

Percentage of Contract Work Completed (\$ expended/\$ total bid price)	Percent of Develop Water Considered to be Complete
More than 25%	40%
More than 50%	60%
≥ 75%	80%
Upon demobilization of all Contractor equipment and appurtenances at the source	100%

- b. **Payment** of the lump sum contract price for as stated in **Bid Item No. 4** - "Develop Water" shall constitute full compensation for furnishing all labor, materials, tools, and equipment, and doing all the work involved in Develop Water and shall include all costs associated with the develop water operations, compliance with all applicable SCAQMD regulations, the Site Safety Plan, hauling, offsite grading, and on-site or off-site disposal/recycling.

**END OF SECTION 5**

## 6. DEMOLITION

### 6.1 GENERAL

The work covered by this section shall include salvage, remove, relocate, recycle, and stockpile material encountered during construction as described in the Contract Documents. The work in this section shall include furnishing all labor, supervision, tools, equipment, and materials necessary to complete and insure that all demolition activities conform to the requirements of the Contract Documents.

### 6.2 MATERIALS

- a. In-place materials/structures requiring demolition activity by the Contractor are summarized in Appendix D "C4P3 Approximate Demolition Quantities":
  - i. Asphalt Concrete Structures located in the areas shown on the Project Drawings, including: the bottom portion of the Canyon 4 Floor Drainage Channel, the C4P1 Asphalt Concrete Access Road ("Chad's Highway") and a portion of the Bench C Drainage Channel. This total in-place quantity is approximately 19,329 square feet of asphalt along the bottom portion of the Canyon 4 floor drainage channel, 1,209 feet along Chad's Highway and 285 feet along Bench C for a total weight of approximately 4,970 tons +/-.
  - ii. Reinforced Shotcrete Drainage Structures located in the areas shown on the Project Drawings, including: channels along Bench P, Bench G, and the toe of east slope, side slopes along the Canyon 4 Floor Drainage Channel, v-ditch between Chad's Highway and the Grouted Rip-Rap Channel, box channel adjacent to Chad's Highway, box channel inlet, box channel outlet and 48" culvert outlet. This total in-place quantity is approximately 857 feet along Bench P, 486 feet along Bench G, 428 feet along the toe of slope, 962 feet along the centerline of the canyon 4 drainage channel, 93 cubic feet for the v-ditch, 90 feet for the box channel including inlets and outlet, and 5 feet along the 48" CMP culvert outlet for a total volume of approximately 7,435 cubic feet +/- or 275 cubic yards +/-.
  - iii. Light Class rock and concrete grout that comprise the (4) four grouted rip-rap pads located along the Canyon 4 floor drainage channel, and the (2) two rip-rap pads located along Bench P as shown on the Project Drawings. This total in-place quantity is approximately 503 square feet along the Bench P shotcrete drainage channel, 327 square feet at the Bench P shotcrete drainage channel outlet, 366 square feet at the Bench G shotcrete drainage channel outlet, 140 square feet at the toe of slope drainage channel outlet and 291 square feet at the outlet of the two 24" culverts for a total volume of approximately 1,625 cubic feet +/- or 60 cubic yards +/-.
  - iv. 100-lb rock and concrete grout within the Grouted Rip-Rap Channel located as shown on the Project Drawings. This in-place quantity is approximately 206 feet of 13 foot

wide grouted rock channel and 667 feet of 16 foot wide grouted rock channel for a total volume of approximately 14,750 cubic feet +/- or 545 cubic yards +/-.

- v. Reinforced Concrete Structures located in the areas shown on the Project Drawings, including: Reinforced concrete walls and bottom of the LCRS secondary containment structure located on the Canyon 4 floor, the reinforced masonry block splash wall adjacent to the Grouted Rip-Rap Channel, the (3) three condensate/leachate tank concrete pads adjacent to Chad's Highway and the 48" culvert headwalls as shown on the Project Drawings. This total in-place quantity is approximately 1,963 cubic feet for the secondary containment structure, 1,232 cubic feet for the reinforced masonry block splash walls, 464 cubic feet for the three tank concrete pads, and 36 cubic feet for the 48" culvert headwalls for a total volume of approximately 3,695 cubic feet +/- or 135 cubic yards +/-.
- vi. Concrete bags buried immediately south of the Canyon 4 Drainage Channel.
- vii. Chain-link fence, consisting of chain-link fabric, steel schedule 40 posts and concrete footings, located adjacent to the proposed Bench P Road Subgrade Preparation limits, as shown on the Project Drawings. This total in-place quantity is approximately 694 feet of fence, 70 posts and 70 cubic feet +/- or 2.5 +/- cubic yards of concrete.
- viii. Wooden Truss Support for the existing LCRS pipe located immediately north of the Secondary Containment Structure located on the Canyon 4 floor.
- ix. K-Rails located throughout the C4P3 Project Limits shall be removed and relocated as shown on the Project Drawings.

b. In-place materials/structures that may require demolition activity by the Contractor:

- i. Old Ironwood Road within the Western Stockpile limits. This total in-place quantity is approximately 1,210 tons +/-.

c. Demolition material quantities are approximate. Contractor is responsible for calculating all material quantities for bidding purposes.

### 6.3 EXECUTION

The Contractor shall perform the aforementioned demolition activities as shown on the Project Drawings or as directed in the field by the County:

- a. Remove, recycle and stockpile Asphalt Concrete from Asphalt Concrete Structures.
- b. Remove, recycle and stockpile concrete from Reinforced Shotcrete Drainage Structures.

- c. Remove, recycle and stockpile Light Class rock contained within the four (4) grouted rip-rap pads located along the Canyon 4 floor drainage channel, and (2) the two rip-rap pads located along Bench P as shown on the Project Drawings.
- d. Remove, recycle and stockpile 100-lb rock and concrete grout contained within the Grouted Rock Channel located in the area shown on the Project Drawings.
- e. Remove, recycle and stockpile the concrete materials from the Reinforced Concrete Structures located in the areas shown on the Project Drawings. Salvage and stockpile rebar materials in a location designated by the County representative in the field.
- f. Remove, recycle and stockpile the concrete bags buried immediately south of the Canyon 4 Drainage Channel.
- g. Remove, recycle and stockpile the concrete materials from the post footings of the chain link fence located adjacent to the proposed Bench P Road Subgrade Preparation limits as shown on the Project Drawings. Remove, salvage and stockpile the chain link fence fabric and steel schedule 40 posts in a location designated by the County representative in the field. Upon completion of the Bench P Road Improvements, the chain link fence, using the salvaged posts and fence fabric, shall be re-installed along the perimeter of Bench P as shown on the Bench P Road Improvement Construction Plans. Concrete for post footings shall be type 500-C-2500 in accordance with Table 201-1.1.2 (A). The re-installed sections of chain link fence shall be placed in accordance with Section 304-3 of the Standard Specifications.
- h. Remove, salvage and stockpile the Wooden Truss Support for the existing LCRS pipe located immediately north of the Secondary Containment Structure.

#### 6.4 MEASUREMENT AND PAYMENT

- a. **Payment** for complying with this section shall be at the lump sum bid price as stated in **Bid Item No. 5 – “Demolition”**, and shall be prorated in each progress payment in accordance with the following schedule:

Item for Demolition	Percent Payment
Remove, recycle and stockpile Asphalt Concrete material from Asphalt Concrete Structures	15%
Remove, recycle and stockpile concrete material from Reinforced Shotcrete Drainage Structures	15%
Remove, recycle and stockpile <u>Light Class Rock</u>	15%
Remove, recycle and stockpile 100-lb Rock and Concrete Grout	15%
Remove, recycle, salvage and stockpile concrete and rebar materials from Reinforced Concrete Structures	15%
Remove, recycle and stockpile the concrete materials from the post footings of the chain link fence and re-install the chain link fence after completion of Bench P Road Improvements	10%
Remove, relocate and install K-Rail barriers	15%

- b. **Payment** of the lump sum contract price for salvage, remove, recycle, and stockpile material from existing structures shall constitute full compensation for furnishing all labor, materials, tools, and equipment, and doing all the work involved in salvage, remove, recycle, and stockpile material from existing structures and shall include all costs associated with the demolition operations, compliance with all applicable SCAQMD regulations and the Site Safety Plan.

END OF SECTION 6

## 7. CRUSH AND PULVERIZE MATERIAL

### 7.1 GENERAL

The work covered by this section shall consist of furnishing all necessary labor, materials, equipment, tools and supervision to crush and pulverize demolition material and stockpile produced crushed miscellaneous base for County's future use as indicated on the Project Drawings and as directed by the County. The demolition material is to be generated during this C4P3 project.

### 7.2 MATERIALS

Materials to be crushed and pulverized are asphalt concrete, unreinforced shotcrete, and reinforced concrete. Refer to Demolition Section 6.2 of these Special Provisions for the approximate quantities and types of materials.

### 7.3 EXECUTION

- a. The crusher shall be with feeder opening size able to fit the largest rock material listed in Section 6.2 in these Special Provisions. Materials to be crushed are asphalt concrete, unreinforced shotcrete, and reinforced concrete. If other materials are larger than the feeder opening size, the Contractor shall pulverize these materials accordingly prior to placement in the crusher.
- b. Crusher capacity and engine power shall be sized to crush the total amount of material in Section 6.2 in these Special Provisions.
- c. The end product of the crushed miscellaneous base material shall consist of one-inch (1") to six-inch (6") in size with some fines, shall conform to the Standard Specifications Section 200-2.4 and shall be stockpiled separately as directed by the County.

### 7.4 MEASUREMENT AND PAYMENT

The **measurement** of the final quantity for **Bid Item No. 6** "Crush and Pulverize Material" shall be based on the pertinent details required by the Contract Documents and Project Drawings as verified by the County. **Payment** shall be based upon lump sum as stated in the Contractor's Proposal, **Bid Item No. 6** "Crush and Pulverize Material" and no additional compensation will be allowed. Payments shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the sedimentation basin completed in place.

END OF SECTION 7

## **8. DRAINAGE CONTROL SYSTEMS**

### **8.1 GENERAL**

The contract items listed in this section are included for this project to prevent ponding and promote positive drainage of stormwater runoff away from the lined portion of the C4P3 project area. The drainage control systems to be constructed include, but are not limited to: concrete structures, grouted rip-rap, reinforced concrete pipe (RCP) culverts, corrugated metal pipe (CMP) culverts, HDPE pipe culverts, drainage inlets, a stormwater sampling catch basin, steel plate baffles and a masonry splash wall.

#### **8.1.1 Concrete Structures**

The work covered by this section shall consist of furnishing all necessary labor, materials, equipment, tools and supervision for the construction of unreinforced and reinforced Portland Cement Concrete (PCC) lined structures which includes: basin spillway structure, bench and spillway access crossings, a box culvert, channel inlet and outlet structures, a concrete apron, a cross-gutter, a dike, a diversion berm, headwalls, junction structures, rectangular channels, road curbs, a secondary containment structure for the relocated leachate tanks, a shotcrete gutter, slope lining, transition channels, trapezoidal (trap) channels, a type "C" curb and "V" ditch channels. The work shall include subgrade preparation and construction of the PCC structures to the elevations, lines and grades and at the locations shown on the Project Drawings or as directed by the County. This work shall also include any cut or backfill necessary to achieve finished elevations adjacent to the structures once construction of the PCC structure is complete.

#### **8.1.2 Grouted Rip-Rap**

The work covered by this section shall consist of furnishing all necessary labor, materials, equipment, tools and supervision for the construction of grouted rip-rap lining for "V" ditch channels, and energy dissipating drainage aprons. The work shall include but not be limited to grading, excavation, subgrade preparation, and construction of grouted rip-rap to the line, grade, elevations, and location shown on the Project Drawings or as directed by the County. This work shall also include any cut or backfill necessary to achieve finished elevations adjacent to the structures.

#### **8.1.3 Reinforced Concrete Pipe (RCP) Culverts**

The work covered in this section shall consist of furnishing all necessary labor, materials, equipment, tools and supervision for the installation of Reinforced Concrete Pipe (RCP) culverts, as shown on the Project Drawings. The work shall include but not be limited to trench excavation through engineered fill, trench excavation through the landfill footprint, subgrade preparation and any associated excavation, fill, backfill, coupling, bedding and the installation of three (3) forty two-inch (42") diameter RCP culverts to the specified lines and grades at the locations shown on the Project Drawings or as directed by the County.

#### **8.1.4 Corrugated Metal Pipe (CMP) Culverts**

The work covered in this section shall consist of furnishing all necessary labor, materials, equipment, tools and supervision for the installation of Corrugated Metal Pipe (CMP) culverts as shown on the Project Drawings. The work shall include but not be limited to trench excavation through engineered fill, subgrade preparation and any associated excavation, fill, backfill, coupling, bedding, and the installation of a thirty-inch (30"), two (2) thirty six-inch (36") and a forty two-inch (42") diameter CMP culverts to the specified lines and grades at the locations shown on the Project Drawings or as directed by the County.

#### **8.1.5 HDPE Pipe Culverts**

The work covered in this section shall consist of furnishing all necessary labor, materials, equipment, tools and supervision for the installation of HDPE Pipe culverts as shown on the Project Drawings. The work shall include but not be limited to trench excavation through engineered fill and subgrade preparation. This work shall also include the welding of HDPE pipes to the liner system and any associated excavation, fill, backfill, coupling, bedding and the installation of a thirty-inch (30"), two (2) thirty six-inch (36") and a forty two-inch (42") diameter HDPE culverts to the specified lines and grades at the locations shown on the Project Drawings or as directed by the County.

#### **8.1.6 Drainage Inlets and Stormwater Sampling Catch Basin**

The work covered in this section shall consist of furnishing all necessary labor, materials, equipment, tools and supervision for the construction of two (2) cast-in-place drainage inlets within the C4P3 Project Limits and installation of a precast catch basin on the Western Stockpile Sedimentation Basin Spillway for stormwater sampling as shown on the Project Drawings. The work shall include but not be limited to trench excavation through engineered fill, trench excavation through the landfill footprint, and subgrade preparation. This work shall also include the anchorage of steel I-beams, frames, grates and steps to the poured in-place catch basin and any associated excavation, fill, backfill, and bedding associated with the construction of two (2) cast-in-place drainage inlets and a precast stormwater sampling catch basin to the specified lines and grades at the locations shown on the Project Drawings or as directed by the County.

#### **8.1.7 Steel Plate Baffles**

The work covered in this section shall consist of furnishing all necessary labor, materials, equipment, tools and supervision for the construction of steel plate baffles for energy dissipation within a concrete rectangular channel as shown on the Project Drawings. The work shall include but not be limited to cleaning and preparing concrete surfaces for installation, anchoring baffles through finished concrete surfaces and the construction of fourteen (14) steel plate baffles at the locations shown on the Project Drawings or as directed by the County.

#### **8.1.8 Masonry Splash Wall**

The work covered by this section shall consist of furnishing all necessary labor, materials, equipment, tools and supervision for the construction of a masonry splash wall as shown on the Project Drawings. The work shall include trench excavation, subgrade preparation and construction of the masonry splash wall to the elevations, lines and grades and at the locations shown on the Project Drawings or as directed



by the County. This work shall also include any cut or backfill necessary to achieve finished elevations adjacent to the wall once construction of the masonry splash wall is complete.

## 8.2 MATERIALS

### 8.2.1 Concrete Structures

- a. Portland Cement Concrete material for basin outlet & spillway structure, dikes, non-retaining transition channels, road curbs, shotcrete gutter, slope lining, trapezoidal channels and inlet structures. "V" ditch channels shall be Class 650-D-3250P (Shotcrete) in conformance with Section 201-1 of the Standard Specifications and shall be air-placed in conformance with sub-section 303-2.1.3 Method B (Shotcrete) of the Standard Specifications.
- b. Fiber Reinforcement for Class 650-D-3250P concrete items shall conform to sub-section 201-2.3 Type III of the Standard Specifications.
- c. Portland Cement Concrete material for the box culvert shall be Class 560-B-3250 in conformance with Section 201-1 of the Standard Specifications.
- d. Portland Cement Concrete material for the concrete apron, grouted rip-rap channel outlets, headwalls, junction structures, leachate secondary containment structure for the relocated leachate tanks, rectangular channels, rectangular channel inlet structures and retaining transition channels, shall be Class 560-C-3250 in conformance with Section 201-1 of the Standard Specifications.
- e. Portland Cement Concrete for the bench and spillway access crossings, concrete diversion berm, cross-gutter and type "C" curb shall be Class 520-C-2500 in conformance with Section 201-1 of the Standard Specifications.
- f. Cement mortar for junction structures shall be Class C; 1:2 Cement to Sand ratio in conformance with Section 201-5 of the Standard Specifications.
- g. Type 2 white pigmented curing compound shall conform to sub-section 201-4.1.1 of the Standard Specifications.
- h. Reinforcing steel (rebar and dowels) of bench and spillway access crossings, the box culvert, the concrete apron, grouted rip-rap channel outlets, headwalls, junction structures, the leachate secondary containment structure for the relocated leachate tanks, rectangular channels, rectangular channel inlet structures and retaining transition channels shall be grade 60 and shall conform to Part 2, sub-section 201-2.2.1 of the Standard Specifications.
- i. Welded Wire Reinforcement (WWR) for basin outlet & spillway structure, a cross-gutter, non-retaining transition channels and trapezoidal channels shall conform to sub-section 201-2.2.3 of the Standard Specifications. The gage of the wire and dimensions of the mesh are specified in the Project Drawings.
- j. Geotextile for filter material in weepholes shall be non-woven and conform to Section 17 of these Special Provisions.

- k. Filter material for weepholes shall conform to sub-section 18.2.1 "Drainage Layer" of these Special Provisions.
- l. Joint filler shall be either pre-molded joint filler or polystyrene joint filler and shall conform to sub-sections 201-3.1 and either 201-3.2 or 201-3.3 of the Standard Specifications.

### **8.2.2 Grouted Rip-Rap**

- a. Stone shall be approved durable broken stone quarry run, and of such quality that it will not disintegrate on exposure to water or weathering and free from structural fractures and defects, and shall not contain shale, unsound sandstone, or other materials which will readily disintegrate. Stone shall also conform to the general characteristics and stone quality requirements listed in sub-sections 200-1.6.1. and 200-1.6.3 of the Standard Specifications.
- b. Stone for rip-rap shall be Light Class and conform to the gradation listed in Table 200-1.6 (A) of the Standard Specifications.
- c. Concrete for rip-rap shall be Class 520-C-2500P or 650-D-3250P in conformance with Section 201-1 of the Standard Specifications except that the slump of the concrete shall be adjusted to provide the penetration of ten inches (10") as shown in Table 300-11.3.1(A), and shall be air-placed in conformance with sub-section 303-2.1.3, Method B (Shotcrete), of the Standard Specifications.
- d. Fiber Reinforcement for concrete rip-rap shall conform to sub-section 201-2.3 Type III of the Standard Specifications.
- e. Type 2 curing compound shall conform to sub-section 201-4.1.1 of the Standard Specifications.
- f. Joint filler shall be either pre-molded joint filler or polystyrene joint filler and shall conform to sub-sections 201-3.1 and either 201-3.2 or 201-3.3 of the Standard Specifications.

### **8.2.3 Reinforced Concrete Pipe (RCP) Culverts**

- a. The RCP shall consist of approximately 473 linear feet of forty two-inch (42") diameter tongue-and-groove (T&G) reinforced concrete pipe that shall conform to Class IV 2000-D and be in accordance to Standard Specification Section 207-2. A certificate of compliance shall be provided to the County stating that the materials furnished comply in all respects with Standard Specifications Section 207-2. This RCP shall be fabricated by Rinker Material Products/Corona or approved equal. RCP sections on a curve shall be beveled to permit a smaller curve radius as follows:
  - i. Alignment requiring a one hundred and fifty-foot (150') radius shall be eight-foot (8') lengths beveled on one end
- b. Concrete slurry for trench backfill shall be Class 100-E-100 and shall conform to Standard Specifications Section 201-1.

### **8.2.4 Corrugated Metal Pipe (CMP) Culverts**

- a. The CMP shall consist of approximately 235 linear feet of thirty-inch (30") diameter spiral rib pipe, 853 linear feet of thirty six-inch (36") diameter spiral rib pipe and 584 linear feet of forty two-inch (42") diameter spiral rib pipe. Thirty-inch (30") spiral rib pipe shall be 18-gauge, thirty six-inch

(36") spiral rib pipe shall be 14-gauge and forty two-inch (42") spiral rib pipe shall be 12-gauge and shall conform to sub-section 207-11.1 and Section 207-11.2 of the Standard Specifications.

- b. Coupling bands used to join sections of CMP shall be annular corrugated and provide watertight joints in accordance with sub-section 207-11.2.2 of the Standard Specifications.
- c. Concrete slurry for trench backfill shall be Class 100-E-100 and shall conform to Standard Specifications Section 201-1.

### **8.2.5 HDPE Pipe Culverts**

- a. The HDPE Pipe shall consist of approximately twenty (20) linear feet of thirty-inch (30"), forty (40) linear feet of thirty six-inch (36"), and twenty (20) linear feet of forty two-inch (42") HDPE Pipe that shall be in accordance to Standard Specification Section 207-19. HDPE Pipe shall be equal to or less than type SDR 11. A certificate of compliance shall be provided to the County stating that materials furnished comply in all respects with Standard Specifications Section 207-19. All fittings, such as internal couplers shall be installed in accordance with the Project Drawings and shall conform to Section 207-19 of the Standard Specifications.
- b. Geotextile shall be non-woven and conform to Section 17 "Geotextiles" of these Special Provisions.
- c. Concrete material for encasement of HDPE pipe shall be Class 450-C-2000 or 560-C-3250, cast in place and shall conform to Standard Specifications Section 201-1.
- d. Class II Base Bedding shall conform to Section 25-1.02A&B of the State Standard Specifications.
- e. Concrete slurry for trench backfill shall be Class 100-E-100 and shall conform to Standard Specifications Section 201-1.

### **8.2.6 Drainage Inlets and Storm Water Sampling Catch Basins**

- a. Portland Cement Concrete material forming the catch basins for drainage inlets and concrete collar for basin outlet RCP shall be Class 560-C-3250 in conformance with Standard Specifications Section 201-1.
- b. Reinforcing Steel (rebar) for the drainage inlets shall be grade 60 and shall conform to sub-section 201-2.2.1 of the Standard Specifications.
- c. I-beams shall be W5 x 18.5 structural steel and conform to the requirements of ASTM A36, Section 206-1.1 and sub-section 206-1.2.1 of the Standard Specifications.
- d. Grate frames shall be fabricated using structural steel and conform to the requirements of ASTM A36 and Section 206-1.1 and sub-section 206-1.2.1 of the Standard Specifications. Grate frame fabrication shall consist of: two (2) three and a half-inch by quarter-inch by three-foot, four and seven eighths-inch (3 1/2" x 1/4" x 3'4-7/8") bars, two (2) four-inch by three-inch by quarter-inch (4" x 3" x 1/4") L angle plates and two (2) #4 or half-inch (1/2") diameter anchors. Complete joint penetration butt welds may be substituted for the fillet welds on all anchors. Anchors may be standard square, hexagon, round or right angle hooks. Bolt holes shall be made through the angle

plate in accordance with Standard Specification sub-section 304-1.5.4, and shall include nine sixteenths-inch (9/16") diameter drill holes for installation of half-inch (1/2") diameter stove bolts. Grate frame shall be galvanized in conformance to Section 210-3 of the Standard Specifications.

- e. Grate shall be structural steel complying with ASTM A36 and sub-sections 206-1.1 and 206-1.2.1 of the Standard Specifications. Contactor has the option of using cast nodular iron, iron cast steel, welded, bolted, or cast and block grate. Grate shall have a width of two feet, nine and five eights inches (2'9-5/8"), a total number of thirteen (13) bars per grate and a two-inch (2") clear spacing between bars. Rounded top of bars optional on all grates. Contractor shall be sure to provide grates that can be placed so that bars parallel direction of principle surface flow, as shown on Project Drawings. Grate shall be galvanized in conformance to Section 210-3 of the Standard Specifications.
- f. Stove bolts placed between grate slots shall be stainless steel or alloys 304 & 316, half-inch (1/2") diameter and conform to the requirements of ASTM F 593 or F 738M.
- g. Lock washers shall be stainless steel or alloys 304 & 316, half-inch (1/2") diameter and conform to the requirements of ASTM 240/A 240M and ASME B18.22M.
- h. Bar steps shall be minimum three quarter-inch (3/4") diameter galvanized or minimum one-inch (1") diameter structural steel conforming to the requirements of ASTM A36. Galvanizing shall conform to Section 210-3 of the Standard Specifications.
- i. Catch basin for stormwater sampling shall be precast with twenty four-inch by twenty four-inch by eighteen-inch (24" x 24" x 18") dimensions with steel frames and parkway grates as provided by J&R Concrete Products, Inc. DWG No. CB2424 or approved equal.

### **8.2.7 Steel Plate Baffles**

- a. The Steel Plate Baffles shall consist of fourteen (14) two-foot by six-inch by quarter-inch (2' x 6" x 1/4") L angle plates with one anchor screw per baffle. The angle plates shall be structural steel and manufactured and tested in accordance with ASTM A36, Standard Specifications Section 206-1.1 and sub-section 206-1.2.1. Angle plates shall be galvanized for corrosion protection in conformance with Section 210-3 of the Standard Specifications.
- b. Bolt Holes shall be made through the angle plate in accordance with Standard Specification sub-section 304-1.5.4, and shall include five sixteenths-inch (5/16") diameter drill holes for installation of quarter-inch by one and three quarters-inch (1/4" x 1 3/4") hex head screws as shown on Project Drawings. One Bolt Hole shall be drilled into each angle. Bolt hole shall be drilled into each angle plate one foot (1') from end of the angle.
- c. Quarter-inch by one and three quarters-inch (1/4" x 1 3/4") hex head screws shall be Simpson's Titen 410 grade structural steel with C4 top coat for added corrosion protection or approved equal.

### **8.2.8 Masonry Splash Wall**

- a. Concrete block masonry units (CMU) for wall structure shall be six-inch by eight-inch by eighteen-inch (6" x 8" x 18") CMU and shall conform to sub-section 202-2.2 of the Standard Specifications.
- b. Reinforced concrete for wall footing shall be Class 560-C-3250 in conformance Section 201-1 of the Standard Specifications.
- c. Reinforcing steel (rebar) for wall footing shall be grade 60 and shall conform to sub-section 201-2.2.1 of the Standard Specifications.
- d. Mortar, grout, and water used in construction of CMU shall conform to sub-section 202-2.1 and Section 202-3 of the Standard Specifications. Mortar shall attain a minimum compressive strength of 1,800 psi and grout shall attain a minimum compressive strength of 2,000 psi in 28 days when tested in accordance with ASTM C109.

## **8.3 EXECUTION**

### **8.3.1 Concrete Structures**

- a. The subgrade for PCC structures shall be prepared either by excavating or filling, and shall conform to lines, grades, and cross sections and be located as shown on the Project Drawings. Where the structures are in native cut, the upper six (6) inches of subgrade shall be compacted to a minimum of 90% of the maximum density as determined per ASTM D1557. This shall be achieved by scarifying the exposed surface to a depth of six (6) inches and re-compacting it as required by the Specifications. For areas requiring engineered fill, the finished subgrade shall be firm and suitable for placement of PCC structures, and shall be compacted to a minimum of ninety-percent (90%) of the maximum density as determined per ASTM D1557. Clearing, grubbing and excavation for the PCC structures shall comply with the provisions of Section 300-7 of the Standard Specifications.
- b. Reinforcing steel of reinforced concrete and shotcrete structures shall be placed in accordance with Section 303-1.7 of the Standard Specifications and in addition, the following:
  - i. Clear cover for bottom slabs reinforced with steel rebar shall be three inches (3") each face and two inches (2") elsewhere unless otherwise shown on Project Drawings.
  - ii. Clear cover for steel in box culvert shall be two inches (2") for the top slab and outer sidewalls. Clear cover shall be three inches (3") for the inner face and three inches (3") for the outer face of the bottom slab.
  - iii. Mortar blocks with wire ties, or other means acceptable to the County shall be used to secure the rebar and welded wire mesh reinforcement firmly in the position shown in the Contract Documents.
  - iv. Steel rebar is dimensioned to back of bar bend.

- v. For construction on curves, straight transverse bars in slab shall be aligned radially with spacing measured at face of walls. For L-bars in walls, spacing shall be measured between vertical legs of bars.
  - vi. All transverse construction joints shall be in a vertical plane normal to the centerline and the spacing thereof shall not exceed fifty feet (50') or be less than 10 feet (10'). Continuous keyways shall be constructed as shown in the Project Drawings. A complete curtain of transverse steel rebar shall be placed three inches (3") from each face of the joints and longitudinal steel will not be continuous through the construction joints.
  - vii. Expansion joints shall be constructed between reinforced concrete transitions and reinforced concrete rectangular channel or box culvert sections as shown on the Project Drawings. Dowels shall be placed at eighteen-inch (18") spacing centered in the middle of the bottom slab and the top third of side walls. A minimum of three (3) dowels per slab and walls shall be placed.
  - viii. Weepholes shall be formed as shown in the Project Drawings in both walls of rectangular channels at a spacing of ten feet (10') with one cubic foot (1 ft.<sup>3</sup>) of filter material wrapped in geotextile filter fabric placed in each hole.
- c. Contractor shall notify County site personnel at least one day prior to delivery of concrete and shotcrete materials to the Badlands Landfill for each day of delivery. Delivery trucks shall access work areas by use of the designated access route shown on the Project Drawings unless otherwise directed in writing by the County. The Contractor shall deliver each and every concrete material load ticket to the County.
- d. Concrete mixing shall comply with Section 201-1.4 of the Standard Specifications.
- e. Concrete for shotcrete drainage structures: basin outlet & spillway structure, dikes, non-retaining transition channels, road curbs, shotcrete gutter, slope lining, trapezoidal channels and inlet structures, and "V" ditch channels shall be air-placed concrete in accordance with sub-section 303-2.1.3 Method B (Shotcrete), part 2 of 303-2.2 for Method B, 303-2.4, 303-2.6, 303-2.7, 303-2.8, 303-2.9 and 303-1.10 of the Standard Specifications. Concrete shall be installed and finished to provide positive drainage towards downstream drainage structures. Contractor shall be aware that the Contractor will also have to install one storm water sampling catch basin within the limits of the spillway once the subgrade for the spillway has been prepared. Contractor shall be responsible for installing welded wire mesh and shotcrete as directed by the County so that the device will finish flush with the reinforced shotcrete surface. Contractor shall coordinate the timing and location for installation of the basin with the County so as not to impact the construction schedule for the project.
- f. Concrete for the box culvert, the concrete apron, grouted rip-rap outlets, headwalls, junction structures, leachate secondary containment structure for the relocated leachate tanks, rectangular channels, rectangular channel inlet structures and retaining transition channels shall be placed in accordance with Sections 303-1.4, 303-1.6 and sub-sections 303-1.1, 303-1.3, 303-1.5, 303-1.8.1, 303-1.8.3, 303-1.8.6, 303-1.9.2 and 303-1.10 of the Standard Specifications. Concrete shall be installed and finished to provide positive drainage towards downstream drainage structures.

- g. Concrete for bench and spillway access crossings, concrete diversion berms, the cross-gutter and type "C" curb shall be placed in accordance with Sections 303-5.2 and sub-sections 303-5.1.1, 303-5.3, 303-5.4.1, 303-5.4.2, 303-5.5.4, 303-5.6, 303-5.7 and 303-5.8 of the Standard Specifications. Concrete shall be installed and finished to provide positive drainage towards downstream drainage structures.
- h. Type 2 – white-pigmented curing compound shall be applied to all concrete and shotcrete structures in accordance with the requirements of sub-sections 201-4.1.2 and 303-1.10.
- i. Weakened plane joints for drainage structures shall be installed perpendicular to the water flow direction at ten (10) foot intervals along the water flow direction as directed by the County. Depth of joint shall be one (1) inch.
- j. Open joints shall be constructed using a suitable material that is subsequently removed. Concrete corners shall not be chipped or broken when removing material. Reinforcement shall not be extended through an open joint. Joint filler shall be placed in position before concrete is placed. Joints shall be filled with mastic to prevent the passage of concrete. Concrete edges at joints shall be finished using an edger.
- k. As deemed necessary by the County, sets of three (3) test cylinders of concrete being placed will be cast and tested by the County or the QA/QC consultant. One (1) of the test cylinders shall be tested at 7 days for 70 percent of project-specified design strength. The remaining two cylinders shall be tested at 14 days and 28 days (for full design strength) respectively. Concrete compressive strength testing shall be per ASTM C39 and ASTM C31. The cylinders shall be paid for by the County.

### 8.3.2 Grouted Rip-Rap

- a. Contractor shall provide written documentation certified by the rock material supplier and acceptable to the County that Light Class Rock conforms to the grading of concreted-rock slope protection, as well as apparent specific gravity, absorption, durability index and percentage wear requirements described in sub-section 200-1.6.3 of the Standard Specifications.
- b. Contractor shall notify County site personnel at least one day prior to delivery of grouted rip-rap materials to the Badlands Landfill for each day of delivery. Delivery trucks shall access work area by use of the designated access route shown on the Project Drawings unless otherwise directed in writing by the County. Contractor shall deliver each and every material load ticket to the County.
- c. The subgrade for the grouted rip-rap shall be prepared by either cutting or filling to the lines, grades and cross sections shown on the Project Drawings or as directed by the County. The subgrade shall be prepared to the specified grades, compacted to 90% relative compaction, contain no loose material, and be subject to the acceptance of the County and QA/QC Consultant.
- d. In placing the rip-rap stones, the Contractor shall take adequate precautions to avoid displacement of underlying bedding material. Stones may be placed by dumping and may be spread in layers by

dozers or other suitable equipment. The Contractor may move and place individual stones as necessary to obtain a reasonably well-graded distribution with a minimum of voids. The surface of the stones to be concreted must be cleaned of adhering soil and then moistened. The finish rip-rap lining shall be free of pockets of small stones or clusters of larger rocks and shall be accepted by the County.

- e. Concrete mixing shall comply with Section 201-1.4 of the Standard Specifications.
- f. The grouted rip-rap shall be placed to the full thickness of twelve inches (12") and consist of a minimum penetration depth of ten inches (10") for the Light Class Rock as listed in Table 300-11.3.1(A) of the Standard Specifications. Concrete for grouted rip-rap shall be air-placed concrete in accordance with sub-sections 303-2.1.3 Method B ("Shotcrete"), part 2 of 303-2.2, 303-2.4, 303-2.6, 303-2.7, 303-2.8, 303-2.9, 303-1.10 and 300-11.3.2 of the Standard Specifications.
- g. Type 2 – white-pigmented curing compound shall be applied to the shotcrete grout in accordance with the requirements of sub-section 201-4.1.2 and 303-1.10.
- h. Traverse expansion joints shall be installed at twenty-foot (20') intervals in rip-rap lining provided for V-ditch channels. Expansion joints shall be filled with half-inch (1/2") thick expansion joint filler.
- i. Open joints shall be constructed using a suitable material that is subsequently removed. Concrete corners shall not be chipped or broken when removing material. Joint filler shall be placed in position before shotcrete is placed. Joints shall be filled with mastic to prevent the passage of shotcrete. Concrete edges at joints shall be finished using an edger.

### **8.3.3 Reinforced Concrete Pipe (RCP) Culverts**

- a. Excavation for the installation of RCP shall be in accordance with Sections 9.3.2 "Excavation" and 9.3.5 "Interim Cover and Refuse Removal and Disposal" of these Specifications. Place a 4" thick layer of bedding in accordance with Section 306-1.2.1 of the Standard Specifications. Place the pipes to lines and grades as shown on the Project Drawings and join the pipe sections in accordance with the manufacturer recommendations. Complete backfill to finished grade in accordance with Section 9.3.4 "Engineered Fill" of these Specifications.
- b. The subgrade for installation of RCP shall be prepared by excavating engineered fill placed by the Contractor to the lines, grades and cross sections shown on the Project Drawings. The trenches for RCP shall be excavated to a minimum depth of three inches (3") greater than the outer diameter (O.D.) of the RCP. The width of trench shall provide a minimum clear distance of six (6) inches between the outside of the pipe and the side of the excavation for each side of the pipe. Prior to installing RCP, the center three inches (3") of the subgrade shall be softened by scarifying or other means to a depth of three inches (3").



- c. RCP installation shall be performed in accordance with Standard Specification sub-section 306-1.2.2. Installation, field jointing and inspection of (T&G) RCP shall be in accordance with Standard Specification sub-section 306-1.2.4.
- d. Junction Structures shall be installed in accordance with Section 8.3.1 "Execution of Concrete Structures" of these Special Provisions, with the following additions:
  - i. Transverse reinforcement in pipe shall be cut in center of opening and bent to uniform distance from top and bottom of junction structure.
  - ii. Reinforcing steel shall be round, deformed, straight bars, an inch and a half (1 ½") clear from face of concrete.
  - iii. Floor of structure shall be steel troweled to spring line.
- e. Concrete mixing shall comply with Section 201-1.4 of the Standard Specifications.
- f. Contractor shall conduct trench backfill operations and subsequent engineered fill operations with due caution and care to prevent damage to the pipes.
- g. The installation of slurry backfill shall be performed in accordance with Standard Specification Section 306-1.3., and slurry shall be installed from bottom of trench to top of pipe. Slurry backfill shall be placed within one (1) hour of mixing. Slurry backfill shall be placed without voids or segregation and in a manner that does not float or shift RCP. Foreign materials that fall into trench shall be removed. The slurry backfill shall cure in-place for a minimum of four (4) hours before earthen trench backfill operations may commence unless otherwise directed in writing by the County. The QA/QC Representative may take test cylinders during slurry installation work as deemed necessary by the County and QA/QC. Cylinder breaks will be performed by the QA/QC Consultant at the direction of the County to ensure that in-place materials meet the full design strength. Cylinders shall be made and handled by the QA/QC Representative and paid for by the County.
- h. The portion of remaining trench (between the top of pipe/slurry and the top of trench) shall be backfilled in accordance with Section 9.3.4 "Engineered Fill" of these Special Provisions. Compaction of Engineered Fill placed on top of the slurry backfilled trench shall be achieved by using sheeps-foot, walk behind whackers, vibrating rollers or an alternative accepted by the County. Heavy impact type equipment such as stompers shall not be permitted for compaction use. Equipment heavier than those listed above for accepted use for compaction shall not be permitted to traverse over the slurry backfilled trench until a minimum thickness of twenty four inches (24") of Engineered Fill is placed on top of the concrete slurry. Aside from the restrictions listed above, Contractor equipment used for this operation shall be in accordance with Standard Specification sub-sections 306-1.3.1 and 306-1.3.2.

#### **8.3.4 Corrugated Metal Pipe (CMP) Culverts**

- a. Excavation for the installation of CMP shall be in accordance with Section 9.3.2 "Excavation" of these Specifications. Place a 4" thick layer of bedding in accordance with Section 306-1.2.1 of the Standard Specifications. Place the pipes to lines and grades as shown on the Drawings and join the

pipe sections in accordance with the manufacturer recommendations. Complete backfill to finished grade in accordance with Section 9.3.4 "Engineered Fill" of these Specifications.

- b. The subgrade for installation of CMP shall be prepared by excavating engineered fill placed by the Contractor to the lines, grades and cross sections shown on the Project Drawings. The trenches for CMP shall be excavated to a minimum depth of three inches (3") greater than the outer diameter (O.D.) of the CMP. The width of trench shall provide a minimum clear distance of six (6) inches between the outside of the pipe and the side of the excavation for each side of the pipe. Prior to installing CMP, the center three inches (3") of the subgrade shall be softened by scarifying or other means to a depth of three inches (3").
- c. CMP installation shall be performed in accordance with Standard Specification sub-section 306-1.2.2. Installation, field jointing and inspection of CMP shall be in accordance with Standard Specification sub-section 306-1.2.7.
- d. Contractor shall conduct trench backfill operations and subsequent engineered fill operations with due caution and care to prevent damage to the pipe.
- e. The installation of slurry backfill for CMP shall be performed in accordance with Standard Specification Section 306-1.3., and slurry shall be installed from bottom of trench to top of pipe. Slurry backfill shall be placed within one (1) hour of mixing. Slurry backfill shall be placed without voids or segregation and in a manner that does not float or shift CMP. Foreign materials that fall into trench shall be removed. The slurry backfill shall cure in-place for a minimum of four (4) hours before earthen trench backfill operations may commence unless otherwise directed in writing by the County. The QA/QC Representative may take test cylinders during slurry installation work as deemed necessary by the County and QA/QC. Cylinder breaks will be performed by the QA/QC Consultant at the direction of the County to ensure that in-place materials meet the full design strength. Cylinders shall be made and handled by the QA/QC Representative and paid for by the County.
- f. The portion of remaining trench (between the top of pipe/slurry and the top of trench) shall be backfilled in accordance with Section 9.3.4 "Engineered Fill" of these Special Provisions. Compaction of Engineered Fill placed on top of the slurry backfilled trench shall be achieved by using sheeps-foot, walk behind whackers, vibrating rollers or an alternative accepted by the County. Heavy impact type equipment such as stompers shall not be permitted for compaction use. Equipment heavier than those listed above for accepted use for compaction shall not be permitted to traverse over the slurry backfilled trench until a minimum thickness of twenty four inches (24") of Engineered Fill is placed on top of the concrete slurry. Aside from the restrictions listed above, Contractor equipment used for this operation shall be in accordance with Standard Specification sub-sections 306-1.3.1 and 306-1.3.2.

### **8.3.5 HDPE Pipe Culverts**

- a. Excavation for the installation of HDPE pipe shall be in accordance with Section 9.3.2 "Excavation" of these Specifications. Place HDPE pipes to lines and grades as shown on the Drawings. Complete backfill to finished grade in accordance with Section 9.3.4 "Engineered Fill" of these Specifications.

- b. Excavation for the installation of HDPE pipes shall be carefully made using both mechanical means and shovels in order that the structure may be positioned in-place on a firm, stable and unyielding surface with minimal resultant voids under the structure.
- c. The subgrade for installation of HDPE pipes shall be prepared by excavating engineered fill placed by the Contractor to the lines, grades and cross sections shown on the Project Drawings. The trenches for HDPE pipe shall be excavated to a minimum depth of three inches (3") greater than the outer diameter (O.D.) of the HDPE pipe and the width of trench shall provide a minimum clear distance of six (6) inches between the outside of the pipe and the side of the excavation for each side of the pipe. Prior to installing HDPE pipe, the center three inches (3") of the subgrade shall be softened by scarifying or other means to a depth of three (inches (3")).
- d. Class II base bedding for the concrete encasement of HDPE pipe, HDPE coupling with internal adapter and CMP pipe shall be placed at a thickness of six inches (6") as shown on the Project Drawings and shall conform to Section 25-1.03 of the State Standard Specifications.
- e. HDPE pipe installation shall be performed in accordance with Standard Specification sub-section 306-1.2.13. HDPE pipes shall be joined as shown on the Project Drawings.
- f. Preparation for the installation of the concrete encasement shall be carefully made by using both mechanical means and shovels in order that the encasement may be poured in-place on a firm, stable and unyielding subgrade surface in accordance with the dimensions shown on the Project Drawings. QA/QC Representative may take concrete test cylinders during this installation as deemed necessary by the County and QA/QC. Cylinder breaks will be performed at the direction of the County to ensure that in-place materials meet the full design strength. Cylinders shall be made and handled by the QA/AC Representative and paid for by the County.
- g. Contractor shall conduct trench backfill operations and subsequent engineered fill operations with due caution and care to prevent damage to the HDPE pipes.
- h. The installation of slurry backfill for HDPE pipe as required by the Project Drawings shall be performed in accordance with Standard Specification Section 306-1.3., and slurry shall be installed from bottom of trench to top of pipe. Slurry backfill shall be placed within one (1) hour of mixing. Slurry backfill shall be placed without voids or segregation and in a manner that does not float or shift the HDPE pipes. Foreign materials that fall into trench shall be removed. The slurry shall cure in-place for a minimum of four (4) hours before earthen trench backfill operations may commence unless otherwise directed in writing by the County. The QA/QC Representative may take test cylinders during slurry installation work as deemed necessary by the County and QA/QC. Cylinder breaks will be performed by the QA/QC Consultant at the direction of the County to ensure that in-place materials meet the full design strength. Cylinders shall be made and handled by the QA/QC Representative and paid for by the County.
- i. The portion of remaining trench (between the top of pipe/slurry and the top of trench) shall be backfilled in accordance with Section 9.3.4 "Engineered Fill" of these Special Provisions. Compaction of Engineered Fill placed on top of the slurry backfilled trench shall be achieved by using sheeps-foot, walk behind whackers, vibrating rollers or an alternative accepted by the County. Heavy impact type equipment such as stompers shall not be permitted for compaction use. Equipment heavier than those listed above for accepted use for compaction shall not be permitted to

traverse over the slurry backfilled trench until a minimum thickness of twenty four inches (24") of Engineered Fill is placed on top of the concrete slurry. Aside from the restrictions listed above, Contractor equipment used for this operation shall be in accordance with Standard Specification sub-sections 306-1.3.1 and 306-1.3.2.

### 8.3.6 Drainage Inlets and Stormwater Sampling Catch Basin

- a. Excavation for the construction of the two (2) cast in-place drainage inlets shall be carefully made using both mechanical means and shovels in order that the structure may be positioned in-place on a firm, stable and unyielding surface with minimal resultant voids under the structure. The subgrade for installation of the drainage inlets shall be prepared by excavating engineered fill placed by the Contractor to the line, grade and cross section shown on the Project Drawings.
- b. The subgrade for installation of the precast stormwater sampling catch basin shall be prepared by placing engineered fill for the construction of the Western Stockpile Sedimentation Basin in accordance with Section 9.3.4 "Engineered Fill" of these Special Provisions.
- c. Place and install the drainage inlets and the stormwater sampling catch basin to the lines and grades as shown on the Project Drawings and join pipe outlets to the drainage inlet catch basins in accordance with the manufacturer recommendations.
- d. Reinforcing steel for drainage inlets shall be placed in accordance with Section 303-1.7 of the Standard Specifications in addition to the following:
  - i. Catch basin walls shall be reinforced with #4 bars centered at eighteen-inch (18") spacing, placed with one and a half-inch (1 1/2") clear cover to inside of box.
  - ii. Reinforcement in the catch basin floor is not required.
- e. Steps shall be installed with lowest rung one foot (1') above the floor and highest rung not more than six inches (6") below top of inlet. The distance between steps shall not exceed one foot (1') and shall be uniform throughout the length of the wall. Steps shall be placed in the wall without a culvert opening. Step inserts may be substituted for the bar steps. Step inserts shall comply with State Industrial Safety requirements and shall be installed as shown on the Project Drawings.
- f. I-beams shall be embedded into the basin walls with a minimum one-inch (1") clear cover to outside of box.
- g. Concrete for catch basin and concrete collar formed around the basin outlet pipe shall be placed in accordance with Section 303-1.6 and sub-sections 303-1.1, 303-1.3, 303-1.4.1, 303-1.4.4 b), 303-1.5, 303-1.8.1, 303-1.8.3, 303-1.9.2 and 303-1.10 of the Standard Specifications.
- h. Basin floors shall have wood trowel finish and a minimum slope of three percent (3%) toward flowline.
- i. Grates shall be placed in tandem with a three-foot, four-inch (3'4") length for each grate. Grates shall be installed as shown on the Project Drawings.

- j. Do not construct drains for the drainage inlets and stormwater sampling catch basin to final grade until the paving or surfacing has been completed immediately adjacent to the drain.

### 8.3.7 Steel Plate Baffles

- a. Surfaces shall be thoroughly cleaned prior to installation.
- b. Steel plate baffles shall be installed in proper relation with adjacent construction and with uniform appearance. Surfaces of steel plate baffles that come in contact with ground concrete surface shall be finished-machined flat to within one thirty second-inch (1/32") tolerance in twelve inches (12") and to within one sixteenth-inch (1/16") tolerance overall. Steel plate baffle assemblies shall be set level and to the elevations shown on the Project Drawings.
- c. Anchor bolts shall be installed in accordance with sub-section 304-1.7.
- d. Anchor holes shall be drilled to the specified embedment depth plus 1/2" to allow the thread tapping dust to settle and shall be blown clean using compressed air.

### 8.3.8 Masonry Splash Wall

- a. Concrete block masonry wall structure shall be constructed in accordance with Section 303-4 of the Standard Specifications.
- b. Concrete block masonry wall structure shall be placed along entire length of horizontal curve and constructed in accordance with the relevant details on the Project Drawings.
- c. The subgrade for the concrete block masonry wall and shotcrete gutter shall be prepared to the specified elevations, compacted to 90% relative compaction, contain no loose material, and subject to the approval of the County and QA/QC Consultant.

## 8.4 MEASUREMENT AND PAYMENT

- a. The **measurement** for payment of **Bid Item No. 7** "Construct Concrete Drainage Structures", which includes the construction of concrete drainage structures located outside of the Western Stockpile including: a box culvert, channel inlet and outlet structures, a cross gutter, diversion berms, headwalls, junction structures, rectangular channels, road curbs, slope lining, transition channels, trapezoidal channels, a type "C" curb and "V" ditch channels, **Bid Item No. 8** "Construct Western Stockpile Concrete Drainage Structures", which includes: the basin outlet & spillway structure, bench and spillway access crossings, channel inlet and outlet structures, a dike, slope lining, trapezoidal channels and "V" ditch channels, and **Bid Item No. 9** "Construct Secondary Containment Concrete Structure" will be paid for at the lump sum price as stated in the Contractor's Proposal **Bid item No. 7, 8 and 9** and no additional compensation will be allowed for subgrade preparation. Payment for **Bid Item No. 9** shall be determined after the secondary containment concrete structure has been constructed, tested and verified by the QA/QC consultant to the satisfaction of the County. Payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing PCC Structures completed in place. Truck drivers at the point of delivery shall deliver each and every

concrete load tickets to the County.

- b. The **measurement** of the final quantity for **Bid Item No. 10** 'Furnish and install 12" thick Grouded Rip-Rap Lined "V" Ditch Channels' and **Bid Item No. 11** 'Furnish and install 12" thick Grouded Rip-Rap Lined Apron' shall be determined by the County by measuring the surface area within the limits specified in the Contract Documents. Measurement shall be determined after the Grouded Rip-Rap structures have been installed, tested, and verified by the QA/QC Consultant to the satisfaction of the County. The area of the final surface shall be verified by the County based on conventional ground surveying method. Quantity shall be calculated based on "true" area of the rip-rap surface area and to the nearest square foot utilizing digital terrain modeling method. **Payment** for all Grouded Rip-Rap structures shall be at the contract unit price per square feet as stated in the Contractor's Proposal, **Bid Items No. 10 and No. 11** and shall constitute full compensation to the Contractor for all work related to the construction of Grouded Rip-Rap structures in the project including but not limited to: furnishing all labor, materials, tools, equipment, subgrade preparation, and incidentals, and for doing all the work involved in constructing Grouded Rip-Rap structures, complete in place, as shown on the Project Drawings or as directed by the County. Payment for all Grouded Rip-Rap structures shall include subgrade preparation as specified in the Contract Documents and indicated in the Project Drawings.
- c. The **measurement** of the final quantity for **Bid Item No. 12** "Furnish and Install 42-inch diameter RCP Culvert" shall be determined by the County based on field measurements of the axial length (linear feet) of the RCP culverts within the limits specified in the Contract Documents. Measurement shall be determined after the RCP culverts have been installed, tested and verified by the QA/QC consultant to the satisfaction of the County. **Payment** for the installation of the RCP culverts shall be based on the unit price per lineal foot measured axially as stated in the Contractors Proposal **Bid Item No. 12**. Payment shall include full compensation for all pipe excavation, bedding, placement, backfill, and no additional compensation will be allowed.
- d. The **measurement** of the final quantity for **Bid Item No. 13** "Furnish and Install 30-inch diameter CMP culverts", **Bid Item No. 14** "Furnish and Install 36-inch diameter CMP culverts" and **Bid Item No. 15** "Furnish and Install 42-inch diameter CMP culverts" shall be determined by the County based on field measurements of the axial length (linear feet) of the CMP culverts within the limits specified in the Contract Documents. Measurement shall be determined after the CMP culverts have been installed, tested and verified by the QA/QC consultant to the satisfaction of the County. **Payment** for the installation of the CMP culverts shall be based on the unit price per lineal foot measured axially as stated in the Contractors Proposal for **Bid Items No. 13, 14 & 15**. Payment shall include full compensation for all pipe excavation, bedding, placement, backfill and no additional compensation will be allowed.
- e. The **measurement** of the final quantity for **Bid Item No. 16** "Furnish and install 30-inch diameter HDPE Culverts, including couplings", **Bid Item No. 17** "Furnish and install 36-inch diameter HDPE Culverts, including couplings", and **Bid Item No. 18** "Furnish and install 42-inch diameter HDPE Culverts, including couplings" shall be based on the pertinent details required by the Contract Documents as verified by the County through field measurements of the HDPE culverts. Measurement shall be determined after the HDPE culverts have been installed, tested and verified by the QA/QC consultant to the satisfaction of the County. **Payment** for the installation of the HDPE culverts shall include but not be limited to trench excavation through engineered fill, subgrade preparation and the supply and installation of the HDPE Culverts to the elevations, lines and grades

and at the location shown on the Project Drawings or as directed by the County. Payment shall also include full compensation for all excavation, bedding, coupling, concrete encasement and backfill. Payment shall be based upon the unit cost for each culvert as stated in **Bid Item No. 16, Bid Item No. 17 & Bid Item No. 18** in the Contractor's Proposal. The price and payment shall constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to completion of this item of work. No additional compensation will be allowed.

- f. The **measurement** of the final quantity for **Bid Item No. 20** "Furnish and Install Drainage Inlets." and **Bid Item No. 21** "Furnish and Install Stormwater Sampling Catch Basin" shall be based on the pertinent details required by the Contract Documents as verified by the County through field measurements of the drainage inlets and stormwater sampling catch basin. Measurement shall be determined after the drainage inlets and stormwater sampling catch basin have been constructed and/or installed, tested and verified by the QA/QC consultant to the satisfaction of the County. **Payment** for the construction of the drainage inlets and installation of the stormwater sampling catch basin shall include but not be limited to trench excavation through engineered fill, trench excavation through the landfill footprint, subgrade preparation and the supply and installation of the drainage inlets and stormwater sampling catch basin to the elevations, lines and grades and at the location shown on the Project Drawings or as directed by the County, including any associated excavation, fill, backfill, and bedding as specified in the Contract documents and indicated in the Project Drawings. Payment for the drainage inlets and stormwater sampling catch basin shall be based upon the unit cost for each drainage inlet and stormwater sampling catch basin as stated in **Bid Items No. 20 and No. 21** in the Contractor's Proposal. The price and payment shall constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to completion of this item of work. No additional compensation will be allowed.
- g. The **measurement** of the final quantity for **Bid Item No. 22** "Furnish and install steel plate baffles including anchor bolts." shall be based on the pertinent details required by the Contract Documents as verified by the County through field measurements of the baffles. Measurement shall be determined after the baffles have been installed, tested and verified by the QA/QC Consultant to the satisfaction of the County. **Payment** for the installation of the baffles shall include but not be limited to cleaning and preparation of concrete surfaces and the supply and installation of the steel plate baffles to the elevations, lines and grades and at the location shown on the Project Drawings or as directed by the County, including the anchoring of the baffles with anchor bolts as specified in the Contract documents and indicated in the Project Drawings. Payment for the steel plate baffles shall be based upon the unit price for each steel plate baffle installed as stated in **Bid Item No. 22** in the Contractor's Proposal. The price and payment shall constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to completion of this item of work. No additional compensation will be allowed.
- h. The **measurement** of the final quantity for **Bid Item No. 23** "Masonry Splash Wall, including reinforced concrete footing." shall be determined by the County based on the field measurements of the axial length (linear feet) along the centerline of the completed masonry splash wall. **Payment** for the masonry splash wall shall be based upon the unit price per linear foot as stated in the Contractor's Proposal, **Bid Item No. 23**. Payment for the masonry splash wall shall include subgrade preparation and construction of reinforced concrete footing and masonry wall including reinforcing steel and grout material as specified in the Contract Documents and indicated in the Project Drawings. Payments shall include full compensation for furnishing all labor, materials,

tools, equipment, and incidentals, and for doing all the work involved in constructing the masonry splash wall completed in place.

END OF SECTION 8



## 9. EARTHWORK

### 9.1 GENERAL

#### 9.1.1 Section Includes

The work in this section shall include furnishing all labor, supervision, tools, equipment, and materials necessary to: achieve design grades and elevations, establish subgrade for surface drainage structures and access roads within the C4P3 Project Limits. This work shall include, but is not limited to: clearing, grubbing, excavation, over-excavation; refuse removal, disposal and interim cover; hauling Excess Material from the C4P3 Grading Limits, and placement and compaction of engineered fill within C4P3 Project Limits as shown on the Project Drawings and as required by the Contract Documents.

“Excess Material” shall be defined in these Project Documents as soil material that is (a) not classified as refuse, (b) not designated for interim cover use, (c) not used to create Low-Permeability or Protective Cover Soil materials, and (d) not required to achieve the design grades and elevations within the C4P3 Grading Limits as shown on the Project Drawings. Removal of Excess Material from the C4P3 Grading Limits shall be performed in accordance with one or more of the following options at the discretion of the County:

Option 1 - **Bid Item No. 25** “Earthwork (Excess material hauled to Western Stockpile)”- suitable material excavated within the C4P3 Grading Limits shall be hauled to the Western Stockpile as engineered fill in accordance with the requirements of Section 9.3.4 of the Special Provisions.

Option 2 - **Bid Item No. 27** “Earthwork (Excess Material for Off-Site Dirt Haul)”- material excavated within the C4P3 Grading Limits shall be hauled off-site in accordance with the requirements of Section 11 of the Special Provisions.

#### 9.1.2 Quality Assurance/Quality Control

All work shall be performed in accordance with the QA/QC Plan, under the ongoing observation of the County and QA/QC Consultant. The QA/QC Consultant shall verify that the engineered fill has been moisture conditioned and compacted adequately in accordance with the QA/QC Plan. The verification will be conducted by field-testing as well as visual observation of the operation. Contractor shall ensure that the moisture content and density requirements for all earthwork are achieved.

The Contractor shall supply labor and equipment for preparing test areas as requested by the QA/QC Consultant. When material has not been properly placed, moisture-conditioned, or compacted, as determined by observation or verification testing, such material shall be removed or reworked as necessary at the sole expense of the Contractor to obtain the required relative compaction and moisture content. When sand cone density tests, field permeability tests, or any other field tests are performed, no equipment shall be operated within the immediate vicinity of the test area or as

requested by the QA/QC Consultant. This requirement is essential since the vibration produced by the construction equipment will adversely impact the testing results.

## **9.2 MATERIALS**

### **9.2.1 General**

The suitability of all earthen and manufactured materials shall be subject to the acceptance of the County and approval of the QA/QC Consultant. Fill materials shall not contain brush, roots, sod, or other deleterious or unsuitable materials. Particle size below the top two (2) feet of engineered fill shall not exceed six (6) inches within the C4P3 Grading Limits. Organic material and particles greater than the specified size shall be deposited in the Canyon 6 Stockpile or as otherwise directed by the County. Where the engineered fill forms the subgrade for the liner, the subgrade shall be prepared in accordance with the requirements of Section 13.3 of these Special Provisions.

## **9.3 EXECUTION**

### **9.3.1 General Subgrade Preparation**

All work areas within the C4P3 Project Limits shown on the Project Drawings shall be evaluated and accepted by the County and QA/QC Consultant to verify satisfactory completion of clear and grub work (including removal of Demolition Section 6 items as shown on the Project Drawings), penetration of the excavation into firm natural soils, and removal of all unsuitable materials. All unsuitable material found at the subgrade design elevations shall be excavated as over-excavation material by the Contractor (under the direction of the QA/QC Consultant) and the area shall be backfilled to design elevations and grades with engineered fill in accordance with the requirements of Section 9.3.3 of these Specifications.

Unless otherwise noted or required, areas where engineered fill is to be placed, or in other areas where unsuitable materials have been removed and where the surface is judged to be loose or otherwise unsuitable, the subgrade shall be prepared as follows:

- a. The upper six (6) inches of in-situ material shall be ripped, moisture-conditioned, and re-compacted to a minimum of 90 percent relative compaction, at a moisture content range between optimum moisture content (OMC) and 2% above OMC in accordance with ASTM D1557 or as determined by the County and QA/QC Consultant.
- b. The compacted surface shall be scarified to provide a good bond between the foundation material and the subsequent fill material, as appropriate.
- c. Areas of hard or dense, natural soil identified by the County and QA/QC Consultant shall be left undisturbed.

### **9.3.2 Excavation**

- a. This work may include ripping, breaking, and dozing of materials using standard earthmoving equipment up to and including CAT D-9 with single ripper type equipment. Based on a previous subsurface soil investigation, the material within limits of excavation has been determined to be rippable. In the event non-rippable material is encountered, the Contractor shall immediately notify the County and the QA/QC Consultant. Prior to the removal of non-rippable material, Contractor, County, and the QA/QC Consultant shall mutually decide upon the most acceptable method of removal for this material. This work shall be considered as extra work and therefore will be paid for in accordance with Section 2.7 of the General Provisions entitled "Extra Work". This item shall also include keeping excavation areas neat and orderly, and completing the excavation to the satisfaction of the County and QA/QC Consultant. Liner construction operations in a given area shall not commence until the subgrade surface preparation has been completed by the Contractor, and has been accepted by the County and QA/QC Consultant.
- b. Areas of excavation shall be graded to drain at all times, and necessary precautions shall be taken to control dust and erosion. The Contractor's access roads shall be maintained as necessary for Contractor, County, and QA/QC personnel, including landfill operation access. Unless specifically required by the Contract Documents, excavations shall not be carried below the design lines and grades shown on the plans or as otherwise recommended by the QA/QC Consultant and accepted by the County in writing. Unauthorized over-excavation shall be immediately corrected by backfilling to grade with engineered fill in accordance with Section 9.3.4 of the Special Provisions at the Contractor's expense.
- c. Excavated material from within the C4P3 Project Limits shall be used by the Contractor as a source of material for executing the following work items and miscellaneous tasks: engineered fill in the C4P3 Grading Limits, constructing the Low Permeability Layer ("LPL") test pad, LPL, screening operation to produce protective cover soil material, supplying interim cover material for disposal of excavated refuse, supplying daily cover material for landfill operations, and any other miscellaneous tasks required by the Contract Documents or as directed by the County.
- d. Based on the County's Earthwork Option selection(s), all remaining quantity of excess excavated material from the C4P3 Grading Limits shall be placed by the Contractor as engineered fill within the Western Stockpile Grading Limits as shown on the Project Drawings and/or for an Off-Site Dirt Haul. Material excavated within the Western Stockpile Grading Limits shall be used as a source material for the placement of engineered fill within the Western Stockpile Grading Limits only and shall not be used as a source material for the placement of engineered fill within the C4P3 Grading Limits and/or for an Off-Site Dirt Haul.
- e. Unsuitable excavated material, as identified by the QA/QC Consultant, shall be placed in the designated Canyon 6 Stockpile Area as uncontrolled fill, and shall not be used as engineered fill.
- f. Surface drainage shall be maintained at all times in the C4P3 Project Limits and these completed areas shall be graded as shown on the Project Drawings and as directed by the County. Final surfaces within these C4P3 Project Limits shall be finished by track walking and left in a uniformly graded condition. Surfaces of flat areas shall be finish-graded with a motor grader or approved equal. The Contractor shall construct drainage and erosion control facilities in accordance with the Project Drawings within the completed portions of the C4P3 Project Limits and as required by the Contract Documents, or as directed by the County. All material required

for the surface drainage and erosion control facilities shall be supplied and installed by the Contractor.

- g. The Contractor shall not be compensated for any earthwork activities which deviate from what is required by the Contract Documents. The Contractor shall be charged actual costs for construction testing and inspection due to any unauthorized haul road alteration.
- h. Side slopes shall be cut to an inclination not steeper than 1.5:1 (H:V) unless otherwise shown on the Project Drawings. The Contractor shall observe temporary and permanent excavations on a regular basis for signs of instability. Should signs of instability be noted, the Contractor shall notify the County and the QA/QC Consultant immediately, and shall undertake remedial measures as soon as practicable, subject to the direction and acceptance of the County and the QA/QC Consultant. It shall be the Contractor's responsibility to remove all loose materials from the excavated slopes, and to maintain the slopes in a safe and stable condition at all times during the progress of the work and during any temporary closure of the work. Permanent cut slopes shall be left in a clean, safe, and stable condition upon completion of the work.
- i. Where necessary, trenches, pits, and other excavations shall be properly sheathed and braced to furnish safe and acceptable working conditions. Any damage occurring from excessive earth pressures, slides, cave-ins, or other causes due to failure to provide proper sheathing or bracing, or through other negligence or fault of the Contractor, shall be repaired by the Contractor at its expense. The manner of bracing for excavations shall be as set forth in the rules, orders, and regulations of the Division of Industrial Safety of the State of California or OSHA California Code of Regulations Subchapter 4, Article 6, Section 1540 "Excavations"; whichever is more restrictive.

### 9.3.3 Over-excavation

- a. Areas identified by the QA/QC Consultant during construction to require over-excavation shall be excavated to limits as determined by the County and/or the QA/QC Consultant. Material removed during over excavation may be used as engineered fill at the discretion of the County and QA/QC consultant when the material meets the requirements for engineered fill. Material that does not confirm to requirements for engineered fill shall be hauled to the Canyon 6 Stockpile.
- b. After excavation, the area shall be backfilled and compacted in accordance with Section 9.3.4 "Engineered Fill" to subgrade elevations in accordance with the Project Drawings. The excavation of these materials shall not, in quantity, include the material excavated for the convenience of the Contractor's operations. Prior to placing engineered fill material, the Contractor shall clear all stabilization, buttress, and key-way fill areas within the limits of over-excavation of loose slough materials. Prior to the placement of any engineered fill, the QA/QC Consultant must approve any areas cleared of loose slough material.
- c. Groundwater Well BL-1 shown on the Project Drawings was abandoned by the County in preparation for this project. The Contractor shall expose the top of the buried concrete slurry backfill over the well and the adjacent subgrade at the elevation of the exposed slurry within a five-foot (5') radius of this abandoned well. County anticipates as little as three and a half feet

(3.5') of existing earthen material cover over the top of the slurry. Slurry backfill shall be protected in place by the Contractor, and Contractor shall have County verify and document condition of slurry and surrounding earthen materials prior to subsequent engineered fill placement over this abandoned well area.

#### 9.3.4 Engineered Fill

- a. Under the direction of the QA/QC Consultant, only suitable material encountered within the excavation areas shall be utilized in the engineered fill areas, and all unsuitable material shall be removed and hauled to the Canyon 6 Stockpile area designated on the Project Drawings, or as otherwise directed by the County.
- b. Engineered fill shall be placed on Bench B, Bench C and Bench P after installation of the liner system and shall also be included in the construction of the Pit Road.
- c. The Contractor shall restrict earthwork movement and haul routes to the areas within the C4P3 Project Limits as shown on the Project Drawings. Any earthwork operations requiring activity outside of the C4P3 Project Limits shall require a written request and written acceptance to and from the County.
- d. Compacted engineered fill is required within the C4P3 Project Limits, as shown on the Project Drawings or as directed by the County or QA/QC Consultant, on-site soil shall be placed and compacted in layers as specified herein. The Contractor shall spread soil evenly by mechanical equipment over the prepared subgrade. The Contractor shall place engineered fill material in thickness of loose lifts no greater than eight inches (8") and compacted lifts no greater than six inches (6"). Each lift shall be spread evenly and compacted to obtain a near uniform condition in each layer. In areas of lift thickness greater than specified herein, the Contractor, prior to construction of additional lifts, must complete re-grading and compacting of the surface to the maximum specified lift thickness. The top of each previously compacted layer shall be scarified so that there is no lamination between layers.
- e. Compaction of Engineered Fill placed on top of slurry backfilled trenches shall be achieved by using sheeps-foot, walk behind whackers, or vibrating rollers. Heavy impact type equipment such as stompers shall not be permitted for compaction use. Excluding the LCRS riser pipes trench, equipment heavier than those listed for approved use for compaction shall not be permitted to traverse over slurry backfilled trenches until a minimum thickness of twenty four inches (24") of Engineered Fill is placed on top of the concrete slurry.
- f. Engineered fill material shall be compacted to a minimum of 90% relative compaction per the Project Drawings, based on the laboratory maximum dry density, determined by ASTM D1557. Engineered fill over cut slopes, or scarified natural steep slopes shall be properly keyed into undisturbed bedrock or firm material in accordance with the Contract Documents and as accepted by the County and QA/QC Consultant.

- g. Engineered fill material within the C4P3 Project Limits for the construction of the permanent engineering fill Termination Berm shall be properly keyed-in into the subgrade, with minimal keying depth along the toe of engineered fill slope of 5 feet.
- h. All general on-site soil material used for engineered fill shall have a moisture content between OMC and 2% above OMC in accordance with ASTM D1557 or as determined by the QA/QC Consultant. Additional water may need to be added at any time during construction. The moisture content of the engineered fill materials prior to and during compaction shall be uniform throughout each layer of the material.
- i. When the moisture content of the fill material is below optimum, water shall be added until the moisture content is within the limits required to assure an adequate bonding and compaction of all fill material. When the moisture content of the fill material is above the specified limits, the fill material shall be aerated by plowing, disking, blading, or other satisfactory methods until the moisture content is acceptable. All plowing, tamping, blending, disking, or air drying of material is considered incidental to the work and no additional compensation will be allowed. Wetting of materials by rain or artificial means to acceptable moisture content will require mixing or air drying to return this material to the required moisture content. Complying with this requirement is considered incidental to the work and no additional compensation will be allowed.
- j. Surfaces of all slopes outside the geosynthetic liner limits shall be finished by track walking with Dozer-type equipment or approved equal by the County Representative in the field and left in a uniformly graded condition. Surfaces of flat areas shall be finish graded with a motor grader or approved equal.
- k. Surfaces of all slopes within the geosynthetic liner limits shall be prepared in accordance with the requirements of Section 13 of these Special Provisions.

### **9.3.5 Interim Cover and Refuse Removal & Disposal**

- a. The Contractor shall remove interim cover soil, refuse, or soil co-mingled with refuse from within the C4P3 Project Limits shown on the Project Drawings and as required to connect the LCRS and to join to existing liner, north of the C4P3 Grading Limits.
- b. Refuse or soil co-mingled with refuse will be encountered within the C4P3 Project Limits inside the landfill footprint; however, it is possible that refuse may be encountered in any excavation area within the C4P3 Project Limits shown on the Project Drawings.
- c. Contractor shall haul contaminated material and refuse to the landfill working face and cover in place with one-foot (1') of clean earthen daily cover material as directed by the County. Recognizing the primary importance of public and landfill worker safety in and adjacent to this area, Contractor shall coordinate proposed haul routes, timing, duration, and other related factors with the County prior to each planned haul sequence to the landfill working face.
- d. In the event the County or Contractor suspects any excavation material from the landfill is hazardous (as defined by CalRecycle or the Local Enforcement Agency), the Contractor shall stockpile the suspect material in a location separate from the rest of the excavated material. The

Contractor shall immediately notify the County if excavation material is suspected to be hazardous. The County will make the appropriate analyses to determine if the suspected hazardous material is hazardous by CalRecycle or LEA definition. The Contractor shall dispose of determined hazardous material in the hazardous waste disposal site designated by the County. The Contractor shall be compensated for disposal of such hazardous waste. This work shall be considered as extra work and therefore; will be paid for in accordance with Section 2.7 of the General Provisions entitled "Extra Work". (Any hazardous material generated by the Contractor, including but not limited to spills or leaks during routine equipment maintenance or any spills caused by any of the Contractor's subcontractors or suppliers, shall be properly disposed of at the Contractor's expense as stated in the Contract Documents.)

- e. The County is in process of obtaining a South Coast Air Quality Management District (SCAQMD) Rule 1150 Permit for refuse excavation. The Contractor must place refuse within the limits of the landfill footprint as shown on the Project Drawings; and the Contractor shall also comply with all requirements of the SCAQMD permit conditions (i.e., daily cover, transportation, dust suppression, etc.) at any time refuse is encountered. A sample SCAQMD permit and associated conditions are included in Appendix A. The Contractor shall address this work in the Site Safety Plan submittal Section 1.7.2. The County will provide required personnel to monitor the activities in accordance with the SCAQMD 1150 permit.

#### **9.3.6 Earthen Berms**

- a. Earthen Berms shall be constructed in accordance with the requirements of Section 9.3.4 using suitable earthen material from excavation areas within the C4P3 Project Limits.
- b. Earthen Berms shall be constructed at locations and to dimensions shown on the Project Drawings and as directed by the County. Earthen berms include configurations as Diversion Berms and as Traffic Safety/Sight Block Berms.

### **9.4 MEASUREMENT AND PAYMENT**

- a. The last available ground topography for the site was generated from a combination of an aerial flight survey completed in November 2010 and a conventional ground survey method completed on October 1, 2012. Due to the ongoing landfill operations, this composite ground topography will not reflect the actual field conditions at the time of award of this contract. Because of this, and since the ongoing landfill activities within the project limits will continue up to award of this contract and issuance of the Notice to Proceed, all earthwork quantities in the "Contractor's Proposal" are only estimates which have been primarily determined by using the aforementioned composite ground topography. However, in order to generate an updated ground topography contour map which will be used as the base map (or pre-construction ground) for this project, the County plans to perform an updated ground survey within any disturbed areas immediately before the issuance of the Notice to Proceed and the commencement of this project. This survey (updated ground survey and the November 2010 aerial flight) will be used to generate an updated ground topography contour map (pre-construction ground contours) that will be used to determine the final pay quantities for all applicable bid items.

- b. Unless otherwise stated, the final measurement of all earthwork quantities for the various layers shall be calculated to the nearest cubic yard or the nearest square foot based only upon comparison of pre-construction and post-construction surfaces of the project work. These surfaces shall be established by a combination of conventional ground surveying done by the County and aerial flight surveys of the project work area. Unless otherwise stated, the surface for any layer which will be covered by subsequent layers shall be established by ground surveying. The surface for any layer which will not be covered shall be established by aerial flight survey. The Riverside County Flood Control and Water Conservation District shall conduct the aerial flight surveys at the County's request immediately following the completion of work. Final volumetric calculation of earthwork quantities for payment purposes shall then be performed by the County based upon the resulting Digital Terrain Models (DTM) using the grid volume method with a grid interval of five (5) feet by five (5) feet. It should be noted that different methods may be used by the County for determining quantities for progress payments. However, the earthwork quantities used for progress payments will be adjusted at the completion of the project based upon the final measurement method stated in this paragraph.
- c. Allowable deviation from design grades shown on the Project Drawings shall be  $\pm 0.10$  feet on all benches, canyon floor areas, and access roads within the project limits; and  $\pm 0.25$  feet for all remaining areas within the project limits. Limits for measurement of the excavations and fills shall be to the lines and grades as shown on the Project Drawings or as directed by the County and QA/QC Consultant.
- d. The **measurement** of the final quantity for **Bid Item No. 24** "Earthwork (Engineered Fill C4P3 Liner Expansion)" shall be based on the total quantity of engineered fill placed only within the C4P3 Grading limits, as shown on the Project Drawings. The total quantity of engineered fill shall include the quantity of engineered fill placed to construct the finished subgrade surface and the quantity of engineered fill placed along Bench B, Bench C, Bench P and Pit Road after the construction of the finished subgrade surface. The total quantity of engineered fill placed to construct the finished subgrade surface shall be determined by comparing the pre-construction ground surface and the finished subgrade surface. For areas requiring the placement of engineered fill after the construction of the finished subgrade surface (Bench B, Bench C, Bench P and Pit Road), the total quantity for those areas shall be determined by comparing the surface prior to placement of engineered fill to the finished surface after the placement of engineered fill. The pre-construction ground surface shall be established by a combination of conventional ground survey and aerial flight survey, and the post-construction ground surface for this work shall be established by ground surveying at completion of the finished subgrade surface, prior to the placement of engineered fill along Bench B, Bench C, Bench P and Pit Road and at the completion of the finished engineered fill surface along Bench B, Bench C, Bench P and Pit Road. **Payment** for the placement of engineered fill shall be made based on the unit price per in-place cubic yard for engineered fill, as stated in the Contractor's Proposal, **Bid Item No. 24** - "Earthwork (Engineered Fill C4P3 Liner Expansion)" and shall constitute full compensation to the Contractor for all work related to the placement of engineered fill within the C4P3 Grading Limits including but not limited to: clearing, grubbing, excavation of material used for engineered fill and compaction.



- e. The **measurement** of the final quantity for **Bid Item No. 28** "Earthwork (C4P3 Over-Excavation and Placement of Engineered Fill)" shall be based on comparison of the original ground surface (pre-construction ground) and/or County-surveyed excavated subgrade surface and the County-surveyed ultimate over-excavation surface (limited as determined by the County and/or the QA/QC Consultant). The Contractor, therefore, shall notify the County in writing a minimum of two (2) days prior to the placement of engineered fill within the over-excavated areas, and shall allow two (2) working days for the County to complete necessary surveying work. Establishing these surfaces and measuring the final quantity shall be performed by the County pursuant to the aforementioned method of calculation. **Payment** for over-excavation and placement of engineered fill shall be made based on the unit price per in-place cubic yard of the total excavation quantity, as stated in the Contractor's Proposal, **Bid Item No. 28**.
- f. The **measurement** of the final quantity for **Bid Item No. 30** "Earthwork (Refuse Excavation & Disposal)" shall be determined in the refuse excavation area by comparing the County-surveyed refuse surface and the County-surveyed refuse excavation surface (limited as determined by the County and/or the QA/QC Consultant) within the approximate limits as shown on the Project Drawings. The Contractor, therefore, shall notify the County in writing a minimum of two (2) days prior to the excavation of the refuse encountered areas, and shall allow two (2) working days for the County to complete necessary survey work. The refuse excavation surface shall also be established by ground surveying after completion of refuse removal, prior to the placement of engineered fill. Establishing these surfaces and measuring the final quantity shall be performed by the County pursuant to the aforementioned method of calculation. **Payment** for refuse excavation and disposal shall be at the contract unit price per cubic yard as stated in **Bid Item No. 30** - "Earthwork (Refuse Excavation & Disposal)" and shall constitute full compensation to the Contractor for all work related to refuse excavation and disposal (within the designated areas) including but not limited to: furnishing all labor, supervision, materials, tools, and equipment; performing pioneering, clearing, grubbing; grading, re-grading, excavating, over-excavating, placing a minimum of one-foot (1') of clean interim cover over the exposed refuse surfaces, shaping, preparing, compacting, hauling, loading, Contractor surveying, compliance with all regulatory permits and conditions (including the SCAQMD 1150 permit), construction of temporary haul roads for refuse excavation and disposal in accordance with the Contract Documents.
- g. The **measurements** of the final quantity for **Bid Item No. 31** "Earthwork (Earthen Berm)" shall be determined by the County based on field measurements of the axial length (linear feet) of earthen berm constructed at the location and to the dimensions shown on the Project Drawings. **Payment** for the construction of earthen berm shall be at the contract unit price per linear foot as stated in the Contractor's Proposal, **Bid Item No. 31** and shall constitute full compensation to the Contractor for all work related to the construction of earthen berms in the project including but not limited to: furnishing all labor, supervision, materials, tools, and equipment; excavating, hauling, loading, moisture conditioning, compacting, grading, shaping, surveying, construction of temporary haul roads, and any other requirements by the Contract Documents for the construction of earthen berms.

- h. No additional compensation will be allowed for removal, reprocessing, or re-compaction of material not meeting the requirement of the Contract Documents. No payment shall be made for excavation or fill outside the limits as shown on the Plans.

END OF SECTION 9

## **10. WESTERN STOCKPILE**

### **10.1 GENERAL**

#### **10.1.1 Section Includes**

The work in this section shall include furnishing all labor, supervision, tools, equipment, and materials necessary to: haul earthen material from the C4P3 Grading Limits and Canyon 6 Stockpile, place and compact this earthen material as engineered fill, achieve design grades and elevations, and establish subgrade for surface drainage structures, access roads and a sedimentation basin. This work shall include, but is not limited to: clearing, grubbing, excavation, over-excavation, and placement and compaction of engineered fill within the Western Stockpile area as shown on the Project Drawings and as required by the Contract Documents.

#### **10.1.2 Quality Assurance/Quality Control**

All work shall be performed in accordance with the QA/QC Plan, under the ongoing observation of the County and QA/QC Consultant. The QA/QC Consultant shall verify that the engineered fill has been moisture conditioned and compacted adequately in accordance with the QA/QC Plan. The verification will be conducted by field-testing as well as visual observation of the operation. Contractor shall ensure that the required moisture content and density of all earthworks are achieved.

The Contractor shall supply labor and equipment for preparing test areas as requested by the QA/QC Consultant. When material has not been properly placed, moisture-conditioned, or compacted, as determined by observation or verification testing, such material shall be removed or reworked as necessary at the sole expense of the Contractor to obtain the required relative compaction and moisture content. When sand cone density tests, field permeability tests, or any other field tests are performed, no equipment shall be operated within the immediate vicinity of the test area or as requested by the QA/QC Consultant. This requirement is essential since the vibration produced by the construction equipment will adversely impact the testing results.

### **10.2 MATERIALS**

#### **10.2.1 Earthwork**

- a. The suitability of all earthen and manufactured materials shall be subject to the acceptance of the County and QA/QC Consultant. Fill materials shall not contain brush, roots, sod, or other deleterious or unsuitable materials. The maximum particle size for general engineered fill material for the Western Stockpile shall be approximately six (6) inches as determined by the QA/QC Consultant by visual inspection. Organic material and particles greater than the specified size shall be deposited in a separate stockpile, as directed by the County and QA/QC Consultant. Particles greater than the specified size shall be stockpiled in a location designated by the County. Organic material shall be deposited at the landfill working face as directed by the County.

- b. In the event the County or Contractor suspects any excavation/engineered fill material from the landfill is hazardous (as defined by CalRecycle or the Local Enforcement Agency), the Contractor shall stockpile the suspect material in a location separate from the rest of the excavated material. The Contractor shall immediately notify the County if excavation material is suspected to be hazardous. The County will make the appropriate analyses to determine if the suspected hazardous material is hazardous by CalRecycle or LEA definition. The Contractor shall dispose of determined hazardous material in the hazardous waste disposal site designated by the County. The Contractor shall be compensated for disposal of such hazardous waste. This work shall be considered as extra work and therefore; will be paid for in accordance with Section 2.7 of the General Provisions entitled "Extra Work". (Any hazardous material generated by the Contractor, including but not limited to spills or leaks during routine equipment maintenance or any spills caused by any of the Contractor's subcontractors or suppliers, shall be properly disposed of at the Contractor's expense as stated in the Contract Documents.)

### **10.2.2 Reinforced Shotcrete/Concrete Structures**

Refer to Section 8.2.1 of the Special Provisions.

### **10.2.3 Grouted Rip-Rap**

Refer to Section 8.2.2 of the Special Provisions.

### **10.2.4 Soil Cement Access Road**

Refer to Section 21.2.4 of the Special Provisions.

## **10.3 EXECUTION**

### **10.3.1 General Subgrade Preparation**

All work areas within the Western Stockpile limits shown on the Project Drawings shall be evaluated and accepted by the County and QA/QC Consultant to verify satisfactory completion of clear and grub work (including removal of Demolition items Section 6 as shown on the Project Drawings), penetration of the excavation into firm natural soils, and removal of all unsuitable materials. All unsuitable material found at the subgrade design elevations shall be excavated by the Contractor (under the direction of the QA/QC Consultant) and the area shall be backfilled to design elevations and grades with engineered fill in accordance with the requirements of Section 9.3.3 of these Specifications.

Unless otherwise noted or required, areas where engineered fill is to be placed, or in other areas where unsuitable materials have been removed and where the surface is judged to be loose or otherwise unsuitable, the subgrade shall be prepared as follows:

- a. The upper six inches (6") of in-situ material shall be ripped, moisture-conditioned, and re-compacted to a minimum of 90 percent relative compaction, at moisture content between

optimum moisture content (OMC) and  $\pm 2\%$  above OMC in accordance with ASTM D1557 or as determined by the County and QA/QC Consultant.

- b. The compacted surface shall be scarified to provide a good bond between the foundation material and the subsequent fill material, as appropriate.
- c. Areas of hard or dense, natural soil identified by the County and QA/QC Consultant shall be left undisturbed.

### **10.3.2 Over-excavation**

Refer to Section 9.3.3 of the Special Provisions.

### **10.3.3 Engineered Fill**

- a. Under the direction of the QA/QC Consultant, only suitable material encountered within the excavation areas shall be utilized in the engineered fill areas, and all unsuitable material shall be removed and hauled to the Canyon 6 Stockpile area designated on the Project Drawings, or as otherwise directed by the County.
- b. Where compacted engineered fill is required, as shown on the Project Drawings or as directed by the County or QA/QC Consultant, on-site soil shall be placed and compacted in layers as specified herein. The Contractor shall spread soil evenly by mechanical equipment over the prepared subgrade. The Contractor shall place engineered fill material in lifts with an uncompacted thickness no greater than eight (8) inches. Each lift shall be spread evenly and compacted to obtain a near uniform condition in each layer. In areas of lift thickness greater than specified herein, the Contractor, prior to construction of additional lifts, must complete re-grading and compacting of the surface to the maximum specified lift thickness. The top of each previously compacted layer shall be scarified so that there is no lamination between layers.
- c. Engineered fill material shall be compacted to a minimum of 90% relative compaction, based on the laboratory maximum dry density, determined by ASTM D1557. Engineered fill over cut slopes, or scarified natural steep slopes shall be properly keyed into undisturbed bedrock or firm material in accordance with the Contract Documents and as accepted by the County and QA/QC Consultant.
- d. Engineered fill material within the Western Stockpile limits shall be properly keyed in into the subgrade, with minimal keying depth at the toe of engineered fill slope of 2 ft.
- e. All general on-site soil material used for engineered fill shall have moisture content of not to exceed 2% above OMC in accordance with ASTM D1557 or as determined by the QA/QC Consultant. Additional water may need to be added at any time during construction. The moisture content of the engineered fill materials prior to and during compaction shall be uniform throughout each layer of the material.
- f. When the moisture content of the fill material is below optimum, water shall be added until the moisture content is within the limits required to assure an adequate bonding and compaction of

all fill material. When the moisture content of the fill material is above the specified limits, the fill material shall be aerated by plowing, disking, blading, or other satisfactory methods until the moisture content is acceptable. All plowing, tamping, blending, disking, or air drying of material is considered incidental to the work and no additional compensation will be allowed. Wetting of materials by rain or artificial means to acceptable moisture content will require mixing or air drying to return this material to the required moisture content. Complying with this requirement is considered incidental to the work and no additional compensation will be allowed.

- g. Based on the County's Earthwork Option selection(s), all remaining quantity of excavated excess material from the C4P3 Grading Limits shall be placed by the Contractor as engineered fill within the Western Stockpile Grading Limits as shown on the Project Drawings and/or for an Off-Site Dirt Haul. The selection to haul excess material excavated from the C4P3 Grading Limits off-site does not exempt the Contractor from completing construction of the Western Stockpile. After the excess material, as defined in section 9.1.1, is exhausted, the Contractor shall use material from the Canyon 6 Stockpile as the source material for engineered fill to complete the construction of the Western Stockpile to the finished design elevations and grades as shown on the Project Drawings.

#### **10.3.4 Reinforced Shotcrete/Concrete Structures**

Refer to Section 8.3.1 of the Special Provisions.

#### **10.3.5 Grouted Rip-Rap**

Refer to Section 8.3.2 of the Special Provisions.

#### **10.3.6 Soil Cement Access Road**

Refer to Section 21.2.4 of the Special Provisions.

### **10.4 MEASUREMENT AND PAYMENT**

- a. The measurement of the final quantity for ***Bid Item No. 25*** "Earthwork (Excess material hauled to Western Stockpile)" shall be based on the total quantity of engineered fill placed within the Western Stockpile Grading Limits, as shown on the Project Drawings, using material excavated from the Western Stockpile and excess material excavated from the C4P3 Grading Limits as the source material for the engineered fill. The total quantity of engineered fill placed within the Western Stockpile Grading Limits shall be determined by comparing the pre-construction ground surface and the finished engineered fill surface using only the source material listed above. The pre-construction ground surface shall be established by a combination of conventional ground survey and aerial flight survey, and the post-construction ground surface for this work shall be established by ground surveying of the finished engineered fill surface using only the source material listed in this paragraph. **Payment** for the placement of engineered fill shall be made based on the unit price per in-place cubic yard for engineered fill, as stated in the Contractor's Proposal, **Bid Item No. 25** - "Earthwork (Excess material hauled to Western Stockpile)" and shall constitute full compensation to the Contractor for all work related to the placement of engineered fill within the Western Stockpile Grading Limits using source material from the

Western Stockpile Grading Limits and C4P3 Grading Limits, including but not limited to: clearing, grubbing, excavation of material within the Western Stockpile Grading Limits, hauling of excess material from the C4P3 Grading Limits and compaction.

- b. The measurement of the final quantity for ***Bid Item No. 26*** "Earthwork (Material hauled to Western Stockpile from Canyon 6 Stockpile)" shall be based on the total quantity of engineered fill placed within the Western Stockpile Grading Limits, as shown on the Project Drawings, using only material hauled from the Canyon 6 Stockpile as the source material for the engineered fill. The total quantity of engineered fill placed within the Western Stockpile Grading Limits using source material from the Canyon 6 Stockpile shall be determined by comparing the finished engineered fill surface using source material from the Western Stockpile Grading Limits and C4P3 Grading Limits and the final finished subgrade surface for the Western Stockpile. The Contractor, therefore, shall notify the County in writing a minimum of three (3) days prior to the placement of engineered fill using source material from the Canyon 6 Stockpile, and shall allow three (3) working days for the County to complete necessary surveying work. The interim engineered fill surface and final subgrade surface for the Western Stockpile shall both be established by ground surveying. **Payment** for the placement of engineered fill shall be made based on the unit price per in-place cubic yard for engineered fill, as stated in the Contractor's Proposal, ***Bid Item No. 26*** - "Earthwork (Material hauled to Western Stockpile from Canyon 6 Stockpile)" and shall constitute full compensation to the Contractor for all work related to the placement of engineered fill within the Western Stockpile Grading Limits using source material from the Canyon 6 Stockpile, including but not limited to: clearing, grubbing, hauling of material from the Canyon 6 Stockpile and compaction.
- c. The **measurement** of the final quantity for ***Bid Item No. 29*** "Earthwork (Western Stockpile Over-Excavation and Placement of Engineered Fill)" shall be based on comparison of the original ground surface (pre-construction ground) and the County-surveyed ultimate over-excavation surface (limited as determined by the County and/or the QA/QC Consultant) as shown on the Project Drawings. The Contractor, therefore, shall notify the County in writing a minimum of two (2) days prior to the placement of engineered fill within the over-excavated areas, and shall allow two (2) working days for the County to complete necessary surveying work. Establishing these surfaces and measuring the final quantity shall be performed by the County pursuant to the aforementioned method of calculation. **Payment** for over-excavation and placement of engineered fill shall be made based on the unit price per in-place cubic yard for the excavated quantity, as stated in the Contractor's Proposal, ***Bid Item No. 29***.

END OF SECTION 10

## **11. OFF-SITE DIRT HAUL**

### **11.1 GENERAL**

This work shall consist of expenditures for all preparatory work and operations, including but not limited to: costs necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; and for all other work and operations which must be performed or costs incurred prior to beginning work on the various contract items on the project site. Throughout all phases of construction, including suspension of work and until final acceptance of the project, the Contractor shall keep the work site clean and free of refuse generated as a result of the Contractor's operations. Any such refuse shall be disposed of in County-designated sanitary landfills.

### **11.2 MATERIALS**

The Contractor shall provide fire extinguishers and first-aid kits on the project site to provide adequate protection to all personnel anticipated to be on the landfill site.

All of the aforementioned materials shall be made available for use by employees associated with the construction project, including (but not limited to) the County and any other agencies involved with the construction project.

All materials furnished for the execution of the work and purchases made by the County shall remain the property of the County. Any existing structures or installations shall be left in a condition that is at least equivalent to the condition prior to construction. The final condition of the construction site shall be subject to approval by the County.

The material is classified as Clayey Sand (SC) as indicated in the Hydraulic Conductivity Testing Program Results dated October 12, 2010 Appendix F.

#### **11.2.1 No Warranty Provided for Material**

THE COUNTY DOES NOT WARRANT THAT THE MATERIAL TO BE REMOVED BY THE CONTRACTOR WILL MEET THE CONTRACTOR'S NEEDS OR EXPECTATIONS OR THE NEEDS OR EXPECTATIONS OF ANY THIRD PARTIES. THE COUNTY DOES NOT WARRANT THAT THE MATERIAL WILL BE SUFFICIENT FOR THE CONTRACTOR'S PURPOSES. THE MATERIAL IS PROVIDED TO AND ACCEPTED BY THE CONTRACTOR "AS IS" AND WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (WHICH ARE HEREBY EXCLUDED).

NO ORAL OR WRITTEN INFORMATION OR ADVICE GIVEN BY THE COUNTY (INCLUDING ITS OFFICERS AND EMPLOYEES) SHALL CREATE ANY TYPE OF WARRANTY RELATED TO THE MATERIAL.



THE COUNTY DOES NOT INVITE RELIANCE BY THE CONTRACTOR (OR ANY THIRD PARTY) UPON THE MATERIAL TO BE REMOVED. THE CONTRACTOR HAS VOLUNTARILY CHOSEN TO REMOVE THIS MATERIAL AND ACCEPTS THE MATERIAL AT THE CONTRACTOR'S OWN RISK. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DETERMINING THE APPROPRIATENESS OF ACCEPTING THE MATERIAL.

THE CONTRACTOR ACCEPTS FULL AND COMPLETE RESPONSIBILITY FOR THE MATERIAL ONCE IT HAS BEEN REMOVED BY THE CONTRACTOR FROM THE LANDFILL SITE. COUNTY SHALL HAVE NO RESPONSIBILITY FOR THE MATERIAL AFTER IT HAS BEEN REMOVED FROM THE LANDFILL SITE BY THE CONTRACTOR. THE MATERIAL MAY NOT BE RETURNED TO THE COUNTY AFTER IT HAS BEEN REMOVED BY THE CONTRACTOR FROM THE LANDFILL SITE.

### 11.3 EXECUTION

- a. Upon receipt of the Notice to Proceed, the Contractor shall furnish, mobilize, and install such temporary works, materials, equipment, supplies, and personnel as necessary for the successful completion of the work. The Contractor shall also operate and maintain temporary works and equipment throughout the duration of construction. All temporary works, such as sanitation facilities, shall fully comply with applicable rules and regulations of governing authorities.
- b. Contractors shall remove and properly dispose of all refuse from the construction site. The County shall have the right to determine what refuse is, and to determine the manner and placement of on-site disposal. Any hydrocarbon-impacted soils found at the site as a result of the construction operation, such as equipment maintenance, shall be removed and properly disposed of at the Contractor's expense.
- c. Contractors shall obtain all necessary permits and permission to utilize public roads for mobilization, demobilization, and access to the site. Access to the site is available through existing public roads during the hours stated in Section 1.8 of these Special Provisions.
- d. Contractors shall install an access ramp for haul trucks between the excavation area and the designated contractor access route, which shall be constructed in accordance with Greenbook Section 300-4, and shall be subject to approval by the Department.
  - 1) Contractor shall propose the area limits for this ramp.
  - 2) Keying the fill material to the underlying hillside in accordance with Greenbook Section 300-4.4 shall be at the direction of the Department.
  - 3) Primary consideration shall be made to protect the in-place Geosynthetics Liner System and associated two-foot thick Protective Cover Soil layer throughout the course of this project.
  - 4) The Department will consider Contractor proposal for alternate/supplemental access between the designated contractor access route and the excavation area.

## 11.4 MEASUREMENT AND PAYMENT

- a. Option 3 -*Bid Item No. 27* "Earthwork (Off-site dirt haul)"- excess material excavated within the C4P3 Grading Limits shall be hauled off-site. Payment shall be made as a unit cost per cubic yard of removed material. The Contractor is solely responsible for all of the costs and expenses related in any way to performance of work. There shall be no payment to the Contractor for all labor, material, equipment and all other items necessary and incidental to completion of this project. No additional payment shall be made for any reason or for facilitating Contractor equipment/haul trucks to and from the excavation area.
- b. The Contractor is solely responsible for all of the costs and expenses related in any way to performance of the work. There shall be no payment to the Contractor for all labor, material, equipment and all other items necessary and incidental to completion of this project. No additional payment shall be made for any reason or for facilitating Contractor equipment/haul trucks to and from the excavation area.
- c. The quantity of material hauled off site by the Contractor shall be determined by using the truck load count method only. One truck load shall be equal to 12.5 cubic yards of material for double trailer bottom dump trucks, regardless of the amount of material which each truck actually contains. The Contractor shall not intentionally load a truck with more or less than 12.5 cubic yards of material. (Prior to using any other type of truck to remove material, the Contractor and the County must agree in writing to the cubic yard load to be used for such other type of truck.). The County and the Contractor shall agree on the total number of truck loads hauled off-site for each working day, within one working day. Both parties agree to reconcile the County daily load counts with the load counts on the actual trucking tags. Both parties agree to resolve any load count discrepancies by investigating the data on the County daily load counts and the actual trucking tags and coming to a mutually agreeable load count based on the data contained on the County daily load counts and those trucking tags and the dispatch logs. At the end of each working day, both parties will sign and agree to the load count in writing.
- d. The County reserves the right to select and weigh up to 10% of the Contractor's loaded trucks on any work day at the landfill site's scale.
- e. On or about the last day of each month, the County shall make an estimate in writing of the total amount material removed from the landfill by the Contractor to the time of such estimate and the value thereof.

END OF SECTION 11

## **12. LOW-PERMEABILITY LAYER (LPL)**

### **12.1 GENERAL**

#### **12.1.1 Section Includes**

This work shall include furnishing all labor, supervision, tools, equipment, and materials necessary to complete the work of constructing a Low Permeability Layer, "LPL", as shown on the Project Drawings and as directed by the County and QA/QC Consultant. This work includes the mixing and processing of low-permeability material for the composite liner construction, construction of a LPL test pad; the construction of a 24"-thick compacted LPL. All construction operations related to construction of the compacted LPL, including mixing, processing, placement, moisture conditioning, and compaction of the LPL, shall conform to applicable requirements of the Standard Specifications and to the requirements specified herein in the Contract Documents.

This process ultimately shall result in the construction of a compacted, 24"-thick layer achieving a laboratory hydraulic conductivity of  $1 \times 10^{-7}$  cm/sec or less, using the ASTM D5084, or USBR modified E-15 test methods or another test method approved equal. The compacted LPL shall be placed over areas of hard, dense, undisturbed, natural subgrade; properly prepared subgrade; or engineered fill subgrade as accepted by the County and QA/QC Consultant.

#### **12.1.2 Test Pad Construction**

Prior to construction of the LPL, the Contractor will be required to construct a LPL test pad. The purpose of this test pad is to evaluate the performance of the actual construction equipment that will be used for soil blending, processing, placement and compaction of the LPL. The parameters for construction of the test pad are dictated by these project specifications. The construction procedures used in construction of the test pad shall be same as those planned for the production phase of the project and shall comply with these Special Provisions.

The test pad shall be a minimum of 20 feet wide by 40 feet long and 24 inches thick. A larger test pad may be required if compaction equipment is not able to achieve operating speed during the test over the 40 foot length. All aspects of the subgrade preparation and fill construction shall be in accordance with these Special Provisions. The Contractor will allow two weeks from the date of completion of the test pad for receipt of test results. No additional contract time will be allotted as a result of this two week period.

If the test results indicate that the test pad meets the project requirements, the test area may be incorporated into the final liner section provided that the Contractor maintains the integrity of the LPL in accordance with the Special Provisions. If the test pad does not meet project requirements, all material shall be removed from the liner area and a new test pad constructed. Prior to construction, the Contractor shall submit for the review of the County, the proposed location of the test pad area, equipment to be used, and procedures to be used for mixing, processing and placement.

## 12.2 MATERIALS

The County has stockpiled clay material imported between October 1 and October 20, 1997 from Eastern Municipal Water Department's Skiland site to the landfill site as shown on the Drawings. The material to be used in the LPL shall consist of the 70% material from the "Clay Stockpile" and 30% material of the "Canyon 6 stockpile" and/or C4P3 project limits. The Contractor shall blend and process this material (the County recommends using a pug mill or an asphalt grinder) to break down large particles and clods and blend the two feedstocks. Resulting particles shall be no larger than one (1) inch in greatest dimension. The material shall be moisture conditioned to within the required moisture range.

The laboratory test results indicate that almost all of the material hauled from the "Clay stockpile" consisted of low plasticity clay with sand classified as CL on the Unified Soil Classification System (USCS), and the Canyon 6 stockpile material is classified as Clayey Sand (SC) as indicated in the Hydraulic Conductivity Testing Program Results dated October 12, 2010 Appendix F. The engineering parameters and the average values for the representative samples of materials tested are summarized below:

Parameters	"Clay Stockpile"	"Canyon 6 Stockpile"
Fine Content (% passing No. 200 Sieve)	84.2	44.3
Soil Type	CL	SC
Liquid Limit	?	?
Plasticity Limit	23	34
Maximum Dry Density (pcf)	119.3	130.8
Optimum Moisture (%)	13.3	8.6
Hydraulic Conductivity* (cm/sec)	$1.1 \times 10^{-8}$ to $9.8 \times 10^{-9}$	$1.1 \times 10^{-5}$ to $6.9 \times 10^{-6}$
* at 92 or 95 percent relative compaction and moisture content 2 to 4 percent wet of optimum		

Based on the laboratory test results for the LPL shall consist of the 70% material from the "Clay Stockpile" and 30% material of the "Canyon 6 stockpile" material that when blended, processed and compacted to a **relative compaction** of at least **95 percent** and **moisture content 2 to 4 percent over optimum**, should meet or exceed the required **hydraulic conductivity of  $1.0 \times 10^{-7}$  cm/sec or less**.

## 12.3 EXECUTION

### 12.3.1 General Requirements

The equipment and procedures shall be identical to those used in construction of the low-permeability test pad. The Contractor may use alternative equipment or procedures than those used in the construction of the test pad with the prior written acceptance of the County. The County's acceptance will be contingent upon the Contractor's construction of one or more test pads using

alternative equipment and/or procedures. The cost of the QA/QC Consultant services for the additional test pad(s) will be borne by the Contractor. Any acceptance of alternate equipment or methods shall not relieve the Contractor of the responsibility of obtaining the specified compaction and required permeability. The County and QA/QC Consultant shall evaluate the Contractor's equipment and procedures on an ongoing basis. Proper grade control shall be employed to ensure proper thickness of each successive lift as well as the overall thickness of the LPL. The Contractor shall control lift thickness with a laser source and receiver mounted on a grader or other method approved equal. The test pad construction equipment and procedures shall form the basis of the construction procedures which shall include at least all of steps outlined in these Special Provisions.

### **12.3.2 Construction and Placement**

Construction and placement of the compacted LPL at the site shall be in accordance with the Contract Documents, and as directed by the QA/QC Consultant and the County.

### **12.3.3 Moisture Conditioning of Mixed Material**

The mixed "clay and regular" material for the construction of the LPL shall be moisture conditioned, thoroughly mixed, and disked or rotomixed to break down the material clods and provide uniform moisture content. The moisture content shall be within 2 to 4 percent above the optimum moisture content as determined by ASTM D1557 or as determined during test pad construction. If the moisture content in the stockpile area is higher than the permissible limits, the material will be thoroughly disked and allowed to air dry before placement.

### **12.3.4 Spreading and Placement of the LPL**

Placement of the mixed "clay and regular" material for the construction of the LPL shall begin after the County Surveyor has verified the constructed subgrade. The material shall be hauled from the stockpile and shall be uniformly spread on the prepared and scarified subgrade surface in thin, horizontal lifts (parallel to the bottom of the landfill) lifts with a maximum un-compacted thickness not to exceed eight (8) inches. Each layer shall be thoroughly mixed to obtain a near uniform condition in each layer. In areas of excess lift thickness, re-grading of the surface to the maximum lift thickness will be completed prior to proceeding with compaction in that area. Removal of oversize particles (greater than one inch) shall be performed on the fill by approved rock rakes or other equipment, as accepted by the County and QA/QC Consultant. Any clay clods greater than one inch shall be broken down by suitable equipment.

### **12.3.5 Moisture Conditioning of the LPL**

After spreading and removing oversize particles, the lift shall be moisture conditioned by a carefully controlled spray nozzle and disked or processed by appropriate means to achieve uniform moisture conditioning. **The moisture content shall be in the range of 2 to 4 percent over optimum as determined during test pad construction.**

If the moisture content of the low-permeability material in the previous lift becomes too high due to rain or the Contractor's construction methods (greater than four percent (4%) above OMC or as determined by the QA/QC Consultant), the Contractor shall remove the material and haul it to the

stockpile area or, at the direction of the QA/QC Consultant and with the acceptance of the County, may disc and rework the low-permeability material.

If moisture content of the low-permeability material spread on previous layer is too high, (with a moisture content of greater than four percent (4%) above OMC or as determined by the QA/QC Consultant), or if proper compaction is not being achieved due to excessive moisture, the Contractor shall remove the material or permit it to dry, assisting it by disking and harrowing, as necessary, until the moisture content is reduced to between 2 to 4 percent above OMC. If material is left to dry, no material may be placed over the wet material until it has been dried to the proper moisture content, reworked, and properly compacted to the satisfaction of the County and QA/QC Consultant.

If the moisture content of the low-permeability material is less than specified (less than 2 percent above OMC), the Contractor shall spray water on the layer, and shall work the moisture into the layer by harrowing or using other methods accepted by the County and QA/QC Consultant, until a uniform distribution of moisture at the proper moisture content is obtained.

#### **12.3.6 Compaction of the LPL**

Following moisture conditioning, each lift shall be compacted by a compaction method proposed by the Contractor and accepted by the County and QA/QC Consultant. The low-permeability material shall be compacted to a dry density of at least 95 percent of the maximum dry density determined by ASTM D1557. If additional compaction is required to obtain the required hydraulic conductivity, the cost of such additional compaction effort shall be borne by the Contractor. The required minimum degree of compaction shall have been demonstrated by the construction of test pad(s). The compaction shall be increased if the minimum density is not achieved within the required moisture content range at the sole expense of the Contractor. The compacted lift thickness shall not exceed six (6) inches.

#### **12.3.7 Soils Testing of the LPL**

The QA/QC Consultant will perform gradation analysis, in situ density tests, and in situ hydraulic conductivity tests and will recover representative tube samples for laboratory hydraulic conductivity tests. Both the compaction and the hydraulic conductivity testing shall be performed by the QA/QC Consultant at the County's expense. If some test samples have failed the compaction tests and/or if the Contractor failed to follow proper procedures in achieving required compaction as specified in these specifications and the QA/QC plan, the failed areas shall be reworked by the Contractor at the direction of the QA/QC Consultant and the County at the Contractor's expense. The re-test of areas which have failed the specified tests shall be performed by the QA/QC Consultant at the Contractor's expense.

#### **12.3.8 Finished Surface of the LPL and Placement of FML**

The successive lifts of the LPL shall be bonded by scarifying a portion of the lower lift to prevent lamination of the fill. The total compacted thickness of the LPL shall be a minimum of twenty four inches (24") as shown on the Project Drawings. After construction and compaction of the LPL as specified and required by the Contract Documents, the finished surface of the LPL shall be graded and proof rolled with a steel drum roller to the elevations shown on the Project Drawings to create a

smooth and uniform surface free of rocks, debris, sharp objects or any other objects which may damage the FML. The finished LPL shall be smooth, uniform and free of depressions that could potentially "pool" leachate. The finished top surface of the LPL shall be compatible with the FML and manufacturer's and installer's recommendations and as specified in Section 16 of these Special Provisions. The LPL surface shall be covered with the FML as soon as practicable to minimize development of desiccation cracks, saturation, or erosion damage. The maximum time limit allowed prior to covering the LPL is three (3) calendar days. Any cracking, saturation, or erosion which occurs prior to covering with the FML shall be repaired at the direction of the QA/QC Consultant to the satisfaction of the County at the sole expense of the Contractor.

### **12.3.9 Construction Scheduling to Protect the LPL**

The Contractor shall submit a phased construction plan with the construction schedule for the County's acceptance within ten (10) calendar days of issuance of Notice to Proceed. This phased construction plan shall include a map showing the location and size of all LPL areas (or portions thereof) to be constructed, and shall outline the installation schedule for all components of the bottom liner system. The bottom FML shall be completely deployed and fusion welded within five (5) calendar days after beginning of deployment. All other welds for the bottom FML liner shall be completed as soon as possible after deployment. Consideration should be made to timing of weekends and holidays in the development of this schedule. The purpose of these scheduling constraints is to protect the LPL in the event of adverse weather conditions during the installation of the LPL. The Contractor may submit alternative approaches for consideration and acceptance by the County and QA/QC Consultant.

### **12.3.10 Stockpiling Prohibited on the Subgrade**

The Contractor shall not stockpile any materials on the subgrade unless acceptance is granted in writing by the County.

### **12.3.11 Protection from Desiccation, Erosion, and Saturation**

The compacted LPL shall be maintained at moisture content between 2 and 4 percent above OMC and shall be prevented from drying or becoming saturated prior to placement of the FML. Any compacted LPL surface shall be moisture conditioned at least every day. Any drying, cracking, rutting, saturation, or unevenness shall be repaired and re-compacted to the satisfaction of the County and QA/QC Consultant.

If rain is expected, the LPL shall be temporarily covered to protect it from damage due to excess moisture. Covering material shall consist of the required FML layer or a synthetic protective cover accepted by the County and QA/QC Consultant. Extreme care shall be exercised in removing any temporary cover layer, so the compacted LPL is not damaged. Any resulting damage that occurs shall be repaired by the Contractor by removal, reprocessing, and re-compaction of material to the satisfaction of the County and QA/QC Consultant. Costs associated with protection of the LPL, removal of temporary cover materials or repair of the LPL due to damage of any kind shall be borne by the Contractor with no additional payment allowed.

### **12.3.12 Quality Assurance/Quality Control (QA/QC)**

All work shall be performed in accordance with the QA/QC Plan under the ongoing observation of the County and QA/QC Consultant. During construction of the LPL, the County shall have the authority to order an immediate stoppage due to improper procedures or for any other reason, including inclement weather that, in the sole opinion of the County or the Consultant, may result in a defective compacted LPL.

#### 12.4 MEASUREMENT AND PAYMENT

- a. The **measurements** of the final quantity for *Bid Item No. 32* – “Construct LPL” shall be measured in place, after the specified moisture content and relative compaction has been achieved, resulting in the specified hydraulic conductivity. Quantities shall be calculated using digital terrain modeling, to the nearest cubic yard, based on the County's measurements and survey before and after the placement of the compacted LPL. The County shall complete a topographic survey to verify that the completed compacted LPL location, thickness, slopes and elevations of the finished surface are in accordance with the Project Drawings. Allowable deviation from the Project Drawings grades shall be  $\pm 0.10$  feet with the additional requirement that the thickness of the LPL shall be 2.0 feet  $+0.10$  feet,  $-0.00$  feet. Payment shall be made for the Compacted LPL, after acceptance, at the unit price per in-place cubic yard for this item, as stated in the Contractor's Proposal, *Bid Item 32*. No additional compensation shall be given for any removal, reprocessing, or re-compaction of material not meeting the specifications described in this section. All other work required to complete the compacted LPL installation, but not specifically described herein, shall be considered incidental to the work and will not be paid for separately.

No additional compensation will be allowed for removal, reprocessing, or re-compaction of material not meeting the requirement of the Contract Documents. No payment shall be made for excavation or fill outside the limits as shown on the Plans.

**END OF SECTION 12**



## 13. FINISHED SUBGRADE SURFACE PREPARATION FOR GEOSYNTHETICS

### 13.1 GENERAL

#### 13.1.1 Section Includes

This section includes the work necessary to finish the surfaces of earth subgrade within the limits to receive geosynthetics on side slopes and benches. All costs associated with finished subgrade surface preparation (FSSP) for geosynthetics shall be included in **Bid Item No. 33**. The finished subgrade surface preparation for geosynthetics for bottom liner shall be in accordance with the requirements of Section 13.3 of the Special Provisions.

#### 13.1.2 References

Reference Standards and Specifications: The following standards and specifications, including documents referenced therein, form part of these Special Provisions and are incorporated herein by reference.

***American Society for Testing Materials (ASTM)***

***D6102*** Standard Guide for Installation of Geosynthetic Clay Liners

#### 13.1.3 QA/QC

All work shall be performed in accordance with the QA/QC Plan.

Prior to the start of work, the Contractor shall discuss with the County, at a minimum, the procedures, equipment and techniques to be used to prepare subgrade surfaces. The County shall have the authority to order an immediate stoppage of work because of non-standard preparation procedures, or for any condition which may result in a deficient earth subgrade surface to receive the geosynthetics.

### 13.2 MATERIALS

Materials shall comply with the applicable requirements of Section 1.1, "Materials" for on-site soils as required.

### 13.3 EXECUTION

- a. Prior to the start of preparation of the earth subgrade surface to receive the geosynthetics on side slopes and benches, a site inspection shall be conducted by the Contractor, the County and QA/QC Consultant to verify surface conditions required to support the geosynthetics. All areas receiving geosynthetic liner shall be smooth drum rolled prior to installation of geosynthetics.
- b. Before final rolling and compaction of the earth subgrade commences, it shall be free from abrupt breaks, sharp objects and other foreign materials that may inhibit proper placement of

geosynthetics on the subgrade. For areas not accessible to large compaction equipment, final smoothing of the earth subgrade surface shall be performed by approved mechanical or hand tamping methods, as accepted by the County and QA/QC Consultant.

- c. The surfaces of the completed earth subgrade shall be smooth, uniform and free from sudden changes in grade, surface voids and un-compacted areas. Final finish subgrade surface preparation shall not precede the geosynthetics installation by more than 48 hours, in order to minimize potential damage due to wind, rain and the actions of man and animals. The surface of the earth subgrade shall be prepared to the tolerances and conditions specified in the Contract Documents.
- d. The subgrade surfaces shall have a smooth finished surface and shall be prepared according to ASTM D6102. The surface shall not be pebbly or tracked and rutted by equipment and shall be free from pockets, holes, and discontinuities that in the judgment of the County and QA/QC Consultant could cause bridging and over stressing of the liner. In addition, all rocks or coarse particles projecting by more than 3/8-inch above the finished surface shall be buried or removed.
- e. The finished subgrade surface shall not be wet or in any condition which will impede proper installation of the liner. Under no circumstances shall the geosynthetics be placed over standing or running water on the subgrade. The Contractor shall be responsible for maintaining the integrity of the geosynthetic liner throughout the duration of the project. Vehicles or personnel that may damage the subgrade or cause ruts shall be kept off the subgrade once the surface is constructed to the design elevations.

### 13.4 MEASUREMENT AND PAYMENT

- a. The **measurement** of the final quantity for **Bid Item No. 33** "*Finished Subgrade Surface Preparation for Geosynthetics*" shall be based on final square footage of ground surface after it has been prepared and tested to the satisfaction of the County and QA/QC Consultant. The area of the final ground surface shall be determined by the County based on conventional ground surveying method. Quantities shall be calculated based on "true" area and to the nearest square foot. Limits of surface to be prepared are shown on the Project Drawings. No separate payment shall be made for finish subgrade preparation for the Low Permeability Layer on canyon floor area, the payment for this work shall be deemed to have been included under Bid Item No. 32 for the Construction of the Low Permeability Layer. **Payment** for finished subgrade preparation shall be at the contract unit price per square foot as stated in **Bid Item No. 33** and shall constitute full compensation to the Contractor for all work related to Finished Subgrade Surface Preparation on side slopes and bench areas within the geosynthetic liner limits in the project including but not limited to: furnishing all labor, supervision, materials, tools, and equipment necessary to finish the surfaces of earth subgrade to receive geosynthetics in accordance with the Contract Documents.

END OF SECTION 13

## **14. ANCHOR BENCH CONSTRUCTION**

### **14.1 GENERAL**

#### **14.1.1 Section Includes**

This work shall include furnishing all labor, supervision, tools, equipment, and materials necessary to complete the work of securing GCL, FML and Geotextiles along benches and slope alignments in accordance with the Contract Documents and Project Drawings. This work includes but is not limited to the placement of the GCL, FML and Geotextiles along the benches shown on the Project Drawings to the lengths along the benches as indicated in the design details; screening material placement on the bench; and placing and compacting the screened material as specified in Section 14.3.3 "PCS Placement and Compaction". All construction of the anchor benches shall conform to applicable requirements of the Standard Specifications and to the requirements of the Contract Documents.

### **14.2 MATERIALS**

Material to be placed over the GCL, FML, and/or Geotextiles shall have maximum particle size no greater than one inch (1"). The Contractor shall screen material obtained from the designated soil stockpile areas or directly from the project excavation area to produce the required material. The soil used for the anchor bench shall be free from organic or other unsuitable material. In general, PCS materials shall be prepared and comply with the applicable material requirements of Section 19.2.a, "Materials" for the PCS layer for the side-slope liner and benches.

### **14.3 EXECUTION**

#### **14.3.1 Anchor Bench Requirements**

Slightly rounded corners shall be provided at the hinge of benches where the FML, GCL and geotextile are laid, so as to avoid sharp bends in the FML, GCL and geotextile. All sharp or protrusive objects, which could cause damage to the FML, GCL and geotextile, shall be removed from the bench in such a manner as to maintain the integrity of the bench. The FML, GCL and geotextile should be placed on the bench such that it extends across the bench; excess material if any, should be cut off and not folded over the top of the existing material. Areas of the bench, which are damaged by the removal of unacceptable material from the bench, shall be repaired to the satisfaction of the County and QA/QC Consultant. No loose soil shall be allowed to underlie the FML, GCL and geotextile. No water shall be impounded in the under the material on the bench. Compliance with the requirements of this section is considered to be part of this item of work and no additional compensation shall be allowed for complying with this section.

#### **14.3.2 Securing of FML, GCL and Geotextile**

The Contractor shall use sandbags filled with one-inch minus material to secure the ends of the FML, GCL and geotextile panels on the anchor bench while the seaming takes place, prior to placement and compaction of PCS on top of materials on the benches.

### 14.3.3 PCS Placement and Compaction

- a. Only screened materials (1" maximum particle size) shall be used on top of the anchor bench as required in Section 14.2 of these specifications.
- b. Sequencing for placement and compaction of protective cover soil on the bench shall be done in such a manner that the FML, GCL, and geotextile are completely seamed and approved by the QA/QC Consultant prior to receiving PCS. The progression of placement and compaction of PCS shall proceed in such a manner that **no more than 100 lineal feet of bench contains FML, GCL and geotextile panels** which have been completely seamed and approved by the QA/QC Consultant but have not received PCS. At the end of each day, all FML, GCL and geotextile panels, which have been seamed, tested, and approved by the QA/QC Consultant, shall either have sufficient sandbags to secure the synthetic liner system or have received PCS.
- c. PCS placement on top of benches shall be placed in maximum eight-inch (8") thick loose lifts (as accepted by the County and QA/QC Consultant) and compacted by equipment without causing damage to the synthetic liner system and as accepted by the County and QA/QC Consultant.
- d. Compaction and required moisture content shall be in accordance with the requirements of Section 9.3.4, "Engineered Fill". A minimum of 90% relative compaction (ASTM D1557) is required. At no time shall construction equipment come into direct contact with the geosynthetic liner system. If damage occurs, it shall be repaired by the Contractor at its expense prior to the completion of placement and compaction.

## 14.4 MEASUREMENT AND PAYMENT

- a. The **measurement** of anchor benches shall be paid under **Bid Item No. 46** "Construct PCS Layer (1" minus)" shall be determined by the County in terms of cubic yards placed. This work shall constitute full compensation to the Contractor for all work related to the construction of anchor benches as required by the Contract Documents and shall include but is not limited to: placement and compaction of protective cover soil, screening material, securing the ends of GCL, FML geotextile and, along Bench P only, temporary protective membrane panels, and all other related work. **Payment** shall be made, at the unit price per actual cubic yard of placed compacted protective cover soil as stated in the Contractor's Proposal, **Bid Item No. 46**. No additional payment will be allowed for any removal, replacement, re-compaction or any other repairs required to provide an anchor bench in compliance with the Contract Documents. All other work required to construct the anchor bench but not specifically described herein, shall be considered incidental to the work and will not be paid for separately.

END OF SECTION 14

## 15. GEOSYNTHETIC CLAY LINER (GCL)

### 15.1 GENERAL

#### 15.1.1 Section Includes

This item of work shall include furnishing all labor, supervision, tools, equipment, and material necessary to complete the work of installing a Geosynthetic Clay Liner (GCL). The GCL shall be installed on the side slopes, and benches within the limits shown on the Project Drawings and as directed by the County.

All construction operations relating to the installation of the GCL shall conform to applicable requirements of the Standard Specifications, to the requirements of the Contract Documents and the manufacturer's recommendations. This process shall result in the installation of a continuous GCL that meets or exceeds the specified minimum average roll values (MARV) in Section 15.2 of the Special Provisions.

#### 15.1.2 References

The following reference standards and specifications, including documents referenced therein, form part of this section:

**American Society for Testing and Materials (ASTM):**

- |                               |  |
|-------------------------------|--|
| <b><i>D 4632-08</i></b>       | Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.   |
| <b><i>D4643-08</i></b>        | Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.   |
| <b><i>D5261-10</i></b>        | Standard Test Method for Measuring Mass per Unit Area of Geotextiles.  |
| <b><i>D5321-08</i></b>        | Standard Test Method for Determining the Coefficient of Soil and Geosynthetics or Geosynthetic and Geosynthetic Friction by the Direct Shear Method. |
| <b><i>D5887-09</i></b>        | Standard Test Method for Measurement of Index Flux through Saturated Geosynthetic Clay Liners Using Flexible Wall Permeameter.                       |
| <b><i>D5888-02 (2006)</i></b> | Standard Guide for Storage and Handling of GCL.  |
| <b><i>D5889-97 (2008)</i></b> | Standard Practice for Quality Control of GCL.  |
| <b><i>D5890-06</i></b>        | Standard Test Method for Swell Index of Clay Mineral Component of GCL.   |
| <b><i>D5891-02 (2009)</i></b> | Standard Test Method for Fluid Loss of Clay Component of GCL.  |

**D5993-99 (2009)** Standard Test Method for Measuring Mass per Unit Area of GCL.

**D6102-06** Standard Guide for Installation of Geosynthetic Clay Liner.

**D6241-04 (2009)** Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

**D6243-09** Standard Test Method for Determining the Internal and Interface Shear Resistance for Geosynthetic Clay Liner by the Direct Shear Method.

### 15.1.3 Submittals

a. Prior to the start of work, the Contractor shall furnish the following:

i. The Contractor shall prepare and submit installation drawings (using AutoCAD or Microstation software application), description of installation procedures, and a schedule for performing/completing the work. Installation drawings shall show a GCL sheet layout with proposed size, number, position, and sequence of placing of all sheets and indicating the location of all field seams. Installation drawings shall also show complete detail and methods for anchoring the GCL at its perimeter.

ii. The Contractor shall submit six (6) representative samples of GCL material which has been made in conformance with these specifications. The samples shall be numbered and dated. Sample size shall be 4-inch x 4-inch.

iii. Complete material specifications, installation instructions, descriptive drawings, literature and field quality control plan.

iv. Method(s) for handling and storage of GCL material(s) prior to installation.

b. Prior to shipment of the GCL material, the Contractor shall furnish the following:

i. GCL manufacturer's QA/QC certifications to verify that the materials supplied for the project are in accordance with the requirements of these specifications. This will include the results of actual QC testing on the representative rolls from the project shipment. Those results shall include the results of index flux tests by ASTM D5887.

ii. The manufacturer shall submit a letter of intent to furnish manufacturer's warranty covering materials and workmanship of the GCL prorated for a period of not less than 20 years after the installation of the material. An executed original of the manufacturer's warranty shall be submitted 5 days after complete installation of the GCL material. The warranty shall warrant against manufacturing defects. The manufacturer's standard warranty shall also warrant against deterioration due to ozone, ultraviolet light or other normal weather aging. The warranty shall be limited to replacement of material only, and shall not cover installation of said material. It shall not cover damage due to vandalism, acts of animals, earthquakes and other acts of God.

iii. The Contractor shall furnish a written guarantee that the GCL installed is free of defects in material and workmanship. The guarantee for the GCL installed shall extend for a period of one (1) year following the final acceptance of the complete project. During the 11<sup>th</sup> month, a pre-guarantee expiration inspection of the exposed portions of the lining will be conducted to identify any necessary repair work covered by the guarantee. The Contractor shall agree to make any repairs or replacements found necessary by defects in material or workmanship which becomes evident within said guarantee period. The Contractor shall make repairs and/or replacements promptly upon receipt of written order from the County. If the Contractor fails to make repairs and/or replacements promptly, the County may do so, and the Contractor shall be liable to the County for the cost of such repairs and/or replacements.

c. Prior to installation of the GCL material, the Contractor shall submit the following:

i. Complete description of installation procedures including seaming procedures for field seams and repairs. Seaming procedures shall conform to the latest procedures recommended by the GCL Manufacturer and these specifications.

ii. Certification that the surface(s) on which the GCL will be placed is acceptable and in conformance with the recommendations of the GCL Manufacturer and these specifications. Installation of the GCL shall not commence until this certification is furnished to and accepted by the County and QA/QC Consultant.

iii. The Contractor shall allow at least two (2) weeks for GCL material conformance testing by QA/QC Consultant before the material is scheduled to be installed on the project.

#### 15.1.4 QA/QC

All installation of the GCL shall be in accordance with the QA/QC plan, under the ongoing observation of the County and QA/QC Consultant. During the installation of the GCL, the County shall have the authority to order an immediate stoppage due to improper procedures or for any other reason, including but not limited to inclement weather, that, based on the County's and QA/QC Consultant's opinion, may result in a defective installation of the GCL.

Daily reports shall be submitted by the Contractor to the County prior to 11:00 a.m. documenting work accomplished the previous day including all personnel and equipment on site, quantities of material received, panels placed, seaming completed, tests performed, repairs made, weather conditions and other comments relative to the progress of the work.

#### 15.1.5 Safety

Prior to installation of the GCL system, the Contractor shall instruct the workmen and the lining subcontractor's superintendent about safety procedures pursuant to local, State, and Federal requirements. The Contractor shall ensure that workers have and use safety gear and equipment required by local, State and Federal requirements. The Contractor shall instruct the workmen relative to the difficulties and potential hazards involved in handling the GCL, including, but not limited to installation during periods of high winds, rain, extreme heat, breathing of fine dust during

bentonite seaming, walking on steep slopes, and working with and around any crane or high-lift used to place the rolls of GCL.

The Contractor shall provide safety equipment pursuant to applicable local, State, and Federal requirements for its personnel, and facilitate access to work area for the County's personnel and QA/QC Consultant's representatives for testing and inspection. Approved personal fall arrest, personal fall restraint or positioning systems shall be worn by those employees whose work exposes them to falling in excess of 7 1/2 feet from the perimeter of a structure, unprotected sides and edges, leading edges, through shaft ways and openings, sloped roof surfaces steeper than 7:12, or other sloped surfaces steeper than 40 degrees. Particular attention shall be given to relevant Division of Industrial Safety Construction. Said Orders are contained in Title 8 of the California Code of Regulations, Chapter 4, and Subchapter 4. Specific reference is made to Article 24 of said Construction Safety Orders.

The County shall have the authority to order an immediate stoppage of work because of improper installation procedures, noncompliance with the QA/QC Plan, safety infractions or for any reason which may result in a defective or unsafe installation of the GCL.

#### **15.1.6 Product Labeling**

Prior to shipment, the GCL manufacturer shall affix a label to each roll identifying the following characteristics:

- a. Product identification information (manufacturer name and address, brand name, product code)
- b. Lot number and roll number.
- c. Roll length and width.
- d. Total roll weight.

#### **15.1.7 Packaging**

The GCL shall be wound around a cardboard core to facilitate handling. The core is not intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit. All rolls shall be labeled and bagged in watertight packaging that is resistant to photo degradation by ultraviolet (UV) light.

#### **15.1.8 Shipping, Handling, Delivery and Storage**

The Contractor shall assume responsibility for initial loading and shipping of the GCL, unloading, on-site handling, and storage. The Contractor shall ensure that the GCL rolls are transported on **flat bed trucks**. Unloading shall be performed **using fabric straps only**. These straps, as supplied by the Contractor, shall be ready for usage at the arrival of each shipment. If the Contractor elects to use a different type of truck or a different method of unloading, the Contractor shall in advance submit a written request outlining the type of trucks, equipments, and method detailing its plan for



the County's review. The County will respond to the Contractor's request in writing and the County's decision will be final. A visual inspection of each roll shall be made as it is unloaded to identify if any packaging has been damaged. Rolls with damaged packaging shall be marked and set aside for further inspection. The packaging shall be repaired prior to being placed in storage.

Prior to shipment and before unloading the GCL, the Contractor shall contact the manufacturer to ascertain the appropriateness of the proposed unloading methods and equipment to be utilized. Storage of the GCL rolls shall be the responsibility of the Contractor. The GCL shall not be stored directly on the ground. The storage area will be such that the GCL is protected from damage by water, mud, debris or ultraviolet light. Rolls of GCL material **shall not be stacked higher than two rolls** or in accordance with the GCL manufacturer's recommendations but never more than can be safely managed considering site conditions, equipment and personnel.

Rolls should be stored in accordance with the GCL manufacturer's recommendations and in a manner that prevents sliding or rolling from the stacks; and may be accomplished by the use of chock blocks or by use of the dunnage shipped between rolls. All stored GCL materials and the accessory bentonite must be covered with a water tight, ultraviolet light resistant plastic sheet or tarpaulin until installation. The Contractor's attention is directed to ASTM D 5888 "Standard Guide for Storage and Handling of GCL" in addition to the above requirements.

## 15.2 MATERIALS

GCL materials shall be certified by the manufacturer to comply with the material specifications as required by the Contract Documents. GCL shall be a new, high quality product designed and manufactured specifically for the purposes of this type of work. Its suitability and durability for this type of work shall have been adequately demonstrated by prior applications. The GCL rolls shall be shipped and stored in opaque and watertight wrappings.

The GCL installation shall be performed under the ongoing observation of the County and QA/QC Consultant, and according to the QA/QC Plan. The Contractor shall be responsible for detecting and repairing all damaged areas. A "lap" line and a "match" line shall be imprinted on both edges of the upper geotextile component of the GCL as a means for providing quality assurance of the overlap. Lines shall be printed in easily visible, non-toxic ink.

The Manufacturer's certification shall demonstrate that the GCL meets or exceeds the following MARV Values:

Property	Unit	Test Method	Value	QA/QC Conformance Testing (Y/N)
<b>Bentonite*: (For GCL)</b>				
Fluid Loss	ml	ASTM D 5891	18(max.)	N
Swell Index	ml/2g	ASTM D 5890	24 (min.)	N

Property	Unit	Test Method	Value	QA/QC Conformance Testing (Y/N)
<b>Bentonite*: (For GCL)</b>				
Moisture Content	%	ASTM D 4643	20 (max.)	N
<b>Geotextiles as Part of GCL (Non-woven):</b>				
Composition	Needle Punched/Slit Film (Polyethylene or Polypropylene)			
Mass/Unit Area	oz/sy	ASTM D 5261	6	N
<b>GCL as Total</b>				
Mass/Unit Area @ 0% moisture	Psf	ASTM D 5993	0.75 (min.)	Y
Moisture Content	%	ASTM D 4643	30(max.)	Y
Hydraulic Flux**	m <sup>3</sup> /m <sup>2</sup> /sec	ASTM D 5887	1x10 <sup>-8</sup> (max.)	Y
Grab Strength	lbs	ASTM D 4632	150	Y
Grab Elongation	%	ASTM D 4632	10(min)	Y
Puncture Resistance	lbs	ASTM D 4833	65	N

\*Bentonite used to fabricate the GCL shall be composed of at least 90% sodium montmorillonite

\*\*At 5 psi confining pressure.

## 15.3 EXECUTION

### 15.3.1 Inspection

Prior to installation of the GCL on side slopes, a site inspection shall be conducted by the County, QA/QC Consultant and Contractor to verify measurements, subgrade compaction and surface conditions to support the GCL. The side slopes surface upon which the GCL is installed shall be prepared and compacted in accordance with Section 13 in these Contract Documents and Project Drawings. All surfaces to be lined shall be smooth and free of debris, material, roots and sticks, and sharp or angular rocks protruding more than 3/8-inch above finish grade. The level of compaction should be such that no rutting is caused by installation equipment or other construction vehicles.

Immediately prior to GCL deployment on side slopes, the subgrade shall be fine-graded to fill in all voids, cracks or erosion and then smooth-rolled to provide a suitable surface for the GCL installation. At completion of this activity, no sharp irregularities or abrupt elevation changes shall exist in the subgrade. Adequate drainage of the subgrade shall be provided and maintained until installation of the GCL is completed. The County will inspect the work daily to confirm that

drainage is provided. The liner subcontractor shall certify to the QA/QC Consultant in writing its acceptance of the subgrade before GCL placement.

It shall be the Contractor's responsibility thereafter to inform the QA/QC Consultant or the County of any change in the condition of the subgrade that could cause the subgrade to be out of compliance with the requirements of the Contract Documents. During unwrapping of the GCL, the Contractor shall visually inspect all materials, particularly the surfaces of the geotextile portion of the GCL for imperfections and faulty areas. All such defective areas of the sheets shall be marked and repaired in accordance with approved methods.

### 15.3.2 Installation

#### a. General Requirements

The GCL installation shall be conducted in accordance with the accepted panel layout installation drawings, the manufacturer's recommendations, and the Contract Documents. Any deviations must be accepted in writing in advance by the County.

*The minimum panel width in the anchor trench shall be three (3) feet. It is the responsibility of the Contractor to remove any panels that may be stressed due to the three (3) feet minimum requirement. The above requirement does not relieve the Contractor from its responsibility to maintain the integrity of the liner until final acceptance by the County.*

#### b. GCL Deployment

The use of equipment capable of freely suspending the GCL roll is required. A spreader bar and core pipe are also required for supporting the roll and allowing it to unroll freely. The core bar and spreader bar shall not bend or flex excessively when a full roll is lifted.

If the GCL material consists of bentonite encapsulated between non-woven and slit-film woven geotextiles, then the GCL panels shall be placed with the non-woven geotextile facing down. The orientation of the GCL panels is important. When working in sloping areas, the long dimension of all panels shall be oriented up and down the slope, and the ends of these panels shall be secured at the top in an anchor trench or anchor bench. On the side slopes, panels shall be placed from the highest elevation to the lowest within the area to be lined, to facilitate drainage in the event of precipitation. End-of-roll seams shall be located at least 3 ft from the toe or crest of the slope. Seams at the base of the slope shall be a minimum of 6 feet from the toe. End-of panel seams on slopes are permissible, but only if the slope steepness is 4H: 1V or less. Panels may only be placed across the slope when the slope is less steep than 4H: 1V or when the slope length is very short (less than or equal to 9 feet) thus for this project **cross-slope or horizontal seaming of panels shall not be allowed.** Panels shall be placed free of tension or stress yet without wrinkles or folds. It is not permissible to stretch the GCL in order to fit a designated area. Panels shall not be dragged across the subgrade into position except where necessary to obtain the correct overlap for adjacent panels. The GCL shall not be placed during rain or high winds.

The Contractor shall unwrap and install only as much GCL in one working day as can be covered with FML or other approved cover in case of emergency. **In no case shall the GCL be exposed at the end of the day.**

**c. GCL Panel Seaming**

All GCL seams shall be lap seams as shown on the accepted installation panel layout drawings to ensure that a continuous seal is achieved between panels. **Lapping the edges of GCL sheets a minimum of twelve inches (12") on side slope liner.** The lap line and match lines printed on the panels shall be used to assist in obtaining this overlap. The edges of the GCL panels should be adjusted to smooth out any wrinkles, creases, or "fishmouths" in order to maximize contact with the underlying panel. After the overlying panel is placed, its edge shall be pulled back to expose the overlap zone. Any soil or debris present in the overlap zone or entrapped in the geotextiles shall be removed. Seams shall shingle in a down slope direction, so that water flows across the seam from upslope sheet to the down slope sheet. **No horizontal seams shall be allowed on the slopes.**

**d. Damage Repair**

Any damage in the form of cuts or tears in the GCL shall be identified by the Contractor and repaired by cutting a patch from unused GCL and placing it over the affected area. The damaged area should be free of all dirt and debris. A **patch of GCL shall be cut to fit over the damaged area and to extend eighteen inches (18") in all directions** around it. An adhesive as recommended by the manufacturer shall be used to keep the patch in position during subsequent FML deployment and/or backfill operations.

**e. Detail Work**

Detail work, defined as the work necessary to seal the liner to pipe penetrations, walls, drainage structures, spillways, and other appurtenances, shall be performed as recommended by the GCL manufacturer and accepted by the County in writing.

**f. Placement of Overlying Materials**

Precautions shall be taken to prevent damage to the GCL during deployment of the FML by restricting heavy equipment traffic. Unrolling the FML can be accomplished by the use of a crane from the bottom or a cable tethered from the top from a truck or other similar equipment.

During the installation of the textured FML over the GCL, a **slip sheet** (such as 20-mil smooth HDPE) shall first be placed over the GCL to allow the FML to slide into its proper position. This slip sheet shall be removed prior to FML welding. Any leading edge of panels left uncovered shall be protected at the end of the working day with a waterproof sheet which is adequately secured with sandbags or other ballast.

**g. Anchor Bench Construction**

Reference is made to Section 14.3.1 of these Special Provisions for the construction of the anchor bench.

**15.3.3 Field Quality Control**

**a. General Requirements**

Inspection and testing shall involve the observation of the installation of the GCL, including all seaming and patches, by the QA/QC Consultant. The QA/QC Consultant shall verify proper overlap of adjacent panels used to seal the seam. The Contractor shall make a visual inspection of the GCL panels, seams and anchors as the installation progresses as well as when the installation is complete. Defective areas shall be clearly marked and repaired. The County and QA/QC Consultant shall give final acceptance of repairs.

The Contractor shall retain responsibility for the integrity of the GCL until final acceptance by the County. The County shall accept the GCL when all of the following conditions have been met:

- i. Written certification letters and "as-built" record drawings including the panel numbers and location have been received from the Contractor and accepted by the County.
- ii. Installation is completed.
- iii. Documentation of completed installation, including all submittals and reports, is complete.
- iv. Verification of adequacy of field seams and repairs is complete.
- v. The GCL and composite liner system has been installed/constructed in accordance with the Contract Documents.

During delivery of GCL material to the site, conformance samples shall be collected by the QA/QC Consultant for testing by an independent laboratory. Samples shall be taken across the entire width of the roll and shall not include the first three feet. Samples shall be 3 feet long by the roll width. The samples shall be marked with an arrow indicating the machine direction and the manufacturer's roll and lot identification number.

Conformance samples will be taken at a rate of one (1) per lot or one per 100,000 square feet, whichever results in the greater number of tests. The County will pay for the cost of conformance tests except for retests of failed samples or conformance tests for lots less than 50,000 square feet, which will be borne by the Contractor. The independent testing agency shall save all test samples including specimens tested until notified by the County regarding their disposal. All specimens that failed shall be returned immediately to the County for determination of corrective measures to be taken.

**b. Material Acceptance Criteria (Interpretation of Conformance Test Results)**

The minimum number of specimens tested per conformance sample for each tested GCL property will be determined in accordance with the respective ASTM Standard. The average value will be calculated from the specimen test values of each conformance sample and compared to the values specified in Section 15.2 of the Special Provisions. A conformance sample that yields any tested property less than the specified value will be recorded as a failure and an additional two (2) rolls will be sampled from the same 100,000 square feet or lot and tested for the failed properties. If a second conformance sample fails, all rolls within the sampled 100,000 square feet or lot will be rejected for use on the project. If no additional conformance tests fail, only the roll which yielded a failure will be rejected from use on the project. The decision of the County shall be final.

**15.4 MEASUREMENT AND PAYMENT**

- a. The **measurement** of the final quantity for **Bid Item No. 34** "Furnish & Install GCL" shall be based on the final in-place square footage of ground covered by the GCL material after it has been installed, tested, and verified by the QA/QC Consultant to the satisfaction of the County. The area of the final surface shall be verified by County based on conventional ground surveying. Quantity shall be calculated based on "true" area and to the nearest square foot utilizing digital terrain modeling methods. **Payment** shall be made, after verification and acceptance, at the unit price per square foot, as stated in the Contractor's Proposal, **Bid Item No. 34**. No additional compensation shall be made for any GCL waste materials from trimming of panels, seam overlaps, patches, repairs or any material damaged during construction by negligence on the part of the Contractor in providing adequate protection for the material.

END OF SECTION 15

## 16. FLEXIBLE MEMBRANE LINER (FML)

### 16.1 GENERAL

#### 16.1.1 Section Includes

This section covers the work necessary to furnish and install the Flexible Membrane Liner (FML) as described by the Contract Documents. The intent of these specifications is to provide a watertight lining system at the completion of the work.

The FML shall consist of the following two (2) types of High Density Polyethylene (HDPE) material:

1. 60-mil double textured HDPE liner (used for bottom liner and encapsulated side-slope liner)
2. 60-mil single textured HDPE liner (used for non-encapsulated side-slope liner above GCL)

The 60-mil double textured HDPE shall be installed on the canyon floor above the LPL. The 60-mil double textured HDPE shall also be installed as a component of the side-slope liner system in the area limits shaded on the Project Drawings. The encapsulated side-slope liner areas shall be installed with 60-mil double textured HDPE placed above and below the GCL along the side-slope. The 60-mil single textured HDPE shall be installed as a component of the non-encapsulated side-slope liner system in the area limits shaded on the Project Drawings. The non-encapsulated side-slope liner areas shall be installed with 60-mil single textured HDPE placed above the GCL along the side-slope. The HDPE materials shall also be used as sacrificial strips and chaffing sheets when required by the project. Sacrificial materials shall be taken from either the single or the double-sided textured material and as directed by the County and QA/QC Consultant.

The Contractor shall provide all labor, supervision, tools, equipment and materials necessary to install the flexible membrane lining system required by the Contract Documents.

#### 16.1.2 References

Reference Standards and Specifications: The following standards and specifications, including documents referenced therein, form part of these Special Provisions and are incorporated herein by reference.

#### American Society for Testing Materials (ASTM)

**D413-98(2007)** Standard Test Methods for Rubber Property Adhesion to Flexible Substrate

**D638-10** Standard Test Method for Tensile Properties of Plastics

- D696-08** Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics
- D746-07** Standard Test Method for Brittleness Temperature and Elastomers by Impact
- D792-08** Standard Test Method for Specific Gravity and Density of Plastics by Displacement
- D882-10** Standard Test Methods for Tensile Properties of Thin Plastic Sheeting
- D1004-09** Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting
- D1149-07** Standard Test Method for Rubber Deterioration-Cracking in an Ozone Controlled Environment
- D1204-08** Standard Test Method for Linear Dimensional Changes of Non-rigid Thermoplastic Sheeting or Film at Elevated Temperature
- D1505-10** Standard Test Method for Density of Plastics by Density Gradient Technique
- D1603-06** Standard Test Method for Carbon Black in Olefin Plastics
- D1693-08** Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
- D3083-(withdrawn1998)** Standard Specification for Flexible Poly (Vinyl Chloride) Plastic Sheeting for Pond, Canal and Reservoir Lining
- D4437-08** Standard Practice for Non-Destructive Testing (NDT) for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
- D4545-(withdrawn 2008)** Standard Practice for Determining the Integrity of Factory Seams used in Joining Manufactured Flexible Sheet Geomembrane
- D4833-07** Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
- D5596-03(2009)** Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
- D5994-10** Standard Test Method for Measuring Core Thickness of Textured Geomembranes
- D5321-08** Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method



- D5397-07** Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
- D6243-09** Standard Test Method for Determining the Internal and Interface Shear Resistance for Geosynthetic Clay Liner by the Direct Shear Method
- D6392-08** Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

### **16.1.3 Submittals**

The Contractor shall submit in advance complete material specifications and descriptive literature for acceptance by the County. The Contractor shall also submit installation panel layout drawings, which show the layout of all FML sheets with proposed size, numbers, position, and sequence of placing all sheets and indicating the location of all field seams. The installation drawings shall also show complete details and methods for anchoring the FML at its perimeter and making field welds. The Contractor shall prepare these installation panel layout drawings by using either AutoCAD or Microstation software applications, and shall submit these drawings to the County in digital format (on a compact disc) as well as hard copies.

The Contractor shall submit written certification by the FML manufacturer that the FML materials conform to the requirements of the Contract Documents; are similar and of same formulation as that for which certification is submitted; and have been demonstrated by actual usage to be satisfactory for the intended application.

The Contractor shall submit **six (6)** 8-inch x 10-inch samples of FML material(s), **six (6)** three foot samples of welding rod used for extrusion welding, and **six (6)** samples of field welds which have been made in conformance with these Contract Documents (three each fusion and extrusion). The Contractor using the same materials, equipment and procedures specified for the FML shall fabricate the field seam samples. Sample width shall measure twelve-inches (12") plus weld width and sample length shall measure eighteen-inches (18"). The samples shall be numbered and dated. The Contractor shall submit a complete description of welding procedures for making field welds and repairs. The welding procedures shall conform to the latest procedures recommended by the FML Manufacturer and to these specifications.

The Contractor shall submit for acceptance by the County a method of handling and storing FML material(s) prior to installation. The Contractor shall install the FML only on surface(s) that it has formally accepted from the Contractor by submitting a written "release" form. This form shall be furnished to the QA/QC Consultant and is subject to acceptance by the County to ensure that the surfaces meet all the requirements for installation as detailed in these specifications.

The FML manufacturer shall submit a letter of intent to furnish a written lining material warranty on a prorated basis for a period of 20 years after the installation of material. An executed original of the manufacturer's warranty shall be submitted 5 days after complete installation of the FML material. The warranty shall protect against manufacturing defects; and the manufacturer warranty shall warrant against deterioration due to ozone, ultraviolet light, or other normal weather aging. The

warranty shall be limited to replacement of material only and shall not cover installation of said material. It shall not cover damage due to vandalism, acts of animals, earthquakes, or acts of God.

The Contractor shall furnish a written guarantee that the FML work constructed by him is free of defects in material and workmanship. The guarantee for the FML installed pursuant to these Contract Documents shall extend for a period of one (1) year following final acceptance of the entire project. During the 11<sup>th</sup> month of the warranty period, a pre-guarantee expiration inspection of the exposed portions of the FML material will be conducted to identify any necessary repair work covered by the guarantee. The Contractor shall agree to make any repairs or replacements found to be necessary by defects in material or workmanship, which become evident within this guarantee period. The Contractor shall make repairs and/or replacements promptly upon receipt of written order from the County. If the Contractor fails to make repairs and/or replacements promptly, the County may do so, and the Contractor shall be liable to the County for the cost of such repairs and/or replacements.

#### **16.1.4 QA/QC**

Prior to installation of FML material, the Contractor shall allow at least two (2) weeks for FML material conformance testing by QA/QC Consultant before the material is scheduled to be integrated into the project. The Quality Control Plan(s) to be implemented for the work by the FML manufacturer, the Contractor and the lining subcontractor shall be in accordance with the Contract Documents and the QA/QC Plan. The County shall have the authority to order an immediate stoppage of work because of improper installation procedures, noncompliance with the QA/QC Plan, safety infractions or for any reason which may result in a defective or unsafe installation of the FML.

Daily reports shall be submitted by the Contractor to the County prior to 11:00 a.m. documenting work accomplished the previous day including all personnel and equipment on site, quantities of material received, panels installed, seaming completed, tests performed, repairs made, weather conditions and other comments relative to the progress of the work.

#### **16.1.5 Safety**

Prior to installation of the FML, the Contractor shall instruct the workmen on the safety procedures pursuant to local, State, and Federal requirements. The Contractor shall ensure that workers have and use safety gear and equipment required by local, State and Federal requirements. The Contractor shall instruct the workmen relative to the difficulties and potential hazards involved in handling the FML, especially during periods of high winds. The Contractor shall provide safety equipment pursuant to applicable local, State, and Federal requirements for his personnel, the County personnel and QA/QC Consultant's representatives when working.

Approved personal fall arrest, personal fall restraint or positioning systems shall be worn by those employees whose work exposes them to falling in excess of 7 1/2 feet from the perimeter of a structure, unprotected sides and edges, leading edges, through shaft ways and openings, sloped roof surfaces steeper than 7:12 (Horizontal: Vertical), or other sloped surfaces steeper than 40 degrees. Particular attention shall be given to relevant Division of Industrial Safety Construction. Said Orders are contained in Title 8 of the California Code of Regulations, Chapter 4, and Subchapter 4. Specific reference is made to Article 24 of said Construction Safety Orders.

### 16.1.6 Delivery, Storage and Handling

The FML shall be shipped, stored and handled in accordance with the manufacturer's recommendations and as in the Contract Documents. Contractor shall be completely responsible for shipping, storage and handling of all FML. The FML rolls shall be delivered to the site only after the County receives and approves the required submittals.

Contractor shall notify the County at least twenty-four (24) hours (one full work day) prior to scheduled delivery. No materials shall be unloaded except in the presence of the QA/QC Consultant's representative. The FML delivered to the site shall be inspected for damage and unloaded and stored with minimal handling. Damaged rolls shall be separated from undamaged rolls until proper disposition of material is determined by the County. The County will be the final authority on the determination of damage.

No hooks, tongs, or other sharp tools or instruments shall be used for handling the FML. Contractor shall use cloth chokers and spreader bars for loading and unloading and spreader bars and roll bars for deployment. The FML shall not be folded or dragged along the ground.

The FML shall be wound onto a minimum 6 inch (6") heavy cardboard or plastic hollow core which is stable enough to support the roll without deflecting, buckling or otherwise falling during handling, storage, and transportation.

The FML shall be protected from storm water, soil, mud, dirt, debris, puncture, cutting, or other damaging or deleterious conditions. The FML rolls shall not be stored on wooden pallets and shall not be stacked more than three (3) rolls high. The welding rod delivered to the site shall be kept covered and dry.

Under no circumstances shall the installed FML be subjected to materials, sandbags, equipment or other items being dragged across its surface, nor shall workmen and others slide down slopes atop the FML. All damaged surfaces resulting from abuse of any kind caused by the Contractor in performance of the work shall be repaired at the Contractor's expense.

## 16.2 MATERIALS

### A. FML Resin

Resin for the geomembrane shall be virgin, first quality high density polyethylene (HDPE) resin produced in North America and compounded and manufactured specifically for the purpose of producing HDPE geomembranes. There shall be no intermixing with other resin types. Reclaimed polymer shall not be added to the geomembrane resin.

HDPE resin shall meet the following minimum specifications:

Test	Test Method	Unit	Requirements
Density*	ASTM D1505	g/cc	0.94 minimum
Melt Flow	ASTM D1238 Condition E	g/10 min	<1.0

Index			
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\*Base resin density without carbon black added.

One set of tests shall be performed per batch of resin. At a minimum, the geomembrane manufacturer shall sample and test each compartment of each rail car or truck to ensure that product purity was maintained during shipment. Certified test results shall be submitted to and approved by the QA/QC Consultant at least five (5) working days prior to shipping geomembrane to the site.

## B. FML Rolls

The material shall be new FML, high quality product designed and manufactured specifically for the purpose of this project. Its suitability and durability for this type of work shall have been adequately demonstrated by prior applications. Labels on the rolls of HDPE material shall identify the thickness of the material, the length and width of the roll, and the manufacturer's run number. The textured surface of the HDPE shall be coextruded textured surface as manufactured by GSE or Polyflex, or approved equal. The textured HDPE lining material shall be certified in writing by the lining manufacturer to meet thickness and material specifications. The texturing of HDPE lining material shall be of the same type of polymer and formulation as that of the base sheet material. The surface texturing material shall be uniform and consistent, shall remain intact and shall be resistant to separation from the base sheet as a result of abrasion and contact with chemicals encountered in solid waste landfill applications. All work associated with the texturing process shall be performed by the manufacturer of the base sheet.

Extrusion resin used for extrusion welding associated with repairs or difficult welding shall be of the same HDPE material used in the supplied sheet. Physical properties shall be the same as in the HDPE sheets. The FML installation shall be performed under the ongoing observation of the County and QA/QC Consultant, and according to the QA/QC Plan. The Contractor shall be responsible for repairing all damaged areas. The material shall have or exceed the following MARV:

Property	Unit	Test Method	Value 60-mil	QA/QC Conformance Testing (Y/N)
Thickness MARV	mils	ASTM D 5994	60	Y
Minimum thickness (lowest individual for any of 10 values)	mils	ASTM D 5994	54	Y
Asperity Height	mils	ASTM D7466	15	Y
Density	g/cm <sup>3</sup>	ASTM D1505	.94 min	Y
Tensile	ppi	ASTM	126	Y

Property	Unit	Test Method	Value 60-mil	QA/QC Conformance Testing (Y/N)
Strength at Yield		D638 TYPE IV Specimen 2 ipm		
Elongation at Break	%	ASTM D638 TYPE IV Specimen 2 ipm	> 150	Y
Elongation at Yield	%	ASTM D638 TYPE IV Specimen 2 ipm	>12	Y
Tear Resistance	lbs	ASTM D1004 Die C	42	N
Stress Crack Resistance	Hours	ASTM D5397	200	N
Carbon Black Content	%	ASTM D1603	2 to 3	Y
Puncture Resistance	lbs	ASTM D4833	90	Y
Carbon Black Dispersion <sup>1</sup>	Rating	ASTM D5596	See Note <sup>1</sup>	Y

**Note 1:** Acceptance Criteria: The test result will be accepted if 8 or more specimens are in Category 1 and 2, and if 10 or more specimens are in category 1, 2 and 3; and if no specimens are in category 4 and 5.

**C. Geomembrane Seam Testing Requirements (For Integrity of Field Seams):**

Property	Unit	Test Method	Value 60- mil	QA/QC Conformance Testing (Y/N)
Shear Seams	ppi	ASTM D 6392	120- ftlb	Y
Peel Strength Fusion	ppi	ASTM D 6392	91- ftlb	Y
Peel Strength Extrusion	ppi	ASTM D 6392	78- ftlb	Y

### **Interface Shear Strength:**

The Contractor shall submit proof of a successful direct shear testing program for acceptance by the County prior to shipment of any material (FML, GCL and geotextile) to the job site. All testing shall be performed in accordance with procedures provided below and during the early stage of the earthwork. The testing shall be performed by a laboratory approved for conformance interface direct shear testing. A test report shall be submitted with complete testing results from the laboratory.

The interface direct shear tests shall be conducted in accordance with ASTM D5321 or ASTM D6243. The testing laboratory will measure peak and large-displacement (i.e., at least 3.0 in. of displacement) shear strengths using a 12-in. square direct shear-testing box. The soil material for the interface shear testing shall be collected by the Contractor for arranging its shipment to the laboratory. The QA/QC Consultant will provide the placement and compaction (re-compacted density and moisture content) requirements for the soil material for the interface tests. The cost of this shear strength interface testing and shipment of the material to the testing laboratory shall be borne by the Contractor.

### **Three types of testing series shall be tested for the interface shear tests:**

#### ***Test Series 1 (bottom to top)***

- $1.0 \times 10^{-7}$  low permeability layer (LPL)
- 60-mil thick double-sided textured HDPE geomembrane
- 12-oz/sy nonwoven geotextile
- LCRS Gravel Layer

#### ***Test Series 2 (bottom to top)***

- Prepared subgrade
- Geosynthetic clay liner (GCL); and
- 60-mil thick single-sided textured HDPE geomembrane (textured side against GCL)
- 16-oz/sy nonwoven geotextile
- Protective Cover Soil

#### ***Test Series 3 (bottom to top)***

- Prepared subgrade
- 60-mil thick double-sided textured HDPE geomembrane (higher asperity height down)
- Geosynthetic clay liner (GCL)
- 60-mil thick double-sided textured HDPE geomembrane (higher asperity height down)
- 16-oz/sy nonwoven geotextile
- Protective Cover Soil

A series of tests shall consist of a set of three tests on samples from the same lots and manufactured specifically for this project. As described below, each of the three tests in each series shall be conducted at three different normal stresses.

**Laboratory Testing Procedures for Test Series No. 1**

The interface direct shear tests shall be conducted in accordance with ASTM D5321. The purpose of this test is to measure the interface shear strength of the compacted LPL against the double textured 60 mil geomembrane interface. The LPL material shall be obtained from the mixture of the "clay stockpile" and the "Canyon 6 Stockpile" and/or C4P3 project limits excavation material that shall be compacted to a relative compaction of 95% and 2 to 4% above optimum moisture content (OMC). The compacted LPL/geomembrane specimen shall be wetted by spraying water; the test should be sheared at a constant rate of deformation. The direction of shear should be in the direction of manufacture (machine direction) of the geomembrane. Shearing should be continued until peak shear strength is measured and then continued until either a stable, large-displacement shear strength is achieved or the maximum displacement of the shear box system is achieved. The interface friction angle shall be a minimum of 15 degrees.

**Laboratory Interface Direct Shear Testing Program for Test Series No. 1**

	Testing Conditions	Shearing Phase
Test No.	Normal Stress during Shear (psi)	Displacement Rate (in./min)
1	30	0.04
2	75	0.04
3	150	0.04

**Laboratory Testing Procedures for Test Series No. 2**

The interface direct shear tests shall be conducted in accordance with ASTM D 5321. The purpose of this test is to measure the interface shear strength of the weakest interface of the entire liner "sandwich" system. The entire liner sandwich should be soaked together in tap water for 12 hours under a normal stress of 10 psi prior to being sheared. The normal stress used for soaking should be applied prior to submerging the liner sandwich in the tap water. After the 12-hour soaking period, the normal load for consolidation should be placed on the liner system sandwich and then it should be allowed to consolidate under this load for the specified time period. After the consolidation period is complete, the test specimen should be sheared at a constant rate of deformation.

**(The GCL will not be soaked if the underside of the proposed GCL material is protected by a vapor barrier).** The direction of shear should be in the direction of manufacturer (machine direction) of the geomembrane. Shearing should be continued until peak shear strength is measured and then continued until either a stable, large-displacement shear strength is achieved or the maximum displacement of the shear box system is achieved. The interface friction angle shall be a minimum of 12 degrees.

**Laboratory Interface Direct Shear Testing Program for Test Series No. 2**

### GCL Hydration and Consolidation Schedule

Test No.	Soaking Phase <sup>2</sup>		Consolidation Phase		Shearing Phase
	Normal Stress during Soaking (psi)	Soaking Time (hr)	Minimum Consolidation Time <sup>1</sup> (hr)	Normal Stress during Consolidation and Shear (psi)	Displacement Rate (in./min)
1	10	12	48	30	0.04
2	10	12	48	75	0.04
3	10	12	48	150	0.04

1 Vertical settlement versus time will be monitored during consolidation and the consolidation phase should be continued until t100 is reached as measured by the  $\sqrt{t}$  method (ASTM D2435)

2 No soaking of GCL if the underside of GCL is protected by a vapor barrier

The sample must be consolidated in the shear box under the prescribed normal stress for at least the prescribed duration and at least as long as it takes to reach t100 is reached as measured by the  $\sqrt{t}$  method (ASTM D2435). The testing laboratory will report peak and large-displacement shear strengths for each of the respective tests.

#### Laboratory Testing Procedures for Test Series No. 3

The test procedures for Test Series 3 is the same as Test Series 2 (same requirements and layers) except use 60 mil double textured HDPE geomembrane and the interface friction angle shall be a minimum of 12 degrees.

#### Laboratory Interface Direct Shear Testing Program for Test Series No. 3

### GCL Hydration and Consolidation Schedule

Test No.	Soaking Phase <sup>2</sup>		Consolidation Phase		Shearing Phase
	Normal Stress during Soaking (psi)	Soaking Time (hr)	Minimum Consolidation Time <sup>1</sup> (hr)	Normal Stress during Consolidation and Shear (psi)	Displacement Rate (in./min)
1	10	12	48	30	0.04
2	10	12	48	75	0.04
3	10	12	48	150	0.04



- 1 Vertical settlement versus time will be monitored during consolidation and the consolidation phase should be continued until t100 is reached as measured by the  $\sqrt{t}$  method (ASTM D2435)
- 2 No soaking of GCL if the underside of GCL is protected by a vapor barrier

All samples are to be returned to the County at the completion of the testing program. These samples along with the laboratory test report shall constitute a submittal which will demonstrate the minimum friction strength of the composite section. This adequacy shall be determined during a review completed by the County. Peak and residual friction angle values shall be reported.

**Required Minimum Shear Strength Envelopes**

The required minimum shear strength envelopes for base (canyon floor) and side slope liners are provided in Tables below:

Liner System	Type of Shear Strength	Minimum Required Strength (in psi)		
		Testing Normal Stresses (psi)		
		30	75	150
Base Liner (1)	Large-Displacement	8.7	15.5	26.9

Liner System	Type of Shear Strength	Minimum Required Strength (in psi)		
		Testing Normal Stresses (psi)		
		30	75	150
Side Slope Liner	Large-Displacement	3.6	8.9	17.9
Test Series 2 - Smooth HDPE	Large-Displacement	?	?	?
Test Series 3 - Textured HDPE	Large-Displacement			

The geosynthetic testing laboratory will report peak and large-displacement shear strengths for each of the respective tests in terms of normal stress and measured peak and large-displacement shear stresses. The QA/QC Consultant and the County will review the shear strengths obtained for confirmation of compliance with this section. Following approval of the test results, the Contractor will be allowed to proceed with the shipment of the geosynthetic materials. During the geosynthetics deployment phase, the QA/QC Consultant will collect two sets of geosynthetic material samples for performing conformance tests for interface shear for each of the Test Series 1 through 3. The Contractor shall assist the QA/QC Consultant in providing representative samples. The cost of the conformance testing shall be borne by the County.

## 16.3 EXECUTION

### 16.3.1 Inspection

Prior to installation of 60-mil HDPE on the canyon floor, a site inspection shall be conducted by the County, QA/QC Consultant and the Contractor to verify measurements and surface conditions to receive the FML. The FML shall be installed only on surfaces for which the Contractor has furnished written certification to the County as acceptable for installation of the FML, and for which the QA/QC Consultant has inspected and verified as acceptable for FML installation.

For the 60-mil HDPE installation on the side-slopes, protection of the underlying GCL is required. Removal of all sharp or abrasive objects on top of the GCL and inspection of the GCL for punctures, tears or other unacceptable conditions is required prior to the placement of FML. Any defects in the underlying GCL shall be repaired to the satisfaction of the County and QA/QC Consultant prior to the placement of the FML. No vehicles shall be permitted to travel on the completed subgrade except for approved equipment necessary to install the lining. Costs for any required repair of the GCL shall be borne by the contractor with no further compensation allowed.

Before the work begins, the Contractor and QA/QC Consultant shall inspect all FML materials for damage from transit. Materials that cannot be repaired shall be rejected, removed from the project site, and disposed of in accordance with federal, state, and local requirements at the Contractor's expense. Prior to transport of FML materials from the storage area for use and placement, the Contractor and QA/QC Consultant shall visually inspect all materials for imperfections and faulty areas. All such defective places shall be marked and repaired in accordance with approved methods and the QA/QC Plan.

### 16.3.2 Installation

The FML shall be installed as shown on the Project Drawings and the accepted panel layout installation drawings. Sheets of FML shall be of such lengths and widths and shall be placed in such a manner as to reduce field welding to a minimum. All FML panels over 25 square feet in area shall be designated with a panel number. The Contractor shall be responsible for assigning the number and shall locate the number marking near the middle of panels less than 50 feet in length and at both ends of panels over 50 feet in length. **Panels less than 25 square feet in area shall be considered a patch** and shall not require a number; these shall be used as seldom as possible. *The minimum panel width in the anchor trench shall be three (3) feet. It is the responsibility of the Contractor to remove any panels that may be stressed due to the three (3) feet minimum requirement.* The above requirement does not relieve the Contractor from its responsibility to maintain the integrity of the liner until final acceptance by the County.

The FML shall be attached at the top and bottom of the slopes, and other places in accordance with details shown on the Project Drawings and the accepted panel layout installation drawings. The FML shall be anchored and sealed to structures, pipes and other types of penetrations in accordance with the details shown on the Project Drawings and the accepted panel layout installation drawings.

All changes in accepted panel layout installation plans and procedures must be accepted by the County in writing in advance. Requests for field changes to the accepted installation drawings, procedures, and schedules shall be submitted in writing to the County for review and comment. No changes shall be allowed prior to written acceptance by the County. The Contractor shall document changes on record drawings.

Extreme care shall be taken during installation of the FML to be certain no damage is done to the prepared supporting surfaces, or to any part of the installed GCL or to the FML texturing. Dragging of the FML material on any rough surfaces including, but not limited to, subgrade, compacted engineered fill grade, compacted LPL, or GCL shall not be permitted. **Smoking shall not be permitted within 100 feet of the FML** by anyone connected with the Contractor's work. No foot traffic shall be allowed on the FML except with approved smooth-sole shoes. No vehicular traffic shall be allowed on the FML. Vehicles used at the job site shall not exceed 15 mph. Excessive speed and/or reckless driving may result in suspension or dismissal of the vehicle operator. All motor equipment using fuel shall have spark arrestors. No gasoline powered generators, gasoline cans, or solvent shall be placed directly on the FML. Under no circumstances shall the FML be used as a work area or to store tools and supplies. If needed, a tarpaulin of approved material shall be spread out as a work area.

During installation, the Contractor shall be responsible for protecting the FML against adverse effects of high winds such as uplift. Sand bags shall be used as required to hold the FML material in position during installation. Sand bags shall be sufficiently close-knit to preclude fines from working through the bottom, sides or seams. Paper bags, whether or not lined with plastic, will not be permitted. Burlap bags, if used, must be lined with plastic. Bags shall contain not less than 40, nor more than 60 pounds of sand having 100 percent passing a number 8 screen and shall be tied closed after filling, using only plastic ties. Metal or wire ties shall not be allowed. Bags that are split, torn, or otherwise losing their contents shall be immediately removed from the work area and any spills immediately cleaned up.

The HDPE lining shall not be installed under adverse climatic conditions, unless the Contractor can demonstrate that its installation techniques adequately compensate for such adverse conditions and quality of workmanship is not compromised. Adverse climatic conditions occur when the air temperature measured six (6) inches above the FML surface is less than 40°F or more than 104°F; when the relative humidity is more than 80 percent; when it is raining; or when there is frost on the ground; or during conditions of excessive winds. Installation of HDPE lining at high temperatures (greater than 104°F) may be performed if approved by the QA/QC Consultant and the County, but **no field seaming shall be permitted** at those temperatures.

**HDPE field seams** shall be lap seams formed by lapping the edges of HDPE sheets a **minimum of 4 inches**. The contact surfaces of the sheets shall be wiped clean to remove dirt, dust, moisture, and other foreign objects. For fillet extrusion weld seams, the edge of the FML shall be beveled and oxidation shall be cleaned from the surfaces to receive extrudate by disk grinding (buffing) or equivalent not more than one hour (1-hr) before welding.

Lap seam intersections involving more than three (3) FML panels of lining material shall be avoided, and all seam intersections shall be offset at least two (2) feet. No base T-seam shall be closer than

five (5) feet from the toe of slope. **No horizontal intersections or seams shall be allowed on the slopes** and sheets of lining material on the slope shall extend down slope out onto the canyon floor as shown on the Project Drawings.

Field seams between sheets of FML shall be made using approved welding systems, equipment and techniques. **Approved welding systems include fillet weld using extrudate (extrusion weld), lap weld using extrudate (extrusion welds); and lap weld using either a single or double wedge welder (fusion welds for 60-mil).** All wedge welders shall be specifically designed for and be compatible with the liner material and recommended by the FML manufacturer. The extrusion welder is to be purged of all heat degraded extrudate in the barrel prior to beginning a seam for approximately 30 seconds. This must be done every time the extruder is restarted after a 2 minute or longer, down time. The purged extrudate shall not be discharged onto the surface of previously placed liner nor on the prepared subgrade where it would eventually form a hard lump under the liner.

Any necessary repairs to the FML shall be made with the FML material itself, using approved welding systems, equipment and techniques. The **patch size** shall be **six (6) inches** larger in all directions than the area to be patched. All corners shall be rounded with a one (1) inch minimum radius. All seams of the FML shall be tightly bonded on completion of the work. Any FML surface showing injury due to scuffing and/or penetration by foreign objects or showing distress shall be replaced or repaired.

The Contractor shall mark adjacent to all welds and repairs, the seam number, date, time, equipment number, mated panel numbers and technician performing the welding. Cleanup within the work area shall be an ongoing responsibility of the Contractor. Particular care shall be taken to insure that no trash, tools, and other unwanted materials are trapped beneath the FML. Care should also be taken to ensure that all scraps of lining material are removed from the work area prior to completion of the installation.

### **16.3.3 Field Quality Control**

#### **a. General**

Inspection and testing shall involve the observation of the installation of the FML, including the making and testing of field welds and patches. After initial welding of any seam, seam testing and repairs shall be completed within 3 working days.

Samples for conformance testing shall be taken by the Contractor from rolls of FML after delivery to the site. Samples shall be taken across the entire width of the roll and shall not include the first three (3) feet. Samples shall be three (3) feet long by the roll width. The samples shall be marked with the machine direction by an arrow and the manufacturer's roll and lot identification number. One sample per lot or one sample per 100,000 square feet of FML shall be taken, whichever results in the greater number of conformance tests. The cost of conformance tests shall be paid for by the County, except for retests of failed samples or conformance tests for lots of less than 50,000 square feet, which will be borne by the Contractor.

The delivery of FML in small quantities from different lots is discouraged. The Contractor shall absorb the cost for excessive conformance testing due to delivery of FML from different lots.

Conformance and destructive weld sample testing shall be conducted by an independent testing laboratory and paid for by the County. However, the laboratory cost of retesting work or material, which fails the first test, will be billed to the Contractor. The independent testing laboratory shall save all test samples including specimens tested until notified by the County relative to their disposal. All specimens which have failed under testing shall be returned immediately to the County for determination of corrective measures to be taken.

**b. Material Acceptance Criteria and Corrective Measures**

**i. Conformance Testing**

The minimum number of specimens tested per conformance sample for each tested FML property will be determined in accordance with the respective ASTM Standard. The average value will be calculated from the specimen test values of each conformance sample and compared to the values specified in Section 16.2 of the Specifications. A conformance sample that yields any tested property less than the specified value will be recorded as a failure and an additional two (2) rolls will be sampled from the same 100,000 square feet or lot and tested for the failed properties. If a second conformance sample fails, all rolls within the sampled 100,000 square feet or lot will be rejected for use on the project. If no additional conformance tests fail, only the roll which yielded a failure will be rejected from use on the project. The decision of the County shall be final.

**ii. Start Up Welds**

Test welds shall be made to verify that adequate conditions exist for field seaming to proceed. Each welder shall produce a test seam at the beginning of each shift to determine the peel and tensile shear strength of the seam. The County and QA/QC Consultant may require a sample field seam be made at any time during seaming production to verify equipment/operator performance and seam integrity. In addition, *if a seaming operation has been suspended for more than 30 minutes or if a breakdown of the welding equipment occurs, a test seam shall be produced prior to resumption of seaming operations.* The Contractor shall continually arrange for one (1) extra welding setup (welder and all related equipment) per crew as a backup at all times in case of a breakdown. The welding equipment shall follow the same procedures for startup welds.

During the field welding operation, the Contractor shall make representative, non-destructive samples of field welds. These samples shall be made of the same HDPE sheet and fusion weld materials using the same installation procedures as the HDPE installation itself. Samples shall have a width of twelve (12) inches plus the seam width and a length of thirty-six (36) inches. A minimum of one (1) sample per crew each morning and each afternoon shall be made. All field seams shall have a film-tearing bond in peel and shear as required herein under Section 16.2 of these Special Provisions when tested.

**iii. Destructive Testing of Field Seam Samples**

During the field welding operation for 60-mil HDPE material, the Contractor at locations selected by the QA/QC Consultant and the County shall remove destructive samples from field seams. Repairs to the field seams shall be made in accordance with repair procedures specified in these specifications. Samples shall have a width of 12 inches plus the seam width and a length of 36 inches. A minimum of one sample per 500 feet of field seam shall be made. All field seams of 60-mil HDPE material shall have the minimum required film tearing bond in peel and shear when tested as specified in these Special Provisions.

All destructive field seam specimens tested by the independent testing laboratory (sets of five test specimens are performed) shall allow for one failure out of five tested, and the rest shall pass. If two specimens out of five fail, the entire sample shall be considered as a failure, and the field weld(s) performed by the same welding equipment between adjacent destructive samples on either side of the failed sample shall be considered to be not in conformance with the Specifications and corrective measures are to be followed.

**Corrective measure shall include the following:**

New test samples shall be taken ten (10) feet on both sides of the failed destructive sample and they shall be tested using the same procedures outlined above. If these new test samples PASS, the weld need only be capped between the two passing tests. If these new test samples FAIL, the iterative process of sampling as outlined above is repeated until passing test results are observed. In this case, the entire seam between the two successful test samples shall be capped. If capping a field seam is required, the Contractor shall use a cover strip of the same material (and from the same roll if available) and a minimum of 8 inches in width. The cap strip shall be extrusion welded and tested as required for extrusion welding. One additional destructive sample shall be taken from the extrusion welded cap strip.

The cost of all additional testing of destructive samples due to failure of the original sample to pass specifications shall be borne by the Contractor. The Contractor shall pay for any and all laboratory failures in addition to any and all passing lab tests resulting from laboratory field failures.

iv. **Nondestructive Testing of Field Seam Samples**

Non-destructive testing of field seam samples shall be performed for the 60-mil HDPE seams. All field seams tested using nondestructive methods by the Contractor and observed by the QA/QC Consultant in the field shall pass. If any welds fail, the weld shall be considered not in conformance with the specifications and corrective measures shall be taken.

If the **fillet extrusion weld or single hot-wedge fusion lap weld** is used to weld seams, the Contractor shall test all seams and repairs in the HDPE lining by vacuum box. The vacuum box shall be an American Vacuum Seam Tester, Series A100 as manufactured by American Parts and Service Company, Alhambra, California, or an approved equal. All vacuum box testing shall be done in the presence of the QA/QC Consultant. The area to be tested shall be cleaned of all dust, debris, dirt and other foreign matter. A soap solution shall be applied to the test area with a paint

roller or spray bottle and a vacuum of 5 psi shall be induced and held as long as necessary to visually inspect and mark for repair any suspicious areas as evidenced by bubbles in the soap solution or failure of a vacuum to be formed.

All **flat extrusion welds**, the Contractor must test all seams using a vacuum box. In the case of the **fillet extrusion weld**, the Contractor may, in lieu of vacuum box testing, test all seams and repairs in the HDPE lining by using a high voltage spark detector, such as Tinker and Rasor Holiday Detector (Model AP-W) or approved equivalent. The setting of the detector shall be 20,000 volts. In order to conduct this test, all seams to be tested shall be provided with not less than a 24 gauge copper wire properly embedded in the seam and grounded. All wire installation and spark testing shall be done in the presence of the QA/QC Consultant. All defective areas shall be marked for repair.

If the **double hot-wedge fusion weld** is used, the Contractor shall test all seams in the HDPE lining by using the air pressure test. This test consists of inserting a needle with gauge in the air space between welds. Air shall be pumped into the air space to 30 psi and held for 5 minutes. If the pressure loss exceeds 4 psi during air pressure testing the outside weld edge (not free edge) shall be sprayed with a soap solution and visually examined for bubbles. If no bubbles appear, the problem is with the inside weld and the seam is acceptable. If any bubbles appear, the defect shall be repaired by extrusion welding and tested by vacuum box or spark detector. If pressure loss is not more than 4 psi, puncture the opposite end of the seam to release the air. If a blockage is present, locate and test seam on both sides of blockage. Extrusion welding shall seal all penetration holes created during testing.

If **capping a field seam** is required, the Contractor shall use a cover strip of the same material (and from the same roll, if available) and a minimum of eight-inches (8") in width. The cap strip shall be extrusion welded and tested as required for extrusion welding. One additional destructive sample shall be taken from the extrusion welded cap strip. The cost of all-additional testing of nondestructive samples due to failure of the original sample to pass specifications shall be borne by the Contractor.

#### 16.4 MEASUREMENT AND PAYMENT

- a. The **measurement** of the final quantity for **Bid Item No. 35** "Furnish & Install 60-mil HDPE Liner (single-side textured)" shall be based on the final in-place square footage of ground covered with material placed within the limits specified in the Project Drawings and after it has been installed and tested by the QA/QC Consultant to the satisfaction of the County. The area of the final surface shall be verified by the County based on conventional ground surveying. Quantity shall be calculated based on "true" area and to the nearest square foot utilizing digital terrain modeling method. **Payment** shall be made, after acceptance, at the contract unit price per square foot as stated in the Contractor's Proposal, **Bid Item No. 35**. Payment shall constitute full compensation to the Contractor for all work related to the furnishing and installation of the FML as required by the Contract Documents. No additional compensation shall be given for waste material from trimming of rolls, seam overlaps, patches, or related items.
- b. The **measurement** of the final quantity for **Bid Item No. 36** "Furnish & Install 60-mil HDPE Liner (double-side textured)" shall be based on the final in-place square footage of ground

covered with material placed within the limits specified in the Project Drawings and after it has been installed and tested by the QA/QC Consultant to the satisfaction of the County. The area of the final surface shall be verified by the County based on conventional ground surveying. Quantity shall be calculated based on "true" area and to the nearest square foot utilizing digital terrain modeling method. **Payment** shall be made, after acceptance, at the contract unit price per square foot as stated in the Contractor's Proposal, **Bid Item No. 36**. Payment shall constitute full compensation to the Contractor for all work related to the furnishing and installation of the FML as required by the Contract Documents. No additional compensation shall be given for waste material from trimming of rolls, seam overlaps, patches, or related items.

END OF SECTION 16



## 17. GEOTEXTILES

### 17.1 GENERAL

#### 17.1.1 Section Includes

This section covers the work necessary to furnish and install the geotextile fabrics. The intent of these specifications is to provide protection to the HDPE lining and to provide for transmissivity and filtration of liquids from above the drainage layer through to the leachate collection pipes.

In general, twelve (12) oz/sy geotextile is to be placed above the FML on the canyon floor; eight (8) oz/sy geotextile is to be placed directly above the LCRS gravel layer on the canyon floor; and sixteen (16) oz/sy geotextile is to be placed above the FML on the side slopes and benches. The Contractor shall provide all labor, supervision, tools, equipment, and materials necessary to install the geotextiles as described in the Contract Documents.

#### 17.1.2 References

Reference Standards and Specifications: The following standards and specifications, including documents referenced therein, form part of these Special Provisions and are incorporated herein by reference.

#### American Society for Testing Materials (ASTM)

- |                        |   |
|------------------------|---|
| <b>D1777-96(2007)</b>  | Standard Test Method for Measuring Thickness of Textile Materials   |
| <b>D3776-09a</b>       | Standard Test Method for Weight (Mass) per Unit area of Fabric  |
| <b>D4354-99(2009)</b>  | Standard Test Method for Practice for Sampling of Geotextiles for Testing   |
| <b>D4355-07</b>        | Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Zenon-Arc Type Apparatus) |
| <b>D4491-99a(2009)</b> | Standard Test Methods for Water Permeability of Geotextiles by Permittivity   |
| <b>D4533-04(2009)</b>  | Standard Test Method for Trapezoid Testing Strength of Geotextiles  |
| <b>D4632-08</b>        | Standard Test Method for Breaking Load and Elongation of Geotextiles (Grab Method)  |
| <b>D4751-04</b>        | Standard Test Method for Determining Apparent Opening Size of a Geotextile  |
| <b>D4833-07</b>        | Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembrane, and Related Products.                         |

- D4759-02(2007)** Standard Practice for Determining the Specification Conformance of Geosynthetics
- D4873-02(2009)** Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls
- D6241-04(2009)** Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

### **17.1.3 Submittals**

The Contractor shall submit in advance complete material specifications and descriptive literature for acceptance by the County. The Contractor shall also submit complete details and/or methods for anchoring the geotextile at its perimeter and making field sewn seams.

The Contractor shall submit written certification by the geotextile manufacturer that the geotextile materials conform to the requirements of these specifications; are similar and of same formulation as that for which certification is submitted; and have been demonstrated by actual usage to be satisfactory for the intended application.

The Contractor shall submit six (6) eight-inch (8") x ten-inch (10") samples of geotextile material(s), six (6) one-yard samples of thread, and six (6) samples of sewn field seams which have been made in conformance to these specifications. The Contractor using the same materials, equipment and procedures specified for the geotextile shall fabricate the field seam samples. Sample width shall measure twelve inches (12") plus seam width and sample length shall measure eighteen inches (18"). The samples shall be numbered and dated.

The Contractor shall submit a complete description of sewing procedures for making field seams and repairs. The sewing procedures shall conform to the latest procedures recommended by the geotextile manufacturer and to these specifications. The Contractor shall submit for acceptance by the County a method(s) for handling and storage of geotextile material(s) prior to installation. The Contractor shall install the geotextile only on surface(s) that have been accepted by the geotextile sub-contractor and with written certification furnished to the County that the surfaces meet the requirements for installation and these specifications.

Daily reports shall be submitted by the Contractor to the County prior to 11:00 a.m. documenting work accomplished the previous day including all personnel and equipment on site, quantities of material received, panels placed, seaming completed, tests performed, repairs made, weather conditions and other comments relative to the progress of the work.

### **17.1.4 QA/QC**

Prior to installation of geotextile, the Contractor shall allow two (2) weeks for geotextile material conformance testing to be completed by the QA/QC Consultant before the material is scheduled to be integrated into the project. The Quality Control Plan(s) to be implemented for the work by the manufacturer, the Contractor and/or the lining subcontractor shall be in accordance with the QA/QC Plan. The County shall have the authority to order an immediate stoppage of work because of

improper installation procedures, noncompliance with the QA/QC Plan, safety infractions or for any reason, which may result in defective or unsafe installation of the geotextile.

#### **17.1.5 Safety**

Prior to installation of the geotextile, the Contractor shall instruct the workmen of the hazards of installation, such as handling sheets of geotextiles in high winds and on steep slopes; use of equipment; and walking on geotextile surfaces. Work gloves, safety glasses, hard hats, and smooth-soled shoes are minimum safety wear requirements. Approved personal fall arrest, personal fall restraint or positioning systems shall be worn by those employees whose work exposes them to falling in excess of 7 1/2 feet from the perimeter of a structure, unprotected sides and edges, leading edges, through shaft ways and openings, sloped roof surfaces steeper than 7:12 (Horizontal: Vertical), or other sloped surfaces steeper than 40 degrees. Particular attention shall be given to relevant Division of Industrial Safety Construction. Said Orders are contained in Title 8 of the California Code of Regulations, Chapter 4, and Subchapter 4. Specific reference is made to Article 24 of said Construction Safety Orders.

#### **17.1.6 Delivery, Storage and Handling**

Geotextile shall be shipped, stored and handled in accordance with ASTM D4873, the manufacturer's recommendations, and as specified herein. Contractor shall be completely responsible for shipping, storage and handling of all geotextile. The Contractor shall ensure deliveries of these rolls are transported on flat bed trucks. Unloading shall be performed by using fabric straps only. These straps, as supplied by the Contractor, shall be ready for usage at the arrival of each shipment. If the Contractor elects to use a different type of truck or a different method of unloading, the Contractor shall submit written request to the County outlining the type of trucks, equipment and method detailing plan for the County's review and acceptance. The County will respond to the Contractor in writing.

Geotextile shall be shipped and stored in opaque and watertight protective coverings. Contractor shall notify the County at least 24 hours prior to scheduled delivery. No materials shall be unloaded except in the presence of a QA/QC Monitor. Geotextile delivered to the site shall be inspected for damage and unloaded and stored with minimal handling. Contractor shall, upon material delivery, assist QA/QC Monitor in conducting inventory, handling and sampling of geotextile at no additional cost to the County.

No hooks, tongs, or other sharp tools or instruments shall be used for handling geotextile. Contractor shall use slings or a pole which extends at least one (1) foot beyond each end to unload or handle geotextile. Geotextile shall not be dragged along the ground.

Geotextile shall be protected from ultraviolet light exposure, precipitation or other inundation, soil, mud, dirt, debris, puncture, cutting, or other damaging or deleterious conditions. Geotextile shall not be stored directly on the ground. Rolls of geotextiles should not be stacked upon one another to the extent that deformation of the core occurs or to the point where accessibility can cause damage in handling. **Rolls of geotextile shall not be stacked higher than three (3) rolls.**

Under no circumstances shall the installed geotextile be subjected to materials, sandbags, equipment or other items being dragged across its surface, nor shall workmen and others slide down slopes on top of the geotextile. All damaged surfaces resulting from abuse of any kind caused by the Contractor in performance of the work shall be repaired at the Contractor's expense.

## 17.2 MATERIALS

The geotextile material shall be a new, high quality product designed and manufactured specifically for the purposes of this project. Its suitability and durability for this type of work shall have been adequately demonstrated by prior applications. The geotextile shall be 100 percent polyester or polypropylene, needle-punched, and non-woven. Geotextile rolls shall be shipped and stored in opaque and watertight wrappings. The geotextile fabric installation shall be performed under the ongoing observation of the County and QA/QC Consultant, and according to the Contract Documents. The Contractor shall be responsible for detecting and repairing all damaged areas.

The manufacturer's certification shall demonstrate that the geotextile meets or exceeds the following Minimum Average Roll Values MARV (in the weakest principal Direction):

Property	Unit	Test Method	Value 8 oz.	Value 12 oz.	Value 16 oz.	QA/QC Conformance Testing Y/N
Mass per unit Area	oz/sy	ASTM D5261	8	12	16	Y
Apparent Opening Size	US Std. Sieve	ASTM D4751	70-140	-	70-140	Y
Permittivity	sec <sup>-1</sup>	ASTM D4491	0.7	-	0.7	Y
Puncture Resistance	lbs	ASTM D4833	95	120	170	Y
Static Puncture Strength	lbs	ASTM D6241	600	750	900	Y
Trapezoidal Tear Strength	lbs	ASTM D4533	75	115	145	Y
Grab Tensile/Elongation	lbs/%	ASTM D4632	175/50	300/50	320/50	Y
UV Resistance – 70% Strength Retained	hrs	ASTM D4355	NA	NA	500	N

## **17.3 EXECUTION**

### **17.3.1 Inspection**

The geotextile shall be installed only on surfaces for which the Contractor has furnished written certification to the County as being acceptable for installation of the geotextile. Any problems in the completed layers underneath the geotextile shall be repaired to the satisfaction of the County and QA/QC Consultant prior to the placement of the geotextile.

Before work begins, the Contractor and QA/QC Consultant shall inspect all geotextiles for damage from transit. Materials that cannot be repaired shall be rejected, removed from the project site, and disposed of in accordance with federal, state, and local requirements at the Contractor's expense.

During unwrapping of geotextile materials for use and placement, the Contractor and QA/QC Consultant shall visually inspect all materials for imperfections and faulty areas. All defects shall be marked and repaired in accordance with approved methods.

### **17.3.2 Installation**

The geotextile shall be installed as shown on the Project Drawings and accepted installation drawings. Sheets of geotextile shall be of such lengths and widths and shall be placed in such a manner as to reduce field seaming to a minimum. The geotextile shall be placed in accordance with details shown on accepted plans. The County and QA/QC Consultant must approve in advance all changes in accepted installation plans and procedures.

Extreme care shall be taken during installation of the geotextile to be certain no damage is done to the prepared supporting surfaces. No foot traffic shall be allowed on the geotextile except with approved smooth-sole shoes. No vehicular traffic shall be allowed on the geotextile. Under no circumstances shall the geotextile be used as a work area or to store tools and supplies. If needed, a tarpaulin of accepted material shall be spread out as a work area.

During installation, the Contractor shall be responsible for protecting the geotextile against adverse effects of high winds such as uplift. Sand bags shall be used as required to hold the geotextile material in position during installation. Sand bags shall be sufficiently close-knit to preclude fines from working through the bottom, sides or seams. Paper bags, whether or not lined with plastic, will not be permitted. Burlap bags, if used, must be lined with plastic. Bags shall contain not less than 40, nor more than 60 pounds of sand having 100 percent passing a 3/8 inch screen and shall be tied closed after filling, using only plastic ties. Metal or wire ties shall not be allowed. Bags that are split, torn, or otherwise losing their contents shall be immediately removed from the work area and any spills shall be cleaned up immediately.

A temporary protective membrane to protect portions of the lined side slope area from ultraviolet (UV) degradation where protective cover soil will not be placed as part of this Contract shall be installed over the existing side slope liner system as shown on the Project Drawings in accordance with Section 20 of these Special Provisions and as shown on the Project Drawings.

Any necessary repairs to the geotextile shall be made with the geotextile material itself, using approved seaming methods, equipment and techniques. Heat bonding may be used for geotextile seams for the floor liner or for repairs as shown on the Project Drawings and when in the opinion of the County and QA/QC Consultant, the seaming or repair area is too contaminated with dirt or the area to be seamed or repaired is not accessible by sewing machines. **The patch size shall be 12 inches larger in all directions than the area to be patched.** All corners shall be rounded. Should any tear exceed 10 percent of the roll width, the roll of geotextile shall be removed and replaced.

All seams of the geotextile shall be tightly seamed on completion of the work. Any geotextile surface showing injury due to penetration by foreign objects or showing distress shall be replaced or repaired. **Geotextile field seams shall be made as follows:**

Material	Seaming Requirement
8-oz on floor	Heat bond with minimum 3-inch overlap
12-oz on floor	Heat bond with minimum 3-inch overlap
16-oz on slopes and benches	Sewn as specified below

In the event the QA/QC Consultant or County determines that the Contractor has not demonstrated good quality workmanship and consistency with heat bonding, the Contractor shall immediately cease all heat bonding activities and seam all remaining geotextile by sewing.

**The sewn seams shall be overlapped a minimum of three inches (3")** as accepted by the County and QA/QC Consultant. The sewn seams shall be formed by joining the edges of geotextile sheets and sewing with stitches located a minimum of three inches (3") from the joined edges (prayer seam). A two-thread, double-locked stitch with a minimum of four stitches per inch shall be used. The sewing thread shall be a strong nylon or polyester thread, the color of the sewing thread should contrast that of the color of the geotextile for ease in visual inspection subject to acceptance of the County and QA/QC Consultant. All seams shall be continuously sewn. **Spot sewing will not be allowed.** No horizontal seams shall be allowed on the slopes. The geotextile shall be cut only with an approved geotextile cutter, and not torn or ripped to size.

All cleanup within the work area shall be an ongoing responsibility of the Contractor. Particular care shall be taken to insure that no trash, tools, and other unwanted materials are trapped beneath the geotextiles.

### 17.3.3 Field Quality Control

#### a. General

Inspection and testing shall involve the observation of the installation of the geotextile, including the making of field sewn seams and patches. Samples for conformance testing shall be taken by the Contractor under direction of the QA/QC Consultant from rolls of geotextile after delivery. One (1) sample per lot or one (1) sample per 100,000 square feet of geotextile shall be taken, whichever results in the greater number, for conformance testing. The delivery of geotextile in quantities less than one (1) lot is discouraged. The Contractor shall absorb the costs for excessive conformance

testing on delivery of geotextile that is less than one (1) lot. Samples shall be taken across the entire roll width and shall not include the first three feet (3'). Unless otherwise specified, samples shall be three feet (3') long by the roll width. The manufacturer's roll identification number shall be marked on the sample.

Sample testing shall be conducted by an independent testing laboratory paid for by the County. However, the laboratory cost of retesting work or materials that fail the first test will be billed to the Contractor. The independent testing laboratory shall save all test samples including specimens tested until notified by the County relative to their disposal. All specimens which have failed under testing shall be returned immediately to the County and QA/QC Consultant for determination of corrective measures to be taken.

**b. Material Acceptance Criteria and Corrective Action**

The minimum number of specimens tested per conformance sample for each tested geotextile property will be determined in accordance with the respective ASTM Standard. The average value will be calculated from the specimen test values of each conformance sample and compared to the values specified in Section 17.2 of the Specifications. A conformance sample that yields any tested property less than the specified value will be recorded as a failure and an additional two (2) rolls will be sampled from the same 100,000 square feet or lot and tested for the failed properties. If a second conformance sample fails, all rolls within the sampled 100,000 square feet or lot will be rejected for use on the project. If no additional conformance tests fail, only the roll which yielded a failure will be rejected from use on the project. The decision of the County shall be final.

## **17.4 MEASUREMENT AND PAYMENT**

- a. The **measurement** of the final quantity for **Bid Item No. 37** "Furnish & Install 16 oz./sy geotextile" shall be based on the final in-place square footage of ground covered with material placed within the limits specified in the project and after it has been installed, tested, and verified by the QA/QC Consultant to the satisfaction of the County. The area of the final surface shall be verified by the County based on conventional ground surveying. Quantity shall be calculated based on "true" area and to the nearest square foot utilizing digital terrain modeling methods. **Payment** shall be made, after acceptance, at the unit price per square foot, as stated in the Contractor's Proposal, **Bid Item 37**. Payment shall constitute full compensation to the Contractor for all work related to the furnishing and installation of geotextiles as required by the Contract Documents. No additional compensation shall be given for any geotextile waste materials (trimming of rolls, seam overlaps, patches, or related items).
- b. The **measurement** of the final quantity for **Bid Item No. 38** "Furnish & Install 12 oz./sy geotextile" shall be based on the final in-place square footage of ground covered with material placed within the limits specified in the project and after it has been installed, tested, and verified by the QA/QC Consultant to the satisfaction of the County. The area of the final surface shall be verified by the County based on conventional ground surveying. Quantity shall be calculated based on "true" area and to the nearest square foot utilizing digital terrain modeling methods. **Payment** shall be made, after acceptance, at the unit price per square foot, as stated in the Contractor's Proposal, **Bid Item 38**. Payment shall constitute full compensation to the Contractor for all work related to the furnishing and installation of geotextiles as required by the

Contract Documents. No additional compensation shall be given for any geotextile waste materials (trimming of rolls, seam overlaps, patches, or related items).

- c. The **measurement** of the final quantity for **Bid Item No. 39** "Furnish & Install 8 oz./sy geotextile" shall be based on the final in-place square footage of ground covered with material placed within the limits specified in the project and after it has been installed, tested, and verified by the QA/QC Consultant to the satisfaction of the County. The area of the final surface shall be verified by the County based on conventional ground surveying. Quantity shall be calculated based on "true" area and to the nearest square foot utilizing digital terrain modeling methods. **Payment** shall be made, after acceptance, at the unit price per square foot, as stated in the Contractor's Proposal, **Bid Item 39**. Payment shall constitute full compensation to the Contractor for all work related to the furnishing and installation of geotextiles as required by the Contract Documents. No additional compensation shall be given for any geotextile waste materials (trimming of rolls, seam overlaps, patches, or related items).

END OF SECTION 17



## 18. LEACHATE COLLECTION AND REMOVAL SYSTEM

### 18.1 GENERAL

#### 18.1.1 Section Includes

This work covered by this section shall consist of furnishing all labor, supervision, tools, equipment, and materials necessary to construct the entire leachate collection and removal system (LCRS) as required by the Contract Documents, and as directed by the County and the QA/QC Consultant. This section covers the work necessary to construct the LCRS which consists of but is not limited to: the drainage layer; HDPE solid and slotted pipes, including a four-inch (4") cleanout line with protective bollards adjacent to cleanout cap; HDPE fittings; flanges; leachate pump system which consists of: a bottom-loading angled riser slider pump, a pump cycle controller, a pump level controller, air supply and leachate discharge lines including a four-inch by eight-inch (4"x8") HDPE dual containment pipe and associated dual containment pipe fittings, a stainless steel safety cable, wellhead flanges and sealing cap, steel support posts, a chain link cage enclosure, two (2) twenty four-inch (24") HDPE riser pipes, associated fittings and accessories; the demolition of the existing secondary containment structure and construction of a new secondary containment structure, and the relocation and installation of the existing leachate storage tanks and various components and accessories. The work shall include trenching, subgrade preparation and the construction of the LCRS to the elevations, lines and grades at the locations shown on the Project Drawings or as directed by the County. This work shall also include any cut or backfill necessary to achieve finished elevations adjacent to the LCRS component once construction is complete. All pipe, fittings, and cables shall be kept clean and undamaged during the progress of the work. Any pipe that becomes either partially or fully clogged or damaged before final acceptance, shall be cleaned, repaired, or replaced to the satisfaction of the County, by the Contractor, at the expense of the Contractor. All work shall conform to applicable requirements of the Standard Specifications, relevant manufacturer's and supplier's specifications, and the Contract Documents.

### 18.2 MATERIALS

#### 18.2.1 Drainage Layer

The material for the drainage layer shall consist of washed gravel with a ½ -1-inch maximum particle size. The Contractor shall submit certified results of sieve analysis and permeability on the proposed gravel material to the County for acceptance. Tests must be completed within ninety (90) calendar days preceding the date of submittal and certified by an independent laboratory by a California registered Civil Engineer. The material to be used for the drainage layer shall consist of clean, hard, durable particles with a hydraulic conductivity of 0.1 cm/sec or greater as verified by the ASTM D2434 test method. The material shall meet the following gradation requirements as determined by sieve analysis (ASTM D422):

U.S. Standard Sieve	PERCENT PASSING BY WEIGHT
1/2 inch	100
3/8 inch	85-100
No. 4	0-30
No. 8	0-10
No. 200	0-1

Permeability 0.1 cm/sec or greater

## 18.2.2 HDPE Pipes

### a. General

HDPE pipes shall be sized as shown on the Project Drawings and described in these specifications. Four-inch (4") nominal diameter pipe and four-inch by 8-inch (4"x8") dual containment nominal diameter pipe shall have a design working pressure of 100 psi or greater at 73.4°F and an SDR of 11 or less. Eight-inch (8") and twenty four-inch (24") nominal diameter pipes shall have a design working pressure of 160 psi or greater at 73.4°F and an SDR of 11 or less.

If required, the pipes shall be slotted based on a schedule as shown on the Project Drawings. Pipe material shall be of ultra-high molecular weight, high-density polyethylene conforming to ASTM D3350 Cell Classification PE 345434C through 355434C, manufactured from PE 3408 resin.

The material shall exceed 1,500 hours on environmental stress crack resistance (ESCR) with no failures and no indication of stress crack initiation, as determined by ASTM D1693, Condition C. Certified laboratory test results documenting cell classification, melt flow index, and tensile strength of actual pipe to be used on the project shall be submitted to the County for acceptance prior to delivery.

Additional, nominal, engineering design specifications required are:

Property	Unit	Test Method	Value	QA/QC Conf. Testing (Y/N)
Elongation at Break	%	ASTM D638 - 10	600-900	N
Flexural Modulus	psi	ASTM D790 - 10	>100,000	N
Impact Strength	N/A	ASTM D256 - 10	no break	N
Resin Density	gm/cm <sup>3</sup>	ASTM D1505/D2839	0.95-0.96	N
Melt Index	gm/10 min	ASTM D1238*	0.11**	N

Hardness	shore "D"	ASTM D2240 – 05(2010)	62-65	N
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Perform test at 216 kg/190oC

\*\* Average melt index value with a standard deviation of 0.01

**c. Slot Design**

Pipes shall be slotted in accordance with the patterns shown on the Project Drawings. The slots shall be cut before installation. All debris generated from the cutting operation shall be completely removed from the pipe prior to assembly and installation.

**d. Defects and Labeling**

The HDPE pipe shall be homogeneous throughout, and shall be free of visible cracks, holes, foreign inclusions, or other defects. Any pipe with nicks, scrapes, or gouges deeper than 5% of the nominal wall thickness shall be rejected. Pipe material shall be uniform in color, capacity, density, and other physical properties.

The following shall be continuously printed on the pipe:

- i. Name and trademark of the pipe manufacturer
- ii. Nominal pipe size
- iii. Standard dimension ratio (SDR)
- iv. The letters HDPE, followed by the hydrostatic design basis in 100's of psi
- v. Manufacturing standard reference (e.g. ASTM D3035 or ASTM F714)
- vi. A production code from which date and place of manufacture can be determined

**18.2.3 HDPE Fittings**

HDPE fittings shall be molded from polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe or shall be manufactured using polyethylene compound having a cell classification equal to or exceeding the cell classification of the pipe as specified herein.

**18.2.4 Flanges**

Unless otherwise noted on the Project Drawings, all flanged connections of polyethylene pipe shall utilize PE flange adapters with 316 stainless steel or ASTM A351 CF8M backing flanges.

**18.2.5 Cleanout Pipe**

The LCRS shall have a cleanout line attached to the main collection pipe to provide access to the system. The cleanout line shall be attached to the main collection pipe along the Canyon Floor and shall terminate on the south side of Bench P. The cleanout line shall consist of the following:

- a) The four-inch (4") HDPE cleanout pipe shall be solid throughout and conform to the same material specifications described in Section 18.2.2 "HDPE Pipes".
- b) HDPE fittings for the cleanout pipe shall conform to the same material specifications described in Section 18.2.3 "HDPE Fittings".
- c) The cleanout sealing cap shall be a four-inch (4") PVC vacuum type fitting.
- d) Geotextile used to wrap cleanout pipe shall be in accordance with Section 17 "Geotextiles".
- e) Temporary protective membrane and sandbags used to cover cleanout pipe shall be in accordance with Section 20 "Temporary Protective Membrane".
- f) Bollards protecting cleanout access on Bench P shall be schedule 40 steel pipe and conform to ASTM A36 or approved equal;
- g) A half-inch (1/2") diameter ten-inch (10") long footing rod anchor shall be securely centered through each vertical pipe six-inches (6") above the bottom of pipe; Anchor rod shall conform to the requirements of ASTM A36 or approved equal
- h) Concrete used to fill bollards and construct footings shall be Class 560-C-3250 and shall conform to Section 201-1 of the Standard Specifications
- i) Bollards shall be hot-dipped galvanized in accordance with Standard Specifications Section 210-3

#### **18.2.6 Leachate Pump System**

##### **a) Slider Pump**

The bottom-loading angled riser slider pump shall be a surface-controlled, pneumatic positive air displacement design, Model 303095P or updated equal as manufactured by QED Environmental Systems, Inc. (QED). Pump shall operate with an angle-independent valve by positive air displacement using compressed air, capable of operations in an angled well/riser at a min. 3:1 slope (H:V) or 18.5° up to a 90° vertical orientation. Standard product design shall include complete pump assembly, including body, end caps, tubing/hose fittings, O-Rings, check valve and inlet to meet the following specifications:

- i. Pump and all corresponding at-well equipment shall operate on compressed air; no electricity shall be required in the well or at the well head
- ii. Pump shall be capable of operating utilizing bubbler tubes or in-well sensors to provide on/off level control
- iii. Pump shall be able to utilize manufacturer provided solar/digital C100M controller
- iv. Pump body, head casing and frame shall be 304 stainless steel
- v. Pump body ends shall be machined to assure precise fit of end cap O-rings for proper seal and easy disassembly and reassembly without O-ring damage
- vi. The leachate inlet check valve shall be a plug type
- vii. The leachate discharge check valve shall be an angle-independent rotating ball type that is affixed above the body of the pump and is serviceable using hand tools
- viii. Valves shall exhibit a self-cleaning action and be able to pass coarse solids and viscous liquids without clogging

- ix. The inlet and discharge check ball shall be located in a housing, which allows passage of solids up to an eighth-inch (1/8")
- x. Pump shall have a bottom inlet screen of 304 stainless steel with a min. of eleven sq. inches (11-inch<sup>2</sup>) of open area with holes for fluid to pass
- xi. The leachate inlet check-valve seat and plunger shall have an abrasion resistance that exceeds that of stainless steel
- xii. The internal pump discharge tube shall be a min. of an inch (1") diameter 304 Stainless Steel to maximize flow rate and reduce clogging/fouling
- xiii. Pump air supply line fitting shall be a half-inch (1/2") O.D. stainless steel tubing barb
- xiv. Pump leachate line fitting shall be one and a quarter-inch (1 1/4") O.D. stainless steel tubing barb
- xv. Pump bubbler line fitting shall be a quarter-inch (1/4") OD stainless steel tubing compression type fitting
- xvi. Pump shall have proven performance and compatibility with landfill leachate and condensate

Pump design and performance shall meet the following requirements and must be able to operate under the following conditions:

- i. Temperature up to 150° F (65° C) or greater
- ii. Operating Air pressure range of 5 psi to 100 psi or greater
- iii. Maximum lift of up to 200' or greater
- iv. Maximum liquid draw down to 12" (when installed on 3:1 slope)
- v. Minimum Flow Rate of 0.35 gpm or greater at 110 ft. pump depth with 2 ft. submergence
- vi. Capable of operating dry with no adverse effects to the system

**b. Pump Cycle Controller**

The pump refill and discharge cycle times shall be managed using the solar-digital timer system, Model C100M pump controller or updated equal, as manufactured by QED. The pump cycle controller shall be surface mounted outside of the pump well/riser with the controller's solar panel orientated south towards the predominant daily position of the sun. Standard product design shall include complete pump cycle controller assembly including: high air flow bypass valve, solar panel, backup battery pack, power converter outlet, LCD display, environmental seal case, air filter/regulator and quick-connect fittings to meet the following specifications:

- i. Air flow bypass valve shall be latching solenoid type with dual port manifold; valve fitting shall be a female three eighths-inch (3/8") NPT brass with nickel plating
- ii. Solar panel shall be shatterproof on enclosure top
- iii. Backup battery pack shall be CSA compliance, intrinsically safe, class 1, division 1, group C & D 110 VAC

- iv. Power converter connector outlet shall be 110 VAC capable of supplying 3 VDC to connector plug
- v. Display shall be LCD with 16 character alphanumeric, temperature compensated contrast, and power off control
- vi. Display window shall be non-glared, double hardened optical acrylic
- vii. Environmentally sealed case shall be suitable for outdoor use
- viii. Filter/Regulator shall regulate air flow and pump operation for Slider Pump Model 303095P or updated equal as manufactured by QED Environmental Systems, Inc. (QED).

The Controller design and performance shall meet the following requirements and must be able to operate under the following conditions:

- i. Temperature up to 150° F (65° C) or greater
- ii. Backup battery pack shall have a 10-day or greater reserve capacity

**c. Pump Level Controller**

The pump level controller shall be a pneumatic powered Iron Horse Pump Level Controller, Model 39573 or updated equal, as manufactured by QED. The pump level controller shall be surface mounted outside of the pump well/riser. Standard product design shall include complete pump level controller assembly and attachments including: enclosure case with on/off indicator, leachate level monitor gauge, air regulator, mounting brackets, bubbler tubing, reference line and connect fittings to meet the following specifications and operate under the following conditions:

- i. Leachate level monitor gauge shall be a WC minihelic gauge displaying a range of 0 to one hundred inches (100")
- ii. Air regulator shall include a brass inlet ball valve to shut off air flow to leachate pump system and attached three eighths-inch (3/8") FPT brass type QC socket; a three eighths-inch (3/8") MPT by three eighths-inch (3/8") I.D. hose barb type brass fitting shall be connected to the QC socket for connection to the main air supply line
- iii. Reference line fitting shall be a five sixteenths-inch (5/16") O.D. brass tubing compression type fitting
- iv. Bubbler line fitting shall be a quarter-inch (1/4") O.D. brass tubing compression type fitting
- v. Pump air supply line fitting shall be a three eighths-inch (3/8") I.D. brass hose tubing barb type fitting
- vi. Bubbler tubing shall be quarter-inch (1/4") O.D. blue-colored Nylon-12 tubing as manufactured by QED
- vii. Reference line tubing shall be five sixteenths-inch (5/16") O.D. red-colored Nylon-12 tubing as manufactured by QED
- viii. Temperature up to 150° F (65° C) or greater

**d. Air Supply Lines**

The leachate pump system also consists of a main air supply line emanating from the existing air compressor located in the Gas to Energy (G2E) Facility, air supply lines between the pump level controller, pump cycle controller and wellhead flange, and an air supply line between the wellhead flange and leachate pump. The diameter and material of the air supply lines vary between pump system components and shall be the following type:

- i. The existing main air supply line is one-inch (1") I.D. P.E. tubing and shall be relocated at the locations shown on the Project Drawings. The main air supply line shall be extended to the pump level controller using three eighths-inch (3/8") I.D. green-colored Insta-Grip 300 hose as manufactured by Goodyear or approved equal; tubing shall be transitioned via a one-inch (1") tubing barb brass type fitting by reducing coupler by three eighths-inch (3/8") hose barb brass type fitting or as recommended by manufacturer, QED.
- ii. Air supply lines conveying air from pump level controller to pump cycle controller to wellhead flange shall be three eighths-inch (3/8") I.D. green-colored Insta-Grip 300 hose as manufactured by Goodyear or approved equal
- iii. Air supply line conveying air from wellhead flange to slider pump shall be half-inch (1/2") O.D. black-colored Nylon-12 tubing as manufactured by QED; a half-inch (1/2") Teflon coated in-well exhaust valve, model L350 as manufactured by QED, shall be connected to the pump air supply line a min. five feet (5') underneath the well head flange

**e. Leachate Discharge Lines**

The leachate pump system also consists of fluid discharge lines that convey leachate from the system sump on the canyon floor to Relocated Salvaged Leachate Tank #1 located on Bench P. The diameter and material vary between pump system components and shall be the following type:

- i. The fluid discharge line conveying leachate from the pump to the wellhead flange shall be one and a quarter-inch (1-1/4") O.D. black-colored Nylon-12 tubing as manufactured by QED
- ii. The fluid discharge line conveying leachate from the twenty four-inch (24") wellhead flange to the four-inch (4") sealing flange shall be one-inch (1") I.D. black-colored Ultra-Grip hose as manufactured by Veyance Technologies or approved equal
- iii. The fluid discharge line conveying leachate under Bench P shall be four-inch by eight-inch (4"x8") HDPE dual containment pipe. Dual containment pipe shall be solid throughout and conform to the same material specifications described in Section 18.2.2 "HDPE Pipes".
- iv. The fluid discharge line conveying leachate from the four-inch (4") sealing flange to the leachate storage tank shall be one-inch (1") I.D. black-colored Ultra-Grip hose as manufactured by Veyance Technologies or approved equal

- v. Upstream of the connection to the leachate storage tank, along the one-inch (1") I.D. black-colored Ultra-Grip hose, a digital in-line flow meter totalizer shall be installed along the leachate discharge line; the flow meter totalizer shall meet the following specifications:

1. Totalizer shall consist of HDPE, stainless steel or other approved material non-corrosive from leachate.
2. Totalizer shall provide a digital output.
3. Display screen shall be a clearly visible LCD screen.
4. Totalizer shall be solar and/or battery powered capable of providing 9000 hours of use before battery replacement.
5. Totalizer shall be capable of measuring a minimum flow rate of 2 gpm
6. Totalizer shall be one-inch (1") I.D. size.
7. Contractor shall provide proper fittings to connect one-inch (1") I.D. black-colored Ultra-Grip hose to and from totalizer.

**f. Safety Cable**

In order to retrieve the slider pump from the well/riser, a safety cable shall be used to suspend the pump to the underside of the wellhead flange. Safety cable system shall consist of a wire rope kit with the following components: wire rope, steel thimble and two (2) saddle clamps to meet the following specifications:

- i. Wire rope shall be five thirty-seconds inch (5/32") thick, seven by nineteen (7 x 19) strand, 304 stainless steel with a min. workload capacity of 100-pounds.
- ii. Thimble shall be five thirty-seconds inch (5/32") thick, 304 stainless steel.
- iii. Saddle clamps shall be 304 stainless steel and field adjustable.

**g. Wellhead Flanges**

In order to ensure leachate displacement from the leachate collection pipe system sump to Relocated Salvaged Leachate Tank #1, wellhead and sealing flanges are necessary to maintain vacuum tight seals along the leachate discharge line. The wellhead and sealing flanges shall be used to create a vacuum seal for the twenty four-inch (24") wells/risers and the four-inch by eight-inch (4"x8") HDPE dual containment pipe inlet and outlet used to convey the leachate discharge line under the Bench P access road. A sealing cap shall be used to cap the four-inch (4") HDPE cleanout line located on the eastside of Bench P. The custom riser wellhead and sealing flanges and sealing cap shall be the following type with the following components:

- i. The wellhead flanges shall be twenty four-inch (24") polypropylene flanges, configured to possess the following attachments:
  1. A one and a quarter-inch (1-1/4") stainless steel tubing barb type fitting underneath the flange transitioned to one-inch (1") stainless steel ninety



- degree elbow above the flange to a one-inch (1") stainless steel hose barb type fitting.
2. A half-inch (1/2") stainless steel tubing barb type fitting underneath the flange transitioned to three eighths-inch (3/8") stainless steel ninety degree elbow above the flange to a three eighths-inch (3/8") stainless steel hose barb type fitting.
  3. A one-inch (1") NPT with plug access hole.
  4. A quarter-inch (1/4") bored-through tubing bubbler fitting.
  5. A quarter-inch (1/4") bored-through vacuum reference fitting.
  6. A Buna-N flange gasket.
  7. A 304 stainless steel support eyebolt with one and a half-inch (1-1/2") threads and corresponding sealing stainless steel washers and nuts.
  8. A twenty four-inch (24") HDPE socket flange.
  9. Four (4) universal length 316 stainless steel type Easy Bolts, as manufactured by QED.
  10. The backup riser wellhead flange shall have plug access holes in place of the fittings on the main riser wellhead flange.
- ii. The sealing flanges shall be four-inch (4") HDPE polypropylene flanges, configured to possess a one-inch (1") stainless steel hose barb underneath the flange and a one-inch (1") stainless steel ninety degree elbow above the flange to hose barb fitting.

#### **h. Steel Support Frames**

Steel posts shall be used to form a frame for mounting the pump cycle and pump level controllers, so that they may be more accessible to personnel. Steel posts shall also be utilized to form an H-frame to support the two (2) 24-inch (24") HDPE riser pipes to maintain an elevated position.

- i. The steel support frame supporting the pump controllers shall be the following type with the following components:
  1. The frame shall be Unistrut Preferred Three-Piece Assembly Telestrut type (Unistrut Frame System), with two horizontal bar sections matching the mounting dimensions of the Iron Horse Pump Level Controller, as manufactured and fabricated by Unistrut or approved equal
  2. Steel posts forming the frame shall be telescoping tubing type to the dimensions shown on the project plans; The vertical tubes of the frame system and four (4) initial horizontal tubes shall be P9000 type, while the middle most horizontal tubes shall be P9200 type; The four (4) initial P9000 type horizontal tubes shall be of sufficient length to align telescoping holes and connect with the P9200 type tubes using through bolt connections. The base plates anchoring the frame to the concrete box culvert shall be P9012 type; Tubing members and base plates shall be

- fabricated from structural grade steel conforming to ASTM specification A1011 SS GR 33 or A653 GR 33 if pre-galvanized
3. Holes drilled in base plate for anchor bolt installation shall conform to sub-section 304-1.5.4 of the Standard Specifications
  4. Connections between vertical and horizontal tubes shall be made using P9324 type angle bracket fittings with a one and five eighths-inch (1-5/8") type Branch and Truck, designator G; Angle bracket fittings shall be fabricated from steel conforming to ASTM specification A36
  5. Connections between horizontal tubes and through angle brackets, P9000 and P9200 horizontal tubes, P9000 vertical tubes and P9012 base plate shall be made using through bolt connections; bolts shall be half-inch by two-inch (1/2" x 2") hex head cap screws secured on its underside by half-inch (1/2") hexagon nuts; Bolts shall be long enough to extend entirely through the nut, but not more than a quarter-inch (1/4") beyond; Both bolts and nuts shall be of steel conforming to the requirements of ASTM A307
  6. Frame system shall be anchored at base plates using four (4) five eighths-inch by four-inch (5/8" x 4") Simpson Strong-Tie Titen HD Anchor Screws or approved equal on each base plate. Anchor screws shall have a zinc plated finish or be hot-dipped galvanized in accordance with Standard Specifications Section 210-3
  7. The steel tubes, angle brackets, bolts and nuts shall be hot-dipped galvanized after fabrication in accordance with Standard Specifications Section 210-3
  8. Exposed ends of vertical tubing members shall be capped using P2860-10 type plastic end caps as manufactured by Unistrut or approved equal
- ii. Steel posts forming an H-frame to support the two (2) twenty four-inch (24") HDPE riser pipes shall be the following type with the following components:
1. Steel posts shall conform to ASTM A36 or approved equal; H-frame shall consist of a two-inch (2") diameter schedule 40 steel pipe cross member welded to two (2) vertical four-inch (4") diameter schedule 40 steel pipes; Steel H-frame shall be formed to the dimensions shown on the Project Drawings; The Contractor shall furnish, before fabrication, a mill certified report in conformance with sub-section 206-1.1.2 of the Standard Specifications
  2. A half-inch (1/2") diameter ten-inch (10") long footing rod anchor shall be securely centered through each vertical pipe six-inches (6") above the bottom of pipe; Anchor rod shall conform to the requirements of ASTM A36 or approved equal
  3. Concrete used to fill the H-frame steel members and construct the post footings shall be Class 560-C-3250 and shall conform to Section 201-1 of the Standard Specifications
  4. H-frame shall be hot-dipped galvanized after fabrication in accordance with Standard Specifications Section 210-3

**i. Chain Link Cage Enclosure**

A chain link cage enclosure shall be installed along the perimeter of the LCRS pump system risers and controllers to prevent access from unauthorized personnel. The material components of the chain link cage enclosure shall be in accordance to Standard Specifications Section 206-6. Chain link fence material components requiring further specification shall be the following type:

- i) Base material for the manufacture of steel pipe used for base plates, posts, braces, top rails and gate frames shall be Class 1 schedule 40 type and shall conform to the requirements of ASTM F1083; Material type and size for posts, rails and braces shall conform to Table 206-6.2 (A) of the Standard Specifications Section 206-6 and be selected as shown and/or in respect to the dimensions shown on the Project Drawings.
- ii) Chain link fence fabric shall conform to sub-section 206-6.3.1 of the Standard Specifications with fabric having a knuckled finish on the top edges and twisted and barbed finish on the bottom edge; Barbing shall be done by cutting the wire on the bias.
- iii) All steel fence components requiring galvanizing shall be hot-dipped galvanized in accordance with Standard Specifications Section 210-3.
- iv) The Contractor shall furnish, before fabrication, a mill certified report in conformance with sub-section 206-1.1.2 of the Standard Specifications.
- v) Face of chain link cage enclosure shall be double swing gate type.
- vi) Footings for fence posts shall be Class 500-C-2500 Concrete and shall conform to Section 201-1 of the Standard Specifications.
- vii) Anchor bolts for posts installed above box culvert shall be five eighths-inch by four-inch (5/8" x 4") Simpson Strong-Tie Titen HD Anchor Screw or approved equal; Anchor screws shall have a zinc plated finish or be hot-dipped galvanized in accordance with Standard Specifications Section 210-3.
- viii) Base plate and post to be installed over box culvert shall be welded to develop a uniform section.
- ix) Holes drilled in base plate for anchor bolt installation shall conform to sub-section 304-1.5.4 of the Standard Specifications.
- x) Concrete for reinforced concrete pad between type "C" curb and box culvert shall be Class 520-A-2500 Concrete and shall conform to Section 201-1 of the Standard Specifications.
- xi) Type 2 white pigmented curing compound shall conform to sub-section 201-4.1.1 of the Standard Specifications.
- xii) Welded Wire Reinforcement (WWR) for reinforced concrete pad shall conform to sub-section 201-2.2.3 of the Standard Specifications. The gage of the wire and the dimensions of the mesh shall be as specified in the Project Drawings.

**j. HDPE Riser Pipes**

- i. The two (2) twenty four-inch (24") HDPE riser pipes shall be solid throughout and conform to the same material specifications described in Section 18.2.2 "HDPE Pipes".
- ii. Concrete slurry for trench backfill over the two (2) 24-inch (24") HDPE riser pipes and 8-inch (8") HDPE gas collection pipe shall be Class 100-E-100 and shall conform to Standard Specifications Section 201-1.

**18.2.7 Storage Tanks and Secondary Containment Structure**

The existing tanks, tank accessories and tank restraint system shall be relocated into a newly constructed secondary containment structure, and reused as shown on the Project Drawings and as required by the Contract Documents. The tanks and accessories shall be installed at the new location and tested in accordance with the manufacturer recommendations, instructions, and Project Drawings.

Leachate secondary containment structure size, location, and grades shall be constructed as shown on the Project Drawings. The following is a list of these materials/layers and the corresponding sections from these specifications:

- a) Subgrade: Special Provisions Section 8.3.1
- b) Class II Base: Special Provisions 21.2.2
- c) Reinforced Concrete: Special Provisions 8.3.1

**18.3 EXECUTION**

**18.3.1 Construction of the Drainage Layer**

The Contractor shall submit a plan to the County showing the areas, sequence of work, and estimated schedule in which the construction of the drainage layer will occur. Drainage layer material shall not be placed on the geotextile until the installation, seaming, and testing of the 12 oz/sy geotextile is complete and is accepted by the County and QA/QC Consultant. Areas on which drainage material is to be placed shall conform to the construction details shown on the Project Drawings to permit placement of the full thickness indicated. Drainage material shall be spread uniformly on the base to the section, thickness, slope lines and grades indicated on the Project Drawings.

The method of placement of material shall be such that it will not cause segregation of particle sizes. The material shall be placed in a manner and with appropriate equipment such that damage does not occur to the underlying liner components. The Contractor shall sequence the material placement so that lightweight spreading equipment (small dozers and loaders) does not operate directly on the geotextile. The Contractor shall place the material in the direction parallel to the geotextile seams. The method of drainage material placement shall be submitted to the County for acceptance.

Any damage or excessive wrinkles/folds in the geotextile in the opinion of the County and QA/QC Consultant, caused during placement of drainage material shall be repaired at the Contractor's expense before proceeding with further placement. The Contractor shall maintain the integrity of the drainage layer until it has been accepted by the County. Any material displaced by any action of the Contractor shall be replaced at the Contractor's expense to the lines and grades shown on the Project Drawings. No vehicles shall drive on uncovered geotextile.

### **18.3.2 Geotextile Placement**

Geotextile discussed in this section of the Special Provisions shall be placed above the drainage layer. The 8 oz/sy geotextile shall be installed in accordance with Section 17 "Geotextiles" of these Special Provisions, except as modified herein. The geotextile shall be placed in the manner and at the locations shown on the Project Drawings and described in the QA/QC Plan, and as directed by the County and QA/QC Consultant. The geotextile shall be placed so as to minimize the number of joints. The fabric shall be laid smooth and free of tension, stress, folds, wrinkles, or creases. The roll length shall be maximized to provide the largest manageable sheet for the fewest field seams. The strips shall be laid smooth to provide a minimum width of three inches (3") for sewn seams.

During geotextile installation sand bags shall be used as necessary, and as directed by the County and QA/QC Consultant to prevent uplift during excessive wind. The sand bags shall not have sharp edges or protrusions that may snag or cut the geotextile. Any portion of the geotextile showing damage from any cause shall be replaced or repaired with an additional piece of geotextile material, according to the procedures in the QA/QC Plan or as directed by the County and the QA/QC Consultant.

The geotextile shall be protected from contamination by surface water run-off at all times during construction. Machinery (other than seaming equipment and portable electric generators) shall not be operated directly on the geotextile. The geotextile shall be rejected immediately if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.

### **18.3.3 Leachate Collection System Pipe Placement**

The leachate collection system components shall be placed to the lines and grades and at locations as shown on the Project Drawings and/or as directed by the County. The leachate collector pipes within the liner limits shall be slotted eight inch (8") diameter with an SDR of 11. The leachate collector pipes shall be placed on a two inch (2") thick gravel bedding within the nine inch (9") drainage layer above the membrane as shown on the Project Drawings.

Slotted pipes shall be joined by appropriate techniques and slip fittings. Butt-fusion welding shall be required only if the elements do not otherwise hold their relative positions. The slotted pipe shall be laid at the location and to the elevations, as shown on the Project Drawings. Maximum acceptable tolerances for positioning of the pipe shall be 0.05 feet vertically and 0.5 feet horizontally. All pipes must be placed, however, to promote positive drainage along the entire length. Excluding the sump, low areas where liquids may collect are not acceptable.

Pipes shall be installed in such a manner so as to provide for expansion and contraction, as recommended by the manufacturer. Pipes shall be fully supported on the base with no induced strain. Where there is evidence of induced pipe strain, the Contractor shall make the required pipe cuts and install angle fittings as necessary to eliminate the strain. The Contractor shall also remove and replace any fittings that induce either torque or strain to the pipe.

HDPE pipe lengths, fittings, and flange connections to be joined by thermal butt-fusion shall be of the same type, grade, and class of HDPE compound, and shall be supplied from the same raw material supplier. Butt-fusion of pipes and fittings shall be performed in accordance with the pipe manufacturer's recommendations for equipment and technique. Jointing can be performed inside or outside of the work area, at the Contractor's discretion.

Mechanical connections of the HDPE pipe to auxiliary equipment, such as valves and other piping systems, shall be through flange connections, consisting of the following:

- a. Fittings and stub ends for HDPE pipe with a minimum design pressure rating of 160 psi at 73.4 °F for eight-inch (8") designated with SDR 11
- b. An HDPE stub end thermally butt-fused to the ends of the pipe
- c. ASTM A240, Type 316 stainless steel bolts and backing flange, 150-pound, ANSI B16.5 Standard
- d. Bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made, tightened to the manufacturer's standard, and re-torque after four hours
- e. Buna-N Gaskets, unless otherwise specified

Before covering the pipes with drainage gravel layer, the pipe shall be surveyed by the Contractor's surveyors for the As-Built Plans and the County's surveyors for verification of alignment and proper drainage. Solid HDPE pipe shall be tested by the Contractor (Air Test) for any leaks as directed by the County or the QA/QC Consultant before covering the solid HDPE pipe.

Pipe and fittings shall be held firmly in position and protected from damage while drainage gravel is being placed. All pipe and fittings shall be kept clean during the progress of the work. Any pipe that becomes either partially or fully clogged or damaged before final acceptance, shall be cleaned, repaired, or replaced to the satisfaction of the County, by the Contractor, at the expense of the Contractor.

#### **18.3.4 Cleanout Pipe Installation**

- a) Trenching for the placement of the four-inch (4") cleanout pipe shall be uniformly constructed as part of the subgrade in accordance with Section 9 "Earthwork". Subgrade along pipe trench shall be prepared either by excavating or placing engineered fill, and shall conform to lines, grades, and cross sections and be located as shown on the Project Drawings. The trench width shall be in accordance with the dimensions shown on the Project Drawings.
- b) Cleanout pipe shall be joined by butt-fusion welding or by other appropriate techniques.
- c) Cleanout pipe shall be placed on top of the 16 oz/sy geotextile layer along the side slope of the encapsulated GCL side-slope liner system as shown on the Project Drawings. At the toe of

slope, the 8 oz/sy geotextile filter fabric layer overlapping the drainage layer shall be heat bonded to the face of the cleanout pipe.

- d) The trench for the portion of the cleanout pipe located within the initial protective soil layer shall be backfilled in accordance with Section 19 "Protective Soil Layer Construction" of these Special Provisions. The portions of the cleanout pipe located outside of the construction of the protective soil layer shall be covered with two-foot by two-foot (2' x 2') sections of 16 oz/sy geotextile at ten-foot (10') intervals in accordance with Section 17.3.2 "Geotextile Placement" of these Special Provisions. The cleanout pipe shall also be covered by temporary protective membrane in accordance with Section 20 "Temporary Protective Membrane".
- e) Bollards protecting cleanout cap shall be coated with primer and painted safety yellow.
- f) Concrete used to fill bollards and for footings as shown on plans shall be placed in conformance with Section 303-1 of the Standard Specifications.

### **18.3.5 Leachate Pump System Installation**

- a) Trenching for the placement of the two (2) 24-inch HDPE riser pipes shall be uniformly constructed as part of the subgrade in accordance with Section 9 "Earthwork". Subgrade along pipe trench shall be prepared either by excavating or placing engineered fill, and shall conform to lines, grades, and cross sections and be located as shown on the Project Drawings. The trench width shall be in accordance with the dimensions shown on the Project Drawings and at a minimum, provide clear distance of six (6) inches between the outside diameter of each pipe with the adjacent pipe and/or the side of the trench for each side of each pipe.
- b) HDPE riser pipes shall be joined by butt-fusion welding or by other appropriate techniques. After riser pipes are joined together, the internal fusion beads shall be removed prior to the installation of the slider pump.
- c) Riser pipes shall be placed on top of the 16 oz/sy geotextile layer along the side slope of the liner system as shown on the Project Drawings. At the toe of slope of the sump, the 8 oz/sy geotextile filter fabric layer overlapping the drainage layer shall be heat bonded to the face of the riser pipe.
- d) Contractor shall conduct trench backfill operations with due caution and care to prevent damage to pipe. The installation of slurry backfill shall be performed in accordance with Standard Specification Section 306-1.3., and slurry shall be installed from bottom of trench to one foot (1') above the top of pipe. Slurry backfill shall be placed within one (1) hour of mixing. Slurry backfill shall be placed without voids or segregation and in a manner that does not float or shift the HDPE pipes. Foreign materials that fall into trench shall be removed. The slurry shall cure in-place for a minimum of four (4) hours before any earthen trench backfill operations may commence unless otherwise directed in writing by the County. The QA/QC Representative may take test cylinders during slurry installation work as deemed necessary by the County and QA/QC. Cylinder breaks will be performed by the QA/QC Consultant at the direction of the County to ensure that in-place materials meet the full design strength. Cylinders shall be made and handled by the QA/QC Representative and paid for by the County.

- e) Trenching for the installation of the four-inch by eight-inch (4"x8") HDPE dual containment pipe shall be carefully made using both mechanical means and shovels in order that the structure may be positioned in-place on a firm, stable and unyielding surface with minimal resultant voids under the structure. The width of excavation for HDPE conduit pipe shall provide a minimum clear distance of six (6) inches between the outside of the pipe and the side of the excavation for each side of the pipe.

The subgrade for installation of the HDPE dual containment pipe shall be prepared by excavating engineered fill placed by the Contractor to the line, grade and cross section shown on the Project Drawings. The trench for the HDPE dual containment pipe shall be excavated in accordance with ASTM D 2321.

HDPE dual containment pipe installation shall be performed in accordance with Standard Specification Section 306-1.2.2. Installation of HDPE dual containment pipe fittings shall be performed as shown on the Project Drawings and in accordance with Standard Specification 306-1.2.13. An HDPE pipe sleeve for the four-inch by eight-inch (4"x8") HDPE dual containment pipe shall be installed during construction of slab of the Leachate Secondary Containment Structure.

Contractor shall conduct trench backfill operations and subsequent engineered fill operations with due caution and care to prevent damage to the HDPE dual containment pipe. The portion of remaining trench (between the top of initial backfill and the top of trench) shall be backfilled in accordance with Section 9.3.4 "Engineered Fill" of these Special Provisions. Contractor equipment used for this operation shall be in accordance with Standard Specification Sections 306-1.3.1. and 306-1.3.2.

- f) A QA/QC representative from QED shall be present during the installation and connection of the slider pump, pump level controller and pump cycle controller to ensure system components are installed correctly per manufacturer recommendations.
- g) Steel H-Frame supporting LCRS Riser Pipes shall be coated with primer and painted safety yellow.
- h) Concrete used to fill steel H-Frame supporting LCRS Riser Pipes and used for H-Frame and chain link fence footings as shown on plans shall be placed in conformance with Section 303-1 of the Standard Specifications.
- i) Unistrut H-frame shall be installed in conformance to the following:
  - i) Surface shall be thoroughly cleaned prior to installation.
  - ii) Steel base plates shall be installed in proper relation with adjacent construction and with uniform appearance. Surfaces of base plates that come in contact with ground concrete surface shall be finished-machined flat to within one thirty second-inch (1/32") tolerance in twelve inches (12") and to within one sixteenth-inch (1/16") tolerance overall. Base plates shall be set level and to the elevations shown on the Project Drawings.



- iii) Anchor screws shall be installed in accordance with sub-section 304-1.7. Anchor screws shall be embedded into the box culvert a minimum depth as recommended by the manufacturer. Five eighths-inch (5/8") diameter Titen HD Anchor Screws require a minimum embedment depth of two and three fourths-inch (2 3/4"). Anchor screws shall be installed a minimum distance from the edge of the box culvert as recommended by the manufacturer. Five eighths-inch (5/8") diameter Titen HD Anchor Screws require a minimum critical edge distance of eight inches (8").
- iv) Anchor hole shall be drilled to the specified embedment depth plus 1/2" to allow the thread tapping dust to settle and shall be blown clean using compressed air.
- j) Chain link fence enclosure shall be constructed and installed as shown on the Project Drawings and in conformance with Standard Specifications Section 304-3. The chain link fence enclosure shall also be constructed and installed in conformance with the following:
  - i) Concrete surfaces shall be thoroughly cleaned prior to installation.
  - ii) Steel base plates shall be installed in proper relation with adjacent construction and with uniform appearance. Surfaces of base plates that come in contact with ground concrete surface shall be finished-machined flat to within one thirty second-inch (1/32") tolerance in twelve inches (12") and to within one sixteenth-inch (1/16") tolerance overall. Base plates shall be set level and to the elevations shown on the Project Drawings.
  - iii) Anchor screws for posts installed above box culvert shall be installed in conformance with Standard Specifications sub-section 304-1.7. Anchor screws shall be embedded into the box culvert a minimum depth as recommended by the manufacturer. Five eighths-inch (5/8") diameter Titen HD Anchor Screws require a minimum embedment depth of two and three fourths-inch (2 3/4").
  - iv) Anchor hole shall be drilled to the specified embedment depth plus 1/2" to allow the thread tapping dust to settle and shall be blown clean using compressed air.
  - v) Ends of all gate hinge bolts shall be battered.
  - vi) The reinforced concrete pad between the type "C" curb and box culvert shall be constructed as shown on the Project Drawings. The Contractor shall use the relevant sections from these Specifications for the construction of each type of material/layer required for the construction of the reinforced concrete pad. The following is a list of these materials/layers and the corresponding sections of execution from these specifications:
 

(1) Subgrade:	Special Provisions Section 8.3.1
(2) Class II Base or Crushed Miscellaneous Base:	Special Provisions Section 21.4.2
(3) Reinforced Concrete:	Special Provisions Section 8.3.1
- k) The construction of the drainage layer shall be constructed according to Section 18.3.1 "Construction of Drainage Layer" in these Specifications.

- D) Anchor benches shall be in accordance with Special Provisions of Section 14 "Anchor Bench Construction."

### **18.3.6 Removal of Existing Leachate Storage System & Installation of Temporary Leachate Storage System**

The existing reinforced concrete secondary containment structure and associated piping shall be demolished, removed, and disposed of as required by the Contract Documents and as directed by the County. This work is covered and paid for under **Bid Item No. 5 "Demolition"** Section 6. In addition, in order to facilitate the construction of C4P3 Project, the existing three (3) 10,000-gallon tanks including all its connections and accessories shall be disconnected and relocated to a new secondary containment structure to be constructed under this contract as required by the Contract Documents.

The existing leachate pipe line which was installed during the previous liner expansion project (referred to as Canyon 4 Phase 2) extends approximately 400 feet south of the existing liner termination, and ends at the existing three (3) 10,000-gallon leachate tanks. This portion of the existing leachate pipe is a solid four-inch (4") diameter HDPE, and falls within the C4P3 project area; thus, shall be removed (after capping to prevent spilling leachate on unlined areas) and disposed of as directed by the County.

In order to maintain serviceability to the existing LCRS at the site, prior to disconnecting the existing three (3) 10,000-gallon tanks and all its connections, and HDPE vertical sump pipe, the Contractor shall furnish and install a temporary leachate storage tank with a minimum capacity of 10,000 gallons. The temporary leachate storage tank shall be placed with secondary containment having storage capacity not less than 110% of the temporary tank capacity. Secondary containment shall, at a minimum, consist of the temporary leachate storage tank installed on Class II Base with a surrounding protective cover soil berm, underlined by 60 mil HDPE in accordance with the current secondary containment system for the existing 5,240 gallon leachate storage tank. This temporary leachate storage system shall be installed at the existing 4" butterfly valves assembly located approximately twenty (20) feet south of Canyon 4 Phase 2 liner limit. This temporary leachate storage tank shall be connected to the main LCRS 4" HDPE pipe extending out of C4P2 area, and shall be either gravity-fed or provided with an automated pump (with power source such as generator) to control the flow of leachate into the temporary tank. The Contractor shall prepare and submit to the County for acceptance a detailed plan for the temporary leachate storage system as described above. Once this system is accepted by the County, and furnished and installed by the Contractor, this temporary system shall remain in service until the installation of the entire new LCRS for C4P3 project is completed by the Contractor, and inspected and accepted by the County. The Contractor shall maintain and facilitate access to this temporary leachate storage system to allow for leachate removal and general inspection by County personnel at all times throughout the project duration.

### **18.3.7 Construction of Leachate Secondary Containment Structure & Reinstallation of Existing Leachate Tanks**

Leachate secondary containment structure size, location, and grades shall be constructed as shown

on the Project Drawings. The Contractor shall use the relevant sections from these Specifications for the construction of each type of material/layer required for the construction of the leachate secondary containment structure. The following is a list of these materials/layers and the corresponding sections of execution from these specifications:

- a) Subgrade: Special Provisions Section 8.3.1
- b) Class II Base or Crushed Miscellaneous Base: Special Provisions 21.4.2
- c) Reinforced Concrete: Special Provisions 8.3.1

The existing three (3) 10,000-gallon leachate storage tanks including all accessories shall then be re-installed within the newly constructed secondary containment structure in accordance with the Project Drawings and as directed by the County. The tanks and accessories shall be installed at the new location and tested in accordance with the manufacturer recommendations, instructions, and Project Drawings.

#### 18.4 MEASUREMENT AND PAYMENT

- a. **Measurement** for all components of the leachate collection and removal system (such as HDPE pipes, drainage material, geotextile, and other items) shall be based on the final in-place quantities of each type of material after it has been constructed and tested to the satisfaction of the County. The final quantities shall be verified and determined by the County's field measurements within the limits specified by the Contract Documents. The lines and grades of the final surfaces shall be verified by the County's topographic survey to assure compliance with the Contract Documents. Allowable deviation from design grades shown on the Project Drawings shall be ± 0.1 feet.
- b. **Measurement and payment** for the 8-oz/sy geotextile layer shall be determined as stated in Section 17 of these Specifications.
- c. **Payment** for the drainage layer shall be made, after acceptance, at the Contract unit price per cubic yard as stated in **Bid Item No. 40** – “Furnish & Install LCRS Drainage Layer (½ - 1” Gravel)”.
- d. **Payment** for **Bid Item No. 41** – “Furnish and Install eight-inch (8”) slotted HDPE pipe including: pipe fittings and connections”; **Bid Item No. 42** – “Furnish and Install four-inch (4”) solid HDPE cleanout pipe including pipe fittings, and connections”, including protective bollards shall be made, after acceptance, at the unit price per lineal feet as stated in **Bid Item No. 41 and 42**. All costs associated with the installation of the , eight-inch (8”) HDPE slotted pipes and four-inch (4”) solid HDPE cleanout pipe such as fittings, connections and testing shall be included in **Bid Items 41 and 42**. The Contractor shall also include the cost of the protective bollards as required by the Contract Documents for the installation of the LCRS pipes in the contract unit prices per lineal feet of **Bid Items No. 41 and 42**.

- e. **Payment** for the construction of a new leachate pump system shall be made after acceptance, at the Contract lump sum price as Stated in **Bid Item No. 43** – “Furnish and Install Leachate Pump System including: tubing, fittings and support components.” The Leachate Pump System consists of: a bottom-loading angled riser slider pump, pump cycle controller, pump level controller, air supply and fluid discharge lines including four-inch by eight-inch (4”x8”) HDPE dual containment pipe, safety cable, well flanges, a unistrut frame supporting the pump level and cyclor controllers, a steel H-frame supporting LCRS riser pipes, a chain link cage enclosure including a reinforced concrete pad, two (2) twenty four-inch (24”) HDPE riser pipes and associated fittings and accessories. All components of the pump system (such as pump, pump cycle controller, pump level controller, air supply lines, fittings, and other items) shall be based on the final in-place quantities of each type of material after it has been constructed and tested to the satisfaction of the County. The Contractor shall also include the cost of backfill, and pipe support as required by the Contract Documents for the installation of the two (2) twenty four-inch (24”) HDPE riser pipes and four-inch by eight-inch (4”x8”) HDPE dual containment pipe for the fluid discharge line as well as trench excavation for the dual containment pipe in the Contract lump sum of **Bid Item No. 43**. The lines and grades of the final surfaces shall be verified by the County's topographic survey to assure compliance with the Contract Documents. Allowable deviation from design grades shown on the Project Drawings shall be ± 0.1 feet.
- f. **Payment for Bid Item No. 44** – “Relocate existing tanks, accessories, valves, vaults, guard posts, removal of existing 4” solid HDPE-LCRS pipe” relocating and salvaging the existing three (3) 10,000-gallon leachate tanks including all related valves, fittings, various components and accessories; and the re-installation of the existing three (3) 10,000-gallon leachate tanks and related accessories as shown on the Project Drawings; shall be made after this work has been completed and tested to the satisfaction of the County at the contract Lump Sum price as stated in **Bid Item No. 44**.

No additional compensation shall be allowed for the repair, reworking, removal or re-compaction of any material not meeting the requirements of the Contract Documents as determined by the County and QA/QC Consultant.

END OF SECTION 18

## 19. PROTECTIVE COVER SOIL (PCS) LAYER CONSTRUCTION

### 19.1 GENERAL

#### 19.1.1 Section Includes

This work shall include furnishing all labor, supervision, tools, equipment, and materials necessary to complete the work of placing a 2-foot-thick PCS layer as shown on the Project Drawings and as directed by the County. The remaining portions of the side slope lined area shall be covered with Temporary Protective Membrane as described below in Section 20 of these Special Provisions and as shown on the Project Drawings. All construction operations related to the screening, stockpiling, placement, grading, and compacting the PCS layer shall conform to the applicable requirements of the Standard Specifications and to the requirements of the Contract Documents.

### 19.2 MATERIALS

- a. The Contractor shall screen material directly from the C4P3 liner expansion area and/or Canyon 6 Stockpile area to produce maximum 1-inch particle size (that is, particles no greater than 1-inch in size) material. This select material will then be placed within the liner limits on side slopes and on benches, as shown on the Project Drawings. This select material shall be carefully protected to avoid contamination with any other material containing particle size larger than 1 inch. The QA/QC Consultant shall continually monitor the screened material stockpile and material placement to ensure that the specified maximum particle size is not exceeded under any circumstances. The Contractor at its own expense shall be responsible for removing or reprocessing the screened material stockpile in the event any greater than maximum 1-inch material is found in that screened material.
- b. The Contractor shall also screen material obtained directly from the C4P3 liner expansion area and or Canyon 6 Stockpile area to produce maximum 3-inch particle size (that is, particles no greater than 3-inch in size) material. This select material will then be placed within the liner limits on the 8 oz. geotextile filter fabric located at the canyon floor area, as shown on the Project Drawings. This select material shall be carefully protected to avoid contamination with any other material containing particle size larger than 3-inch. The QA/QC Consultant shall continually monitor the screened material stockpile and material placement to ensure that the specified maximum particle size is not exceeded under any circumstances. The Contractor at its own expense shall be responsible for removing or reprocessing the screened material stockpile in the event any greater than maximum 3-inch material is found in that screened material.

### 19.3 EXECUTION

The PCS layer shall be placed in a method that prevents damage to the underlying liner. The material shall be placed in uniform lifts and the depth of each lift shall be what is required to achieve a thickness of at least (24") twenty-four inches after grading and applying reasonable compaction

efforts as directed by the County and the QA/QC Consultant and as specified on the Project Drawings. **Wheeled equipment shall operate on no less than two feet (2') of PCS.**

**Only low ground pressure type compaction equipment shall be used, operating on no less than twelve inches (12") of soil cover above any geosynthetics.** Unless otherwise specified on the Project Drawings, the PCS layer on the benches shall be placed, graded, and compacted to 85% relative compaction. Compaction of the protective layer on the bottom and side slope areas shall be achieved by track walking, with at least one pass, over the entire surface. Additional track walking may be required when the QA/QC Consultant observes that adequate protection of the liner is not being met.

The **minimum thickness** of the PCS layer over the composite liner system shall be 2 feet thick. If damage occurs to the geotextile, FML, or GCL during the spreading or compaction operation, the PCS layer material shall be removed from the damaged area and the damaged section shall be repaired as specified in the QA/QC Plan at no additional cost to the County.

#### 19.4 MEASUREMENT AND PAYMENT

- a. The **measurement** of the final quantity for ***Bid Item No. 45 "Construct PCS Layer (3"-minus)"*** on Canyon Floor shall be measured in place, after proper moisture content and compaction have been applied, and finished grading is achieved in accordance with the project requirements. The **measurement** of the final quantity shall be calculated utilizing digital terrain modeling methods, to the nearest square foot of true surface area, based on survey measurements of ground after placement of the PCS layer. **Payment** for the construction of the PCS layer shall be at the contract unit price per square foot as stated in the Contractor's Proposal, **Bid Item No. 45**. **Payment** shall constitute full compensation to the Contractor for the work specified herein, and no additional compensation will be given for water supply or removal and re-compaction of material that does not meet the specifications described in this section. **Payment** shall also constitute full compensation for furnishing all labor, supervision, materials, tools, and equipment necessary to screen the material and construct the PCS layer in accordance with the Contract Documents.
- b. The **measurement** of the final quantity for ***Bid Item No. 46 "Construct PCS Layer (1"-minus)"*** on Side Slopes, Benches and a portion of the LCRS Trench, shall be measured in place, after proper moisture content and compaction have been applied, and finished grading is achieved in accordance with the project requirements. The **measurement** of the final quantity shall be calculated utilizing digital terrain modeling methods, to the nearest cubic yard of true Volume, based on survey measurements of ground before and after placement of the PCS layer. **Payment** for the construction of the PCS layer shall be at the contract unit price per cubic yard as stated in the Contractor's Proposal, **Bid Item No. 47**. **Payment** shall constitute full compensation to the Contractor for the work specified herein, and no additional compensation will be given for water supply or removal and re-compaction of material that does not meet the specifications described in this section. **Payment** shall also constitute full compensation for furnishing all labor, supervision, materials, tools, and equipment necessary to screen the material and construct the PCS layer in accordance with the Contract Documents.

END OF SECTION 19

## 20. TEMPORARY PROTECTIVE MEMBRANE

### 20.1 GENERAL

#### 20.1.1 Section Includes

This section covers the work necessary to furnish and install a temporary protective membrane to protect portions of the side slope lined area from ultraviolet (UV) degradation. The remaining portions of the side slope lined area shall be covered with PCS Layer as described above in Section 19 of these Special Provisions and as shown on the Project Drawings.

The temporary protective membrane work includes the supply and installation of polyethylene cover sheets with reinforcing scrim over the existing side slope liner system as shown on the Project Drawings. The Contractor shall provide all labor, supervision, tools, equipment, and materials and anchorage necessary to install the temporary protective membrane.

#### 20.1.2 References

Reference Standards and Specifications: The following standards and specifications, including documents referenced herein, form part of these Special Provisions and are incorporated herein by reference.

#### American Society for Testing Materials (ASTM)

- |                       |   |
|-----------------------|---|
| <i>D751-06</i>        | Test Methods for Coated Fabrics                             |
| <i>D2103-10</i>       | Specification for Polyethylene Film and Sheeting            |
| <i>D4533-04(2009)</i> | Test Method for Trapezoid Tearing Strength of Geotextiles   |
| <i>D5261-10</i>       | Test Method for Measuring Mass per Unit Area of Geotextiles |
| <i>E96/E96M-10</i>    | Test Methods for Water Vapor Transmission of Materials      |

### 20.2 SAFETY

The Contractor shall instruct workmen of the hazards of installation such as handling the sheets of protective membrane in winds and on the slopes; use of equipment; and walking on the polyethylene cover sheet surface. The Contractor shall ensure that workers have and use proper safety gear and equipment. Approved personal fall arrest, personal fall restraint or positioning systems shall be worn by those employees whose work exposes them to falling in excess of 7 1/2 feet from the perimeter of a structure, unprotected sides and edges, leading edges, through shaft ways and openings, sloped roof surfaces steeper than 7:12 (Horizontal: Vertical), or other sloped surfaces steeper than 40 degrees. Particular attention shall be given to relevant Division of Industrial Safety

Construction. Said Orders are contained in Title 8 of the California Code of Regulations, Chapter 4, and Subchapter 4. Specific reference is made to Article 24 of said Construction Safety Orders.

### 20.3 DELIVERY, STORAGE, AND HANDLING

Protective membrane shall be shipped, stored and handled in accordance with the manufacturer's recommendations and as specified herein and as directed by the QA/QC Consultant. The material shall be delivered to the site only after the County and the QA/QC Consultant receive and accept the required submittals. Material shall be protected from damage and degradation.

### 20.4 MATERIALS

The protective membrane material shall consist of an UV-stabilized, 8-mil, 3-ply, linear low-density polyethylene copolymer, with a nonwoven nylon yarn scrim. Material shall be Duraskrim 8BV or equivalent, as manufactured by Raven Industries, Inc. The manufacturer's certification shall demonstrate the cover material meets the following MARV:

Properties	Test Method	Specified Value
Thickness, Nominal	ASTM D2103	8 mil
Weight	ASTM D5261	40 lbs/1,000 sq ft
Grab Tensile	ASTM D751	70 lbf
Elongation at Break	ASTM D751	600%
Trapezoid Tear	ASTM D4533	55 lbf
Hydrostatic Resistance	ASTM D751	70 psi
Maximum Use Temperature	-	180°F
Minimum Use Temperature	-	-70°F
WVTR	ASTM E96	0.030
Perm Rating	ASTM E96	0.066

Prior to use of an alternative material, the Contractor shall submit for the County's acceptance the material specifications.

Manufacturer's Warranty: The Contractor shall deliver to the County the Manufacturer's Warranty for the material supplied.

Sandbags shall be Duraskrim 8BBR ultra violet resistance or approved equal. Ropes used to secure the sandbags shall be rated at 700 lb (ultra violet resistance twisted polypropylene rope or approved equal). Placement and type of anchor for the rope shall be accepted by the County and the QA/QC Consultant prior to use.

### 20.5 INSTALLATION

The Contractor shall take steps to prevent damage to the existing geosynthetic liner layers during the installation of the protective membrane. The Contractor shall predetermine the liner layout and shall submit to the County for acceptance prior to installation. All panels should be placed as straight as possible and **all seams shall be tightly sewn** on completion of work. **No horizontal seams, pre-**



**manufactured or field sewn will be allowed.** Before the sewing process begins, sandbags shall be ready for placement on the liner edges in the event of wind. Seams shall be **overlapped and sewn a minimum of three (3) inches**, and a maximum of six (6) inches, from the edges of seamed panels. A two-thread, double-locked stitch shall be used. **All seams shall be continuously sewn. Spot sewing will not be allowed.**

The protective membrane shall be cut only with an approved cutter, and not torn or ripped to size. The material shall not be pulled tight. Sufficient slack shall exist throughout the protective membrane. A 5% allowance of excess material in both directions shall be incorporated into the liner for seasonal expansion/contraction. If possible, edge anchorage shall be delayed overnight to allow for preliminary shrinkage.

To avoid wind or other weather related damage, the membrane shall be properly secured and anchored as shown on the Project Drawings. The membrane shall be secured to the slope with **sandbags and rope placed five (10) foot on center** along the entire length of slopes and anchored with stakes at the top of slope as shown on the Project Drawings. The **sandbags shall be installed at 10-foot intervals along each rope**, and shall be filled with 1-in maximum particle size screened material. In addition, these vertical ropes with sand bags shall be connected together with **horizontal ropes at 10-ft vertical interval** as shown on the Project Drawings and as directed by the County.

When anchor benches are required along the termination boundary of the protective membrane as shown on the Project Drawings, anchor benches shall be constructed in accordance with the requirements of Section 14 of these Special Provisions.

No foot traffic shall be allowed on the membrane except with approved smooth-sole shoes. No vehicular traffic shall be allowed on the membrane. The completed membrane shall be free of holes, tears, and punctures. Repair, if necessary, shall require a **patch extending 18 inches in all directions** beyond the damaged area, secured with tape and anchored as necessary.

## 20.6 MEASUREMENT AND PAYMENT

- a. The **measurement** of the final quantity for **Bid Item No. 19** "Construct benches A, B, C, and S Scrim Temporary Drainage Protection along toe of bench" shall be based on the final in-place square footage of ground covered with protective membrane material placed within the limits specified in the Project Drawings and after it has been installed to the satisfaction of the County and the QA/QC Consultant. The area of the final surface shall be verified by the County based on conventional ground surveying. Quantity shall be calculated based on "true" area and to the nearest square foot utilizing digital terrain modeling method. **Payment** shall be made, after acceptance, at the contract unit price per square foot as stated in the Contractor's Proposal, **Bid Item No. 19**. Payment shall constitute full compensation to the Contractor for all work related to the furnishing and installation of the protective membrane material including but not limited to all anchor trench construction, ropes, sand bags, plywood strips, anchor stakes, and any other material or other work required by the Contract Documents. Payment shall also constitute full compensation for furnishing all labor, supervision, materials, tools, and equipment necessary to install this protective membrane layer in accordance with the Contract Documents. No

additional compensation shall be given for waste material from trimming of rolls, seam overlaps, or related items.

- b. The **measurement** of the final quantity for **Bid Item No. 47** "Furnish and Install 8-mil Temporary Protective Membrane" on side slopes shall be based on the final in-place square footage of ground covered with protective membrane material placed within the limits specified in the Project Drawings and after it has been installed to the satisfaction of the County and the QA/QC Consultant. The area of the final surface shall be verified by the County based on conventional ground surveying. Quantity shall be calculated based on "true" area and to the nearest square foot utilizing digital terrain modeling method. **Payment** shall be made, after acceptance, at the contract unit price per square foot as stated in the Contractor's Proposal, **Bid Item No. 47**. Payment shall constitute full compensation to the Contractor for all work related to the furnishing and installation of the protective membrane material including but not limited to all anchor trench construction, ropes, sand bags, plywood strips, anchor stakes, and any other material or other work required by the Contract Documents. Payment shall also constitute full compensation for furnishing all labor, supervision, materials, tools, and equipment necessary to install this protective membrane layer in accordance with the Contract Documents. No additional compensation shall be given for waste material from trimming of rolls, seam overlaps, or related items.

END OF SECTION 20

## **21. ACCESS ROADS**

### **21.1 GENERAL**

#### **21.1.1 Asphalt Structures**

The work covered in this section shall consist of furnishing all necessary labor, materials, equipment, tools and supervision for the construction of seven-inch (7") thick Asphalt Concrete (A.C.) paving which shall include access roads including the underlying aggregate base. The work shall include subgrade preparation and installation of A.C. pavement to the specified lines and grades and at the locations shown on the Project Drawings and as required by the Contract Document and as directed by the County.

#### **21.1.2 Aggregate Base**

The work covered by this section shall consist of furnishing all necessary labor, materials, equipment, tools, and supervision for the construction and installation of Class II, III, and/or Crushed Miscellaneous Base material. The work shall include subgrade preparation and construction of the plan required type of Aggregate Base at the locations shown on the Project Drawings or as directed by the County.

#### **21.1.3 Roadway Markings**

The work covered by this section shall consist of furnishing all necessary labor, materials, equipment, tools, and supervision for the construction and installation of thermoplastic Roadway Striping. The work shall include surface preparation and installation of the roadway striping at the locations shown on the Project Drawings or as directed by the County.

#### **21.1.4 Soil-Cement**

The work covered in this section shall consist of furnishing all necessary labor, materials, equipment, tools and supervision for the construction of twelve-inch (12") thick Soil Cement (S.C.) paving which shall include access roads. The work shall include subgrade preparation and installation of S.C. pavement to the specified lines and grades and at the locations shown on the Project Drawings and as required by the Contract Document and as directed by the County.

#### **21.1.5 K-Rails**

The work covered in this section shall consist of furnishing all necessary labor, materials, equipment, tools and supervision for the placement of K-Rails after the completion of the access roads as shown in the Project Drawings.

## 21.2 MATERIALS

### 21.2.1 Asphalt Structures

- a. Asphalt concrete pavement shall consist of hot mineral aggregate uniformly mixed with hot bituminous material.
- b. Asphalt cement for pavement shall conform to Section 203-1, "Paving Asphalt" of the Standard Specifications and shall be of performance grade of PG 64-10.
- c. A.C. pavement for roads material shall be III-B3 PG-64-10 and shall conform to Section 400-4 of the Standard Specifications.
- d. Seal coat material shall conform to 203-9, "Sealcoat – Asphalt Based."
- e. Tack Coat shall conform to Section 302-5.4, "Tack Coat" of the Standard Specifications and shall be PG 64-10.

### 21.2.2 Aggregate Base

- a. All aggregate base must be clean and consist of materials as described in the State Standard Specifications Section 26-1.02A.
- b. Class II Aggregate Base with a maximum aggregate size of .75" in accordance of the State Standard Specifications shall be used. The aggregate shall be uniformly graded and shall conform to the requirements of Section 200-2.2.2 "Grading" of the Standard Specifications.
- c. Class III Aggregate Base with a maximum aggregate size of .75" in accordance of the State Standard Specifications shall be used. The aggregate shall be uniformly graded and shall conform to the requirements of Section 200-2.2.2 "Grading" of the Standard Specifications.
- c.
- d. Crushed Miscellaneous Base as described in Section 200-2.4 of the Standard Specifications may be used instead of Class III Aggregate base.
- c.
- e. Crushed Miscellaneous Base shall consist of crushed and screened recycled asphalt millings stockpiled on site blended with crushed and pulverized demolition material produced during this project. Approximately 6500 tons of asphalt chips consisting of ¼ to 1 ½-inch size rock are stockpile on site. Refer to Demolition Section 6.2 of these Special Provisions for the approximate quantities and types of materials.
- c.
- f. Recycled asphalt millings stockpiled on site utilized to produce Crushed Miscellaneous Base shall have priority placement.
- c.
- k. Recycling agent added to the recycled asphalt shall consist of Cyclogen or equal per the Standard Specifications Section 203-7.2
- l. Aggregate base shall be mixed in a stationary or traveling plant. Proportion aggregates by weight or volume in quantities to meet the project-specified requirements for the aggregate base

material. Incorporate, during the mixing operation, water in quantities sufficient to provide the necessary moisture content for the specified compaction. Mixing operations shall produce satisfactory uniform blending and the method of discharging into trucks shall not produce segregation. Placing aggregate base shall be in accordance with Section 301-2.2, "Spreading" of the Standard Specifications. The Contractor shall not process or drag base material to which may cause the segregation or loss of gradation of the base material.

### **21.2.3 Roadway Markings**

- a. The thermoplastic material shall conform to either State Specification 8010-01A or 8010-19A. Glass beads to be applied to the surface of the molten thermoplastic material shall conform to the requirements of State Specification 8010-004 (Type II).
- b. Thermoplastic traffic stripes and raised pavement markers, where applicable, shall conform to the most current approved pre-qualified and tested signing and delineation materials and products list maintained by the California Department of Transportation.
- c. Raised pavement markers shall conform to Section 85, "Pavement Markers" of the latest edition of the State of California Department of Transportation Standard Specification, Part 3 "Markings" of the Cal MUTCD, and the Contract Document.

### **21.2.4 Soil-Cement**

- a. Portland cement shall be Type II or V conforming to the requirements of Section 201-1.2.1 "Portland Cement" of the Standard Specifications for Public Works Construction. Pozzalonic material shall not be substituted for portland cement.
- b. Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Water shall be tested in accordance with and shall conform to the requirements as described in the Standard Specifications 201-1.2.3. Water known to be of potable quality may be used without testing.
- c. The soil for this work shall consist of materials on the site or imported and shall be free of roots, sod, weeds, wood, construction debris, and stones larger than 2-1/2 inches (60 mm).

### **21.2.5 K-Rails**

- a. During Demolition, K-Rails located throughout the C4P3 Project Limits shall be removed and relocated as shown on the Project Drawings, as described in Section 6.2. These located K-Rails will be placed in locations shown on the Project Drawings after the completion of construction of the access roads.
- b. Additional K-Rail barriers shall consist of interconnected new precast concrete barrier units, and shall be supplied and installed at the locations and in conformance with the details shown on the Project Drawings

and as required by the Contract Documents.

- c. All K-Rail barriers shall conform to the provisions in Section 12-3.08 of the State Standard Specifications.

## **21.3 SUBMITTALS**

### **21.3.1 Asphalt Structures**

- a. The Contractor shall submit Certificates of Compliance for bituminous materials used in asphalt concrete pavement and asphaltic emulsion mixes proposed for this project. The certificates shall be signed by the manufacturer of the materials and shall state that materials involved shall comply in all respects with the requirements of these specifications.
- b. The Contractor shall prepare and submit a mix design to the County for review and acceptance at least 48 hours prior to beginning placement of asphalt concrete pavement for each mix design incorporated for use in this project.
- c. The Contractor shall submit to the County gradation test reports 48 hours before delivery of aggregate base materials to the project site. The Contractor shall obtain the County's acceptance of the aggregate base material and material source in advance of the use of such materials in the work.

## **21.4 EXECUTION**

### **21.4.1 Asphalt Structures**

- a. The Contractor shall arrange and conduct a pre-job paving meeting no later than 48 hours prior to the scheduled paving date. The Contractor, the Paving Subcontractor and County personnel shall attend this meeting. Discussion topics shall include Contractor-proposed: paving machine and asphalt roller equipment spread, methodology for paving pass sequence, paving pass widths, longitudinal joint locations, and traffic control implementation and maintenance specific to each paving operations.
- b. The subgrade for all asphalt structures in this project, prepared either by excavation or engineered fill, shall conform to the locations and cross sections as shown on the Project Drawings or as directed by the County. Where the structures are in native cut, the upper six (6) inches of subgrade shall be compacted to a minimum of 95 percent of the maximum density as determined by ASTM D1557. This shall be achieved by scarifying the exposed surface to a depth of six (6) inches and re-compacting. For areas requiring engineered fill, the finished subgrade shall be firm and suitable for placement of asphalt pavement, and shall be compacted to a minimum of 95 percent of the maximum density within the upper one foot, as determined by ASTM D1557.
- c. The Contractor shall install the ten -inch (10") thick Class II aggregate base material on a prepared and approved subgrade as required by the Contract Documents and as shown in the

Project Drawings. The aggregate base material shall consist of aggregate processed, deposited, spread, and compacted on a prepared surface. Compacting and finishing shall be in accordance with Section 301-2.3, "Compacting" of the Standard Specifications. The Contractor shall be solely responsible for protection of completed areas against detrimental effects. Recondition, reshape, and re-compact areas damaged by rainfall, or other weather conditions.

- d. Prior to pavement application, surface preparation shall consist of cleaning the underlying course of foreign or objectionable matter with power blowers or brooms where necessary. A tack coat shall be applied to the areas receiving pavement in accordance with Section 302-5.4, "Tack Coat" of the Standard Specifications.
- e. Distribution and spreading shall conform to the requirements of Section 302.5.5, "Distribution and Spreading" of the Standard Specifications. All transitions and edges shall be feathered to conform to the existing surface and provide a smooth transition.
- f. Rolling shall conform to the requirements of Section 302-5.6, "Rolling" of the Standard Specifications. Hand and mechanical tampers will not be permitted for compaction of road way section.
- g. Density and smoothness shall conform to the requirements of Section 302-5.6.2 "Density and Smoothness" of the Standard Specifications. Corrective work to meet specified tolerances shall be at the Contractor's expense.
- h. The Contractor shall furnish and place asphaltic emulsion (fog seal) on all asphalt concrete surfaces fourteen days after their placement at a quantity of 0.05 gallon per square yard of asphalt surface. Prior to placing the fog seal, all dirt or other asphalt concrete loose material shall be cleaned from the area to be covered. Asphaltic emulsion for the required fog seal shall conform to requirements in Sections 203-9 "Seal Coat – Asphalt Based". Bituminous Materials shall conform to the Standard Specifications and these Special Provisions, with a bituminous base of paving asphalt, viscosity grade PG 64-10 as per section 203-1 "Paving Asphalts," of the Standard Specifications.
- i. The asphalt pavement for the speed bumps shall be placed on the new paved asphalt access road and shall conform to the cross sections and locations as shown on the Project Drawings or as directed by the County. Surface preparation shall consist of cleaning the underlying surface of foreign or objectionable matter where necessary. A track coat shall be applied to the areas receiving pavement in accordance with Section 302-5.4,"Tack Coat" of the Standard Specifications. Signage and striping of the speed bumps will be performed by the County and is not part of this contract.

#### **21.4.2 Aggregate Base**

- a. Subgrade preparation and aggregate base placement operations (adding water, spreading and compacting) shall be performed in accordance to Section 26 of the State Standard Specifications.

- b. Subgrade for Class II Aggregate Base shall be placed in various thicknesses as depicted in the Project Drawings and compacted to a minimum of 90 percent relative compaction as determined by ASTM D1557. Compacting and finishing shall be in accordance with Section 301-2.3, "Compacting" of the Standard Specifications."
- c. The Contractor shall construct the graded aggregate base on a prepared and approved subgrade, as required by the Contract Documents. The Contractor shall provide construction stakes to control line and grade. Placement of grade stakes shall be parallel to the construction pavement placement lifts and spaced for string lining or other control methods. The base material shall consist of aggregate processed, deposited, spread, and compacted on a prepared and accepted surface. The Contractor shall be solely responsible for protection of completed areas against detrimental effects. Reconditioning, reshaping, and re-compacting of areas damaged by rainfall, or other weather conditions shall be the Contractor's responsibility.
- d. Place earth or other accepted materials along the edges of the aggregate base material in such a quantity that it will compact to the thickness of the course being constructed. When the aggregate base is being constructed in two or more layers, place material to the width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each base layer.
- e. After placement is completed, and prior to pavement application, the Contractor shall maintain the aggregate base course throughout, except where portion of the succeeding course is under construction thereon. Maintenance includes drainage, rolling, shaping, and watering, as necessary, to maintain the course in proper condition. Correct deficiencies in thickness, composition, construction, smoothness, and density, which develop during the maintenance, to conform to the requirements specified herein. Maintain sufficient moisture by light sprinkling with water at the surface to prevent a dusty condition.
- f. Recycled asphalt millings stockpiled on site utilized to produce Crushed Miscellaneous Base shall have priority placement.
- g. Recycling agent added to the recycled asphalt shall consist of Cyclogen or equal per the Standard Specifications Section 203-7.6

### **21.4.3 Roadway Markings**

- a. All work necessary to establish alignment and layout for stripes and pavement markers shall be performed by the Contractor with any device or method that will not damage the pavement or conflict with other control devices.
- b. Traffic stripes and pavement markings shall conform to the dimensions and details shown on the corresponding Cal MUTCD detail.
- c. Completed strips shall have clean and well defined edges without running or deformation, shall be uniform, shall be straight on tangent alignment and shall be on a true arc on curved alignments. The widths of the completed stripes shall not deviate more than 1/4-inch (1/4") on tangent or more than 1/2-inch (1/2") on curves as determined by the County representative in the field. Broken stripes shall also conform to the following requirements:



- i. The lengths of the gaps and individual stripes that form broken traffic stripes shall not deviate more than 1-inch (1") from their standard lengths.
  - ii. The lengths of the gaps and individual stripes shall be of such uniformity throughout the entire length of each broken traffic stripe that a normal striping machine will be able to repeat the pattern and superimpose additional stripes upon the traffic stripe being applied.
- d. Completed pavement markings shall have clean and well-defined edges without running or deformation and shall conform to dimensions shown on the referenced details, except that minor variations may be accepted by the County representative in the field.
- e. Thermoplastic striping for the projects shall be in accordance with requirements of the Contract Documents, and shall be implemented in compliance with the manufacturer's instructions and the applicable construction procedures, and details expressed in referenced standards.
- f. Existing surfacing which is to receive the thermoplastic material shall be mechanically wire brushed to remove all dirt and contaminants. Surfaces of new Portland cement concrete pavement to receive the thermoplastic material shall be mechanically wire brushed or abrasive blast cleaned to remove all laitance and curing compound. Any areas exposed to landfill traffic after surface preparation and cleaning shall be subject to inspection by the County and may require additional cleaning prior to application of striping.
- g. Thermoplastic material shall be applied only to dry pavement surfaces and only when the pavement surface temperature is above 10°C {50°F}.
- h. The primer shall be applied at the application rate recommended by the manufacturer and shall not be thinned. Preheaters with mixers having 360 degree rotation shall be used to preheat material.
- i. The thermoplastic material shall be applied to the pavement at a temperature between 200°C {400 F} and 220°C {425°F}, unless a different temperature is recommended by the manufacturer. The thermoplastic material shall be applied by either spray or extrusion methods in a single uniform layer.
- j. Stencils shall be used when applying thermoplastic material for pavement markings. The pavement surface to which thermoplastic material is applied shall be completely coated by the material and the voids of the pavement surface shall be filled.
- k. The thermoplastic material for traffic stripes shall be applied at a minimum thickness of 1.5mm {0.060-inch}. Thermoplastic material for pavement markings shall be applied at a thickness of 2.5 to 3.8mm {0.100-to0.150-inch}. Glass beads shall be applied immediately to the surface of the molten thermoplastic material at a rate of not less than 4kg {8-pounds} per 10 m<sup>2</sup> {100square feet}. The amount of glass beads applied shall be measured by stabbing the glass bead tank with a calibrated rod.

#### **21.4.4 Soil-Cement**

- a. The subgrade for all soil-cement structures in this project, prepared either by excavation or engineered fill, shall conform to the locations and cross sections as shown on the Project Drawings or as directed by the County. Where the structures are in native cut, the upper six (6)

inches of subgrade shall be compacted to a minimum of 95 percent of the maximum density as determined by ASTM D1557. This shall be achieved by scarifying the exposed surface to a depth of six (6) inches and re-compacting. For areas requiring engineered fill, the finished subgrade shall be firm and suitable for placement of soil cement pavement, and shall be compacted to a minimum of 95 percent of the maximum density within the upper one foot, as determined by ASTM D1557.

- b. On the onset of construction the QA/QC Consultant will create 3 sets of three (3) test soil cement cylinders at cement concentrations of 6%, 7%, and 8%. The test cylinders shall be tested at 7 days for unconfined compressive strength by the QA/QC Consultant. The results of the tested cylinders will be submitted by the QA/QC to the County for review. The County will then determine the final cement content of the Soil-Cement.
- c. Prior to beginning any cement treatment, the existing road grade shall be shaped to conform to the typical sections, lines, and grades as shown on the plans. Bulking of the road grade resulting from the stabilization process should be considered.
- d. Cement shall be applied at a rate of not less than 6% percent based on the in-place dry unit weight of soil and for the depth of road grade treatment shown on the plans. For estimating purposes, an in-place dry unit weight of soil of 125 pounds per cubic foot should be used. The County reserves the right to modify the values of both the cement percentage value and the in-place dry unit weight of soil.
- e. The cement content shall vary no more than 0.5 percent under and not more than 1.0 percent over the specified cement content (example: tolerance on spread rate of 4.0% is 3.5% to 5.0%). However, the moving average of the rate of cement content tests/inspections shall not be less than the specified cement content. The Engineer reserves the right to increase the rate of application of cement from the specified rates during the progress of construction as necessary to maintain the desired characteristic of the cement treated soil.
- f. Cement shall be distributed with a non-pressurized mechanical vane-feed spreader capable of spreading the cement at not less than 5.6 lbs per square yard per inch. The County reserves the right to modify the distribution rate. Cement shall not be spread upon prepared grade more than 2 hours prior to the mixing operation. No traffic other than the mixing equipment shall be allowed to pass over the spread cement until the mixing operation is completed.
- g. Mixing of the soil, cement, and water shall be done with a four-wheel drive rotary mixer (CMI RS-650B, CAT 500 or equivalent). The mixing machine shall have equipment provisions for introducing water at the time of mixing through a metering device.
- h. The full depth of the cement treated road grade shall be mixed a minimum of two times with the approved mixing machine. If necessary, one of the two mixes shall be done while introducing water into the soil through the metering device on the mixer. Water shall be added during mixing to provide a moisture content not less than 1 percentage point below nor more than three percentage points above (-1 to +3 of OMC) the optimum moisture of the cement treated soil to ensure chemical action of the cement and soil.

- i. Soil-cement structures shall be uniform in color and texture. The County will direct the Contractor to remove and replace soil cement structures bearing a streaked appearance.
- j. To ensure a uniformly treated section, any material/soil around manholes, utility risers, valves and adjacent to curbs/gutters or in corners, must have that material/soil pulled out at the depth of treatment where it is accessible to be mixed with the reagent. After that material is mixed with the reagent, it will be placed back and compacted.
- k. The Contractor shall regulate the sequencing of the cement treatment such that final compaction of the cement treated soil to the specified density shall be completed within 2 1/2 hours after the initial application of water during the mixing operation.
- l. Compaction shall commence within 30 minutes after the mixture has been completed and placed on grade.
- m. Compaction shall proceed continuously until completed.
- n. Initial compaction shall be by means of steel padfoot rollers. Final compaction shall be by means of steel drum rollers. Areas inaccessible to rollers shall be compacted to the required compaction by other means satisfactory to the Engineer.
- o. The mixture shall be spread and compacted in two (2) six-inch (6") lifts.
- p. The field dry density of the compacted cement treated soil shall be at least 95 percent of the maximum dry density of the in-place material as determined in accordance with ASTM D 1557.
- q. Should the cement treated road grade yield under the weight of the compaction equipment, compaction effort will cease in an effort not to compromise the section; in this case, the maximum achievable field density will be accepted or an alternate remedial plan will be proposed by the Engineer.
- r. After the final layer of cement treated road grade has been compacted, it shall be brought to the required lines and grades in accordance with the typical section. The completed section shall then be finished by rolling with a pneumatic or other suitable roller approved by the Engineer.
- s. The completed cement treated grade shall be cured by use of a bituminous, asphaltic emulsion curing seal per 301-3.1.9. The seal rate application shall be maintained between .1 to .15 gallons per square yard. The curing seal shall be of a slow setting and will be applied the day when finish rolling has been completed.
- t. If a soil-cement structure requires repair, it shall be repaired by removing and replacing the entire depth of the affected layers in the damaged area. Feathering will not be permitted for repair of low areas.
- u. No cement or soil-cement mixture shall be spread when the aggregate or grade is frozen or when

the air temperature is less than 40°F in the shade. The finished soil-cement shall be protected against freezing.

#### 21.4.5 K-Rails

- a. K-Rail barriers shall be installed in accordance with detail Temporary Railing (Type K) T3A and B of the State Standard Plans.
- b. The Contractor shall set the K-Rail barrier on firm, stable surface as required by the Contract Documents in order to provide a uniform bearing throughout the entire length of the railing.
- c. Abutting ends of precast concrete units (K-Rail barrier) shall be placed and maintained in alignment without substantial offset to each other. The precast concrete units shall be positioned straight on tangent alignment and on a true arc on curved alignment.
- d. The completed K-Rail barrier units shall present a smooth uniform appearance in their final position, conforming closely to the horizontal and vertical lines shown on the Project Drawings and as directed by the County.

#### 21.5 MEASUREMENT AND PAYMENT

- a. The **measurement** of the final quantity for **Bid Item No. 48** "Asphalt Access Road" shall be based on the pertinent details required by the Contract Documents as verified by the County through field measurements of the completed in-place asphalt access road, and shall include all subgrade surface preparation, the supply and installation of Class II aggregate base material as specified and required by the Contract Documents and the supply and installation of the K-Rail barriers. **Payment** quantities for asphalt access road shall be at the unit price per square foot, as stated in the Contractor's Proposal **Bid Item No. 48** "Asphalt Access Road".
- b. The **measurement** of the final quantity for **Bid item No. 49** "Construct Asphalt Concrete Speed Bumps" shall be based on the pertinent details required by the Contract Documents as verified by the County through field measurements of these structures. **Payment** for all Asphalt Speed bumps shall be at the contract unit price per each as stated in the Contractor's Proposal, **Bid Item No. 49**.
- c. The **measurement** of the final quantity for **Bid Item No. 50** "Class III or Crushed Miscellaneous Base" shall be at the contract unit price per square feet as stated in **Bid Item No. 50** "Class III or Crushed Miscellaneous Base" and shall constitute full compensation to the Contractor for all work related to the construction of Class III or Crushed Miscellaneous Base in the project including but not limited to: furnishing all labor, materials, tools, equipment, subgrade preparation, and incidentals, and for doing all the work involved in constructing Class III or Crushed Miscellaneous Base, complete in place, as shown on the Project Drawings or as directed by the County.
- d. Payment for Roadway Markings shall be at the Contract Lump Sum price as stated in **Bid Item No. 51** "Roadway Markings". This payment shall constitute full compensation to the Contractor

for all work related to the construction of Roadway Striping including but not limited to: furnishing all labor, materials, tools, equipment, earthwork, surface preparation, and incidentals, and for doing all the work involved in Roadway Striping, complete in place, as required by these Contract Documents.

- e. The **measurement** of the final quantity for **Bid Item No. 52** "Soil-Cement – Bench P and Sedimentation Basin Roads" shall be determined by the County based on field measurements of the surface area of soil-cement installed along Bench P and the Sedimentation Basin Access Road, as shown on the Project Drawings. **Payment** for the construction of soil cement shall be at the unit price per square foot, as stated in the Contractor's **Bid Item No. 52**. If an increase in cement percentage is required to meet County's requirements a \$.10 cost per square foot per percent increase may be applied to the cost. **Payment** for soil-cement shall be based on the pertinent details required by the Contract Documents as verified by the County through field measurements of completed in-place soil-cement roads, and shall include all the supply and installation of the soil-cement material as specified and required by the Contract Documents.
  
- f. The **measurement** of the final quantity for **Bid Item No. 53** "Soil-Cement – Western Stockpile Road" shall be determined by the County based on field measurements of the surface area of soil-cement installed along the Western Stockpile Access Road as shown on the Project Drawings. **Payment** for the construction of soil cement shall be at the unit price per square foot, as stated in the Contractor's **Bid Item No. 53**. If an increase in cement percentage is required to meet County's requirements a \$.10 cost per square foot per percent increase may be applied to the cost. **Payment** for soil-cement shall be based on the pertinent details required by the Contract Documents as verified by the County through field measurements of completed in-place soil-cement roads, and shall include all the supply and installation of the soil-cement material as specified and required by the Contract Documents.

END OF SECTION 21

## **22. GAS COLLECTION SYSTEM**

### **22.1 GENERAL**

The work covered in this section shall include the Contractor furnishing all labor, materials, supervision, tools, and equipment necessary to install eight-inch (8") diameter HDPE SDR 17 mostly above grade header pipe, eight-inch (8") diameter HDPE SDR 11 or 17 landfill gas (LFG) collection lateral piping, and a two-hundred forty foot long 8" HDPE SDR 17 header bridge support system, and 2" condensate U-trap drain pipe from the 8" header pipe to a relocated gas condensate tank as shown on the Project Drawings. The work shall include but not be limited to trench excavation through engineered fill, subgrade preparation and any associated fill, backfill, anchoring, coupling, and bedding for the installation of eight-inch (8") diameter HDPE header to the specified lines and grades at the locations shown on the Project Drawings or as directed by the County. This work also includes the excavation of refuse and soil co-mingled with refuse and other unsuitable material, and hauling and disposal at the designated areas as directed by the County.

### **22.2 MATERIALS**

#### **22.2.1 HDPE Pipe and Fittings**

- a. The HDPE pipe supplied in this section for header pipe shall be eight-inch (8") diameter SDR 17.
- b. HDPE pipe shall conform to the requirements of Section 207-19 of the Standard Specifications unless otherwise indicated on the Project Drawings and Specifications.
- c. All landfill gas piping and fittings shall be made from a polyethylene resin Type 3408 except where called out otherwise on the Project Drawings. HDPE pipe shall be protected against U.V. degradation from exposure to the sun.
- d. HDPE fittings shall be of material which is compatible with the pipe for the purpose of fusion welding and shall be free from cracks, holes foreign intrusions, voids, or other defects. The minimum "quick-burst" strength of the fittings shall not be less than that of the pipe.
- e. All flange gaskets shall be made of Neoprene.
- f. All bolts, washers and nuts shall be 316 stainless steel.
- g. Concrete slurry for trench backfill over the 8-inch (8") diameter HDPE LFG collection lateral pipe shall be Class 100-E-100 and shall conform to Standard Specifications Section 201-1

#### **22.2.2 Precast Concrete Cradle Pipe Supports**

- a. Twelve (12) Precast Concrete Cradle Pipe Supports.

- b. Precast Concrete Cradle Pipe Supports will be 18-inch x 18-inch x 18 inch (18"x18"x18").
- c. Precast Concrete Cradle Pipe Supports will be able support a pipe with an 8" outer diameter.
- d. One .75-inch diameter zinc plated insert will be included in the precast concrete cradle pipe support.
- e. J&R concrete cradle pipe support or equal will be used.

### **22.2.3 Header Support System**

- a. Twenty-one (21) 18" diameters 30" long Sono-tube or approved equal brand shall be used to house concrete pillars.
- b. Concrete for header support post foundations shall be type 560-C-3250 per Section 201-1 of the Standard Specifications.
- c. Twenty-five (25) 3" diameter schedule 40 steel pipe shall be used as support posts. Coarse male thread on top end.
- d. Twenty-five (25) adjustable steel pipe saddles with yoke, B-line systems part No. B3092-8, or approved equal.
- e. All steel will be primed with Federal Specification TT-P-86, Type II (red lead/alkyd type) or TT-P-645 (zinc chromate type) to be compatible with finish coat.
- f. All primed steel will be painted with manufacturer's recommended material.
- g. The county reserved the right to choose colors up to and including time of execution.
- h. Fabricate four ¼" steel saddles to fit over 8" thick concrete containment wall. Drill two ½" bolt holes on each side. Supply and install saddle and bolts.
- i. Two ninety (90) degree 2" HDPE elbows.
- j. One 8" flange adapter with epoxy coated cast iron back up ring.

## **22.3 EXECUTION**

- a. The Contractor will give the County a two (2) day notice before any work commences on the Gas Collection System. The County will give the Contractor the notice to proceed on the gas system during or at the end of the day notice.
- b. The eight-inch (8") diameter HDPE LFG collection lateral pipe shall be installed in a joint trench with two (2) twenty four-inch (24") HDPE LCRS riser pipes. Excavation, trenching and backfill, including concrete slurry backfill, for the installation of the vertical LFG collection pipe shall be in accordance with Section 18.3.5 "Leachate Pump Installation" of these specifications. Excavation for the installation of HDPE buried gas header and lateral pipes shall be in accordance with Section 9.3.2 "Excavation" and Section 9.3.5 "Interim Cover and Refuse

Removal and Disposal” of these Specifications. Place HDPE gas pipes to be buried to lines and grades as shown on the Project Drawings. Complete backfill for header and lateral pipes to finished grade in accordance with Section 9.3.4 “Engineered Fill” of these Specifications.

- c. Excavation for the installation of HDPE buried gas header and lateral pipes shall be carefully made using both mechanical means and shovels in order that the structure may be positioned in-place on a firm, stable and unyielding surface with minimal resultant voids under the structure.
- d. The subgrade for installation of HDPE buried gas header and lateral pipes shall be prepared by excavating engineered fill placed by the Contractor to the lines, grades and cross sections shown on the Project Drawings. The Contractor shall not excavate or remove materials beyond indicated sub-grade elevations or dimensions without the approval of the County. The Contractor shall backfill and compact to 90% relative compaction for any unauthorized excavation.
- e. The trenches for HDPE header and lateral gas pipes shall be excavated in accordance with Section 306-1.1 of the Standard Specifications. The trench bottom shall be continuous, relatively smooth and free of rocks and/or refuse material.
- f. The Contractor shall excavate and backfill in a manner and sequence that will provide proper drainage at all times. The Contractor shall remove all water, including runoff and run-on collected from rain water encountered during excavation, to a location approved by the County, by pumps, drains, and other approved methods. The Contractor shall prevent water from ponding in site excavation and site construction area. The Contractor shall control drainage in the vicinity of work to prevent water from accumulating or running into adjacent property.
- g. The Contractor shall comply with all applicable regulations and shall protect open excavations, trenches, holes, with fences, covers, or railing as required to maintain safe pedestrian and /or vehicular traffic and against accidental or unauthorized entry until backfilled.
- h. The Contractor shall remove all groundwater encountered during excavation, to a location approved by the County, by pumps, drains, and other approved methods.
- i. The Contractor shall notify the County twenty four (24) hours in advance of backfilling operations to permit required testing. Density tests shall be determined by ASTM D1557. Compaction shall be achieved by using sheeps-foot, walk behind whackers, or vibrating rollers. Heavy impact type equipment such as stompers shall not be permitted for compaction use.
- j. All HDPE piping shall be joined by butt fusion and in conformance with the manufacturer's recommendations. Laterals shall be joined to the header pipe by the County.
- k. Fusion welding of HDPE pipe shall be performed by a qualified person. The pipe supplier shall verify the qualifications of the pipe installer, and the Contractor shall submit a copy of this verification to the County. No pipe shall be installed prior to submittal of the verification.
- l. Flange alignment shall be perpendicular to pipe center line and shall not exceed plus or minus one thirty second of an inch (1/32”) in tolerance measured at the flange O.D.



- m. All bolts and nuts must be easily accessible for installation and tightening.
- n. Pipe cutting shall be done only with mechanical cutters.
- o. All pipes two inches (2") and larger shall be flanged at the weld ends and welded with full penetration butt welds.
- p. When mating two pieces of equipment with a flat-face flange, the corresponding pipe flange shall also be flat faced. Otherwise, all flanges shall be raised face.
- q. Prior to connecting new sections of pipe to the existing collection system, the new pipe shall be flushed with water until only clean water comes out.
- r. The Contractor shall install rebar stakes on the downhill side of the pipe every ten feet (10') along the header pipe. Rebar stakes shall be driven into the ground a minimum of eighteen inches (18") and shall extend several inches above the header pipe. After placement, the rebar shall be capped with OSHA approved plastic safety caps.
- s. The Contractor shall relocate and install concrete pipe cradle supports from existing 8" SDR 17 Gas Header to the new Gas Header location. The relocated pipe cradle supports shall be inverted so as to rest on top of the 8" Gas Header. Cradle supports will be installed every forty five linear feet (45'), or as instructed by the engineer, along sections to secure the pipe in place. Any surplus concrete cradle pipe supports will be moved to a location as instructed by the engineer for storage. Project Drawings show details of the installation.
- t. Precast Concrete Cradle Pipe supports shall be installed as anchors within 1 foot of each saddle connection.

## 22.4 MEASUREMENT AND PAYMENT

- a. **Measurement** of the final quantity for **Bid Items No. 54** 'Realign and Furnish and Install Additional 8" HDPE Header Pipe' shall be determined after the HDPE pipes have been installed, tested and verified by the QA/QC consultant to the satisfaction of the County. **Payment** for the installation of the HDPE pipes shall be based on the lump sum price as stated in the Contractors Proposal for **Bid Item No. 54**. The price and payment shall constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to completion of this item of work. No additional compensation will be allowed.
- b. **Measurement** of the final quantity for **Bid Items No. 55 and 56** 'Furnish and Install 8" HDPE LFG Collection Pipe' and 'Furnish and Install 8" Slotted HDPE LFG Collection Pipe' shall be determined by the County based on field measurements of the axial length (linear feet) of HDPE pipe installed. Measurement shall be determined after the HDPE pipes have been installed, tested and verified by the QA/QC consultant to the satisfaction of the County. **Payment** for the installation of the HDPE pipes shall be based on the unit price per lineal foot measured axially as stated in the Contractors Proposal for **Bid Item No. 55 and Bid Item No. 56**. The price and payment shall constitute full compensation for all labor, materials, equipment and all other items

necessary and incidental to completion of this item of work. No additional compensation will be allowed.

- c. The **measurement** of the final quantity for **Bid Item No. 57** "Furnish and Install 8" Header Bridge Support" shall be based on the pertinent details required by the Contract Documents as verified by the County through field measurements of the Header. **Payment** for the **Bid Item No. 57** shall be based upon a lump sum quantity. The price and payment shall constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to completion of this item of work. No additional compensation will be allowed.

END OF SECTION 22

**CONSTRUCTION QUALITY ASSURANCE / QUALITY CONTROL PLAN  
(QA/QC Plan)**

**FOR  
THE CONSTRUCTION OF THE  
CANYON 4 PHASE 3 LINER EXPANSION**

**AT THE  
BADLANDS SANITARY LANDFILL**

## TABLE OF CONTENTS

<b>CONSTRUCTION QUALITY ASSURANCE / QUALITY CONTROL PLAN.....</b>	<b>1</b>
<b>(QA/QC PLAN).....</b>	<b>1</b>
<b>FOR.....</b>	<b>1</b>
<b>AT THE .....</b>	<b>1</b>
<b>SECTION 1 - GENERAL .....</b>	<b>1</b>
<b>1.1. INTRODUCTION.....</b>	<b>1</b>
<b>1.2. Summary of Work .....</b>	<b>2</b>
<b>1.3. Responsible Parties .....</b>	<b>2</b>
<b>1.4. Project Organization.....</b>	<b>3</b>
1.4.1. Landfill Owner/Operator.....	3
1.4.2. Contractor .....	3
1.4.3. Project Manager .....	3
1.4.4. Resident Engineer .....	4
1.4.5. QA/QC Consultant.....	4
1.4.6. QA/QC Manager .....	5
1.4.7. QA/QC Monitors .....	6
1.4.8. Surveying .....	7
1.4.9. Meetings.....	8
1.4.10. Documentation and Record Keeping .....	10
<b>SECTION 2 - EARTHWORK.....</b>	<b>14</b>
<b>2.1. Engineered Fill Construction.....</b>	<b>14</b>
2.1.1. General.....	14
2.1.2. Testing & Observation.....	16
<b>2.2. County Acceptance .....</b>	<b>17</b>
<b>SECTION 3 - LOW-PERMEABILITY LAYER.....</b>	<b>18</b>
<b>3.1. General.....</b>	<b>18</b>
<b>3.2. Low Permeability Layer Material and Processing .....</b>	<b>18</b>
<b>3.3. Low Permeability Test Pad .....</b>	<b>18</b>
<b>3.4. Low Permeability Placement and Compaction .....</b>	<b>18</b>
<b>3.5. Materials Properties Testing.....</b>	<b>19</b>
<b>3.6. Acceptance Criteria .....</b>	<b>20</b>
3.6.1. General.....	20
3.6.2. Moisture Content and Density .....	20
3.6.3. Permeability .....	21
3.6.4. County Acceptance .....	21

<b>SECTION 4 - GEOSYNTHETIC CLAY LINER (GCL)</b> .....	<b>22</b>
4.1. General.....	22
4.2. GCL Manufacturing.....	22
4.3. GCL Delivery .....	23
4.3.1. Transportation and Handling .....	23
4.3.2. Storage .....	23
4.4. GCL Conformance Testing.....	24
4.4.1. Tests .....	24
4.4.2. Sampling Procedures .....	24
4.4.3. Test Results.....	24
4.5. GCL Installation .....	24
4.5.1. Surface Preparation.....	24
4.5.2. Placement.....	25
4.5.3. Repairs .....	26
4.6. County Acceptance .....	26
<b>SECTION 5 - FLEXIBLE MEMBRANE LINER (FML)</b> .....	<b>28</b>
5.1. FML Manufacturing.....	28
5.2. FML Delivery .....	29
5.2.1. Transportation and Handling .....	29
5.2.2. Storage .....	30
5.3. FML Conformance Testing.....	30
5.3.1. Tests .....	30
5.3.2. Sampling Procedures .....	30
5.3.3. Test Results.....	30
5.3.4. Multilayer Interface Shear Testing.....	30
5.4. FML Installation .....	31
5.4.1. Earthwork.....	31
5.4.2. FML Placement.....	32
5.4.3. Field Seaming .....	34
5.5. FML Construction Testing.....	36
5.5.1. Nondestructive Seam Testing .....	36
5.5.2. Destructive Seam Testing .....	36
5.5.3. Laboratory Testing .....	38
5.6. Defects and Repairs .....	39
5.6.1. Identification .....	39
5.6.2. Repair Procedures .....	40
5.7. Seam Test Summary .....	40
5.8. Wrinkles.....	40
5.9. County Acceptance .....	40
<b>SECTION 6 - GEOTEXTILES</b> .....	<b>42</b>
6.1. General.....	42
6.2. Manufacturing .....	42
6.3. Delivery .....	43

6.3.1. Transportation and Handling .....	43
6.3.2. Geotextile Storage.....	43
<b>6.4. Geotextile Conformance Testing .....</b>	<b>44</b>
6.4.1. Tests .....	44
6.4.2. Sampling Procedures .....	44
6.4.3. Test Results.....	44
<b>6.5. Geotextile Installation.....</b>	<b>44</b>
6.5.1. Surface Preparation.....	44
6.5.2. Geotextile Placement .....	45
<b>6.6. County Acceptance .....</b>	<b>46</b>
<b>SECTION 7 - LEACHATE COLLECTION AND REMOVAL SYSTEM.....</b>	<b>48</b>
<b>7.1. LCRS Construction .....</b>	<b>48</b>
7.1.1. Piping & Leachate Storage Tank .....	48
7.1.2. Construction Material .....	48
7.1.3. County Acceptance .....	48
<b>7.2. Drainage Layer Construction .....</b>	<b>49</b>
7.2.1. General .....	49
7.2.2. Material Properties Testing.....	49
7.2.3. In-Place Properties Testing .....	49
7.2.4. County Acceptance .....	49
<b>SECTION 8 - PROTECTIVE SOIL LAYER.....</b>	<b>51</b>
<b>SECTION 9 - ASPHALT STRUCTURES .....</b>	<b>53</b>
<b>SECTION 10 - REINFORCED CONCRETE STRUCTURES.....</b>	<b>54</b>

## SECTION 1 - GENERAL

### 1.1. INTRODUCTION

The Construction QA/QC Plan has been prepared to meet the following objectives:

- A. Provide quality control procedures and a quality assurance program, which will demonstrate that the Canyon 4 Phase 3 liner expansion design is properly implemented by performing monitoring and testing during construction.
- B. Provide a mechanism that allows the evaluation of design changes that occur during construction.
- C. Prepare and maintain documentation that can demonstrate the design has been implemented and the performance requirements have been met.
- D. Serve as a reference source for personnel performing and monitoring the construction activities.
- E. Establish lines of communication and responsibilities of all project personnel.

A Quality Assurance (QA) program consists of continuously overseeing the project to confirm that observations and testing procedures are being implemented by qualified personnel as planned; that procedures are in compliance with applicable regulations, standards, and project specifications and drawings; and that all work, including the final product, is appropriately documented, filed, and made readily available for review. A Quality Control (QC) program consists of selected tests and observations during construction that assist the Contractor in producing the required quality product.

Owing to the similarity of ultimate objective, QA and QC functions for construction projects are typically combined to become the Quality Assurance/Quality Control (QA/QC) Plan. This QA/QC Plan should be used in conjunction with the Plans and Specifications for the construction of Canyon 4, Phase 3 liner expansion at the Badlands Sanitary Landfill in Riverside County, California.

The Contractor must be aware that QA/QC matters influence the Contractor's daily operations and can affect the Contractor's progress and profitability; the Contractor should therefore prepare its bid accordingly.

An independent testing laboratory will be responsible for conducting QA tests on geosynthetic samples, such as conformance testing and testing of field seams for peel and shear, and QA tests on low-permeability layer (LPL). The laboratory shall be independent of the County, Manufacturer, Lining Subcontractor, or any party involved with the manufacturing or installation of any of the geosynthetics. The QA/QC tests must be conducted using a certified independent testing laboratory for soil property analyses and tests.

## 1.2. SUMMARY OF WORK

The liner system proposed for Canyon 4 Phase 3 liner expansion at the Badlands Sanitary Landfill consists of individual components, including a low-permeable layer, a geosynthetic clay liner (GCL), flexible membrane liners (FML), geotextiles, a leachate collection and removal system (LCRS), a protective soil layer, and a surface drainage system. The LCRS includes drainage layer, geotextile filter fabric, and leachate conveying pipes. This document details the type, procedure, and frequency of the QA/QC tests to be performed during construction of the earthwork, geosynthetic liner system, LCRS, and installation of the drainage structures. The access roads proposed for Canyon 4, Phase liner expansion at the Badlands Sanitary Landfill consists of scrubbed and prepared subgraded, aggregate base, and asphalt concrete.

Each of the above-mentioned subsystems (components) functions as an integral part of the overall Canyon 4 Phase 3 liner expansion, and consequently must become a finished product during construction. Thus, construction of the entire project will be performed in phases, with each portion completed prior to construction of successive or overlying portions. For this reason, it is necessary to conduct an ongoing QA/QC program during construction to verify a quality end product. Nevertheless, it is the Contractor's responsibility to complete the project in accordance with the Contract Documents; and nothing stated in this document or any testing, inspection or observation by the County or the QA/QC Consultant shall in any way relieve the Contractor of its obligations to properly construct the project in accordance with all of the Contract Documents.

This project is formatted to meet strict Federal and State Code requirements for liner expansions of landfills as administered by the Regional Water Quality Control Board (RWQCB). RWQCB staff will be advised of any design and specification revisions.

## 1.3. RESPONSIBLE PARTIES

The responsible parties for the expansions at the Badlands Sanitary Landfill are identified below:

### Landfill Owner/Operator:

Riverside County, Waste Management Department  
14310 Frederick Street  
Moreno Valley, California 92553  
Phone: (951) 486-3200  
Representative: Mr. Hans Kernkamp, P.E.

### Project Manager:

Riverside County, Waste Management Department  
14310 Frederick Street  
Moreno Valley, California 92553  
Phone: (951) 486-3200



Representative: Mr. Andrew M. Cortez, P.E.

Resident Engineer:

Riverside County, Waste Management Department  
14310 Frederick Street  
Moreno Valley, California 92553  
Phone: (951) 486-3200  
Representative: To Be Determined

QA/QC Consultant

Geosyntec Consultants  
2100 Main Street, Suite 150  
Huntington Beach, California 92648  
Phone: 714-465-1214  
Representative: Chris Conkle, P.E, G.E.

**1.4. PROJECT ORGANIZATION**

The principal functions of the QA/QC team are presented below:

**1.4.1. Landfill Owner/Operator**

The Owner or the County is the Riverside County Waste Management Department or an authorized County official. Work shall always be subject to acceptance by the County.

**1.4.2. Contractor**

The Contractor is the firm or its representatives responsible for the construction activities. Responsibilities of the Contractor include but are not limited to the following:

- Assign duties and supervise the construction crew.
- Manage the day-to-day execution of construction activities in accordance with the Contract Documents and the provisions of this plan.
- Perform required QC duties.
- Conform to federal, state, and local safety regulations pertinent to the construction work.
- Notify the QA/QC Consultant when materials are received on site so that the receiving monitoring can be performed.
- Immediately report to the County in writing any unexpected field conditions.
- Complete construction records required by this plan.

**1.4.3. Project Manager**

The Project Manager shall be the person working on behalf of the County having ultimate authority on the project (unless County Board or General Manager-Chief Engineer approval is required). The Project Manager will be responsible for

reviewing all design and QA/QC issues that may arise during construction. The approval of the Project Manager will be required prior to any design and/or QA/QC changes.

#### **1.4.4. Resident Engineer**

The Resident Engineer serves as the Project Manager's on-site representative. All coordination, reporting, and issues related to non-compliance will be directed to the Project Manager through the Resident Engineer. In addition, the Resident Engineer will participate with the Project Manager and QA/QC Manager in all decisions related to design and QA/QC issues that arise during the course of construction.

#### **1.4.5. QA/QC Consultant**

QA/QC Consultant is a party independent from the Owner, Contractor, and the product manufacturers. The QA/QC Consultant shall have authority for QA/QC activities only and shall maintain continuous communication with the Project Manager and Resident Engineer regarding QA/QC activities. The QA/QC Consultant organization will consist of a QA/QC Manager and QA/QC Monitors. The QA/QC Manager has overall responsibility for reviewing and approving QA/QC activities and is responsible for daily direction of QA/QC Monitors and testing laboratories. The QA/QC Monitors conduct observation, sampling, testing and documentation as required by this document and as directed by the QA/QC Manager. This work shall be subject to consultation with and/or acceptance from the County.

The work to be done by the QA/QC Consultant as stated in the QA/QC Plan, or any of the other Contract Documents, shall not in any way relieve the Contractor of its own obligations or responsibilities under the Contract Documents.

Along with County staff, the QA/QC Consultant is responsible for observing, inspecting, testing, and documenting activities related during construction. The role of the QA/QC Consultant is critical to successful control and demonstration of construction procedures and required documentation. Their responsibilities include but are not limited to the following:

- Monitoring receipt of materials, and obtain required samples of incoming materials for testing.
- Perform construction monitoring and in situ tests as specified and at the frequencies required.
- Collect samples in the field for subsequent testing by on-site or off-site laboratories.
- Report non-conformance, as appropriate, to the Contractor's representatives, if correction can be made during the normal course of work.
- Report non-conformance to the County, if correction cannot be readily achieved to the satisfaction of the QA/QC Consultant, so that resolution can be accomplished by the County.

- Report to the County any activities which are adverse to overall quality and any non-conformance which are recurring, even though resolution is readily achievable.
- Document non-conformance.
- Document the construction monitoring and testing activities and prepare the as-built report.

#### 1.4.6. QA/QC Manager

The QA/QC manager must be a registered civil engineer or certified engineering geologist as stated in Title 27 California Code of Regulations (CCR) §20324. The QA/QC Manager shall serve as the QA/QC Consultant's representative. All QA/QC functions shall be under his direct authority. Coordination, reporting, and issues related to noncompliance will be directed to the QA/QC Manager. In addition, the QA/QC Manager will communicate directly with the Project Manager in decisions related to potential design and construction changes and any problems that arise during the course of construction.

The QA/QC Manager will be responsible for overall review of observation, sampling, and testing activities for all earthworks and geosynthetic liner including the LCRS work. Specific duties will include the following:

- Review and knowledge of all Contract Documents.
- Review of Contractor submittals and design changes.
- Implementation of the QA/QC Plan, including assigning and managing all QA/QC personnel, reviewing all field reports, and providing engineering review of QA/QC-related issues.
- Serving as the representative of the QA/QC Consultant.
- Making QA/QC Monitors familiar with the site and the QA/QC requirements for the project.
- Attendance at QA/QC-related meetings, including pre-construction, progress, and special meetings, as required.
- Participate in the preparation of the As-Built Plans.
- Coordination of field-testing, sampling, and laboratory testing, and shipping of samples to laboratories.
- Review of the results of field and laboratory testing, and the preparation of appropriate recommendations.
- Review of QA/QC Monitors' daily reports and logs.
- QA/QC Manager is responsible for observations of on-site activities and/or conditions that could jeopardize the quality or function of the construction, and reporting these to the County and QA/QC Consultant.
- Observation and evaluation of cut slopes that may be impacted by geologic conditions.
- Evaluation of the quality and engineering characteristics of the subgrade or engineered fill used to support compacted engineered fill.

- Certification that the constructed earthworks, geosynthetics, and LCRS conform to the requirements of the Contract Documents.
- Preparation of a weekly summary of QA/QC activities.
- QA/QC Manager is responsible to designate a Senior QA/QC Monitor to act on his behalf at the site during his absence and while operations are ongoing.
- Preparation of the final as-built report on the construction of the project.

#### 1.4.7. QA/QC Monitors

The duties of the QA/QC Monitors include monitoring, testing, logging, and documenting all construction operations. The Geosynthetics operations to be monitored include (but are not necessarily limited to) the following:

- Material delivery.
- Unloading and on-site transport and storage.
- Placement operations.
- Joining and seaming operations.
- Conditions of materials placed.
- Selection of samples for conformance testing by the independent testing laboratory.
- Marking of samples for conformance testing.
- Repair operations.
- Identification of problems or unusual conditions by reference to the surveyor coordinates.

The QA/QC Monitors shall observe and document earthwork operations to establish that construction is carried out in conformance with the Contract Documents. Their duties will include (but are not necessarily limited to) the following tasks:

- Verification of preparation and condition of soil subgrade, including over excavation and replacement with engineered fill.
- Verification that engineered fill is derived from approved sources.
- Visual confirmations that the physical soil properties are consistent with the Contract Documents.
- Identification and reporting of deleterious materials or other deficiencies in soil quality and taking action to prevent such materials from being incorporated within compacted engineered fill or permeable layers of the project.
- Verification of lift thickness of compacted earthen materials.
- Verifications that proper moisture conditioning and mixing are performed to achieve uniformity of material and compaction requirements.
- Verifications that oversize material is removed from the native soil or the permeable materials, and that clods are broken down to maximum sizes in accordance with the Contract Documents.
- Monitoring construction of the protective soil layer during the contract duration.

- Observation of uniformity and coverage of compaction equipment, especially at edges and turnaround areas.
- Observation of existing engineered fill at the beginning of each day, and establishment of requirements for wetting, drying, and/or processing prior to placing additional materials.
- Recovery of samples for laboratory testing.
- Performing field density tests at the minimum frequencies noted herein, or at any time that a deficiency is suspected.
- Verification that the field density and grain size of compacted engineered fill are in conformance with the Contract Documents and this QA/QC Plan, which will include retests of any previously failed areas.

#### **1.4.8. Surveying**

##### **1.4.8.1. Contractor's Surveyors**

The responsibilities of the Contractor's Surveyor include the following functions:

- Protection of all primary control points set by the County; any required replacement of these points, due to Contractor negligence, shall be at the Contractor's expense.
- Provision of elevation checks to assure that slopes, elevations, grades, and alignments adhere to the Contract Documents.
- Strict control of the line and grade of subgrade during earthwork operations.
- Perform regular field surveys to provide control, verification, and documentation of the required thickness and position of the in-place liner system as shown in the Contract Documents.
- Establishment of secondary control points within the area of work for monitoring of construction progress.
- Completion of As-Built Plan(s) of the constructed surfaces and pipe placements prior to construction of the subsequent layers.
- Placement of cut/fill stakes on slopes, stakes at all pad-slope and slope-bench transitions, and stakes on the perimeters of the earthwork layers.
- Provision for horizontal and vertical location of reference points for geotechnical field testing and sampling.
- Remove all stakes and properly repair all resulting holes in the completed earthwork layers.
- Completion of As-built surveying for the project finished grades.
- Responsibility to immediately report in writing any errors, discrepancies, or omissions that could lead to inaccurate control point placement to the Resident Engineer for interpretation or correction prior to proceeding with that portion of work.

##### **1.4.8.2. County Surveyors**

The responsibilities of the County Surveyor include the following functions:

- Establishment of primary control points on firm ground, outside the limits of the work, to be used throughout the construction period.
- Verification of the Contractor's work as the County deems appropriate.
- Performance of periodic field surveys to provide a basis for progress payments and for evaluating and documenting that the thickness and position of the earthen layers are consistent with the Contract Documents.

#### **1.4.9. Meetings**

Communication between project participants is crucial and includes the exchange of information that allows required reporting and work to proceed. Communications in the form of construction documents, monitoring results, test results, and daily logs must be timely so that reviews and evaluation of construction activities can take place.

In order to assure a high degree of quality during construction, close coordination between County, QA/QC Consultant, Contractor, and subcontractor(s) is essential. To assist in achieving this objective, the following meetings will be held:

##### **1.4.9.1. Pre-Construction Meeting**

Before construction begins, a pre-construction meeting will be held and led by the Project Manager. Attendance at the meeting should include: the County's Resident Engineer, QA/QC Consultant, the Contractor's project manager and other representatives such as superintendents and foremen. Representatives of the regulatory agencies may be invited to attend the meeting. Meeting notes shall be prepared by the County and maintained in the on-site records system. Subcontractor personnel shall attend the meeting as appropriate to their scope of work.

Specific items to be considered at this meeting include but are not necessarily limited to the following:

- Distribute relevant documents to all parties.
- Review of the responsibilities of each party.
- Review of lines of authority and communication.
- Review of work area security and safety protocol.
- Review of methods for documenting and reporting, distributing and filing documents and reports, and processing of shop drawing submittals.
- Review of proposed methods of construction.
- Review procedure for change orders.
- Review procedure for applications for progress payments and processing.
- Establish procedures for correcting and documenting construction deficiencies.
- Review of the project schedule.

- Conducting of a site inspection to discuss work areas, stockpile areas (off the landfill), storage areas, access roads, haul roads, and related items.
- Agree on a specific date and time for weekly progress meetings.

The County will document the meeting, and minutes will be distributed to all parties and to the RWQCB. Additions or corrections to minutes shall be submitted within five working days of receipt.

#### 1.4.9.2. Weekly Progress Meetings

A progress meeting shall be held each week. All parties involved shall agree upon the time and date of the meeting during the pre-construction meeting. At a minimum, the Project Manager, Resident Engineer, the QA/QC Consultant, and the Contractor shall attend these meetings. The purpose of the meetings shall be the following:

- The previous week's activities and progress will be reviewed. The Contractor shall submit a written report signed by a representative of the Contractor which shall include, but not be limited to, the number of people and major pieces of equipment under his employment, including subcontractors, work accomplished by them, weather conditions, and accidents in the previous week.
- Test data will be reviewed.
- Quantities and percentages that indicate the progress of work to date will be discussed and agreed upon. The County's estimate, if different than the Contractor's estimate, shall govern partial payments.
- Scheduled work activities for the next two weeks shall be discussed. The Contractor shall submit a chart for the schedule of work during this period.
- Contractor and subcontractor personnel, equipment, and assignments for the next week will be discussed. The Contractor shall submit a written report signed by a representative of the Contractor, that shall include, but not be limited to, the number of people and major pieces of equipment anticipated under his employment, including subcontractors, and their anticipated accomplishments for the next week.
- Portions of the QA/QC Plan that will be pertinent in the next week shall be discussed.
- Expected Contractor submittals for upcoming work shall be reviewed.
- Quality related problems shall be discussed. The Contractor shall submit a written report, signed by a representative of the Contractor, that shall include, but not be limited to, a description of problem areas (recent, current, and anticipated), any resulting delays and their impact, and an explanation of corrective actions taken or proposed.
- The Resident Engineer shall document the meetings, and minutes shall be distributed to all parties. Additions or corrections to the minutes shall be submitted within five working days of receipt.

### **1.4.9.3. Quality Resolution Meeting**

The County, Contractor, and the QA/QC Consultant may request a special meeting to discuss activities that adversely affect construction quality and to provide resolution. It is intended that this meeting may be called to discuss quality problems which cannot be readily resolved and/or which are ongoing or recurring. The County will have the authority to schedule such a meeting given 24 hours notice to both the Contractor and QA/QC Consultant.

The meeting should:

- Define and discuss the quality-related problem.
- Review possible solutions.
- Implement a plan to resolve the quality-related problem.
- Establish whether change orders are required.

The Resident Engineer will document the meeting and minutes will be distributed to all parties. Additions or corrections to minutes shall be submitted within five working days of receipt.

### **1.4.10. Documentation and Record Keeping**

To provide evidence of satisfactory work performance, Several types of records shall be collected by the QA/QC consultant as outlined below.

#### **1.4.10.1. General**

The QA/QC Consultant shall document that the QA/QC requirements described in the specifications and this plan have been addressed and satisfied. To provide evidence of satisfactory work performance, all stages of construction shall be documented.

Documentation shall consist of daily reports, construction problem reports, photographs, design and specification revisions, weekly progress reports, and a final report of the as-built product, supplemented by documentation from all material manufacturers and suppliers. This documentation may include items such as copies of manufacturer and supplier specification sheets, certification sheets, shop drawings, transportation tickets, and any other pertinent documents. The information shall be recorded on standardized forms.

#### **1.4.10.2. Daily Reports**

The purpose of daily record keeping is to record construction activities, including results of visual observations, laboratory/field test data, repairs, problems, and



solutions. The daily record keeping will include a daily field activity log and a daily test summary report, as discussed below.

The daily record keeping shall include a daily field observation report, a daily test summary report, a summary of daily meetings with the Contractor and construction problem reports. These separate reports may be combined into a single report covering the required area prepared daily by the QA/QC consultant.

Daily reports by the QA/QC Consultant must be submitted to the County no later than 10:00 AM of the following working day. This is required to meet RWQCB daily report submittal no later than 12:00 PM.

#### **1.4.10.2.1. Daily Field Observation Reports**

The QA/QC Monitor(s) shall keep a daily field observation report of project activities which will document general observations.

#### **1.4.10.2.2. Daily Test Summary Report**

A daily Test Summary Report of the field and laboratory tests for the QA/QC of the earthwork, geosynthetic, and the LCRS will be prepared. The Daily Test Summary Report will include:

- Locations and results of all field and laboratory tests with comments regarding the pass and/or fail status.
- Results of all retests for failed tests with remarks showing the corrective action before the retest. If retest also shows rejection, final corrective action shall be noted.

#### **1.4.10.2.3. Summary of Daily Meetings**

A summary of daily meetings with the Contractor, when applicable, shall be prepared and include the following:

- Date.
- Project name and location.
- Names of parties attending.
- Scheduled activities.
- Items discussed.
- Signatures.

#### **1.4.10.2.4. Construction Problem Reports**

These reports identify and document construction problems and solutions. They are intended to document problems involving significant rework, and

are not intended to document problems that are easily corrected, unless the problems are recurring. Each report shall include:

- A detailed description of the problem.
- The location and cause of the problem.
- How the problem was identified.
- A solution to the problem.
- Personnel involved.
- Signatures of the QA/QC Monitor, Resident Engineer, and Contractor, as appropriate.

The results of equipment calibration, laboratory analysis, daily field activity logs, daily test summaries, and internal memoranda can be used as portions of the nonconformance report.

#### **1.4.10.2.5. Weekly Progress Reports**

The Resident Engineer shall prepare a weekly progress report. This weekly progress report shall summarize the work activities, deficiencies, and corrective actions implemented. It shall also summarize the QA/QC test results.

#### **1.4.10.3. Photographs**

The QA/QC Monitor shall prepare a photographic record as part of the construction control activities.

#### **1.4.10.4. Design and Specification Revisions**

If revision to the Contract Documents is required during construction, the QA/QC Consultant shall immediately notify the Project Manager. Revisions to the Contract Documents shall become official only after written acceptance by the County.

#### **1.4.10.5. As-Built Plans**

As the work is completed, the Contractor shall prepare final As-Built Plans and the QA/QC Consultant shall prepare a report. The As-Built Plans and the report shall be submitted by the Contractor and the QA/QC Consultant, respectively, to the County.

In preparation for compiling the final As-Built Plans, interim as-built plans shall be updated daily by the Contractor under the direction of the QA/QC Consultant and the Resident Engineer, and by utilizing the records prepared by the Contractor's Surveyors. The As-Built Plans shall be to scale and show the location and elevation, where applicable, of all materials used in construction.

The final report by the QA/QC Consultant shall include a summary of field and laboratory test results; and photographs showing and narrative describing typical construction conditions and procedures used throughout the entire duration of the project.

**1.4.10.6. Final Construction Report**

At completion of the work, the QA/QC Consultant shall submit a final construction report to the County. RWQCB staff must review and approve the final construction report prior to refuse placement. The QA/QC consultant is expected to submit the final construction report within one week of construction completion in order not to delay the refuse placement in the new cell.

**END OF SECTION**

## SECTION 2 - EARTHWORK

### 2.1. ENGINEERED FILL CONSTRUCTION

#### 2.1.1. General

The following earthwork requirements are the minimum requirements applicable to the Contractor's earthwork operations used in the construction of this project. The Contractor must strictly comply with these requirements.

- a. The materials used or placed to construct the required earthwork in the project must meet or exceed the criteria indicated in this QA/QC Plan and the other Contract Documents. The Contractor shall be solely responsible for the completion of the earthwork in strict accordance with the requirements.
- b. Unless otherwise stated in the Contract Documents, equipment used in the excavation, transport, processing, installation and compaction of the materials used in construction of the earthwork part in this project shall be standard of practice grading machinery of known specifications suitable for performing this type of landfill liner expansion work in a timely, proper, and efficient manner.
- c. Clearing, grubbing, stripping and site preparation for the project shall be accomplished to the satisfaction of the QA/QC Consultant and the County.
- d. Material considered by the QA/QC Consultant to be unsuitable shall be removed and stored as directed by the County. Materials incorporated as part of compacted engineered fill must be inspected and the QA/QC Consultant must observe placement.
- e. Engineered fill shall be placed to achieve final design grades and elevations, and to establish subgrade for geosynthetic liner and surface drainage structures. Generally, on-site soil obtained from within project grading limits may be used for the construction of the compacted engineered fill. Processing may be needed to bring on-site soils into compliance with the project specifications. QC procedures for these materials will include visual verification that the materials do not include organic matter, oversize particles, or other deleterious or unsuitable materials prior to use. Particle size below the top 2 feet of engineered fill of the termination berm and engineered fill other than Compacted Clay Liner (CCL) shall not exceed six (6") inches. These particle size requirements are in accordance with the Stability Evaluation Letter submitted by Geosyntec Consultants dated May 08, 2012 and included as Appendix E.
- f. The ground surface to receive engineered fill shall be prepared to the satisfaction of the QA/QC Consultant and the County; and the engineered fill shall be

prepared, placed, spread, mixed, watered and compacted in strict accordance with this QA/QC Plan, Special Provisions, and the other Contract Documents.

- g. Prior to the start of engineered fill work, the existing soils on the ground surface shall be scarified, disked or bladed to a depth of six (6) inches until the soils are uniform and free from uneven features which may prevent uniform compaction. The scarified ground surface shall then be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557. If the scarified depth is greater than 12 inches, the excess shall be removed and placed in lifts of six to eight inches in thickness. Prior to placement of engineered fill, the ground surface to receive engineered fill shall be inspected and accepted by the County and QA/QC Consultant.
- h. Suitable and sufficient hauling, processing, grading and compaction equipment shall be continuously utilized to handle the amount of engineered fill being generated and placed. Excavation or import equipment shall be shut down temporarily in order to allow time for proper preparation, placement, and/or compaction of engineered fill material. Sufficient watering apparatus shall be provided by the Contractor with due consideration to the type of engineered fill material, rate of placement, and time of year.
- i. Engineered fill material within the C4P3 project limits shall be moisture conditioned to  $\pm 2$  percent of the Optimum Moisture Content (or as determined by the QA/QC Consultant) and compacted to a minimum of 90 percent of the maximum dry density, as determined by ASTM D1557.
- j. The Contractor shall place engineered fill material only in thin lifts with an uncompacted thickness of no greater than eight (8) inches. Thickness of compacted lifts shall not exceed six (6) inches. Each layer shall be spread evenly, thoroughly mixed, and compacted to obtain a near uniform condition in each layer. In areas of excess lift thickness, the Contractor prior to construction of additional lifts must complete re-grading of the surface to the maximum lift thickness.
- k. As determined by the QA/QC Consultant, engineered fill over natural slopes shall be properly keyed into rock or firm material. All transitions shall be stripped of all loose soils prior to placing engineered fill. Engineered fill material within the C4P3 project limits for the construction of the permanent Termination Berm shall be properly keyed in into the subgrade, with minimal keying depth along the toe of engineered fill slope of 5 ft.
- l. Where work is interrupted by heavy rains, engineered fill operations shall not be resumed until observations and field tests by the QA/QC Consultant or County indicate in-place fills and/or materials intended for placement are within the limits specified in the Contract Documents.

### 2.1.2. Testing & Observation

Construction of all earthworks shall be performed strictly in accordance with the Contract Documents and the QA/QC Plan. Construction shall be continuously observed, routinely sampled, and tested by the QA/QC Consultant to confirm compliance with all applicable requirements.

The testing frequency stated in the following table is a minimum. Additional tests will be conducted by the QA/QC Consultant to retest previously failed areas and at any time that, in the opinion of the QA/QC Consultant, additional testing is required and/or a deficiency is suspected. At the discretion of the QA/QC Consultant, retest of previously failed areas will be performed after sufficient re-working of such areas, to warrant a retest, has been performed by the Contractor. Following re-working of a previously failed area, the QA/QC Consultant will perform retests to verify that the requirements of the Contract Documents are satisfied.

Material properties testing of the soils used as engineered fill shall consist of laboratory moisture-density tests in accordance with ASTM D1557. This test shall be conducted when the material changes, based on visual observation of the soils, and/or based on in-place density test results of the compacted fill.

Laboratory and field-testing of engineered fill material shall be performed at the frequency specified in the following table:

TEST	TEST DESIGNATION	TEST FREQUENCY	Project Minimum Value
<b>Field Testing</b>			
In-place moisture/density (nuclear)	ASTM D6938 or ASTM D2937	Every 1000 cubic yards; a minimum of two per day or 5 per acre per lift; whichever comes first	90% of Maximum Dry Density and from $\pm 2\%$ of OMC
In-place density and moisture content (sand cone)	ASTM D1556 and ASTM D4643	Every 20 <sup>th</sup> Nuclear test.	90% of Maximum Dry Density and from $\pm 2\%$ of OMC
Visual Soil Classification	ASTM D2488	Continuous	---
<b>Laboratory Testing</b>			
Moisture Density Relationship	ASTM D1557	One every 25,000 cubic yards; or change of Material	---

## 2.2. COUNTY ACCEPTANCE

The Contractor shall retain full responsibility for all earthwork until formal final acceptance by the County. Conditions for formal final earthwork acceptance (by the County) shall include but not be limited to the following:

- A. The construction of the entire liner expansion system is properly finished and summarized in writing by the QA/QC Consultant.
- B. All required laboratory tests have been completed and summarized in writing by the QA/QC Consultant.
- C. All record drawings to be used in the drafting of the final As-Built Plans have been completed.
- D. All documentation concerning the earthwork is received from the QA/QC Consultant and Contractor and is accepted by the County.

**END OF SECTION**

## SECTION 3 - LOW-PERMEABILITY LAYER

### 3.1. GENERAL

The construction of the compacted low permeability layer (LPL) shall be performed in accordance with the Project Drawings and Specifications. The compacted LPL shall be observed and tested by the QA/QC Monitors for conformance with the physical parameters described in the Specifications.

### 3.2. LOW PERMEABILITY LAYER MATERIAL AND PROCESSING

The material to be used in the LPL shall consist of 70% material from the "clay stockpile and 30% material from the "canyon 6 stockpile". This material will be borrowed by the Contractor from the clay stockpile and the excavation area and/or Canyon 6 stockpile, respectively. The Contractor shall process this material to remove particles and break down clods larger than one inch (1") in greatest dimension and moisture condition the material to within the required moisture range. The QA/QC Monitor shall monitor the borrowing and processing of this material.

### 3.3. LOW PERMEABILITY TEST PAD

Prior to construction of the LPL, the Contractor will be required to construct a low permeability test pad. The purpose of this test pad is to evaluate the performance of the actual construction equipment that will be used for soil blending, processing, placement and compaction of the LPL. The parameters for construction of the test pad are dictated by the project specifications. The construction procedures used in construction of the test pad shall be same as those planned for the production phase of the project and shall comply with the project specifications.

The QA/QC consultant will participate in the test pad by reviewing the proposed equipment and methods to be used by the Contractor. The QA/QC consultant will perform the same monitoring as for a typical section of LPL at the frequencies dictated in Section 3.5. below.

### 3.4. LOW PERMEABILITY PLACEMENT AND COMPACTION

Samples of the compacted LPL shall be taken and tested by the QA/QC Consultant to verify that material properties are in conformance with the Specifications, after processing by the Contractor.

The subgrade shall be properly prepared and documented by the QA/QC Monitor prior to construction of the LPL.

The placement and compaction operations for the compacted LPL shall be observed by the QA/QC Monitor. Construction testing by the QA/QC Monitor for evaluating the in-place condition of the constructed LPL shall be carried out as individual lifts and sections are completed. **The frequency of tests presented is considered the minimum.** Additional tests shall be taken and documented by the QA/QC Monitor for retests and at any time that a deficiency is suspected.



The Contractor shall supply labor and equipment for preparing test areas as requested by the QA/QC Consultant. When material has not been properly placed, moisture-conditioned, or compacted, as determined by observation or verification testing, such material shall be removed or reworked as necessary to obtain the required relative compaction and moisture content, at the sole expense of the Contractor.

When the sand cone density tests are performed, no equipment shall be operated within an area that will produce vibration of the test apparatus, or in a way that will adversely impact the test results.

All sampling holes used by the QA/QC Consultant for testing, sampling, or observation will be repaired by the QA/QC Consultant. Any unsuitable material shall be removed from the hole, and the hole shall be plugged with properly moisture conditioned bentonite. The backfill shall be hand-tamped in four-inch (4") maximum compacted lifts. The material requirements for the bentonite shall be the same as the material requirements for the bentonite in the GCL as indicated in Section 11.2 of the Special Provisions.

Successive lifts of material shall not be placed until the prior layer is approved by the QA/QC Consultant. It is the Contractor's responsibility to ensure that proper and uniform moisture content, adequate mixing and relative compaction of the entire compacted LPL is achieved. Verification testing performed by the QA/QC Consultant does not relieve the Contractor of his responsibility to ensure uniform moisture content, mixing and relative compaction of the entire compacted LPL.

### 3.5. MATERIALS PROPERTIES TESTING

The following tests shall be used to verify the physical properties of the materials used in the compacted LPL. The minimum frequency of testing is indicated below. The following tests are to be performed in the field or in the QA/QC Consultants' laboratory, on samples taken in the field.

TEST	TEST DESIGNATION	PROJECT MINIMUM VALUE	LPL PLACEMENT TEST FREQUENCY	TEST PAD NUMBER OF TESTS
Visual Soil Classification	ASTM D2488	-	Continuous	Continuous
Particle size analysis	ASTM D422 and D1140	$D_{100} < 1''$	One per 5,000 cy and one per material change or once per week	3
Plasticity index (Atterberg limits)	ASTMD4318	-	One per 5,000 cy and one per material change or once per week	3

Moisture-density relationship	ASTMD1557	-	One per 5,000 cy and one per material change or once per week	1
Laboratory Hydraulic conductivity (Shelby tube)	ASTMD5084	$\leq 1 \times 10^{-7}$ cm/sec	One test per 40,000 sf or one per material type,	3
In-Place moisture/density (nuclear or drive ring)	ASTM D2922 ASTM D3017 ASTM D2937	95% of Maximum dry density at 2% to 4% above OMC	Every 250 cubic yards; a min. of four per day;	As required
In-place density & moisture content (sand cone and oven dry)	ASTM D1556 ASTM D2216	95% of Maximum dry density at 2% to 4% above OMC	Every 20 <sup>th</sup> Nuclear test.	As required
Field hydraulic conductivity	BAT <sup>TM</sup> Test	$\leq 1 \times 10^{-7}$ cm/sec	One test per 40,000 sf or one per material type,	3

### 3.6. ACCEPTANCE CRITERIA

#### 3.6.1. General

Where test results indicate that the density, moisture content, or permeability, as applicable, of any layer of compacted LPL, or portion thereof, is not in compliance with project requirements, the particular layer or portion thereof shall be reworked or replaced, and then retested until the required density, uniform moisture content, or permeability has been attained. No additional LPL fill shall be placed over an area until the last fill has been tested horizontally and vertically, and is found to meet the Specifications. If required, the area to be reworked will be verified by survey.

#### 3.6.2. Moisture Content and Density

If initial test results indicate a density less than the specified percent of maximum dry density (ASTM D1557) or moisture content outside of the specified limits, two additional field density/moisture content tests will be taken by the QA/QC Consultant, in the immediate area. If either of these tests fail to meet the moisture content or the minimum compaction requirement, the area will be considered inadequate and must be reworked. Any reworked

areas must be retested by QA/QC Consultant to confirm that the reworked area meets the density and moisture content requirements.

### **3.6.3. Permeability**

The QA/QC Consultant may require additional hydraulic conductivity tests in areas where the QA/QC Consultant suspects that the LPL fill does not meet the specified hydraulic conductivity.

Each liner portion tested for laboratory hydraulic conductivity will be similarly tested for field hydraulic conductivity using the BAT™ test. BAT™ tests shall be used as an indicator of whether an area will pass the laboratory tests. In no case shall BAT™ testing of areas be used for final acceptance.

If the hydraulic conductivity exceeds  $1 \times 10^{-7}$  cm/sec as defined by ASTM D5084, the area represented by the test will be considered inadequate, and will be removed or reprocessed and re-compacted. Acceptance of the re-built area will be based on the results of the re-test consistent with permeability requirements.

### **3.6.4. County Acceptance**

The Contractor shall retain all ownership and responsibility for the LPL until acceptance by the County. The LPL shall be accepted by the County when:

- The installation is finished and approved in writing by the QA/QC Consultant.
- All required laboratory tests have been completed and approved in writing by the QA/QC Consultant.
- All required supplier documentation has been received and approved in writing by the QA/QC Consultant.
- All record drawings to be used in the drafting of the As-Built Plans have been completed and approved in writing by the QA/QC Consultant.
- All above documentation and any additional documentation concerning the LPL is received from the QA/QC Consultant and Contractor, and is accepted by the County.

**END OF SECTION**

## SECTION 4 - GEOSYNTHETIC CLAY LINER (GCL)

### 4.1. GENERAL

Prior to shipment of the GCL material, the Contractor shall provide the County and/or the QA/QC Consultant with the GCL manufacturer's QA/QC certifications for each shipment of GCL. The certification shall be signed by a responsible party employed by the manufacturer such as the Production Manager or Technical Service Manager. The QA/QC certifications shall include:

- A. GCL lot and roll numbers (with corresponding shipping information).
- B. Certificates of analysis for the bentonite used in GCL production.
- C. Manufacturer's test data for raw materials used in GCL production.
- D. Manufacturer's test data for finished GCL product.

The County and the QA/QC Consultant will arrange for a meeting with the Contractor prior to the installation of the GCL. Topics for review/discussion shall include, as a minimum, Project Drawings and Specifications, approved submittals, and training and qualifications for lining (sub) Contractor's personnel.

The manufacturer shall provide technical supervision and assistance as necessary during the installation of the GCL material. After the installation of the material, the Contractor shall submit to the County written certification that the GCL was installed in accordance with the GCL manufacturer's recommendations, project specifications and drawings and approved submittals.

### 4.2. GCL MANUFACTURING

The Contractor shall provide the County and the QA/QC Consultant with the following Manufacturer's literature:

- A. Materials' specification sheet listing all specified properties measured using test methods indicated in the Special Provisions and other Contract Documents.
- B. The sampling procedure and results of testing.
- C. A certification that property values given in the materials specification sheet are guaranteed by the Geosynthetics Manufacturer.

The QA/QC Consultant shall verify the following:

- A. The property values certified by the GCL manufacturer meet all of the specifications.
- B. The measurements of properties by the GCL manufacturer are properly documented and the test methods used are acceptable.
- C. Verify that the quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it.
- D. Review the quality control certificates and verify that the certified roll properties meet the specifications.

### **4.3. GCL DELIVERY**

#### **4.3.1. Transportation and Handling**

Transportation of the GCL and all handling on-site is the responsibility of the Contractor.

The QA/QC Monitor shall verify the following:

- a. The GCL has been protected from ultraviolet light exposure, precipitation, or any other damaging conditions.
- b. Equipment used to unload the rolls does not damage the GCL.
- c. Care is used to unload the rolls.
- d. All required documentation has been received.

Upon delivery at the site, the Geosynthetics Subcontractor and QA/QC Monitor shall conduct a surface observation of all rolls for defects and for damage. This observation shall be conducted without unrolling rolls unless defects or damages are found or suspected. The QA/QC Manager shall advise the County if any rolls, or portions thereof, should be rejected and removed from the site because they have severe flaws.

Any damaged rolls shall be rejected and removed from the site or stored at a location, separate from accepted rolls, designated by the County. All rolls that do not have proper GCL manufacturer's documentation shall also be stored at a separate location until all documentation have been received and approved. The QA/QC Monitors shall maintain a log on the GCL received.

#### **4.3.2. Storage**

The Contractor shall be responsible for the storage of the GCL on-site. Storage space should be protected by the Contractor from theft, vandalism, damage from vehicles, or other harm.

The GCL shall be protected from ultraviolet light exposure and from contamination by surface run-off and precipitation. Any GCL so contaminated shall not be used in the construction.

The QA/QC Monitors shall verify that the materials shall not be stored directly on the ground, and that storage of the GCL ensures adequate protection against damage from actions of man, weather, animals, and other sources.

#### **4.4. GCL CONFORMANCE TESTING**

##### **4.4.1. Tests**

Upon delivery of the rolls of GCL, the QA/QC Manager shall verify that samples are removed and forwarded to the Independent Testing Laboratory for testing to ensure conformance to project specifications.

As a minimum, tests to determine the field characteristics shall be performed on the GCL in accordance with the project specifications.

##### **4.4.2. Sampling Procedures**

Samples shall be taken by the Geosynthetics Subcontractor in the presence of the QA/QC Monitor.

Samples shall be taken at a rate of one per lot or one per 100,000 square feet, whichever results in the greater number of samples.

##### **4.4.3. Test Results**

The QA/QC Manager shall document all conformance test results from Independent Testing Laboratory, and shall report any non-conformance to the Contractor and Geosynthetics Subcontractor.

For GCL rolls rejected and replaced with new rolls from a different lot, the Contractor shall be responsible for all costs associated with retesting.

#### **4.5. GCL INSTALLATION**

##### **4.5.1. Surface Preparation**

The Contractor shall be responsible for preparing the supporting soil according to the Special Provisions and as needed by the Geosynthetics Subcontractor.

Prior to installation, the Contractor, Geosynthetics Subcontractor, Resident Engineer, and QA/QC Monitors shall verify that:

- a. All lines and grades have been verified by a qualified surveyor.
- b. The supporting surface does not contain stones or other sharp objects that could damage the GCL.
- c. No soft areas are present that could result in damage to the GCL.
- d. All construction stakes and hubs have been removed and the resulting holes have been properly filled.
- e. The Contractor has certified in writing that the surface on which the GCL shall be installed is acceptable.

The certificate of acceptance shall be given by the Contractor to the Resident Engineer prior to commencement of GCL installation. The QA/QC Monitor shall have a copy of this certificate before installation of GCL commences in any given area. The subject area shall also be observed by the QA/QC Consultant. The QA/QC Monitor shall have the authority to reject an area even after it has been accepted by the Contractor.

At any time before, during, or after the supporting surface has been accepted, it shall be the Contractor's responsibility to indicate to the QA/QC Monitor changes in the supporting soil condition that may require repair work. The QA/QC Monitor shall also make observations to identify such conditions.

#### **4.5.2. Placement**

Field Panel Identification: The Contractor shall provide for County and QA/QC Consultant acceptance, a GCL panel layout plan before any placement occurs, and it shall be updated daily as the job proceeds. A field panel (sheet) is an area of GCL that is to be placed in the field, such as a roll or a portion of roll cut in the field. The Contractor shall give each field panel an identification code that shall be agreed to and used by the QA/QC Consultant, Resident Engineer, and the Geosynthetics Subcontractor. The QA/QC Monitors shall establish a chart showing correspondence between roll numbers, certification reports, and panel identification code. The field panel identification code shall be used for all QA/QC records and for the final As-Built Plans.

Field Panel Placement: The QA/QC Monitors shall record the identification code, location, and date of installation of each field panel.

During panel placement, the QA/QC Monitor shall:

- a. Verify that field panels are installed at the location indicated in the layout plan, as accepted or modified by the County.

- b. Verify that the surface beneath the GCL has not deteriorated since previous acceptance.
- c. Verify that the method used to unroll the panels does not cause folds in the GCL and does not damage the supporting surface.
- d. Verify that there are no stones, construction debris, or other items beneath the GCL that could cause damage.
- e. Observe and document the GCL as it is placed and record all defects; all repairs are to be made in accordance with the Specifications.
- f. Verify that equipment used does not damage the GCL or supporting surface by handling, traffic, leakage of hydrocarbons, or by any other means.
- g. Verify that people working during installation of GCL do not smoke, wear shoes that could damage the GCL, or engage in activities that could damage the GCL.
- h. Verify that the GCL is properly anchored to prevent movement by the wind, and record the procedure used (Securing pins are unacceptable).
- i. Verify that the adjacent panels of GCL are overlapped a minimum of twelve-inches (12") on side slopes and (6") on canyon floor area.
- j. Verify that the direct contact with the GCL is minimized when placing the GCL; i.e., the GCL is protected by suitable materials as approved by the Resident Engineer in areas where excessive traffic may be expected.
- k. Verify that the GCL is cut only with an approved GCL cutter, and is not torn or ripped.

The QA/QC Monitors shall inform the Contractor, the QA/QC Manager, and the Resident Engineer if the above conditions are not met. The QA/QC Monitor shall observe and document the condition of each panel after placement. The QA/QC Monitors shall advise the QA/QC Manager which panels, or portions of panels, should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels that have been rejected shall be marked, and their removal from the work area shall be recorded by the QA/QC Monitors. A GCL panel replacement log shall be maintained by the QA/QC Monitors.

#### **4.5.3. Repairs**

Each repaired area shall be documented and located by the QA/QC Monitor for the final As-Built Plans.

#### **4.6. COUNTY ACCEPTANCE**



The Contractor shall retain all ownership and responsibility for the GCL until acceptance by County. The GCL shall be accepted by the County when:

- A. The installation is finished and summarized in writing by the QA/QC Consultant.
- B. All construction and materials mentioned in this section have been completed and tested, as appropriate, and summarized in writing by the QA/QC Consultant.
- C. All required manufacturer's and supplier's documentation have been received and summarized in writing by the QA/QC Consultant.
- D. All record drawings to be used in the drafting of the final As-Built Plans have been completed and summarized in writing by the QA/QC Consultant.
- E. The GCL is permanently covered.
- F. All above documentation and any additional documentation concerning the items mentioned in this section are received from the QA/QC Consultant and Contractor, and are accepted by the County.

**END OF SECTION**

## **SECTION 5 - FLEXIBLE MEMBRANE LINER (FML)**

### **5.1. FML MANUFACTURING**

The Contractor shall provide the County and/or QA/QC Consultant with the FML manufacturer's QA/QC certifications for each shipment of FML. The certification shall be signed by a responsible party employed by the manufacturer such as the Production Manager, or Technical Services Manager. The QA/QC certifications shall include:

- A. FML lot and roll numbers (with corresponding shipping information)
- B. Manufacturer's test data for the FML product, including all test data for all conformance specifications required by the project specification.

The manufacturer shall provide on-site technical supervision and assistance as necessary during the installation of the FML material. The FML manufacturer and the Contractor, as applicable to each, shall submit for acceptance by the County the written certification that the FML was installed in accordance with the FML manufacturer's recommendations, project specifications, drawings and approved submittals.

The Contractor shall make arrangements with the FML manufacturer, if requested by the County and/or QA/QC Consultant, to allow the County and/or QA/QC Consultant to visit the manufacturing facility during manufacture of the FML material(s) for this project to observe manufacturing methods and quality control of manufactured materials.

The County and the QA/QC Consultant will arrange for a pre-installation meeting with the FML installation Contractor prior to the installation of the FML. Topics for review/discussion shall include, as a minimum, Project Drawings and specifications, approved submittals, training and qualification procedures for the lining (sub) Contractor's personnel, and demonstration of making field weld(s).

Prior to installation of the FML, a site inspection shall be conducted by the QA/QC Manager and the Contractor to verify measurements and surface conditions to receive the FML.

The Contractor shall provide the County with the following manufacturer's literature:

- A. Materials' specification sheet including all specified properties measured using test methods indicated in the specifications, or equivalent.
- B. The sampling procedure and results of testing.
- C. A certification that property values given in the materials specification sheet are guaranteed by the FML manufacturer.

The QA/QC Consultant shall verify that:

- A. The property values certified by the manufacturer meet all of the project specifications.
- B. The actual test results performed at the manufacturer's Quality Control Laboratory meet all of the project specifications.

Prior to shipment, the FML manufacturer shall provide the County and the QA/QC Consultant with a quality control certificate for each roll of FML. The quality control certificate shall be signed by a responsible person employed by the manufacturer. The quality control certificate shall include:

- A. Lot and roll numbers and identification.
- B. Sampling procedures and results of quality control tests; at a minimum, results shall be given for thickness, density, carbon black content, and tensile characteristics, evaluated in accordance with the methods indicated in the specifications or by equivalent methods approved by the QA/QC Consultant and the County.

The QA/QC Consultant shall:

- A. Verify that the quality control certificates have been provided at the specified frequency for all rolls and that each certificate identifies the rolls related to it.
- B. Review the quality control certificates and verify that the certified Minimum Average Roll Values (MARV) meet the project specifications.

## **5.2. FML DELIVERY**

### **5.2.1. Transportation and Handling**

Transportation of the FML and all handling on site is the responsibility of the Contractor.

The QA/QC Consultant shall verify the following items:

- a. Handling equipment used on the site is adequate and does not pose any risk of damage to the FML.
- b. The Geosynthetics Subcontractor's personnel handle the FML with care.
- c. All documentation required by the Specifications has been received.

Upon delivery at the site, the Geosynthetics Subcontractor and the QA/QC Monitor shall conduct a surface observation of all the rolls for defects and for damage. This shall be conducted without unrolling the rolls unless defects or damages are found or suspected. The

QA/QC Consultant shall report to the County the rolls, or portions thereof, that should be rejected and removed from the site because they have severe flaws.

Any damaged rolls shall be rejected and removed from the site or stored at a location, separate from accepted rolls, that is designated by the County. All rolls that do not have proper manufacturer's documentation shall also be stored at a separate location until all documentation has been received and approved. An updated log on the FML received shall be maintained by the QA/QC Monitors.

#### **5.2.2. Storage**

The Contractor shall be responsible for the storage of the FML on site. The County shall provide storage space in one or several locations such that on-site transportation and handling are minimized. Storage space should be protected by the Contractor from theft, vandalism, damage from vehicles, or other harm. The QA/QC Monitors shall verify that the materials shall not be stored directly on the ground, and that storage of the FML ensures adequate protection against damage from actions of man, weather, animals, and other sources.

### **5.3. FML CONFORMANCE TESTING**

#### **5.3.1. Tests**

Upon delivery of the rolls of FML, the QA/QC Manager shall ensure that samples are removed and forwarded to the independent testing laboratory for testing to ensure conformance to the specifications.

As a minimum, tests to determine the field characteristics shall be performed on the Flexible Membrane Liner (FML) in accordance with the project specifications.

#### **5.3.2. Sampling Procedures**

Unless otherwise specified, samples shall be taken at a rate of one per lot or one per 100,000 square feet, whichever results in the greater number of tests.

#### **5.3.3. Test Results**

The QA/QC Manager shall document all conformance-testing results from Independent Testing Laboratory and shall report any non-conformance to the Contractor.

For FML rolls rejected and replaced with new rolls from a different lot, the Contractor shall be responsible for all costs associated with retesting of new rolls.

#### **5.3.4. Multilayer Interface Shear Testing**

Multilayer Interface shear testing shall be conducted at a rate of one per 100,000 square feet of installed composite liner in accordance with the requirements set forth in Section 13 of the Special Provisions. Where optional procedures are noted in the test method, the requirements of the Special Provisions shall prevail. A minimum of one sandwich test is required for each different liner type.

The Contractor shall sample composite liner components (including appropriate geosynthetic and soil components of the liner system) and send them to a laboratory approved for conformance interface direct shear testing. Care should be taken to identify appropriate samples for the soil components of this testing and available information about moisture density relationships of these soils should be incorporated into the testing program.

Note that while this description of interface shear sandwich testing is included in the geomembrane section of this plan these requirements apply to the liner system as a whole and not any individual component.

For the respective base and side slope liners, the approved laboratory shall report: (i) interface peak and large-displacement shear strength parameters (friction angle and adhesion); (ii) normal stress applied during testing; (iii) displacement corresponding to the peak and large-displacement shear strength parameters evaluated; and (iv) interface along which sliding occurred.

For this project, the interface shear strength parameters shall be established in accordance with the procedures described in Thiel et al. [2001]<sup>1</sup>.

## 5.4. FML INSTALLATION

### 5.4.1. Earthwork

Surface Preparation: The Contractor shall be responsible for preparing the supporting soil according to Special Provisions and as needed by the Geosynthetics Subcontractor.

Prior to the FML installation, the Contractor, Resident Engineer, and QA/QC Monitor shall verify that:

- a. All lines and grades have been checked by survey.
- b. The subgrade for the lower FML layer for the bottom floor liner system has been prepared in accordance with the Special Provisions.

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<sup>1</sup> Thiel, R., Daniel, D.E., Ericson, R.B., Kavazanjian, E., Jr. and Giroud, J.P. [2001], "The GSE GundSeal GCL Design Manual," *Design Manual*, GSE Lining Technology, Inc., Houston, Texas.

- c. The surface has been rolled and compacted to be free of surface irregularities, loose soil, and protrusions, and a geotextile, if specified, has been installed.
- d. The supporting surface does not contain stones that could damage the FML.
- e. There are no soft areas that could result in FML damage.
- f. All construction stakes and hubs have been removed, and any holes properly filled.
- g. The Contractor has certified in writing that the surface on which the FML will be installed is acceptable.

The certificate of acceptance shall be given by the Contractor to the County prior to commencement of FML installation in the area under consideration. The QA/QC Monitors shall have a copy of this certificate before installation of FML commences in any given area. The subject area will also be observed by the QA/QC Monitors. The QA/QC Monitor shall have the authority to reject an area even after it has been accepted by the Contractor.

After the supporting surface has been accepted by the Contractor, it shall be the Contractor's responsibility to indicate to the QA/QC Monitor any change in the supporting soil condition that may require repair work. If the QA/QC Monitor concurs with the Contractor, then the QA/QC Monitor shall coordinate the repair of the supporting surface. At any time before, during or after the FML installation, the QA/QC Monitor shall indicate locations that may not provide adequate support to the FML to the Resident Engineer.

Anchor Trench: Care shall be taken when backfilling the trenches to prevent any damage to the geosynthetics. The QA/QC Monitors shall observe the backfilling operation and advise the QA/QC Manager of any problems.

#### **5.4.2. FML Placement**

Field Panel Identification: The QA/QC Monitors shall establish a chart showing correspondence between roll numbers, certification reports, and panel identification code. The field panel identification code shall be used for all QA/QC records and for the final As-Built Plans.

Field Panel Placement: The QA/QC Monitors shall record the identification code, location, and date of installation of each field panel.

During panel placement, the QA/QC Monitors shall:

- a. Verify that field panels are installed at the location indicated in the layout plan, as accepted or modified by the County.