in a flooded condition for a period of 24 hours prior to applying the shear loads. Each sample shall be sheared using a constant strain rate of .04 inches per minute up to 3 inches of displacement. The post peak shear strength shall be measured at 2.5 inches of displacement.
4. Qualifications (Installer):
- a. Submit, three weeks prior to installation, name of Installer, resume of installation supervisor/field Engineer to be assigned to the project, and list of projects completed by Installer that involved GCLs.
5. Quality Control Plan and Installation Procedures (Manufacturer):
- a. Submit, three weeks prior to installation, copy of Manufacturer's quality control plan including list of quality control tests performed and typical testing frequencies.

- b. Submit, three weeks prior to installation, recommended installation procedures.
- B. Submit, upon completion of the installation, Manufacturer's product warranty against Manufacturer defects (material not in compliance with this specification). The warranty shall cover the full material replacement cost not including installation.

## 1.6 QUALIFICATIONS

- A. Product shall be obtained from a Manufacturer listed in Section 2.1 or a Manufacturer-approved distributor.
- B. Installer shall meet the following requirements:
  - 1. Have experience in similar capacity involving GCLs on at least 3 landfill projects and have installed a minimum of 500,000 square feet of GCL.

## 1.7 QUALITY ASSURANCE

- A. The owner will engage and pay for the services of (1) Construction Quality Assurance Consultant (CQAC) and (2) Construction Quality Assurance (CQA) Laboratory for monitoring the quality and installation of the GCL unless otherwise specified.
- B. The Manufacturer shall not charge any time or material expenses to the Owner, related to a plant visit during manufacturing.
- C. The Installer shall aid the Owner in product sampling by providing personnel and equipment necessary to move, cut, and protect GCL rolls.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. General: Conform to the Manufacturer's requirements unless otherwise specified.
- B. Delivery:
  - 1. Deliver materials to the site only after the Engineer accepts required submittals.
  - 2. Material shall be covered with a waterproof, tightly fitting, plastic covering resistant to ultraviolet degradation.
  - 3. Ship less than one month prior to scheduled installation.

4. Each roll shall be marked with the following information:

- a. Manufacturer's name.
- b. Product identification.
- c. Lot and roll numbers.
- d. Roll dimensions and weight.

C. Storage:

- 1. Store rolls in space allocated by the Engineer. Space should be at high-ground level or elevated aboveground surface. Follow storage procedures outlined in ASTM D5888.
- 2. Stack no more than 3 rolls high.
- 3. Protect rolls from precipitation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.
- 4. Preserve integrity and readability of roll labels.

D. Handling:

- 1. Use appropriate handling equipment following Manufacturer's recommendations to load, move, or deploy GCL rolls.
- 2. Handling of rolls shall be done in a competent manner such that damage does not occur to the product or to its protective wrapping. Follow handling procedures outlined in ASTM D5888.
- 3. Damage to protective covering due to mishandling or sampling must be repaired immediately. Repairs shall be such that the GCL roll is protected from moisture or other deleterious conditions.
- 4. Installer is responsible for off-loading, storage, and transporting material from storage area to installation site.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURER**

A. Name, address, and telephone number of Manufacturer given below (product names are shown in parenthesis):

1. Colloid Environmental Technologies Company (CETCO), 1500 West Shore Drive, Arlington Heights, IL 60004, (800) 527-9948. (Bentomat.)
  2. GSE, 19103 Gundle Road, Houston, TX 77073, (800) 435-2008.
- B. Material may be provided by a different office than shown above or by a Manufacturer-approved distributor.
- C. Products other than those shown above may be used only with written pre-bid authorization from the Engineer.

## 2.2 BENTONITE

- A. Supplied in granular form.
- B. Meet the requirements of Table 02779-1.

**TABLE 02779-1.  
PROPERTIES FOR BENTONITE**

Test	Test Designation <sup>(1)</sup>	Requirement
<b>Bentonite</b>		
Free Swell	ASTM D5890	>18 ml/2 g minimum
Fluid Loss	ASTM D5891	Maximum 18 ml

NOTES: <sup>(1)</sup> Alternate tests are allowed only with prior written approval of Engineer.

## 2.3 REINFORCED NEEDLE PUNCHED GCL

- A. Consists of bentonite encapsulated by a non-woven Geotextile and a woven Geotextile.
- B. Continuous waterproof laplines and matchlines shall be printed directly on the Geotextile-type GCL at 6 and 9 inches from the edges of the rolls, respectively.
- C. Wrapped around structurally sound core that can support weight of GCL without excessive bending or buckling. The core shall be accessible to stingers or rods placed full-length within the core.
- D. Geotextiles shall be needle-punched or lock-stitched together through the bentonite layer to form a stable composite. Adhesives may be used in addition to, but not in lieu of, needle-punching, or lock stitching.
- E. Continuously inspected for presence of needles and other deleterious materials and certified to be "needle-free."

- F. Meet the requirements of Table 02779-2.

**TABLE 02779-2.**  
**PROPERTIES FOR REINFORCED GEOSYNTHETIC CLAY LINER**

Test	Test Designation <sup>(1)</sup>	Requirement
<b>GCL<sup>(2)</sup></b>		
Dried Clay Mass Per Unit Area	ASTM D5993	>0.85 lbs <sup>(3)</sup>
Peel Strength	ASTM D4632	>15 lbs
Grab Strength	ASTM D4632	>90 lbs
Permeability	ASTM D5084	Maximum $5.0 \times 10^{-9}$ cm/sec <sup>(4)</sup>
Interface Shear Strength	ASTM D6243	See Table 02778-3 <sup>(5)</sup>

- NOTES: <sup>(1)</sup> Alternate tests are allowed only with prior written approval of Engineer.  
<sup>(2)</sup> Required values for Geotextile and GCL are MARV.  
<sup>(3)</sup> Weight of GCL minus weight of Geotextiles and corrected to 0 percent bentonite moisture content.  
<sup>(4)</sup> Measured under 5psi confining pressure and 2 psi head pressure.  
<sup>(5)</sup> To be performed as part of third party conformance testing prior to shipment. Not a quality control requirement of the manufacturer. See Part 1.5.A.3.e & f for testing procedures and Table 02778-3 for required strengths.

## 2.4 MANUFACTURER SOURCE QUALITY CONTROL

- A. Perform the quality control tests at the frequencies shown on Table 02779-4.
- B. Supply copies of testing to the Engineer.

**TABLE 02779-4.**  
**MANUFACTURER'S TESTING FOR GEOSYNTHETIC CLAY LINER**

Test	Frequency <sup>(1)</sup>
<b>Bentonite<sup>(2)</sup></b>	
Free Swell	1 per 100 tons
Fluid Loss	1 per 100 tons
<b>GCL</b>	
Dried Clay Mass Per Unit Area	1 per 40,000 square feet
Peel Strength/Grab Strength	1 per 100,000 square feet
Permeability <sup>(3)</sup>	1 per 500,000 square feet

- NOTES: <sup>(1)</sup> One test per quantity indicated; minimum one test per lot.  
<sup>(2)</sup> Frequencies based on material with ten percent moisture content.  
<sup>(3)</sup> Minimum of two tests for permeability.

**PART 3      EXECUTION****3.1      PREPARATION OF FOUNDATION**

- A.      Conformance testing of the GCL shall be performed and approved by the Engineer in accordance with the CQA plan.
- B.      The liner subgrade shall be prepared as specified in Section 02223.

**3.2      DEPLOYMENT**

- A.      General:
  - 1.      Deploy only after the Engineer and the Installer accept the liner subgrade in writing.
  - 2.      Do not allow foot traffic on the GCL if the material is at the moisture content of 35 percent or greater.
  - 3.      Deploy manually or by use of a spreader bar attached to loader or backhoe.
  - 4.      Take care not to entrap objects or moisture beneath GCL.
  - 5.      Beginning deployment implies acceptance of subgrade by the Installer.
- B.      Vehicular traffic shall not be allowed on the GCL without the expressed written consent of the Engineer.
- C.      The Installer shall not drag the GCL over areas that may damage the GCL, dislodge stones, or entrap materials such as rocks, sticks, grass, etc., beneath the GCL.
- D.      The Installer shall place a rub sheet of smooth HDPE geomembrane or other acceptable material over areas that may damage the GCL or entrap foreign materials during deployment.

**3.3      JOINING**

- A.      Overlaps:
  - 1.      Using the lapline and matchline as guides, maintain a minimum overlap of inches along length of the panel until covering the liner with soil.
  - 2.      Maintain a minimum overlap of 12 inches at ends of rolls and in sump areas (if applicable) until covering the liner with soil.

3. Overlaps or seams are not allowed perpendicular to slopes greater than 10 percent. In these areas GCLs must be placed in one piece along the entire slope, unless otherwise approved by the Engineer.

B. Seams:

1. Spread loose bentonite or bentonite paste at the rate of 0.25 lbs per lineal foot of overlap. Bentonite along overlaps is not required if Manufacturer can document that the permeability at the overlaps is no greater than the permeability of the GCL material ( $5 \times 10^{-9}$  cm/sac). Approval to forego the use of additional bentonite along seams must be received in writing from the Engineer before installation begins.
2. Bentonite shall be same material used in the GCL.
3. Use lime spreader if powdered bentonite is used to reduce wind-blown particles.
4. Do not sew or use mechanical connections (except for repairs).

### 3.4 RESTRAINING AND PROTECTING

- A. Restrain GCL against wind using sandbags filled with fine-grained material.
- B. Sandbags must remain until GCL is removed.
- C. GCL must be covered with geomembrane the day it is installed. If overlying geomembrane is not seamed the same day, the Engineer may request geomembrane edges to be pulled back to inspect GCL at no additional cost to Owner. Torn, punctured, or hydrated material shall be removed and replaced in accordance with Section 3.5 at no additional cost to Owner.
- D. The bentonite material that becomes hydrated to a moisture content greater than 40 percent before being covered by a seamed geomembrane will be rejected. Rejected material shall be removed and replaced at no additional cost to the Owner.

### 3.5 REPAIR PROCEDURES

- A. Remove punctured, torn, or hydrated material.
- B. Cover area with same type of GCL material with same side up.
- C. Overlap defective area by a minimum of 12 inches in all directions.
- D. Adhesion tape may be used to keep patch in place.



- E. Apply loose bentonite as with normal overlaps at 4 ounces per linear foot.

### 3.6 FIELD QUALITY CONTROL AND QUALITY ASSURANCE

#### A. General:

- 1. Field quality control is the responsibility of the Installer who must document that the installation proceeds in accordance with this specification.
- 2. Field quality assurance is the responsibility of the Owner who is assisted by the Installer.

#### B. The Installer and Owner shall inspect:

- 1. The underlying surface for entrapped particles that may impact the GCL.
- 2. The surface of the GCL for needles, punctures, tears, thinning, or other evidence that the material may not meet specification requirements.
- 3. The GCL for evidence of premature hydration such as wet areas or swelling. Hydrated areas shall be removed and replaced with unhydrated material.
- 4. Overlaps using the laplines and matchlines as a guide. The Engineer shall periodically measure the distance of the laplines and matchlines from the edge of the GCL.
- 5. The bentonite seam (if necessary) to check the location of the seams over the overlap and the amount of bentonite being used.
- 6. The Engineer must approve each section of the GCL before the GCL is covered.

#### C. The Installer shall aid the Owner in collecting samples for conformance testing.

### 3.07 ACCEPTANCE

#### A. Contractor shall retain ownership and responsibility of GCL until acceptance by the Engineer.

#### B. Engineer will accept GCL installation when:

- 1. All required documentation from the Manufacturer and Installer has been received and accepted.

2. Test reports verifying material properties have been received and accepted.
3. The Engineer has completed final inspection and any noted defects have been repaired.

END OF SECTION

**SECTION 02820**

**FERTILIZER AND SEED**

**PART 1- GENERAL**

**1.1 SUMMARY**

- A. Section included
  - 1. Preparing, fertilizing and seeding the vegetative layer.
- B. Related Sections
  - 1. Section 02222 – Earthfill

**1.2 SUBMITTALS**

- A. Product data: within 30 days after Contractor has received Owner notice to proceed, submit:
  - 1. Complete materials list of items proposed to be provided under this section
  - 2. Complete data on source, size, and quality
  - 3. Sufficient data to demonstrate compliance with the specified requirements

**PART 2- PRODUCTS**

**2.1 WATER**

- A. Shall be clear and suitable for agricultural use.
- B. Reclaimed water may be used; however, it must be tested by a certified laboratory and found suitable for plant growth before it is applied.
- C. If water is obtained at the site, it shall be done so only under permit where facilities are utilized.

## 2.2 SEED

- A. All seeds shall be in conformance with the California State Seed Law of the Department of Food and Agriculture.
- B. Each bag shall be delivered to the site sealed and clearly marked as to species, purity, percent germination, dealer's guarantee, and dates of test.
- C. Seed containers shall be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained.
- D. Prior to seeding at the request of the CQA Officer, the Contractor shall provide a letter of certification, original Association of Official Seed Analysts (AOSA)-certified seed test results, and calculation of PLS content.
- E. All legume seed shall be pellet-inoculated as provided in Bulletin AXT-280 of the University of California Cooperative Extension, "Pellet Inoculation of Legume Seed". Inoculant sources shall be species-specific and shall be applied at a rate of 2 pounds of inoculant per one hundred pounds of seed.
- F. The seed mixture shall meet the requirements of LM Erosion blend as supplied by Lockwood Seed and Grain, Chowchilla, California, telephone 559-665-5702.
- G. Species to be applied at the specified rates as follows:
  - 1. Common Barley 40 pounds/acre
  - 2. Annual Rye 40 pounds/acre
  - 3. Crimson Clover 15 pounds/acre
  - 4. Rose Clover 5 pounds/acre

## 2.3 FERTILIZER

- A. Shall conform to the requirements of the California Food and Agricultural Code.
- B. Shall be pelleted or granular form.
- C. Shall have a minimum guaranteed analysis of 16-20-0+S (Sulfur).
- D. Shall be applied at the rate of 300 pounds per acre.

## **PART 3 – EXECUTION**

### **3.1 PREPARATION OF SEEDING AREAS**

- A. Fertilizer and seed shall be applied to a freshly-graded surface while soil remains friable and weed-free.
- B. If seeding area is compacted, loosen top ½ inch of soil to create favorable conditions for germination. Method to be approved by the CQA Officer.
- C. Remove soil lumps, ridges, and depressions.
- D. Track walk with dozer.

### **3.2 WEATHER LIMITATIONS**

- A. Apply during the following months: October and November, unless otherwise approved by Owner.
- B. Do not apply in wind conditions which would not allow uniform application of seed mix.
- C. Apply on soil that is surface moist.

### **3.3 EQUIPMENT**

- A. Use a broadcast distribution system for fertilizer and seed.

### **3.4 PROTECTION**

- A. Protect broadcast distribution areas from damage.
- B. Repair damaged areas.

END OF SECTION

**SECTION 02920****HDPE GEOMEMBRANE****PART 1 - GENERAL****1.1 SCOPE**

The work covered in this Section includes the manufacturing, fabrication, testing, supply and installation of polyethylene geomembrane for the Synthetic Barrier of the final cover system over the landfill. The Contractor shall furnish all labor, materials, transportation, handling, storage, supervision, tools, equipment and other incidentals necessary to install, test, and quality control the geomembrane as required by the Contract Documents.

**1.2 QUALITY ASSURANCE AND CONTROL DURING INSTALLATION**

The County's third party Construction Quality Assurance (CQA) Consultant will observe geomembrane installation and construction and certify that construction is in accordance with Contract Documents. All tests and test frequencies specified in this section are Construction Quality Assurance (CQA) tests, and these tests are the responsibility of the Owner, CQA Officer, and Monitor.

**1.3 REFERENCES**

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)  
STANDARD TEST METHODS/PRACTICE:

ASTM D 638	Tensile Properties of Plastics
ASTM D 792	Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 1004	Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1204	Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM D 1238	Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D 1505	Density of Plastics by the Density-Gradient Technique
ASTM D 1603	Carbon Black in Olefin Plastics

ASTM D 1693	Environmental Stress-Cracking of Ethylene Plastics
ASTM D 5596	Microscopical Examination of Pigment Dispersion in Plastic Compounds
ASTM D 6392	Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
ASTM D 4833	Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 5994	Measuring Nominal Thickness of Geotextiles and Geomembranes
ASTM D 5321	Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
ASTM D 5397	Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test

GEOSYNTHETICS RESEARCH INSTITUTE (GRI) STANDARD PRACTICE FOR:

GRI GM-4	Multi Axial Elongation
GRI GM-5(a)	Single Point Notched Constant Tensile Load (SP-NCTL) Test for Polyolefin Resin or Geomembrane
GRI GM-6	Pressurized Air Channel Test for Dual Seamed Geomembranes

#### 1.4 SUBMITTALS

- A. The Contractor or Geomembrane Installer shall submit the following information to the Engineer for approval at least 30 days (unless otherwise specified) prior to procurement of the geomembrane:

1. Proof of Manufacturer's Qualifications:

- a. The Manufacturer must have at least two (2) years [continuous] documented experience in the manufacture of the geomembrane and/or documented experience totaling 10,000,000 ft<sup>2</sup> of the manufactured geomembrane for at least ten (10) completed facilities.

- b. Manufacturer's Brochure: Submit complete manufacturer's specifications, descriptive drawings, and literature for the geomembrane, including the product identification and supplier of the polymer resin and recommended method for handling and storage of all materials prior to installation. Include information on plant size, equipment, personnel, number of shifts per day and capacity per shift.
- c. Manufacturer Quality Control (MQC) Program: Submit a complete description of the geomembrane manufacturer's formal quality control programs for manufacturing, fabricating, testing, quality control, defects repair, handling, and shipping. The description shall include, but not be limited to, polymer resin supplier(s) and product identification, acceptance testing, production sampling and testing, installation testing, documentation of changes, alterations, repairs, retests, and acceptance.
- d. Prior to purchasing material the following conformance testing is required: Submit independent quality control laboratory test results demonstrating compliance with material properties listed in Table 1-02920, Resin Properties (Without Carbon Black), and Table 2-02920, Geomembrane Properties. The independent laboratory tests are to be performed once by an approved laboratory independent of the manufacturer. In addition, the manufacturer must provide a certificate of compliance which states that the material to be installed will use the same resin type and formulation as that for which test results are submitted.
- e. Manufacturer Quality Control Certificates:
  - 1. The Geosynthetic Installer shall submit test reports to the Engineer prior to geomembrane shipment. The tests and frequencies are specified in Part 2 - "Manufacturer Quality Control Tests" and material properties.
  - 2. The following information must be submitted for approval prior to shipping the material:

Resin:

    - a) Batch number, lot number, or identification number and production date(s).



- b) A certification by a qualified individual employed by the manufacturer that the quality of the resin used to manufacture the geomembrane rolls assigned to this project meets specified properties measured using test methods indicated in the specifications, or equivalent;
- c) Copy of quality control certificates issued by the Resin Supplier.
- d). Certified statement that no reclaimed polymer was added to the resin during the manufacture of the actual geomembrane to be used in this project.

Geomembrane:

- a) Roll numbers, production dates, and identification;
  - b) A certification by a qualified individual employed by the manufacturer that the geomembrane roll assigned to this project meets specified properties measured using test methods indicated in the specifications, or equivalent;
  - c) A list of quantities and descriptions of materials other than the base polymer which comprise the geomembrane.
- f. Factory Visit: At the request of Owner or the Engineer, submit contact names, telephone numbers, addresses, and production schedule information for purposes of scheduling an Owner or Engineer's plant visit during production. (See Part 2).

2. Proof of Geosynthetic Installer's Qualifications:

- a. List at least ten (10) completed facilities totaling a minimum 10,000,000 ft<sup>2</sup>, for which the Geosynthetic Installer has manufactured the proposed geomembrane, including thickness, amount, date(s) and intended usage. (See Part 2).
- b. Show a minimum of two years continuous experience and list completed facilities for which the Geosynthetic Installer has installed geomembrane, totaling a minimum of 10,000,000 ft<sup>2</sup>.

- c. The name or names of the field superintendents who will be proposed for the project and a list of completed facilities for which the field superintendent has installed the selected geomembrane totaling a minimum of 10,000,000 ft<sup>2</sup>.
  - d. The name or names of the Master Seamer(s) who will be proposed for the project and a list of completed facilities for which the Master Seamer(s) has installed the selected geomembrane totaling a minimum of 2,000,000 ft<sup>2</sup>.
  - e. Construction Quality Control Program: Submit a complete description of the Geosynthetic Installer's formal quality control programs for handling, installing, testing, quality control, and defect repair. The description shall include, but not be limited to installation testing, documentation of changes, alterations, repairs, retests, and acceptance. The document shall include a complete description of seaming by extrusion welding and hot wedge welding.
  - f. Panel Layout Drawing: As a minimum, Drawings shall include an approximate panel deployment sequence, panel orientation, type of weld to be used for each seam, incorporate restrictions on panel and seam orientation, methods of deployment, and details of each step in the construction of any penetrations. The panel layout drawing shall be drawn to scale, and shall indicate areas where horizontal seams will be utilized., and CQA representative.
  - g. Proposed schedule of installation showing the critical path of installation.
  - h. Licensed Installer: The Geosynthetic Installer shall be approved and/or licensed by the geomembrane manufacturer.
  - i. Warranty: Submit an advance (sample) copy of the warranty.
- B. Upon delivery of the rolls of geomembrane, a copy of the certification from the manufacturer certifying the batch delivered to the site was manufactured and QC inspected.
- C. During Construction Conformance Test Results: Submit conformance test results to the Engineer for approval within 3 days of completed testings. See Part 1.5.C. for conformance testing requirements and frequency.

- D. List of Personnel: The Contractor or Geosynthetic Installer shall submit a list of proposed seaming personnel and their experience records. All personnel shall be approved by the Engineer before they perform seaming operations.
- E. Submittals Required for Project Closeout
  - 1. Record Drawings: Submit geomembrane record drawings to the Engineer as specified in Section 01050 - SURVEYING.
  - 2. Geomembrane Warranty
- 1 Each field panel and seam shall be given an "identification code" (number or letter-number). This identification code shall be agreed upon by the County, Geosynthetic Installer, Engineer, and CQA Officer.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

##### A. Handling

The Geosynthetic Installer's personnel shall handle the material with care, shall use adequate equipment and shall take all precautions necessary to prevent damaging the geomembrane.

##### B. Inspection upon Delivery

Upon delivery at the site, the Geosynthetic Installer, in the presence of a CQA Representative, conduct a visual inspection of rolls or factory panels for defects and for damage. This inspection shall be conducted without unrolling rolls or unfolding factory panels unless, in the Geosynthetic Installer's or CQA Monitor's opinion, defects or damages are found or suspected.

Defects or flaws in the materials shall be brought to the attention of the CQA Officer. Rolls, factory panels, or portions thereof, which have unacceptable flaws shall be recorded by the CQA Monitor and Geosynthetic Installer, rejected and shall be removed from the site.

Rejected materials shall be replaced by the Contractor at no additional cost to Owner. No time extension will be allowed in the case of rejected materials.

##### C. During Construction Conformance Testing

The Geosynthetic Installer shall take samples from the delivered lot or factory seams retained (delivered along with the lot) and sent to the CQA Geosynthetic Laboratory for conformance testing. The cost for laboratory conformance testing

shall be paid by the Contractor or Geosynthetic Installer. The following conformance tests and minimum frequency are required prior to installation:

1. Thickness (ASTM D 5994): 10 times per sample.
2. Tensile Strength and Elongation (ASTM D 638): one test per 100,000 square feet.
3. Puncture Resistance (ASTM D 4833): one test per 100,000 square feet.
4. Tear Resistance (ASTM D 1004, die C): one test per 100,000 square feet.

All conformance test results shall be reviewed and approved by the Engineer prior to any placement. If a conformance test result fails the specifications, at least two additional conformance tests shall be performed on samples taken immediately from adjacent numbered rolls. If both additional conformance test results pass the specifications, the entire lot or 100,000 square feet shall be accepted except that roll from which the failed sample is taken. If any of the conformance test results fails for the two (minimum) additional samples, the entire lot or 100,000 square feet shall be rejected by the Engineer.

#### D. Storage

The Geosynthetic Installer shall be responsible for ensuring that the stored materials are protected from rain, snow, ice, dirt, ultra violet light, shock, theft, vandalism, passage of vehicles, and other sources of damage. The Contractor is responsible for clearing, grubbing, and grading necessary to prepare the storage area. Provide for surface water control, access and storage area surfacing, and lighting necessary for adequate unloading of highway transport vehicles and access by construction equipment.

### 1.6 WARRANTY

Provide a five (5) year material warranty and workmanship defects for a period of one (1) year following the date of final completion of the work under this contract. The warranty required herein shall be provided in addition to any warranty required by the General Conditions.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURING PLANT VISIT (At the request of Owner or Engineer)

The Manufacturer shall allow the Engineer, CQA Officer, Owner, or designated alternates to visit the manufacturing plant for a project specific visit. The Engineer,

Owner or designated alternate shall be allowed to review the manufacturing process, quality control, laboratory facilities and testing procedures as necessary to verify that:

- A. Properties guaranteed by the Manufacturer meet all specifications;
- B. Measurements of properties by the Manufacturer are properly documented and test methods used are acceptable;
- C. Rolls of geomembrane are free of holes, blisters, or any sign of contamination by foreign matter;
- D. Packaging and transportation procedures do not damage the geomembrane;
- E. Roll packages are labeled to indicate the name of the manufacturer, the type of geomembrane, the roll thickness and the roll number; and
- F. That extrusion rods and/or beads are derived from the same base resin type as the geomembrane.

## 2.2 GEOMEMBRANES

### A. Single Source

All geomembrane sheets and extrudate material for the construction of the project shall be obtained from a single material supplier and manufacturer. It must be certified and warranted that the sheets, extrudate, and pipe boots are compatible with one another. The Geosynthetic Installer shall provide manufacturer's warranties for the sheets, extrudate material, and pipe boots.

## 2.3 MATERIAL PROPERTIES

### A. Geomembrane

Resin shall be a High Density Polyethylene (HDPE) that will meet or exceed the requirements of Table 1-02920, Resin Properties (without Carbon Black). Geomembrane shall meet or exceed the requirements of Table 2-02920, Geomembrane Properties. Equivalent test methods are subject to the approval of the Engineer.

### B. Extrudate

Extrudate shall be the same resin as the geomembrane. The manufacturer shall provide documentation and shall certify that the extrudate meets this requirement.

### C. Material Composition

The geomembrane shall consist of new, first-quality products designed and manufactured specifically for the purpose of this project, as satisfactorily demonstrated by prior use. The geomembrane shall be unmodified containing no plasticizer, fillers, chemical additives, reclaimed polymers, or extenders. Approximately 2 percent carbon black shall be added to the resin for ultraviolet resistance. The only other allowable compound elements shall be anti-oxidants and heat stabilizers, of which up to 1.5 percent total, as required for manufacturing, may be added.

## 2.4 MANUFACTURER QUALITY CONTROL TESTS

A. Test Reports: Submit all test reports to the Engineer for review and approval.

B. Manufacturer Quality Control (MQC) Tests:

1. Resin shall be tested at a frequency of one test per resin batch. One batch is defined as one rail car load of resin. As a minimum perform tests for Density and Melt Index. Compliance with the Polymer Composition test requirement shall be established with a manufacturer's certificate of compliance. The finished rolls shall be identified by a roll number corresponding to the resin batch used.
2. Geomembrane shall be tested for properties required by Table 2-02920. The following minimum test frequencies shall be observed:

<u>Property</u>	<u>Test Method</u>	<u>Minimum Frequency</u>
Thickness	ASTM D 5994	25 times per roll
Density	ASTM D 792 or ASTM D 1505	1 per 50,000 sf
Tensile Properties	ASTM D 638	1 per 50,000 sf
Tear Resistance die C	ASTM D 1004	1 per 50,000 sf
Multi Axial Elongation	GRI-GM 4	1 per resin batch
Low Temperature Impact	ASTM D 746	1 per resin batch
Dimensional Stability	ASTM D 1204	1 per resin batch

Puncture Resistance	ASTM D 4833	1 per 50,000 sf
Carbon Black Content	ASTM D 1603	1 per 50,000 sf
Carbon Black Dispersion	ASTM D 5596	1 per 50,000 sf
Notched Constant	ASTM D 5397/	1 per resin
Tensile Load	GRI GM 5(b)	batch

### **PART 3 - INSTALLATION**

#### **3.1 GENERAL REQUIREMENTS**

- A. Installation shall be performed under the direction of a qualified field superintendent who shall remain on site and be in charge throughout the entire geomembrane installation (including subbase acceptance, geomembrane layout, panel placement, seaming, testing and repairs) and all other activities performed by the Geosynthetic Installer. The Geosynthetic Installer's field superintendent shall have previously installed or supervised the installation of a minimum of 10,000,000 ft<sup>2</sup> of the selected geomembrane.
- B. All personnel performing seaming operations shall be qualified by experience and by successfully passing trial seam tests and shall be approved by the CQA Monitor prior to installing the geomembrane.
- C. Actual seaming shall be performed under the direction of a "Master Seamer" who may be the same person as the field superintendent, and who has seamed a minimum of 2,000,000 ft<sup>2</sup> of the selected geomembrane using the type of seaming apparatus as that proposed for use for this project. The Master Seamer must be on site whenever installation and/or seaming is being performed.
- D. Wind

The Contractor shall provide sufficient ballast and temporary anchorage to protect the material from wind damage or displacement. The Contractor is responsible for protecting the material from damage due to weather at all times.

### 3.2 INSTALLATION EQUIPMENT

#### A. Seaming Methods

Approved processes for field seaming are extrusion welding and fusion (wedge) welding. Solvent or adhesive welding is prohibited unless approved by the Engineer. Proposed alternate processes shall be documented and submitted to the Engineer for approval PRIOR to installation. Only apparatus which have been specifically approved by make and model shall be used.

#### B. Welding Equipment

The Geosynthetic Installer shall provide welding equipment with gauges showing temperatures at the nozzle or barrel (extrusion welder) and at the wedge (fusion welder). The fusion-welding apparatus must be automated self propelled devices, and shall be equipped with gauges giving the important temperatures and pressures. Equipment shall be maintained in good condition and in adequate number to avoid delaying work in the event of equipment failure or malfunction, and shall be supplied by a power source capable of providing constant voltage under a combined line load. At least one spare operable seaming apparatus of each type used shall be maintained on-site. Equipment used for seaming shall be handled so as to avoid damaging the geomembrane. The welding apparatus shall be able to produce a "double hot wedge" with void for non-destructive testing.

#### C. Field Tensiometer

The Geosynthetic Installer shall provide a field tensiometer for on site peel and shear testing of geomembrane seams. The tensiometer shall be calibrated prior to arrival at the site, capable of performing testing according to ASTM D 6392, and be accompanied by evidence of current valid calibration. The tensiometer shall be motor driven and have jaws capable of traveling at a maximum measured rate of 2 inches per minute. The tensiometer shall be equipped with a gauge that measures the force exerted between the jaws in pounds and have a digital readout.

#### D. Punch Press

The Geosynthetic Installer shall provide a punch press for the on site preparation of specimens for testing. The press shall be capable of cutting specimens in accordance with ASTM D 6392.



### 3.3 PREPARATION

#### A. Surface Preparation

Prior to geomembrane panel deployment, the Geosynthetic Installer shall inspect the surface upon which the geomembrane will be placed. The surface shall be prepared smooth, free of rocks, soil particles greater than 3/8-inch, protrusions, sharp objects, and deleterious material that could puncture or abrade the geomembrane. Edges of excavations and grade breaks shall be rounded to preclude sharp corners.

#### B. Certification of Subgrade Acceptance

The Contractor shall be responsible for preparing the subgrade soil according to the Contract Documents and geomembrane manufacturer's recommendations. Prior to geomembrane installation the Geosynthetic Installer shall certify in writing that the surface upon which the geomembrane will be installed is acceptable. The Certificate of Acceptance shall be given by the Geosynthetic Installer to the CQA Officer prior to commencement of geomembrane installation in the area under consideration (an example certificate is provided in this section). Commencement of geomembrane installation by the Geosynthetic Installer shall mean acceptance and approval was accomplished.

After the subgrade soil has been accepted by the Geosynthetic Installer, it shall be the Geosynthetic Installer's responsibility to indicate to the Contractor changes in the subgrade soil condition that require repair work. The Contractor shall ensure that the subgrade soil is repaired.

#### C. Damaged Subgrade

Prior to geomembrane panel deployment, the Contractor shall repair damage to the subgrade which has occurred due to his or the Geosynthetic Installer's activities.

#### D. Anchor trench

Geomembrane anchor trenches shall be constructed to the lines and grades shown on the Drawings. The geomembrane in the anchor trench shall be constructed as shown on the Drawings, and backfilled as indicated with care not to damage the geomembrane. When the anchor trench will be excavated in soil susceptible to desiccation, no more than the amount of trench required for geomembrane to be anchored in one day shall be excavated. The anchor trench shall be maintained clean and dry prior to backfilling.

### 3.4 PANEL DEPLOYMENT

#### A. Identification

Each field panel shall be given a unique "identification code" (numbers or letters and numbers) consistent with the layout plan.

#### B. Installation Sequence

The Geosynthetic Installer shall be responsible for the final installation sequence of geomembrane panels. Geomembrane panels shall not be deployed unless they can be seamed within 8 hours of deployment or earlier.

#### C. Orientation

Panels shall be oriented perpendicular to the line of the slope crest. Seams parallel to or less than a 45 degree angle from any crest or toe of slope are defined as horizontal seams. Horizontal seams are prohibited on slopes greater than 10:1 (H:V) and shall be at least 5 feet from the crest or toe of slopes greater than 10:1.

#### D. Wrinkles

Geomembrane panels shall be unrolled using methods that will minimize wrinkles and will not damage, stretch, or crimp the geomembrane and shall protect the underlying subsurface from damage. All wrinkles higher than they are wide (across their base) shall be removed by repair methods. The Contractor and/or Geosynthetic Installer shall also remedy wrinkles which develop during subsequent placement of overlying layers.

#### E. Bridging

Material shall be installed to allow for temperature related shrinkage and to avoid bridging of the geomembrane.

#### F. Seam Layout

Panels shall be placed such that the seam layout conforms as closely as practicable to the approved panel layout drawing. No panels may be seamed in the field without the CQA Officer's approval. In addition, panels not specifically shown on the seam layout drawing may not be used without the CQA Officer's prior approval. Seams shall be identified using the identification codes shown on the panel and seam layout drawing.

### 3.5 FIELD SEAMS

#### A. Seam Strength

All field seams shall meet or exceed the requirements of Table 3-02922 for Geomembrane Seam Properties.

#### B. Overlapping

Panels of geomembrane must have a finished overlap of a minimum of three (3) inches for extrusion welding and four (4) inches for fusion welding, but in any event, sufficient overlap shall be provided to allow peel tests to be performed on the seam.

Field seams shall have a minimum width of one (1) inch.

The procedure used to temporarily bond adjacent panels together shall not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any spot welding apparatus shall be controlled such that the geomembrane is not damaged.

#### C. Weather Conditions for Seaming

- a. Unless authorized in writing by the Engineer or CQA Officer, no seaming shall be attempted at ambient temperatures below 32°F (0°C) or above 95°F (35°C). If seaming is authorized at temperatures below 32°F (0°C), pre-heating devices shall be placed on all welding machines. Trial seams shall be prepared and tested every two to three hours. Additionally, if the air temperature drops more than 10°F from the time the trial seam(s) were produced, additional trial seams shall be performed as required by the QA Representative.
- b. Between ambient temperatures of 32°F (0°C) and 50°F (10°C), seaming may be carried out if the geomembrane is preheated by either the sun or a hot air device, and if there is not excessive cooling resulting from the wind.
- c. Above an ambient temperature of 50°F (10°C), no preheating is required.
- d. In all cases, the geomembrane shall be dry and protected from wind damage. Seaming shall not proceed during precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, in an area of saturated soil, in the presence of wind speeds exceeding 20 mph (32 km/hr), or in an area of free water.

#### D. General Seaming Procedures

Prior to seaming, the seam area shall be clean and free of moisture, dust, dirt, debris of any kind, and foreign material.

Seams shall be aligned with the fewest possible number of wrinkles and "fishmouths." Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of six (6) inches (150 mm) beyond the cut in all directions.

As deemed necessary by the Geosynthetic Installer, Contractor, or CQA Representative, a movable protective layer shall be used below each overlap of geomembrane that is to be seamed to prevent buildup of moisture between the sheets. Upon completion of welding, the movable protective layer shall be removed entirely.

For seams which are to be extrusion welded, and as necessary for fusion welds, the seam overlap shall be grinded in accordance with the Manufacturer's instructions, within one hour of the seaming operation and in a way that does not damage the geomembrane. The grind shall not extend more than 0.25 inches past the weld and shall not be excessively deep.

Welding speed and pressure, preheating temperature, nozzle (die) temperature, ambient air and sheet temperatures, and extrudate bead thickness shall not deviate from the Manufacturer's recommendations or welding criteria established during start-up operations unless approved by the Engineer and approved and certified in writing by the Fabricator that such deviation will not result in any short or long term damage to the geomembrane.

The edge of cross seams shall be grinded to a smooth incline (top and bottom) prior to welding.

For extrudate seams, the extrusion welding device shall be purged prior to beginning a seam and until all heat-degraded extrudate has been removed from the barrel.

In locations where a firm substrate does not exist, a flat board, or a similar hard surface shall be provided directly under the seam overlap to achieve proper support.

Seaming shall extend to the outside edge of panels to be placed in anchor trenches.

### 3.6 PROTECTION

- A. The Contractor and Geosynthetic Installer shall take precautions as necessary to protect the geomembrane, including but not limited to:
1. Providing a smooth insulating plate or fabric beneath hot welding apparatus before and after usage.
  2. Providing additional protection over the geomembrane in heavily trafficked areas.
  3. Protecting the geomembrane from ultraviolet exposure. The geomembrane shall not be left exposed (uncovered) to the elements for any period longer than 30 days unless otherwise approved by the Engineer.
  4. Positioning overlaps of panels to facilitate drainage prior to seaming.
  5. Preventing damage to the geomembrane by scraping, scarring, scuffing, scratching, gouging, handling, trafficking, excessive heat, vibration, leakage of hydrocarbons or any other means.
  6. Assuring that the prepared surface underlying the geomembrane has not deteriorated or changed significantly since acceptance, and is still acceptable at the time of geomembrane placement.
  7. Assuring that the surfaces underlying the geomembrane are clean and free of debris.
  8. Preventing personnel working on the geomembrane from smoking, wearing damaging shoes, or engaging in other activities which could damage the geomembrane.
  9. Using methods to unroll the panels that do not cause scratches or crimps in the geomembrane and do not damage the underlying surfaces.
  10. Using methods to place the panels that minimize wrinkles (especially differential wrinkles between adjacent panels). Temperature changes should be considered in scheduling of panel deployment and seaming to minimize shrinkage and expansion problems.
  11. Adequately anchoring the geomembranes before and after deployment to prevent wind damage.

12. Minimizing direct contact with geomembrane; (i.e., protecting the geomembrane with geotextiles, extra geomembrane, or other suitable materials) in areas where excessive traffic may be expected.
13. Preventing all wheeled and tracked equipment from driving directly on the geomembrane. See Section 3.11 "PLACEMENT OF GEOCOMPOSITE DRAINAGE NET AND VEGETATIVE SUPPORT LAYER MATERIALS" for required minimum protective cover to allow use of equipment.
14. Not allowing the geomembrane surface to be used as a work area for preparing patches, storing tools and supplies, etc.
15. Ensuring that sharp objects are not left on the surface of the geomembrane.

### 3.7 FIELD QUALITY CONTROL TRIAL SEAMS

Trial seams shall be performed in the presence of the CQA Monitor. Trial seams shall be made on scrap pieces of geomembrane under the same conditions that production seaming will be performed to verify that seaming conditions are satisfactory. Trial seams shall be made, at a minimum, at the beginning, middle, and end of each work day, and at least once every four hours or as directed by the CQA Monitor for each seaming apparatus used that day. Also, each seamer shall make at least one trial seam each day. (Note extra requirements for seaming in cold weather)

The trial seam sample shall be at least three (3) feet long by one (1) foot wide (after seaming) with the seam centered lengthwise. Four adjoining specimens, each one (1) inch (25 mm) wide, shall be cut from the trial seam sample by the Geosynthetic Installer at locations selected randomly by the CQA Monitor. Two of the specimens shall be tested in peel and two tested in shear; none should fail in the seam. If a specimen fails in the seam, the entire trial seam procedure shall be repeated. If an additional specimen fails, the seaming apparatus or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two (2) consecutive successful full trial seams are achieved.

### 3.8 FIELD NONDESTRUCTIVE SEAM TESTING

To check for seam continuity, the Geosynthetic Installer shall nondestructively test 100 percent of field seams over their entire length using a vacuum test unit, air pressure test, or other approved method. Air pressure testing is only applicable to those processes which produce a double seam with an enclosed space, and shall follow GRI GM6, Pressurized Air Channel Test for Dual Seamed Geomembranes.

Continuity testing shall be performed as the seaming work progresses, not at the completion of all field seaming.

A. Vacuum Testing Equipment

Test equipment, including but not limited to the following shall be furnished by the Geosynthetic Installer:

1. The vacuum box (1 to 3 feet long by 1 foot wide) shall have a transparent viewing window on top and a soft, closed cell neoprene gasket attached to the bottom. The housing shall be rigid and equipped with a bleed valve and vacuum gauge. A separate vacuum source shall be connected to the vacuum box. The equipment shall be capable of inducing and holding a vacuum of 5 psig (10 in of Hg vacuum). The viewing window shall be replaced if it becomes excessively scratched.
2. A steel vacuum tank and pump assembly equipped with a pressure controller and pipe connections; mounted on a cushion to protect the geomembrane.
3. A rubber pressure/vacuum hose with fittings and connections.
4. A bucket and wide paint brush.
5. A soapy solution.

B. Vacuum Test Procedure

1. Energize the vacuum pump and adjust the tank vacuum to approximately 5 psig (10 in. of Hg vacuum) (35 kPa absolute).
2. Apply soapy solution to wet a strip of geomembrane approximately 12 inches by 48 inches (0.3 m by 1.2 m).
3. Place the box over the wetted area.
4. Close the bleed valve and open the vacuum valve.
5. Ensure that a leak tight seal is created by the gasket.
6. For a period of not less than 10 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.

7. If no bubbles appear after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inches (75 mm) overlap, and repeat the process.
8. All areas where soap bubbles appear indicate leaks or poor seam continuity and shall be marked, repaired and retested.

C. Air Pressure Test Equipment (GRI GM-6)

1. An air pump (manual or motor driven) equipped with pressure gauge capable of generating and sustaining a pressure between 25 and 30 psi (160 and 200 kPa) and mounted on a cushion to protect the geomembrane.
2. A rubber hose with fittings and connections.
3. A sharp hollow needle, or other approved pressure feed device.

D. Air Pressure Test Procedure

1. Seal both ends of the seam to be tested (to a maximum length of 300 feet).
2. Insert needle or other approved pressure feed device into the channel created by the dual track fusion weld.
3. Energize the air pump to a pressure between 25 and 30 psi (160 and 200 kPa), close valve, and sustain pressure for a minimum of 5 minutes.
4. If pressure drop exceeds 2 psi (15 kPa), or does not stabilize, locate the faulty area, repair and retest.
5. Remove needle or other approved pressure feed device and seal ends and needle puncture with extrudate.

### 3.9 FIELD DESTRUCTIVE SEAM TESTING

A. Test Location

To establish that there is adequate seam strength, destructive seam tests shall be performed at selected locations. Test locations shall be determined after seaming, at the CQA Monitor's discretion, and may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential cause of inadequate welding. The Geosynthetic Installer shall not be informed in advance of the locations where the seam samples will be taken.



**B. Test Frequency**

As a minimum, one test location shall be selected per 500 feet of seam length produced by each welding machine. (This minimum frequency is to be determined as an average taken throughout the entire facility.) Seam strength testing shall be performed as the seaming work progresses, not at the completion of the seaming.

**C. Test Procedure**

A sample is taken by the Geosynthetic Installer from the seam and cut into three individual samples. Individual samples go to the Installer CQC Organization, the CQA Monitor and Owner. The Installer CQC Organization and CQA Monitor each cut their respective samples into 5 shear and 5 peel (alternating adjacent) test specimens and conduct the tests immediately in accordance with ASTM D 4437. The remaining sample is archived by Owner. Owner will be responsible for storing the archive samples in the storage building provided by the Contractor.

All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired in accordance with specified repair procedures. The continuity of the new seams in the repaired area shall be tested and repaired if necessary.

**D. Geosynthetic Laboratory Testing**

If destructive seam testing is to be performed off-site, packaging and shipping of destructive test samples shall be conducted in a manner which will not damage the test sample. The CQA Monitor shall verify that packaging and shipping conditions are acceptable. This procedure shall be fully outlined prior to construction.

Testing shall include "Shear Testing" and "Peel Testing" (ASTM Designation D 6392). The minimum acceptable values to be obtained in these tests are those indicated in Table 3-02920, Geomembrane Seam Properties. At least 5 specimens shall be tested for each test method. Specimens shall be selected alternately by test from the samples (i.e., peel, shear, peel, shear,...). At least 4 of the 5 specimens tested shall meet or exceed the requirements indicated in Table 3-02920. The failed specimen must not be so significantly different in failure load (>75% of average failure load of the other four specimens) so as to be "suspect" of other problems.

The Geosynthetic Installer's laboratory test results shall be presented in writing to the CQA Officer, Engineer and the County as required by ASTM D 6392.

#### E. Procedures for Destructive Test Failures

All failed seams must be bounded by two locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 150 feet (50 m) of reconstructed seam, a sample taken from the zone in which the seam has been reconstructed must pass destructive testing.

The Contractor is responsible for providing quality seams. For all QA retests due to destructive failures exceeding 10% of all tests, the Contractor shall be charged to QA time and lab costs.

The following procedures shall apply whenever a sample fails a destructive test, whether that test is conducted by the CQA Monitor, the Geosynthetic Installer, the Contractor's independent CQC laboratory, or by field tensiometer. The Geosynthetic Installer has two options:

- a. The Geosynthetic Installer can reconstruct the seam between any two passing test locations;
- b. The Geosynthetic Installer can trace the welding path to an intermediate location (at 3 m (10 feet) minimum from the point of the failed test in each direction) and take a single specimen for an additional field test at each location. If these additional specimens pass the test, then full samples are taken. If these samples pass the tests, then the seam is reconstructed between these locations. If either sample fails, then the process is repeated, in that direction, to establish the zone in which the seam should be reconstructed.

The Installer shall notify the CQA Monitor before beginning either option. The CQA Representative shall be present during this entire process to document all actions taken in conjunction with destructive test failures.

### 3.10 DEFECTS AND REPAIRS

#### A. Identification

The entire geomembrane, including seams, shall be visually examined by the CQA Representative for identification of visual defects, holes, blisters, undispersed raw materials and signs of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of examination. The geomembrane surface shall be swept or washed by the Geosynthetic Installer if dust, mud or other matter inhibits examination. All areas having defects and/or requiring repairs shall be repaired at no additional cost to the County.

Work shall not proceed with any materials which will cover locations which have been repaired until the CQA Monitor has re-examined the repaired area and applicable laboratory test results with passing values are available. Panels or portions or panels which, in the opinion of the CQA Representative, are damaged beyond repair shall be removed from the site and replaced.

**B. Repair Procedures**

Any portion of the geomembrane exhibiting a flaw or failing a destructive or nondestructive test, shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be agreed upon between the QA Officer, Geosynthetic Installer, and Engineer. The procedures available include:

1. Patching -- used to repair large holes, tears, areas of undispersed raw materials, and contamination by foreign matter.
2. Grinding and Rewelding — used to repair small defective sections of extruded seams less than one foot in length.
3. Spot Welding -- used to repair small tears, pinholes, or other minor, localized flaws.
4. Capping -- used to repair large lengths of failed seams; (maximum allowable cap width is three feet).
5. Removing a bad seam and replacing with a strip of new material welded into place -- used with large lengths of fusion seams.
6. Other methods approved by the Engineer.

In addition, the following provisions shall be satisfied:

1. Surfaces of the geomembrane which are to be repaired by extrusion welding shall be abraded no more than one hour prior to the repair.
2. All surfaces must be clean and dry at the time of the repair.
3. All seaming equipment used in repairing procedures must be approved. The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the CQA Monitor.
4. Patches or caps shall extend at least six (6) inches (150 mm) beyond the edge of the defect, and all corners of the patches shall be rounded with a radius of at least three (3) inches (75 mm).

5. The geomembrane below large caps should be appropriately cut or removed to avoid water or gas collection between the two sheets.

C. Verification of Repairs

Each repair shall be nondestructively tested. Repairs which pass the non-destructive test shall be taken as an indication of an adequate repair. At the discretion of the QA Officer, large repairs may require destructive test sampling. In the case of failed tests, the repair shall be redone and retested until a passing test result is obtained. The CQA Monitor shall observe all non-destructive testing of repairs and shall record the identification of each repair, date, technician, and test outcome.

D. Wrinkles

When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlying materials, the CQA Monitor shall indicate which wrinkles shall be cut and re-seamed by the Geosynthetic Installer. The seam thus produced shall be tested like any other seam. Wrinkle size shall be evaluated during the time of day and under conditions similar to those expected when overlying protective cover/drainage layer material is to be placed. All wrinkles higher than they are wide (across their base) shall be removed by repair methods.

E. Bridging

The geomembrane shall be continuously supported on the accepted subgrade. Bridging (unsupported geomembrane) is not permissible. Geosynthetic Installer shall take necessary steps to prevent bridging and repair or replace any geomembrane so affected.

### 3.11 PLACEMENT OF GEOCOMPOSITE DRAINAGE NET AND VEGETATIVE COVER LAYER MATERIALS

- A. Placement of the geocomposite drainage net and overlying vegetative cover layer soils on the geomembrane shall not proceed at an ambient temperature below 40°F (5°C) nor above 95°F (35°C) unless otherwise approved by the CQA Representative.
- B. The geomembrane shall not be left exposed (uncovered) to the elements including UV light, for any period more than thirty (30) days.
- C. All soils installed in direct contact with the geomembrane shall have a maximum particle size of 3/8 inches.

- D. All protective cover/drainage layer materials placed over geomembrane (and other geosynthetics) shall be installed without damaging the geosynthetics. Equipment used for placing soil shall not be driven directly on the geomembrane. A minimum thickness of one (1) foot of soil is required between a light dozer (such as a low ground pressure Caterpillar D-3 or lighter) and the geomembrane. Placement of material overlying the geosynthetics shall be in conformance with the following guidelines for equipment ground pressure:

<u>EQUIPMENT GROUND PRESSURE</u>		<u>MINIMUM SOIL THICKNESS</u>	
<u>kPa</u>	<u>(psi)</u>	<u>meters</u>	<u>(inches.)</u>
<30	(<4)	0.30	(12)
30-45	(4-6)	0.38	(15)
45-60	(6-8)	0.45	(18)
60-85	(8-11)	0.60	(24)

- E. In heavily trafficked areas such as access ramps, vegetative cover thickness shall be at least three (3) feet.

### 3.12 DOCUMENTATION OF CONSTRUCTION

Upon project completion, the CQA Officer shall prepare a Construction Certification/Documentation Report. This report will document that the work was accomplished according to the Construction Contract Documents, and summarize quality control and quality assurance tests and inspection. If appropriate, supplementary information such as modifications approved by the Engineer shall be included to justify deviations from the original contract documents. Justification for all such deviations must be fully documented in the Report. At a minimum, the report shall contain the following information:

1. Identification of parties and their roles and responsibilities with signatures of key personnel and an officer of their employer's company.
2. Scope of work.
3. Summary of the project construction activities.
4. Construction Quality Assurance methodology.
5. Test and inspection results.
  - a. Results of prequalification testing (including extrudate);
  - b. The results of all non-destructive seam tests.

- c. Subgrade acceptance forms.
- 6. Construction Quality Assurance certification statement, sealed and signed by a licensed professional Engineer.
- 7. Geomembrane record drawings, see Section 01050 Surveying.
- 8. CQA and CQC records regarding panel deployment, seaming, and repairs.

The Geosynthetic Installer shall provide necessary signatures, test results, record drawings, and inspection results as described by aforementioned Part 3.12.A.1 to A.8

### 3.14 TABLES

**TABLE 1-02920.  
RESIN PROPERTIES (WITHOUT CARBON BLACK)**

Property	Qualifier	Unit	Test Method	Specified Value
Polymer Specific Gravity	minimum	g/cc	ASTM D 792 Method A or ASTM D 1505	$\geq 0.94$
Flow Rates of Thermoplastics	maximum	g/10 min	ASTM D 1238 (Condition E)	$< 1.0$

**TABLE 2-02920.  
GEOMEMBRANE PROPERTIES**

Property	Qualifier	Unit	Test Method	Specified Values
Thickness	average	mils	ASTM D	57
Surface				TEXTURED
Density	minimum	g/cc	ASTM D	0.940
Tensile Properties (each direction):				
1. Tensile Strength at Yield	minimum	lb/in/width	ASTM D 6693	132
2. Tensile Strength at Break	minimum	lb/in/width		115
3. Elongation at Yield	minimum	percent		12
4. Elongation at Break	minimum	percent		100
Tear Resistance	minimum	lbs	ASTM D 1004 (die c)	45
Asperity Height, mil	minimum	mils	ASTM D7466	18
Dimensional Stability (each direction)	maximum change	percent	ASTM D 1204	2.0 – 3.0
Notched Constant Tensile Load OR Single Point Notched Constant Tensile Load	minimum	hours	ASTM D 5397	1000
	minimum	hours	GRI GM	200
Puncture Resistance	minimum	lbs	ASTM D 4833	130
Carbon Black Content	Range	percent	ASTM D 1603	2.0
Carbon Black Dispersion	Rating	N/A	ASTM D 5596	1, 2, and 3 GRI GM-13
Interface Friction Angle w/ Subgrade	minimum	degrees	ASTM D 5321(1)	22

NOTES: (1) Soil at approximately optimum moisture and 90% of maximum compaction (ASTM D1557). Normal stresses 100 psf, 200 psf, and 500 psf.

**TABLE 3-02920.  
GEOMEMBRANE SEAM PROPERTIES**

Property	Qualifier	Unit	Test Method	Specified Values
Thickness	average	mils	ASTM D 5994	57
Surface Type				TEXTURED
Shear Seam Strength:				
Fusion	minimum	lb/in	ASTM D 6392 (1)	120
Extrusion	minimum	lb/in	ASTM D 6392 (1)	120
Peel Seam Strength:				
Fusion	minimum	lb/in	ASTM D 4437 (1)	78
Extrusion	minimum	lb/in	ASTM D 4437 (1)	80

NOTES: (1) The geomembrane shall yield before failure of the seam for shear tests. Seam separation shall not extend more than ten (10) percent into the seam for peel adhesion tests. Testing shall be discontinued when the sample has visually yielded. At least 4 of 5 specimens tested in shear and in peel shall exhibit a film tear bond (FTB) failure not in the seam area.

END OF SECTION



**SECTION 02930****GEOCOMPOSITE DRAINAGE LAYER****PART 1 - GENERAL****1.1 SUMMARY**

The work covered in this Section includes the manufacture, fabrication, testing, supply and installation of the Geocomposite Drainage Layer in specific areas of the final cover. The Contractor shall furnish all labor, materials, transportation, handling, storage, supervision, tools, incidentals and other equipment that may be necessary install and test the Geocomposite Drain as specified by the Contract Documents. All testing specified in this section is quality control (QC) testing and is the Contractor's responsibility.

**1.2 REFERENCES**

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)  
STANDARD TEST METHODS/PRACTICE

ASTM D 7005	Ply Adhesion to Flexible Substrate
ASTM D 1238	Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D 1505	Density of Plastics by the Density-Gradient Technique
ASTM D 1603	Carbon Black in Olefin Plastics
ASTM D 4491	Water Permeability of Geotextiles by Permittivity
ASTM D 4533	Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	Grab Breaking Load and Elongation of Geotextiles
ASTM D 4716	Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products

ASTM D 4751	Determining the Apparent Opening Size of a Geotextile
ASTM D 4833	Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 5199	Measuring Nominal Thickness of Geotextiles and Geomembranes
ASTM D 5261	Measuring Mass per Unit Area of Geotextiles
ASTM D 5321	Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

### 1.3 SUBMITTALS

#### A. Product Information

The Contractor or Geocomposite Drainage Net Installer shall submit the following product information to the Engineer for approval at least 30 days (unless otherwise specified) prior to procurement of the product:

1. Prequalification: Independent laboratory test results demonstrating compliance with the material properties listed in Table 1-02930, HDPE Drainage Net; Table 2-02930, Geotextile Properties; and Table 3-02930, Geocomposite Properties. The independent laboratory tests are to be performed once for each material. In addition, the manufacturer must provide a certificate of compliance which states that the material to be installed will use the same manufacturing techniques, resin type, and formulation as that for which test results are submitted.
2. Roll Layout Drawings: As a minimum, include a roll layout drawing and installation details. The roll layout drawing shall be drawn to scale, and shall be coordinated with the geomembrane panel layout. Installation details shall include cross sections of toe drains, temporary anchorage, key trench and other terminations, and pipe penetrations.
3. Protection from Wind and Weather: Submit plans to protect the Geocomposite Drain from wind, dirt, and direct sunlight.
4. Material Data: Complete manufacturer's specifications, descriptive drawings, and literature for the geocomposite, including the product identification and suppliers of the polymer resin and recommended

methods for handling and storage of all materials prior to installation. Describe the manufacturer's methodology to comply with the requirements specified for manufacturing quality control.

5. Manufacturing Quality Control (MQC): Complete description of the manufacturer's formal quality control/quality assurance programs for manufacturing, fabricating, handling, installing, and testing. The description shall include, but not be limited to, polymer resin supplier and product identification, acceptance testing, production testing, installation inspection, installation techniques, repairs, and acceptance. The document shall include a complete description of methods for both roll end and roll side joining.
6. Installation Instructions: Samples of the Geocomposite Drain with a complete set of specifications, and manufacturer's complete written instructions for storage, handling, installation, and joining.
7. Qualifications: Manufacturer's qualifications for the Geocomposite Drainage Net, geotextile, and geocomposite.
8. Resin: The name of the resin supplier, the production plant, the brand name, and name of resin used to manufacture the product.
9. Factory Visit: Upon request, arrange with the geocomposite manufacturer to allow Owner or representative to visit to the manufacturing plant during the manufacture of material for this project, for the purpose of observing the manufacturing process and quality control procedures. Submit contact names, telephone numbers, addresses, and production schedule information.
10. Suppliers and/or manufacturers shall certify that geonet and geotextile are compatible with one another when bonded into the Geocomposite Drainage Net.

B. Manufacturing Quality Control

The Contractor shall submit quality control test reports within 48 hours of completion of tests. Submit the following manufacturing quality control information to the Engineer prior to material shipment:

1. Production Dates: Submit statement of production dates for the Geocomposite Drain.
2. Test Reports: See Part 2 for tests and test frequencies.

C. Proof of Installer's Qualifications:

1. The name or names of the field superintendents who will be proposed for the project and a list of completed facilities for which the field superintendent has installed geocomposite drainage net totaling a minimum of 2,000,000 ft<sup>2</sup>.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURER'S QUALIFICATIONS**

Manufacturer shall have manufactured a minimum of 5,000,000 ft<sup>2</sup> of Geocomposite Drain.

A. Single Source

All HDPE drainage net used for construction of the Geocomposite Drainage Net must be obtained from a single material supplier or manufacturer. All non-woven geotextile fused to the geonet and used for the construction must be obtained from a single material supplier. All fusion of HDPE drainage net to non-woven geotextile must be accomplished by a single material supplier or manufacturer. Suppliers and/or manufacturers shall certify that the geonet and geotextile will be compatible with one another.

### **2.2 HDPE DRAINAGE NET**

The HDPE drainage net component of the Geocomposite Drainage Net shall be manufactured by extruding strands of material into a counter-rotating die to form a three dimensional structure to provide planar water flow.

A. Material Properties

HDPE drainage net shall meet the requirements of Table 1-02930, HDPE Drainage Net Properties.

B. Material Composition

The HDPE drainage net shall consist of new, first-quality products designed and manufactured specifically for the intended purpose designated in this contract, as satisfactorily demonstrated by prior use. The drainage net shall contain stabilizers to prevent ultraviolet light degradation. The HDPE shall be unmodified HDPE containing no plasticizer, fillers, chemical additives, reclaimed polymers, or extenders. Carbon black shall be added to the resin for ultraviolet resistance. The

only other allowable compound elements shall be anti-oxidants and heat stabilizers, of which up to one (1) percent total, as required for manufacturing, may be added.

### 2.3 GEOTEXTILE

The geotextile component of the Geocomposite Drainage Net shall meet the requirements of Table 2-02930, Geotextile Properties.

### 2.4 GEOCOMPOSITE DRAINAGE NET

The material shall meet the requirements of Table 3-02930, Geocomposite Drainage Net Properties. It is comprised of three layers: a lower geotextile, a middle HDPE drainage net, and an upper geotextile. The lower and upper geotextiles shall be heat bonded to the middle HDPE drainage net.

#### A. Manufacture

The Geocomposite Drainage Net shall be fabricated by heat bonding the geotextile to both sides of the HDPE drainage net. No burn through of geotextiles will be permitted. No glue or adhesive shall be permitted. The bond between the geotextile and the HDPE drainage net shall meet the requirements of Table 3-02930, Geocomposite Drainage Net Properties.

#### B. Labels

Geocomposite Drainage Net shall be supplied in rolls, marked or tagged with the following information:

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

#### C. Roll Dimensions

The HDPE drainage net shall be supplied as a continuous sheet with no factory seams. During installation, the roll length shall be maximized to provide the largest manageable roll for the fewest field seams. Rolls shall be wound on a core which shall be stable enough to support the rolls during handling and shipping.

## D. Coefficient of Interface Friction

HDPE drainage net - geotextile shall have a soil and geosynthetic interface friction angle with the Vegetative Support Layer meeting the requirements of Table 3-02930.

## 2.5 MANUFACTURING QUALITY CONTROL TESTING

All of the specified tests are the Contractor's responsibility. Testing during manufacturing shall be accomplished by the manufacturer's laboratory.

- A. HDPE resin shall be tested at a frequency of one test per resin batch for compliance with Table 1-02930, HDPE Drainage Net Properties. One batch is defined as one rail car load of resin. The finished rolls of the drainage net shall be identified by a roll number corresponding to the resin batch used. The following minimum test frequencies shall be observed:

<u>Property</u>	<u>Test Method</u>	<u>Minimum Frequency</u>
Polymer Density	ASTM D 1505	1 per batch
Polymer Melt Index	ASTM D 1238	1 per batch

- B. HDPE drainage net shall be tested during manufacturing for compliance with Table 1-02930 HDPE Drainage Net Properties. The following minimum test frequencies shall be observed:

<u>Property</u>	<u>Test Method</u>	<u>Minimum Frequency</u>
Polymer Density	ASTM D 1505	1/40,000 sf
(with Carbon Black)		
Mass per Unit Area	ASTM D 5261	1/40,000 sf
Thickness	ASTM D 5199	1/40,000 sf

- C. Geotextile shall be tested during manufacturing for the compliance with Table 2-02930 Geotextile Properties. The following minimum test frequencies shall be observed:

<u>Property</u>	<u>Test Method</u>	<u>Minimum Frequency</u>
Mass (Wt.) per Unit Area	ASTM D 5261	1/100,000 sf
Grab Strength	ASTM D 4632	1/100,000 sf
Trapezoidal Tear	ASTM D 4533	1/100,000 sf
Strength		
Burst Strength	ASTM D 3786	1/100,000 sf

Puncture Resistance	ASTM D 4833	1/100,000 sf
Thickness	ASTM D 5199	1/100,000 sf

- D. Geocomposite Drainage Net shall be tested during manufacturing for compliance with Table 3-02930, Geocomposite Properties. The following minimum test frequencies shall be observed:

<u>Property</u>	<u>Test Method</u>	<u>Minimum Frequency</u>
Ply Adhesion (minimum)	ASTM F 7005	1/40,000 sf

The Contractor shall inspect every roll for bonding integrity between the HDPE drainage net and the geotextile. All poorly bonded and/or delaminated material shall be rejected.

### **PART 3 - INSTALLATION**

#### **3.1 FIELD QUALITY CONTROL**

Field Joining: The Contractor shall inspect all roll end joints and roll edges. The results of these inspections shall be documented in the daily reports. Field joints shall comply with the requirements of Table 4-02930, Geocomposite Drainage Net Joining Methods.

##### **A. Quality Control Reporting Procedures**

All information regarding the installation of the Geocomposite Drainage Net shall be recorded in the Contractor's daily report. This information shall include:

1. Reference to product submittals, certifications, substitutions and approvals;
2. Dates of installation;
3. Location and quantity of materials installed;
4. Statement whether materials were installed in accordance with the Technical Specifications; and
5. Additional information as required.
6. All product certifications, filed appropriately for future reference.

### 3.2 MANUFACTURER'S RECOMMENDATIONS

Geocomposite Drain shall be installed in accordance with the contract documents and the manufacturer's recommendations. In case of a conflict between requirements, the more stringent shall apply.

### 3.3 CLEANLINESS

Both Geocomposite Drainage Net and the underlying Geomembrane shall be clean, dry, and free of dirt and dust during installation. If dirt, dust, or water is present, the Contractor shall clean the work area. Geocomposite Drainage Net which is wet, dirty or muddy shall be discarded and shall not be installed.

### 3.4 ROLL JOINING METHODS

Table 4-02930, Geocomposite Drainage Net Joining Methods, summarizes acceptable roll joining methods.

#### A. Lap Seams

The bottom layer of geotextile shall be lap seamed. Lap seaming is accomplished by overlapping adjacent geotextile a minimum of 6 inches.

#### B. Nylon Ties

The GDN material shall be overlapped and fastened with nylon ties. Nylon ties shall be yellow or white in color to facilitate inspection.

#### C. Machine Sewn Seams

Sewing shall be accomplished with a chain-stitching sewing machine. The thread shall be polymeric thread which complies with geotextile manufacturer's recommendations and is a color which contrasts with the color of the geotextile. The seam shall be placed a minimum of 4 inches from the geotextile edges. The finished seam shall be folded to one side ("J" seam) and be secured with a double row of stitches. There shall be no horizontal seams except at roll ends on slopes greater than 5 (horizontal) to 1 (vertical).

### 3.5 ROLL JOINING REQUIREMENTS

The minimum requirements for joining rolls are specified in Table 4-02930, Geocomposite Drain Joining Methods.



A. Roll Ends

At roll ends the material shall be overlapped a minimum of 1 foot. Roll ends shall be shingled; the uphill roll end shall be overlapped one foot over the downhill roll end. At roll ends, the drainage net shall be tied every 2 feet (on centers) at a minimum. The bottom layer of geotextile shall be overlapped a minimum of six (6) inches. The upper layer of geotextile shall be machine sewn.

B. Adjacent Roll Sides

At roll sides the material shall be overlapped a minimum of 4 inches. The bottom geotextile shall be lap seamed. The HDPE drainage net shall be overlapped and tied a minimum of 5 feet on center. The upper layer of geotextile shall be machine sewn.

### 3.6 INSTALLATION

The Geocomposite Drainage Net shall be installed in accordance with the manufacturer's recommendations and as specified herein. In case of a conflict between requirements, the more stringent shall apply.

A. Orientation

Geocomposite Drainage Net shall be rolled down the slope in such a manner as to continually keep the material in tension. If necessary, the material shall be positioned by hand after unrolling to minimize wrinkles. The material shall not be unrolled horizontally (i.e., across the slope).

B. Wind

The Contractor shall provide sufficient ballast and temporary anchorage to protect the material from wind damage or displacement. The Contractor is responsible for protecting the material from damage due to weather at all times.

C. Physical Damage

- a. Personnel walking on the material shall not engage in activities or wear footwear that could damage the material. Smoking shall not be permitted on or near the geosynthetics.
- b. Vehicular traffic shall not be permitted on the geosynthetics. Equipment shall not damage the material by handling, trafficking, or leakage of hydrocarbons. The surface shall not be used as a work area for preparing patches, storing tools and supplies, or other uses.

D. Bridging

The material shall be installed to avoid bridging.

E. Corners

In corners, where overlaps between rolls are staggered, an extra roll shall be installed from the top to the bottom of the slope to provide a smooth, protected surface.

F. Weather Protection

Geocomposite Drainage Net shall be protected from direct sunlight or precipitation prior to installation. After installation this material shall have minimal exposure to direct sunlight and shall be completely protected from direct sunlight within 30 days of installation. Material which is exposed to direct sunlight for 30 days or more shall be replaced at the Contractor's expense.

It is the Contractor's responsibility to provide all labor and materials for protection of the Geocomposite Drain during the period of time prior to installation of overlying materials. The Contractor's protection method is subject to the approval of the CQA Officer.

### 3.7 REPAIRS

A. Limitations

Damaged, soiled, or delaminated Geocomposite Drainage Net shall be removed and discarded.

B. Minor Damage

Minor damage is defined as a defect or hole in the material that is smaller than 2 inches in its lesser dimension. Minor damage may be repaired by snipping out any protruding drainage net and machine sewing a geotextile patch over the hole. The patch shall be a minimum of 12 inches larger than the damaged area in all directions.

C. Major Damage

Major damage is defined as a defect or hole in the material that is 2 inches or larger in its lesser dimension. Major damage shall be repaired by replacing the entire Geocomposite Drain panel width.

**TABLE 1-02930.  
HDPE DRAINAGE NET PROPERTIES**

Property	Qualifier	Unit	Test Method	Specified Value
Polymer Density, Resin	Minimum	g/cm <sup>3</sup>	ASTM D 1505	0.930
Polymer Density, Resin plus Carbon Black	Minimum	g/cm <sup>3</sup>	ASTM D 1505	0.940
Polymer Melt Index	Maximum	g/10 min.	ASTM D 1238	1.0
Carbon Black	Range	Percent	ASTM D 1603	2-3
Nominal Thickness	Range	Inches	ASTM D 5199	0.20 - 0.265
Mass per Unit Area	Range	lbs/1000 ft <sup>2</sup>	ASTM D 5261	180 ± 18
Tensile Strength (machine direction)	Range	lbs/in	ASTM D 4632	45

**TABLE 2-02930.  
GEOTEXTILE PROPERTIES**

Property	Qualifier	Unit	Test Method	Specified Value
Fabric Weight	Minimum	oz/yd <sup>2</sup>	ASTM D 5261	8.0
Grab Strength	Minimum	Lbs	ASTM D 4632	220
Grab Elongation (at break)	Minimum	Percent	ASTM D 4632	60
Trapezoid Tear Strength	Minimum	Lbs	ASTM D 4533	80
Puncture Resistance	Minimum	Lbs	ASTM D 4833	120
Permittivity	Minimum	1/sec	ASTM D 4491	1.3
AOS	Maximum	Sieve size	ASTM D 4751	80

**TABLE 3-02930.  
GEOCOMPOSITE DRAINAGE NET PROPERTIES**

Property	Qualifier	Unit	Test Method	Specified Value
Ply Adhesion	Minimum	lbs/inch	ASTM F 7005	1
Transmissivity	Minimum	m <sup>2</sup> /sec	ASTM D 4716*	1.0 x 10 <sup>-4</sup>
Coefficient of Interface Friction w/Vegetative Support Layer	Minimum	degrees	ASTM D 5321	22*

\*Soil at approximately optimum moisture and 90% of maximum compaction (ASTM D 1557). Normal stresses 100 psf, 200 psf, and 500 psf.

**TABLE 4-02930.  
GEOCOMPOSITE DRAINAGE NET JOINING METHODS**

Location	Layer	Joining Method	Min. Overlap	Tying Frequency
Roll End	Upper geotextile	Machine sewing	4"	N/A
	Geonet	Nylon ties	12"	2' on center
	Lower geotextile	Overlap	6"	N/A
Roll Side	Upper geotextile	Machine sewing	4"	N/A
	Geonet	Nylon ties	4"	5' on center
	Lower geotextile	Overlap	6"	N/A
Repair of minor damage*	Upper geotextile	Machine sewing	4"	N/A
	Geonet	N/A	N/A	N/A

\*Minor damage is defined in paragraph 3.7.2.

END OF SECTION

**SECTION 15012**

**HIGH-DENSITY POLYETHYLENE (HDPE) PIPING**

**PART 1. GENERAL**

**1.1 DESCRIPTION**

**A. Work Included:**

1. The work described in this section consists of furnishing all labor, materials, equipment, and incidentals necessary to install and test high density polyethylene (HDPE) piping and pipe fittings for LFG headers and laterals, air and condensate lines, complete in place and ready for operation as shown on the Contract Drawings and as specified herein.

**B. Related Work Described Elsewhere:**

1. Section 02210 - Clearing and Grubbing.
2. Section 02221 – Excavation and Grading.

**1.2 SUBMITTALS**

**A. Submittals shall be made in accordance with Section 01300 - Submittals. In addition, the following specific information shall be provided:**

1. A statement, in writing, from the pipe manufacturer, stating that he is listed with the Plastic Pipe Institute as a qualified extruder for polyethylene resin being used to manufacture the pipe for this project.
2. Catalog information confirming the pipes and fittings conform to the requirements of the specifications.
3. Certification and Test Reports. The Contractor shall submit to the Engineer a manufacturer's certification and test reports as follows: That the HDPE pipe was manufactured from resins in compliance with these Specifications. The certificate shall state the specific resin, its source, and the specific information required by ASTM 1248. The pipe shall not contain recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the raw material. The pipe shall be homogenous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects and shall be identical in color, density, melt index, and other physical properties.

4. The HDPE pipe manufacturer shall provide certification that stress regression testing has been performed on the specific product. This stress regression testing shall have been done in accordance with ASTM D-2837, and the manufacturer shall provide a product supplying a minimum hydrostatic design basis (HDB) of 1,600 psi, as determined in accordance with ASTM D-2837. The manufacturer must warrant the pipe to be free from defects in material and workmanship in accordance with ASTM D-3350 and F-714.

### 1.3 DAMAGE CONTROL

- A. Transportation. Care shall be taken during transportation of the pipe that it is not cut, kinked, or otherwise damaged.
- B. Handling Pipe Lengths:
  1. Ropes, fabric, or rubber-protected slings and straps shall be used when handling pipes.
  2. Chains, cables, or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe. Pipe or fittings shall not be dropped onto rocky or unprepared ground.
- C. Storage. Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects which could damage the pipe:
  1. Stacking of the pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions.
  2. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

### 1.4 EXCAVATION AND BACKFILL

- A. All excavation (if required) in the preparation of pipe bedding shall be performed in accordance with the requirements of Section 02220 - Excavation, Backfilling, and Compaction.
- B. During trenching and backfilling, the Contractor shall comply with the safety requirements of Section 01030 – Special Provisions.

## **PART 2. PRODUCTS**

### **2.1 PIPING MATERIALS**

- A. The polyethylene pipe shall be high performance, HDPE pipe, conforming to ASTM D-1248 (Type III, Class C). Minimum cell classification values shall be PE345434C, as referenced in ASTM D-3350. The SDR for each type of pipe shall be as shown on the Contract Drawings. The pipe shall contain a minimum of 2 percent carbon black.
- B. Fittings:
  - 1. Fittings shall be butt fusion type, meeting the requirements of ASTM D-3261. All fittings shall be rated to match the system piping to which they are fused. At the point of fusion, the outside diameter and minimum wall thickness shall meet the outside diameter and minimum wall thickness specifications of ASTM F-714 for the same size of pipe. Pipe connections between dissimilar materials shall be joined by stub end and backing flange.
  - 2. Flanges, when required, shall be of plate type ANSI B16.5-B1, Class 125 lb. The bolts for the flanges shall be galvanized carbon steel. For above- and below-ground installation, bolts shall conform to the requirements of ASTM A307. Bolts shall be carbon steel, Grade B, heavy hex, hot dip-coated in accordance with the requirements of Class C of ASTM A153. Nuts shall conform to the requirements of ASTM A563. Nuts shall be Grade A, heavy hex, hot dip zinc-coated in accordance with Class C of ASTM A153. Washers shall be Grade A, hot dip zinc-coated in accordance with Class C of ASTM A153. All flanges shall have gaskets. Gaskets are to be HYPALON or approved equal material for the service.
- C. The piping and pipe fittings shall be comprised of new, first quality HDPE material.
- D. The Contractor shall submit a certification from the manufacturer of the piping and pipe fittings, stating that the piping meets physical property requirements for the intended application.
- E. Each standard and random length of pipe in compliance with this specification shall be clearly marked at a minimum: (1) pipe size, (2) SDR number, and (3) class and profile numbers.

## **PART 3. EXECUTION**

### **3.1 PREPARATION**

- A. Contractor shall stake out pipe alignment and a site survey of the area shall be completed and approved by the Engineer before installation can begin. This will allow

the Engineer to determine if any change in the collection system design is needed. On completion of the header and lateral installation, the Contractor shall submit the survey data to the Engineer for preparation of As-Built drawings.

- B. The Manufacturer shall furnish complete written instructions for the storage, handling, installation, fusion, and repair of the piping in compliance with this Specification and the conditions of this warranty.
- C. The interior of all pipe shall be thoroughly cleaned and free of all foreign material before being lowered in the trench and shall be kept clean during laying operations by means of plugs, or other industry-approved methods.

### 3.2 INSTALLATION

#### A. Below-Ground Installation:

1. Trench excavation shall be located as shown on the Contract Drawings, and shall be by open cut from the ground surface. Trenching, backfilling, and compaction shall conform to the requirements of Section 02220 -Excavation, Backfilling, and Compaction.
2. Trenches shall be excavated to maintain depths as shown on the Contract Drawings.
3. The Contractor shall be responsible for maintaining alignment and depth of the pipeline. Contractor shall survey installed pipe to insure compliance with plans prior to backfilling.
4. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench or weather conditions are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. All pipe in place shall be inspected by the Engineer and surveyed before backfilling.
5. Lowering Pipe Into Trench. Care shall be exercised when lowering pipe into the trench to prevent damage to or twisting of the pipe.
6. The construction of the any piping trench, which exposes landfill trash to the atmosphere, shall be staged such that at no time more than one hundred (100) linear feet of trench is exposed at any time prior to backfill. All trenches and excavations shall be completed, backfilled to grade, isolated, and covered when non-work periods exceed 24-hrs (e.g., weekends, holidays, etc.).

- B. Cutting shall be done with approved mechanical cutters in a manner that will not damage the pipe. Pipe shall be firmly and uniformly supported on the bedding material.



Pipe interior shall be kept thoroughly clean as the work progresses. Care shall be taken that pipe is not disturbed until joints are cured. Any adapters for joining shall be in accordance with the pipe manufacturer's printed instructions.

- C. Special Precautions. Pipe connected to heavy fittings, manholes, and rigid structures shall be supported in such a manner that no subsequent relative movement between the pipe and the joint with the rigid structures is possible.
- D. Joining (HDPE Pipe). Sections of the HDPE pipe (40-foot joints) shall be joined into continuous lengths by the butt fusion method above or beside the trench and shall be performed in strict conformance with the pipe manufacturer's recommendations using approved equipment. Butt fusion operation shall only be conducted by the factory trained and certified fusion operator. All valves and transition piping shall be by flange or mechanical joint connections. Joining and installation of pipe shall be accomplished under the direction of an authorized manufacturer's representative.
- E. Handling Pipeline. The handling of the pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects.
- F. All taps in the pipe as shown on the Contract Drawings shall be made and necessary plugs shall be inserted by the Contractor.
- G. Pipe and fittings shall be selected so that there will be as small a deviation as possible at the joints and so that inverts present a smooth surface. Pipe and fittings which do not fit together to form a tight fitting joint will be rejected.
- H. All pipe cuts shall be square, perpendicular to center line of pipe.
- I. Damaged pipe that results in reduction of the wall thickness by more than approximately 10 percent should be cut out and discarded. Damaged pipe shall be repaired according to manufacturer's recommendations.
- J. The Contractor shall protect the pipe and workers from the build-up of static electricity, which can be generated in the pipe by friction from the handling of pipe in storage, shipping, and installation. The Contractor shall minimize the hazard of discharge by applying a film of water to the work surface, to drain away the static electricity. Other recommendations by the pipe manufacturer will be acceptable.

### 3.3 TESTING

- A. The Contractor shall conduct a pneumatic pressure test on installed HDPE header. He shall furnish all necessary equipment and materials, and make all taps in the pipe, as required. The Engineer shall be notified at least 72 hours in advance of testing. The County and/or Engineer shall witness the test.

- B. All installed pipes shall be subjected to air test pressure of 100 psig for a period of 1 hour, except for the LFG headers and lateral pipes. The LFG headers and laterals shall be tested at 10 psig for a period of 1 hour. During this period, no loss of pressure shall be observed.
- C. The piping, except at the joints and flanged connections, shall be backfilled prior to air testing. Upon the approval of the Engineer and after passing the air-testing program, the joints shall be backfilled.
- D. Any section of pipe, which fails to meet the stipulated pressure test, shall be checked by the Contractor and corrective measures taken. The test shall then be repeated, at no additional cost to the County, until test results meet the specified requirements.
- E. No pipe installation will be accepted unless and until it meets the pressure test requirements.
- F. Equipment. The Contractor shall provide the following equipment for the pressure test:
  - 1. Pneumatic compressor separator-dryer system capable of providing oil-free dry air and equipped with one or more full capacity safety relief valves set at a pressure of not more than 105 percent of the required test pressure.
  - 2. Pressure gauges of suitable sizes.
- G. Procedure:
  - 1. Pneumatic testing shall be performed using accurately calibrated instruments and oil-free, dry air. Tests shall be performed on piping after the piping has been completely installed. All parts of the piping system shall be subjected to the test pressure of 10 psi for 1 hour. During this period, no loss of pressure shall be observed. The Contractor shall recognize the hazards associated with air testing and shall take all necessary precautions to protect test personnel. All piping to be tested shall be secured to prevent damage to adjacent piping and equipment in the event of a joint failure. Any appurtenant instruments or devices that could be damaged by the test shall be removed from the piping or suitably isolated prior to applying the test.
  - 2. Test Records: Records shall be made of each piping system installation during the test. These records shall include:
    - a. Date of test.
    - b. Description and identification of piping tested.
    - c. Test pressure.

d. Remarks, to include such items as:

- 1) Leaks (type, location).
- 2) Repairs made on leaks.

e. Certification by Contractor and signed acknowledgment by the Engineer.

### 3.4 CERTIFICATION OF COMPLETION

A. Upon completion of the backfilling operation over the piping system, the Contractor shall certify the following to the Engineer:

1. The piping system has been constructed in accordance with the approved project plans and specifications.
2. The piping system has been field tested and has passed all of the required tests in the approved project plans and specifications.
3. The piping system has not been damaged during the backfilling operation or construction.

END OF SECTION