FINAL REPORT

Groundwater, Surface Water, and Sediment Monitoring Plan, Subunit 2, Meade Street Operable Unit

University of California, Berkeley Richmond Field Station Richmond, California

(Tasks 2b, 3b, 4a, and 5a of RWQCB Order No. 01-102)

University of California, Berkeley
Capital Projects
1936 University Avenue, 2nd Floor
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December 3, 2004

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December 3, 2004

Cecilio S. Felix
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, California 94612

Re: Groundwater, Surface Water, and Sediment Monitoring Plan
Subunit 2, Meade Street Operable Unit
University of California Berkeley,
Richmond Field Station, Richmond, California
BBL Project #: 24210

Dear Mr. Felix:

In compliance with the California Regional Water Quality Control Board, San Francisco Bay Region's (RWQCB) Order No. 01-102, Tasks 2b, 3b, 4a, and 5a, Blasland, Bouck, and Lee (BBL) is pleased to submit the enclosed document titled *Groundwater, Surface Water, and Sediment Monitoring Plan Subunit 2, Meade Street Operable Unit, University of California Berkeley, Richmond Field Station, Richmond, California* on behalf of the University of California Berkeley.

If you have any questions of need further information, please call me at (925) 274-1100.

Sincerely,

BLASLAND, BOUCK & LEE, INC.

William B. Copeland
Senior Scientist/Manager

Enclosure

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Approval

Approvals

I have read and approved this *Groundwater, Surface Water and Sediment Monitoring Plan, Subunit 2, Meade Street Operable Unit, University of California Berkeley, Richmond Field Station, Richmond, California (Task 2b, 3b, 4a, and 5a of RWQCB Order No. 01-102)* Report.

Project Name: Richmond Field Station Remediation Project, University of California Berkley, Richmond, California

_____ _____

Michael P. Fleischner, P.E. Date

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1. Introduction

On the behalf of the University of California, Berkeley (UC Berkeley) and Zeneca, Inc. (Zeneca), Blasland, Bouck & Lee, Inc. (BBL), and URS Corporation (URS), UC Berkeley's environmental consultants, have prepared this *Groundwater, Surface-Water, and Sediment Monitoring Plan, Subunit 2, Meade Street Operable Unit, University of California, Berkeley, Richmond Field Station, Richmond, California* (Monitoring Plan) in compliance with Task 2b, 3b, and 4a of the California Regional Water Quality Control Board, San Francisco Bay Region's (RWQCB) Order No. 01-102 Site Cleanup Requirements (the Order) for Subunit 2 of the Meade Street Operable Unit and with the RWQCB's letter dated July 30, 2004.

The Richmond Field Station (RFS) is owned by the UC Regents and operated by UC Berkeley. It is designated as Subunit 2 of the Meade Street Operable Unit. The RFS is located at 1301 S. 46th Street in Richmond, California, as shown on Figure 1. Subunit 2 was divided by the RWQCB into two subunits. Subunit 2A consists of the southeastern portion of the RFS, for which UC Berkeley and Zeneca are named as joint responsible parties. Subunit 2B consists of the northern and western portion of the RFS, for which UC Berkeley is named as the sole responsible party. The location of Subunit 2A and 2B and their respective boundaries are shown on Figure 2. A large portion of the RFS Property was previously owned by the California Cap Company (Cap Company), a manufacturer of blasting caps from 1877 to 1948. The majority of the impacts to upland soil are believed to be attributable to Cap Company operations. Since purchasing the RFS in October 1950, UC Berkeley has used the RFS uplands and marsh for research and educational activities.

Task 2b of the Order states:

"The dischargers shall submit a technical report, acceptable to the Executive Officer, which proposes installation of groundwater wells necessary to monitor the extent of groundwater contamination and evaluate the effectiveness of site cleanup in MSOU Subunit 2A. The work plan shall specify at a minimum, well location, well construction, sampling methods, and quality assurance controls. The discharger shall propose sampling frequency, methodology, and parameters, and laboratory analytical methods."

Task 3b of the Order states:

"The dischargers shall submit a technical report, acceptable to the Executive Officer, which proposes any additional surface water and sediment sampling necessary to monitor the extent of contamination with the Stege Marsh area of Subunit 2A. The work plan shall specify at a minimum, sample location, sampling methods, and quality assurance controls. The discharger shall propose sampling frequency, methodology, and parameters, and laboratory analytical methods."

Task 4a of the Order states:

"The dischargers shall submit a technical report, acceptable to the Executive Officer, which proposes additional soil and groundwater sampling necessary to completely define the extent of pollution in the upland portion of Subunit 2B associated with on-site activities. The report should also propose installation of groundwater wells necessary to monitor the extent of groundwater contamination and evaluate the effectiveness of site cleanup in the upland portion of Subunit 2B. The work plan shall specify at a minimum, well location, well construction, sampling methods, and quality assurance controls."

The July 30, 2004 RWQCB letter states:

The work plan shall specify, at a minimum:

- *Monitoring well locations and screen intervals relative to the contaminant sources and hotspots, biologically active permeable barrier, slurry wall, and the upland-wetland transition area. Pertinent hydrologic conditions, including groundwater gradient, subsurface lithologies, and hydrologic boundaries shall be considered;*
- *Any reconnaissance sampling necessary to identify the most appropriate monitoring well location;*
- *Monitoring well construction detail; and*
- *Proposed groundwater monitoring program, including a list of chemicals to be analyzed, sampling frequency and methodology, and laboratory analytical methods.*

This Monitoring Plan includes a groundwater and stormwater monitoring plan for the upland areas of Subunits 2A and 2B and a surface-water and sediment monitoring plan for the marsh portion of Subunit 2A. The marsh portion of Subunit 2B (Task 5a of the Order) is not included in this plan because this area is still under investigation. The Monitoring Plan proposes locations and construction details for a series of groundwater monitoring wells in Subunit 2A based on hydrologic conditions and an evaluation of analytical results for contaminant sources and hotspots in Subunit 2B. The analytical results are summarized for groundwater samples collected during investigations performed by BBL and URS since 1999. The results of previous sampling events in the upland area are discussed in the following reports submitted to the RWQCB:

- *Field Sampling and Analytical Results (URS, 2000);*
- *Work plan for Additional Soil and Groundwater Investigation, Upland Portion of Subunit 2B (URS, 2002a); and*
- *Results of Additional Soil and Groundwater Investigations, Upland Portion of Subunit 2B (URS, 2002b).*

1.1 Site Description

The RFS Site consists of both upland and offshore areas, as shown on Figures 1 and 2. The upland area is located north of Western Stege Marsh and occupies approximately 90 acres. The offshore area consists of an inner and outer portion of Western Stege Marsh. The outer portion of Western Stege Marsh is located south of the East Bay Regional Parks District (EBRPD) Bay Trail and includes approximately 60 acres of tidal mud flat, marsh, and open water. The inner marsh, including the fill area known as "the bulb," occupies approximately 12 acres. A 100-foot-wide strip of Western Stege Marsh on either side of the EBRPD Bay Trail is owned by the EBRPD. UC Berkeley has used the RFS upland area for research and educational activities since its purchase of the land in October 1950. Western Stege Marsh is bounded on the east side by Cherokee Simeon Ventures (CSV) Property, formerly the Zeneca Property. The property on the western shore and most of Meeker Slough is owned by the Richmond Redevelopment Agency.

1.2 Report Organization

The sections of the Monitoring Plan that discuss data evaluation and the rational for monitoring well placement is subdivided into areas shown on Figure 3. The areas include Subunit 2A, Subunit 2B, and the slurry wall placed in 46th Street along the UC Berkeley/CSV Property. The areas discussed in the Subunit 2A section include Areas 1 and 4 of the upland portion and the Subunit 2A portion of the marsh. The areas discussed in the Subunit 2B section include the upland areas of concern (AOCs) and the property boundary area. Six of the eight

AOCs are also discussed in the *Remedial Action Plan – Phase 3, Upland Portion of Subunit 2B* (BBL, 2004), submitted to the RWQCB on July 13, 2004. The Monitoring Plan is organized as follows:

- Section 2 discusses a brief remedial history, hydrogeologic conditions, and proposed monitoring well locations for Subunit 2A.
- Section 3 discusses the planned remedial activities and analytical results for groundwater samples from Subunit 2B.
- Section 4 presents the proposed construction details and groundwater monitoring program.
- Section 5 lists references cited in this report.

2. Subunit 2A

Because Zeneca and UC Berkeley are jointly responsible for the remediation of Subunit 2A, as defined in the Order, the allocation of cleanup costs has been negotiated between the two parties. During the negotiations, Subunit 2A was further subdivided into Areas 1 through 4, as shown on Figure 3. The upland area includes Areas 1 and 4, and the marsh includes Areas 2 and 3. The remedial activities for Subunit 2A were implemented during the fall 2002 and 2003 construction seasons (Phases 1 and 2, respectively). The portions of Subunit 2A completed during Phase 1 include Area 1, the eastern portion of Area 2, and Area 3. The Phase 1 remedial activities are discussed in *Implementation Report, Phase 1 – Subunit 2A, Meade Street Operable Unit* (Implementation Report) (URS, 2003), which was submitted to the RWQCB on August 13, 2003. Phase 2 work included the western portion of Area 2 and Area 4. The report discussing Phase 2 activities is in preparation and will be submitted to the RWQCB in December 2004.

2.1 Upland Groundwater Monitoring

2.1.1 Area 1 and 38' Strip

Surface fill, pyrite cinders, and sediment containing elevated concentrations of chemicals of concern (COCs) were excavated from Area 1 and a small portion of the eastern side of Area 4 to an elevation of approximately-2 feet 1929 National Geodetic Vertical Datum (NGVD) (see Figure 4 of the Implementation Report). The excavation was backfilled with imported material and clean overburden material previously excavated from Area 1. Following the placement of backfill material, a biologically active permeable barrier (BAPB) was placed to a depth of approximately 20 feet below ground surface (bgs) just north of the southern downgradient boundary of Area 1. The purpose of the BAPB is to treat any residual dissolved metals in Area 1 groundwater before it migrates into the marsh. The BAPB consists of marine sediment, leafy compost, and limestone. The location of the BAPB is shown on Figure 3.

One monitoring well, designated MW101 on Figure 4, is proposed for the 38' Strip. Two monitoring wells, designated MW102 and MW103 on Figure 4, are proposed for Area 1. MW101 and MW102 will be downgradient of the BAPB to monitor groundwater quality following treatment within the BAPB. MW103 will be located on the upgradient side of the BAPB to evaluate the quality of groundwater before treatment by the BAPB.

Based on groundwater level measurements in three temporary piezometers, the groundwater flow direction is south-southwest, as shown on Figure 3. Known subsurface lithologies at the locations of the three monitoring wells north and south of the BAPB consist of imported fill to a depth of approximately 7 feet bgs (-2 feet NGVD) and medium stiff clay (Bay Mud) to a known depth of approximately 12 feet bgs (-7 feet NGVD). The bottom of the BAPB is approximately 15 feet bgs (-10 feet NGVD). The depth of the monitoring wells will be 16 feet bgs, with well screen from 3 feet bgs to 16 feet bgs. Additional well construction details are discussed in Section 5.

2.1.2 Area 4

Surface fill, pyrite cinders, and sediment containing elevated concentrations of COCs were excavated from Area 4 to an elevation of approximately -5 feet NGVD in the deepest portion of the excavation. The excavation was

backfilled with imported material and clean overburden material previously excavated from Area 4. The location of the Area 4 excavation is shown on Figure 3.

Three monitoring wells, designated MW104, MW105, and MW106 on Figure 4, are proposed to evaluate groundwater quality within Area 4. MW104 will be located at the western end of the BAPB to evaluate the quality of groundwater that may be bypassing the BAPB. MW105 and MW106 will be located on the downgradient side of the Phase 2 excavation area.

Based on groundwater level measurements in three temporary piezometers the groundwater flow direction is south-southwest, as shown on Figure 3. Known subsurface lithologies at the locations of the easternmost well, MW104, consist of fill to a depth of approximately 7 feet bgs (-2 feet NGVD) and medium stiff clay (Bay Mud) to a known depth of approximately 12 feet bgs (-7 feet NGVD). The lithologies vary slightly to the westernmost well, MW106, where fill occurs to a depth of approximately 6 feet bgs (0 feet NGVD), overlying former tidal flat deposits of fine sand, silt, and clay. The construction of MW104 will be like that of the wells in Area 1 because it is located adjacent to the western end of the BAPB. Because the depth of the Area 4 excavation was approximately 7 feet bgs, MW105 and MW106 will be installed to a depth of 10 feet bgs, with screening from 3 feet bgs to 10 feet bgs. Additional well construction details are discussed in Section 5.

2.2 Marsh Surface-Water Monitoring

Within the marsh portion of Subunit 2A, surface vegetation, sediment, and pyrite cinders containing elevated concentrations of COCs were excavated during Phases 1 and 2 to the stiff tan clay layer at an elevation of approximately -2 feet NGVD. The excavation was backfilled with clean, imported Bay Mud to elevations ranging from 2 feet to 5 feet NGVD. This area is currently undergoing restoration to create marsh habitat.

This Monitoring Plan proposes collecting surface-water samples at three locations to monitor dissolved COCs in the eastern portion of the marsh, as well as parameters that relate to the viability of flora that are being reintroduced. Details of the monitoring plan are discussed in Section 5.

2.3 Marsh Sediment Monitoring

In addition to surface-water samples, three sediment samples will be collected in the marsh portion of Subunit 2A from the surface to 6 inches bgs. The locations are shown on Figure 4. Sampling methods and frequency are discussed in Section 5.

3. Subunit 2B

3.1 Upland Groundwater Monitoring

UC Berkeley does not recommend groundwater monitoring wells in the upland portion of Subunit 2B based on the following data evaluation, the surficial occurrence of COCs, and the planned remediation of each of these AOCs during 2004 and 2005. Eight AOCs have been identified within the upland portion of Subunit 2B. Six of these areas were remediated during fall 2004, as discussed in the *Remedial Action Plan – Phase 3, Upland Portion of Subunit 2B* (BBL, 2004), submitted to the RWQCB on July 13, 2004. The remaining two areas, AOCs 5 and 7, are planned for remediation during Phase 4 in fall 2005.

This section discusses previous groundwater analytical results in and downgradient from each of the AOCs. The analytical results for dissolved metals, volatile organic compounds (VOCs), pesticides, and polychlorinated biphenyls (PCBs) are summarized in Tables 1 through 4, respectively. Because the sampling locations are greater than 50 feet from the San Francisco Bay/Stege Marsh shoreline in the upland area, metals are screened against 10 times the United States Environmental Protection Agency (USEPA) Ambient Water Quality Criteria (AWQC) for saltwater continuous concentration. The precedent for these screening criteria was set by RWQCB Order No. 98-072 (RWQCB, 1998) due to the predicted attenuation of constituents in groundwater. Figure 5 shows groundwater sampling locations where results are below the screening criteria, exceed the screening criteria, and are 10 times the screening criteria.

3.1.1 AOC U1 – Cap Company Explosives Storage Area

Two grab groundwater samples, ES101 and 102, were collected by URS in this area and analyzed for priority pollutant metals in spring 2000. In addition, BBL collected one grab groundwater sample, AOC1-GW, downgradient of AOC U1 in spring 2004. Concentrations of the metals were below their respective reporting limits.

3.1.2 AOC U2 – Cap Co Test Pit Area

Two grab groundwater samples, TP101 and 102, were collected by URS in this area and analyzed for priority pollutant metals in 2000. Metals results for these samples did not exceed the screening criteria. In addition, BBL collected one grab groundwater sample, AOC2-GW, downgradient of AOC U2 in spring 2004. In this sample, three metals exceeded the screening criteria: copper at 140 micrograms per liter (µg/L, mercury at 0.27 µg/L, and nickel at 450 µg/L as shown in Table 1. The screening criteria are 31 µg/L, 0.25 µg/L, and 82 µg/L for copper, mercury, and nickel, respectively. Because the analytical results only slightly exceeded the criteria, and the area is several thousand feet from San Francisco Bay, groundwater monitoring is not recommended in this area.

3.1.3 AOC U3 – Forest Products Area

Five grab groundwater samples, FP101 through 105, were collected by URS in this area and analyzed for priority pollutant metals in 2000. One sample, nickel (at 120 µg/L), exceeded the screening criterion of 82 µg/L at location FP-105. No other exceedances were reported. In addition, BBL collected one grab groundwater

sample, AOC3-GW (shown on Figure 5), downgradient of AOC U3 in spring 2004. In this sample, copper was reported at a concentration of 54 µg/L, exceeding the screening criterion of 31 µg/L, as shown in Table 1. The sample was also analyzed for VOCs because of the proximity of the area to Lot 1 on the former Zeneca Property. No VOCs were detected. Because the analytical results for metals only slightly exceeded the criteria, the area is several thousand feet from the Bay, and the area will be excavated during Phase 3, groundwater monitoring is not recommended in this area.

3.1.4 AOC U4 – Cap Company Shell Manufacturing Area

Three grab groundwater samples, SH101, SH102, and PC101, were collected by URS in this area and analyzed for priority pollutant metals in 2000. Concentrations of the metals were below their respective reporting limits. In addition, BBL collected one grab groundwater sample, AOC4-GW, downgradient of AOC U4 in spring 2004. In this sample, copper was reported at a concentration of 33 µg/L, exceeding the screening criterion of 31 µg/L. Because the analytical result only slightly exceeded the copper criterion, groundwater monitoring is not recommended in this area.

3.1.5 AOC U5 – Western Storm Drain Area

Two grab groundwater samples, SD101 and 102, were collected by URS in this area and analyzed for priority pollutant metals and PCBs in 2000. In one sample, copper was reported at a concentration of 89 µg/L, exceeding the screening criterion of 31 µg/L, and total PCBs were reported at 0.88 µg/L, exceeding the criterion of 0.3 µg/L. The two groundwater sampling locations are located with the Western Storm Drain trench. The collection of a grab groundwater sample from a Geoprobe boring is recommended for PCB and dissolved metals analysis to evaluate the need for a monitoring well in this area.

3.1.6 AOC U6 – Heron Drive Area

BBL collected one grab groundwater sample, AOC6-GW, downgradient of AOC U6 in spring 2004. In this sample, mercury (at 0.92 µg/L) and nickel (at 93 µg/L) slightly exceed their screening criteria of 0.25 µg/L and 82 µg/L, respectively. This area is adjacent to the northern boundary of Subunit 2A and is approximately 150 feet upgradient of MW106 (discussed in Section 2.1.2). Therefore, groundwater monitoring is not recommended at this time. If the downgradient monitoring in Subunit 2A shows elevated metals, additional sampling may be proposed at a later date.

3.1.7 AOC U7 – Cap Company Mercury Fulminate Area

Of the 24 grab groundwater samples (listed in Table 1 and shown on Figure 5) that have been collected since 2000, 10 samples contained mercury, with an average concentration of 1.6 µg/L and a maximum concentration of 5.9 µg/L, exceeding the screening criterion of 0.25 µg/L. As discussed in Section 2.1.2, groundwater monitoring well MW105 will be installed approximately 150 feet downgradient of AOC U7 at the location shown on Figures 4 and 5. In addition, the locations exceeding 10 times the screening criteria will be excavated in 2005 during Phase 4.

3.1.8 AOC U8 – Lark Drive Ditch

No groundwater samples were collected in this area. However, PCBs are the only known COCs in this area, and, following excavation during Phase 3 remediation in fall 2004, known concentrations in soil are less than 3 milligrams per kilogram (mg/kg). Bay water carrying sediment from high tides and/or storm surges into the western storm drain may be the source of PCBs in this area.

3.1.9 Eastern Property Boundary Area

Twelve grab groundwater samples (listed in Tables 1 through 3) were collected in the area along the eastern property boundary adjacent to the CSV Property. The sampling locations are designated "PB-x," as shown on Figure 5. Of these locations, samples from seven locations contained metals or pesticides exceeding the screening criteria and two locations contained metals exceeding 10 times the screening criteria. Location PB102 contained copper at 4,100 µg/L and zinc at 11,000 µg/L, and PB16 contained copper at 990 µg/L. The screening criteria are 31µg/L and 810 µg/L for copper and zinc, respectively. Except for PB16, the locations with exceedances are adjacent to a slurry wall installed by Zeneca. Groundwater monitoring along the slurry wall is not recommended.

3.2 Surface-Water and Stormwater Monitoring

UC Berkeley proposes collecting and analyzing surface-water and stormwater samples at the following locations shown on Figure 4 and at the frequency discussed in Section 5:

- Surface water in Meeker Slough at the Bay Trail Bridge (SW104).
- Stormwater at the outfalls of the eastern and western storm drain systems (SW105 and SW106). These storm drain systems drain the upland portion of Subunit 2B.
- Stormwater at the outfall in the concrete drainage ditch that extends along the western property boundary (SW107). The water shed for this storm drainage ditch includes an unknown area of Richmond north of the RFS.
- Stormwater in Meeker Slough just upstream of the confluence of the concrete outfall (SW108).

Additional surface-water sampling locations will be proposed in the marsh portion of Subunit 2B following remediation of that area.

4. Slurry Wall

A 600-foot-long, soil-bentonite slurry wall was constructed in December 2003 within the southern portion of 46th Street, immediately north of the BAPB wall. The location of the slurry wall is shown on Figure 3. The wall was installed to elevation -10 feet NGVD, corresponding to an approximate depth of 20 feet bgs. The upper 3 feet of the slurry wall trench were backfilled with crushed concrete.

The stratigraphy along the slurry wall is shown by a series of cone penetrometer testing (CPT) boring logs in *Results of Additional Soil and Groundwater Investigation, Upland Portion of Subunit 2B* (URS, 2002b), dated October 11, 2002. In general, there are several discontinuous granular units within the upper 15 feet and generally fine-grained silt and clay layers between 15 and 25 feet bgs.

No monitoring wells are proposed for this area.

5. Monitoring Program

5.1 Monitoring Frequency

UC Berkeley and Zeneca propose a semiannual monitoring program for up to five years, depending on results. If concentrations show a decreasing trend and reach a concentration that may justify an early cessation of monitoring, a modification to the monitoring duration will be proposed to the RWQCB on a well by well basis. However, the BABP monitoring wells, MW 101 and MW 103 may need to be monitored at least annually for five years.

The surface-water and sediment samples from the eastern portion of the marsh in Subunit 2A, as well as the Meeker Slough sample from below the Bay Trail bridge in Subunit 2B, (locations SED101 through SED103 and SW101 through SW104 on Figure 4) will be collected during an outgoing tide.

The stormwater samples from the storm drain outfalls, concrete ditch, and upper Meeker Slough (locations SW105 through SW108 on Figure 4) will ideally be collected during the first fall rainfall event producing surface runoff (i.e., the "first flush"). An additional sample will be collected from the outfalls in the spring (late in the rainy season in March or April).

5.2 Monitoring Well Construction Details

5.2.1 Subunit 2A, Area 1, and 38-foot Strip

Based on the lithology and BAPB construction, proposed monitoring wells MW101 through MW103 will be constructed as shown on Figure 6, with the following specifications:

- 2-inch-diameter Schedule 40 polyvinyl chloride (PVC) blank casing from 2.5 feet above ground surface to 3 feet bgs;
- 2-inch-diameter Schedule 40 PVC 0.01-inch slotted casing from 3 feet bgs to 16 feet bgs;
- concrete surface seal from ground surface to 2 feet bgs;
- bentonite seal from 2 feet bgs to 2.5 feet bgs;
- #2/12 sand filter pack from 2.5 feet bgs to 16 feet bgs; and
- protective outer casing, 3 feet tall, set in a concrete pad.

5.2.2 Subunit 2A, Area 4

Monitoring well MW104, placed at the western end of the BAPB, will be constructed with the same design as MW101 through MW103.

Proposed monitoring wells MW105 and MW106, along the south side of Area 4, will be constructed as shown on Figure 7, with the following specifications:

- 2-inch-diameter Schedule 40 PVC blank casing from 2.5 feet above ground surface to 3 feet bgs;
- 2-inch-diameter Schedule 40 PVC 0.01-inch slotted casing from 3 feet bgs to 10 feet bgs;

- concrete surface seal from ground surface to 2 feet bgs;
- bentonite seal from 2 feet bgs to 2.5 feet bgs;
- #2/12 sand filter pack from 2.5 feet bgs to 10 feet bgs; and
- protective outer casing, 3 feet tall, set in a concrete pad.

5.3 Installation

Drilling activities will be performed by a California-licensed driller using a truck-mounted drill rig with 8-inch-diameter hollow-stem augers. Monitoring wells will be constructed of 2-inch-diameter Schedule 40 PVC with 0.010-inch slotted well screen and a solid PVC riser. The solid riser will be installed from the top of the screen to approximately 2.5 feet above ground surface. The annular space will be filled with #2/12 washed silica sand to at least 6 inches above the top of the well screen. A hydrated bentonite slurry seal will be placed above the sand pack, and the remaining annular space will be filled with cement/bentonite grout to ground surface.

The wells will be fitted with locking well caps and finished in a stickup fashion approximately 3 feet above ground surface with a protective steel outer casing sealed with concrete. The steel casing will extend approximately 1 foot bgs. The concrete seal will be flush with the ground surface, will extend approximately 2 feet below grade and laterally at least 2 feet in all directions from the protective steel casing, and will slope gently to drain water away from the well. Figures 6 through 9 present the proposed monitoring well construction details. Well construction details may be modified based on field observation of lithologic conditions.

Following well installation and development activities, the horizontal location, ground elevation, and top-of-casing elevations of the monitoring wells will be surveyed by URS.

5.3.1 Permit Requirements

Prior to installing groundwater monitoring wells, a monitoring well construction permit application will be submitted to the Contra Costa County Department of Environmental Health Services. After a groundwater monitoring well permit is issued, well installation activities will begin.

5.3.2 Monitoring Well Development

Following well installation, each monitoring well will be developed by over-pumping using a submersible pump or a centrifugal pump with the intake lowered near the bottom of the screened interval to remove sediment from the well casing. A clean surge block may be used to loosen sediment from the well screen. Purging will continue until the developed water is free of observable sediment (the goal is less than 5 nephelometric turbidity units [NTUs] of turbidity). Development and purge water will be placed in 55-gallon U.S. Department of Transportation- (USDOT-) approved drums for waste characterization and disposal. If the well is pumped dry, the well will be allowed to recover, and purging will continue until the well is developed. Equipment that will be placed into a well will be decontaminated by pressure washing prior to use. Each well will be allowed to recover for a minimum of 24 hours prior to sampling.

5.4 Sampling Activities

5.4.1 Groundwater and Surface-Water Sampling

BBL has placed a pressure transducer beneath the Bay Trail Bridge over Meeker Slough, which continuously records tidal levels. The levels prior to and following groundwater sampling will be reported with the sampling data. Prior to sampling, the static water level and total well depth will be measured in each of the wells. One round of synoptic water-level measurements will be collected at the start of each sampling event. Depth to water will be measured using an electronic water-level indicator from the top of the well casing and will be recorded in the field logbook. The probe will be decontaminated with an Alconox and tap-water scrub and rinse between each well. Measurements will be subtracted from the surveyed top-of-casing elevation to calculate groundwater elevations for each monitoring well.

Following the measurement of water levels in the wells, the wells will be purged and sampled using low-flow sampling techniques and dedicated sampling equipment. A groundwater quality meter will be used to evaluate the influx of formation water. Groundwater quality parameters will be recorded in the field logbook. The well is considered purged and stabilized as soon as indicator parameters meet the following criteria for three consecutive readings:

- pH measurements remain stable within 0.1 Standard Units;
- specific conductivity varies by no more than 3%; and
- a constant non-turbid discharge (< 5 NTU) is achieved, or turbidity varies no more than 10%.

All purge water will be containerized in 55-gallon DOT-approved drums and temporarily stored onsite pending waste characterization and proper disposal.

Surface-water and stormwater samples will be collected using a clean dipper. Water samples will be transferred to clean laboratory-supplied sample containers. Chain-of-custody records will be used to track sample possession. A chain-of-custody entry will be recorded for every sample and will accompany every shipment of samples to the laboratory.

Sample labels will be affixed to each sample bottle. These labels will be durable and water-resistant so that they remain legible when wet. Each label will contain the following information:

- sample identification;
- initials of sample collector;
- time and date of sample collection;
- preservatives (if any); and
- required analysis.

5.4.2 Sediment Sampling

Sediment samples will be collected by pushing a 6-inch-long by 2-inch-diameter brass liner to a depth of 6 inches bgs. Prior to sample collection, the brass liners will be decontaminated using the procedures discussed in Section 4.4.3. The liner will be extracted with an intact core and capped with Teflon® sheeting and plastic end caps.

5.4.3 Decontamination Procedures

Any equipment reused between wells will be decontaminated by the following procedure prior to and between each purging or sampling event.

- Equipment will be washed with a solution of non-phosphate detergent.
- Equipment will be rinsed twice, first with potable water and then with de-ionized water.

Decontamination of sampling and monitoring equipment will include (but not necessarily be limited to) the following items: bailers, water-level probes, and stainless steel drop weights for Teflon® tubing. Decontamination water and purge water will be contained and disposed of appropriately.

5.5 Laboratory Analysis

Following collection, groundwater, surface-water, stormwater, and sediment samples will be packed on ice, cooled to approximately 4 degrees Celsius (°C), and delivered under appropriate chain-of-custody protocols to a California-certified laboratory for analysis. Prior to analysis and within 24 hours of sample delivery, the lab will filter the water samples to remove particulates.

Groundwater samples collected from MW101 through MW104 will be analyzed for dissolved priority pollutant metals by USEPA Method 6010B, VOCs by USEPA Method 8260, pesticides (including Zeneca's proprietary pesticides) by USEPA Method 8082, and pH. The proprietary pesticides include the following:

- EPTC;
- butylate;
- vernolate;
- pebulate;
- molinate;
- cycloate;
- fonofos;
- napropamide;
- nitrobenzene-ds;
- 2-fluorobiphenyl; and
- terphenyl-d14.

If pesticides are not detected in the first round of sampling, they will be eliminated from future monitoring episodes.

Groundwater samples collected from MW105 and MW106 will be analyzed for dissolved priority pollutant metals by USEPA Method 6010B and pH.

Quality assurance/quality control (QA/QC) samples, inclusive of blind duplicates, matrix spike/matrix spike duplicates, and field blanks, will also be submitted for laboratory analysis. One blind duplicate sample will be collected during each sampling event. One field rinse blank will be collected each day for all parameters sampled for that day.

Three sediment samples, SED101 through 103, will be analyzed for priority pollutant metals by USEPA Method 6010B, pesticides and PCBs by USEPA Method 8082, and pH. If pesticides are not detected in the first round of sampling, they will be eliminated from future monitoring episodes.

Three surface-water samples will be collected in the marsh portion of Subunit 2A, SW101 through SW103, and one surface-water sample in Meeker Slough at the Bay Trail Bridge, SW104, will be analyzed for dissolved priority pollutant metals by USEPA Method 6010B, pesticides and PCBs by USEPA Method 8082, and pH. In addition, marsh surface-water samples will be analyzed for total nitrogen, phosphorus, potassium, nitrate nitrogen, iron, and total dissolved solids. If pesticides are not detected in the first round of sampling, they will be eliminated from future monitoring episodes.

Three stormwater samples will be collected from the east and west upland storm drain outfalls and the concrete drainage ditch outfall at the western property boundary. Samples SW105 through SW108 will be analyzed for dissolved priority pollutant metals by USEPA Method 6010B, PCBs by USEPA Method 8082, and pH.

5.6 QA/QC Samples

The purpose of QA/QC procedures is to produce data of known high quality that meet or exceed the requirements of standard analytical methods. It is essential that data collection personnel adhere to strict QA/QC procedures to establish quality. The objectives of the QA program are two fold:

- provide the mechanism for ongoing control; and
- evaluate data quality during the project, qualifying data precision and accuracy.

The following data quality indicators will be used to evaluate the data usability and certainty:

- accuracy;
- precision;
- representativeness;
- completeness; and
- comparability.

A discussion of each of these data quality indicators is provided below.

5.6.1 Accuracy

Accuracy is a measure of how close a reported value is to the true value and is evaluated using spike analyses. Spike analyses are performed by adding a known quantity of analyte to a sample, analyzing the sample, and comparing the observed result to the known addition. Accuracy is expressed as percent recovery (the difference between known and observed concentrations divided by the known concentration) and is calculated as:

$$\%R = \left(\frac{C_{OB} - C_X}{C_{sp}} \right) x\,100$$

Where:

%R = percent recovery
Csp = concentration of spike
COB = concentration measured in spiked sample analysis
Cx = concentration measured in unspiked sample analysis

Accuracy is evaluated using matrix spike, laboratory control spikes, and surrogate spikes. Matrix spikes are spikes of target analytes into environmental samples and are used to evaluate impacts of matrix interference on accuracy. Laboratory control spikes are spikes of target analytes into clean water or sand and are used to evaluate accuracy of laboratory performance. Surrogate spikes are spikes of non-target analytes (compounds that are not likely to be detected in the sample but that behave similarly to the target analytes) into each sample. Surrogate spikes can only be performed for organic analyses and are used to evaluate accuracy on a sample-specific basis.

Matrix spikes and laboratory control spikes will be analyzed with each analytical batch. (A batch is up to 20 samples extracted and analyzed together under a given method protocol. Samples in an analytical batch should be of the same matrix. Reagent lots and handling procedures should be the same for all samples in a batch.) Surrogate spikes will be analyzed with each sample. Matrix spikes, laboratory control spikes, and surrogate spike percent recoveries will be calculated and compared to the control limits provided in Appendix B. Analyses exhibiting recoveries outside control limits will be considered for re-analysis.

5.6.2 Precision

Precision refers to the level of agreement among repeated measurements of the same parameter. Precision is expressed as the relative percent difference (RPD) between duplicate measurements, calculated as:

$$RPD = \left(\frac{(C_1 - C_2)}{\left[\frac{(C_1 + C_2)}{2} \right]} \right) \times 100$$

Where:

RPD= relative percent difference
C_1 = result from first sample
C_2 = result from second sample

Precision is evaluated using duplicate analyses and analyses of duplicate matrix spike samples. Objectives for precision are provided in Appendix B.

5.6.3 Representativeness

Representativeness is the degree to which data accurately and precisely represent variations at a sampling point. Representativeness is a qualitative parameter.

To maintain representativeness in the samples being collected for this investigation, standard sampling procedures, as described above, will be strictly adhered to. Any deviations from these procedures will be noted

in permanent ink in the field notebook. The field notebooks will be reviewed for deviations as part of evaluation of representativeness.

To maintain representativeness in the analyses being performed, the laboratory will follow standard procedures for collecting the aliquot of sample used for analysis as representative of the whole. Additional laboratory procedures to maintain representativeness include proper log-in, storage, handling, and tracking of samples to minimize possibility of sample contamination, loss, or cross-labeling, and discrete sampling and analysis of immiscible layers, if present in sufficient quantity.

5.6.4 Completeness

Completeness is evaluated as the amount of valid, usable data obtained from a measurement system compared to the amount that was expected. The quantitative description of completeness will be evaluated as the percentage of analytical results that are usable (i.e., results that do not require rejection based on review of QA/QC data). The objective for completeness for this investigation is 90% for each analytical parameter.

5.6.5 Comparability

Comparability is a qualitative evaluation of the confidence with which one data set can be compared to another measuring the same parameters. Comparability will be maintained through the use of the standard operating procedures for sampling and field operations, as described in this Monitoring Plan.

5.6.6 Field Sampling Quality Control

Field QA data are provided by the analysis of rinsate blanks and field duplicate samples. The following field QA/QC samples will be submitted for laboratory analysis:

- Rinsate Blanks – Rinsate blanks will be obtained by collecting water used to rinse the sampling equipment following decontamination. Rinsate blanks will be collected and analyzed at a frequency of about 10% of the number of sediment samples collected.
- Field Duplicate Samples – Blind field duplicate samples will be collected and analyzed at a frequency of about 5% of the number of samples collected for each medium.

5.7 Monitoring Letter Reports

Groundwater and surface-water monitoring letter reports will be submitted to the RWQCB following each monitoring event. Groundwater monitoring reports will include:

- sampling activities performed;
- problems encountered during the sampling event;
- groundwater sampling purge logs;
- groundwater and tidal elevation measurements; and
- analytical results for groundwater, surface-water, and stormwater samples.

Quarterly groundwater monitoring reports will be submitted within 30 days of receipt of all laboratory reports.

6. References

BBL. 2004. *Remedial Action Plan – Phase 3, Upland Portion of Subunit 2B*; Meade Street Operable Unit; University of California, Berkeley; Richmond Field Station; Richmond, California. Prepared for the University of California Berkeley (July 13).

California Regional Water Quality Control Board (RWQCB), San Francisco Bay Region. 1998. Order No. 98-072. Adoption of Site Cleanup Requirements for: Catellus Development Corporation and SF Pacific Property, Inc., Proposed Eastshore Park Property, Berkeley and Albany (Alameda County) and Richmond (Contra Costa County).

URS. 2000. *Field Sampling and Analytical Results.* Prepared for the University of California, Berkeley (December).

URS. 2002a. *Workplan for Additional Soil and Groundwater Investigation, Upland Portion of Subunit 2B.* Prepared for the University of California, Berkeley (February 28).

URS. 2002b. *Results of Additional Soil and Groundwater Investigations, Upland Portion of Subunit 2B.* Prepared for the University of California, Berkeley (October 31).

URS. 2003. *Implementation Report, Phase 1 – Subunit 2A, Meade Street Operable Unit*. Prepared for the University of California, Berkeley (August 13).

TABLE 1
METALS AND pH IN GROUNDWATER
UPLAND PORTION OF SUBUNIT 2
RICHMOND FIELD STATION

EPA Method 6010 (7471 for mercury); units = ug/L

Sample Location	Date	Antimony	Arsenic	Berullium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Zinc	pH
Screening =10xAWQC*		--	360	--	88	500	31	81	0.25	82	710	--	--	810	--
AOC 1 - Cap Co Explosives Storage Area															
ES-101	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	<20	<5	<5	<5	<20	7
ES-102	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	<20	<5	<5	<5	<20	7.3
AOC1-GW	May-04	<60	<5	<2	<5	<10	10	3.7	<0.2	31	<5	<5	<5	31	6.7
AOC 2 - Cap Co Test Pit Area															
TP-101	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	<20	7.5	<5 UJ	<5	<20	7
TP-102	Feb-00	<60	<5	<2	<5	<10	<10	<3	0.24	24	<5	<5 UJ	<5	<20	7
AOC2-GW	May-04	<60	32	5.2	6.5	160	**140**	3.4	**0.27**	**450**	<5	<5	<5	140	6.6
AOC 3 - Forest Products Area															
FP-101	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	<20	<5	<5 UJ	<5	<20	7.1
FP-102	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	<20	<5	<5 UJ	<5	<20	7.1
FP-103	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	<20	<5	<5 UJ	<5	<20	6.9
FP-104	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	<20	<5	<5 UJ	<5	31	6.4
FP-105	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	**120**	<5	<5 UJ	<5	<20	6.7
FP-106	Feb-00	<60	<5	<2	<5	<10	10	<3	<0.2	<20	<5	<5 UJ	<5	48	7.3
AOC3-GW	May-04	<60 [<60]	27 [29]	5.3 [6.6]	<5 [<5]	<10 [15]	**50 [54]**	5 [4]	<0.2 [<0.2]	52 [83]	<5 [<5]	<5 [<5]	<5 [<5]	70 [96]	6.7 [6.6]
AOC 4 - Cap Co Shell Manufacturing Area															
PC-101	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	45	<5	<5	<5	<20	7
SH-101	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	22	<5	<5	<5	<20	7
SH-102	Feb-00	<60	<5	<2	<5	<10	23	<3	<0.2	<20	<5	<5	<5	37	6.6
AOC4-GW	May-04	<60	<5	2.3	<5	14	**33**	16	<0.2	64	<5	<5	<5	46	7.2
AOC 5 - Storm Drain															
SD-101	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	<20	<5	<5	<5	30	7
SD-102	Feb-00	<60	<5	<2	<5	<10	**89**	<3	<0.2	<20	<5	<5	<5	80	7.2
AOC 6 - Heron Drive Area															
AOC6-GW	May-04	<60	<5	<2	<5	26	15	5.3	**0.92**	**93**	<5	<5	<5	40	6.9
AOC 7 - Cap Co Mercury Fulminate Area															
MF-101	Feb-00	<60	21	<2	<5	<10	**38**	<3	**3.3**	25	<5	<5	<5	110	NA
MF-102	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	<20	<5	<5	<5	83	NA
MF-103	Feb-00	<60	<5	<2	<5	<10	17	<3	<0.2	38	<5	<5	<5	140	NA
MF-104	Feb-00	<60	24	<2	<5	<10	10	<3	**1.5**	<20	<5	<5	<5	22	NA
MF-105	Feb-00	<60	<5	<2	<5	<10	<10	<3	**5.9**	<20	<5	<5	<5	58	NA
MF-106	Feb-00	<60	<5	<2	<5	<10	26	<3	**0.78**	<20	<5	<5	<5	<20	NA
MW1	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	<20	<5	<5 UJ	<5	<20	NA
MF-107	Jun-01	<60	13	<2	<5	<10	<10	<3	0.22	<20	<5	<5	<5	<20	7.5
MF-108	Jun-01	<60	5.4	<2	<5	<10	<10	<3	<0.2	<20	<5	<5	<5	<20	7.5
MF-109	Jun-01	<60	<5	<2	<5	<10	<10	<3	<0.2	<20	<5	<5	<5	<20	7.1
MF-110	Jun-01	<60	<5	<2	<5	<10	<10	<3	<0.2	<20	<5	<5	<5	<20	7.2

TABLE 1
METALS AND pH IN GROUNDWATER
UPLAND PORTION OF SUBUNIT 2
RICHMOND FIELD STATION

Sample Location	Date	Antimony	Arsenic	Berullium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Zinc	pH
Screening =10xAWQC*		--	360	--	88	500	31	81	0.25	82	710	--	--	810	--
MF-111	Jun-01	<60	<5	<2	<5	<10	<10	<3	**1.6**	<20	<5	<5	<5	<20	7.0
MF-112	Jun-01	<60	<5	<2	<5	<10	<10	<3	0.23	<20	<5	<5	<5	<20	7.0
MF-113	Jun-01	<60	<5	<2	<5	<10	<10	<3	<0.2	30	<5	<5	<5	<20	7.0
MF-114	Jun-01	<60	<5	<2	<5	<10	<10	<3	0.24	<20	8.5	<5	<5	88	NA
MF-115	Jun-01	<60	32	<2	<5	<10	<10	<3	<0.2	<20	7.4	<5	<5	<20	NA
MF-116	Jun-01	<60	26	<2	<5	<10	<10	<3	**2**	<20	8.3	<5	<5	<20	NA
MF-117	Jun-01	<60	92	<2	<5	<10	<10	3.5	<0.2	<20	10	<5	<5	40	NA
MF-118	Jun-01	<60	24	<2	<5	<10	<10	<3	<0.2	<20	8.9	<5	<5	41	NA
MF-119	Jun-01	<60	45	<2	<5	<10	<10	<3	<0.2	<20	8.7	<5	<5	<20	NA
MF3-1	May-03	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA
MF3-2	May-03	NA	NA	NA	NA	NA	NA	NA	**0.39**	NA	NA	NA	NA	NA	NA
MF3-3	May-03	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA
MF3-4	May-03	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA
Property Boundary															
PB-101	Feb-00	<60	<5	<2	15	<10	**120**	<3	<0.2	**190**	8.1	<5	<5	**6,500**	NA
PB-102	Feb-00	<60	5.2	<2	46	<10	**4,100**	6.5	<0.2	**470**	18	<5 UJ	26	**11,000**	NA
PB-103	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	27	<5	<5 UJ	<5	70	NA
PB-104	Feb-00	<60	<5	<2	5.4	<10	25	<3	<0.2	69	5.3	<5 UJ	<5	810	NA
PB-105	Feb-00	<60	<5	<2	<5	<10	<10	<3	<0.2	42	<5	<5 UJ	<5	130	NA
PB-8	Sep-01	<60	<5	<2	<5	<10	<10	<3	**0.31**	<20	<5	<5	<5	20	7.2
PB-10	Sep-01	<60	<5	<2	<5	<10	30	3.9	**0.48**	**120**	7	<5	14	270	6.2
PB-11	Sep-01	<60	31	<2	<5	<10	**34**	3.1	<0.2	**180**	11	<5	27	29	7.3
PB-13	Sep-02	<60	17	<2.0	<5.0	<10	11	<3.0	<0.2	<20	13	<5.0	<5.0	<20	9.2
PB-14	Sep-02	<60	22	<2.0	<5.0	<10	21	<3.0	<0.2	<20	15	<5.0	<5.0	<20	9.2
PB-15	Sep-02	<60	8.1	<2.0	<5.0	<10	<10	<3.0	<0.2	<20	<5.0	<5.0	<5.0	<20	9.2
PB-16	Sep-02	<60	<5.0	2.9	44	<10	**990**	8.4	<0.2	**780**	14	<5.0	64	**7300**	4.5

Notes

* Comparison of upland groundwater concentrations is consistant with "Basis for Groundwater Action Levels" in RWQCB Order No. 98-072.

0.05 Exceedance 10 X AWQC Saltwater Continuous Concentration

J = The analyte was positively identified. The associated numerical value is the approximate concentration of the analyte in the sample.

TABLE __
VOCs IN GROUNDWATER
PROPERTY BOUNDARY AREA
RICHMOND FIELD STATION

EPA Method 8260B, Units = ug/L

Parameter	10 x AWQC	MCL	PB6	PB7	PB8	PB9	PB10
Freon 12			<1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane			<1.0	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride	na	na	<0.5	<0.5	<0.5	<0.5	**3.4**
Bromomethane			<1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane			<1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane			<0.5	<0.5	<0.5	<0.5	<0.5
Acetone	na	na	**10**	<10	<10	<10	<10
Freon 113			<5.0	<5.0	<5.0	<5.0	<5.0
1,1-Dichloroethene	na	na	<0.5	<0.5	<0.5	<0.5	**0.7**
Methylene Chloride			<10	<10	<10	<10	<10
Carbon Disulfide			<0.5	<0.5	<0.5	<0.5	<0.5
MTBE			<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,2-Dichloroethene	na	100	<0.5	<0.5	<0.5	<0.5	**0.9**
Vinyl Acetate			<10	<10	<10	<10	<10
1,1-Dichloroethane			<0.5	<0.5	<0.5	<0.5	<0.5
2-Butanone			<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	na	70	<0.5	**0.9**	<0.5	<0.5	**10**
2,2-Dichloropropane			<0.5	<0.5	<0.5	<0.5	<0.5
Chloroform	na	5	<0.5	<0.5	**1.1**	<0.5	**7.1**
Bromochloromethane			<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane			<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloropropene			<0.5	<0.5	<0.5	<0.5	<0.5
Carbon Tetrachloride	na	5	<0.5	<0.5	**0.8**	<0.5	<0.5
1,2-Dichloroethane	na	na	<0.5	<0.5	<0.5	**2.5**	**25**
Benzene	7000		<0.5	<0.5	<0.5	<0.5	**0.6**
Trichloroethene (TCE)	na	5	<0.5	**120**	**4.1**	**33**	**76**
1,2-Dichloropropane			<0.5	<0.5	<0.5	<0.5	<0.5
Bromodichloromethane			<0.5	<0.5	<0.5	<0.5	<0.5
Dibromomethane			<0.5	<0.5	<0.5	<0.5	<0.5
4-Methyl-2-Pentanone			<10	<10	<10	<10	<10
cis-1,3-Dichloropropene			<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	50000	1000	**0.8**	<0.5	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene			<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane			<0.5	<0.5	<0.5	<0.5	<0.5
2-Hexanone			<10	<10	<10	<10	<10
1,3-Dichloropropane			<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene (PCE)	4500	5	<0.5	<0.5	<0.5	**1.0**	**14**
Dibromochloromethane			<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dibromoethane			<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	1290	100	<0.5	<0.5	<0.5	**2.0**	**9.8**
1,1,1,2-Tetrachloroethane			<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene			<0.5	<0.5	<0.5	<0.5	<0.5
m,p-Xylenes	na	10000	**0.8**	<0.5	<0.5	<0.5	<0.5
o-Xylene			<0.5	<0.5	<0.5	<0.5	<0.5
Styrene			<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform			<1.0	<1.0	<1.0	<1.0	<1.0

TABLE __
VOCs IN GROUNDWATER
PROPERTY BOUNDARY AREA
RICHMOND FIELD STATION

EPA Method 8260B, Units = ug/L

Parameter	10 x AWQC	MCL	PB6	PB7	PB8	PB9	PB10
Isopropylbenzene			<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane			<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-Trichloropropane			<0.5	<0.5	<0.5	<0.5	<0.5
Propylbenzene			<0.5	<0.5	<0.5	<0.5	<0.5
Bromobenzene			<0.5	<0.5	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene			<0.5	<0.5	<0.5	<0.5	<0.5
2-Chlorotoluene			<0.5	<0.5	<0.5	<0.5	<0.5
4-Chlorotoluene			<0.5	<0.5	<0.5	<0.5	<0.5
tert-Butylbenzene			<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene			<0.5	<0.5	<0.5	<0.5	<0.5
sec-Butylbenzene			<0.5	<0.5	<0.5	<0.5	<0.5
para-Isopropyl Toluene	na	na	<0.5	<0.5	<0.5	<0.5	**1.4**
1,3-Dichlorobenzene			<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene			<0.5	<0.5	<0.5	<0.5	<0.5
n-Butylbenzene			<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene			<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dibromo-3-Chloropropane			<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trichlorobenzene			<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobutadiene			<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene			<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-Trichlorobenzene			<0.5	<0.5	<0.5	<0.5	<0.5

TABLE 2
VOCs IN GROUNDWATER
UPLAND PORTION OF SUBUNIT 2
RICHMOND FIELD STATION

Sample ID:	PB6	PB7	PB8	PB9	PB10	PB13	PB14	PB15	PB16	AOC3-GW	
Date Collected:	9/21/01	9/21/01	9/21/01	9/21/01	9/21/01	8/26/02	8/26/02	8/26/02	8/26/02	5/6/04	Screening Value[a]
Units:	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Parameter											
1,1,1,2-Tetrachloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
1,1,1-Trichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<5	NA
1,1,2,2-Tetrachloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<5	NA
1,1,2-Trichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<5	NA
1,1-Dichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<5	NA
1,1-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	0.7	<0.5	<0.5	<0.5	<0.5	<5	NA
1,1-Dichloropropene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
1,2,3-Trichlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
1,2,3-Trichloropropane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
1,2,4-Trichlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	**129**
1,2,4-Trimethylbenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
1,2-Dibromo-3-Chloropropane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
1,2-Dibromoethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
1,2-Dichlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<5	**129**
1,2-Dichloroethane	< 0.5	< 0.5	< 0.5	2.5	25.0	<0.5	6.3	8.7	<0.5	<5	NA
1,2-Dichloropropane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<5	**3040**
1,3,5-Trimethylbenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
1,3-Dichlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<5	**129**
1,3-Dichloropropane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	**3040**
1,4-Dichlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<5	**129**
2,2-Dichloropropane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
2-Butanone	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	NA	NA	NA	NA	<10	NA
2-Chlorotoluene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
2-Hexanone	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	NA	NA	NA	NA	<10	NA
4-Chlorotoluene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
4-Isopropyl Toluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	<5	NA
4-Methyl-2-Pentanone	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	NA	NA	NA	NA	<10	NA
Acetone	10.0	< 10.0	< 10.0	< 10.0	< 10.0	NA	NA	NA	NA	<20	NA
Benzene	< 0.5	< 0.5	< 0.5	< 0.5	0.6	NA	NA	NA	NA	<5	NA
Bromobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
Bromochloromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<10	NA
Bromodichloromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<5	NA
Bromoform	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<0.5	<0.5	<0.5	<0.5	<5	NA
Bromomethane	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0	<1.0	<1.0	<10	NA
Carbon Disulfide	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
Carbon Tetrachloride	< 0.5	< 0.5	0.8	< 0.5	< 0.5	2.2	53	16	<0.5	<5	NA
Chlorobenzene	< 0.5	< 0.5	< 0.5	2.0	9.8	<0.5	1.8	3.7	<0.5	<5	**129**
Chloroethane	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0	<1.0	<1.0	<10	NA
Chloroform	< 0.5	< 0.5	1.1	< 0.5	7.1	2.4	48	45	<1.0	<5	NA
Chloromethane	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0	<1.0	<1.0	<10	NA
cis-1,2-Dichloroethene	< 0.5	0.9	< 0.5	< 0.5	10.0	0.8	1.1	1.3	<0.5	<5	NA
cis-1,3-Dichloropropene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<5	NA
Dibromochloromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<5	**6400**
Dibromomethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
Ethylbenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
Freon 113	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	<1.0	<1.0	<1.0	<1.0	<5	NA
Freon 12	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	NA	NA	NA	NA	<10	NA
Hexachlorobutadiene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
Isopropylbenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
m,p-Xylenes	0.8	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
Methylene Chloride	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	<20	<20	<20	<20	<20	NA
MTBE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
Naphthalene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
n-Butylbenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
o-Xylene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
para-Isopropyl Toluene	< 0.5	< 0.5	< 0.5	< 0.5	1.4	NA	NA	NA	NA	NA	NA
Propylbenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
sec-Butylbenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
Styrene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA

TABLE 2
VOCs IN GROUNDWATER
UPLAND PORTION OF SUBUNIT 2
RICHMOND FIELD STATION

Sample ID:	PB6	PB7	PB8	PB9	PB10	PB13	PB14	PB15	PB16	AOC3-GW	
Date Collected:	9/21/01	9/21/01	9/21/01	9/21/01	9/21/01	8/26/02	8/26/02	8/26/02	8/26/02	5/6/04	Screening Value[a]
Units:	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Parameter											
1,1,1,2-Tetrachloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
tert-Butylbenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	NA
Tetrachloroethene	< 0.5	< 0.5	< 0.5	1.0	14.0	<0.5	0.6	11	0.6	<5	**450**
Toluene	0.8	< 0.5	< 0.5	< 0.5	< 0.5	NA	NA	NA	NA	<5	**5000**
trans-1,2-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	0.9	<0.5	<0.5	<0.5	<0.5	<5	NA
trans-1,3-Dichloropropene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<5	NA
Trichloroethene	< 0.5	120.0	4.1	33.0	76.0	19	64	55	7.7	<5	NA
Trichlorofluoromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<1.0	<1.0	<1.0	<1.0	<5	**6400**
Vinyl Acetate	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	NA	NA	NA	NA	<50	NA
Vinyl Chloride	< 0.5	< 0.5	< 0.5	< 0.5	3.4	<0.5	0.9	1.1	<0.5	<10	NA

Note:

[a] USEPA National Recommended Ambient Water Quality Criteria; Saltwater Aquatic Life Protection; Chronic

EPA Method 8260B

NA = not analyzed

TABLE 3
PESTICIDES IN GROUNDWATER
UPLAND PORTION OF SUBUNIT 2
RICHMOND FIELD STATION

EPA Method 8081; units = ug/L

Sample Location	4,4'-DDE	4,4'-DDD	4,4'-DDT	Beta-BHC	Alpha-BHC	Delta-BHC	Gamma-BHC	Heptachlor	Endrin	Heptachlor epoxide A	Dieldrin	Chlodane
10 x AWQC (1)			0.01				1.6	0.036	0.023	0.036	0.019	0.04
Property Boundary												
PB- 101	<0.09 UJ	<0.09 UJ	<0.09 UJ	<0.09 UJ	<0.09 UJ	<0.09 UJ	<0.09 UJ	<0.09 UJ	<0.09 UJ	<0.05 UJ	<0.09 UJ	<0.5 UJ
PB- 102	<0.1 UJ	<0.1 UJ	<0.1 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.1 UJ	<0.5 UJ
PB- 103	<0.1 UJ	<0.1 UJ	<0.1 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.1 UJ	<0.5 UJ
PB- 104	<0.1 UJ	<0.1 UJ	**0.1 UJ**	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.05 UJ	<0.1 UJ	<0.5 UJ
PB- 105	<0.1 R	<0.1 R	<0.1 R	<0.05 R	<0.05 R	<0.05 R	<0.05 R	<0.05 R	<0.05 R	<0.05 R	<0.1 R	<0.5 R

Notes

1) Comparison of upland groundwater concentrations is consistant with "Basis for Groundwater Action Levels" in RWQCB Order No. 98-072.

R = data rejected due to poor surragate recoveries.

0.1 Exceeds 10 times the AWQC, chronic exposure

<0.1 The laboratory reporting limit exceeds the screening value.

TABLE 4
TOTAL PCBs IN GROUNDWATER
UPLAND PORTION OF SUBUNIT 2
RICHMOND FIELD STATION

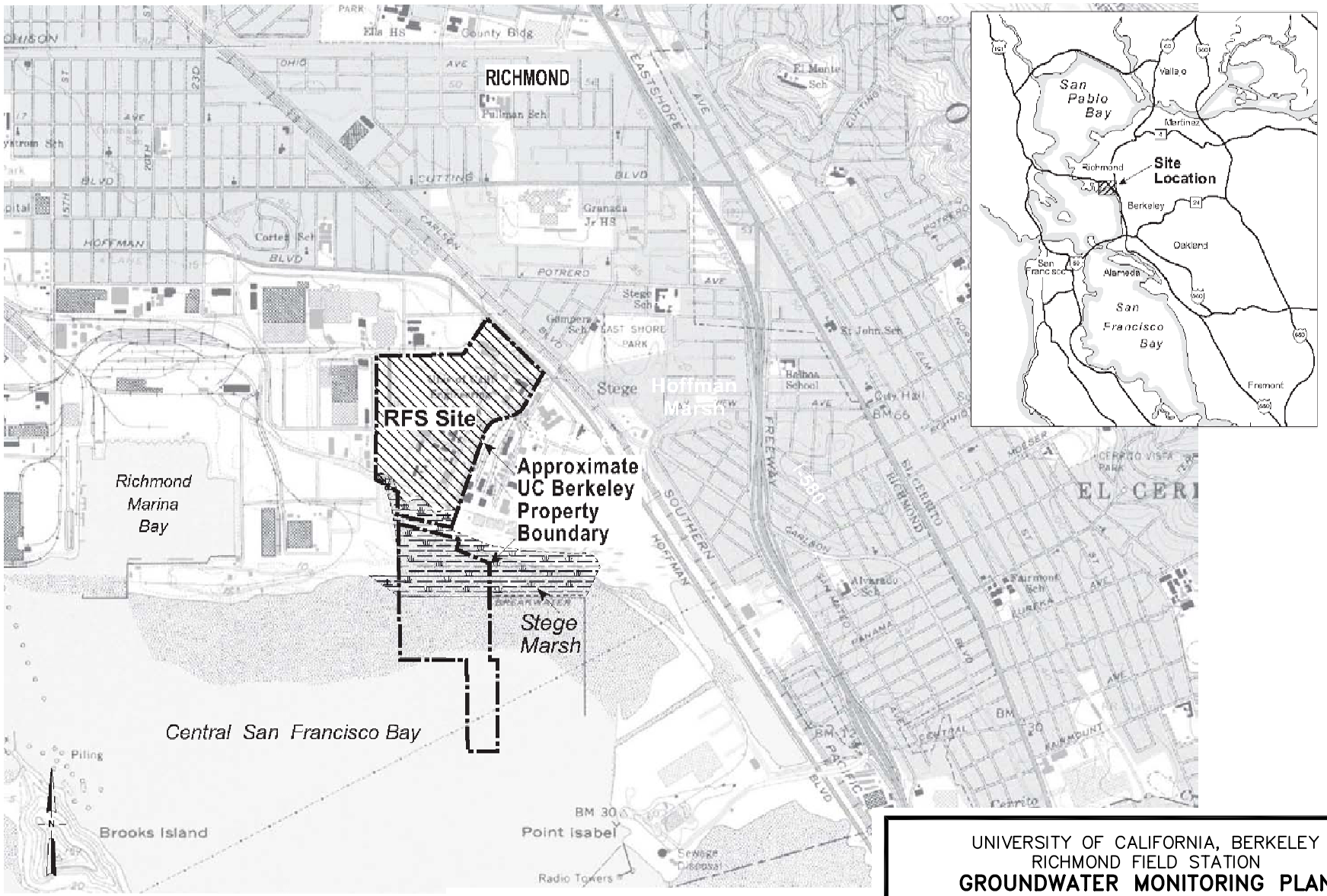
EPA Method 8082; units = ug/L

Sample Location			Total PCBs	Aroclor
10 X AWQC			0.3	
AOC U5 - Heron Drive Area				
SD-	101-	GW	**0.88**	1248
SD-	102-	GW	<0.51	
Sewer Line				
SL-	101-	GW	<0.48	
SL-	102-	GW	<0.47 UJ	
SL-	103-	GW	**1.3**	1260
SL-	104-	GW	<0.47	

Notes

0.05 = 10 x AWQC exceedance

<1.00 The laboratory reporting limit exceeds the screening level.



Map Source: USGS, 7.5 min. Quadrangle map, Richmond, California, 1980 revised

NOTE:
MAP WAS PREPARED FROM A USGS TOPOGRAPHIC 7.5 MIN QUADRANGLE PROVIDED BY URS ON 7/8/03

X: FIGURE 1 SITE LOC MAP.TIFF
L: OFF=REF
P: PAGESET/PLT-AL
11/30/04 IRV-85-JMS
F: /IBM/CAD/2004PROJ/24210.341/24210G05.DWG

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
GROUNDWATER MONITORING PLAN

SITE LOCATION MAP

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
1

LEGEND:

CHEROKEE SIMEON VENTURES (CSV)

RICHMOND FIELD STATION PROPERTY (SUBUNIT 2 & OFFSHORE PROPERTY)

NOTE:

FIGURE PROVIDED BY URS CORPORATION.

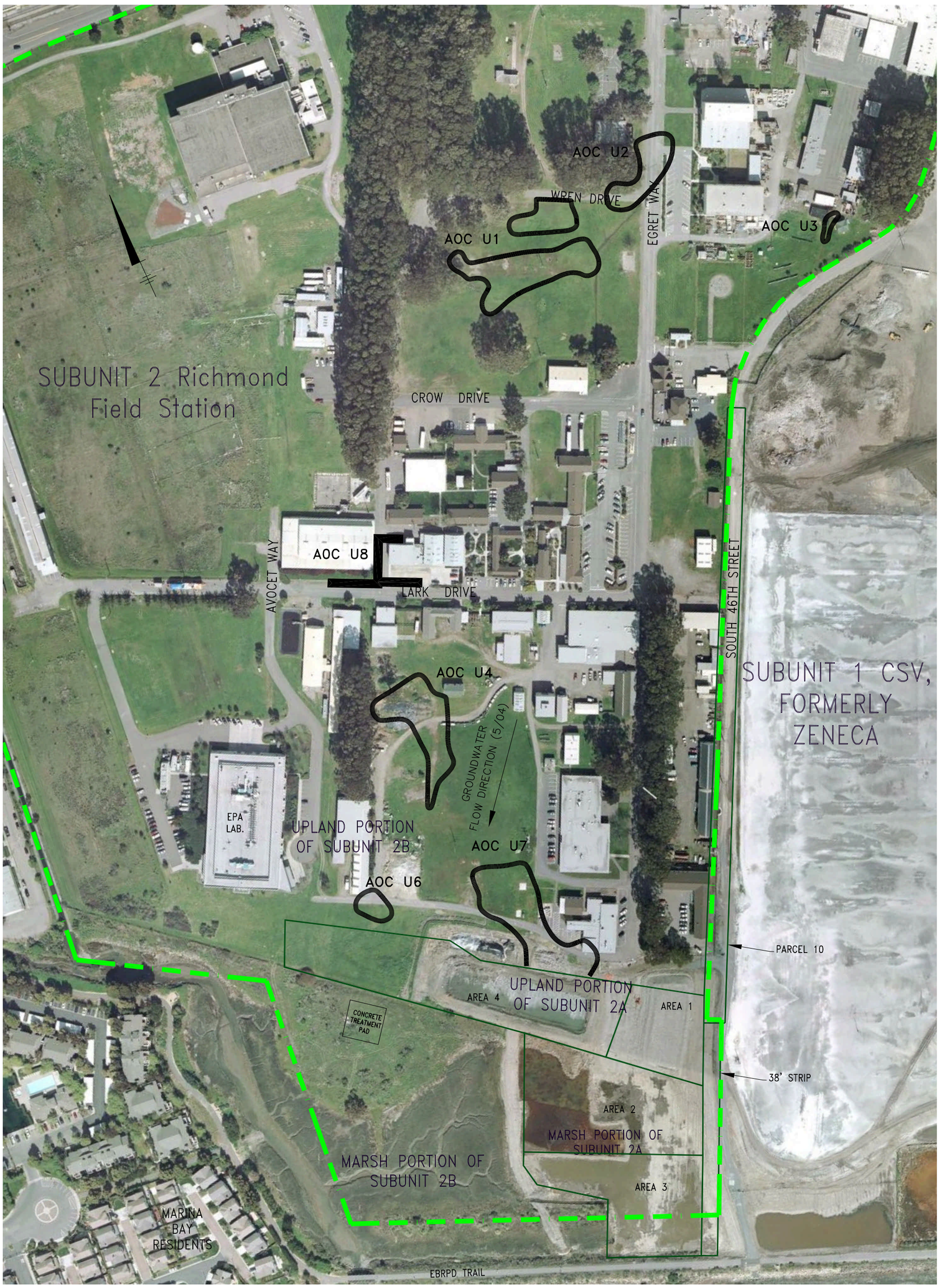
UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
GROUNDWATER MONITORING PLAN

SUBUNITS 2A AND 2B LOCATIONS AND BOUNDARIES

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE **2**

L: OFF=REF
P: PAGESET/PLT-BL
8/19/04 IRV-85-JMS
F:/IBM/CAD/2004PROJ/24210.341/24210G04.DWG



LEGEND:

– PROPERTY BOUNDARY

– AREAS OF CONCERN (AOC) BOUNDARY

NOTE:

AERIAL PHOTO SUPPLIED BY URS ON 7/9/03 AT A SCALE OF 1"=100'.

0 200' 400'

GRAPHIC SCALE

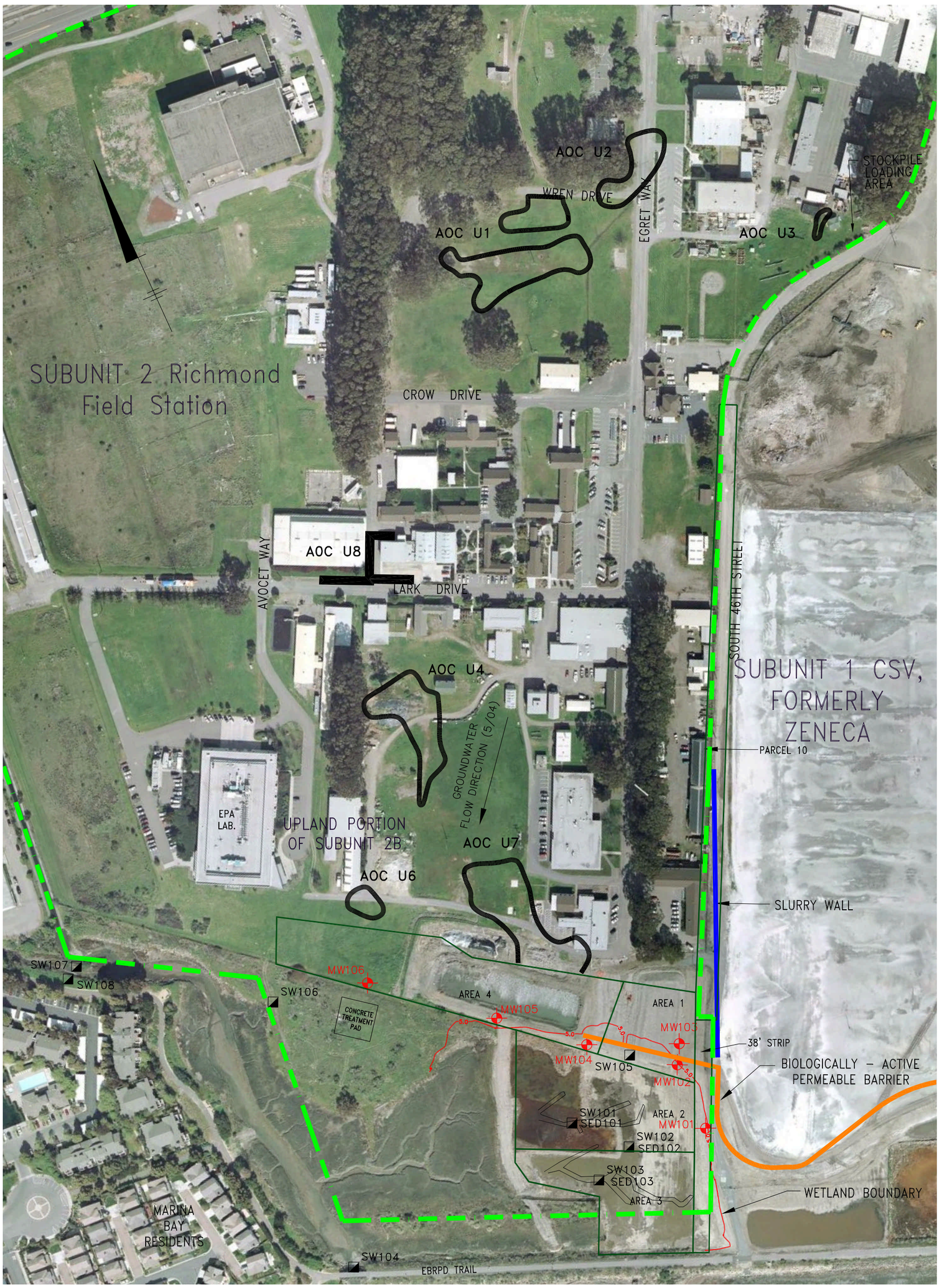
X: FIELD_STATION_40SMALL.JPG
L: OFF=REF
P: PAGESET/PLT-DP
11/11/04 IRV-85-JMS
F: /IBM/CAD/2004PROJ/24210.341/24210G01.DWG

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
GROUNDWATER MONITORING PLAN

SUBUNIT 2 AREAS

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
3



LEGEND:

- PROPERTY BOUNDARY
- 5.0 – 5 FOOT CONTOUR LINE
- BIOLOGICALLY – ACTIVE PERMEABLE BARRIER
- SLURRY WALL
- ◪ – PROPOSED SURFACE WATER, STORM WATER, OR SEDIMENT SAMPLE LOCATION (SW = STORM OR SURFACE WATER, SED = SEDIMENT)
- ⌖ – PROPOSED MONITORING WELL LOCATION

NOTES:

1. AERIAL PHOTO SUPPLIED BY URS ON 7/9/03 AT A SCALE OF 1"=100'.
2. LOCATIONS OF BAPB AND SLURRY WALL ARE APPROXIMATE.

0 200' 400'

GRAPHIC SCALE

X: FIELD_STATION_40SMALL.JPG
L: OFF=REF
P: PAGESET/PLT-DP
11/4/04 IRV-85-JMS
F: /IBM/CAD/2004PROJ/24210.341/24210G03.DWG

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
GROUNDWATER MONITORING PLAN

PROPOSED GROUNDWATER MONITORING WELL LOCATIONS

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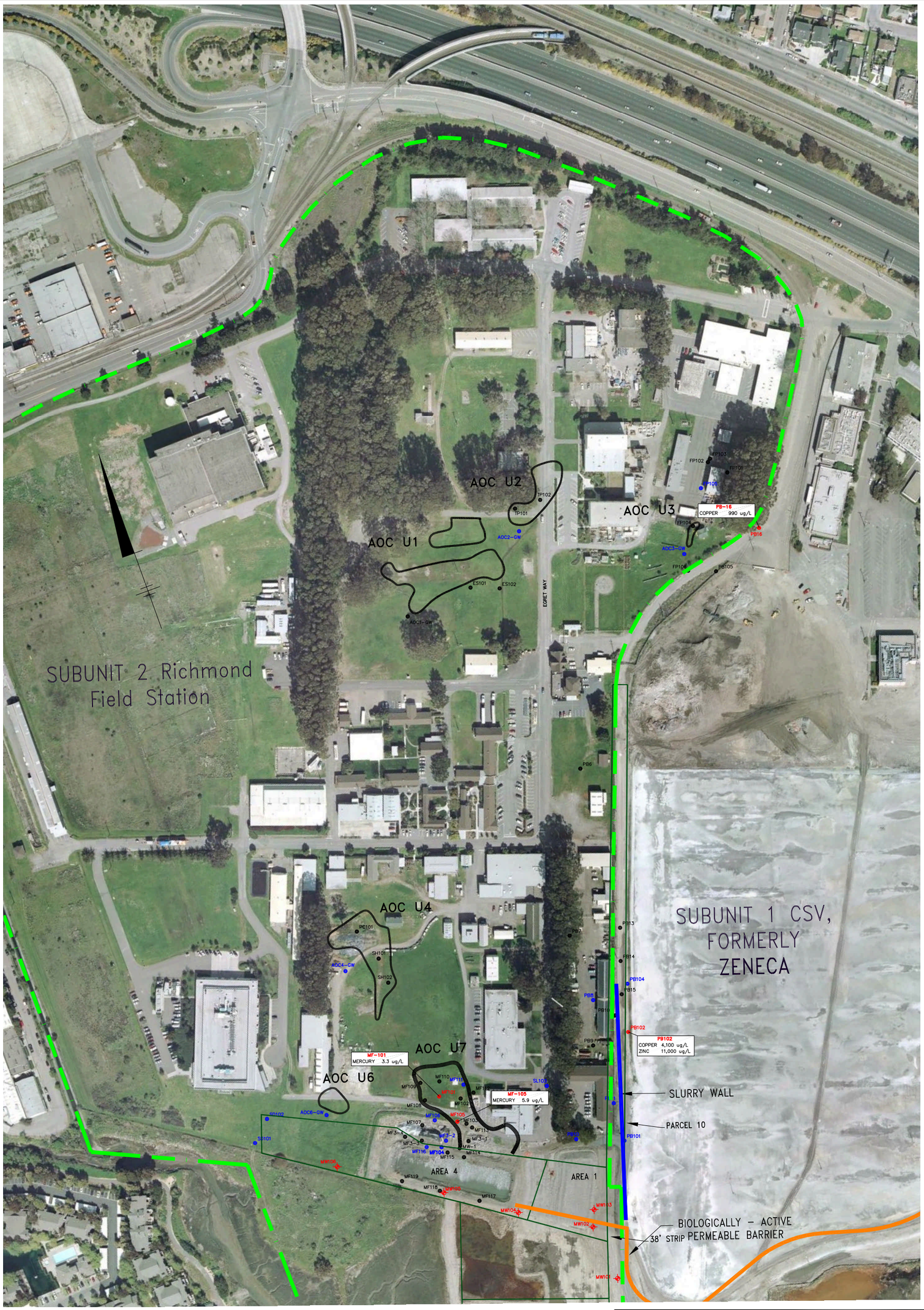
engineers, scientists, economists

FIGURE 4



LEGEND:

- PROPERTY BOUNDARY
- GROUNDWATER SAMPLE LOCATIONS WITH NO EXCEEDANCES
- GROUNDWATER SAMPLE LOCATIONS THAT EXCEEDS SCREENING CRITERIA (< 10 TIMES)
- GROUNDWATER SAMPLE LOCATIONS THAT EXCEEDS SCREENING CRITERIA (> 10 TIMES)
- AREAS OF CONCERN (AOC) BOUNDARY
- PROPOSED MONITORING WELL LOCATION

NOTES:

1. SCREENING CRITERIA = 10 X AWQC; Hg = 0.25 ug/L, Cu = 31 ug/L, Zn = 810 ug/L.
2. AERIAL PHOTO SUPPLIED BY URS ON 7/9/03 AT A SCALE OF 1"=100'.
3. LOCATIONS OF BAPB AND SLURRY WALL ARE APPROXIMATE.

X: FIELD_STATION_40SMALL.JPG
L: OFF=REF
P: PAGESET/PLT-DP
11/4/04 IRV-85-JMS
F:/IBM/CAD/2004PROJ/24210.341/24210G02.DWG

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
GROUNDWATER MONITORING PLAN

SUBUNIT 2B GROUNDWATER ANALYTICAL RESULTS

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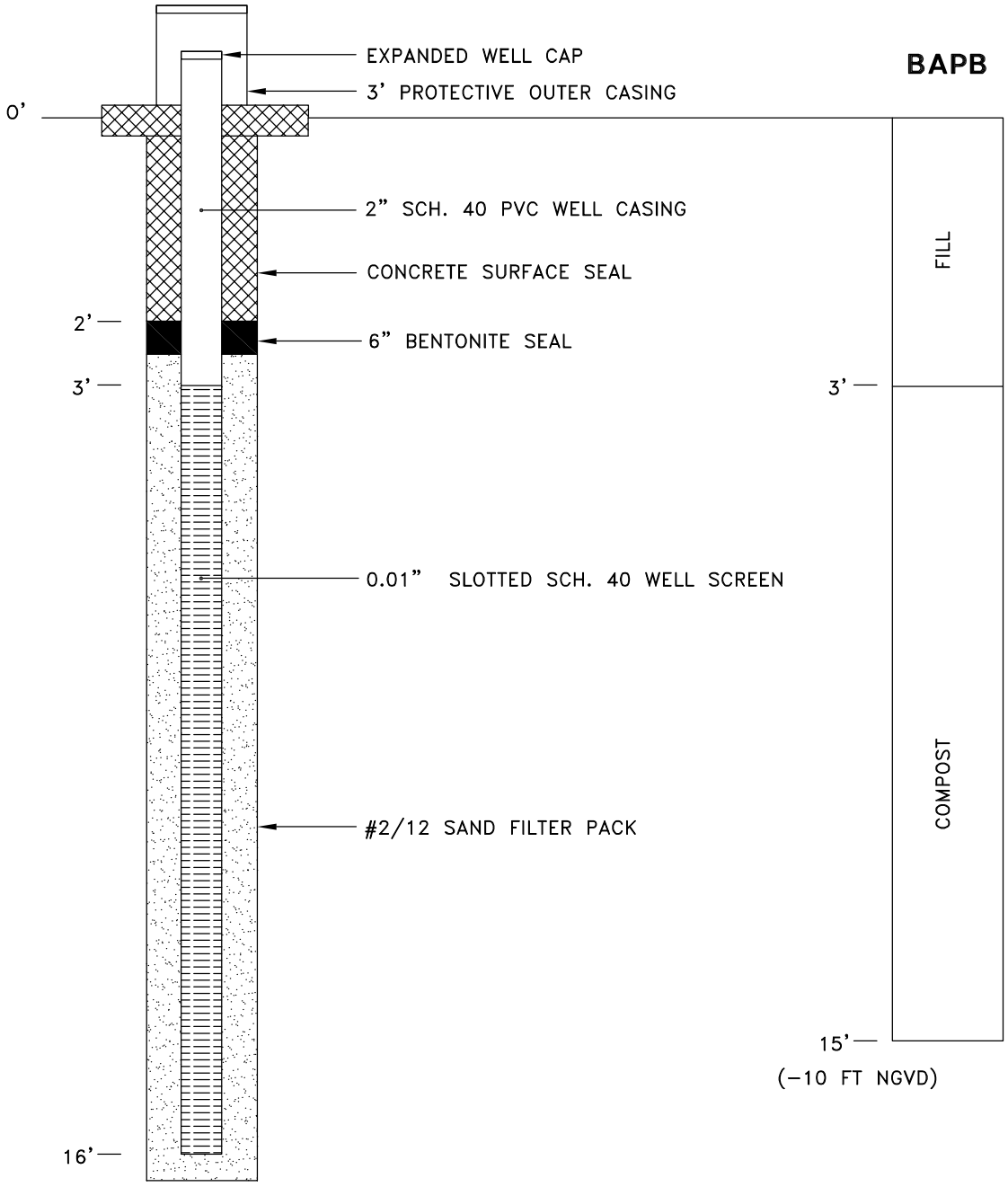
FIGURE
5



NOT TO SCALE

NOTES:

BAPB = BIOLOGICALLY - ACTIVE PERMEABLE BARRIER WALL

NGVD = 1929 NATIONAL GEODETIC VERTICAL DATUM.

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION

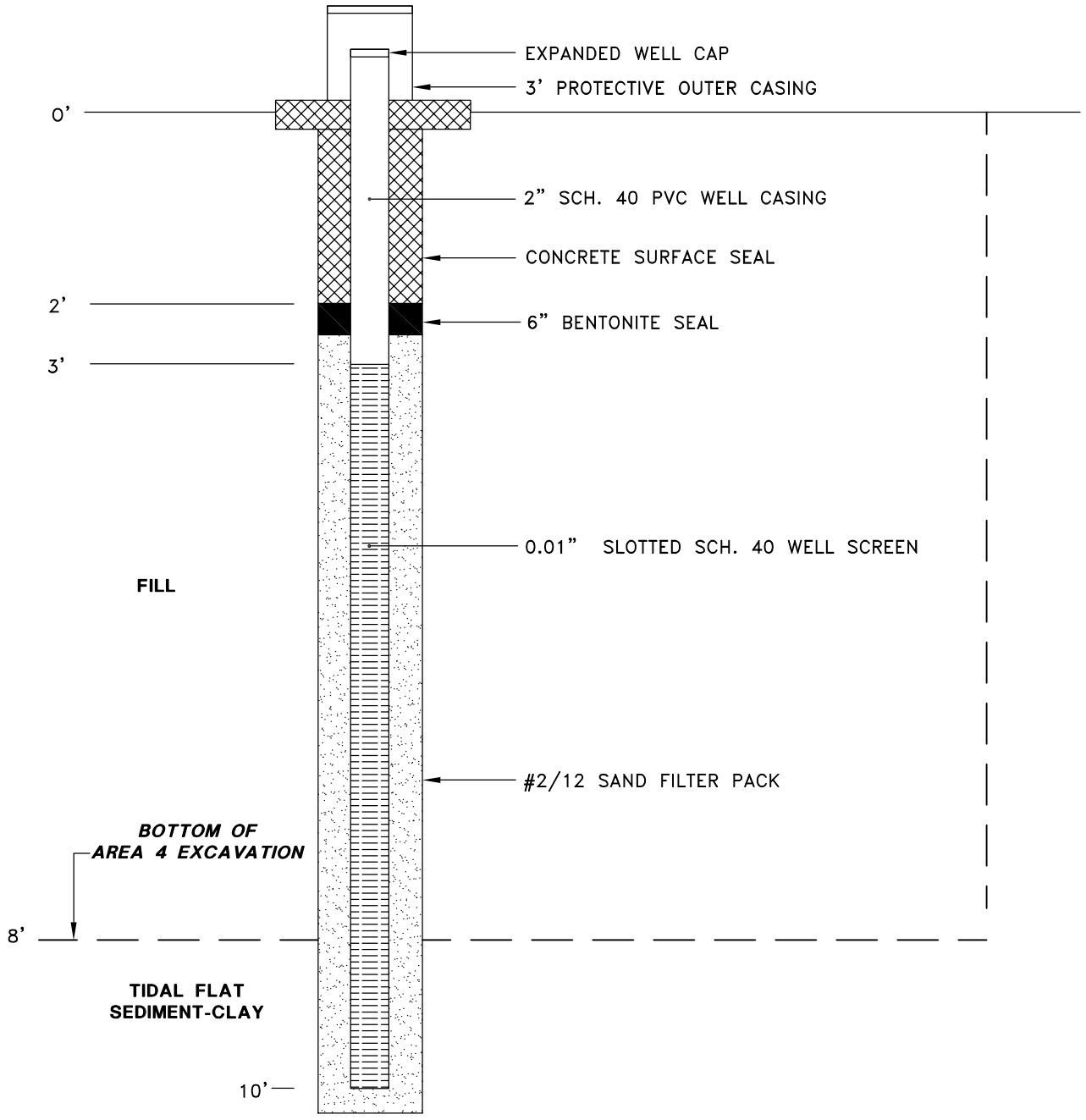
GROUNDWATER MONITORING PLAN

MONITORING WELL CONSTRUCTION DETAILS
MW101, MW102, MW103, AND MW104

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
6

L: (LAYER)
P: STD-PCP/AP
11/2/04 IRV-85-JMS
F: /IBM/CAD/2004PROJ/24210.341/24210N01.DWG



NOT TO SCALE

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION

GROUNDWATER MONITORING PLAN

MONITORING WELL CONSTRUCTION DETAILS
MW105 AND MW106

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
7

L: (LAYER)
P: STD-PCP/AP
11/2/04 IRV-85-JMS
F: /IBM/CAD/2004PROJ/24210.341/24210N02.DWG