FINAL
2000-2001 CLOSURE CONSTRUCTION AS-BUILT REPORT
HUNTERS POINT NAVAL SHIPYARD PARCEL E
IR 1/21 INTERIM LANDFILL CAP
SAN FRANCISCO, CALIFORNIA

Environmental Remediation
Contract Number N62474-98-D-2076
Contract Task Order 0025

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Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
CCR	California Code of Regulations
CETCO	Colloidal Technologies Company
CFR	Code of Federal Regulations
cm/sec	centimeters per second
CQA/QC	construction quality assurance/quality control
cy	cubic yard(s)
GCL	geosynthetic clay liner
GSE	GSE Lining Technology, Inc.
HDPE	high-density polyethylene
HPS	Hunters Point Shipyard
IT	IT Corporation
ITSI	Innovative Technical Solutions, Inc.
lbs/acre	pounds per acre
mil	millimeter
oz.	ounce(s)
PI	plasticity index
psi	pound(s) per square inch
QA	quality assurance
QC	quality control
tsf	tons per square foot
UCS	unconfined compression strength
VSC	vegetative soil cover

1.0 Introduction

The Hunters Point Shipyard (HPS) Parcel E is a 135-acre facility located at Hunters Point Naval Shipyard in San Francisco, California. Figure 1, "Site Location Map," shows the location of the site. The facility has been inactive as a U.S. Naval Shipyard since 1974, but an interim closure cover system was mandated after a brush fire occurred in Parcel E in August of 2000. As a result, a 13.8-acre interim closure cover system was designed for the landfill.

This report summarizes the construction and performance documentation collected during the 2000 to 2001 construction season, including the installation of the interim cover system at the HPS Parcel E Landfill. The 2000 to 2001 closure construction activities represent a 7-month construction schedule, including weather delays. This work was performed under the provisions of Environmental Remediation Contract Number N62474-98-D-2076 and Contract Task Order 0025. All work has been implemented per project specifications and other approved modifications, as appropriate. The major construction activities of the 2000 to 2001 construction season included within this report are as follows:

- Site preparation, clearing and removal of grub material
- Installation of one well point (probe) and monitoring for subsurface activities
- Extension of existing wells for monitoring of subsurface activities
- Testing and approval of a minimum 2-foot-thick foundation layer
- Installation of a multilayer geosynthetic cover system
- Placement of a minimum 1½-foot-thick vegetative soil cover (VSC)
- Winterization of the site, including construction of a surface water collection and drainage system and erosion control for disturbed areas
- Hydroseeding of the final cap areas

1.1 Project Summary

Closure construction activities for the HPS Parcel E Landfill began in September of 2000. This report documents the construction activities completed for the interim closure cover installation at the HPS Parcel E Landfill.

Throughout this report, reference will be made to the IT Corporation (IT) Resident Engineering group. This group refers to the Engineer of Record, Resident Engineer, field engineers, and all field quality control (QC) technicians and inspectors. The IT Resident Engineer was represented by Vector Engineering, Inc., of Grass Valley, California. The purpose of the IT Resident Engineering group was to ensure that the landfill was closed in accordance with the project technical specifications and other approved modifications, as appropriate. The construction quality assurance/quality control (CQA/QC) activities of the IT Resident Engineering group were also monitored, reviewed, and certified by Purdue Engineering and Construction, Rich Purdue, P.E., of Concord, California, an Independent Certifying Engineer. The controlling document for this project, except where noted, was the IT Project Technical Specifications (see Appendix A, "Technical Specifications, Hunters Point Shipyard Parcel E Landfill Cap Construction," of this report).

In addition to the previously mentioned activities, several other independent activities occurred throughout the 2000 to 2001 construction season, one of which being clearing and grubbing of the site. Resulting trash and debris was stockpiled on-site to be disposed of at an appropriate off-site disposal facility.

Other non-construction-related activities included the extension of existing groundwater monitoring wells above final grade of the VSC prior to completing the foundation layer. A total of 12 monitoring wells were extended within the landfill cap boundary. Additionally, one well point was installed to monitor subsurface activity in an area that was still smoldering at the time of liner installation. Subsurface monitoring of the above-mentioned wells was initiated on December 18, 2000 to determine if combustion existed within the landfill.

In addition, air monitoring stations were installed to detect health-related particulate matter as a result of the fire. Perimeter air monitoring was initiated on September 9, 2000, and terminated on March 14, 2001. Subsurface air monitoring commenced on December 18, 2000, and is on-going. Perimeter monitoring was conducted on-site by Mendelian Construction and subsurface air monitoring was conducted by Innovative Technical Solutions, Inc. (ITSI).

Finally, two settlement markers were installed prior to the completion of construction of the foundation layer. The settlement markers were placed at the approximate center of the two high points, where the thickness of the foundation layer was the greatest. The settlement marker comprised of a 10-foot steel pole welded to a 3-foot-by-3-foot steel base plate and was placed at the top of the original grade during placement of the foundation layer.

This report documents the 2000 to 2001 HPS Parcel E Landfill cap construction and the associated CQA/QC activities as follows:

- Section 2.0 – Site Preparation
- Section 3.0 – Final Cover System Design
- Section 4.0 – Foundation Layer
- Section 5.0 – Geosynthetic Layers
- Section 6.0 – Vegetative Soil Cover
- Section 7.0 – Summary and Certifications
- Section 8.0 – References

2.0 Site Preparation

This section summarizes the activities conducted for the protection of monitoring wells, removal of debris, and subgrade preparation. Existing site topography of the HPS Parcel E Landfill area prior to construction is shown on Figure 2, "Preconstruction Topography."

2.1 General

The site preparation activities for the HPS Parcel E landfill areas included protection of existing monitoring wells throughout construction. Further site preparation involved removal of objectionable materials and vegetation prior to placement of soil for the foundation layer. Objectionable materials included burned debris such as vegetation, soil, railroad ties, and concrete rubble. Materials were segregated and stored on-site in separate stockpiles. The subgrade was scarified, moisture conditioned, and compacted to incorporate remaining vegetative roots into the existing subgrade soil prior to placement of the foundation layer.

2.2 Protection of Monitoring Wells

Monitoring wells were protected by painting the wells with fluorescent orange paint and placing delineators, such as traffic cones, around the wells. Within the construction area of the 13.8-acre closure cover, 50-gallon drums were placed around the 12 existing wells and painted fluorescent orange so they were easily visible to the equipment operators. These existing wells are shown in Figure 7, "Final Topography." The drums were left in place until the closure cover system was completed. Once the VSC was placed, a concrete pad and bollards were installed around each well. Table 1, "Monitoring Well Location Data," lists the 12 wells and their locations.

2.3 Preparation of Subgrade

Prior to placement of the foundation layer, the subgrade was prepared by stripping objectionable materials and vegetation. This was accomplished using a CAT D6H dozer to push debris into a pile from which it was loaded into a dump truck with a Volvo L90 C loader and a Komatsu WA 450 loader. The debris was transferred and stockpiled on-site at Parcel E in segregated piles for disposal.

Following the stripping of objectionable materials and vegetation, the subgrade was scarified and moisture conditioned using a Hutch Master disk pulled by a CAT D6C tractor (No. 2633) to blend and incorporate remaining vegetative roots into the existing subgrade soil. Some areas were compacted prior to the fill placement.

2.4 Debris Disposal

During the preparation of the subgrade, segregated piles of debris were transferred and stockpiled on-site for disposal. The debris consisted of vegetation, soil, railroad ties, and concrete rubble. Burned debris was also removed from the site. Quantities of debris are shown in Table 2, "Debris Removal—Summary of Removed Debris Quantities." All debris has been removed from the site.

2.5 Construction Quality Control

A QC program was conducted to verify and document that the site preparation specifications were met (see Appendix A). The QC program required supervision of the above-mentioned stripping and disposal of objectionable materials. Documentation consisted of debris removal quantities, which are presented in Table 2.

3.0 Final Cover System Design

3.1 Introduction

The remainder of this report summarizes the construction and performance documentation collected during the 2000 to 2001 construction of the interim cover system at the HPS Parcel E Landfill. Construction was completed in accordance with the project technical specifications requirements and other approved modifications as appropriate (see Appendix A). The major activities included the following:

- Subgrade preparation and approval for foundation layer placement
- Installation of a minimum 2-foot-thick compacted foundation layer
- Extension of existing monitoring wells over the approved foundation
- Installation of a geosynthetic clay liner (GCL), where required
- Installation of the 80-millimeter (mil) high-density polyethylene (HDPE) geomembrane layer
- Installation of a geocomposite drainage layer
- Placement of a 1½-foot-thick VSC
- Hydroseeding the finished cap

3.1.1 General

The design of the final cover system is described in the *Technical Specifications, Hunters Point Shipyard Parcel E, IR 1/21 Interim Landfill Cap Construction* technical specifications (IT, 2000).

Requirements for quality-related activities, such as inspections and testing specific to the final cover construction, are contained in Appendix A. Steps were taken to ensure that all field engineering and/or QC personnel who were part of the daily working staff at the facility were familiarized with the CQA/QC Program, as well as the specifications, drawings, and ongoing site activities. Daily logs of the Resident Engineer and the Field Quality Control Inspectors, documenting the CQA/QC activities, may be found in Appendices B, "Field Activity Daily Logs: Resident Engineer," and C, "Field Activity Daily Logs: Field Quality Control Inspector," respectively.

3.2 Cover System Design

A multi-layer closure cover system was used to cover the site. The closure covers were constructed to meet the applicable requirements of the technical specifications (IT, 2000). Soil used for the foundation layer and the VSC in the closure covers was obtained from clean, off-site borrow sources. Documents and analytical data supporting the cleanliness of the off-site borrow material are provided in Appendix D. Two types of closure covers, referred to as Covers A and B, were used to cover the site. The two types of closure covers were implemented for varying slopes on the designed cover. The final closure cover systems are described below in Section 3.2.1.

3.2.1 Final Design for Closure Covers

Cover A

Cover A was placed in areas where the final ground surface slope was flat, (i.e., typical 3 to 8 percent), as shown on Figure 3, "Plan and Locations of Final Closure Covers." Cover A includes the following layers from bottom to top:

<u>Cover A for slopes of 3 to 8 percent</u>

- Compacted foundation layer, 2 feet thick
- GCL, non-reinforced
- Smooth 80-mil HDPE geomembrane layer
- Single-sided geocomposite drainage layer (HDPE drainage net with a geotextile fused to one side)
- VSC, 1½ feet thick

Cover B

Cover B was placed where the final slopes were greater than 8 percent, as shown on Figure 3. Cover B includes the following layers from bottom to top:

<u>Cover B for slopes greater than 8 percent</u>

- Compacted foundation layer, 2 feet thick
- Textured 80-mil HDPE geomembrane layer
- Double-sided geocomposite drainage layer (HDPE drainage net with a geotextile fused to both sides)

- VSC, 1½ feet thick

Both cover systems A and B required a double-sided gecomposite drainage layer on the perimeter of the cover system extending beyond the anchor trench to enhance drainage and limit erosion. This was accomplished by placing a layer of geotextile beneath the single-sided geocomposite layer in the area beyond the anchor trench. This additional layer of geotextile also serves as a separation layer and prevents the geonet component of the single-sided geocomposite from getting clogged by soil at the ground surface.

4.0 Foundation Layer

The following section describes the work conducted during the construction of the foundation layer and the QC procedures related to this task. The observations and verification testing required for the foundation layer were conducted in accordance with the technical specifications, (IT, 2000).

4.1 General

The foundation layer for the cover system is designed to:

- Prevent failure of the cover system due to settlement
- Provide adequate strength to:
    1. Support the loads associated with the cover system
    2. Maintain the integrity of the closure cover during and after an earthquake
    3. Provide appropriate grades for drainage control

The foundation layer, common to all cover systems, was constructed to be a minimum thickness of 2 feet to meet the design topography of the foundation layer. This layer was constructed from clean off-site borrow materials. Compaction of the newly constructed foundation layer was performed as part of the layer installation. The compaction provided adequate bearing capacity to support heavy construction equipment and to support the closure cover system. Letters of certification for the clean borrow material used for the foundation layer are found in Appendix D, “Material Certifications.” If letters of certification were not provided, analytical testing was performed on the borrow material. The results of the analytical tests are also presented in Appendix D.

Prior to placement of the compacted foundation layer, the existing subgrade was prepared as follows:

- Stripped objectionable materials and vegetation that interfered with work, including, but not limited to, boulders, concrete blocks, trees, stumps, and debris

- Stripped and removed existing vegetation. Stripped vegetative material was re-utilized where feasible and incorporated into the foundation layer

- Scarified to blend and incorporate the remaining vegetative roots into the existing foundation soil

- Placed lifts of clean borrow soil and compacted with heavy equipment for preparation of the foundation layer; the layer was constructed in controlled lifts not exceeding 8 inches in loose thickness to obtain a nominal 6-inch compacted thickness.

- Smooth drum rolled the top lift (minimum 4-passes) prior to GCL placement.

Preparation of the foundation layer began on September 19, 2000. Once the placing of the foundation material began, two CAT 825 B compactors were used to condition and compact the foundation layer in lifts not exceeding 8 inches. Compaction of the foundation was done under the continuous observation of the IT Resident Engineering group to ensure that complete and uniform coverage was achieved. In all, approximately 14 acres of foundation were approved for final cover placement.

4.2 Construction Quality Control

A QC program was conducted to verify and document that the foundation design specifications were met (Appendix A). The QC program required the 2-foot-thick foundation layer to be tested at a minimum frequency of one test every 3 acres for each 6-inch lift in order to demonstrate a minimum strength. IT personnel conducted testing for the foundation approval. The results of these tests as well as field daily logs are presented in Appendices E, “Conformance Test Data,” and B, respectively.

4.2.1 Foundation Approval

Samples of the compacted foundation were collected from random locations for strength testing at the specified frequencies during the placement of the foundation material. Samples were collected using Shelby tubes that were hydraulically pushed by a CAT D6H dozer blade to a depth of 6 inches. The Shelby tubes were removed from the soil by carefully excavating around the perimeter of the tube with hand tools until it could be lifted by hand. Each sample was given a unique sample number and the location was surveyed by Foresite Engineering. In addition to collecting samples for strength testing, samples were collected to determine the permeability of the compacted foundation layer. The method used for collecting the samples was identical to the method used for strength testing. The collected samples were then tested for the following:

- Unconfined Compressive Strength (American Society for Testing and Materials [ASTM] D 2166)

- Moisture Content (ASTM D 2216)

- Hydraulic Conductivity (ASTM D 5084)

The unconfined compressive strength testing was performed at Smith-Emery Geoservices directed under Pat Morrison. The laboratory is located at HPS, Building 114, San Francisco, California. The hydraulic conductivity tests were performed under Raf B. Hutalla of Smith-Emery Geoservices in Los Angeles, California. The sample collection logs and the laboratory chain-of-custody records may be found in Appendices F, "Sample Collection Logs," and G, "Chain-of-Custody Forms," respectively.

4.2.1.1 Unconfined Compression Strength Tests

Unconfined compression strength (UCS) tests were conducted in accordance with ASTM D 2166 at a frequency of test every 3 acres for each 6-inch lift. The acceptance criterion for the unconfined compression test was a minimum value of 1.0 tons per square foot (tsf). The results of these tests are presented in Table 3, "Foundation Approval—Summary of Unconfined Compressive Strength Tests." As shown, the final unconfined compressive strength of the approved foundation layer ranges from 1.0 to 6.2 tsf. A total of 39 samples were taken, with 35 tests conducted.

The location of each passing test was surveyed by Foresite Engineering. The surveyed foundation tests are shown in Figure 4, "Foundation Layer Topography with Passing Test Locations."

4.2.1.2 Moisture Content Tests

Moisture content tests (ASTM D 2216) were conducted routinely as part of the UCS tests, the results of which are listed in Table 3. No criterion for moisture content tests was detailed in the design specifications.

4.2.1.3 Hydraulic Conductivity

Hydraulic conductivity tests were conducted in accordance with ASTM D 5084, at a frequency of one test every 3 acres from the final grade of the foundation layer. The hydraulic conductivity tests were not required for foundation approval; therefore, the results are for informational purposes only. The results of these tests are presented in Table 4, "Foundation Approval—Summary of Hydraulic Conductivity Tests." As shown, the final permeability of the approved foundation layer ranges from 2.70 E-05 to 9.84 E-08 centimeters per second (cm/sec). The average permeability is 5.54 E-06 cm/sec. A total of five tests were conducted. The results indicate that the foundation layer has low permeability and thus provides an added barrier to infiltration, in conjunction with the other cover components.

The locations of these tests were surveyed by Foresite Engineering. The surveyed locations of the hydraulic conductivity tests are shown in Figure 4.

4.2.1.4 Verification Survey

After final approval of the foundation layer and prior to placement of the geosynthetic layers, a survey was conducted on a minimum 100-x-100-foot grid. This survey was conducted to verify that the foundation layer was constructed according to the design and was later used to verify the thickness of the VSC. Figure 4 shows the resulting foundation topography and the surveyed location of each of the passing UCS and hydraulic conductivity tests.

5.0 Geosynthetic Layers

The following sections describe the work conducted during the installation of the geosynthetic layers including the GCL, HDPE geomembrane layer, and the geosynthetic drainage layer. The sections also describe the materials used and the QC activities related to this task.

5.1 General

Approximately 1,954,985 square feet of geosynthetic material was installed during the 2000 construction of the final cover system. The various layers of geosynthetics as constructed in the cover system consist of the following components from bottom to top:

- GCL (non-reinforced), on slopes 3 to 8%
- 80-mil HDPE geomembrane layer (smooth), on slopes 3 to 8%
- 80-mil HDPE geomembrane layer (textured), on slopes greater than 8%
- Single-sided Geocomposite drainage layer, on slopes 3 to 8%
- Double-sided Geocomposite drainage layer, on slopes greater than 8%
- 8-ounce (oz.) Geotextile extending beyond the anchor trench

Installation of the geosynthetic layers began on October 24, 2000, at the northwestern corner of the Parcel E Landfill, and was completed on November 21, 2000. During that time, approximately 14 acres were covered under the continuous observation of the IT Resident Engineering group. The as-built surveyed quantities of these materials, not including overlap or anchor trench work, are listed in Table 5, “Material Quantity Summary.”

5.2 Materials

From September 27, 2000 to November 18, 2000, geosynthetic materials were delivered to the site from various manufacturers via flat bed trucks. Upon delivery, each truckload of material was inspected by a member of the IT Resident Engineering group for damage during shipment. To document any damage, receiving inspection forms were completed for each truckload of material received. Slight damage, if any, was identified during the receiving inspections and was repaired at the time of deployment. Roll numbers and quantities received were also checked against the truck tags. The material receiving inspection logs for each truckload of material have been included in Appendix H, “Material Receiving Inspection Logs.”

After the receiving inspections were completed, each roll number was cross-checked against the manufacturer’s certification provided by the supplier. This documentation provided certified test results for the physical and chemical properties of each material received on site.

Manufacturer's certifications were reviewed, maintained, and completed on site by members of the IT Resident Engineering group. The manufacturer's certifications are located in Appendix D. The test results for each of the properties of the received materials met or exceeded the specified requirements.

The geosynthetic materials were stored on site at the Parcel E Landfill on railroad ties and railroad tracks and covered with plastic tarps to minimize any damages that may occur due to weather. This is standard acceptable practice and prevents damage of the materials from protrusions in the ground surface and standing water during the rainy season. Storage of geosynthetic material was done in accordance with the technical specifications (see Appendix A).

5.3 Installation

The geosynthetic installation Contractor for this project was GSE Lining Technology, Inc. (GSE), of Houston, Texas. The required seamer and supervisor resumes, and panel layout drawings were provided to IT prior to commencement of installation activities. In addition, a preconstruction meeting was held with GSE's superintendent and IT Corporation's Resident Engineering group. The purpose of this meeting was to discuss sequencing of the liner deployment.

Installation of the geosynthetic layers followed the procedures outlined in the technical specifications (Appendix A). This was accomplished by the continuous inspection of the geosynthetic system materials and workmanship throughout the period of the installation. The IT Resident Engineering group provided the field QC with periodic oversight by the Independent Certifying Engineer. The inspections and tests conducted during installation of the geosynthetic layers are described in the following sections.

5.4 Geosynthetic Clay Liner

Non-reinforced GCL was used in the original design of the geosynthetic layer system. Due to a shortage of non-reinforced GCL near the end of deployment, a rush shipment of reinforced GCL was shipped from the IT Panoche Facility located in Benicia, California. This material was GSE-owned, but at the time it was being stored at the Panoche Facility. The non-reinforced rolls of GCL were manufactured by the GSE Clay Lining Technology Company in Spearfish, North Dakota. The reinforced rolls of GCL were manufactured by the Colloid Technologies Company (CETCO), a subsidiary of the American Colloid Company. The reinforced product, Bentomat® ST, was supplied in rolls measuring 15 feet wide and approximately 150 feet in length The reinforced product is superior when compared to the non-reinforced product and meet or exceeds the required technical specifications of the project. This sustitution provides an overall superior product and enhances the performance of the cover system as designed. The non-reinforced product, GundSeal®, was supplied in rolls 17½ feet wide and approximately 200 feet in length. The installed panels were sized and seamed in the field by GSE. Certified physical properties of the GCL and the powdered bentonite were collected, along with the manufacturer's QA test results.

The foundation layer beneath the GCL was kept moist until the areas were ready for deployment. The soil surfaces were also proof rolled with a Hamm smooth drum vibratory compactor prior to installation of the GCL. This was done to ensure that the GCL was being deployed over a smooth, firm, and unyielding surface free of abrupt elevation changes. The final foundation surface was approved in writing by the IT Resident Engineering group and the geosynthetics installation Contractor. Documentation supporting the subgrade acceptance is found in Appendix I, "Foundation Subgrade Approval Forms." An anchor trench measuring a minimum of 1 foot wide by 2 feet deep was excavated using a modified trenching machine. A total of 2,866 linear feet were excavated for the anchor trench at the perimeter of the designed landfill cap and the trench is shown in Figure 5, "80-Mil HDPE Panel Layout with Destructive Sample Locations." After the installation of geosynthetics, the anchor trenches were backfilled with the excavated soil and wheel compacted using the front wheel of a CAT 140G motor grader.

All GCL panels were installed in accordance with the plans and specifications as described herein. A technical paper prepared by GSE detailing the installation of GSE GundSeal® was referenced for deployment (GSE, 1997). The GundSeal® was deployed with the 15-mil HDPE backing facing the prepared foundation layer. Both GundSeal® and Bentomat® ST were deployed by means of a Volvo L120C wheel loader, which could maneuver the roll into position and then, with the assistance of several laborers and a WA 450 Komatsu wheel loader, unroll the required length of material. All GCL seams were constructed by overlapping their adjacent edges. The minimum dimension of all overlap was 6 inches with the exception of the end-of-roll overlap, which was a minimum of 24 inches. Supplemental bentonite was used only for the seaming of the Bentomat® ST. The minimum application rate at which the bentonite was applied was one quarter pound per lineal foot.

All cover penetrations were lined by cutting an "X" in the GCL blanket and wrapping the penetration in a GCL skirt. Granular sodium bentonite was added at the base of each penetration as additional protection. Only as much GCL as could be covered by the following layer of HDPE was placed in a single day. During the course of construction, no GCL panels were left uncovered overnight. Members of the IT Resident Engineering group maintained panel deployment logs throughout the deployment process to ensure that the project specifications were met. All panel deployment logs are included in Appendix J, "Geosynthetic Deployment Logs."

5.4.1 Construction Quality Control Program

A QC program was conducted to document the installation of the GCL and to verify that the design specifications were met. This was accomplished by the continuous inspection of the GCL and workmanship throughout the period of the installation. The IT Resident Engineering group provided the field QC. Throughout the installation of GCL, QC inspectors maintained all panel deployment logs. These logs were compiled each day and were used to complete the construction inspection forms, in accordance with the CQA/QC Plan (IT, 2000). The material certifications, inspections, and tests that were performed for the GCL are described in the following sections.

5.4.1.1 Manufacturer's Material Certification

Certified test results for the physical and chemical properties of the GCL were obtained from the manufacturer. The test results for each of the properties were checked by the IT Resident Engineering group and all roll values met or exceeded the technical specification. The manufacturer's material certifications are included in Appendix D.

5.4.1.2 Inspection of Material Received

The GCL rolls were inspected upon delivery for damage during shipment. The manufacturer's identification numbers were obtained to ascertain that the proper materials were received and that the lot numbers matched those listed on the quality assurance (QA) certificates. Every roll of GCL met the specifications. The IT Resident Engineering group conducted inspections of every deployed panel during installation activities. No significant damage was noted during these inspections. The material receiving inspection records are included in Appendix H.

5.4.1.3 Conformance Testing

In addition to the manufacturer's QC documentation, samples were cut from random rolls of each material received and delivered to Geotechnics Geosynthetic Laboratories of Pittsburgh, Pennsylvania for third party conformance testing. In accordance with the specifications, a minimum of one sample for every 100,000 square feet of material was collected for testing. At a minimum, each sample was tested for Bentonite Swell Index (ASTM D 5890), Bentonite Mass/Area (ASTM D 5993), Bentonite Hydraulic Conductivity (ASTM D 5887), HDPE Thickness (ASTM D 5199), HDPE Puncture Resistance (ASTM D 4833), and HDPE Tensile Strength and Elongation (ASTM D 638, Method IV) as outlined in technical specifications

(Appendix A). Subsequent modifications were made to the conformance testing specifications (see Appendix K, "Memorandums" for details).

Members of the IT Resident Engineering group reviewed the results of the conformance tests. All of the conformance test results met the design specifications.

Tables 6, "Material Receiving Summary—GundSeal® GCL," and 7, "Material Receiving Summary—Bentomat ST® GCL," include summaries of the CQA/QC activities involved with the materials inspection for the GundSeal® GCL and the Bentomat® GCL, including a summary of the conformance samples collected. A copy of the laboratory testing results has also been included in Appendix E.

5.4.1.4 Inspection of the Subgrade

The finished foundation layers received smooth steel drum rolling to produce soil surfaces that were relatively smooth and free of any sharp discontinuities and desiccation cracks. Prior to installation of the GCL, an inspection of the completed foundation layer was made by a member of the IT Resident Engineering group and the geosynthetic subcontractor's superintendent. Subgrade acceptance forms were completed during these inspections, and any corrective actions were noted and implemented prior to deployment of the GCL.

5.4.1.5 Inspection of the Anchor Trench

As the anchor trenches were excavated, the dimensions of the excavation and the conditions of the trench bottom and side walls were inspected for conformance with the technical specifications. The constructed anchor trench dimensions conformed with the specifications. The trenches were excavated, backfilled, and compacted in accordance with the specifications.

5.4.1.6 Inspection of Panels

Each GCL panel was inspected for damage during deployment. All areas of damage were marked and repaired.

5.4.1.7 Inspection of Panel Overlap

The overlap of the panels was inspected to verify a minimum overlap of 6 inches at the sides and 24 inches on the ends of the rolls, in accordance with the manufacturer's recommendation. All panels had sufficient overlap and conformed to the specifications. Patches were also overlapped a minimum of 12 inches over the defective area to be patched. Supplemental bentonite was used only for the seaming of the Bentomat® ST product. The minimum application rate at which the bentonite was applied was one quarter pound per lineal foot.

5.4.1.8 Walk-Through Inspection of Completed Installation

After the completion of each GCL panel, and prior to the HDPE deployment, the surface was given a final walk-through inspection by members of the IT Resident Engineering group and GSE's superintendent. Any damaged or defective areas were marked and repaired. Any protrusions observed in the subgrade were also repaired. No HDPE was allowed to be deployed over the GCL until this walk-through was completed and all required repairs made.

5.5 High-Density Polyethylene Geomembrane

The textured and smooth 80-mil HDPE geomembrane was supplied in 22½-foot-wide and 34½-foot-wide rolls, respectively. The length of the rolls was approximately 320 feet. The installed panels were sized and seamed in the field. Certified physical properties of the HDPE geomembrane and the resins used to manufacture the geomembrane were collected, along with the manufacturer's QA test results. The HDPE geomembrane was installed in accordance with the plans and specifications and as described herein.

The HDPE panels were deployed by several laborers who, with the assistance of a Volvo L120C loader, held the rolls in an elevated position just outside of the anchor trench, and unrolled the geomembrane onto the soil surface. A Komatsu WA 450 loader assisted the laborers in deploying the HDPE geomembrane.

Two types of field seams were used to join the geomembrane panels: extrusion welding and hot-wedge fusion welding. Both methods were performed per the manufacturer's recommendations. Field Seaming Logs may be found in Appendix L, "HDPE Geomembrane Seaming Logs." Panels were overlapped a minimum of 4 inches and sandbags were placed along the edges of unseamed panels to minimize the risk of uplift during strong winds. Destructive samples were cut from the installed HDPE geomembrane at a minimum rate of one per 500 linear feet of field seam (Appendix A). The destructive samples were tested in the field by GSE laborers under the supervision of a member of the IT Resident Engineering group. The destructive samples were also delivered to Geotechnics Laboratories of Pittsburgh, Pennsylvania for third party conformance testing. Field test results are provided in Appendix M, "Field Destructive Sample Test Results," and the laboratory test results are provided in Appendix E.

The as-built HDPE panel layout for the cover system is shown on Figure 5. These figures show the surveyed locations of all field seams, destructive samples taken for laboratory testing, and pipe penetrations. HDPE boots were attached to all pipes that penetrated the liner. The boots over each pipe were constructed according to the manufacturer's recommendations. As-built details of the boot configurations are shown on Figure 6. Details and sections of the interim cover system are also shown on Figure 6.

5.5.1 Construction Quality Control Program

A QC program was conducted to document the installation of the geomembrane layers and to verify that the design specifications were met. This was accomplished by the continuous inspection of the geomembrane materials and workmanship throughout the period of the installation. The IT Resident Engineering group provided the field QC. Throughout the installation of HDPE geomembrane, QC inspectors maintained logs of deployment, seaming, and testing of welded seams. These logs were compiled each day and were used to complete the construction inspection forms, in accordance with the CQA/QC Plan (IT, 2000). The material certifications, inspections, and tests that were performed for the HDPE are described in the following sections.

5.5.1.1 Manufacturer's Material Certification

Certified test results for the physical and chemical properties of the HDPE geomembrane were obtained from the manufacturer. The test results for each of the properties were checked by the IT Resident Engineering group and all roll values met or exceeded the specification. The manufacturer's material certifications are included in Appendix D.

5.5.1.2 Inspection of Material Received

The HDPE geomembrane was inspected upon delivery for damage during shipment. The manufacturer's identification numbers were obtained to ascertain that the proper materials were received and that the lot numbers matched those listed on the QA certificates. Every roll of HDPE geomembrane met the specifications. The IT Resident Engineering group conducted inspections of every deployed panel during installation activities. No significant damage was noted during these inspections. Material receiving inspection records are included in Appendix H.

5.5.1.3 Conformance Testing

In addition to the manufacturer's QC documentation, samples were cut from random rolls of each material received and delivered to Geotechnics Laboratories of Pittsburgh, Pennsylvania for third party conformance testing. In accordance with the specifications, a minimum of one sample for every 100,000 square feet of material was collected for testing. At a minimum each sample was tested for Thickness (ASTM D 5199), Tensile Strength and Elongation (ASTM D 638), Puncture Resistance (ASTM D 4833), and Tear Resistance (ASTM D 1004) as outlined in the specifications.

Members of the IT Resident Engineering group reviewed results of the conformance tests. All of the conformance test results met the technical specifications.

Table 8, "Material Receiving Summary—80-Mil HDPE Liner," includes a summary of the CQA/QC activities involved with the materials inspection including a summary of the conformance samples collected. A copy of the laboratory testing results has also been included in Appendix E.

5.5.1.4 Inspection of the Subgrade

Prior to installation of the HDPE geomembrane, a member of the IT Resident Engineering group inspected the completed GCL panel. Any shifting of the GCL panel or other damage was marked and repaired prior to HDPE deployment.

5.5.1.5 Inspection of the Anchor Trench

As the anchor trenches were excavated, the dimensions of the excavation and the conditions of the trench bottom and sidewalls were inspected for any nonconformance with the specifications. The constructed anchor trench dimensions conformed to the specifications. The trenches were excavated, backfilled, and compacted in accordance with the specifications.

5.5.1.6 Inspection of Panels

Each HDPE panel was inspected for damage during deployment. All areas of damage were marked, repaired, and tested.

5.5.1.7 Inspection of Panel Overlap

The overlap of the panels was inspected to verify a minimum overlap of 4 inches, in accordance with the manufacturer's recommendation. All-field welded seams had sufficient overlap. Seam patches were also overlapped a minimum of 4 inches over the defective area to be patched.

5.5.1.8 Visual Inspection of Seams

All field seams were visually inspected for noticeable defects such as burn-through, fishmouths, drifting of the welding unit, and any other abnormalities. All defects were marked, repaired, and tested in accordance with the specifications.

5.5.1.9 Field Testing of Seams

Field testing of seams was performed by the subcontractor under the continuous observation of members of the IT Resident Engineering group. A "start-up" weld was performed and tested at the beginning of each work shift on days when seaming was performed to ensure the quality of the seaming process. GSE tested each start-up weld in both shear and peel in accordance with

ASTM D 4437. All start-up testing was observed, documented, and maintained in the project files by members of the IT Resident Engineering group. No field seam testing was allowed unless a member of the IT Resident Engineering group was present to monitor the test and to observe that defects were detected and marked for repair. Two primary field test methods were employed for seam testing: air pressure testing and vacuum testing. An electrical spark test was employed when the extrusion weld to be tested was located on the side of a boot, or at a location that prohibited the use of a vacuum box. One hundred percent of field seams were tested. Throughout the installation of HDPE geomembrane, QC inspectors maintained logs of deployment, seaming, and testing of welds and seams. These logs were compiled each day and used to complete the construction inspection forms. All QC documentation on the start-up welds was compiled at the end of each day and is provided in Appendix N, "Daily Start-Up Welds."

The air pressure test was performed on all wedge welds, in accordance with the methods described in the technical specifications (Appendix A). The wedge weld channel was fusion sealed on both ends and pressurized to 25 to 30 pounds per square inch (psi) for a minimum of 5 minutes. Any seam channels exhibiting pressure drops greater than 5 psi were repaired and retested.

The vacuum test was performed on extrusion welds, which primarily consisted of patches, minor repairs of defects, and repairs of air test punctures. The vacuum test was conducted in accordance with the methods described in the specifications. The vacuum box induced a negative pressure of 3 to 6 psi (or greater). This pressure was held as long as necessary for the QC inspector to note the presence of any opening or puncture in the seam, as evidenced by the creation of bubbles in the applied soapy solution. Any failures were noted, rewelded, and retested to the satisfaction of the QC inspector.

The electrical spark test was performed on extrusion welds located on the sides of boots and on any seams where a vacuum test could not be utilized. The seams were constructed with copper wires embedded under the extrusion weld. After grounding the wires, a high-voltage (15 to 30 kilovolts) electrical current was applied to the seam area using a high voltage detector and any leakage to the ground was detected by the creation of an arc that sounded an alarm. No leaks were found during these spark tests.

Documentation supporting inspections on air pressure tests, vacuum tests, and spark tests are included in Appendix O, "Field Testing Logs."

5.5.1.10 Destructive (Laboratory) Testing of Seams

Seam samples for laboratory testing were collected at a minimum rate of one per 500 linear feet of field seam. The destructive samples were randomly cut from the installed geomembrane, but in such a manner that a sample was obtained from as many different areas as possible. Each sample measured no less than 12 inches wide by 36 inches long. All cut-out areas of geomembrane were patched using HDPE material of the same thickness as the parent material. The patches were extrusion welded and vacuum tested.

Analyses were performed on destructive samples collected from the HDPE geomembrane to determine their as-built engineering properties. The tests performed, with reference to the applicable standards, are as follows:

- Bonded Seam Strength in Shear (ASTM D 4437)
- Bonded Seam Strength in Peel (ASTM D 4437)
- Thickness (ASTM D 5199)

Each destructive sample was identified with a sample number (date-seam number) at the time of sampling and the location was noted on a working drawing in the field. The locations of the samples were surveyed and are shown on Figure 5. A total of 47 destructive samples were taken from approximately 21,228 linear feet of seam produced in the 80-mil HDPE layer of the final cover system. All destructive samples were tested in the field by GSE laborers under the supervision of the IT Resident Engineering group. The destructive samples were also delivered to Geotechnics Laboratories in Pittsburgh, Pennsylvania for third party conformance testing. Field test results are provided in Appendix M, and the laboratory test results are provided in Appendix E.

Destructive samples were collected from fusion and extrusion welds. A total of 47 destructive samples were taken from approximately 21,228 linear feet of seam produced by fusion welds. Of these 47 destructs, a total of 3 destructive samples were taken from seams produced by extrusion welds.

If a destructive test failed to meet the specification, then retests were performed on both sides of the original destructive test location. This process was continued, if necessary, until two passing destructive tests were achieved. The seam was then patched and extrusion welded between the two passing tests. This remediation process was necessary in one seam area where there was a failed test. A failure occurred in the extrusion weld destructive sample number 15 as determined by Geotechnics conformance test results. Destructive sample numbers 15A and 15B were collected to meet the specifications.

Shear and Peel Testing

The minimum acceptable shear strength value is 90 percent of the parent material tensile strength at yield. This value is 156 pounds per inch for both the 80-mil smooth and textured HDPE. All test result values of bonded seam strength in shear for 80-mil textured and 80-mil smooth HDPE exceeded the minimum criteria. Test results for bonded seam strength in shear are included in Appendix O of this report. The minimum acceptance criteria for bonded seam strength in peel is a tear in the parent material, rather than a parting at the seam interface. This condition is often referred to as a film tearing bond. This is a pass/fail test. All destructive samples taken passed the bonded seam peel strength test. Test results for bonded seam strength in peel are provided in Appendix G of this report.

Thickness Testing

The specified thickness for HDPE geomembrane is the base thickness of 80-mil minus 10 percent. In addition to the manufacturer's QC documentation, samples were cut from random rolls of each material received and delivered to Geotechnics Laboratories of Pittsburgh, Pennsylvania for third party conformance testing. All values of thickness for the installed geomembrane met the minimum criterion. Results of laboratory thickness testing are provided in Appendix E of this report.

5.5.1.11 Walk-Through Inspection of Completed Installation

After the completion of each HDPE geomembrane layer, the IT Resident Engineering group and GSE's superintendent performed a walk-through inspection of the installation. Any damaged or defective areas were marked, repaired, and tested during the inspection. No geosynthetics (geocomposite) were allowed to be deployed over the HDPE geomembrane until this walk-through was completed and all required repairs were made.

5.6 Geocomposite Layer

The geocomposite used for the final cover system was the GSE FabriNet and FabriCap product, which is a single or double-sided geocomposite comprising of an HDPE geonet. The double-sided geocomposite is comprised of a geonet sandwiched in between two 6-oz. geotextile layers. The single-sided product was installed with the HDPE geonet in contact with the HDPE geomembrane. The geocomposite layer was installed above the 80-mil HDPE layer as outlined in the specifications. The geocomposite was supplied in rolls measuring approximately 14 feet wide by 250 feet long.

Wherever possible, the geocomposite was installed with its long dimension oriented down slope. Sides and ends were butted (or overlapped slightly) and secured with plastic ties. The ties were installed approximately 4 feet apart on the long seam, 6 inches apart on the cross seam, and as necessary to produce flat and uniform layers. The geotextile fused to the bottom of the geocomposite was overlapped. The geotextile fused to the top of the geocomposite panels was either heat bonded or sewn together. In both cases, all seams were continuously seamed. The seam was located approximately 12 inches from the sides of the panels.

5.6.1 Construction Quality Control Program

A QC program was conducted to document the installation of the geocomposite layer and to verify that the design specifications were met. Construction inspection documentation was completed for the geocomposite layer. These forms may be found in Appendix P, "Construction Inspection for the Geocomposite Layer." This was accomplished by the continuous inspection of the geocomposite and workmanship throughout the period of the installation. The IT Resident Engineering group provided the field QC. Throughout the installation of geocomposite layer, QC inspectors maintained logs of deployment. These logs were compiled each day and were used to complete the construction inspection forms, in accordance with the CQA/QC Plan (IT, 2000). The material certifications, inspections, and tests that were performed for the geocomposite layer are described in the following sections.

5.6.1.1 Manufacturer's Material Certification

Certifications, specifications, and laboratory test results regarding the physical properties of the geocomposite were obtained from the manufacturer prior to installation. The properties and test values were checked by members of the IT Resident Engineering group and all roll values met or exceeded the specifications. The manufacturer's material certifications are included in Appendix D.

5.6.1.2 Inspection of Material Received

The geocomposite material was inspected upon receipt for damage during shipment. In addition, the manufacturer's identification numbers were obtained to ascertain that the proper materials were received. All geocomposite material received was the proper material with no noticeable damage found during the material receiving inspections. Detailed inspections of the entire rolls occurred during installation. Material receiving inspection records can be found in Appendix H.

5.6.1.3 Conformance Testing

In addition to the manufacturer's QC documentation, samples were cut from random rolls of each material received and delivered to Geotechnics Laboratories of Pittsburgh, Pennsylvania for third party conformance testing. In accordance with the specifications, a minimum of one sample for every 100,000 square feet of material was collected for testing. At a minimum the HDPE drainage net portion of each sample was tested for Thickness (ASTM D 5199), Density (ASTM D 1505), and Transmissivity (ASTM D 4716) as outlined in the specifications. Due to the difficulty in separating an intact sample of geotextile, testing was conducted only for the HDPE drainage net portion.

Members of the IT Resident Engineering group reviewed the results of the conformance tests. All of the conformance test results met the design specifications.

Table 9, "Material Receiving Summary—Geocomposite," includes a summary of the CQA/QC activities involved with the materials inspection and a list of the conformance samples collected. A copy of the laboratory testing results has also been included in Appendix E.

5.6.1.4 Inspection of the Underlying HDPE Geomembrane for Cleanliness

The underlying HDPE geomembrane was inspected for dirt and debris prior to installation of the geocomposite. The surface of the HDPE geomembrane was swept before the geocomposite was installed. Any debris was removed.

5.6.1.5 Inspection of Panels

The geocomposite panels were inspected for cleanliness, defects, and appearances of nonuniformity, both before and after deployment. Any defective geocomposite was removed and replaced. Sandbags were placed along the edges of unseamed panels to minimize the risk of uplift during strong winds.

5.6.1.6 Inspection of Joints

The joints of adjacent sheets were inspected to ensure that the panels were properly butted and tied together. The ties were installed approximately 4 feet apart on the long seam, 6 inches apart on the cross seam, and as necessary to produce flat and uniform layers. The geotextile fused to the bottom of the geocomposite was inspected to ensure sufficient overlap, and to ensure a relatively unwrinkled layer. The geotextile fused to the top of the geocomposite panels was inspected to ensure a completely bonded seam without areas of burn-through. Sewn seams were inspected to ensure the stitching was complete and that there were no inconsistencies. Open stitches in sewn geotextiles were secured by additional sewing.

5.7 Geotextile

The geotextile used for the final cover system was the nonwoven 8-oz TC Mirafi 180N product. The geotextile product was installed in conjunction with the single-sided geocomposite as outlined in the technical specifications (Appendix A), as an alternative to double-sided geocomposite. The geotextile layer was installed under the single-sided geocomposite layer where the geocomposite extended beyond the anchor trench. The combination of the two geosynthetics acted as erosion control for runoff exiting the geosynthetic cover system where the 80-mil HDPE did not exist. A schematic representing the use of this system is shown in Figure 6. The geotextile was supplied in rolls measuring approximately 15 feet wide by 300 feet long.

The geotextile was installed with 10 feet extending beyond the anchor trench outside the landfill cap and the remaining 5 feet on top of the HDPE. The single-sided geocomposite was installed with and extra 10 feet extending beyond the anchor trench to simulate a double-sided geocomposite with the long dimension oriented down the slopes. The ends of the geotextile were overlapped approximately 3 feet.

5.7.1 Construction Quality Control Program

A QC program was conducted to document the installation of the geotextile layer and to verify that the design specifications were met. This was accomplished by the continuous inspection of the geotextile and workmanship throughout the period of the installation. The IT Resident Engineering group provided the field QC. Throughout the installation of geotextile layer, QC inspectors maintained logs of deployment. These logs were compiled each day and were used to complete the construction inspection forms, in accordance with the CQA/QC Plan (IT, 2000). The material certifications, inspections, and tests that were performed for the geotextile layer are described in the following sections.

5.7.1.1 Manufacturer's Material Certification

Certifications, specifications, and laboratory test results regarding the physical properties of the geotextile were obtained from the manufacturer prior to installation. The properties and test values were checked by members of the IT Resident Engineering group and all roll values met or exceeded the specifications. The manufacturer's material certifications are included in Appendix D.

5.7.1.2 Inspection of Material Received

The geotextile material was inspected upon receipt for damage during shipment. In addition, the manufacturer's identification numbers were obtained to ascertain that the proper materials were received. All geotextile material received was the proper material with no noticeable damage found during the material receiving inspections. Detailed inspections of the entire rolls occurred during installation. Material receiving inspection records are included in Appendix H.

5.7.1.3 Conformance Testing

In addition to the manufacturer's QC documentation, samples were cut from random rolls of each material received and delivered to Geotechnics Laboratories of Pittsburgh, Pennsylvania for third party conformance testing. In accordance with the specifications, a minimum of one sample for every 100,000 square feet of material was collected for testing. At a minimum, the geotextile of each sample was tested for Thickness (ASTM D 5199), Mass/Unit Area (ASTM D 5261), Grab Tensile Strength (ASTM D 4632), Elongation at Break (ASTM D 4632), Trapezoidal Tear (ASTM D 4533), Mullen Burst Strength (ASTM D 3786), and Equivalent Opening Size (ASTM D 4751) as outlined in the specifications. Subsequent modifications were made to the conformance testing specifications. Please refer to Appendix K for details.

Members of the IT Resident Engineering group reviewed the results of the conformance tests. All of the conformance test results met the technical specifications.

Table 10, "Material Receiving Summary—Geotextile Liner," includes a summary of the CQA/QC activities involved with the materials inspection and a list of the conformance samples collected. A copy of the laboratory testing results has also been included in Appendix E.

5.7.1.4 Inspection of the Underlying HDPE Geomembrane for Cleanliness

The underlying HDPE geomembrane was inspected for dirt and debris prior to installation of the geocomposite. The surface of the HDPE geomembrane was swept before the geocomposite was installed. Any debris was removed.

5.7.1.5 Inspection of Panels

The geotextile panels were inspected for cleanliness, defects, and appearances of nonuniformity both before and after deployment. Any defective geotextile was removed and replaced. Sandbags were placed along the edges of unseamed panels to minimize the risk of uplift during strong winds.

5.7.1.6 Inspection of Joints

The joints of adjacent sheets of geotextile were inspected to ensure that the panels were properly butted and tied together. The ties were installed approximately 4 feet apart on the long seam, 6 inches apart on the cross seam, and as necessary to produce flat and uniform layers. The geotextile fused to the bottom of the geocomposite was inspected to ensure sufficient overlap, as well as a relatively unwrinkled layer. The geotextile fused to the top of the geocomposite panels was inspected to ensure a completely bonded seam without areas of burn-through. Sewn seams were inspected to ensure the stitching was complete and that there were no inconsistencies. Open stitches in sewn geotextiles were secured by additional sewing.

6.0 Vegetative Soil Cover

6.1 General

The following sections describe the earthwork and related activities completed during the construction of the VSC and the QC procedures related to the tasks. The specifications call for a minimum 1½ feet of clean soil as the vegetative soil layer.

6.2 Placement

Prior to placement of the VSC, documents certifying the cleanliness of the off-site borrow source and tests verifying the soil properties in accordance with the technical specifications were obtained.

Placement of the vegetative soil layer began on November 30, 2000, along the southeast corner of the Parcel E Landfill cap and was completed on March 24, 2001, along the west and northwest slope. The final topography for the top of the vegetative soil layer is shown on Figure 7. The material used for the VSC was obtained from several clean off-site borrow sources that are listed below:

- Alameda Creek, Fremont
- 3rd and Oak Street, Oakland
- BART Excavation, San Bruno
- Moscone Center Stockpile, Specialty Crushing
- Leona Quarry – Gallagher & Burk, Oakland
- 16th Street, San Francisco
- Airway and North Canyon, Livermore
- Oak Grove and El Camino, Menlo Park

The VSC materials were continuously inspected to ensure that they were clean and conformed to the specifications.

A 1½-foot-thick layer of clean soil has been placed over the approved geosynthetic cover system at Parcel E. The VSC was constructed in a minimum of two lifts: the first lift at a thickness of 12 inches and compacted by an Ingersoll Rand Pro Pac 100 compactor at a minimum of four passes; the second lift at a thickness of 6 inches was track-walked using a John Deere 750C and 850C bulldozer.

During placement of the first lift, the soil was transported to the fill area by end-dump trucks. The piles of soil were pushed out over the existing drainage layer by means of a CAT D6H bulldozer, a Komatsu D58E bulldozer, and a John Deere 750 C and 850 C bulldozer while a member of the IT Resident Engineering group and IT laborers closely inspected the drainage layer and other geosynthetics for damage during placement. Any roots or rocks larger than 2 inches in any dimension that did arrive in the soil were removed by "rock pickers" prior to the soil being pushed over the geocomposite layer. A John Deere 200 LC excavator was used to place bucket loads of soil at the perimeter of the VSC to minimize wrinkles in the geocomposite produced from the dozers pushing soil. Prior to forecasts of rain, the first lift was graded using a CAT 140G grader and compacted with HAMM smooth drum roller. This allowed runoff to drain properly without erosion of the VSC. Erosion control was also performed by placing hay bales where necessary.

6.2.1 Construction Quality Control Program

A QC program for the VSC was conducted in accordance with the construction QA/QC Plan (IT, 2000). The program was incorporated to verify and document that the placement and compaction of materials met the project technical specifications. The IT Resident Engineering group provided the field QC. In addition, the results of the QC program verified that the VSC was from clean, existing borrow sources, inorganic, resisted erosion, and promoted vegetative growth. Verification was determined by obtaining documents that supported the cleanliness of the off-site borrow material, and soil testing was conducted at a minimum frequency of one test per every 5,000 cubic yards (cy) of borrow material. The field inspections and tests that were performed are described in the following sections.

6.2.1.1 Soil Certification and Testing

Prior to placement of the VSC, documents and analytical data certifying the cleanliness of the off-site borrow source were obtained from the subcontractor. Samples were collected and tests conducted to verify that the soil properties met the specifications. The soil chosen was inorganic, free of debris and other deleterious materials, resisted erosion, and promoted vegetative growth. The collected samples were then tested for the following:

- Plasticity Index (PI) (ASTM D 4318)
- Sieve Analysis (ASTM D 422)

The PI tests were conducted in accordance with ASTM D 4318 at a frequency of one test per every 5,000 cy for each off-site borrow source. Due to the logistics of soil delivery and borrow source locations, PI tests were conducted as necessary by the Resident Engineer. A total of

22 tests were conducted. The acceptance criterion for the PI test was a value of 15 percent or less. Test results for the PI and respective sieve analysis of the off-site borrow materials are included in Appendix E. Table 11, "Vegetative Soil Cover—Summary of Plasticity Index Tests," provides a summary of the PI results. Soil samples HP010401-SS01 and HP-011801-MP2 had plasticity indices of 16 percent and 17 percent, respectively, higher than the specification. This small variance in the specification is not expected to adversely affect the performance of the cover system. The soil was allowed to be used in the field in the interest of maintaining production because a suitable source of competent vegetative soil cover material was difficult to find on a consistent basis. Documents and analytical data supporting the cleanliness of the off-site borrow material are provided in Appendix D.

The PI and sieve analysis testing was performed by Smith-Emery Geoservices under the direction of Pat Morrison. The laboratory is located at HPS, Building 114, San Francisco, California.

6.2.1.2 Field Inspection

The VSC field inspection included the following general tasks:

- Inspection of lift thickness for conformance
- Inspection of soil for rocks, roots, and other deleterious materials
- Surveying the lines and grade of the finished cover

The IT Resident Engineering group inspected the VSC placement and logged the daily activities. The construction logs for the VSC placement are provided in Appendix Q, "Construction Inspection for Vegetative Soil Cover."

6.2.1.3 Surveying

After final grading had been completed, the top of the VSC was surveyed for thickness verification. Survey points from the previous foundation layer as-built survey were resurveyed over the VSC on a minimum grid of 100 feet x 100 feet and the elevations were compared to determine the thickness of the soil cover. In any areas where the thickness was deficient, additional soil was placed and the top of the VSC was resurveyed. This procedure was conducted until the VSC was at the specified thickness of 1½ feet. A tabulation of survey and thickness verification data is presented in Table 12, "Vegetative Soil Cover—Thickness Verification." The final VSC topography is shown in Figure 7. Figure 7 also shows the locations of the existing wells and the installed settlement markers. A portion of the final cap on the western edge at the central drainage termination was not surveyed at publication time due to wet conditions in that area. This area will be surveyed once the area dries and access is available.

6.3 Seeding

For mitigating erosion-related impacts, the VSC was seeded with a special erosion control mix of seed. Hydroseeding was conducted on March 29 through 31, 2001. The temperature- and drought-resistant vegetation is indigenous; has a root system that does not extend into the geosynthetic drainage layer; needs little maintenance; is able to survive in low-nutrient soil; and has sufficient density to control the rate of erosion to less than 2.0 tons per acre per year (standard of practice of minimal long term maintanence). Seeding of the completed closure cover was conducted by means of the spray method. The erosion control seed mix was purchased from Carefree Greens of Newcastle, California. The hydroseeding mix was as follows and certifications for the seed mix are included in Appendix D:

- Zorrow Annual Fescue 15 pounds per acre (lbs/acre)
- Blando Brome 20 lbs/acre
- Rose Clover 20 lbs/acre
- Wimmera Rye 20 lbs/acre
- Mixed California wildflowers 3 lbs/acre

A minimum seeding rate of 78 lbs/acre was used. The following ingredients were mixed with clean potable water for application with the seed:

- 16-20-0 fertilizer 500 lbs/acre
- Wood fiber mulch 2000 lbs/acre
- Stabilizer (either type) R Type – 100 lbs/acre
M Type – 80 lbs/acre

6.4 Winterization

Starting in early October, work began to prepare the site for the upcoming rainy season. To prevent runoff of silt into the San Francisco Bay waters, a silt fence was constructed between the bay and the Parcel E Landfill. The foundation layer was graded and compacted with a smooth drum roller to promote drainage. VSC was also smooth drum rolled to prevent ponding.

6.5 Erosion Control

Riprap, hay bales, and silt fencing have been placed along the ditches and at the inlets/outlets of all pipes. These items were placed as erosion and sedimentation controls to reduce the velocity of the runoff and protect the integrity of the cover system. Riprap placed at the outlet of the central drainage ditch is shown in Figure 6.

Water within the VSC is collected in the central drainage collection ditch. The drainage ditch was constructed on top of the foundation layer with a trenching machine and has a depth and width of 12 inches. Both GCL and HDPE lined the ditch. A "burrito" wrap was constructed within the ditch using 8-oz. geotextile containing pea gravel and a 4-inch flexible perforated drainage pipe. The pea gravel surrounded the drainage pipe and was flush to the final grade of the foundation layer. Geocomposite was placed over the top of the ditch. This drainage feature of a perforated pipe encased in gravel and geotextile works efficiently in collecting and diverting concentrated flow and percolation away from the landfill. This system also reduces head on the HDPE geomembrane liner further precluding infiltration into the landfill. A cross-section of the drainage ditch is shown in Figure 6. Material certifications for the pipe and gravel are provided in Appendix D.

Surface water runoff throughout the landfill cap is diverted and managed through a central drainage system. On March 26, 2001, a central drainage ditch was installed on the VSC. Riprap protection is required in the central area over the VSC to mitigate erosion impacts during the winter season. This component of the cover system was not included in the original design when construction work began. It is critical to protect the underlying geosynthetics and control erosion during winter rains.

The VSC was excavated to a minimum of 6 inches and TC Mirafi 160N nonwoven geotextile was placed on the soil cover. Approximately 300 tons of mattress gabion rock (3 x 6 inches) was placed on the geotextile. The plan width of rock is approximately 10 feet and the nominal thickness is approximately 9 inches. A cross section of this ditch is shown in Figure 6. Material certifications for the drainage gravel and the geotextile can be found in Appendix D.

A photo log showing the construction activities, from foundation placement to hydroseeding, may be found in Appendix R, "Photo Log."

7.0 Summary

The 2000 to 2001 closure construction activities at the HPS Parcel E Landfill included:

- Site preparation
- Installation, testing, and approval of a 2-foot-thick foundation layer
- Installation/Extension of monitoring wells and well points
- Installation of a GCL over the approved foundation
- Installation of the 80-mil HDPE geomembrane layer
- Installation of a geocomposite drainage layer
- Placement of a 1½-foot-thick VSC with winter seeding
- Construction of a temporary surface water collection/drainage system
- Hydroseeding

Interim closure of the HPS Parcel E Landfill was performed in accordance with the approved specifications, as described in this report.

The extensive QA and QC procedures performed, as specified in the CQA/QC program, are documented by the test results and inspections summarized in this report. These procedures substantiate that the interim closure of the HPS Parcel E Landfill was performed satisfactorily as designed and constructed.

8.0 References

IT Corporation, 2000, *Technical Specifications, Hunters Point Shipyard Parcel E Landfill Cap Construction, September 20*.

FIGURES

IMAGE	X-REF	OFFICE	DRAWING NUMBER
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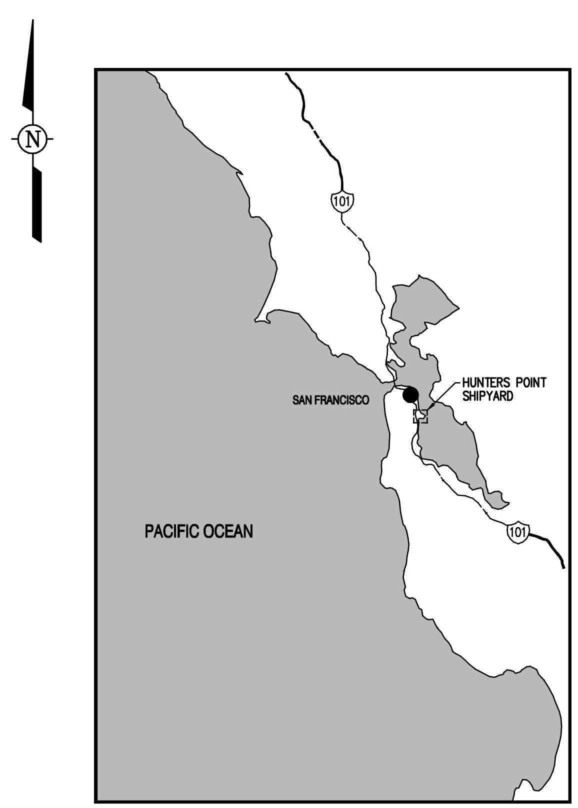
NOT TO SCALE



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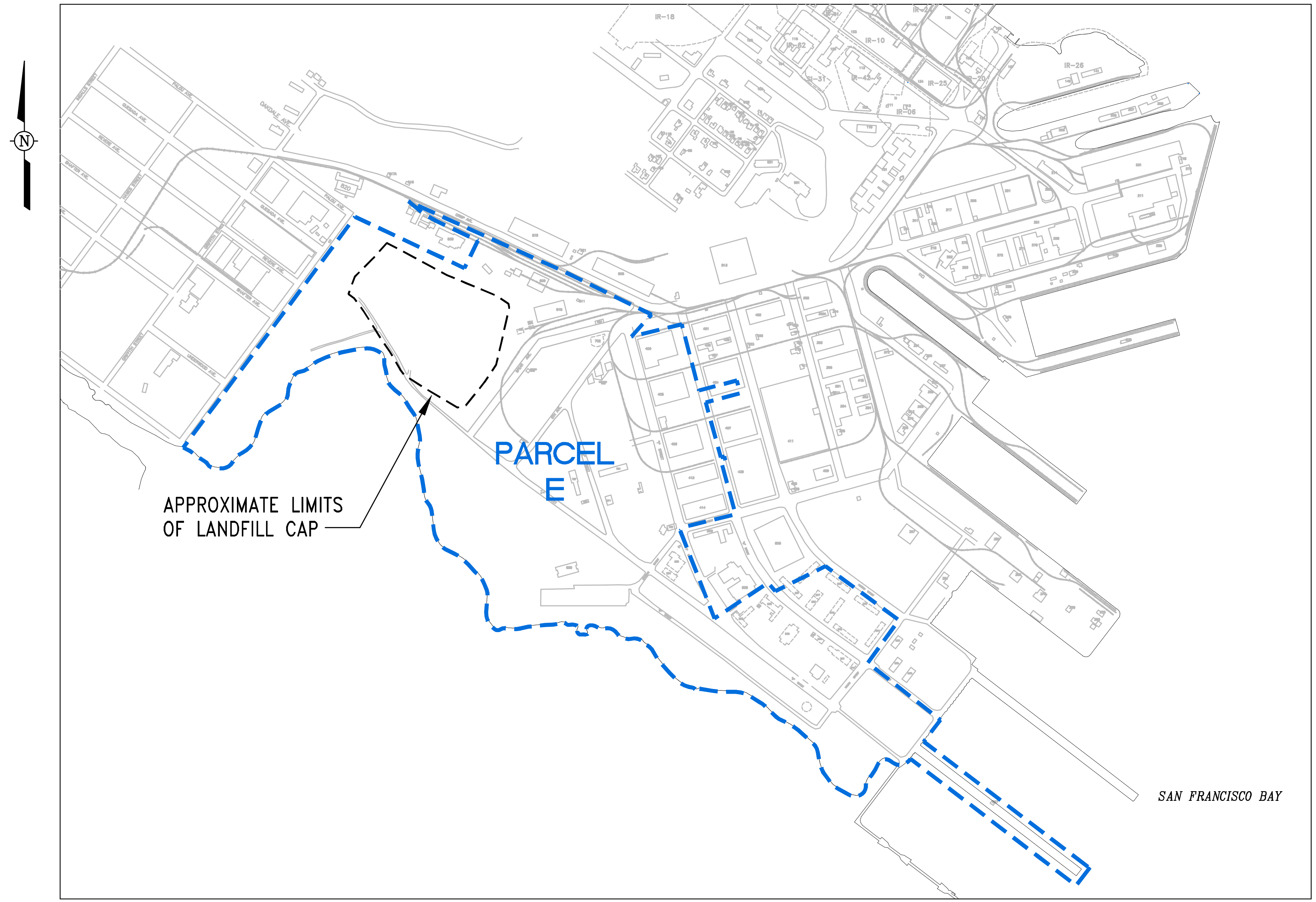


SCALE

0 400 800 1200 FEET

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE

IT CORPORATION	DEPARTMENT OF THE NAVY ENGINEERING FIELD ACTIVITIES WEST SAN BRUNO, CALIFORNIA CTO 025				
	SITE LOCATION MAP HUNTERS POINT SHIPYARD, PARCEL E SAN FRANCISCO, CALIFORNIA				
DESIGNED BY	B. YUREK	4/11/01	CHECKED BY		
DRAWN BY	T .SCHAEFFER	4/24/01	APPROVED BY		
SCALE: AS SHOWN	DRAWING NO. 812575-D9		FIGURE NO. 1	REVISION NO. 0	

FORMAT REVISION 2/26/99

IMAGE	X-REF	OFFICE	DRAWING NUMBER
---	---	Concord	812575-D5

LEGEND

PRE-CONSTRUCTION TOPOGRAPHY

LIMIT OF INTERIM COVER (ANCHOR TRENCH)

SCALE IN FEET: 0 50 100

REFERENCE:
PRE-CONSTRUCTION TOPOGRAPHY SURVEYED BY FORESITE ENGINEERING, 2000

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE

IT CORPORATION

DEPARTMENT OF THE NAVY
HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

PRE CONSTRUCTION TOPOGRAPHY
HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

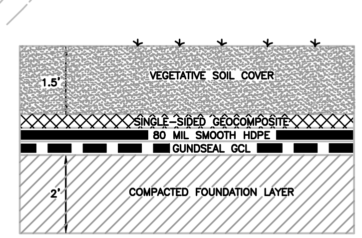
DESIGNED BY	D. Hullings	10/1/00	CHECKED BY	
DRAWN BY	R. Bricker	4/23/01	APPROVED BY	

SCALE:	DRAWING NO.	FIGURE NO.	REVISION NO.
AS SHOWN	812575-D5	2	0

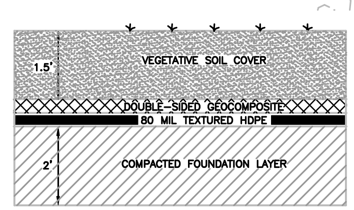
VERIFY SCALE 0 1"

FORMAT REVISION 2/26/99

DRAWING NUMBER 812575–D6 | OFFICE Concord | X–REF --- | IMAGE ---



COVER A
NOT TO SCALE



COVER B
NOT TO SCALE

TYPICAL CLOSURE COVER SECTIONS

LEGEND

COVER A

COVER B

SCALE IN FEET: 0 – 50 – 100

NOTE:
TOPOGRAPHY SHOWN IS AS–BUILT OF TOP OF THE FOUNDATION LAYER.

REFERENCE:
FOUNDATION LAYER CONTOURS SURVEYED BY FORESITE ENGINEERING, 2000.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE

IT CORPORATION

DEPARTMENT OF THE NAVY
HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

PLAN AND LOCATIONS OF
FINAL CLOSURE COVERS
HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

DESIGNED BY	D. Hullings	10/1/00	CHECKED BY	
DRAWN BY	R. Bricker	4/24/01	APPROVED BY	
SCALE: AS SHOWN	DRAWING NO. 812575–D6	FIGURE NO. 3	REVISION NO. 0	

FORMAT REVISION 2/26/99

IMAGE	X-REF	OFFICE	DRAWING NUMBER
---	---	Concord	812575-D7

REFERENCE:

FOUNDATION LAYER CONTOURS, LINER LIMITS, AND SAMPLE LOCATIONS SURVEYED BY FORESITE ENGINEERING, 2000.

LEGEND

2' FOUNDATION LAYER CONTOURS

UCS SAMPLE LOCATIONS • HP092800-UC02

HYDRAULIC CONDUCTIVITY SAMPLE LOCATIONS ⊕ HP110600-UC02

SCALE IN FEET: 0 50 100

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE

IT CORPORATION

DEPARTMENT OF THE NAVY
HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

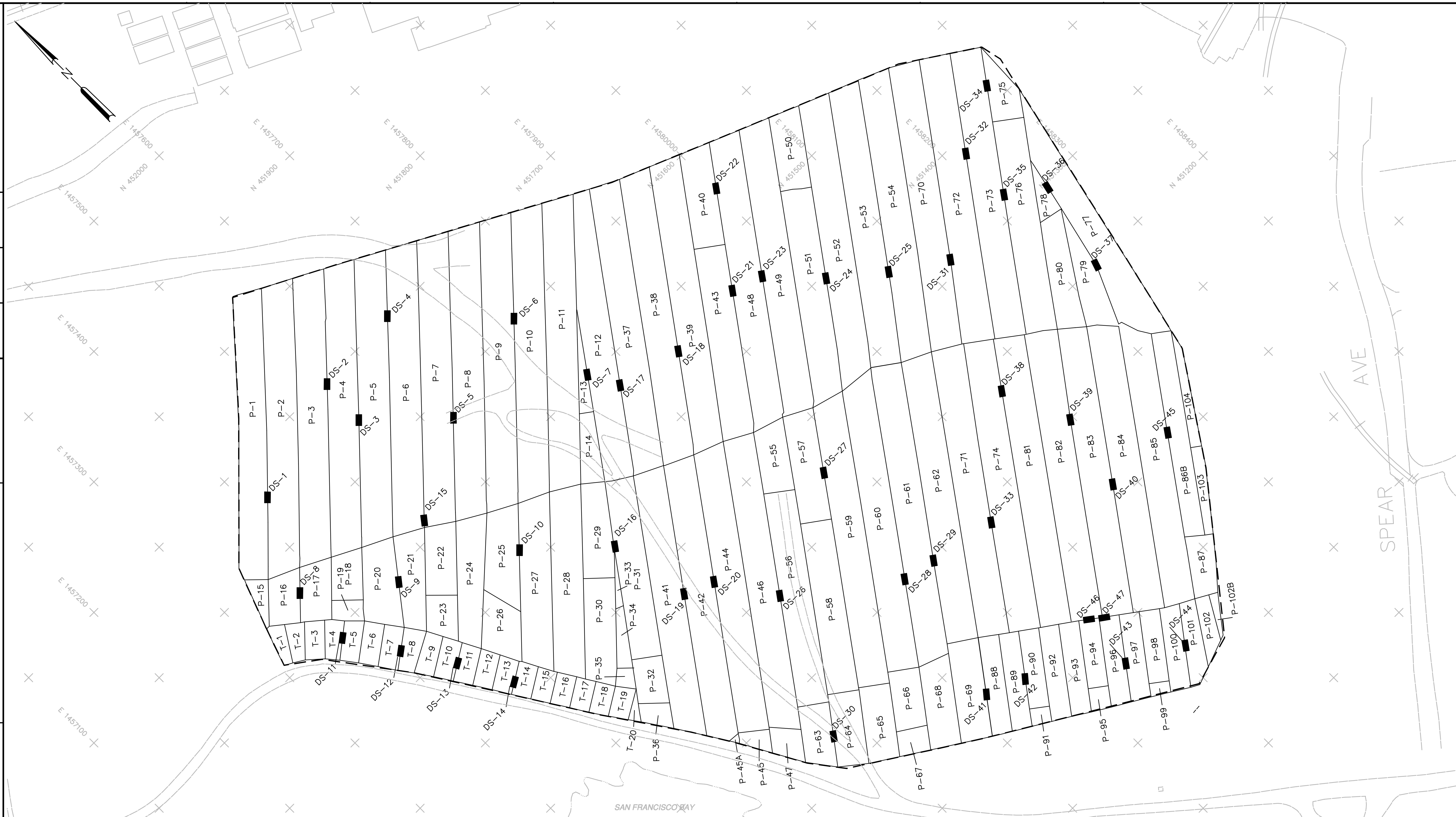
FOUNDATION LAYER TOPOGRAPHY
WITH PASSING TEST LOCATIONS
HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

DESIGNED BY	D. Hullings	10/1/00	CHECKED BY	
DRAWN BY	R. Bricker	4/24/01	APPROVED BY	

SCALE:	DRAWING NO.	FIGURE NO.	REVISION NO.
AS SHOWN	812575-D7	4	0

FORMAT REVISION 2/26/99

IMAGE	X-REF	OFFICE	DRAWING NUMBER
---	---	Concord	812575-D8



NOTES:

T-# INDICATES TEXTURED HDPE GEOMEMBRANE.

P-# INDICATES SMOOTH HDPE GEOMEMBRANE.

LEGEND

LINER LIMITS (ANCHOR TRENCH)

DESTRUCT SAMPLE LOCATIONS DS-38

REFERENCE:
PANELS AND DESTRUCT SAMPLES SURVEYED BY FORESITE ENGINEERING, 2000.

FORMAT REVISION 2/26/99

VERIFY SCALE 0 1"

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE

IT CORPORATION

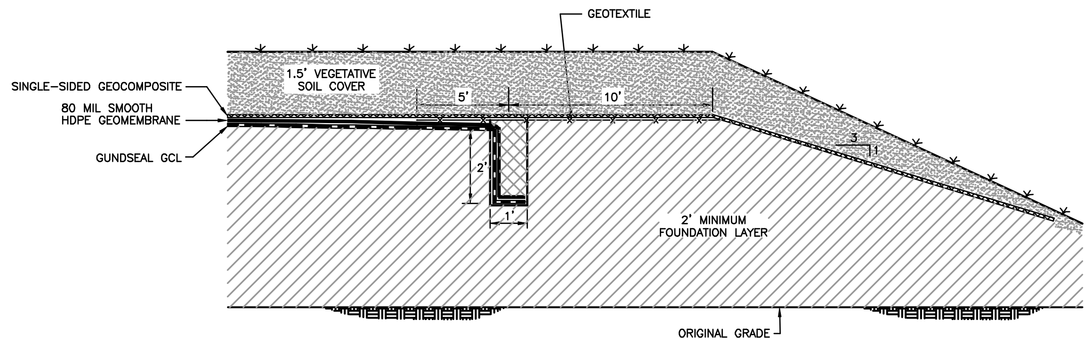
DEPARTMENT OF THE NAVY
HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

80-MIL HDPE PANEL LAYOUT WITH DESTRUCTIVE SAMPLE LOCATIONS
HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

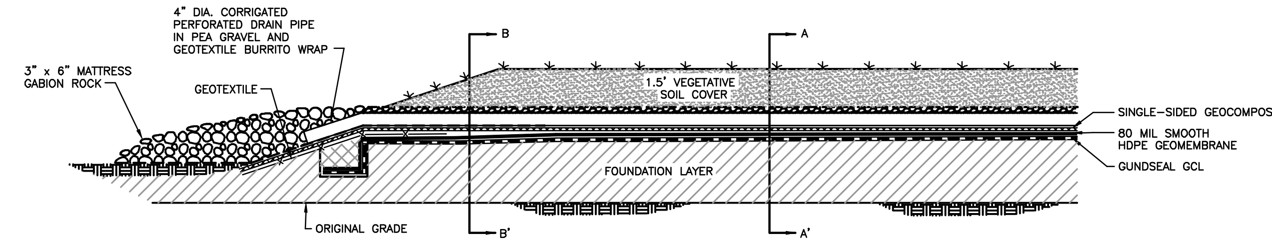
DESIGNED BY	D. Hullings	10/1/00	CHECKED BY	
DRAWN BY	R. Bricker	4/24/01	APPROVED BY	

SCALE:	DRAWING NO.	FIGURE NO.	REVISION NO.
AS SHOWN	812575-D8	5	0

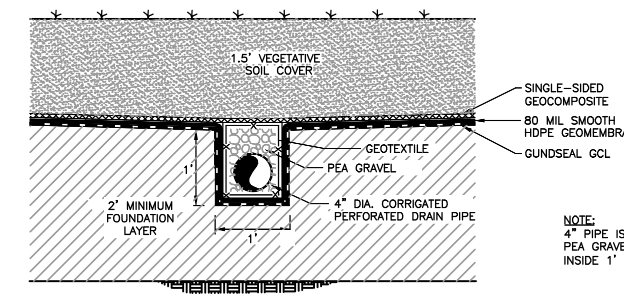
DRAWING NUMBER	OFFICE	X-REF	IMAGE
812575–D4	Concord	---	---



SECTION A/3

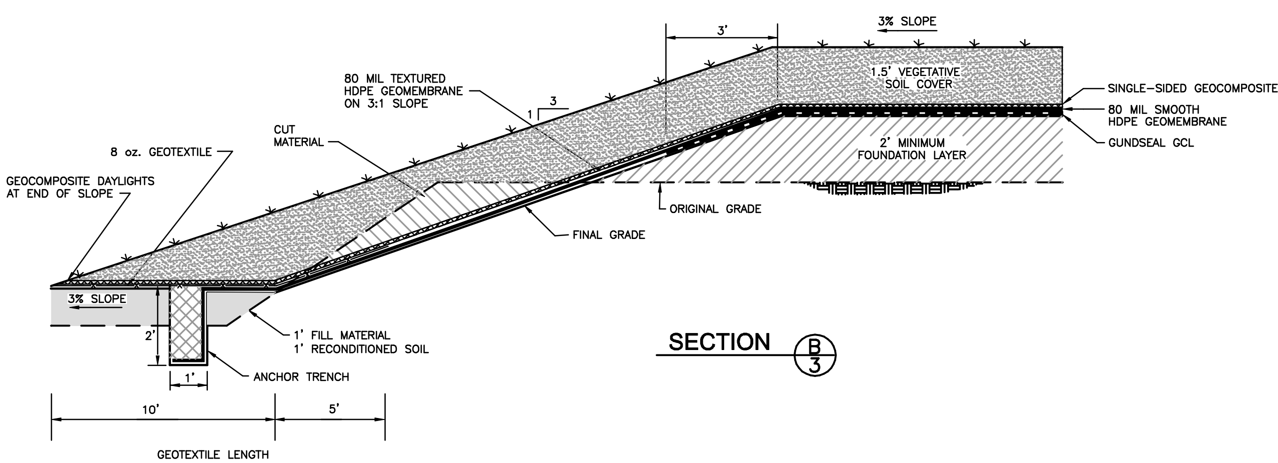


SECTION E/3

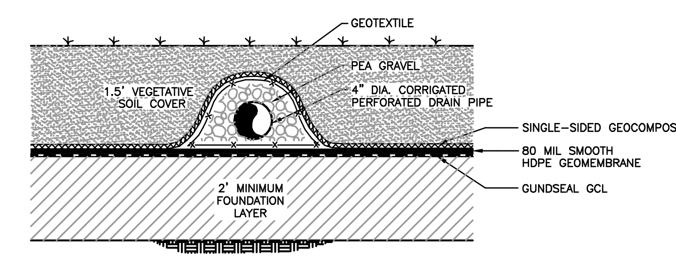


NOTE:
4" PIPE IS WRAPPED WITH PEA GRAVEL INSIDE GEOTEXTILE, INSIDE 1' X 1' TRENCH.

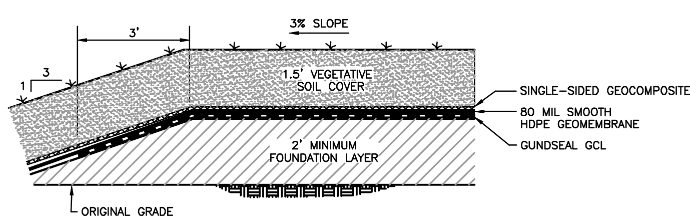
SECTION A–A'



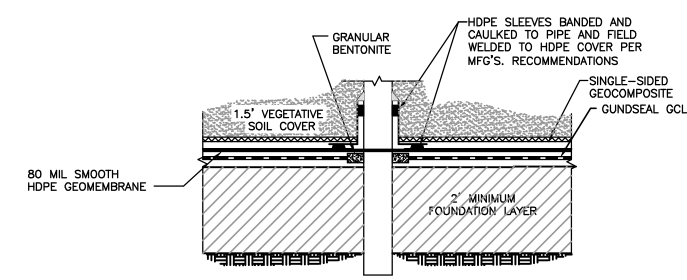
SECTION B/3



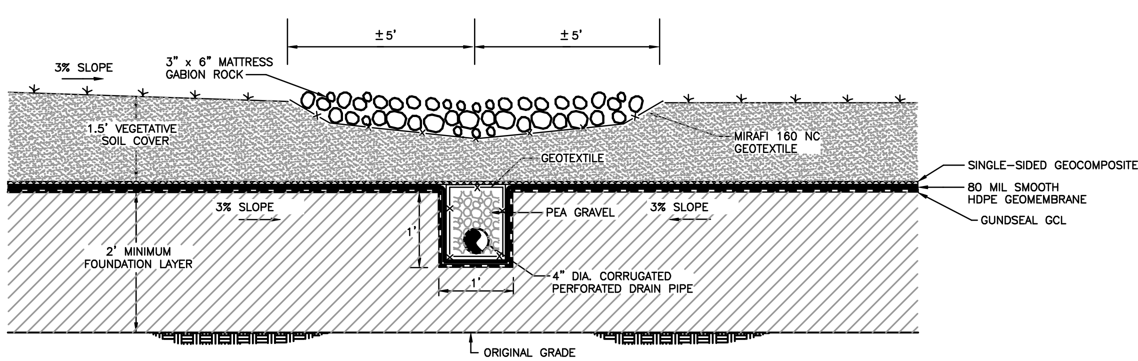
SECTION B–B'



SECTION C/3



SECTION F/3
HDPE PIPE BOOT



SECTION D/3
CENTRAL DRAINAGE

VERIFY SCALE 0 1"

FORMAT REVISION 2/26/99

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE

IT CORPORATION

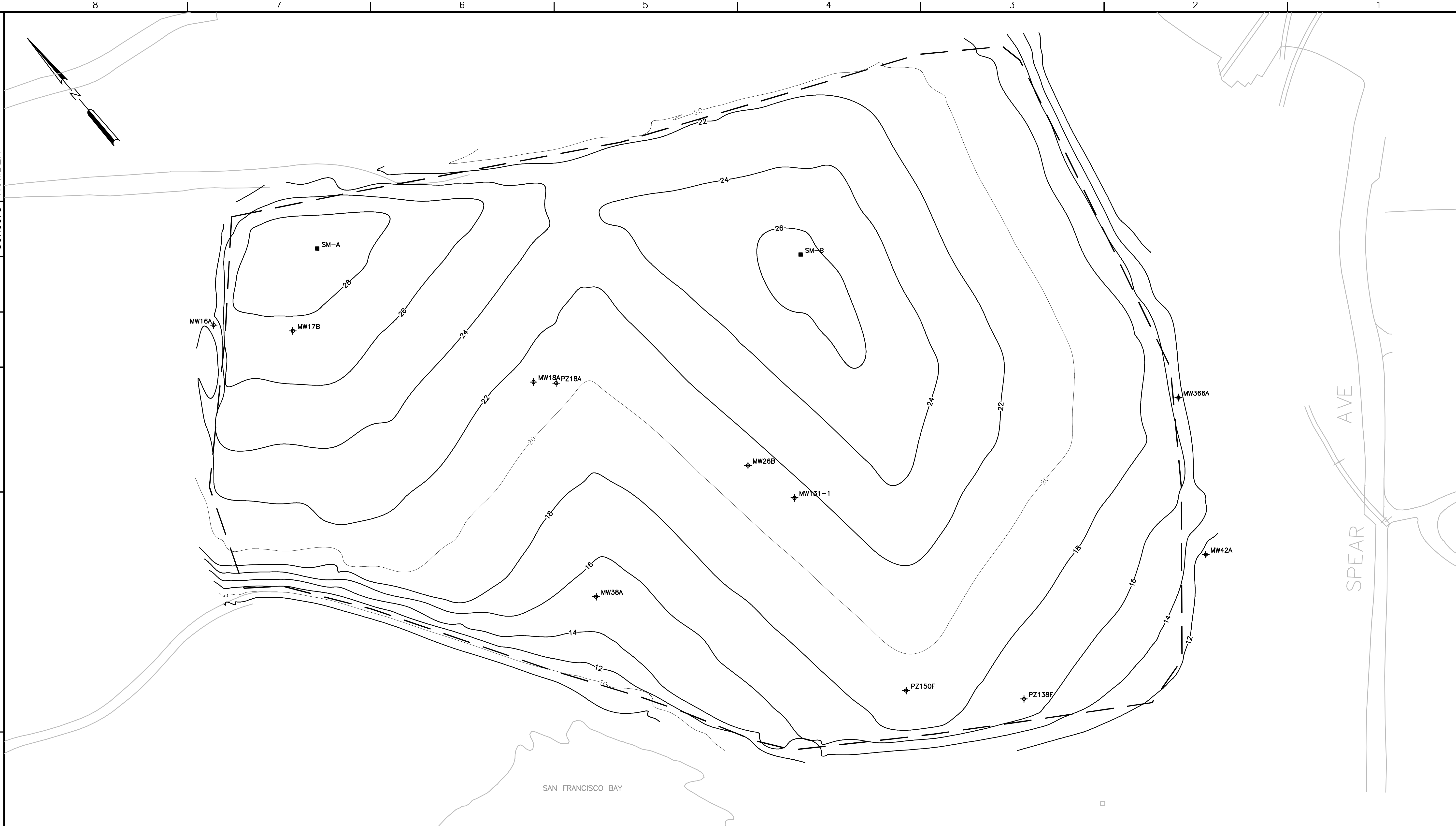
DEPARTMENT OF THE NAVY
HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

CLOSURE COVER
SECTIONS AND DETAILS
HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

DESIGNED BY	D. Hullings	12/18/00	CHECKED BY	
DRAWN BY	R. Bricker	4/25/01	APPROVED BY	

SCALE:	DRAWING NO.	FIGURE NO.	REVISION NO.
NOT TO SCALE	812575–D4	6	0

IMAGE	X-REF	OFFICE	DRAWING NUMBER
---	---	Concord	812575-D11



VERIFY SCALE 0 1"

FORMAT REVISION 2/26/99

REFERENCE:
FINAL TOPOGRAPHY SURVEYED BY FORESITE ENGINEERING, 2001

LEGEND

FINAL TOPOGRAPHY
ANCHOR TRENCH
MONITORING WELL MW38A
SETTLEMENT MARKER SM-A

SCALE IN FEET
0 50 100

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE

IT CORPORATION

DEPARTMENT OF THE NAVY
HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

FINAL TOPOGRAPHY

HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

DESIGNED BY	D. Hullings	12/18/00	CHECKED BY	
DRAWN BY	R. Bricker	5/3/01	APPROVED BY	

SCALE:	DRAWING NO.	FIGURE NO.	REVISION NO.
AS SHOWN	812575-D11	7	0

TABLES

Table 1
Hunters Point Parcel E Landfill Cap Monitoring Well Location Data

Well ID	Northing (feet)	Easting (feet)	Elevation (feet)
MW60-1	450982.5	1457653	14.69
MW17B	451697	1457522	29.95
MW16A	451755	1457458	23.85
MW18A	451490	1457688	22.94
PZ18A	451474	1457707	22.34
MW38A	451297	1457594	17.30
MW26B	451274	1457813	23.39
MW131-1	451215	1457828	23.78
PZ150F	450976	1457792	21.27
PZ138F	450889	1457887	18.76
MW42A	450888	1458138	14.03
MW366A	451038	1458221	16.74

[NOTE: Shaded numbers will change with the final survey—that's why they are shaded]

Table 2
Hunters Point Parcel E Landfill Cap Debris Removal
Summary of Removed Debris Quantities

Date	Truck Loads of Debris Removed			
	Burn Debris Vegetation	Burn Debris Soil	Burn Debris RxR Ties	Concrete Rubble
11/30/00	6	—	—	14
12/01/00	—	16	5	9
12/04/00	—	28	—	—
12/05/00	—	9	—	—
12/06/00	—	1	—	—
Total Loads Removed	**6**	**54**	**5**	**23**

TABLE 3
Hunters Point Parcel E Landfill Cap
Foundation Approval
Summary of Unconfined Compressive Strength Tests

Sample Number	Test Location Northing (ft)	Test Location Easting (ft)	Test Location Elevation (ft)	Test Location	Unconfined Compressive Strength (tsf) Actual	Unconfined Compressive Strength (tsf) Criteria	Unconfined Compressive Strength (tsf) P/F	Moisture Content (%)	Wet Density (pcf)	Retest Information
HP 092100-UC01	451065.7	1457972.9	14.3	S'ly End	0.7	1.0	F	8.8	110.6	NA
HP 092100-UC02	451190.6	1457859.2	16.8	S'ly End	1.2	1.0	P	14.8	123.4	NA
HP 092100-UC03	451449.8	1457601.5	16.6	S'ly End	NA	1.0	NA	NA	NA	Untestable
HP 092100-UC04	451605.9	1457336.3	18.1	S'ly End	NA	1.0	NA	NA	NA	Untestable
HP 092100-UC05	451781.6	1457540.7	22.0	S'ly End	NA	1.0	NA	NA	NA	Untestable
HP 092300-UC01	451065.7	1457972.9	14.3	S'ly End	1.7	1.0	P	24.3	129.3	Re-test of Sample No. HP 092100-UC01
HP 092300-UC02	451395.3	1457820.5	16.8	S'ly End	NA	1.0	NA	NA	NA	Untestable
HP 092800-UC01	451713.5	1457573.5	23.3	N'ly End	1.5	1.0	P	17.2	129.6	NA
HP 092800-UC02	451540.7	1457421.5	19.2	N'ly End	3.1	1.0	P	12.0	143.0	NA
HP 092800-UC03	451426.2	1457721.4	15.7	S'ly End	1.4	1.0	P	16.7	135.3	NA
HP 092900-UC01	451106.5	1457728.3	14.2	S'ly End	0.4	1.0	F	13.7	133.0	NA
HP 092900-UC02	451537.3	1457917.9	14.7	S'ly End	2.7	1.0	P	10.3	136.2	NA
HP 092900-UC03	450944.5	1457928.6	19.4	S'ly End	4.6	1.0	P	10.4	121.1	NA
HP 100200-UC01	451089.8	1457792.0	15.6	S'ly End	1.3	1.0	P	14.5	134.1	NA
HP 100200-UC02	450984.0	1458037.7	14.9	S'ly End	3.7	1.0	P	9.2	138.9	NA
HP 100200-UC03	451360.3	1458121.0	19.8	S'ly End	1.5	1.0	P	13.8	137.7	NA
HP 100200-UC04	451344.8	1457628.7	14.6	N'ly End	1.5	1.0	P	12.4	135.9	NA
HP 100200-UC05	451501.2	1457466.7	19.9	N'ly End	2.2	1.0	P	12.1	135.5	NA
HP 100200-UC06	451723.3	1457568.4	24.9	N'ly End	2.5	1.0	P	13.7	137.3	NA
HP 100300-UC01	451168.1	1457780.3	16.6	N'ly End	1.9	1.0	P	12.3	138.1	NA
HP 100300-UC02	451358.8	1457592.0	15.4	S'ly End	2.6	1.0	P	13.5	126.2	NA
HP 100400-UC01	451401.5	1457769.2	18.5	S'ly End	1.4	1.0	P	13.1	136.9	NA
HP 100400-UC02	451534.9	1457720.5	20.3	N'ly End	0.7	1.0	F	14.8	127.7	NA
HP 100600-UC01	451476.9	1457555.0	19.3	N'ly End	4.8	1.0	P	13.3	135.7	NA
HP 100600-UC02	451615.2	1457545.0	23.3	N'ly End	2.7	1.0	P	13.5	134.5	NA
HP 100600-UC03	451639.6	1457660.8	21.0	N'ly End	NA	1.0	NA	NA	NA	Untestable due to bent Shelby tube
HP 100600-UC04	451438.6	1457795.1	19.4	S'ly End	1.6	1.0	P	12.0	134.7	NA
HP 100600-UC05	451266.4	1457844.5	18.8	S'ly End	2.7	1.0	P	8.7	134.2	NA
HP 101000-UC01	451639.6	1457660.8	21.0	N'ly End	5.0	1.0	P	7.4	133.9	Re-test of Sample No. HP 100600-UC03
HP 101200-UC01	450992.0	1457927.2	16.1	S'ly End	1.6	1.0	P	13.6	129.6	NA
HP 101200-UC02	451013.1	1458047.4	15.9	S'ly End	1.5	1.0	P	14.7	137.3	NA
HP 101200-UC03	451358.5	1457760.2	17.8	S'ly End	0.9	1.0	F	14.6	137.4	NA
HP 101700-UC01	451170.4	1458159.0	18.2	S'ly End	1.8	1.0	P	14.2	140.6	NA
HP 101700-UC02	451362.4	1458182.1	18.5	S'ly End	3.5	1.0	P	9.2	126.3	NA
HP 101700-UC03	451682.1	1457751.5	23.5	N'ly End	1.6	1.0	P	9.6	119.5	NA
HP 101700-UC04	451534.9	1457720.5	20.3	N'ly End	1.8	1.0	P	14.2	140.6	Re-test of Sample No. HP 100400-UC02
HP 101700-UC05	451358.5	1457760.2	17.8	S'ly End	1.0	1.0	P	12.9	135.0	Re-test of Sample No. HP 101200-UC03
HP 101900-UC01	451106.5	1457728.3	14.2	N'ly End	1.5	1.0	P	8.7	124.9	Re-test of Sample No. HP 092900-UC01
HP 111300-UC01	451139.0	1458173.0	17.9	S'ly End	1.7	1.0	P	9.6	124.9	NA
HP 111300-UC02	450980.6	1458023.0	16.3	S'ly End	6.2	1.0	P	13.4	132.9	NA

Table 4
Hunters Point Parcel E Landfill Cap Foundation Approval
Summary of Hydraulic Conductivity Tests

Sample Date	Sample Number	Test Location			Test Location	Hydraulic Conductivity* k (cm/sec) ASTM 5084
		Northing (feet)	Easting (feet)	Elevation (feet)		
10/23/00	HP-102300-UC01	451681.7	1457717.2	24.7	N'ly End	2.19E-07
11/06/00	HP-110600-UC02	451410.3	1457464.0	17.7	N'ly End	2.70E-05
11/09/00	HP-110900-UC03	450994.7	1457779.0	17.2	S'ly End	2.53E-07
11/09/00	HP-110900-UC04	451046.7	1458118.0	17.4	S'ly End	1.49E-07
11/09/00	HP-110900-UC05	451423.3	1458063.0	22.8	S'ly End	9.84E-08

**Samples were taken at final grade of foundation layer*

Table 5
Material Quantity Summary**

		Geosynthetic Clay Liner		80-Mil HDPE		Geocomposite		Geotextile
Landfill Areas	**Required Cover**	**Non-reinforced**	**Reinforced**	**Smooth**	**Textured**	**Single-sided**	**Double-sided**	**8 oz.**
3-8%	A	611,388	29,250	608,895	0	592,340	0	0
>8%	B	0	0	0	19,802	0	31,050	0
All*	A/B	0	0	0	0	28,660	0	33,600
Totals		**611,388**	**29,250**	**608,895**	**19,802**	**621,000**	**31,050**	**33,600**

***Areas of application included perimeter at anchor trench and central drainage*

****All quantities are in square feet.*

Table 6
Hunters Point Parcel E Landfill Cap Material Receiving Summary
GundSeal® GCL

Date of Delivery	Delivery Slip No.	Certifications Received	GundSeal® (HDPE used as backing) Quantity (ft²)	Conformance Sample	GCL Roll No.	HDPE Roll No.	HDPE Lot No.	Bentonite Mass/Area (P / F)	Bentonite Swell Index (P / F)	Thickness (P / F)	Tensile Strength & Elongation (P / F)	Puncture Resistance (P / F)	Tear Resistance (P / F)	Comments
09/28/00	3248	Y	34,895	21035323	21035323	104102704	7131265	P	P	P	P	P	P	
09/28/00	3255	Y	34,615	—	—	—	—	—	—	—	—	—	—	
09/29/00	3254	Y	34,930	—	—	—	—	—	—	—	—	—	—	
09/29/00	3247	Y	35,000	—	—	—	—	—	—	—	—	—	—	
09/29/00	3256	Y	35,000	21035411	21035411	104106859	7101043	P	P	P	P	P	P	
10/02/00	3259	Y	34,930	21035400	21035400	104106869	7101043	P	P	P	P	P	P	
10/02/00	3258	Y	36,750	—	—	—	—	—	—	—	—	—	—	
10/02/00	3257	Y	35,875	—	—	—	—	—	—	—	—	—	—	
10/02/00	3260	Y	34,685	—	—	—	—	—	—	—	—	—	—	
10/03/00	3262	Y	35,000	—	—	—	—	—	—	—	—	—	—	
10/04/00	3264	Y	34,475	—	—	—	—	—	—	—	—	—	—	
10/05/00	3267	Y	34,335	21035426	21035426	104106868	7101043	P	P	P	P	P	P	
10/05/00	3263	Y	34,580	—	—	—	—	—	—	—	—	—	—	
10/05/00	3265	Y	34,930	21035274*	21035274	104105984	7100711	P	P	P	F/P	P	P	Retested, Passed 10/25/00
10/05/00	3266	Y	34,580	21035443	21035443	104106856	7101043	P	P	P	P	P	P	
10/06/00	3507	Y	35,735	—	—	—	—	—	—	—	—	—	—	
10/09/00	3506	Y	35,000	21035431	21035431	104106867	7101043	P	P	P	P	P	P	
10/09/00	3508	Y	33,915	21035423*	21035423	104106868	7101043	P	P	P	F/P	P	P	Retested, Passed 10/31/00
		Totals	**629,230**	**8**										

** Sample failed while testing the HDPE for the elongation at break in the machine direction (MD).*

Table 7
Hunters Point Parcel E Landfill Cap Material Receiving Summary
Bentomat ST® GCL

Date of Delivery	Delivery Slip No.	Certifications Received	Bentomat ST® GC				Mentonite Mass/Area	Bentonite Swell Index	Comments
			Quantity (ft2)	Conformance Sample	Roll No.	Lot No.	P / F		
11/16/00	3542	Y	18,000	7279-081500-11	7279	200031LO	P	P	Lot numbers of the conformance samples represent those that were used at the Hunters Point Parcel E Landfill cap. Samples were previously taken at IT Panoche Landfill site.
11/17/00	3558	Y	33,750	6692-072800-2	6292	200030LO	P	P	
		Totals	**51,750**	**2**					

Table 8
Hunters Point Parcel E Landfill Cap Material Receiving Summary
80-Mil HDPE Liner

Date of Delivery	Delivery Slip No.	Certifications Received	30-Mil HDPE (Smooth / Textured)				Thickness	Tensile Strength & Elongation	Puncture Resistance	Tear Resistance
			Quantity (ft²)	Conformance Sample	Roll No.	Lot No.	P / F			
09/27/00	4079	Y	99,539	—	*106104659	7101070	—	—	—	—
09/27/00	4414	Y	110,400	106104658	*106104658	7101070	P	P	P	P
09/27/00	3755	Y	110,400	106104635	*106104635	7101070	P	P	P	P
09/28/00	5155	Y	93,669	HP-092800-HDPET02	t105104416	7100283	P	P	P	P
09/28/00	5155	Y	—	HP-092800-HDPES01	*106104676	7101061	P	P	P	P
09/28/00	7669	Y	110,400	106104680	*106104680	7101061	P	P	P	P
09/28/00	7669	Y	—	106104687	*106104687	7101061	P	P	P	P
09/29/00	4223	Y	110,400	106104699	*106104699	7101061	P	P	P	P
10/06/00	4860 A	Y	11,040	—	*106104701	7101061	—	—	—	—
11/18/00	3427	Y	48,357	105105637	**105105637	7100714	P	P	P	P
		Totals	**694,205**	**8**						

** Smooth Black HDPE*

*** Smooth Black / White HDPE*

t Textured Black / White HDPE

Table 9
Hunters Point Parcel E Landfill Cap Material Receiving Summary
Geocomposite

Date of Delivery	Delivery Slip No.	Certifications Received	Geocomposite				Thickness	Density	Transmissivity
			Quantity (ft²)	Conformance Sample	Roll No.	Lot No.	P / F		
09/29/00	1121	Y	84,000	111123990	111123990	B50935	P	P	P
09/29/00	1136	Y	84,000	111124051	111124051	B50935	—	—	—
09/29/00	1136	Y		111124050	111124050	B50935	P	P	P
09/29/00	7001B	Y	84,000	111124040	111124040	B50935	—	—	—
09/29/00	7001B	Y		111124108	111124108	B50935	P	P	P
10/02/00	TP-7006B	Y	81,424	111124119	111124119	B50935	—	—	—
10/02/00	TP-7006B	Y		111124329	111124329	B50933	P	P	P
10/05/00	2382	Y	80,220	111124317	111124317	B50933	—	—	—
10/05/00	2382	Y		111124339	111124339	B50933	—	—	—
10/05/00	2382	Y		111124335	111124335	B50933	P	P	P
10/05/00	2382	Y		111124328	111124328	B50933	P	P	P
10/06/00	1150	Y	84,000	111124286	111124286	B50933	—	—	—
10/06/00	1150	Y		111124349	111124349	B50933	—	—	—
10/06/00	1143	Y	64,120	111124332	111124332	B50933	—	—	—
10/06/00	1143	Y		111124086	111124086	B50935	—	—	—
10/06/00	7013	Y	84,000	111124079	111124079	B50935	P	P	P
10/06/00	7013	Y		111125386**	111125386	B50939	—	—	—
11/18/00	3427	Y	51,800	111124444	111124444	B50933	P	P	P
		Totals	**697,564**	**8**					

**Number refers to quantity of all rolls listed on that delivery slip*
***Fabrinet, all others listed are Fabricap w/SI 651 - 6 oz.*

Table 10
Hunters Point Parcel E Landfill Cap Material Receiving Summary
Geotextile

Date of Delivery	Delivery Slip No.	Certifications Received	Geotextile (Mirafi 180N - 8 oz.)				Mass/Unit Area	Thickness	Grab Tensile Strength	Elongation at Break	Trapezoidal Tear	Mullen Burst Strength	Equivalent Opening Size
			Quantity (ft2)	Conformance Sample	Roll No.	Lot No.	P / F						
10/21/00	39163	Y	9000	10092076	10092076	11096E	P	P	P	P	P	P	P
10/25/00	39320	Y	40500	—	—	—	—	—	—	—	—	—	—
		Totals	**49,500**	**1**									

Table 11
Hunters Point Parcel E Landfill Cap Vegetative Soil Cover Approval
Summary of Plasticity Index Tests Results

Sample Date	Sample Number	Sample Information		Plasticity Index	Soil Description
		Soil Source	Sample Location		
10/02/00	HP-DD Fremont-SA01	Alameda Creek, Fremont	At Source	9.2	Brown Clayey Sandy Silt
10/02/00	HP-100200-Fremont	Alameda Creek, Fremont	NW Stockpile, Parcel E	6.9	Gray Brown Clayey Sand (Silt)
11/30/00	HP-113000-OAK01	3rd & Oak St., Oakland	SE Stockpile, Parcel E	NP	Gray Brown Clayey Silty Sand
12/01/00	HP-120100-FR01	Alameda Creek, Fremont	SE Stockpile, Parcel E	4	Gray Brown Clayey Silty Sand
12/04/00	HP-120400-SB01	Bart, San Bruno	San Bruno Excavation	NP	Olive Brown Silty Sand
12/04/00	HP-120400-SB02	Bart, San Bruno	San Bruno Excavation	3	Light Brown Silty Sand
12/13/00	HP-121300-Moscone01	Moscone Ctr. Excavation	Stockpile at Specialty Crushing	NP	Light Brown Silty Sand
12/14/00	HP-121400-MC01	Moscone Ctr. Excavation	End Dump Pile, Parcel E	NP	Yellow Brown Sandy Silty
12/18/00	HP-121800-LQ01	Leona Quarry, Oakland	Stockpile at Leona Quarry	NP	Orange Brown Silty Sand
12/21/00	HP-122100-SB01	Bart, San Bruno	End Dump Pile, Parcel E	10	Olive Brown Clayey Sand
01/03/01	HP-010301-LQ01	Leona Quarry, Oakland	End Dump Pile, Parcel E	NP	Yellow Brown Silty Sand w/ trace Gravel
01/04/01	HP-010401-SS01	16th Street	End Dump Pile, Parcel E	16	Brown Clayey Sand
01/18/01	HP-011801-MP1	Menlo Park	At Source	14	Dark Brown Sandy Clay w/ trace Gravel
01/18/01	HP-011801-MP2	Menlo Park	End Dump Pile, Parcel E	17	Light Brown Sandy Clay/Clayey Sand w/ Silt
01/19/01	HP-0119-SF1	16th Street	End Dump Pile, Parcel E	NP	Brown Sand w/ Silt
02/01/01	HP-020101-SF1	16th Street	End Dump Pile, Parcel E	NP	Brown Sand w/ Clay
02/05/01	HP-020501-MP1	Menlo Park	End Dump Pile, Parcel E	NP	Silty Sand
03/10/01	HP-031001-FR01	Alameda Creek, Fremont	SE Stockpile, Parcel E	8.5	Gray Brown Silty Sand with Organics
03/10/01	HP-031001-FR02	Alameda Creek, Fremont	End Dump Pile, Parcel E	8	Gray Clayey Sand with Silt
03/14/01	HP-031401-FR01	Alameda Creek, Fremont	End Dump Pile, Parcel E	7.4	Brown Silty Sand
03/29/01	HP-032901-FR01	Alameda Creek, Fremont	SE Veg. Cover Excavation	7	Light Brown Silty Sand

NP = Non-plastic

Table 12
Hunters Point Parcel E Landfill Cap Vegetative Soil Cover Thickness Verification

Initial Survey				Final Survey				Cover Thickness (feet)
Point ID	Northing (feet)	Easting (feet)	Elevation (feet MSL)	Point ID	Northing (feet)	Easting (feet)	Elevation (feet MSL)	

APPENDIX A
TECHNICAL SPECIFICATIONS
HUNTERS POINT SHIPYARD PARCEL E LANDFILL CAP CONSTRUCTION

Complete Appendix A is provided on CD-ROM #2 of this submittal

APPENDIX B
FIELD ACTIVITY DAILY LOGS: RESIDENT ENGINEER

Complete Appendix B is provided on CD-ROM #2 of this submittal

APPENDIX C
FIELD ACTIVITY DAILY LOGS: FIELD QUALITY CONTROL INSPECTOR

Complete Appendix C is provided on CD-ROM #2 of this submittal

APPENDIX D
MATERIAL CERTIFICATIONS

Complete Appendix D is provided on CD-ROM #2 of this submittal

APPENDIX E
CONFORMANCE TEST DATA

Complete Appendix E is provided on CD-ROM #2 of this submittal

APPENDIX F
SAMPLE COLLECTION LOGS

Complete Appendix F is provided on CD-ROM #2 of this submittal

APPENDIX G
CHAIN-OF-CUSTODY FORMS

Complete Appendix G is provided on CD-ROM #2 of this submittal

APPENDIX H
MATERIAL RECEIVING INSPECTION LOGS

Complete Appendix H is provided on CD-ROM #2 of this submittal

APPENDIX I
FOUNDATION SUBGRADE APPROVAL FORMS

Complete Appendix I is provided on CD-ROM #2 of this submittal

APPENDIX J
GEOSYNTHETIC DEPLOYMENT LOGS

Complete Appendix J is provided on CD-ROM #2 of this submittal

APPENDIX K
MEMORANDUMS

Complete Appendix K is provided on CD-ROM #2 of this submittal

APPENDIX L
HDPE GEOMEMBRANE SEAMING LOGS

Complete Appendix L is provided on CD-ROM #2 of this submittal

APPENDIX M
FIELD DESTRUCTIVE SAMPLE TEST RESULTS

Complete Appendix M is provided on CD-ROM #2 of this submittal

APPENDIX N
DAILY START-UP WELDS

Complete Appendix N is provided on CD-ROM #2 of this submittal

APPENDIX O
FIELD TESTING LOGS

Complete Appendix O is provided on CD-ROM #2 of this submittal

APPENDIX P
CONSTRUCTION INSPECTION FOR THE GEOCOMPOSITE LAYER

Complete Appendix P is provided on CD-ROM #2 of this submittal

APPENDIX Q
CONSTRUCTION INSPECTION FOR THE VEGETATIVE SOIL COVER

Complete Appendix Q is provided on CD-ROM #2 of this submittal

APPENDIX R
PHOTO LOG

Complete Appendix R is provided on CD-ROM #2 of this submittal