NW2.3 – Prevent Surface and Groundwater Contamination.

Level of Achievement:
RESTORATIVE

Summary:
The project remediated an existing Brownfield site (reference NW1.7). The land use designation for the site was changed from Light Industrial to Open Space (reference NW2.1).

There are no equipment or facilities on site that contain potentially polluting substances. The project is designed to collect 100% of dry weather runoff from the regional storm drain network. A series of stormwater best management practices (BMPs) are designed to enhance the quality of runoff prior to release back to the storm drain network, therefore minimizing the discharge of pollutants from urban run-off to receiving waters. Bureau of Sanitation (BOS) regularly visits the site to monitor water quality.

In addition, all three wetland cells are lined with a primary geosynthetic clay liner (GCL) to form an impermeable layer that 1) prevents water loss via infiltration and 2) prevents infiltration into the former Brownfield site. GCLs are primarily used as low-permeability barrier layers in waste-containment systems, and are a promising barrier material for situations in which differential settlement is expected. For additional spill and leak prevention, the wetland cells are lined with a secondary linear low-density polyethylene liner. The project also includes ultrasonic level sensors in the wetland itself to mitigate potential water loss.

The pump station includes an infrared combustible gas detector that is wired to shut down the pump station if oil or other volatile hydrocarbons pass through the pre-treatment system.

Supporting documentation:

- Section 6.3.5 – Impermeable Liner Options from Pre-Design Report
- Contractor's submittal for GCL
- Specification Section 02615 – Dual-Sided Textured HDPE Liner
- Construction drawing for a secondary impermeable liner

Section 6.3.5 – Impermeable Liner Options from Pre-Design Report

significant portions of the wetland may become anoxic thereby promoting anaerobic conditions. This scenario is most likely to occur during the summer months when runoff baseflow through the wetland is at its lowest.

Deficiencies of DO can be mediated by installation of water features and/or air pumps in the wetland cells. Water features will consist of cascading water over rocks and will be powered by individual pumps separate from the high/low pump system components. Air pumps will be installed to deliver additional oxygen into the water when needed.

Water quality analysis of the runoff water to be diverted into the wetland could provide information that can be used to estimate the level of oxygen consumption in the proposed wetland. Water analysis should include, among other constituents, analyses for organic matter content (COD/BOD_5) and nutrients (TKN, nitrate, nitrite, ammonia). DO measurements may be necessary throughout the year, specifically during summer months and drought periods, in order to track oxygen levels.

6.3.5 Impermeable Liner Options

The soil materials on-site are generally sandy. Sands generally accommodate good to moderate permeability. No subsurface natural clay layers occur on the project site at shallow enough depths to prevent infiltration of water from the wetland once filled. Therefore, all three wetland cells will be lined with an appropriate geosynthetic clay liner (GCL) material to prevent infiltration. The liner must be strong, thick, and smooth to prevent root attachment or penetration. If the site soils contain angular stones, sand bedding or geotextile cushions will be placed under the liner to prevent punctures.

Liner placement will occur following excavation of the wetland cells to the design depth. With the exception of the existing building to remain, all other structures shall be demolished. After the pond is excavated, the slough on the pond's sides and bottom will be rolled to compact soil and to even out bumps and dips for the application of the GCL. If debris is protruding from the sub-grade that could potentially puncture the GCL, it will be removed.

Once the sides and bottom of the pond are smooth, compacted and free of any debris that would puncture the GCL, the GCL will be applied to the pond sides and bottom. Soil then can be placed on top of the GCL per recommendation from a landscape architect to assure proper thickness for root growth and organic amendments for the vegetation. Plant roots will exploit any minor crack or defect in a liner and may eventually break through the liner. A soils or materials engineer can recommend specific material, thickness, and compaction specifications for a liner that would prevent this problem, but the problem may be minimized by confining the riparian and upland plantings above the liner to herbaceous and shrub species only.

The soil suitability evaluation in the next section (Section 6.3.7) concludes that the soils presently on-site do not show any evident constraints or limitations for native habitat based on soil agronomy testing done by Wallace Laboratories (Appendix C). Wallace

Laboratory recommends adding an organic amendment to the soil which will assist with initial water holding capacity and nutrient cycling.

Contractor's Submittal for GCL

CONTRACTOR'S SUBMITTAL TRANSMITTAL

PROJECT TITLE: South LA Wetlands
CONTRACTOR: Ford E.C., Inc.
W.O. No.: EW40006F & SZW00061
CONSTRUCTION MANAGER: Marlon Calderon **DATE SENT:** 07/12/2010
SPEC REFERENCE: 02220 **DRAWING REFERENCE:** C
SCHEDULE ACTIVITY No.:
DATE REQUESTED BY GC:

TO: Marlon Calderon -

FROM: Amir Amini

CONTRACTOR'S SUBMITTAL No.: 021

CHECK ONE

[X] AN ORIGINAL SUBMITTAL
[ ] A 2nd SUBMITTAL OF
[ ] A SUBMITTAL OF
[ ] AN O&M SUBMITTAL

ITEM No.:	*	SUBJECT OF SUBMITTAL / EQUIPMENT SUPPLIER	EQUIPMENT DESIGNATION(S): SPECIFICATION SECTION(S):
1		Manufacturer's material data sheet-Bentomat SDN	
2		Manufacturer's quality control spec including shipping, handling, storage and installation	
3		Installation drawing (proposed layout)	

*** CHECK FOR SPECIFIED SHOP INSPECTION REQUIREMENT, FOR ITEM SOURCE GREATER THAN 50 MILES, ATTACH TESTING LABORATORY DOCUMENTATION FOR ACCEPTANCE.**

COMPLETE EITHER (a) OR (b), FOLLOWING:

[X] (a) WE HAVE VERIFIED THAT THE MATERIAL, EQUIPMENT, OR OTHER INFORMATION CONTAINED IN THIS SUBMITTAL MEETS ALL THE REQUIREMENTS SPECIFIED OR SHOWN (NO EXCEPTIONS)

[ ] (b) WE HAVE VERIFIED THAT THE MATERIAL, EQUIPMENT, OR OTHER INFORMATION CONTAINED IN THIS SUBMITTAL MEETS ALL THE REQUIREMENTS SPECIFIED OR SHOWN, EXCEPT FOR THE FOLLOWING DEVIATIONS (LIST DEVIATIONS):

Please see attached submittal for clay liner.

Amir Amini

CONTRACTOR'S AUTHORIZED REPRESENTATIVE

DATE: 07/12/2010

Uploaded Files

File Name	Size(Bytes)	Uploaded By
Submittal-21-1.pdf	84376	Amir Amini

Submittal-21-2.pdf	189137	Amir Amini
Submittal-21-3.pdf	62442	Amir Amini

SHOP DRAWING REVIEW

PROJECT TITLE: South LA Wetlands
CONTRACTOR: Ford E.C., Inc.
WORK ORDER No.: EW40006F & SZW00061
CONSTRUCTION MANAGER: Marlon Calderon
CONTRACTOR'S SUBMITTAL No.: 00021 **DATE RECEIVED:** 07/12/2010
SPEC REFERENCE: 02220 **DRAWING REFERENCE:** C
SCHEDULE ACTIVITY No.:

To: Amir Amini - 310-877-3321
Gregory Gifford - 310-908-4749
Sam Daghighian - 310-488-3636
Norman Peck - 213-305-8950

Item No.	SUBJECT OF SUBMITTAL / EQUIPMENT SUPPLIER:	No. of Copies	"A" No Exception Taken	"B" Make Corrections Noted	"C" Reject Resubmit
1	Manufacturer's material data sheet-Bentomat SDN	1	[X]	[ ]	[ ]
2	Manufacturer's quality control spec including shipping, handling, storage and installation	1	[X]	[ ]	[ ]
3	Installation drawing (proposed layout)	1	[X]	[ ]	[ ]

Package Received From GC: 07/12/2010
Package Out To PE:
Package In From PE:
Package Back To GC:

Remarks:

This submittal has been actioned "A - No Exception Taken".

Corrections or comments made relative to submittals during this review do not relieve the contractor from compliance with the requirements of the drawings and specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of other trades, and performing his work in a safe and satisfactory manner.

Marlon Calderon
CM

07/20/2010
Date

Uploaded Files

File Name	Size(Bytes)	Uploaded By

SUBMITTAL CONTROL FORM

DATE: JULY 7, 2010

JOB NO: 103008

SUBMITTAL NO: 1

PROJECT: SOUTH LOS ANGELES WETLANDS PARK

TO:	**Ford E.C., Inc.**	FROM:	**EC Applications, Inc. (ECA)**
ATTN:	**Sam Daghighian**		**Chris Fore**
	10850 Wilshire Blvd. # 380		**415 W. Taft Ave, Suite H**
	Los Angeles, Ca 90024		**Orange, CA 92865**
PHONE:	**310-264-2147**	PHONE:	**(714) 921-9848 x 104**
FAX:	**310-264-2146**		
EMAIL:	**sam@fordecinc.com**		**cfore@ecapplications.com**

WE ARE SUBMITTING THE ENCLOSED:

☐ SHOP DRAWINGS ☐ CERTIFICATES OF COMPLIANCE ☐ SAMPLES

☒ MATERIAL DATA ☐ QC INFORMATION ☐ OTHER

THESE ARE TRANSMITTED FOR:

☒ APPROVAL ☐ INFORMATION ☐ RESUBMIT

☐ AS REQUESTED ☐ FOR REVIEW PREV SUB NO:

ITEM NO.	DESCRIPTION OF ITEM	NO. OF COPIES	CONTRACT REFERENCE/SPEC SECTION OR DRAWING SHEET NO.
1	*Manufacturer's Material Data Sheet:* • *Bentomat SDN*	*1*	*Geosynthetic Clay Liner*

NOTE: As specified

THE ABOVE SUBMITTED ITEMS HAVE BEEN REVIEWED IN DETAIL AND ARE CORRECT AND IN GENERAL CONFORMANCE WITH THE CONTRACT DRAWINGS AND SPECIFICATIONS EXCEPT AS OTHERWISE STATED.

Christopher Fore

EC Applications, Inc.. AUTHORIZED SIGNATURE

IF THE ABOVE VARIANCES ARE ACCEPTABLE, PLEASE CONFIRM IN WRITING WITHIN TEN (10) DAYS, OTHERWISE WE WILL PROCEED PER THE PROPOSED VARIANCES

BENTOMAT® SDN CERTIFIED PROPERTIES

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY $ft^2(m^2)$	REQUIRED VALUES
Bentonite Swell Index[1]	ASTM D 5890	1 per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss[1]	ASTM D 5891	1 per 50 tonnes	18 mL max.
Bentonite Mass/Area[2]	ASTM D 5993	40,000 ft^2 (4,000 m^2)	0.75 lb/ft^2 (3.6 kg/m^2) min
GCL Grab Strength[3]	ASTM D 6768	200,000 ft^2 (20,000 m^2)	25 lbs/in (44 N/cm) MARV
GCL Peel Strength[3]	ASTM D 6496	40,000 ft^2 (4,000 m^2)	3.0 lbs/in (5.2 N/cm) min
GCL Index Flux[4]	ASTM D 5887	Weekly	1×10^{-8} m^3/m^2/sec max
GCL Hydraulic Conductivity[4]	ASTM D 5887	Weekly	5×10^{-9} cm/sec max
GCL Hydrated Internal Shear Strength[5]	ASTM D 5321 ASTM D 6243	Periodic	500 psf (24 kPa) typ @ 200 psf

Bentomat SDN is a reinforced GCL consisting of a layer of sodium bentonite between two nonwoven geotextiles, which are needlepunched together.

Notes

[1] Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.
[2] Bentonite mass/area reported at 0 percent moisture content.
[3] All tensile strength testing is performed in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496. Upon request, tensile and peel results can be reported per modified ASTM D 4632 using 4 inch grips.
[4] Index flux and permeability testing with deaired distilled/deionized water at 80 psi (551kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 925 gal/acre/day. This flux value is equivalent to a permeability of 5×10^{-9} cm/sec for typical GCL thickness. Actual flux values vary with field condition pressures. The last 20 weekly values prior the end of the production date of the supplied GCL may be provided.
[5] Peak values measured at 200 psf (10 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

CETCO has developed an edge enhancement system that eliminates the need to use additional granular sodium bentonite within the overlap area of the seams. We call this edge enhancement, SuperGroove™, and it comes standard on both longitudinal edges of Bentomat® SDN. It should be noted that SuperGroove™ does not appear on the end-of-roll overlaps and recommend the continued use of supplemental bentonite for all end-of-roll seams.

800.527.9948 Fax 847.851.1899

SUBMITTAL CONTROL FORM

DATE: JULY 7, 2010

JOB NO: 103008

SUBMITTAL NO: 2

PROJECT: SOUTH LOS ANGELES WETLANDS PARK

TO:	**Ford E.C., Inc.**	FROM:	**EC Applications, Inc. (ECA)**
ATTN:	**Sam Daghighian**		**Chris Fore**
	10850 Wilshire Blvd. # 380		**415 W. Taft Ave, Suite H**
	Los Angeles, Ca 90024		**Orange, CA 92865**
PHONE:	**310-264-2147**	PHONE:	**(714) 921-9848 x 104**
FAX:	**310-264-2146**		
EMAIL:	**sam@fordecinc.com**		**cfore@ecapplications.com**

WE ARE SUBMITTING THE ENCLOSED:

☐ SHOP DRAWINGS ☐ CERTIFICATES OF COMPLIANCE ☐ SAMPLES

☒ MATERIAL DATA ☐ QC INFORMATION ☐ OTHER

THESE ARE TRANSMITTED FOR:

☒ APPROVAL ☐ INFORMATION ☐ RESUBMIT

☐ AS REQUESTED ☐ FOR REVIEW PREV SUB NO:

ITEM NO.	DESCRIPTION OF ITEM	NO. OF COPIES	CONTRACT REFERENCE/SPEC SECTION OR DRAWING SHEET NO.
1	*Manufacturer's quality control program including shipping, handling, storage and Installation*	*1*	*Geosynthetic Clay Liner*

NOTE:

THE ABOVE SUBMITTED ITEMS HAVE BEEN REVIEWED IN DETAIL AND ARE CORRECT AND IN GENERAL CONFORMANCE WITH THE CONTRACT DRAWINGS AND SPECIFICATIONS EXCEPT AS OTHERWISE STATED.

Christopher Fore

EC Applications, Inc.. AUTHORIZED SIGNATURE

IF THE ABOVE VARIANCES ARE ACCEPTABLE, PLEASE CONFIRM IN WRITING WITHIN TEN (10) DAYS, OTHERWISE WE WILL PROCEED PER THE PROPOSED VARIANCES

INSTALLATION QUALITY CONTROL PROGRAM
Geosynthetic Clay Liner

Prepared for: South Los Angeles Wetlands Park

www.ECApplications.com

TABLE OF CONTENTS

SECTION 1

ON-SITE HANDLING

This section describes the procedures and equipment to be used in handling the GCL when it arrives at the job site. Proper execution of these procedures will ensure that the GCL is not damaged prior to installation. It should be noted that ASTM D 5888 also provides guidelines for GCL handling. The recommendations included herein are consistent with all ASTM guidelines. CETCO's GCLs are produced in slightly different sizes depending upon the product selected. Weights and dimensions of these products and their corresponding core pipe sizes required for safe handling are provided in Table 1 below.

Product	Panel Size (m)	Roll Diam. (mm)	Typ. Roll Weight (kg)	Core Diam. (mm)	Core Pipe Diameter (mm)	Core Pipe Length (m)	Minimum Core Pipe Strength
Bentomat	4.57 x 45.7	610	1,200	100	89	6.1	XXH
Claymax	4.57 x 45.7	510	1,250	100	89	6.1	XXH

Table 1. GCL panel sizes and corresponding core pipe requirements.

It should be recognized that the weight of the GCL rolls will dictate what type of core pipe will be sufficiently strong for unloading and handling activities. Experience has shown that the type of steel from which the pipe was produced will influence its ability to sustain the weight of the roll. The strongest steel available should be used to prevent pipe bending. A core pipe that deflects more than 75 mm as measured from end to midpoint when the roll is lifted can cause damage to the GCL and is *not acceptable.* The pipes used to unload or deploy the GCL *must not bend* at any time.

1.1 Unloading Procedures

The GCL may be delivered to the job site in one of two ways: by flatbed truck or by closed trailer/container. Regardless of the delivery method, all unloading activities should take place away from main roadways and high-traffic areas at the site. The designated unloading area should be flat, dry, and stable, and should provide adequate peripheral access for the unloading equipment. Different techniques for unloading the GCL are used accordingly. Using the procedures and equipment described below will minimize unloading time.

1.1.1 Flatbed Truck Delivery

A front-end loader or forklift is typically used to remove the rolls from the flatbed truck. Starting from the top rolls on the truck, the core pipe is inserted through the roll core. The core has an inside diameter of 100 mm but may be slightly bowed upon arrival to the job site. In this case, it may be necessary to assist the core pipe insertion process by using the back of the loader bucket to carefully push the pipe through the core.

After the core pipe has been inserted, straps or chains are looped around each end of the pipe protruding from the roll. The other ends of the chains should be connected to a spreader bar (typically an I-beam) of equal length to the core pipe. The spreader bar itself is suspended from the loader bucket. The purpose of the spreader bar is to prevent the chains from chafing the ends of the roll as it is lifted. It is recommended that the chains or straps be secured by the placing a pin through each end of the pipe. The GCL roll should then be lifted and slowly carried from the flatbed to the temporary storage area. GCL rolls can also be provided with a pair of slings to facilitate lifting and handling.

1.1.2 Trailer or Container Delivery

The GCL may also be delivered in closed trailers or shipping containers. In these cases, different unloading equipment and techniques must be employed. Because of limited access to the GCL rolls, it is usually necessary to utilize an extendable-boom forklift with a "stinger" attachment. ECA can provide details on selecting the proper stinger for the type of forklift used at the job site.
The rolls are placed inside the trailer or container in the same way that they are positioned on a flatbed truck. The rolls are removed by inserting the stinger through the roll cores and lifting/pulling the rolls from the trailer/container.

1.2 Materials Handling

The equipment used to unload the GCL from the delivery vehicle may also be used to handle the material on site and to convey it to work areas. All unloading and handling activities must be undertaken with great care to avoid damage to the GCL. The GCL should never be handled in ways that could affect its performance. Some activities to avoid:

- Dropping the rolls from the edge of the delivery truck or container.
- Pushing or pulling the rolls on the ground surface.
- Lifting the roll without a core pipe.
- Bending the rolls by using a core pipe that cannot bear the weight of the roll.
- Forcing a bent core pipe through the core.

• Carrying the GCL over excessively rutted, bumpy terrain, causing the roll to bend and bounce in transit. Adherence to these common-sense precautions will prevent handling-related damage to the Bentomat.

The CQA engineer or designee should supervise the unloading and storage operations. It is the duty of the CQA engineer to maintain records of the shipments and to verify that the roll numbers on the labels match the roll numbers on the bills of lading. Any apparent discrepancies should be noted and reported to EC Applications, Inc.

At this time, all of the rolls should also be visually inspected for damage. Damaged rolls should be clearly marked and set aside where they will not be immediately used. Major damage suspected to have occurred during shipment should *immediately* be reported to the carrier and EC Applications

1.3 On-Site Storage

The GCL may be stored at a project site indefinitely, provided that proper storage procedures are followed. First, a dedicated storage area should be identified. This area should be level, dry, well drained, and located away from high-traffic areas of the job site. For reasons of safety and material integrity, GCL rolls must never be stored on end. Rolls should be stored horizontally, in small stacks not to exceed four rolls in height. It is preferred that the bottom rolls be placed on plywood, on an arrangement of pallets, or on some other man-made surface, to promote drainage and to prevent damage by contact with the ground surface. If the rolls are to be placed directly on the ground, the local ground surface should be carefully prepared and proof-rolled to minimize the potential for damage

The polyethylene sleeves of the GCL rolls should be examined for any obvious rips or tears. Sleeve damage should be repaired immediately with adhesive tape or additional plastic sheeting. At this time it is also recommended that the labels be examined and taped to the roll if they were displaced in transit.

SECTION 2

INSTALLATION

This section of the GCL CQA Manual covers the techniques and procedures to be used for ensuring the quality of a GCL installation. ASTM D 6102 also contains sound GCL installation guidelines.

2.1 Start-Up Assistance

ECA will work with the on-site engineer and CQA engineer in order to verify that the proper unloading, installation and conformance testing procedures are utilized. ECA's input is based on extensive experience with GCL installation and on intimate knowledge of the physical characteristics of GCLs.

2.2 Equipment

In many projects, the equipment used for unloading the GCL can also be used to install it. Most applications require a vehicle to lift and suspend the roll as it is deployed. Front-end loaders, bulldozers, boom cranes, forklifts, and tracked excavators all have been successfully used for this task. Other, more specialized equipment exists for these operations and may also be used. The equipment for unrolling the GCL should be able to lift the roll and suspend it *freely* such that it does not chafe against the vehicle or the ground. The vehicle must also have the ability to accommodate a spreader bar above the roll of GCL.

The spreader bar should be sufficiently strong to bear the full weight of the GCL roll without bending. Readily available I-beams or T-beams made of structural steel are typically used for this purpose, although steel pipes have also been successfully used. The chains or straps should be checked for their strength before the installation begins and should continually be inspected for wear as the installation continues.

The core pipe should be of the dimensions and strength indicated in Table 1. The type of steel from which the pipe is made, the presence of a longitudinal weld, and the overall length of the pipe all have an influence on its ability to sustain the weight of the GCL. It is essential that the core pipe *does not bend* when the full roll of GCL is suspended from it. Lastly, it is recommended that the core pipe have a means to prevent the chains or straps from slipping off the ends of the pipe. This can be accomplished by using pins or clamps.

It will often be necessary to cut the GCL before the end of the roll or to cut it to fit in certain confined areas. Cutting the GCL requires a *sharp* utility knife. It is very important to maintain the sharpness of the knife blades used for cutting the GCL, in order to prevent tearing its geosynthetic

components and damaging the GCL where the cut is made. Frequent blade changes for the utility knives are strongly recommended.

For construction of the bentonite enhanced overlapped seams of the Bentomat products, an acceptable fillet of bentonite can be poured directly from the bags of granular bentonite supplied with each roll of Bentomat.

2.3 Field Conditions

At the beginning of each working day, the CQA engineer should confirm that there are no ambient site conditions which could affect the quality of the installation. Specifically, the presence at the job site of excessively high winds, rain, standing water, or snow may be construed as unsuitable weather for GCL installation. There are no temperature restrictions for installing the GCL, however.

Bentomat is not as susceptible as Claymax to damage due to "premature hydration" (i.e., hydration before a confining stress is applied). Although Bentomat will not delaminate when wetted, CETCO nevertheless recommends that it be installed in dry weather as with Claymax. This lessens the potential for damage to the material and ensures that its integrity is not compromised by the swelling of the bentonite.

2.4 Site Inspection

Prior to each day's installation activities, the site engineer and/or CQA engineer should inspect the work area to ensure that it has been prepared in accordance with the specification and design drawings. Specifically, the design grades should be verified, the slope length and steepness should be checked, the anchor trench dimensions should be measured, and the subgrade should be inspected and approved. Any deviations from the specifications or design drawings should be noted and rectified before the GCL is installed. The anchor trench is especially important in applications where slopes are present. The anchor trench must meet or exceed the design dimensions but must also be free of any sharp corners or protrusions which could put excessive stress on the GCL. The CQA engineer must ensure that the anchor trench is as carefully prepared as the rest of the subgrade.

2.5 Panel Placement

The unrolling and placement of the GCL should be performed in such a way that the GCL is not damaged or unduly stretched, folded, or creased. The GCL rolls are typically suspended from the front of the vehicle while it travels backwards along the intended path of placement. During this activity, the roll should be able to rotate freely around the core pipe. Excessive friction due to a bent or large-diameter core pipe, or due to contact between the roll and the deployment equipment, may cause undesirable levels of tension to develop. It is necessary that the GCL be deployed in a fully relaxed (but not wrinkled) state.

A common deployment technique when the GCL is placed on slopes is to suspend the roll at the top of the slope while several laborers unroll it as they walk downslope. This is an acceptable technique, but the CQA engineer should verify that excessive tension does not develop on the material and that the underside of the panel is not damaged by friction with the subgrade. Flat-bladed vise grips are very useful for handling and moving unrolled panels.

It is important to ensure that, at the top of a slope, the GCL is properly placed in the anchor trench. After confirming that the trench has been constructed according to the specifications, the GCL should be placed in the trench such that it extends across the trench floor but not up the rear wall of the trench. Excess material if any, should be cut off, *not* folded over on top of the existing material. Proper anchorage will be achieved if and only if the GCL is placed within the trench in this manner.

The orientation of the GCL panels is important. When working in sloping areas, the panels should be positioned such that their long dimension is parallel to the direction of the slope. 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 3 m).

2.6 Seaming

Proper field seaming is vital for the liner to function to its maximum abilities. There are three elements of CQA for this important task:

• Verification of the minimum acceptable overlap.
• Verification of the continuity of the accessory bentonite (Bentomat only).
• Verification that there is no dirt in the overlap zone or on the bottom geotextile of the overlying GCL panel.

These elements for field seam CQA are straightforward and require only visual inspection by the CQA engineer. The upper surface of the GCL has two heavy dashed lines on both sides of the panel. The lap lines are 150 mm from the edges of the panel, and the match lines are 250 mm from the edges of the panel. The minimum acceptable overlap is 150 mm. Thus, the installer's objective is to place the overlying panel *between* the two lines of the underlying panel. The CQA engineer needs only to visually verify that the 150-mm lap line of the underlying panel is not visible. A properly executed seam, therefore, is verified when three dashed lines (not four) are visible at the overlap, as shown in Figure 1.

The hydraulic performance of Bentomat is maximized when the accessory bentonite is placed *continuously* within the overlap zone. Continuity is best achieved when a watering can or other similar device is used, by pouring the bentonite directly from the bag is also effective in this regard. Verification of continuity should be performed visually by the CQA engineer. The CQA engineer should observe the accessory bentonite as it is being placed within the overlap zone and should give verbal approval of the seam before the overlap is flipped back into place.

Bentomat ST, DN, and SDN with Supergroove® have self-seaming capabilities in their longitudinal overlaps (Figure 2) and do not require supplemental bentonite. For these Bentomat products, supplemental bentonite is required for the end-of-panel overlapped seams.

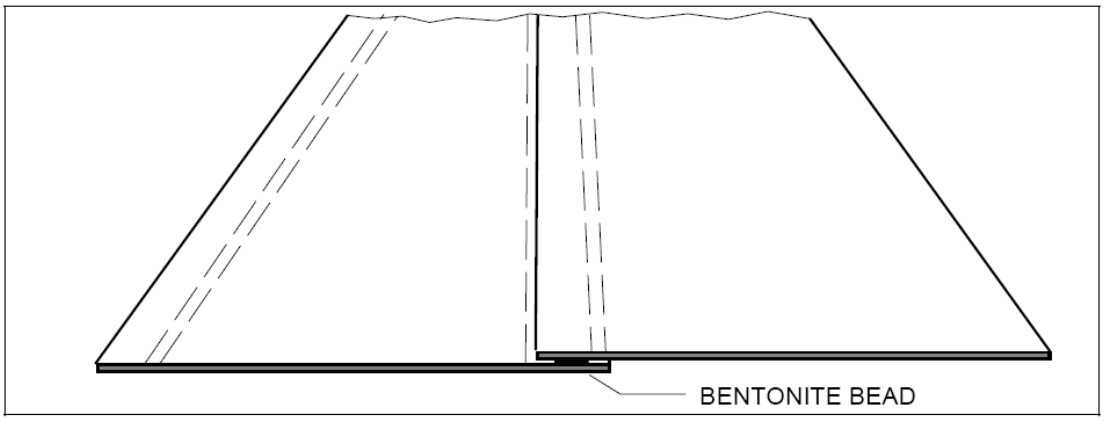


Figure 1. Schematic representation of a properly executed Bentomat field seam.

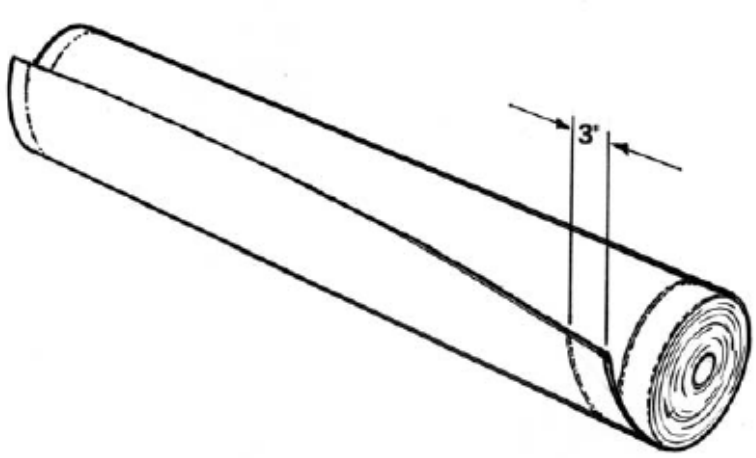


Figure 2. Supergroove Bentomat field seam.

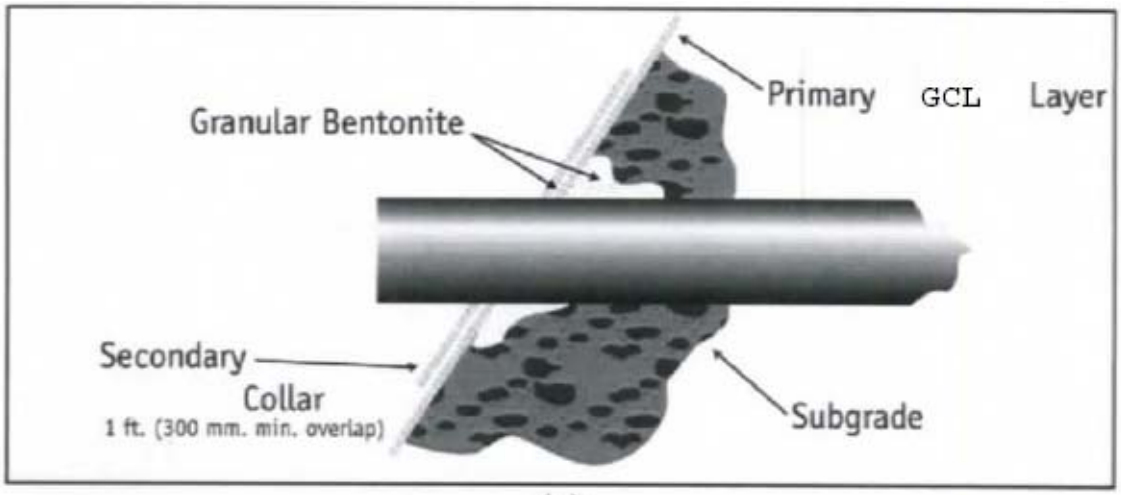
Verification of the cleanliness of the overlap is also required, because dirt can enter the overlap and create a conduit for excessive lateral leakage. Exposing the overlap in this manner forces extra attention on the seam and reveals the presence of loose dirt that may have inadvertently entered the overlap zone or may have become adhered to the bottom geotextile of the overlying panel. The CQA engineer should either verify that no dirt is present or ensure that the dirt is swept out of the overlap.

Verification of the *amount* of bentonite placed at the seam may be achieved by ensuring that one full 22.5 kg bag of granular bentonite is used for the lateral and longitudinal seaming of each roll of GCL. CETCO recommends that a minimum of 375 grams of granular bentonite be applied per lineal meter of seam. If the installer places bentonite at the rate of one bag per roll, this target application rate will be achieved.

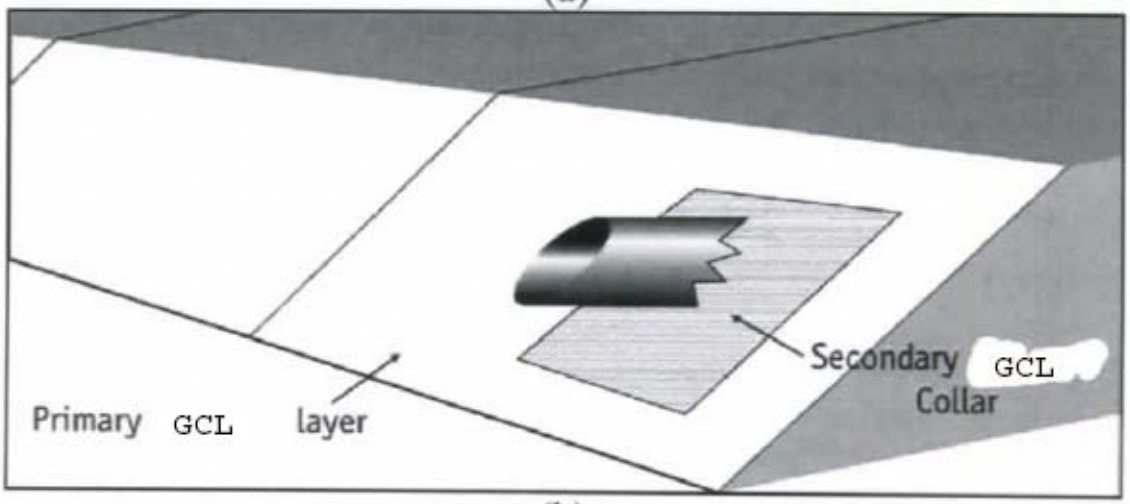
The longitudinal overlap for the GCL should be at least 150 mm (Bentomat) and 300 mm (Claymax). Overlaps at the *ends* of the rolls, however, ("transverse" overlaps) should be at least 300 mm (Bentomat) and 600 mm (Claymax) to account for any incidental loss of bentonite that could occur due to excessive handling of this portion of the roll or to stress relaxation after placement. Overlap distances can be increased if unusual site conditions (such as a soft subgrade, or GCL covered only with geomembrane) exist.

2.7 Sealing around Penetrations and Structures

The liner should be sealed around penetrations and structures embedded in the subgrade in accordance with Figures 11 and 12. Granular bentonite shall be used liberally (approx. 2 lb/lin ft or 3 kg/m) to seal the liner to these structures. Granular Bentonite



(a)



(b)

Horizontal pipe penetrations are potential leakage zones and must be detailed properly. These diagrams show the proper installation procedures.

When the liner is placed over a horizontal pipe penetration, a notch should be excavated into the subgrade around the penetration (Figure a). The notch should then be backfilled with granular bentonite. A secondary liner collar should be placed around the penetration as shown in Figure b.

2.8 Detail Work

The term "detail work" refers to the placement of GCL around structures such as vertical walls, gas vents, drainage basins, and pipe penetrations. In all of these cases, it is necessary to utilize granular bentonite or a bentonite mastic to create a seal between the GCL and the structure. CQA of these areas involves a visual inspection of the methods used to make the seal. Specific items requiring inspection include:

• Dimensions of the "notch" excavated around the structure.

• Amount of bentonite applied to the detail

• Condition of the GCL at its cut edge (the cut should be clean, not frayed, with little or no bentonite edge loss from the GCL)

• Integrity of the detail as cover material is placed over and around it.
When cutting the GCL, it is important to ensure that the cut is made where the GCL hangs from the roll or where it rests on the subgrade . The GCL cut should *never* be made on the roll itself or when it rests on any other liner system component.

2.9 Damage and Damage Repair

Even when all reasonable protective measures are taken, the GCL may still become damaged during shipping and handling or during installation. This section provides instructions on assessing and managing the damaged materials.

2.9.1 Damage From Shipping and Handling

Occasionally, a GCL roll will arrive at a job site with its protective plastic sleeve torn due to movement during transit. This roll should be inspected for damage in the area where the sleeve was torn. If the geotextile under the torn sleeve is also torn, The outermost wrap of GCL on the roll should be unwound and discarded when the roll is installed. It is not necessary to consider the entire roll unusable. It is important, however, to mark the roll in order to alert the installer that the initial wrap should be cut away and discarded, because the damaged geotextile may be hidden from view when the GCL is unrolled. It is remotely possible that further layers of GCL on the roll could be similarly damaged. If this happens, additional wraps may be unrolled and discarded prior to placement.

Damage due to poor handling may occur as a result of accidentally dropping a suspended roll onto the ground or using weak core pipes that bend when the GCL is lifted. These activities can cause damage not just to the outer wrap of GCL but to the entire roll. If such damage occurs, the rolls should be clearly marked and moved away from the storage area. The CQA engineer should ensure that procedures are immediately implemented in order to prevent the recurrence of this problem.

2.9.2 Damage From Installation Activities

The more commonly observed incidents of damage occur during installation, as a result of inadvertent contact by heavy equipment. Because this type of damage will potentially have the largest overall effect on the integrity of the liner system, ECA strongly recommends that equipment operating on or near the GCL *be monitored continuously.*

Equipment operators should be made fully aware of the importance of their actions and should be encouraged to notify the CQA engineer directly if they suspect at any time that the liner may have become damaged by their equipment. Close communication among everyone involved in the installation will help to ensure that this type of damage is reported and repaired.

Repeated passes by loaded dump trucks over GCL, which has minimal cover, can cause damage. It is therefore preferred to prevent potential for such damage by placing the GCL over these high-traffic areas *after* cover material delivery is largely completed. If this is not possible, then extra cover should be placed over high-traffic areas. At least 600-900 mm of screened, cohesive soil is recommended. Should damage occur to the already-installed GCL, the following procedures should be followed:

1. Remove equipment from the damaged area and notify the CQA engineer.
2. *Manually* clean away all cover material within a 600-mm radius of the damaged area. Use a broom to sweep away the remaining dirt in order to make the area as clean as possible.
3. If necessary, repair the subgrade to its original conditions. Replace the torn/damaged GCL as closely as possible to its original position.
4. Place a bead of granular bentonite or bentonite paste at the minimum rate of 500 g per lineal meter around the damaged area.
5. Cut a patch of new GCL to fit over the damaged area and extending 600 mm beyond it.
6. Place the patch over the damaged area and carefully backfill over the patch.

Note that it is necessary only to repair the damaged portion of the GCL. It is usually not necessary to remove and replace the entire panel, unless the damage has occurred on a slope. In this case, slope stability may be compromised and the site engineer should be contacted to help determine whether a repair is acceptable.

SECTION 3

PLACEMENT OF COVER MATERIALS

As mentioned previously, the proper placement of cover on the GCL is crucial to the overall success of the installation. This section of the Bentomat CQA manual includes recommended materials and procedures, which will help to ensure that the integrity of the GCL is not compromised when it is covered.
Regardless of the nature of the cover material used, it should be placed as soon as possible after the GCL has been deployed. The efforts of placing the GCL and placing the final cover should be coordinated to the extent that only as much GCL as can be covered should be deployed in one working day. This will prevent premature hydration and will greatly reduce the chances for incidental damage to the GCL during other activities.

3.1 Soil Cover

When a GCL is the sole liner system component, soil cover *must* be placed over it to provide protection from physical damage, erosional forces, and degradation by UV light. The presence of cover also provides a confining stress, which allows the overlapped seam to perform properly and enhances the long-term physical integrity of the material. Lastly, the cover may provide a base for vehicular traffic. Because it serves so many functions, proper placement and CQA of the soil cover is essential.
Frequently used cover materials include clay, sand, gravel, crushed stone, and common earth fill.

Regardless of the type of material selected for the cover, it should be free of large stones (greater than 50 mm in diameter), sticks, and any other materials, which could cause puncture or tearing. The source of all cover material should be identified in order to ascertain its suitability well in advance of the installation.

In addition to particle size, the *angularity* of a crushed stone or gravel will impact the construction survivability of the GCL. It is preferred that relatively rounded materials be utilized. If these materials are not available, then extra caution must be taken during cover placement. Dumping the cover from a loader bucket positioned high above the GCL is unacceptable. The cover should be gently placed from as low a height as possible. Vehicular traffic should also be restricted if particularly angular or abrasive material is used. If there is some doubt as to the suitability of a potential cover material, a representative sample should be submitted to CETCO for analysis.
With respect to the equipment used to place the protective cover, it is strongly recommended that no heavy equipment come in direct contact with the GCL. Obviously, tracked equipment will damage the liner. In some cases, however it is necessary to drive equipment directly on the GCL. This can be accomplished with low-pressure, *rubber-tired* equipment. Permission to do so will be granted by ECA through the CQA engineer on a case-by-case basis *only* and will include restrictions on the equipment itself and on the type of movements the vehicle may make on the GCL.

The chemical nature of the cover soil must also be considered. The use of fine-grained, calcareous soil or stone is strongly discouraged due to the potential for an adverse reaction with the sodium bentonite contained in the GCL.

The cover material placed as backfill in the anchor trench should be of the same quality as the rest of the backfill. It is especially important that the anchor trench backfill be compacted either by hand tamping or by the use of a small walk-behind compactor. Compaction should be performed over each 150-mm lift of backfill placed in the anchor trench.

SUBMITTAL CONTROL FORM

DATE: JULY 7, 2010

JOB NO: 103008

SUBMITTAL NO: 3

PROJECT: SOUTH LOS ANGELES WETLANDS PARK

TO:	**Ford E.C., Inc.**	FROM:	**EC Applications, Inc. (ECA)**
ATTN:	**Sam Daghighian**		**Chris Fore**
	10850 Wilshire Blvd. # 380		**415 W. Taft Ave, Suite H**
	Los Angeles, Ca 90024		**Orange, CA 92865**
PHONE:	**310-264-2147**	PHONE:	**(714) 921-9848 x 104**
FAX:	**310-264-2146**		
EMAIL:	**sam@fordecinc.com**		**cfore@ecapplications.com**

WE ARE SUBMITTING THE ENCLOSED:

☐ SHOP DRAWINGS ☐ CERTIFICATES OF COMPLIANCE ☐ SAMPLES

☒ MATERIAL DATA ☐ QC INFORMATION ☐ OTHER

THESE ARE TRANSMITTED FOR:

☒ APPROVAL ☐ INFORMATION ☐ RESUBMIT

☐ AS REQUESTED ☐ FOR REVIEW PREV SUB NO:

ITEM NO.	DESCRIPTION OF ITEM	NO. OF COPIES	CONTRACT REFERENCE/SPEC SECTION OR DRAWING SHEET NO.
1	*Installation drawings (Proposed Panel Layout)*	*1*	*Geosynthetic Clay Liner*

NOTE:

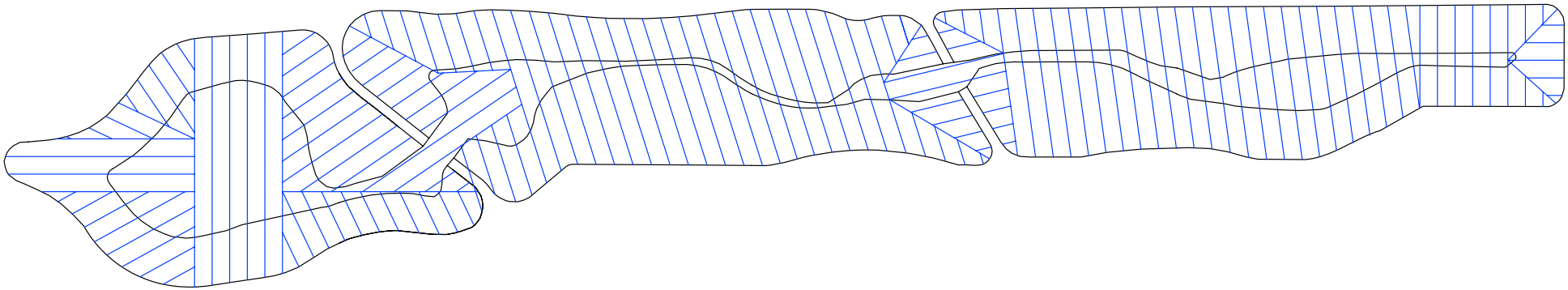
THE ABOVE SUBMITTED ITEMS HAVE BEEN REVIEWED IN DETAIL AND ARE CORRECT AND IN GENERAL CONFORMANCE WITH THE CONTRACT DRAWINGS AND SPECIFICATIONS EXCEPT AS OTHERWISE STATED.

Christopher Fore

EC Applications, Inc.. AUTHORIZED SIGNATURE

IF THE ABOVE VARIANCES ARE ACCEPTABLE, PLEASE CONFIRM IN WRITING WITHIN TEN (10) DAYS, OTHERWISE WE WILL PROCEED PER THE PROPOSED VARIANCES

NORTH



NOTES

Deployment orientation and final panel sequence will be determined based on field conditions.

REVISIONS/NOTES	South Los Angeles Wetlands Park Panel Placement Layout	South Los Angeles, CA	Geosynthetic Clay Liner

ECApplications INC
415 W. Taft Ave. Suite H
ORANGE, CA 92865
TELEPHONE: (714) 921-9848
FAX: (866) 475-1225
Email: www.ecapplications.com

DRAWN BY: RB	CHKD. BY: CF	DWG. NO: 1
DATE: 7-7-2010	APPRVD. BY: CF	
PLOT SCALE: 1" = NTS	Los Angeles Wetlands Park	
PROJECT NO.: 103008		

Specification Section 02615 – Dual-Sided Textured HDPE Liner

SECTION 02615
DUAL-SIDED TEXTURED HDPE LINER

PART 1 -- GENERAL

1.1 SUMMARY

A. Provide all labor, materials, equipment and services to complete the work generally described as: The South Los Angeles Wetland Park cells shall be drained and a secondary containment liner installed on top of the existing geosynthetic liner. The secondary liner will consist of a double-sided textured 40-mil HDPE liner, secured with an anchor trench, and installed up to the permanent pool volume (PPV) elevation of each cell. All liner penetrations for inlet storm drains, outlet drainage structure and bridge piles shall be properly sealed. Upon completion of the liner installation, testing and acceptance, the cells are to be filled up to the PPV elevations and monitoring of the water level shall begin. All disturbed wetlands planting shall be replaced. The liner installation work shall be performed in accordance with the plans, details, liner manufacturer's installation manual and these specifications.

B. Related Sections:

1. Documents affecting work of this Section includes, but are not necessarily limited to the GENERAL CONDITIONS, SUPPLEMENTARY CONDITIONS and Sections in DIVISION 1-GENERAL REQUIREMENTS of this Project Manual.

2. Section 02220 Earthwork.

3. Section 02900 Landscaping

4. Section 02950 Trees, Plants and Ground Cover

This specification covers the technical requirements for the Manufacturing and Installation of the geomembrane. All materials shall meet or exceed the requirements of this specification, and all work will be performed in accordance with the procedures provided in these project specifications

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. American Society for Testing and Materials (ASTM)
1. D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting
2. D 1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
3. D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
4. D 1603 Test Method for Carbon Black in Olefin Plastics
5. D 3895 Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
6. D 4218 Standard Test Method for Determination of Carbon Black in Polyethylene Compounds
7. D 4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
8. D 5199 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
9. D 5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
10. D 5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
11. D 5994 Standard Test Method for Measuring Core Thickness of Textured Geomembranes
12. D 6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
13. D 6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

14. D 7240 Standard Practice for Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark Test)

B. Geosynthetic Research Institute
   1. GRI GM 13 Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
   2. GRI GM 17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes

1.3 DEFINITIONS

A. Lot - A quantity of resin (usually the capacity of one rail car) used in the manufacture of geomembranes. Finished roll will be identified by a roll number traceable to the resin lot used.
B. Construction Quality Assurance Consultant (CONSULTANT) – Third party, independent from MANUFACTURER, INSTALLER, AND ENGINEER that is responsible for observing and documenting activities related to quality assurance during the lining system construction.
C. ENGINEER- The individual or firm responsible for the design and preparation of the project's Contract Drawings and Specifications.
D. Geomembrane Manufacturer (MANUFACTURER) - The party responsible for manufacturing the geomembrane rolls.
E. Geosynthetic Quality Assurance Laboratory (TESTING LABORATORY) - Party, independent from the CITY, MANUFACTURER and INSTALLER, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the CITY.
F. INSTALLER- Party responsible for field handling, transporting, storing, deploying, seaming and testing of the geomembrane seams.
G. Panel- Unit area of a geomembrane that will be seamed in the field that is larger than 100-sf.
H. Patch - Unit area of a geomembrane that will be seamed in the field that is less than 100-sf.
I. Subgrade Surface - Soil layer surface which immediately underlies the geosynthetic material(s).

1.4 SUBMITTALS

A. Furnish the following product data, in writing, to ENGINEER prior to installation of the geomembrane material:
   1. Resin Data shall include the following.
      a. Certification stating that the resin meets the specification requirements (see Table 2.1B).
   2. Geomembrane Roll
      a. Statement certifying no recycled polymer and no more than 10% rework of the same type of material is added to the resin (product run may be recycled).
B. The INSTALLER shall furnish the following information to the ENGINEER and CITY prior to installation:
   1. Installation layout drawings
      a. Must show proposed panel layout including field seams and details
      b. Must be approved prior to installing the geomembrane
   2. Approved drawings will be for concept only and actual panel placement will be determined by site conditions.
   3. Installer's Geosynthetic Field Installation Quality Assurance Plan
C. The INSTALLER will submit the following to the ENGINEER upon completion of installation:
   1. Certificate stating the geomembrane has been installed in accordance with the Contract Documents
   2. Material and installation warranties
   3. As-built drawings showing actual geomembrane placement and seams including typical anchor trench detail

1.5 QUALITY ASSURANCE

A. The CITY will engage and pay for the services of a Geosynthetic Quality Assurance Consultant and Laboratory to monitor geomembrane installation.

1.6 QUALIFICATIONS

A. MANUFACTURER
   1. Geomembrane shall be manufactured by the following:
      a. GSE Lining Technology, Inc.
      b. Agru America
      c. approved equal
   2. MANUFACTURER shall have manufactured a minimum of 10,000,000 square feet of polyethylene geomembrane during the last year.

B. INSTALLER
   1. Installation shall be performed by one of the following installation companies:
      a. GSE Lining Technology, Inc.
      b. GSE Approved Installers
      c. approved equal
   2. INSTALLER shall have installed a minimum of 2,000,000 square feet of HDPE geomembrane during the last 5 years.
   3. INSTALLER shall have worked in a similar capacity on at least 3 projects similar in complexity to the project described in the contract documents, and with at least 100,000 square feet of HDPE geomembrane installation on each project.
   4. The Installation Supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the Contract Documents.
   5. The INSTALLER shall provide a minimum of one Master Seamer for work on the project.
      a. Must have completed a minimum of 1,000,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for the use on this Project.

1.7 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

A. Labeling - Each roll of geomembrane delivered to the site shall be labeled by the MANUFACTURER. The label will identify:
   a. manufacturer's name
   b. product identification
   c. thickness
   d. length
   e. width
   f. roll number

B. Delivery- Rolls of liner will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

C. Storage- The on-site storage location for geomembrane material, provided by the CONTRACTOR to protect the geomembrane from punctures, abrasions and excessive dirt and moisture for should have the following characteristics:
   a. level (no wooden pallets)
   b. smooth
   c. dry
   d. protected from theft and vandalism
   e. adjacent to the area being lined

D. Handling- Materials are to be handled so as to prevent damage.

PART 2 -- PRODUCTS

2.1 GEOMEMBRANE PROPERTIES

A. Material shall be smooth/textured polyethylene geomembrane as shown on the drawings.

B. Resin
   1. Resin shall be new, first quality, compounded and manufactured specifically for producing geomembrane.
   2. Natural resin (without carbon black) shall meet the following requirements:

Table 2.1B: Raw Material Properties

Property	Test Method	HDPE	LLDPE

Density (g/cm3)	ASTM D 1505	≥0.932	≥0.915
Melt Flow Index (g/10 min)	ASTM D 1238 (190/2.16)	≤1.0	≤1.0
OIT (minutes)	ASTM D 3895 (1 atm/200^{0}C)	≥100	≥100

C. Geomembrane Rolls
1. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black.
2. Geomembrane shall be free of holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.
3. Geomembrane material is to be supplied in roll form. Each roll is to be identified with labels indicating roll number, thickness, length, width and MANUFACTURER.
4. All liner sheets produced at the factory shall be inspected prior to shipment for compliance with the physical property requirements listed in section 2.1D and be tested by an acceptable method of inspecting for pinholes. If pinholes are located, identified and indicated during manufacturing, these pinholes may be corrected during installation.

D. Textured surfaced geomembrane shall meet the requirements shown in the following data sheet below.
1. Table 1.8D for black coextruded textured HDPE

Table 2.1D: GSE HD Textured Geomembrane

TESTED PROPERTY VALUE	TEST METHOD	FREQUENCY	MINIMUM AVERAGE				
Thickness, (minimum average) mil (mm) Lowest individual	ASTM D 5994	every roll	30 (0.75)	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Density, g/cm^3	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction) Strength at Break, lb/in-width (N/mm) Strength at Yield, lb/in-width (N/mm) Elongation at Break, %	ASTM D 6693, Type IV Dumbell, 2 ipm G.L. 2.0 in (51 mm) G.L. 1.3 in (33 mm)	20,000 lb	66 (11) 68 (11) 100 12	75 (13) 90 (15) 100 12	115 (20) 132 (23) 100 12	155 (27) 177 (31) 100 12	230 (40) 225 (39) 100 12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	24 (106)	32 (142)	45 (200)	60 (266)	75 (333)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	65 (289)	95 (422)	130	160	190 (845)
Carbon Black Content, %	ASTM D 1 603*/421	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note(1)	Note(1)	Note(1)	Note(1)	Note(1)
Asperity Height, mil (mm)	ASTM D 7466	second roll	16 (0.40)	18 (0.45)	18 (0.45)	18 (0.45)	18 (0.45)
Notched Constant Tensile Load(2), hr	ASTM D 5397, Appendix	200,000 lb	1000	1000	1000	1000	1000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>140	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS							
Roll Length(3), ft (m)	Double-Sided Textured Single-		830 (253)	700 (213)	520 (158)	400 (122)	330 (101) 250 (76)
Roll Width(3), ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft^2 (m^2)	Double-Sided Textured		18,675 (1,735) 18,900 (1,755)	15,750 (1,463) 14,625 (1,359)	11,700 (1,087) 9,450 (878)	9,000 (836) 7,200 (669)	7,425 (690) 5,625 (523)

NOTES:

· [1]Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.

· [2]NCTL for GSE I-ID Textured is conducted on representative smooth membrane samples.

· [3]Roll lengths and widths have a tolerance of ± 1%.

• GSE I-ID Textured Double-Sided is available in rolls weighing approximately 4,000 lb (1,800 kg) and Single-Sided weighing approximately 3,000 lb (1,360 kg).

• All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.

• *Modified.

E. Extrudate Rod or Bead
   1. Extrudate material shall be made from same type resin as the geomembrane.
   2. Additives shall be thoroughly dispersed.
   3. Materials shall be free of contamination by moisture or foreign matter.

PART 3 -- EXECUTION

3.1 EQUIPMENT

A. Welding equipment and accessories shall meet the following requirements:
   1. Gauges showing temperatures in apparatus such as extrusion welder or fusion welder shall be present.
   2. An adequate number of welding apparati shall be available to avoid delaying work.
   3. Power source must be capable of providing constant voltage under combined line load.

3.2 DEPLOYMENT

A. Assign each panel a simple and logical identifying code. The coding system shall be subject to approval and shall be determined at the job site.
B. Visually inspect the geomembrane during deployment for imperfections and mark faulty or suspect areas.
C. Deployment of geomembrane panels shall be performed in a manner that will comply with the following guidelines:
   1. Geomembranes shall be installed according to the drawings and site-specific specifications.
   2. Unroll geomembrane using methods that will not damage geomembrane and will protect underlying surface from damage (spreader bar, protected equipment bucket).
   3. Place ballast (commonly sandbags) on geomembrane which will not damage geomembrane to prevent wind uplift.
   4. Personnel walking on geomembrane shall not engage in activities or wear shoes that could damage it. Smoking will not be permitted on the geomembrane.
   5. Do not allow heavy vehicular traffic directly on geomembrane. Rubber-tired ATV's and trucks are acceptable if wheel contact is less than 8 psi.
   6. Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.
D. Sufficient material (slack) shall be provided to allow for thermal expansion and contraction of the material.

3.3 FIELD SEAMING

A. Seams shall meet the following requirements:
   1. To the maximum extent possible, orient seams parallel to line of slope, i.e., down and not across slope.

2. Minimize number of field seams in corners, odd-shaped geometric locations and outside corners.
3. Slope seams (panels) shall extend a minimum of five-feet beyond the grade break into the flat area.
4. Use a sequential seam numbering system compatible with panel numbering system that is agreeable to the CONSULTANT and INSTALLER.
5. Align seam overlaps consistent with the requirements of the welding equipment being used. A 6-inch overlap is commonly suggested.

B. During Welding Operations
1. Provide at least one Master Seamer who shall provide direct supervision over other welders as necessary.

C. Extrusion Welding
1. Hot-air tack adjacent pieces together using procedures that do not damage the geomembrane.
2. Clean geomembrane surfaces by disc grinder or equivalent.
3. Purge welding apparatus of heat-degraded extrudate before welding.

D. Hot Wedge Welding
1. Welding apparatus shall be a self-propelled device equipped with an electronic controller which displays applicable temperatures.
2. Clean seam area of dust, mud, moisture and debris immediately ahead of hot wedge welder.
3. Protect against moisture build-up between sheets.

E. Trial Welds
1. Perform trial welds on geomembrane samples to verify welding equipment is operating properly.
2. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.
3. Minimum of two trial welds per day, per welding apparatus, one made prior to the start of work and one completed at mid shift.
4. Cut four, one-inch wide by six-inch long test strips from the trial weld.
5. Quantitatively test specimens for peel adhesion, and then for shear strength.
6. Trial weld specimens shall pass when the results shown in the following tables for HDPE are achieved in both peel and shear test.

Table 3.3E: Minimum Weld Values for HDPE Geomembranes

Property	Test Method	30 (0.75)	40 (1.0)	60 (1.5)	80 (2.0)	100 (2.5)	120 (3.0)
Peel Strength (fusion), ppi (kN/m) Peel Strength (extrusion), ppi (kN/m)	ASTM D 6392 ASTM D 6392	49 (8.6) 39 (6.8)	65 (11.4) 52 (9.1)	98 (17.2) 78 (13.7)	130 (22.8) 104 (18.2)	162 (28.4) 130 (22.8)	196 (34.3) 157 (27.5)
Shear Strength (fusion & ext.), ppi (kN/m)	ASTM D 6392	61 (10.7)	81 (14.2)	121 (21.2)	162 (28.4)	203 (35.5)	242 (42.4)

a. The break, when peel testing, occurs in the liner material itself, not through peel separation (FTB).
b. The break is ductile.

7. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.
8. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed trial weld.

F. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. INSTALLER shall demonstrate that acceptable seaming can be performed by completing acceptable trial welds.

G. Defects and Repairs
1. Examine all seams and non-seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.

2. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

3.4 FIELD QUALITY ASSURANCE

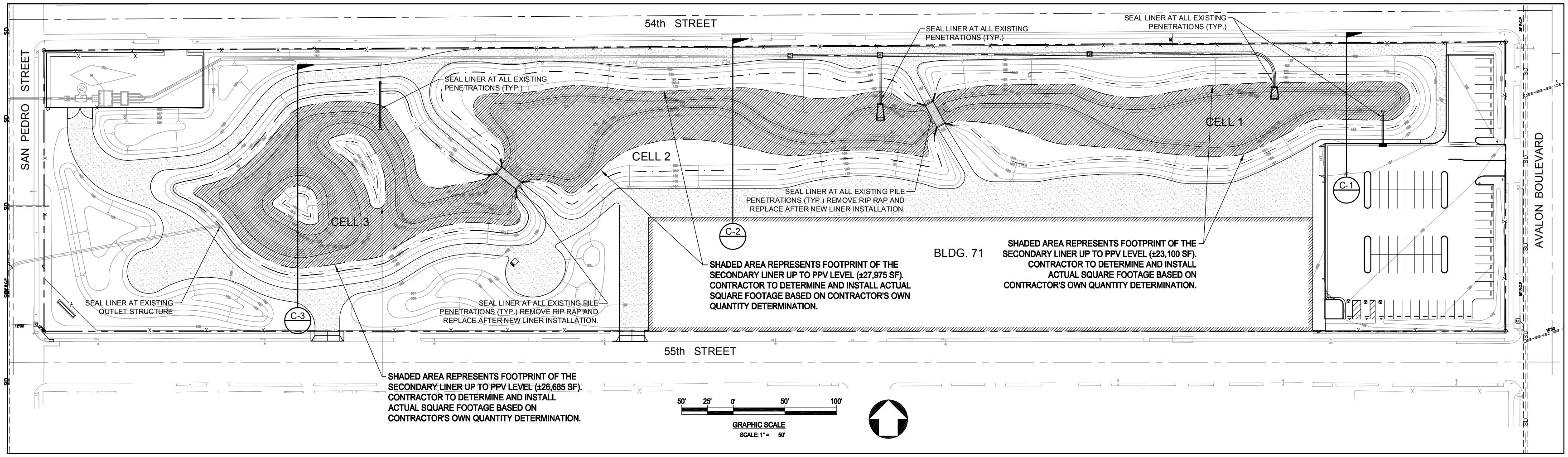
A. MANUFACTURER and INSTALLER shall participate in and conform to all terms and requirements of the Owner's quality assurance program. CONTRACTOR shall be responsible for assuring this participation.
B. Quality assurance requirements are as specified in this Section and in the Field Installation Quality Assurance Manual.
C. Field Testing
   1. Non-destructive testing may be carried out as the seaming progresses or at completion of all field seaming.
      a. Vacuum Testing
         1) Shall be performed in accordance with ASTM D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
      b. Air Pressure Testing
         1) Shall be performed in accordance with ASTM D 5820, Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.
      c. Other approved methods.
   2. Destructive Testing (performed by CONSULTANT with assistance from INSTALLER)
      a. Location and Frequency of Testing
         1) Collect destructive test samples at a frequency of one per every 500 lineal feet of seam length.
         2) Test locations will be determined after seaming.
         3) Exercise Method of Attributes as described by GRI GM-14 (Geosynthetic Research Institute, http://www.geosynthetic-institute.org) to minimize test samples taken.
      b. Sampling Procedures are performed as follows:
         1) INSTALLER shall cut samples at locations designated by the CONSULTANT as the seaming progresses in order to obtain field laboratory test results before the geomembrane is covered.
         2) CONSULTANT will number each sample, and the location will be noted on the installation as-built.
         3) Samples shall be twelve (12) inches wide by minimal length with the seam centered lengthwise.
         4) Cut a 2-inch wide strip from each end of the sample for field-testing.
         5) Cut the remaining sample into two parts for distribution as follows:
            a) One portion for INSTALLER, 12-inches by 12 inches
            b) One portion for the Third Party laboratory, 12-inches by 18-inches
            c) Additional samples may be archived if required.
         6) Destructive testing shall be performed in accordance with ASTM D 6392, Standard Test Method for Determing the Integrity of Non-Reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
         7) INSTALLER shall repair all holes in the geomembrane resulting from destructive sampling.
         8) Repair and test the continuity of the repair in accordance with these Specifications.
   3. Failed Seam Procedures
      a) If the seam fails, INSTALLER shall follow one of two options:
         1) Reconstruct the seam between any two passed test locations.
         2) Trace the weld to intermediate location at least 10 feet minimum or where the seam ends in both directions from the location of the failed test.
      b) The next seam welded using the same welding device is required to obtain an additional sample, i.e., if one side of the seam is less than 10 feet long.
      c) If sample passes, then the seam shall be reconstructed or capped between the test sample locations.
      d) If any sample fails, the process shall be repeated to establish the zone in which the seam shall be reconstructed.

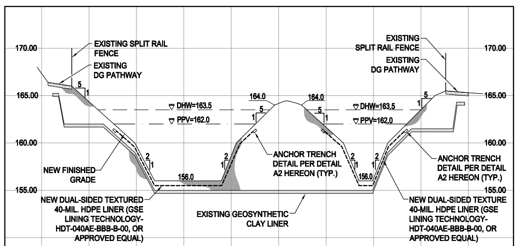
3.5 REPAIR PROCEDURES

A. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.
B. Repair any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test.
C. INSTALLER shall be responsible for repair of defective areas.
D. Agreement upon the appropriate repair method shall be decided between CONSULTANT and INSTALLER by using one of the following repair methods:
   1. Patching- Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter.
   2. Abrading and Re-welding- Used to repair short section of a seam.
   3. Spot Welding- Used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced.
   4. Capping- Used to repair long lengths of failed seams.
   5. Flap Welding- Used to extrusion weld the flap (excess outer portion) of a fusion weld in lieu of a full cap.
   6. Remove the unacceptable seam and replace with new material.
E. The following procedures shall be observed when a repair method is used:
   1. All geomembrane surfaces shall be clean and dry at the time of repair.
   2. Surfaces of the polyethylene which are to be repaired by extrusion welds shall be lightly abraded to assure cleanliness.
   3. Extend patches or caps at least 6 inches for extrusion welds and 4 inches for wedge welds beyond the edge of the defect, and around all corners of patch material.
F. Repair Verification
   1. Number and log each patch repair (performed by CONSULTANT).
   2. Non-destructively test each repair using methods specified in this Specification.

(END OF SECTION)

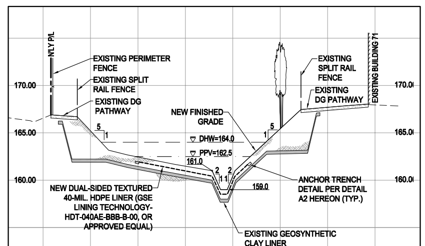
Construction drawing for a secondary impermeable liner


54th STREET
SAN PEDRO STREET
55th STREET
AVALON BOULEVARD
CELL 1
CELL 2
CELL 3
BLDG. 71
SEAL LINER AT ALL EXISTING PENETRATIONS (TYP.)
SEAL LINER AT EXISTING OUTLET STRUCTURE
SEAL LINER AT ALL EXISTING PILE PENETRATIONS (TYP.) REMOVE RIP RAP AND REPLACE AFTER NEW LINER INSTALLATION.
SHADED AREA REPRESENTS FOOTPRINT OF THE SECONDARY LINER UP TO PPV LEVEL (±26,685 SF). CONTRACTOR TO DETERMINE AND INSTALL ACTUAL SQUARE FOOTAGE BASED ON CONTRACTOR'S OWN QUANTITY DETERMINATION.
SHADED AREA REPRESENTS FOOTPRINT OF THE SECONDARY LINER UP TO PPV LEVEL (±27,975 SF). CONTRACTOR TO DETERMINE AND INSTALL ACTUAL SQUARE FOOTAGE BASED ON CONTRACTOR'S OWN QUANTITY DETERMINATION.
SHADED AREA REPRESENTS FOOTPRINT OF THE SECONDARY LINER UP TO PPV LEVEL (±23,100 SF). CONTRACTOR TO DETERMINE AND INSTALL ACTUAL SQUARE FOOTAGE BASED ON CONTRACTOR'S OWN QUANTITY DETERMINATION.
C-1
C-2
C-3
GRAPHIC SCALE
SCALE: 1" = 50'


EXISTING SPLIT RAIL FENCE
EXISTING DG PATHWAY
DHW=163.5
PPV=162.0
164.0
156.0
NEW FINISHED GRADE
NEW DUAL-SIDED TEXTURED 40-MIL. HDPE LINER (GSE LINING TECHNOLOGY-HDT-040AE-BBB-B-00, OR APPROVED EQUAL)
EXISTING GEOSYNTHETIC CLAY LINER
ANCHOR TRENCH DETAIL PER DETAIL A2 HEREON (TYP.)
170.00
165.00
160.00
155.00

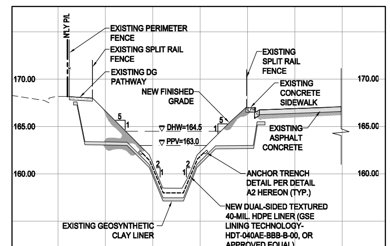
C-3 CELL 3 SECTION

SCALE: N.T.S.


N'LY P/L
EXISTING PERIMETER FENCE
EXISTING SPLIT RAIL FENCE
EXISTING DG PATHWAY
EXISTING BUILDING 71
NEW FINISHED GRADE
DHW=164.0
PPV=162.5
161.0
159.0
NEW DUAL-SIDED TEXTURED 40-MIL. HDPE LINER (GSE LINING TECHNOLOGY-HDT-040AE-BBB-B-00, OR APPROVED EQUAL)
ANCHOR TRENCH DETAIL PER DETAIL A2 HEREON (TYP.)
EXISTING GEOSYNTHETIC CLAY LINER
170.00
165.00
160.00

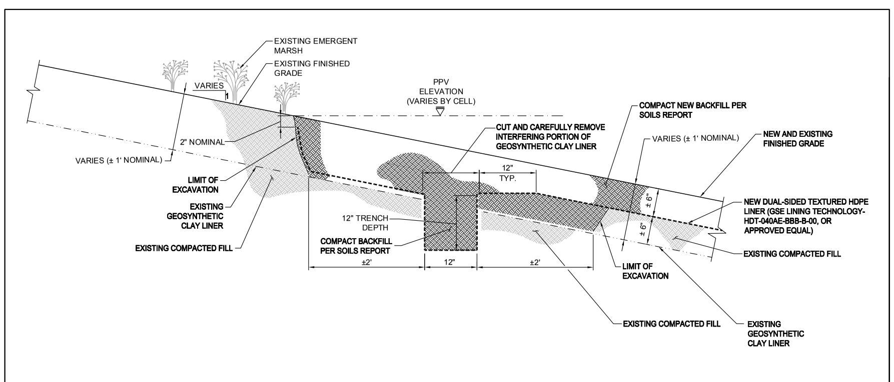
C-2 CELL 2 SECTION

SCALE: N.T.S.


N'LY P/L
EXISTING PERIMETER FENCE
EXISTING SPLIT RAIL FENCE
EXISTING DG PATHWAY
NEW FINISHED GRADE
EXISTING CONCRETE SIDEWALK
EXISTING ASPHALT CONCRETE
DHW=164.5
PPV=163.0
ANCHOR TRENCH DETAIL PER DETAIL A2 HEREON (TYP.)
NEW DUAL-SIDED TEXTURED 40-MIL. HDPE LINER (GSE LINING TECHNOLOGY-HDT-040AE-BBB-B-00, OR APPROVED EQUAL)
EXISTING GEOSYNTHETIC CLAY LINER
170.00
165.00
160.00

C-1 CELL 1 SECTION

SCALE: N.T.S.


EXISTING EMERGENT MARSH
EXISTING FINISHED GRADE
VARIES
2" NOMINAL
VARIES (± 1' NOMINAL)
LIMIT OF EXCAVATION
EXISTING GEOSYNTHETIC CLAY LINER
EXISTING COMPACTED FILL
PPV ELEVATION (VARIES BY CELL)
CUT AND CAREFULLY REMOVE INTERFERING PORTION OF GEOSYNTHETIC CLAY LINER
12" TYP.
12" TRENCH DEPTH
COMPACT BACKFILL PER SOILS REPORT
±2'
12"
COMPACT NEW BACKFILL PER SOILS REPORT
VARIES (± 1' NOMINAL)
NEW AND EXISTING FINISHED GRADE
NEW DUAL-SIDED TEXTURED HDPE LINER (GSE LINING TECHNOLOGY-HDT-040AE-BBB-B-00, OR APPROVED EQUAL)
± 6"
EXISTING COMPACTED FILL
LIMIT OF EXCAVATION
EXISTING GEOSYNTHETIC CLAY LINER

A2 HDPE LINER ANCHOR TRENCH DETAIL

SCALE: N.T.S. REF

PROCEDURE OVERVIEW:

1. CONTRACTOR SHALL COMPLETELY DEWATER CELLS 1,2 AND 3 AND ALLOW SUFFICIENT TIME FOR SOIL ON TOP OF THE EXISTING GEOSYNTHETIC LINER TO DRY, PRIOR TO EXCAVATING FOR NEW SECONDARY LINER INSTALLATION.
2. CONTRACTOR SHALL FIELD SURVEY, USING EXISTING CONTROL, THE ORIFICE INVERT ELEVATIONS FOR EACH CELL TO DETERMINE THE "AS-BUILT" PPV ELEVATIONS. CONTRACTOR SHALL PAINT MARK THE PLAN LIMIT OF THE DESIGN PERMANENT POOL, AT THE PPV ELEVATION FOR EACH CELL. ENGINEER SHALL INSPECT AND APPROVE PLAN LIMIT PRIOR TO ANY EXCAVATION. CONTRACTOR SHALL EXCAVATE BY HAND ALONG THE PAINT MARKED PERIMETER TO EXPOSE THE GEOSYNTHETIC CLAY LINER AND VERIFY THE DEPTH OF SOIL COVER. THE ENGINEER SHALL OBSERVE THE EXPOSED LINER PRIOR TO INSTALLATION OF THE HDPE SECONDARY LINER. CONTRACTOR SHALL SUBMIT LINER SUBMITTAL TO ENGINEER FOR APPROVAL PRIOR TO ORDERING INSTALLATION.
3. CONTRACTOR SHALL INSTALL NEW HDPE SECONDARY LINER ACCORDING TO THE PLANS, SPECIFICATIONS, AND MANUFACTURER'S RECOMMENDATIONS, INCLUDING SEALING AROUND ALL LINER PENETRATIONS. EXCAVATION AND BACKFILL TO COMPLY WITH THE PROJECT SOILS REPORT. CONTRACTOR SHALL EXERCISE CAUTION AND PROTECT IN PLACE THE EXISTING GEOSYNTHETIC LINER. CONTRACTOR SHALL EXCAVATE BY HAND OR RUBBER WHEELED VEHICLES TO MINIMIZE DAMAGE TO EXISTING LINER. IN THE EVENT OF DAMAGE TO THE EXISTING LINER, DAMAGE SHALL BE REPAIRED AT CONTRACTOR'S COST.
4. UPON COMPLETION OF THE SECONDARY LINER INSTALLATION AND INSPECTION/TESTING, CONTRACTOR SHALL FILL CELLS 1,2 AND 3 WITH POTABLE WATER TO THE PPV ELEVATIONS.
5. CONTRACTOR SHALL MONITOR WATER SURFACE ELEVATION IN CELLS 1,2 AND 3 AFTER THE CELLS ARE FILLED TO THE PPV ELEVATION. NO ADDITIONAL WATER IS TO BE ADDED UNTIL MONITORING IS COMPLETED. THE WATER SURFACE ELEVATIONS ARE TO BE RECORDED DAILY, AND MEASURED AGAINST A PERMANENTLY INSTALLED REFERENCE POINT IN EACH CELL. THE ELEVATION OF THE FIXED REFERENCE POINT(S) IS TO BE ACCURATELY SURVEYED. THE DAILY MONITORING SHALL INCLUDE THE TEMPERATURE, WIND CONDITIONS, SKY CONDITIONS, PRECIPITATION, ETC. DAILY MONITORING SHALL CONTINUE FOR TWO WEEKS.
6. CONTRACTOR SHALL EXERCISE CAUTION AND PROTECT THE EXISTING WETLANDS PLANTING IN PLACE.

PLANS PREPARED BY:
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Los Angeles, CA 90071
(213) 223-1400 (213) 223-1444 (FAX)

REVISION DATES (DESIGN STAGE ONLY)

CITY OF LOS ANGELES — DEPARTMENT OF PUBLIC WORKS — BUREAU OF ENGINEERING

THIS PLAN WAS ELECTRONICALLY SIGNED AND STAMPED

VERTICAL CONTROL:BENCHMARK NO.18-09500, ELEV.187.306'(NGVD 1929)1985 ADJ
HORIZONTAL CONTROL: NAD 83, ZONE 5, EPOCH 2002.0000

SHEET TITLE:

PROJECT: SOUTH LOS ANGELES WETLAND PARK

ADDRESS: 5413 AVALON BOULEVARD, SOUTH LOS ANGELES DISTRICT, LOS ANGELES, CA

WORK ORDER NO. EW40006F

DRAWING NO.

SHEET OF SHEETS

GARY LEE MOORE, P.E. CITY ENGINEER
ACCEPTED BY :
DEPUTY CITY ENGINEER / PROGRAM MANAGER — DATE
CITY ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — SEAN P. VARGAS — No. C63309 — Exp. 06-30-10 — CIVIL — STATE OF CALIFORNIA

NO.	REVISIONS:	DATE:	BY:

WORK ACCEPTED — SERIAL NO.

INDEX NO. D-33828

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