FILLSITES AND QUARRIES
SITE INSPECTION REPORT

For
Environmental Investigation at the Formerly Used Defense Site (FUDS)
at the Benicia Arsenal, Benicia, California

FUDS Site Number: J09CA075600

FINAL

Prepared for:

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UNITED STATES ARMY ENGINEER DISTRICT, SACRAMENTO DISTRICT
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FILLSITES AND QUARRIES SITE INSPECTION REPORT
BENICIA ARSENAL, BENICIA, CALIFORNIA

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LIST OF ACRONYMS AND ABBREVIATIONS

Arsenal	Benicia Arsenal
BCLA	BC Associates
bgs	below ground surface
BII	Benicia Industries, Incorporated
BSLs	Benicia Screening Levels
CCR	California Code of Regulations
CD	compact disk
CERCLA	Compensation and Liability Act
COI	chemicals of interest
COPC	chemical of potential concern
CSM	Conceptual Site Model
CVOCs	chlorinated volatile organic compounds
DoD	Department of Defense
DQOs	Data Quality Objectives
DTSC	Department of Toxic Substance Control
EM	electromagnetic
EMAX	EMAX Laboratory, Inc.
EMLL	electromagnetic line locating
USEPA	United States Environmental Protection Agency
FA/BC	Forsgren Associates/Brown and Caldwell
FSIP	Field Site Inspection Plan
FUDS	Formerly Used Defense Sites
GPR	ground penetrating radar
HHRS	Human Health Risk Screening
HLA	Harding Lawson and Associates
HTRW	hazardous, toxic, or radiological waste
IDW	Investigation Derived Waste
MDL	Method Detection Limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MTBE	Methyl Tert-Butyl Ether
OE	ordnance and explosives
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PID	photo ionization detector
PPE	personal protective equipment
PRGs	Preliminary Remediation Goals
QAPP	Quality Assurance Project Plan
QCSR	Quality Control Summary Report
RBSLs	Risk-Based Screening Levels
RCRA	Resource Conservation and Recovery Act
RRR	Records Research Report
SI	Site Inspection
SVOCs	semi-volatile organic compounds

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

TCE	trichloroethylene
TDS	total dissolved solids
TPH-d	total petroleum hydrocarbons as diesel
TPH-g	total petroleum hydrocarbons as gasoline
TPH-mo	total petroleum hydrocarbons as motor oil
µg/L	micrograms per liter
USACE	United States Army Corp of Engineers
VMG	vertical magnetic gradient
VOCs	volatile organic compounds

EXECUTIVE SUMMARY

This Site Inspection (SI) Report presents data from an environmental investigation conducted at Fillsite 1, Fillsite 2, Quarry 1 and Quarry 3 between November 2000 through February 2001 and in October 2002. This work was performed on behalf of and with oversight by the United States Army Corps of Engineers (USACE), Sacramento District. Regulatory comments were requested for the drfat review of this report in December 2003. No comments have been received. A tab has been added to the back of this report. If comments are received, they will be added to the report behind this tab.

The suspected fillsites and quarries were identified from historical information as possible repositories for industrial wastes from the shop area and other facilities at the Arsenal.

Fillsite 1. Fillsite 1 is noted on the 1918 map included in "Benicia, Portrait of an Early California Town," (Jacobs, 1999). Identified on the map is a "dump" located slightly northeast of the former industrial shop buildings, at what appears to be the beginning of a swale leading northwest from the swamp area to the industrial area. The swamp area below the swale has since been filled. Building 71 was constructed over the filled in swamp area in 1920 and overlies the "dump". Compressible clays caused this building and others built on the former swamp to settle unevenly. Several attempts were made to enhance the structural foundation of this building by the Army, including replacing wooden piling supports with concrete piling supports or buttresses. Building 71 was demolished in the 1980's by the current landowner. The site is currently paved and used for temporary storage of new vehicles. The exact location and extent of this fillsite is unknown.

Fillsite 2. The Fillsite 2 area is situated southwest of Building 29, the Clocktower and is defined as the area bordered to the northeast and northwest by relatively steep escarpments, southeast and southwest by Adams Street and by Bayshore Road. Currently, Fillsite 2 consists of a large graded flat area that slopes gently to the southeast. Available aerial photographs did not show the exact location or boundaries of the fillsite. As a result, the location and boundaries investigated are approximate and based solely on the outline of the current graded area.

Quarry 1. Quarry 1 is located approximately 200 feet east of Building 9 (part of the Camel Barn Museum site) and is expressed by a bowl-shaped indentation in the bluff.

Quarry 3. Quarry 3 is located behind residences near the northwest corner of Park Street and Jefferson Street and is expressed by a bowl-shaped indentation in the bluff. The expression of the quarry is not as readily seen as at Quarry 1. Fill has been added to the area of Quarry 3 from soil pushed over from development activities on top of the bluff, natural erosion of the escarpment and from unsolicited dumping.

Quarries 1 and 3 provided stone for construction of several large structures on Arsenal grounds. These quarries may also have been used as dumpsites and historical information is not specific about whether fill material was placed in the quarries.

The Arsenal functioned as a site for testing gunpowder; for storing, issuing, and repairing Army ordnance; as a principal ordnance repository and distribution point for the Pacific Coast; and as a transshipment depot for storing ammunition and explosives for the Port of San Francisco (Jacobs, 1999). Exact materials handled at Fillsites 1 and 2 are unknown, but these areas may have been used for disposal of industrial wastes. Fillsite 1 is adjacent to the 50 Series Complex which used a variety of fuels and solvents when the Arsenal was operational making this site a potential location for dumping of used fuels and solvents generated at the 50 Series Complex. Therefore, there is a potential for acids, metal cleaning corrosives, petroleum, oils, lubricants, gasoline, foundry wastes, infectious wastes, and pesticides to be present. It should be noted that such practices were standard prior to the 1970's. Additionally, research indicates that these types of wastes may also have been discarded in the quarries.

Project and Field Activities

The following activities were completed during this project:

- The Arsenal fillsites and quarries were identified and located. The source of most of this information came from the Records Research Report (RRR). Additional information was attained from several site visits.

- A list of potential chemicals of interest (COI) was generated by examining past use. The COI list was compared against historical activities, taking into account site geology and hydrogeology, to determine where COIs may have been released.

- A geophysical investigation was performed to locate buried metallic and non-metallic materials and assess the extent.

- Based on the results of the geophysical survey, a field investigation was performed that included trenching to identify the nature, type, depth and extent of the buried materials.

- If refuse was encountered during the trenching, soil and groundwater samples were collected and analyzed to evaluate whether the presence of refuse resulted in soil and/or groundwater contamination.

- After the completion of the trenching, surface soil samples were collected and analyzed to evaluate the presence or absence of metals and other non-volatile constituents in surface soil as a function of risk.

- Also three temporary groundwater monitoring wells were planned on the perimeter of each fillsite to measure water level elevations, and to collect groundwater samples if refuse was found during the trenching activities. Fillsite 2 was the only site where refuse was encountered. The planned locations were spaced to accommodate a shallow and flat groundwater gradient, an assumed flow direction to the south based on topography, proximity to the Carquinez Strait and information from another environmental study, and placing one well in the assumed downgradient direction of the refuse. Three borings were

drilled at Fillsite 2 in June 2001; however, no groundwater was encountered in any of the borings. Therefore, no temporary groundwater monitoring wells were installed.

- A human health risk screening analysis was performed in the areas where refuse was found and included comparing concentrations of metals detected with the preliminary ambient metal concentrations in soil. The analysis was used to eliminate chemicals from the COI list that were not found in amounts likely to cause a significant health concern. The remaining group of chemicals is referred to as chemicals of potential concern (COPC). The risk screening analysis identified areas of potential risk and/or areas requiring further investigation.

- A total of 41 soil samples and 5 grab groundwater samples were collected during this investigation. The soil and groundwater samples collected from all fillsites and quarries were analyzed for compounds that may have been commonly used and discarded at these locations.

Results and Conclusions

In general, perched groundwater was encountered only in trenches at Fillsite 1 and Fillsite 2. Groundwater was not encountered in the three borings advanced to bedrock (37 feet bgs) at Fillsite 2. Geophysics identified metallic and non-metallic anomalies at Fillsite 1, Fillsite 2 and Quarry 3 where debris was found by trenching.

Fillsite 1

- Stratigraphy of Fillsite 1 consists of artificial fill with underlying native clays (Bay Mud). Fill material included unconsolidated sandy silt with gravel and occasional wood, brick, and a discontinuous buried asphalt layer beneath the western 1/3 of the site.

- No refuse was encountered in any trenches at Fillsite 1. Motor oil, diesel fuel and lead were detected in soil at Fillsite 1 and all decrease with depth. Solvents were detected in groundwater. Petroleum hydrocarbons, diesel fuel and motor oil, were also reported in groundwater samples collected.

- Solvents and fuels were detected in soil and groundwater. The source of solvents in groundwater is not clearly understood, but is likely associated with a nearby source area (i.e the 50 Series Complex or another upgradient unknown source area) since widespread use of solvents in the manufacturing industries began during World War II after the area was filled in and Building 71 was built on top of the "dump" site. Fuels were used throughout the Arsenal and could have been discarded at the fillsite. However, it is more likely that the fuels reported in soil and groundwater is attributed to the decomposition of the buried asphalt layer.

- Low levels of Methyl Tert-Butyl Ether (MTBE) were detected in groundwater samples from Fillsite 1. The discovery of MTBE in groundwater at the fillsite demonstrates that fuels were released after the Arsenal closed.

Fillsite 2

- Loose unconsolidated fill material with native undisturbed soil and sandstone characterize the soil at Fillsite 2. Debris and refuse material are present south of Adams Street. In the soil borings and trenches advanced at Fillsite 2, the thickness of the fill material ranges from 4.5 to 8.5 feet bgs. Native silt with minor sand is moderately to poorly graded.

- Refuse, including burnt ash, broken pottery, slag, and Cosmoline were discovered at Fillsite 2, south of Adams Street. Construction debris such as asphalt pieces, culvert pipe, and concrete blocks were also encountered at Fillsite 2, north of Adams Street.

- Elevated concentrations of lead in soil were reported at Fillsite 2, where the refuse was encountered. Additionally, lead and benzo(a)pyrene were identified as COPCs in soil for the refuse area. Motor oil and diesel fuel were also reported in soil and groundwater at Fillsite 2. The area has a dirt surface and has been used for storage of construction equipment which may be a source of the impact.

- The impact to soil north of Adams Street at Fillsite 2 and Quarry 3 are from recent activities and not associated with former DoD activities. The refuse found south of Adams Street is DoD-related.

Quarry 1

- The soil at Quarry 1 is characterized as sandy silt fill overlying sandstone. No refuse was encountered, however, minor construction debris such as brick and pipe fragments were found in a corner of the quarry. The thickness of the fill ranges from 0 to 4.5 feet bgs.

- Minor amounts of construction debris from recent dumping were encountered at Quarry 1. Motor oil, diesel fuel, pesticides, and lead were reported in surface or subsurface samples collected in trenches. Groundwater was not encountered at Quarry 1.

- The buried material found in the fill and the chemical impact to soil at Quarry 1 is from recent activities and not associated with former DoD activities.

Quarry 3

- Stratigraphy at Quarry 3 consists of unconsolidated silty sand fill and sandstone bedrock. Small fragments and pieces of concrete and asphalt are present but no refuse was encountered.

- Trenches at Quarry 3 did not encounter refuse. Low concentrations of PAHs were reported in surface soil samples. Groundwater was not encountered at Quarry 3.

- The buried material found in the fill did not impact the soil. The chemical impact in soil at Quarry 3 is from recent activities and is not associated with former DoD activities.

Recommendations

Based on the findings for the Fillsites and Quarries investigation, suspected sources appear to have impacted soil or groundwater at Fillsite 1 and Fillsite 2. Forsgren Associates/Brown and Caldwell (FA/BC) recommends the following:

- Conduct additional groundwater testing to assess the lateral extent of solvents detected in groundwater at Fillsite 1. Assess the source of the solvents in this area.

- Re-evaluate lead and benzo(a)pyrene found above Benicia Screening Levels in soil at the Fillsite 2 refuse area during the remedial investigation at the Arsenal.

- No DoD Action Indicated (NDAI) for north of Adams Street at Fillsite 2, Quarry 1, and Quarry 3.

1.0 INTRODUCTION AND BACKGROUND

The Benicia Arsenal (Arsenal) is located in Benicia, California, about 25 miles northeast of San Francisco (Figure 1-1). The Arsenal was created in 1849 with the transfer of 345 acres of land by the founders of the City of Benicia (Jacobs, 1999). Between 1849 and 1958, the facility grew by land acquisition to a total of 2,728 acres, of which 190 acres were located in Carquinez Strait to the south and Suisun Bay to the northeast. During its active life, this facility served the United States Army as a principal depot for ordnance and ordnance stores, issuance, and the manufacture and testing of small arms. The Arsenal was declared excess by the government in 1963. Deactivation and closure of the facility were completed in 1964 (Jacobs, 1999).

Two possible fillsites and two quarries were identified from historical information as possible repositories for industrial wastes from the industrial shop area and other facilities at the Arsenal. The two fillsites, identified as Fillsite 1 and Fillsite 2, and one quarry, Quarry 3 are located in Area I ("I" for Industrial of the former Arsenal property (Figure 1-2)). The second quarry, Quarry 1, is located in Area M ("M" for Motor Pool) (Figure 1-2). Prior to use as possible repositories, Area I Quarry 3 and Area M Quarry 1 provided stone for the construction of several large structures on the Arsenal grounds.

This Site Inspection (SI) Report presents data from an environmental investigation conducted at Fillsites 1 and 2 and Quarry 3 between November 8, 2000 and February 15, 2001 and at Quarry 1 on October 29, 2002. FA/BC conducted the investigation in accordance with the Field Site Inspection Plan (FSIP) for the Area I Landfill 1, Landfill 2, Quarry 3, and Area M Quarry 1 (FA/BC, 2001) and the Arsenal-Wide Quality Assurance Project Plan (QAPP) (FA/BC, 1999a). This work was performed on behalf of and with oversight by the United States Army Corps of Engineers (USACE), Sacramento District. The FSIP name of Landfill 1 and Landfill 2 refers to the names given to these sites in the Records Research Report (RRR) (Jacobs, 1999). The term "landfill" is inappropriate and has been changed to "fillsite" because the materials disposed of meet the definition of inert wastes under California Code of Regulations (CCR), Title 27 regulations. Therefore, the names "Landfill 1" and "Landfill 2" are changed to "Fillsite 1" and "Fillsite 2", respectively for the remainder of this report and for future documents.

In accordance with the Formerly Used Defense Sites (FUDS) program and USACE guidance, this SI Report documents investigation activities at these fillsites and quarries within the former Arsenal. Under the FUDS program, land that was previously utilized by the United States Department of Defense (DoD) that has no "beneficial use history" from subsequent landowners or lessors will be characterized and if necessary remediated appropriately. Beneficial use of former DoD land is defined as use by subsequent landowners or lessors in manners that would either mask contamination caused by DoD or continue contamination in the same way.

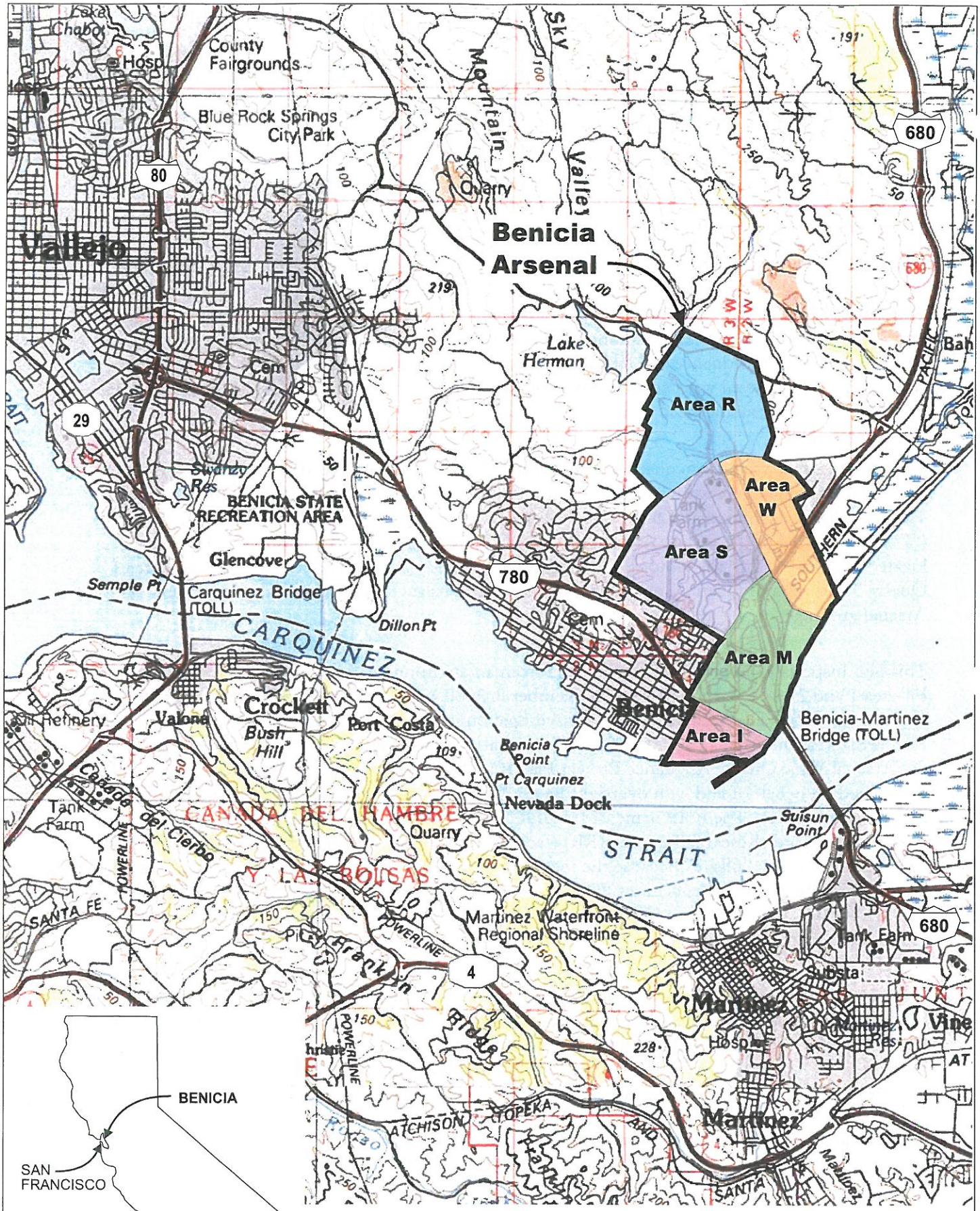


Figure 1-1
Arsenal Location Map
Site Inspection Report
Former Benicia Arsenal, Benicia, CA

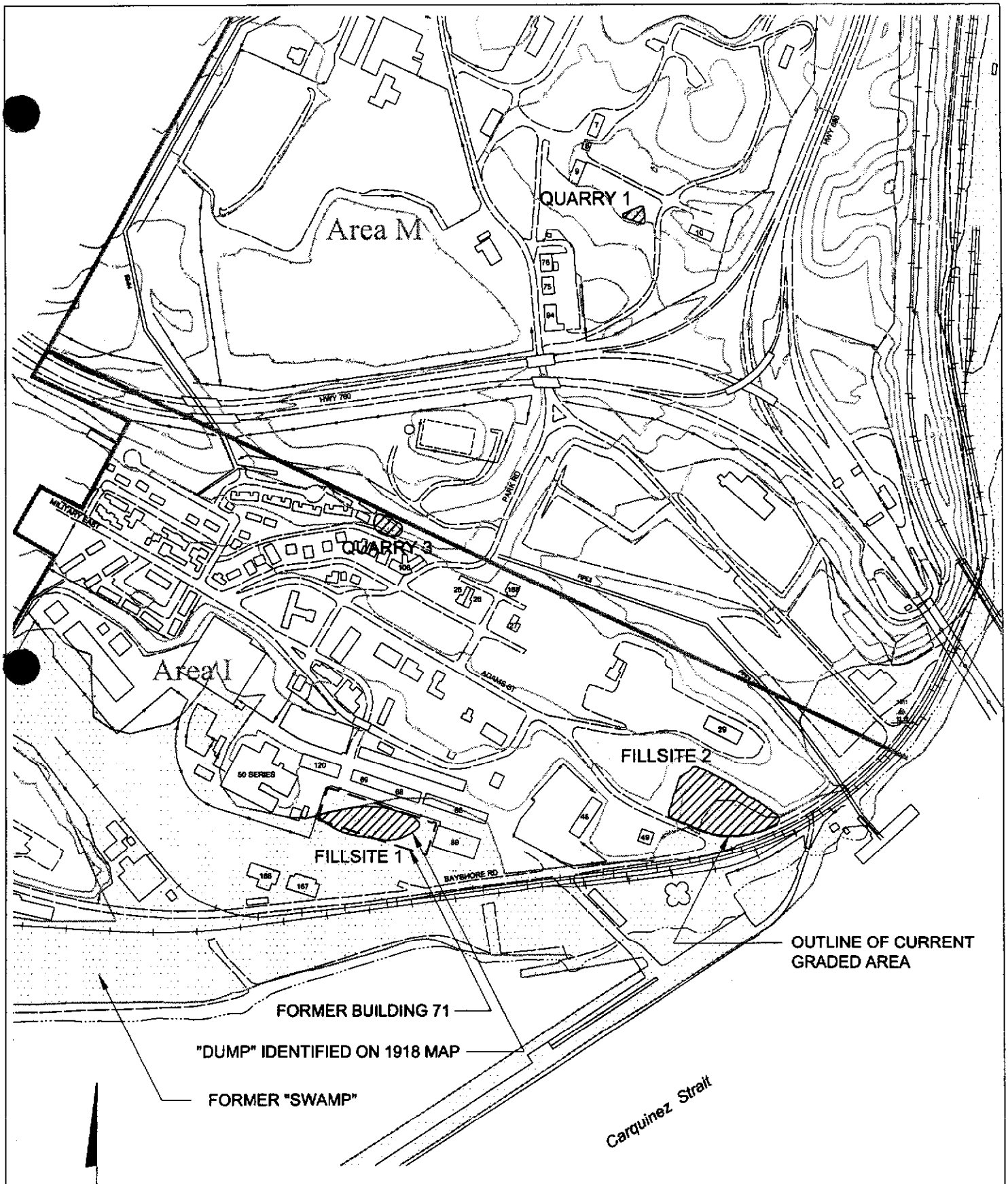


Figure 1-2
Locations of Fillsite 1, Fillsite 2, and Quarry 3 in Area I, and Quarry 1 in Area M
Site Inspection Report
Former Benicia Arsenal, Benicia, CA

This SI report is organized into nine sections. Section 1.0 presents background information, including the historical uses and a summary of previous investigations. Section 2.0 describes the investigative approach used at each fillsite and quarry and presents the Data Quality Objectives (DQOs). Section 3.0 presents a summary of field methods and sampling rationale. It also summarizes disposal of Investigation Derived Waste (IDW). Section 4.0 describes the regional, localized, and site-specific geology and hydrogeology. Section 5.0 describes the quality and usability of the data collected during this site inspection. A summary and analysis of results are presented in Section 6.0. Section 7.0 summarizes a human health risk screening, and Section 8.0 presents the conclusions and recommendations. References are included as Section 9.0.

This SI report contains 7 appendices. Each appendix is described briefly below:

- **Appendix A – Glossary.** Definitions of commonly used terms in this report.
- **Appendix B – March 5, 2001 NORCAL Geophysical Consultants Survey Report.** Results of a geophysical survey conducted at Fillsite 1, Fillsite 2, and Quarry 3.
- **Appendix C – Trench Logs/Test Pits for Fillsites 1 and 2 and Quarries 1 and 3.** Trench logs from the fillsite and quarry investigation.
- **Appendix D – Fillsite 2 Boring Logs.** Boring logs from the attempted installation of temporary groundwater monitoring wells.
- **Appendix E – IDW Manifests.** Transportation and disposal manifests for soil generated during the Site Inspection.
- **Appendix F – Legend for Analytical Result Tables.** Definitions of data acronyms, quality control flags, and reason codes.
- **Appendix G - Analytical Results for All Constituents in Soil at the Fillsites and Quarries.** The analytical results for soil are included in Adobe Acrobat® PDF format on the included compact disc (CD). The PDF file is bookmarked by analyte.
- **Appendix H - Analytical Results for All Constituents in Groundwater at the Fillsites.** Groundwater results in Adobe Acrobat® PDF format are included on the same CD as the soil results. The PDF file is bookmarked by analyte.

1.1 Problem Definition and Scope

Based on information collected for the Benicia Arsenal RRR (Jacobs, 1999), these sites might have served as the industrial waste repository from the shop area, as well as other facilities at the Arsenal. Quarry 1 and Quarry 3 were used to provide stone for construction of several large structures on Arsenal grounds. Additionally, the quarries may have been used as a dumpsite. Historical information is not specific about whether fill material was placed into the quarries. This site inspection sought to ascertain whether the DoD deposited refuse into the fillsites/quarries and if present, whether the refuse resulted in soil or groundwater contamination. Data collected from this investigation will be used to determine if additional investigation or remedial action are necessary.

The RRR identified three "landfills" (Landfill 1, Landfill 2, and Landfill 3) and three quarries (Sandstone Quarry 1, Sandstone Quarry 2, and Quarry 3) at the former Arsenal. This SI report addresses all but two of these sites, Landfill 3 and Quarry 2. Landfill 3 was in operation from 1940 through 1964 and may have encompassed up to 20 acres. Based on the size of Landfill 3 and the available funding, it was not included in this investigation. Sandstone Quarry 2 originated around 1894 and was later filled in and used as a primer destruction area. The site was investigated as part of an Arsenal-wide ordnance and explosives investigation and removal effort conducted by USACE in 2001 (USACE, 2001). There were no hazardous, toxic, or radiological waste (HTRW) related issues identified for the Quarry 2 site and therefore no further DoD HTRW action was taken.

The following activities were completed during this project:

- The Arsenal fillsites and quarries were identified and located. The source of most of this information came from the RRR. Additional information was attained from several site visits.

- A list of potential COI was generated by examining past use. The COI list was compared against historical activities, taking into account site geology and hydrogeology, to determine where COIs may have been released.

- A geophysical investigation was performed to locate and assess the extent of buried non-metallic and metallic materials at the fillsites/quarries.

- Based on the results of the geophysical survey, a field investigation was performed that included trenching to identify the nature and extent of the materials identified in the geophysical survey. Additionally, the type, extent, and depth of any refuse could be determined.

- If refuse was encountered during the trenching, soil and groundwater samples were collected and analyzed to evaluate whether the presence of refuse resulted in soil and/or groundwater contamination.

- A human health risk screening analysis was performed that included comparing concentrations of metals detected with the preliminary ambient metal concentrations in soil calculated by FA/BC (FA/BC, 2003a). The analysis was used to eliminate chemicals from the COI list that were not found in amounts likely to cause a significant health concern. The remaining group of chemicals are referred to as COPC.

- The risk screening analysis identified areas of potential risk and/or areas requiring further investigation.

1.2 Site Location and Historical Use

For organizational purposes, the Arsenal was divided into five distinct areas (the "WIRMS") based on land use:

- Area W: Warehouse Area
- Area I: Industrial/Manufacturing Area
- Area R: Revetment/Explosives Holding Area
- Area M: Motor Pool and Historical Ordnance Storage Area
- Area S: Magazine Storage Expansion Area

These areas are shown on Figure 1-1. This report focuses on Fillsite 1, Fillsite 2 and Quarry 3 located in Area I and Quarry 1 located in Area M.

Area I contains several of the original Arsenal structures that were erected in the late 1800s. This area served as the main industrial and manufacturing area throughout the 115-year history of the facility and was the center of activity at the Arsenal. Several machine shops, manufacturing shops, and cleaning and painting shops were housed here, along with a blacksmith shop, a welding shop, numerous vehicle and artillery repair shops and small arms shops. Area I also housed the Arsenal's administrative offices, most of the permanent housing facilities, photographic laboratories, a firehouse, and hospital. Fuel storage and dispensing facilities, a locomotive house, boiler houses, storehouse and warehouse facilities, open storage facilities, fillsites and quarries were also located within Area I.

Area M also contains many original structures that were built between 1852 and 1857. The western section of Area M was the location of the original Benicia Barracks, established in 1849. The Barracks were incorporated into the Arsenal in 1924. For nearly one hundred years, Area M was used primarily for ammunition, powder, and ordnance storage and for the manufacturing of black powder. The amount of black powder manufactured yearly ranged from 150,000 to 250,000 pounds, and the total amount stored at the Arsenal in 1905 was approximately 500,000 pounds (Jacobs, 1999).

Fillsite 1. Fillsite 1 is noted on the 1918 map included in "Benicia, Portrait of an Early California Town," (Jacobs, 1999). Identified on the map is a "dump" located slightly northeast of the former shop buildings (55, 56, and 57), at what appears to be the beginning of a swale leading northwest from the swamp area (Figure 1-2) through the industrial area. The swamp area below the swale has since been filled. The exact date the Army filled in the entire swamp area is unknown, but believed to be between 1918 and the 1930's. However, in the area of Fillsite 1, it was between 1918 and 1920. Building 71 was constructed over the filled in swamp area in 1920, with the building footprint coinciding with the Fillsite 1 area (Figure 1-2). Compressible clays and inadequate engineering support structure caused this building and others built on the former swamp to settle unevenly. The Army made several attempts to enhance the structural foundation of this building, including replacing wooden piling supports with concrete piling supports or buttresses. Benicia Industries, Incorporated (BII), the current property owner, demolished Building 71 in the 1980's because the building was unstable. The site is currently paved and used for temporary storage of new vehicles. Available aerial photographs did not show the boundaries of the fillsite, as a result, the exact location and extent of this fillsite is unknown, and boundaries referenced are based on the outline of the "dump" identified on the 1918 map. It was standard practice to dispose of wastes into surface water bodies during the time the military occupied the Arsenal.

Fillsite 2. The Fillsite 2 area was identified by USACE in its 1997 report as Area 9, situated southwest of Building 29, the Clocktower (Jacobs, 1999) (Figure 1-2). The Fillsite 2 area is defined as the area bordered to the northeast and northwest by relatively steep escarpments, southeast and southwest by Adams Street and by Bayshore Road (Photo 1).

Benicia Industries has owned the property since deactivation of the Arsenal in 1964. Currently, Fillsite 2 consists of a large graded flat area that slopes gently to the southeast. Available aerial photographs did not show the exact location or boundaries of the fillsite. As a result, the location and boundaries shown on Figure 1-2 are approximate and based solely on the outline of the current graded area.

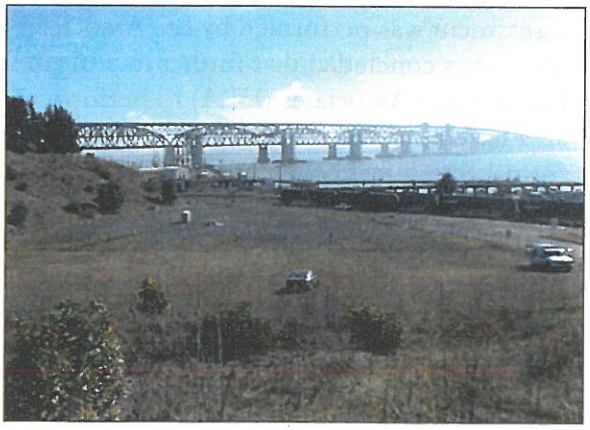


Photo 1. Looking southeast at the grade flat area of Fillsite 2. Carquinez Strait in background. Photo taken March 2001.

Quarry 1. Quarry 1 is located approximately 200 feet east of Building 9 (part of the Camel Barn Museum site) in the central portion of Area M (Figure 1-2) and is expressed by a bowl-shaped indentation in the bluff (Photo 2).

Photo 2. Looking south at the bowl-shaped escarpment of Quarry 1. Photo taken 2001.

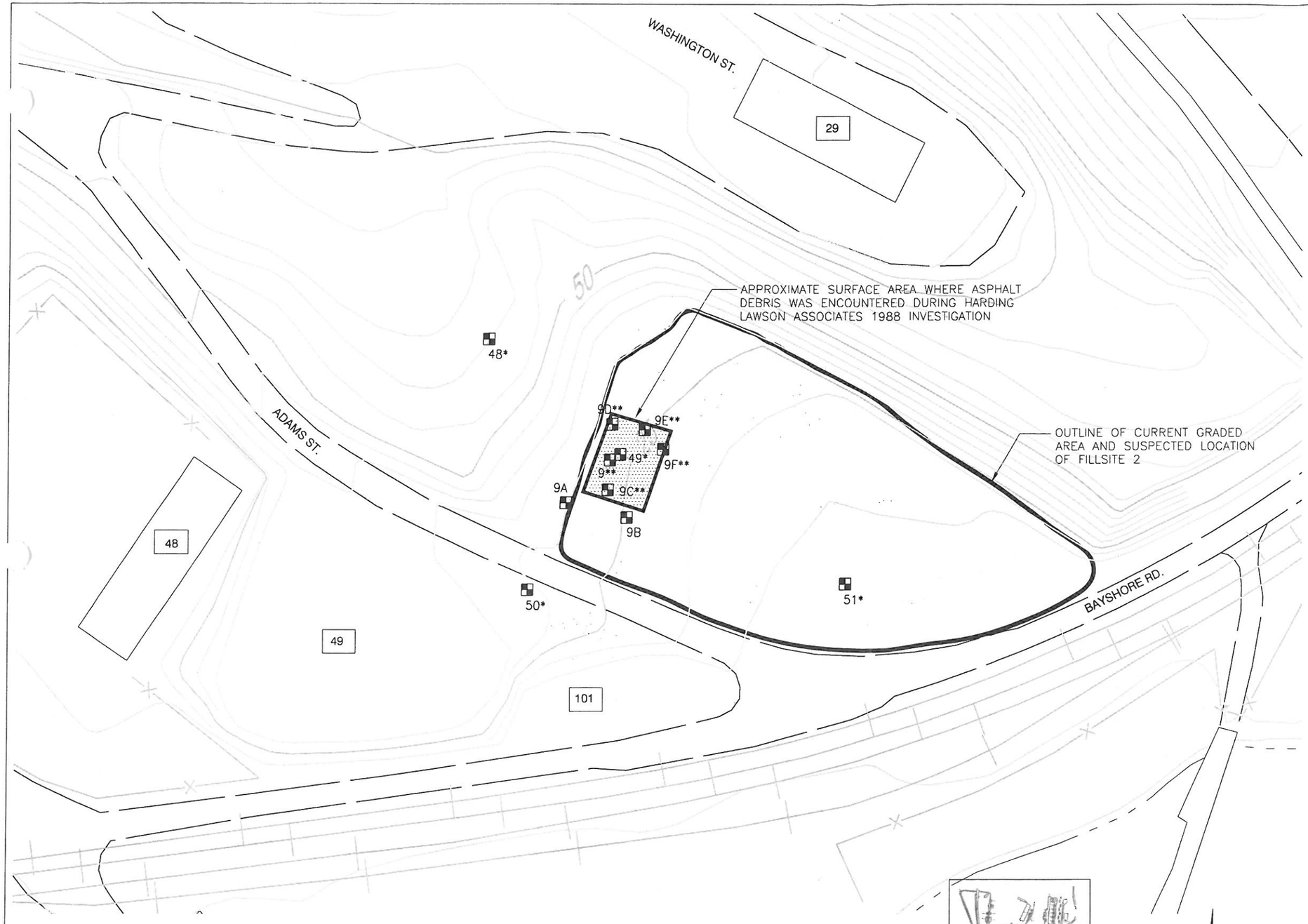
Quarry 3. Quarry 3 is located behind residences near the northwest corners of Park Street and Jefferson Street and is expressed by a bowl-shaped indentation in the bluff (Figure 1-2 and Photo 3). The expression of the quarry is not as readily seen as at Quarry 1. Fill has been added to the area of Quarry 3 from soil pushed over from development activities on top of the bluff, natural erosion of the escarpment and from unsolicited dumping.

Photo 3. Looking north at the escarpment of Quarry 3. Photo taken 2001.

1.3 Previous Investigations

This section presents a summary of previous investigations at the sites discussed in this report.

Based on FA/BC's research, previous investigations were only performed at Fillsite 2. Two previous investigations were conducted at Fillsite 2. In 1987, a preliminary hazardous waste assessment was performed by BC Associates (BCLA). The assessment included testing soil samples and it was concluded that further investigation was required. In 1988, BII contracted Harding Lawson and Associates (HLA) to perform an independent field investigation of the former fillsite area based on BCLA's data (HLA, 1988). This investigation consisted of digging seven test pits from 1.8 to 5 feet below ground surface (bgs). Figure 1-3 identifies the test pit locations in the area of the former fillsite. In addition, HLA collected soil samples that were analyzed for total and soluble lead only. Based on laboratory results it was determined that remediation was warranted. Although lead was detected at concentrations above 1,000 milligrams per kilogram (mg/kg), the detections were localized and not considered characteristic of the fill. Figure 1-3 summarizes the results of HLA and BCLA's investigation results.



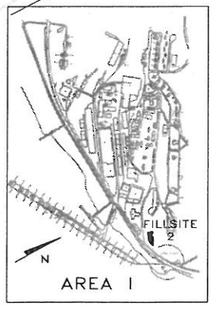
LEGEND

29	Building Number
49	Former Building Location
++++++++	Railroad Tracks
48 ■	Existing Test Pit Location and Number
*	Approximate Location
**	Fill Encountered in Test Pit
WET	Analyzed by the California Waste Extraction Test Method

Number	Depth (ft bgs)	Method	Concentration
9	0.0 1.0 2.0	7420-Pb	1,100 mg/kg 1,500 mg/kg 11 mg/kg
9A	0.0	7420-Pb	32 mg/kg
9B	0.0	7420-Pb	24 mg/kg
9C	0.5 1.5	7420-Pb	230 mg/kg 8.2 mg/kg
9D	0.0 1.0	7420-Pb	460 mg/kg 89 mg/kg
9E	0.0 1.0	7420-Pb	230 mg/kg 6.2 mg/kg
9F	0.0 1.0	7420-Pb	34 mg/kg 130 mg/kg
48	0.0 0.5 1.0	WET Pb WET Pb WET Pb	1.13 mg/L 1.43 mg/L 0.86 mg/L
49	0.0 0.5 1.0	WET Pb WET Pb WET Pb	10.86 mg/L 6.94 mg/L 14.2 mg/L
50	0.0 0.5 1.0	WET Pb WET Pb WET Pb	6.34 mg/L 3.75 mg/L 2.84 mg/L
51	0.0 0.5 1.0	WET Pb WET Pb WET Pb	0.16 mg/L 0.03 mg/L 0.04 mg/L

Note 1.
Samples 9, 9A, 9B, 9C, 9D, 9E, and 9F were collected by Harding Lawson Associates (HLA) in March 1988. Samples 48, 49, 50, and 51 were collected by BCL Associates in 1987. Only the samples within or adjacent to the approximate fillsite boundary are shown.

Note 2.
Contour interval = 5 feet



N

25 0 50 100
Scale In Feet

Figure 1-3
Previously Collected Data
Lead Concentrations in Soil at Fillsite 2
Site Inspection Report
Former Benicia Arsenal, Benicia, CA

2.0 INVESTIGATIVE APPROACH

A Preliminary Conceptual Site Model (CSM) was developed and used during this phase of the project to help design and guide this investigation. The CSM developed for the fillsites and quarries incorporates site-specific historical, geologic, and hydrogeologic information to identify COIs, potential sources of impacts to the environment, and migration pathways. The CSM is discussed in the following section.

2.1 Conceptual Site Model

The CSM was developed after reviewing the RRR (Jacobs, 1999), previous investigations, other pertinent reports, and numerous field surveys.

2.1.1 Physical Setting

Fillsite 1 is located within an asphalt-covered area at the southeast corner of Tyler Street and Polk Street, the former location of Building 71. Fillsite 1 is in a flat area with what appears to be a swale between the swamp area of the Carquinez Strait and the industrial area to the northwest. The swamp area has since been filled.

Fillsite 2 is situated southwest of Building 29, the Clocktower, and is bordered to the northeast and northwest by relatively steep sandstone escarpments.

Currently, this site is a relatively flat, graded area that slopes gently to the southeast.

Quarry 1 is located east of Building 9 and is part of the Camel Barn Museum site. The quarry is expressed by a bowl-shaped indentation in a sandstone bluff. In addition to providing stone for the construction of several large structures on the Arsenal, this site may have been used as a dumpsite.

Quarry 3 is expressed by a slight indentation in the adjacent hillside. It is located behind existing residential housing and overlooks Fillsites 1 and 2 on the sandstone hillside.

2.1.2 Source Areas and Chemicals of Interest

The Arsenal functioned as a site for testing gunpowder; for storing, issuing, and repairing Army ordnance; as a principal ordnance repository and distribution point for the Pacific Coast; and as a transshipment depot for storing ammunition and explosives for the Port of San Francisco (Jacobs, 1999). Exact materials handled at Fillsites 1 and 2 are unknown, but these areas may have been used for disposal of industrial wastes. Fillsite 1 is adjacent to the 50 Series Complex (Figure 1-2) which used a variety of fuels and solvents when the Arsenal was operational making this site a potential

location for dumping of used fuels and solvents generated at the 50 Series Complex. Therefore, there is a potential for acids, metal cleaning corrosives, petroleum, oils, lubricants, gasoline, and foundry wastes, infectious wastes, and pesticides to be present. It should be noted that such practices were standard prior to the 1970's. Fillsite 2 is located in the eastern corner of Arsenal (Figure 1-2) and farther removed from the 50 Series Complex, but still adjacent to other shop buildings (e.g., Building 48 and 49).

Various chemicals were used throughout the historical activities of the Arsenal. At the 50 Series Complex, (only 300 feet northeast of Fillsite 1) ammonium persulfate, ammonium carbonate, ammonia, white lead and grease were used for various small arm preservatives (Jacobs, 1999). Other chemicals used at the shop buildings included trichloroethylene (TCE), phosphoric acid, Oakite (bluing compound), light oil P-20, and Stoddard solvent (Jacobs, 1999). Fuel related petroleum hydrocarbons including fuel oil, diesel fuel and gasoline were used throughout the Arsenal and spent fuels/oils may have been deposited in the fillsites/quarries. Additional items used at the Arsenal that may have been disposed of at the fillsites/quarries include machinery parts, metal scraps, foundry sand, and boiler parts.

Quarries 1 and 3 provided stone for construction of several large structures on Arsenal grounds. These quarries may also have been used as dumpsites and historical information is not specific about whether fill material was placed in the quarries. Existing topography at Quarry 3 indicates that some filling has occurred. Waste material found during the investigation (e.g. poly vinyl pipe, asphalt debris, concrete, fencing and trash) indicates some post-Army dumping. The site contains a sign prohibiting unlawful dumping in the area.

Each fillsite and quarry was evaluated to assess potential chemical source areas and if chemicals were left at the site. As historical information is not specific in the types of waste buried, broad arrays of potential chemicals of interest were evaluated at each potential source area.

2.1.3 Release Mechanisms

The fillsites/quarries where refuse may have been discarded is a potential location for a variety of chemicals and machinery parts. Tanks throughout the Arsenal were used for storing petroleum products and other chemicals which, when spent, may have been dumped into nearby fillsites or quarries. The shop area adjacent to Fillsite 1 used many chemicals in cleaning and arms production. Degreasing, paint stripping, and tar removal chemicals were stored in tanks in the 50 Series Complex and usually emptied every two to three weeks (Jacobs, 1999). Metal shavings, such as lead and copper, were also by-products in the Arsenal's foundry operations and were possibly dumped into the nearby fillsites. Used machinery parts that no longer functioned were likely thrown away into the fillsites.

2.1.4 Pathways and Mobility

Once released into the environment at the fillsites and quarries, several mechanisms can transport the chemicals. Potential pathways include air, surface water, soil, and groundwater.

Air

COIs may be transported in the air via dust or volatilization. Examples of airborne transport of chemicals in dust include nonvolatile dusts of metals from discharged bullets or burnt wastes discarded or scattered around the fillsites. Nonvolatile chemicals may be transported by air when wind suspends dust in the air and distributes the chemicals throughout the area. The fine particles of dust could contain COIs, such as lead from ammunition. In addition to dust, airborne COIs may be volatile. For example, volatile chemicals may be released to the air when solvents are dumped into the fillsites or quarries. Another possible pathway for volatiles to contaminate air is by volitization from contaminated soil. Volatile chemicals in soil and groundwater may also eventually reach the surface and the atmosphere.

Surface Water

Released chemicals may be transported by surface water either by dissolving or physically mixing with the fine sediment in surface water. Discarded machinery parts may have contained metal or polychlorinated biphenyls (PCBs) particles that adhered to soil from transformers or the foundry facilities and may have been carried during rains to the former swamp and deposited there.

Soil

Potential mobility associated with contaminated soil is by volatilization or percolation/infiltration. The volatilization of chemicals in soil occurs when they are present in the shallow soil. The shallow soil at the fillsites include artificial fill overlying alluvial/fluvial material consisting of native silt and clay with poorly graded sand and gravel. At the quarries, the shallow soil consists of silty and sandy fill overlying sandstone bedrock. Discarded volatile chemicals may volatilize in the silt, sand and poorly graded gravel creating soil vapor or gases.

Another possible transport mechanism is infiltration. Infiltration of surface water through surface soil may carry contaminants downward into subsurface soil and groundwater. For example, waste solvents spilled or spent fuels may have infiltrated into the subsurface soil or into groundwater.

Groundwater

Migration pathways for groundwater contamination include migration of chemicals in liquid, gaseous, or vapor form from the soil to groundwater. After contaminants infiltrate in soil, they may

migrate further downward into groundwater or be transported laterally as gas or vapor. Once in groundwater, the contaminants spread in the direction of groundwater flow. Groundwater is not present at the quarries and portions of Fillsite 2. Therefore, it is not a pathway at these sites.

2.2 Project Objectives

The overall objectives of this investigation are to ascertain whether soil or groundwater contamination resulted from past DoD use of the fillsites and quarries. The project objectives (FA/BC, 2001) were to include:

- assess whether Fillsite 1, Fillsite 2, Quarry 1 and Quarry 3 contain refuse/fill materials;
- assess the boundaries of Fillsite 1, Fillsite 2, Quarry 1 and Quarry 3;
- ascertain whether past DoD activities at Fillsite 1, Fillsite 2, Quarry 1 and Quarry 3 have resulted in soil or groundwater contamination;
- assess the subsurface stratigraphy in the vicinity of Fillsite 1, Fillsite 2, Quarry 1 and Quarry 3;
- if refuse was found, assess the depth, flow direction, gradient and chemical quality of groundwater in the vicinity of Fillsite 1 and Fillsite 2;
- if refuse was found, assess the depth and chemical quality of groundwater in the vicinity of Quarry 1 and Quarry 3;
- assess the nature of the fill or refuse material in the center of each site by trenching;
- assess the chemical quality of surface soil samples at Fillsite 2 and both quarries for risk analysis (note: Fillsite 1 is paved, while the others are not); and,
- develop preliminary estimates of the volumes of material disposed of at each fillsite/quarry.

The DQO process is used as a strategic planning approach to optimize the data collection activities and guide the investigation. It uses a systematic procedure for defining the criteria that data collection should satisfy and is described in United States Environmental Protection Agency (USEPA) guidance (EPA, 1994). The DQOs presented in Table 2-1 were outlined in the FSIP (FA/BC, 2001). A discussion as to whether or not they were satisfied is included below.

Table 2-1. Data Quality Objectives

Data Quality Objective	DQO Met?	Discussion
Confirm the existence of each fillsite/quarry at locations indicated in historical documentation and other pertinent information.	Yes	Geophysical surveys and trenching activities were conducted at each suspected fillsite/quarry location. Refuse was discovered at only one location, Fillsite 2.
Use geophysical techniques to assess if OE (ordnance and explosives) may be present in the fillsites/quarries.	Yes	Geophysical surveys were conducted at each fillsite/quarry to determine the location of buried metallic objects. No OE was identified during trenching activities.
Assess groundwater quality, elevation, flow direction, and gradient and evaluate if COPCs are present in groundwater at concentrations that exceed assessment criteria at Fillsites 1 and 2.	Yes	Grab samples of perched groundwater were collected from the trenches at Fillsites 1 and 2 to assess groundwater quality. Based on the presence of refuse at Fillsite 2, wells were drilled. During borehole advancement, no groundwater was encountered; therefore, groundwater monitoring wells were not installed and flow direction, gradient, and elevation could not be determined.

Table 2-1. Data Quality Objectives (continued)

Data Quality Objective	DQO met?	Discussion
Assess the lateral extent of fillsite/quarry refuse/fill by determining boundaries of the fillsites/quarries using geophysical techniques.	Yes	Each fillsite/quarry was evaluated by geophysical techniques to determine the lateral extent of buried metallic and non-metallic materials (geophysical anomalies).
Confirm lateral extent of fillsite/quarry refuse/fill by trenching.	Yes	Several trenches were excavated at each fillsite/quarry. Trenches were located at the edges of geophysical anomalies to delineate their lateral extent. Refuse was only found at Fillsite 2. The lateral and vertical extent of the refuse was determined.
Assess groundwater quality and elevation and evaluate if COIs are present in groundwater at concentrations that exceed assessment criteria at Quarries 1 and 3.	Yes	No groundwater was encountered at Quarries 1 and 3 during trenching. Since no refuse was found at these quarries, no groundwater sampling was performed.
Assess the surface soil quality and evaluate if COIs are present in surface soils at concentrations that exceed risk assessment criteria at Fillsite 2 and both quarries.	Yes	Surface soil samples were collected (see Section 6.0 for details). Risk values were calculated for the Fillsite 2 area only (see Section 7.0 for details).
Assess the extent and type of refuse/fill within each site.	Yes	Refuse was only encountered at Fillsite 2. The refuse was a mixture of ash, metal slag from welding, pottery, glass and a small container of Cosmoline[1]. The volume of the refuse is approximately 60 cubic yards and extends over an area estimated at 400 square feet. The refuse at Fillsite 2 is approximately 4.5 feet below grade and approximately 4 feet thick.
Determine if geophysical data indicate the potential presence of OE in the fillsites/quarries and assess if potential OE geophysical anomalies may require further investigation.	Yes	Geophysical surveys were conducted at each fillsite/quarry. No OE was confirmed to be present.
If refuse is identified, assess if additional subsurface investigation may be necessary to determine the impact of the refuse/fill on soil, soil gas and groundwater.	Yes	Soil samples were collected in native soil below the refuse to evaluate potential impact to soil at Fillsite 2. Diesel and motor oil were detected at concentrations ranging from 7 mg/kg to 32 mg/kg.
Develop a preliminary estimate of the volumes of the materials disposed in each fillsite/quarry using results from the geophysical survey, and trenching.	Yes	The volume of refuse found at Fillsite 2 is approximately 60 cubic yards.
Evaluate the depth of fill and refuse in each fillsite/quarry, as feasible, by sampling at multiple locations.	Yes	Fill was evaluated at each location. Fillsite 2 is the only location where refuse was encountered. The amount of fill ranged from surface to 8.5 feet bgs. The refuse at Fillsite 2 is approximately 4.5 feet below grade and approximately 4 feet thick.

[1] Cosmoline is a low-hazard petroleum distillate used as a rust preventative.

3.0 FIELD METHODS AND SAMPLING RATIONALE

This section describes the field methods used, the rationale for selecting the number and location of samples, analytical parameters, and IDW management procedures for the Fillsite and Quarry investigation.

3.1 Field Methods

A geophysical survey was conducted as an initial step to better define the fillsite and quarry areas. After the geophysical survey, trenching and sampling activities were focused in areas identified by the survey. Field techniques used are described in the FSIP (FA/BC, 2001) and QAPP (FA/BC, 1999a).

3.1.1 Geophysical Survey

The purpose of the geophysical survey was to assess the extent of buried fill (ferrous and non-ferrous) in the suspected areas of the fillsites and quarries.

Geophysical surveys were conducted at Fillsite 1, Fillsite 2 and Quarry 3, but not at Quarry 1. Quarry 1 is relatively small (approximately 4,000 square feet). The outline of Quarry 1 is fairly well defined by an existing escarpment, and the five trenches proposed encompassed the entire area. This quarry is also located within a known ordnance and explosive (OE) area where 187 OE items were demilitarized by detonation and 1,059 pounds of ordnance-related scrap were removed [USACE, 2001]. Our trenching at Quarry 1 could not begin until after the OE removal action was completed. Appropriate OE construction safety support personnel supervised our trenching activities.

NORCAL Geophysical Consultants (NORCAL) performed geophysical investigations at Fillsite 1, Fillsite 2, and Quarry 3 on November 8, 9, 10, 14, and 15, 2000, January 9 and 29, 2001, and February 8 and 13, 2001. Several different geophysical methods were used: a vertical magnetic gradient (VMG), electromagnetic (EM) 31 and EM61 metal detector, electromagnetic line locating (EMLL), and ground penetrating radar (GPR) methods. These methods were chosen since the buried debris could be variable and include both ferrous and non-ferrous metal, as well as non-metallic debris. Appendix B contains a letter report by NORCAL, dated March 5, 2001 that describes the geophysical survey.

VMG surveys were used to assess the presence of buried ferrous objects. EMLL was used to characterize the proposed trenches and test pits at each site for detectable utility alignments. Shallow conductivity variations were detected with the EM31 using the terrain conductivity and the in-phase component. The terrain conductivity measurements indicate electrical conductivity to a depth of approximately 12 to 15 feet below ground surface while the in-phase component detected ferrous and non-ferrous metals object at approximately 7 to 10 feet bgs. The EM61 surveys were

used to determine the presence of buried near-surface ferrous and non-ferrous metal objects. GPR was used to obtain subsurface information that may indicate the presence of utilities and potential subsurface obstructions.

NORCAL evaluated their results and recommended several locations for trenching (Appendix B). These locations were excavated and the anomalies and trenching results are explained below.

Fillsite 1

The surveyed area measured approximately 540 by 264 feet, as shown on Figure 3-1, and is covered by asphalt. The area is bounded on the north and west by chain link fences adjacent to Tyler Street and Polk Street. On the east the area is bounded by Building 89 and to the south is a parking lot. The entire area is currently used as a parking lot.

The geophysical survey results indicate a highly conductive area (shown as two circular diagonally striped anomalies) in the eastern 2/3 of the site. This area may represent native Bay Mud or imported fill material. A lower conductivity zone was revealed in the western 1/3 of the site, the area with the numerous magnetic and ferrous anomalies. Some of the lower conductivity zone corresponds to VMG anomalies and may indicate buried metallic and non-metallic refuse.

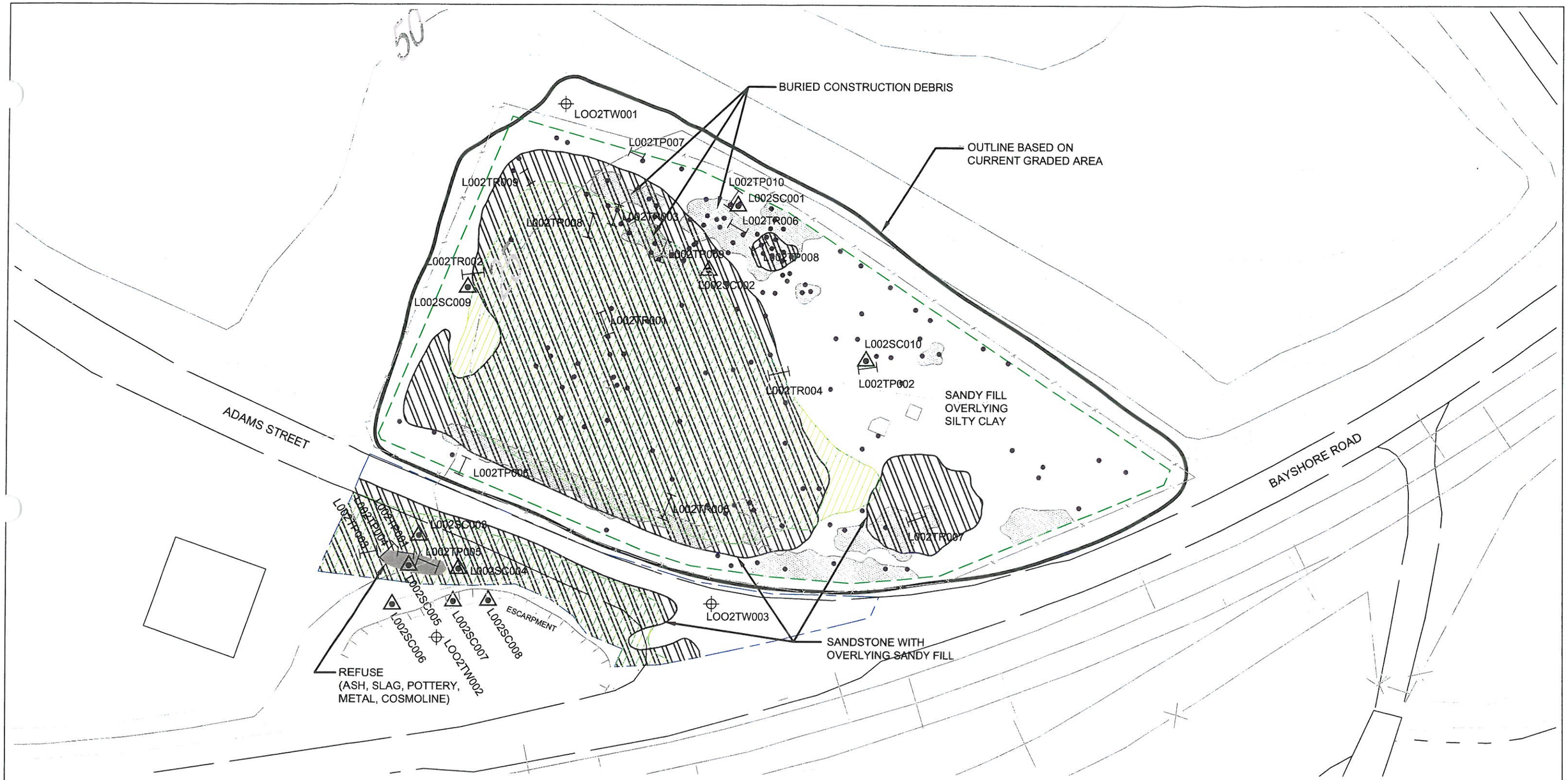
Two fire hydrants are located along the northern boundary of the survey and the water line connecting them is probably the cause of the linear, east-west trending VMG anomaly (Figure 3-1). The fence line probably caused the magnetic anomaly along the north and west sides. Also, near the west and north perimeters are several anomalies, which indicate isolated subsurface buried metal or utility lines. Buried railroad tracks are located along the southern portion of the survey area and caused the linear magnetic and conductivity anomalies.

There are several equally spaced (approximately 60 feet apart) circular anomalies in a west-east line that traverses the length of the site (Figure 3-1). These anomalies are close to the southern wall of former Building 71 and are likely the historical attempts to reinforce the exterior walls of former Building 71 due to settlement.

Fillsite 2

The survey area at Fillsite 2 covered approximately 97,000 square feet and is shown on Figure 3-2. A geophysical survey reported two large anomalies and a ferrous anomaly on the north side of Adams Street. A smaller anomaly was reported in the south side of Adams Street. These zones indicate small accumulations of localized buried metal objects. The east-west trending anomaly just north of Adams Street may represent an abandoned utility or former railroad spur.

An expanded geophysical survey was conducted to delineate a southern boundary of the anomaly across Adams Street. The anomaly represents a decrease of conductivity, which may be indicative of buried non-metallic debris or refuse. However, bedrock is typically less conductive than surface



Source: NORCAL Geophysical

LEGEND			
— — —	LIMITS OF VERTICAL MAGNETIC AND EM61 SURVEYS	•	EM61 ANOMALY REPRESENTING LOCALIZED NEAR-SURFACE METAL
— — —	LIMITS OF EXPANDED EM31 TERRAINE AND INPHASE CONDUCTIVITY SURVEYS	⊢—⊣	TRENCH LOCATION AND NUMBER
	VERTICAL MAGNETIC ANOMALOUS ZONE REPRESENTING BURIED FERROUS METAL DEBRIS	— x —	CHAIN-LINK FENCE (NOW REMOVED)
	TERRAINE CONDUCTIVITY ANOMALY (<100 mS/m) REPRESENTING POSSIBLE BURIED METALLIC DEBRIS	△	SURFACE SCRAPE LOCATION AND NUMBER
	INPHASE CONDUCTIVITY ANOMALY REPRESENTING A CHANGE IN SUBSURFACE MATERIALS	⊕	ATTEMPTED TEMPORARY MONITORING WELL LOCATION (NOT INSTALLED DUE TO LACK OF GROUNDWATER)

N

0 30 60

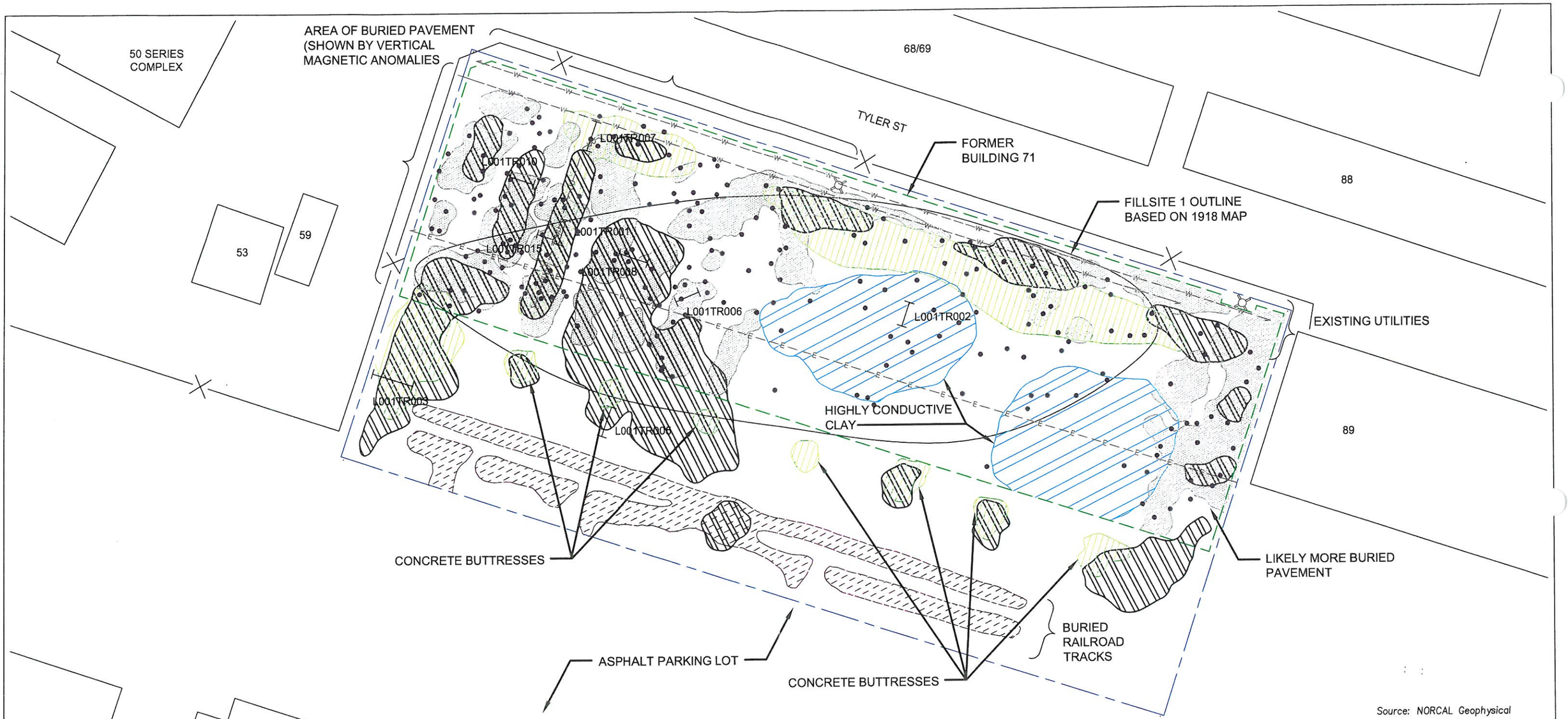
Scale In Feet (Approximate)

Contour Interval = 5 Feet

Figure 3-2
Fillsite 2 Trench and Surface Scrape Locations and Geophysical Results
Site Inspection Report
Former Benicia Arsenal, Benicia, CA

Final
November 2004

Forsgren Associates/Brown and Caldwell
00736-005 P:\US Army Corps\Benicia Arsenal\Reports\Fillsites & Quarries\Final\native files\FQ-Fig3-2LF2results.dwg



LEGEND

— — —	LIMITS OF VERTICAL MAGNETIC AND EM61 SURVEYS	•	EM61 ANOMALY REPRESENTING LOCALIZED NEAR-SURFACE METAL
	VERTICAL MAGNETIC ANOMALOUS ZONE REPRESENTING BURIED FERROUS METAL DEBRIS	—E—	ELECTRIC LINE
	TERRAINE CONDUCTIVITY ANOMALY (>150 mS/m) REPRESENTING POSSIBLE IMPORTED FILL OR NONMETALLIC DEBRIS	—UU—	UNDIFFERENTIATED UTILITY LINE
	TERRAINE CONDUCTIVITY ANOMALY (<150 mS/m) REPRESENTING POSSIBLE BURIED METALLIC DEBRIS	—W—	WATER LINE
	INPHASE CONDUCTIVITY ANOMALY REPRESENTING A CHANGE IN SUBSURFACE MATERIALS	⊢——⊣	TRENCH LOCATION AND NUMBER
	EM31 TERRAINE AND INPHASE CONDUCTIVITY ANOMALIES REPRESENTING LINEAR FEATURES SUCH AS POSSIBLE UTILITIES, RAILROAD SPURS, ETC.	—x—	CHAIN-LINK FENCE
			FIRE HYDRANT

Note:
Overlay of Former Building 71 based on a office of the Post Engineer Map #5995, dated January 1958 (Records Research Report ref #643CE [Jacobs, 1999])

Figure 3-1
Fillsite 1 Trench Locations and Geophysical Results
Site Inspection Report
Former Benicia Arsenal, Benicia, CA
Final
November 2004

soils and fill material and a bedrock outcrop is located north of Fillsite 2, therefore, the lower conductivity zone could represent an area of shallow bedrock.

Trenching was focused in the areas of the observed geophysical anomalies. The trenches and test pit locations are shown on Figure 3-2.

Quarry 1

As discussed in Section 3.1.1, no geophysical survey was conducted at Quarry 1.

Quarry 3

The geophysical survey at Quarry 3 indicates an area of low conductivity (see Figure 3-4 as the Terrain conductivity anomaly) and several magnetic (gray) anomalies throughout the quarry, mostly scattered around the perimeter. Sandstone and sandy soil are typically low in conductance, whereas clay is highly conductive. There are bedrock outcrops and escarpments adjacent to the quarry. Therefore, the low conductivity zones may represent shallow bedrock with overlying sandy fill material. The conductive (green) anomalous areas may also indicate isolated buried metal objects.

3.1.2 Trenching and Test Pits

The purposes of the trenching and test pits were to obtain stratigraphic data, determine the fillsite/quarry boundaries (lateral and vertical extent), and to visually document the type of refuse/fill materials present in each site. Except for Quarry 1, the trenches and test pit locations were chosen based on anomalies detected during the geophysical survey. The geophysical survey results were reviewed by the project team (USACE, FA/BC, and regulatory agency staff) before the intrusive portion (trenching and test pits) of the investigation began. Trenches/test pit locations and geophysical results for each fillsite/quarry are shown on Figures 3-1 through 3-4. The rationale for each trench is discussed in Section 3.2. At least one trench was dug within each fillsite/quarry and a total of 38 trenches/test pits were advanced. Typically, the trenches were approximately 15 feet long and advanced to 2.5 to 14 feet bgs unless refuse, groundwater or bedrock were encountered. Appendix C contains the trench and test pit logs.

Although it is unlikely, records do not exclude the possibility of buried OE at the fillsites and quarries. As such, OE construction support was provided during the trenching. Trenches were excavated according to OE construction support procedures and under the direction of USA Environmental, a company qualified in OE construction support. The presence of OE at Quarry 1 had a higher probability than the other sites. As a result, excavation activities were planned around an OE removal action by USACE (USACE, 2000). The removal action was completed prior to beginning any excavation activities at Quarry 1.

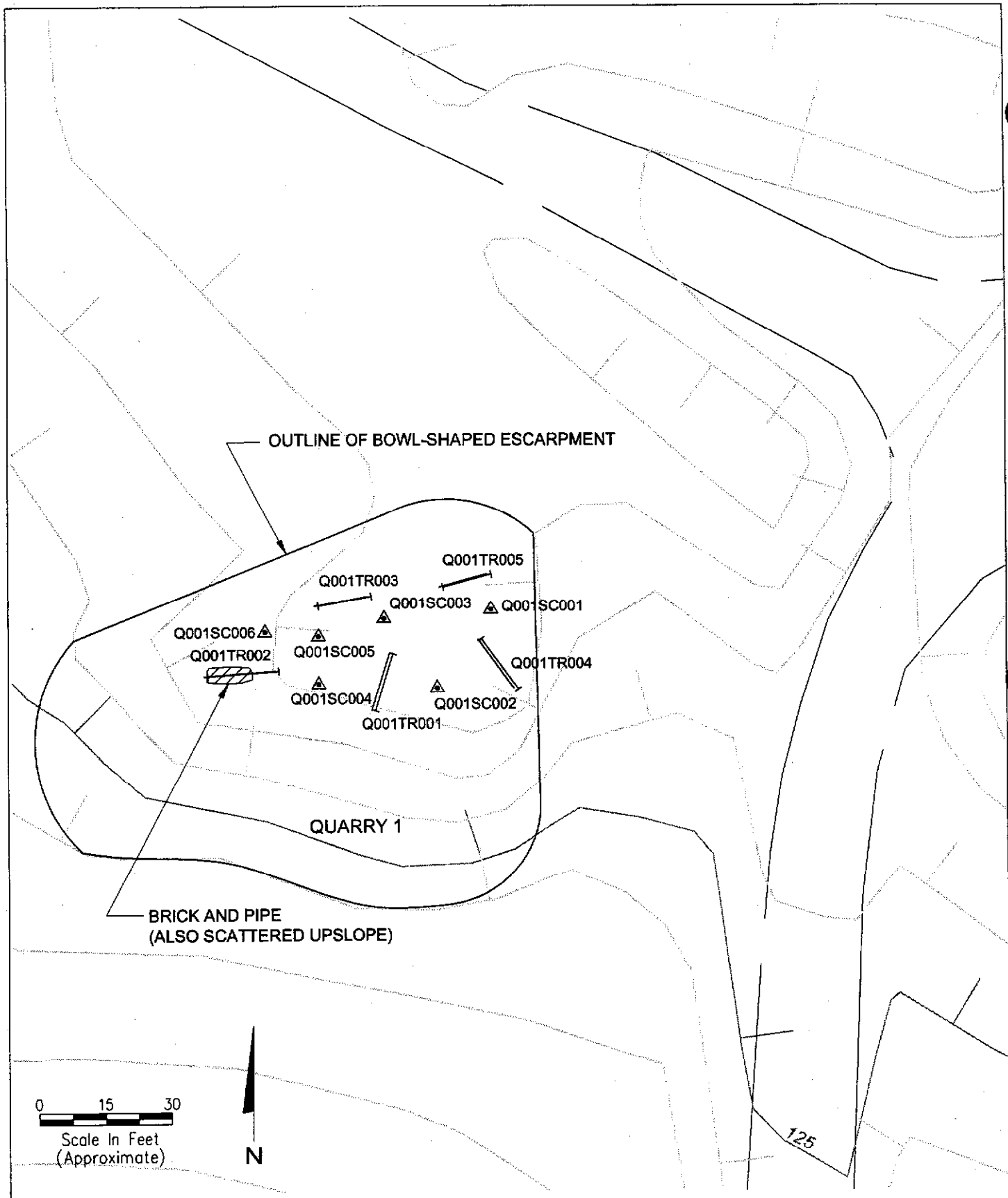
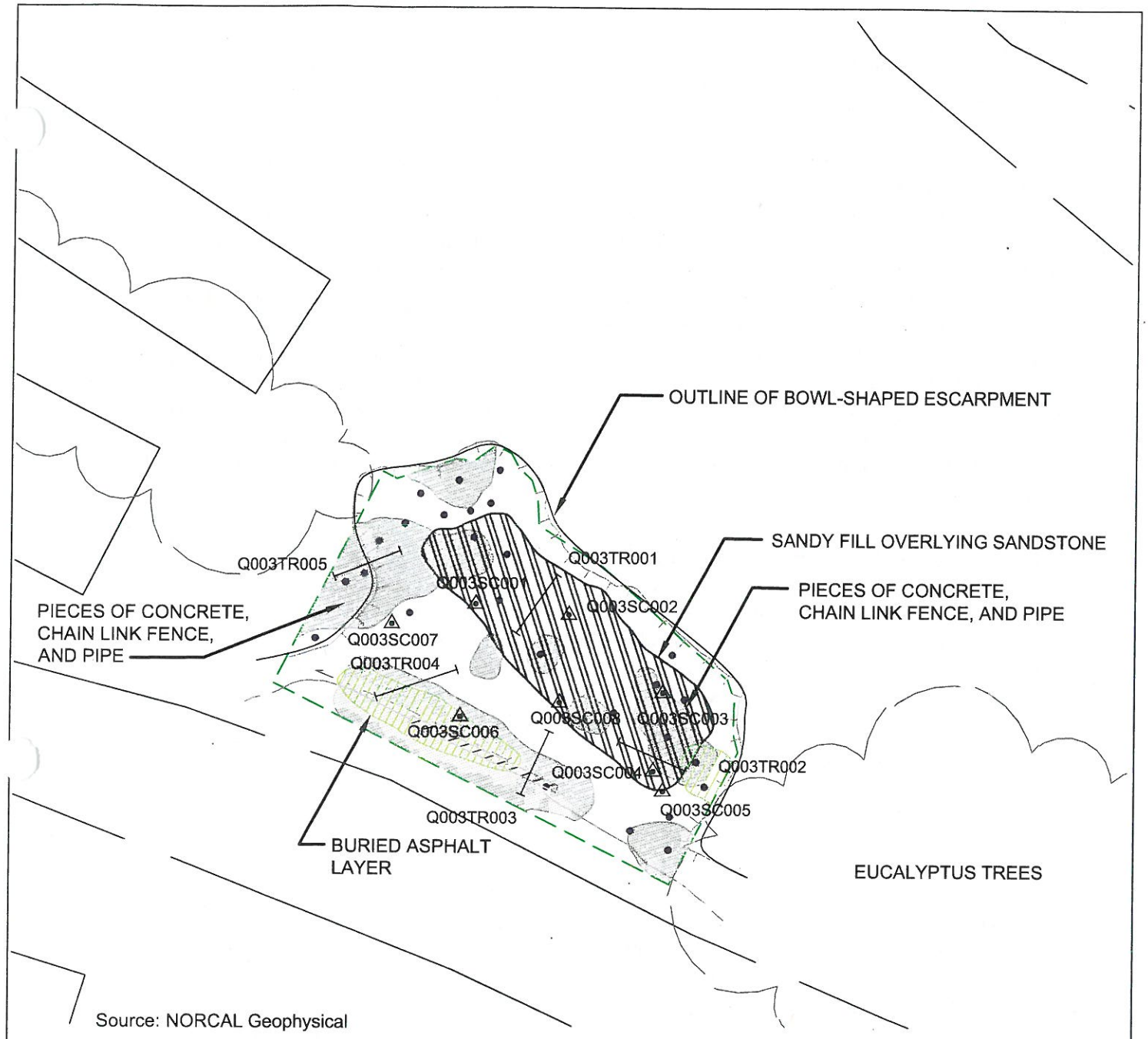


Figure 3-3
Quarry 1 Trench and Surface Scrape Locations
Site Inspection Report
Former Benicia Arsenal, Benicia, CA



Source: NORCAL Geophysical

LEGEND

— — —	LIMITS OF GEOPHYSICAL SURVEY
	VERTICAL MAGNETIC ANOMALOUS ZONE REPRESENTING BURIED FERROUS METAL DEBRIS
	TERRAINE CONDUCTIVITY ANOMALY (<40 mS/m) REPRESENTING POSSIBLE BURIED LANDFILL MATERIAL
	INPHASE CONDUCTIVITY ANOMALY (<-1 ppt) REPRESENTING BURIED METAL
•	EM61 ANOMALY REPRESENTING LOCALIZED NEAR-SURFACE METAL
⊢——⊣	TRENCH LOCATION AND NUMBER
◬	SURFACE SCRAPE LOCATION AND NUMBER
	DOWNED UTILITY POLE
— · —	POSSIBLE UTILITY LINE

N

0 15 30

Scale In Feet (Approximate)

Figure 3-4
Quarry 3 Trench and Surface Scrape Locations and Geophysical Results
Site Inspection Report
Former Benicia Arsenal, Benicia, CA

Stratigraphic information was attained from within the trench or test pit at depths of 4 feet or less. When the trench or test pit became deeper than 4 feet, soil samples were collected from the backhoe bucket for lithologic interpretation. Once the trenches were advanced to the desired depth and refuse was observed in the excavation, samples were collected from native soil below the refuse using a manual slide impact sampler with a sample sleeve. These samples were used to evaluate potential impact from the refuse/fill materials. See Section 3.2 for the list of analyses. Some samples were also used to supplement the ambient metals study which was conducted separately (FA/BC, 2003a). The sleeve was pounded into the side or bottom of the excavation to a depth of 6 inches (the length of the sample sleeve). A total of 17 soil samples were collected. Soil samples collected were designated in the sample identification with "L" for a fillsite location or "Q" for a quarry and "TR" for trench or "TP" for a test pit location. For example, Q001TR001 indicated the sample was collected from Quarry 1 at trench 1.

When trenching activities were complete, materials were replaced in their original position. Refuse/fill material deemed to be potentially hazardous was not used as backfill. Cosmoline was encountered at Fillsite 2 in test pit L002TP005. The substance was removed, placed in an over packed drum and profiled for proper disposal. Some clean, imported gravel was required to achieve appropriate stability to backfill trenches where groundwater was encountered. When imported backfill was used, excess excavated material was contained and disposed of as IDW. See Section 3.3 for information on IDW disposal.

3.1.3 Surface Scrapes

Surface soil samples were collected at Fillsite 2 and Quarries 1 and 3. Surface soil samples were collected and analyzed to evaluate the presence or absence of metals and other non-volatile constituents in surface soil. A total of 13 surface soil samples were collected from Quarry 1 (seven samples) and Quarry 3 (six samples). The sampling locations were evenly distributed throughout each site. Because Fillsite 2 is much larger than the quarry sites, ten samples were collected. The locations of the surface scrapes are shown on Figures 3-2 through 3-4 for Fillsite 2, Quarry 1 and Quarry 3, respectively. Fillsite 1 is paved; therefore, no surface soil samples were collected.

Surface soil samples collected were designated in the sample identification with "L" for a fillsite location or "Q" for a quarry and "SC" for a surface soil location. For example, Q001SC001 indicated the sample was collected from Quarry 1 at surface soil location 1.

3.1.4 Temporary Monitoring Wells

The installation of three temporary monitoring wells was planned on the perimeter of each fillsite to measure water level elevations, calculate a gradient, and to collect groundwater samples if refuse was found during the trenching activities. Fillsite 2 was the only site where refuse was encountered. The project team selected the location of the temporary wells (Figure 3-2) based on the results of the intrusive activities. The planned locations were spaced to accommodate a shallow and flat

groundwater gradient, an assumed flow direction to the south based on topography, proximity to the Carquinez Strait and information from the HLA study (HLA, 1980), and placing one well in the assumed downgradient direction of the refuse. Three borings were drilled at Fillsite 2 on June 7 and 8, 2001; however, no groundwater was encountered in any of the borings. Therefore, no temporary groundwater monitoring wells were installed. The boring logs are included as Appendix D.

3.2 Sample Locations and Analytical Parameters

A total of 41 soil samples and 5 grab groundwater samples were collected during this investigation. Trenching/test pit locations were chosen based on anomalies detected during the geophysical survey and during site visits. Figures 3-1 through 3-4 depict the trench/test pit locations advanced during this SI, with results from the geophysical survey for Fillsite 1, Fillsite 2 and Quarry 3. Soil samples were collected in native soil below any observed refuse or debris. No soil samples were collected at a particular location if the trenches appeared to contain only clean soil and no further delineation was needed. Groundwater was sampled when encountered in test pits or trenches. The soil and groundwater samples collected from all fillsites and quarries were analyzed for constituents related to substances commonly used at these locations, as listed below:

- Volatile organic compounds (VOCs);
- Semi-volatile organic compounds (SVOCs);
- Total petroleum hydrocarbons as gasoline (TPH-g);
- Total petroleum hydrocarbons as diesel (TPH-d);
- Total petroleum hydrocarbons as motor oil (TPH-mo);
- Polynuclear aromatic hydrocarbons (PAHs);
- Metals including antimony, arsenic, barium, beryllium, cadmium, total chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, tin, vanadium, and zinc;
- Acids and bases;
- Pesticides;
- PCBs;
- Cyanide; and
- Explosives.

Details about the rationale for the sampling locations and depths for each fillsite and quarry are described below.

3.2.1 Fillsite 1

Table 3-1 lists the sampling depths and rationale for the nine trenches advanced at the suspected Fillsite 1 location.

Table 3-1. Fillsite 1 Trench Samples and Rationale (see Figure 3-1)

Trench	Sample Depths (feet bgs)	Rationale
L001TR001	GW (3)	Positioned north-south in the center of a north-south linear magnetic and ferrous anomaly to assess the presence and exteht of refuse/fill material. A groundwater sample was collected.
L001TR002	3	Positioned north-south in a highly conductive area (shown as two circular diagonally striped anomalies) in the east central portion of the site to assess the presence and extent of refuse/fill material. Soil sample collected below a layer of asphalt pieces.
L001TR003	None collected	Positioned west-east along the boundary of a magnetic anomaly to assess the presence and extent of refuse/fill material.
L001TR005	None collected	Positioned north-south along the boundary of a magnetic anomaly to assess the presence and extent of refuse/fill material.
L001TR006	None collected	Positioned northeast-southwest within a magnetic and across ferrous anomalies to assess the presence and extent of refuse/fill material.
L001TR007	4.6, 7, GW (3)	Positioned north-south along the boundary of a magnetic and ferrous anomaly to assess the presence and extent of refuse/fill material. Soil and groundwater samples were collected.
L001TR008	6, GW (3)	Positioned west-east across a magnetic and ferrous anomalies to assess the presence and extent of refuse/fill material. Soil sample collected below asphalt layer at 3.5 feet bgs. Perched groundwater collected at 3 feet bgs filled the trench (cascading off the asphalt layer) after the soil sample at 6 feet bgs was collected.
L001TR010	None collected	Positioned west-east in the center of a north-south linear magnetic an ferrous anomaly to assess the presence and extent of refuse/fill material.
L001TR015	None collected	Positioned west-east to explore the lateral extent of the magnetic and ferrous anomaly west of TR001 and to assess the presence and extent of refuse/fill material.

GW = groundwater with depth in parentheses

3.2.2 Fillsite 2

Table 3-2 lists the surface scrape samples, sampled depths and rationale for the trenching performed at Fillsite 2.

Table 3-2. Fillsite 2 Samples and Rationale (see Figure 3-2)

Location	Sample Depths (feet bgs)	Rationale
L002TR001	None collected	Positioned northwest-southeast in the middle of the large conductivity anomaly to assess the presence and extent of refuse/fill material.
L002TR002	3.5, 4.5, 9.5	Positioned west-east on the western side of the large conductivity anomaly to assess the presence or absence of refuse/fill material and to determine the boundary of any refuse/fill material. Located near previous investigation by HLA to confirm depths to bedrock in area. Soil samples collected from fill, native and sandstone bedrock for metals only to be included into ambient metals study.

Table 3-2. Fillsite 2 Samples and Rationale (see Figure 3-2) (continued)

Location	Sample Depths (feet bgs)	Rationale
L002TR003	2.5, GW (4.5)	Positioned northeast-southwest on the north side of the large conductivity anomaly to assess the presence or absence of refuse/fill material and to determine the boundary of any refuse/fill material. Located near previous investigation by HLA to confirm depths to bedrock in area. Soil sample collected in fill for full suite of analytes because construction debris found (a metal pipe and a concrete block).
L002TR004	None collected	Positioned west-east on the east side of the large conductivity anomaly to determine the presence or absence of refuse/fill material and to assess the boundary of any refuse/fill material.
L002TR005	GW (1.5)	Positioned north-south on the south side of the large conductivity anomaly to assess the presence or absence of refuse/fill material and to determine the boundary of any refuse/fill material.
L002TR006	None collected	Positioned northwest-southeast at the vertical magnetic and conductivity anomaly along the northern border of the site to assess the presence or absence of refuse/fill material.
L002TR007	None collected	Positioned west-east at the vertical magnetic and conductivity anomaly along the eastern side of the site to assess the presence or absence of refuse/fill material.
L002TR008	None collected	ADDED during field activities: Positioned north-south on the west side of TR003 to assess the lateral extent of refuse/fill material found in TR003 (a metal pipe and a concrete block).
L002TR009	None collected	ADDED during field activities: Positioned northwest-southeast on the west side of the vertical magnetic anomaly along the northern border of the site to assess the presence or absence of refuse/fill material.
L002TP001	8.5	Positioned west-east on the south side of Adams Street at the conductivity anomaly to assess the presence or absence of refuse/fill material. Soil sample collected below the refuse found in the test pit.
L002TP002	1.5, 3.5, 9	Positioned west-east in the area of a conductivity anomaly to assess the presence or absence of refuse/fill material. Soil samples collected from fill, native and sandstone bedrock for metals only to be included into ambient metals study.
L002TP003	None collected	ADDED during field activities: Positioned west-east on the south side of Adams Street and west of TP004 to assess the presence or absence of refuse/fill material.
L002TP004	None collected	ADDED during field activities: Positioned northeast-southwest on the south side of Adams Street and west of TP001 to assess the lateral extent of refuse/fill material (ash, pottery) in TP001.
L002TP005	8	ADDED during field activities: Positioned northwest-southeast on the south side of Adams Street and east of TP001 to assess the lateral extent of refuse/fill material (ash, pottery) in TP001. Refuse found. The trench was widened to the south to further define the lateral extent of the refuse (ash, metal slag, Cosmoline, white "chalky" material). Soil sample collected below the Cosmoline found in the test pit.
L002TP006	None collected	ADDED during field activities: Positioned northeast-southwest along the northern side of Adams Street to assess the lateral extent of refuse/fill material found in TP001 and TP005.
L002TP007	None collected	ADDED during field activities: Positioned northwest-southeast on the north side of TR003 to assess the lateral extent of refuse/fill material found in TR003 (a metal pipe and a concrete block).

Table 3-2. Fillsite 2 Samples and Rationale (see Figure 3-2) (continued)

Location	Sample Depths (feet bgs)	Rationale
L002TP008	None collected	ADDED during field activities: Positioned northeast-southwest on the southeast side of L002TR006 to assess the lateral extent of construction debris (pieces of metal pipes) found in TR006 and to investigate the near surface anomalies from the EM61 in the area.
L002TP009	None collected	ADDED during field activities: Positioned northeast-southwest on the southwest side of L002TR006 to assess the lateral extent of construction debris (pieces of metal pipes) found in TR006.
L002TP010	None collected	ADDED during field activities: Positioned northeast-southwest on the north side of L002TR006 to assess the lateral extent of construction debris (pieces of metal pipes) found in TR006
L002SC001	0.25	Positioned north of TR006 to assess the presence or absence of contaminants in surface soil from debris found in subsurface at TR006.
L002SC002	0.25	Positioned south of TR006 to assess the presence or absence of contaminants in surface soil from debris found in subsurface at TR006.
L002SC003	0.25	Positioned north of TP001 to assess the presence or absence of contaminants in surface soil from refuse found in subsurface at TP001 and TP005.
L002SC004	0.25	Positioned east of TP005 to assess the presence or absence of contaminants in surface soil from refuse found in subsurface at TP001 and TP005.
L002SC005	0.25	Positioned south of TP001 to assess the presence or absence of contaminants in surface soil from refuse found in subsurface at TP001 and TP005.
L002SC006	0.25	Positioned south of SC005 to assess the presence or absence of contaminants in surface soil in the cutbank downslope from refuse found in subsurface at TP001 and TP005.
L002SC007	0.25	Positioned south of SC004 to assess the presence or absence of contaminants in surface soil in the cutbank downslope from refuse found in subsurface at TP001 and TP005.
L002SC008	0.25	Positioned east and downslope of SC007 to assess the presence or absence of contaminants in surface soil in the cutbank downslope from refuse found in subsurface at TP001 and TP005.
L002SC009	0.25	Positioned south of TR002 to assess the presence or absence of metals in surface soil and to supplement the ambient metals study.
L002SC010	0.25	Positioned west of TP002 to assess the presence or absence of metals in surface soil and to supplement the ambient metals study.

GW = groundwater with depth in parentheses

3.2.3 Quarry 1

Table 3-3 lists trenches and surface scrapes samples, the depths of the samples, and trenching rationale for Quarry 1.

Table 3-3. Quarry 1 Samples and Rationale (see Figure 3-3)

Location	Depth Sampled (feet bgs)	Rationale
Q001TR001	None collected	Positioned north-south on the south side of the quarry floor to assess the presence or absence of refuse/fill material and to assess the boundary of any refuse/fill material.
Q001TR002	3	Positioned west-east in the southwest corner of the quarry floor to assess the presence or absence of refuse/fill material and to assess the boundary of any refuse/fill material. Soil sample collected in fill just above sandstone bedrock and amongst some debris (brick pieces and a piece of pipe).
Q001TR003	None collected	Positioned west-east on the west side of the quarry entrance to assess the presence or absence of refuse/fill material and to assess the boundary of any refuse/fill material.
Q001TR004	None collected	Positioned northwest-southeast on the east side of the quarry floor to assess the presence or absence of refuse/fill material and to assess the boundary of any refuse/fill material.
Q001TR005	None collected	Positioned west-east on the east side of the quarry entrance to assess the presence or absence of refuse/fill material and to assess the boundary of any refuse/fill material.
Q001SC001	0.5	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.
Q001SC002	0.5	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.
Q001SC003	0.5	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.
Q001SC004	0.5	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.
Q001SC005	0.5	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.
Q001SC006	0.5	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.

3.2.4 Quarry 3

Table 3-4 lists trenches and surface scrapes sampled, and the depths of the samples and trenching rationale for Quarry 3.

Table 3-4. Quarry 3 Samples and Rationale (see Figure 3-4)

Location	Depth Sampled (feet bgs)	Rationale
Q003TR001	8	Positioned northeast-southwest on the north side of the quarry floor in an area of a conductivity anomaly to assess the presence or absence of refuse/fill material and to assess the boundary of any refuse/fill material. Soil sample collected in weathered sandstone below some debris (pieces of asphalt and concrete).
Q003TR002	4.5	Positioned northwest-southeast on the east side of the quarry floor in an area of a conductivity and magnetic anomaly to assess the presence or absence of refuse/fill material and to assess the boundary of any refuse/fill material. Soil sample collected below some debris (a piece of PVC pipe and pieces of brick).
Q003TR003	None collected	Positioned northeast-southwest on the south side of the quarry floor in an area of a conductivity and magnetic anomaly to assess the presence or absence of refuse/fill material and to assess the boundary of any refuse/fill material.
Q003TR004	None collected	Positioned west-east on the south side of the quarry floor in an area of a conductivity and magnetic anomaly to assess the presence or absence of refuse/fill material and to assess the boundary of any refuse/fill material.
Q003TR005	4	Positioned west-east on the west side of the quarry floor in an area of a conductivity and magnetic anomaly to assess the presence or absence of refuse/fill material and to assess the boundary of any refuse/fill material. Soil sample collected below some debris (metal pipe, pieces of plastic).
Q003SC001	0.25	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.
Q003SC002	0.25	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.
Q003SC003	0.25	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.
Q003SC004	0.25	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.
Q003SC005	0.25	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.
Q003SC006	0.25	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.
Q003SC007	0.25	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.
Q003SC008	0.25	Positioned on the quarry floor to assess the presence or absence of contaminants in surface soil.

3.3 IDW Disposal

IDW generated as part of the field effort included soil from trenching and sampling activities, decontamination rinsate from sampling equipment, and disposable protective clothing and ground covers. During trenching activities, groundwater was encountered in several of the trenches/test pits at Fillsite 1 and Fillsite 2. Clean, imported backfill was required to stabilize and backfill trenches/test pits. When imported backfill was used, the remaining excavated material was containerized into drums or soil bins and disposed as IDW. Additionally, Cosmoline and pieces of metal pipe/rebar were encountered at Fillsite 2. The Cosmoline and surrounding soil was removed and segregated into a separate 55-gallon drum for disposal. The volume of Cosmoline removed was

no more than 2 gallons. The metal debris was placed into a bin containing IDW from Fillsite 1. All of the excavated soil at the quarries was placed back into the excavation and no IDW was generated.

Table 3-5 presents the quantities of IDW generated during this investigation. The soil containers were stored at a temporary waste staging area at Fillsite 1 and Fillsite 2. Decontamination rinsate from cleaning drilling equipment was also stored at Building 103. All decontamination was performed as specified in the QAPP (FA/BC, 1999a). Decontamination of sampling equipment during hand auguring was staged at the FA/BC Benicia Arsenal Field Office at 940 Tyler Street. Decontamination rinsate water was added to an existing Department of Transportation approved 55-gallon drum in the Field Office. The rinsate water was not disposed of during this investigation but will be manifested for proper disposal when the drum is full.

Table 3-5. Quantities of Soil IDW

Location/Activity	Quantity	Waste Classification
Fillsite 1/Trenching	4- 20 cubic yard bins	Non-hazardous
Fillsite 2/Trenching	57- 55 gallon drums	Non-hazardous
Fillsite 2/Trenching	1- 55 gallon drum (Cosmoline and soil mixture)	Non-RCRA hazardous
Fillsite 2/Borings	7- 55 gallon drums	Non-hazardous

Based on analytical results, IDW soil from this investigation contained low levels of petroleum hydrocarbons and chlorinated solvents. Soil in the bins and 57 of the 58 drums from trenching were manifested as non-hazardous soil. Integrated Waste Management of Milpitas, California transported the non-hazardous soil to Bay Soil Remediation in Richmond, California. The other drum contained a mixture of soil and Cosmoline. It was transported to Crosby & Overton in Long Beach, California as Non-RCRA hazardous soil. Lastly, 7 drums of soil generated during the drilling of the borings at Fillsite 2 were transported as non-hazardous to Crosby & Overton. IDW manifests are included in Appendix E.

Excess disposable wastes derived from sampling, such as personal protective equipment (PPE), gloves, and bailers were disposed by BFI, which provides local garbage disposal service for the area.

4.0 GEOLOGY AND HYDROGEOLOGY

The former Arsenal is located in the southern part of the Northern Coast Range of California where the geologic history has been complicated by stresses associated with the San Andreas strike-slip fault system. The stratigraphic names used in this report are from the most recent geologic publication for the area (Graymer et. al., 1999) (Figure 4-1). The geology and hydrogeology of the former Benicia Arsenal are discussed in the CHM report (FA/BC, 2003b), and summarized in this section. The site lithologic data and groundwater quality parameters are also discussed.

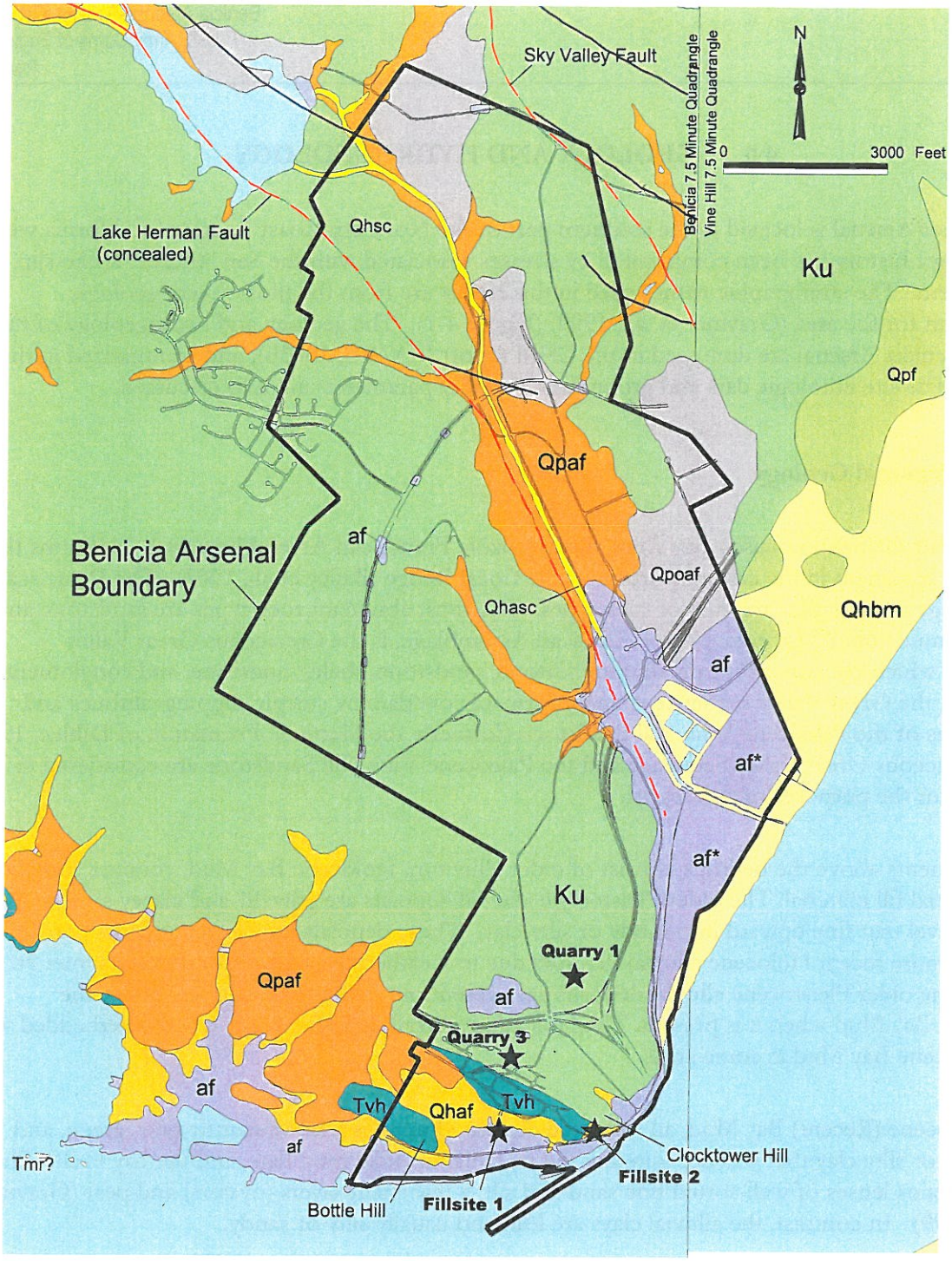
4.1 Regional Geology

Throughout the San Francisco Bay Area, the Mesozoic Franciscan Assemblage probably forms the structural basement in the eastern portion of the Coast Range (Bailey et al., 1964). The Franciscan Assemblage is a complex mixture of rock types. The most abundant rock types are sandstone and shale (or mudstone). Overlying the Franciscan Assemblage, is the Cretaceous Great Valley Sequence which consists of steeply dipping silttone, sandstone, shale, mudstone, and conglomerate. In Area I, the Great Valley sequence is unconformably overlain by steeply-dipping silttones and sandstones of the Paleocene Vine Hill Sandstone (formerly the Martinez Formation of Diblee, 1980). The Cretaceous Great Valley Sequence and the Paleocene Vine Hill Sandstone are considered to be bedrock for the purposes of this report.

The sediments above the bedrock consist of older alluvium, Holocene Bay Mud, younger alluvium, and artificial fill material. The older Pleistocene alluvial deposits are gravelly and clayey sand or clayey gravel that fine upward into sandy or silty clay. These deposits are denser and less permeable than the more recent Holocene alluvial deposits due to weathering and compaction (Graymer et. al., 1999). The older Pleistocene alluvial deposits are present on the bedrock surface, below the Holocene Bay Mud when it is present. The Holocene alluvial deposits overly or are interbedded with the Holocene Bay Mud in some areas.

The Holocene (Recent) Bay Mud, an estuarine deposited mud, is predominantly gray, green, and blue, clay or silty clay that was deposited in the marshlands, tidal mud flats, and the bay itself. The mud contains lenses of well-sorted fine sand and silt, a few shelly layers (oysters) and peat (Graymer et. al., 1999). In contrast, the alluvial clays are lean and usually silty or sandy.

There are two prominent faults in the Benicia area the Sky Valley Fault and the Lake Herman Fault (Graymer et. al., (1999). The Lake Herman Fault is a west-dipping thrust fault that trends north-northwest from the Carquinez Strait up the drainage channel of Sulphur Springs creek and across the foothills to the northwest beneath Lake Herman (Figure 4-1). The Sky Valley fault is an east-dipping oblique reverse fault, it has both vertical and horizontal (strike-slip) offset. A section of this fault cuts across the northeastern corner of the former Arsenal (Figure 4-1). Neither fault cuts Quaternary strata.



Legend

Water
Main roads
Faults (dashed where buried)
Anticline

Surficial Geologic Units (Graymer, 1999 and 1988 aerial photo)

- Artificial fill - af (Historic) and af* (1988 photo)
- Stream channel deposits - Qhsc and Qhasc (Holocene)
- Bay mud - Qhbm (Holocene)
- Alluvial fan and fluvial deposits - Qhaf (Holocene)
- Alluvial fan and fluvial deposits - Qpaf and Qpf (Pleistocene)
- Older alluvial fan deposits - Qpoaf (Pleistocene)
- Vine Hill Sandstone of Weaver (1953) Tvh (Paleocene)
- Great Valley Sequence - undivided sandstone and shale - Ku (Cretaceous)

Figure 4-1
Geologic Map of the Benicia Area
Site Inspection Report
Benicia Arsenal, Benicia, CA

4.2 Geology of the Arsenal

As discussed in the CHM (FA/BC, 2003b) the former Arsenal was divided into two hydrogeologic areas: the Highlands and the Lowlands (Figure 4-2).

The Highlands are the foothill areas of the former Arsenal. The Highland areas drain into the Lowlands of the Sulphur Springs Creek drainage area, or to the Lowlands of southern Area I. The boundary between the Highland and the Lowland areas in the Sulphur Springs Creek drainage area is approximately the break in slope between the flat Lowlands and the foothills of the Highlands, and roughly the extent of the Holocene Bay Mud in the Lowlands (Figure 4-2). The Highlands in Area I are the foothills above the filled former marshlands or swamp.

The geology of the Highland area is characterized by a relatively thin veneer (usually less than 50 feet thick) of Pleistocene alluvial and fluvial deposits over the bedrock (the Vine Hill Sandstone or the Great Valley Sequence). The alluvial material consists of sandy silt interbedded with clay, or as cemented sand with seams of gravel layers. Unconsolidated fluvial deposits of clay, silt, sand and gravel cover the bedrock along the creek valleys.

The Lowland area, as shown on Figure 4-2 is the flatlands associated with the Sulphur Springs Creek drainage channel, and the former marshlands in Area I. The geology of the Lowland area is characterized by artificial fill and/or Holocene alluvial and fluvial deposits overlying the Bay Mud. The Bay Mud may lie directly on the bedrock, or older alluvial and fluvial deposits may be present on the bedrock surface below the Bay Mud.

4.3 Site-Specific Geology of the Fillsites and Quarries

Lithologic logs of the trenches and of the three borings drilled at Fillsite 2 during this field investigation are presented in Appendix C and D, respectively. Figure 4-3 is a cross section showing the geology beneath Fillsite 1 using data collected from this investigation and previous investigations.

The soil profiles in the test pits and trenches at Fillsite 1 include various types of artificial fill material. The fill material consists of loose unconsolidated sandy silt and gravel with some pieces of wood, brick, and asphalt debris. Trenches L001TR006, L001TR008, L001TR010, and L001TR015 contain an approximate 6-inch thick asphalt layer at depths of 3 to 4 feet bgs. In trench L001TR003, base rock for the railroad is present in the southern end of the trench at approximately 2 feet bgs, with timber debris (possible railroad ties) at 4 feet bgs. The excavation at trench L001TR005 was limited by concrete obstructions at depths ranging from 2 to 6 feet bgs and by a concrete footing (buttress) just below the asphalt at the surface.

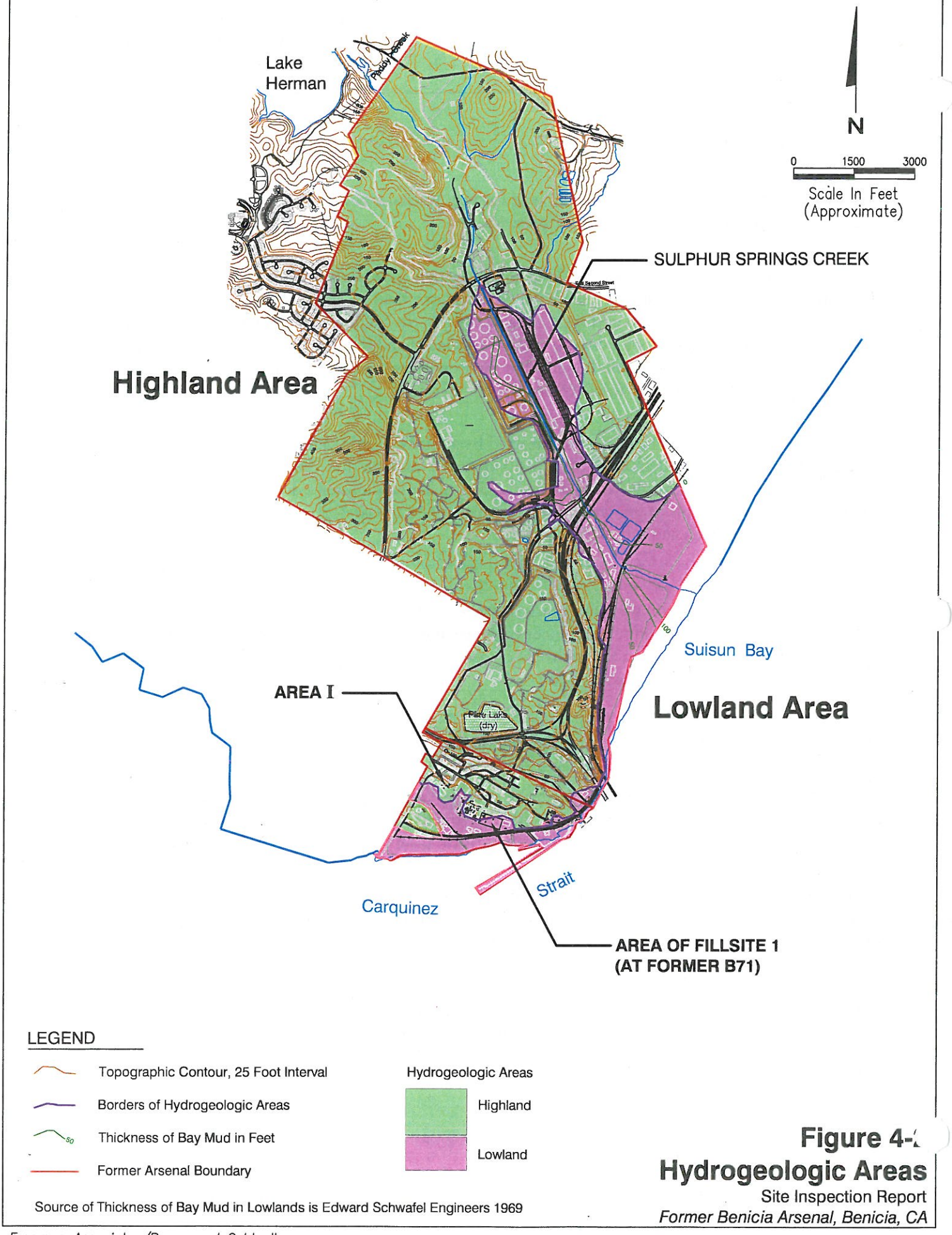
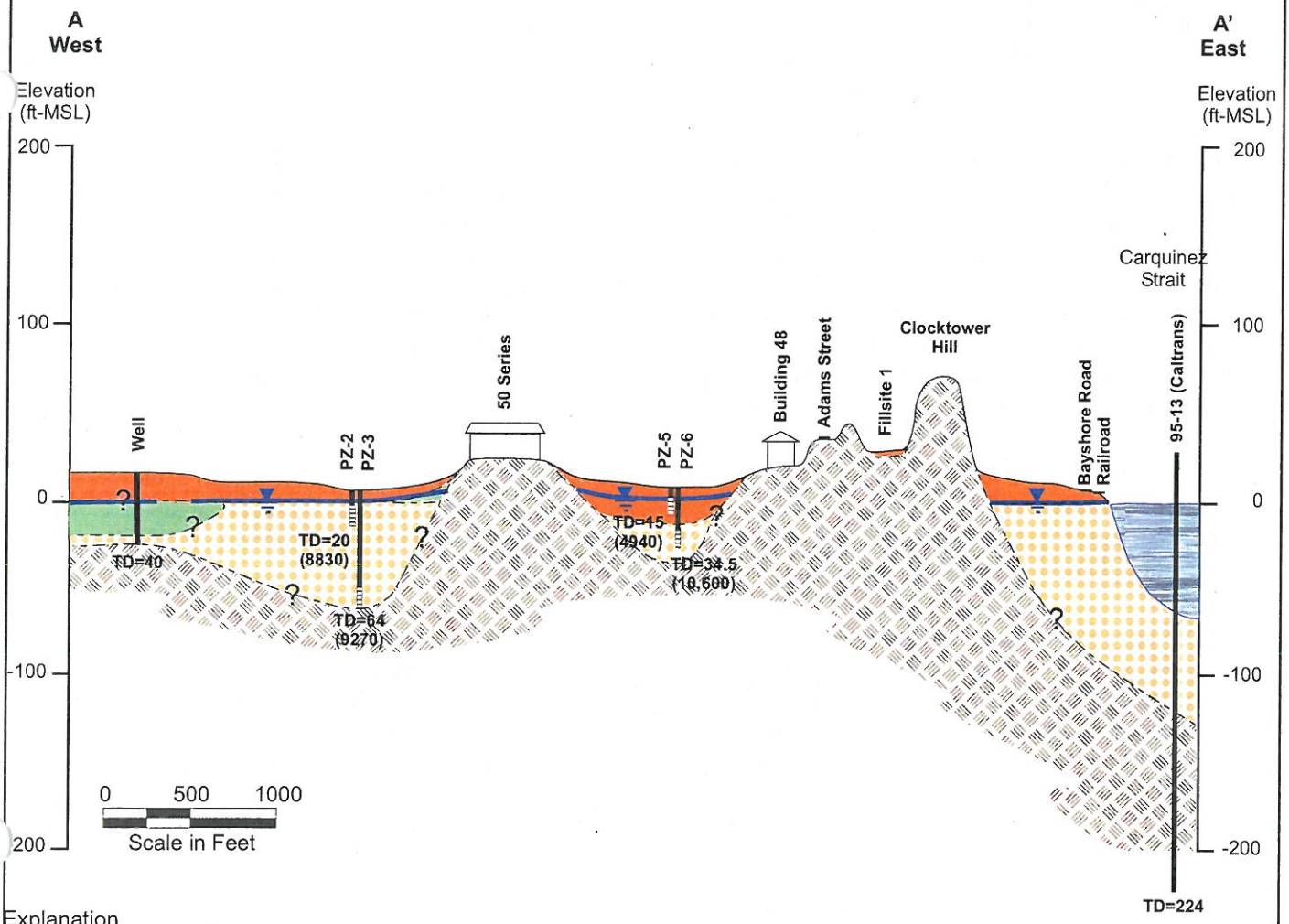


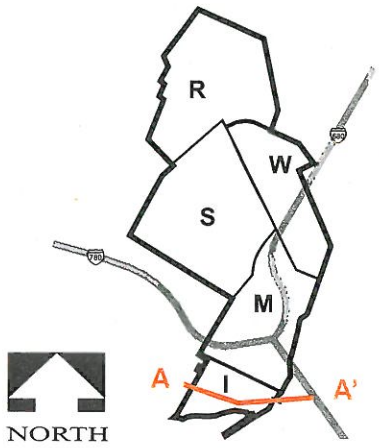
Figure 4-
Hydrogeologic Areas
Site Inspection Report
Former Benicia Arsenal, Benicia, CA



Explanation

Well	Monitoring Well Location
PZ-3	CHM Piezometer
	Boring
	Screen Interval
TD=30	Total Depth, Feet Below Ground Surface
(2970)	Total Dissolved Solids, mg/L
	Approximate Static Depth to Water from Geologic Logs (Piezometers water levels measured 10/29/02)

Hydrostratigraphic Units	Geologic Units
Relatively Permeable Units	Artificial Fill
	Alluvium, Colluvium, Weathered Bedrock
Relatively Non Permeable Units	Bay Mud
	Competent Bedrock



Former Benicia Arsenal

Note: The geology is projected on to the line of section. This section is from the Benicia Arsenal Preliminary Conceptual Hydrogeologic Model (CHM) (FA/BC, 2003 Draft Final). Refer to the CHM regarding the details and information used to develop this cross section. This section includes data gathered from the Fillsites and Quarries Investigation.

Figure 4-3
Hydrogeologic Cross Section A-A'

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Former Benicia Arsenal, Benicia, CA

Trenches L001TR002, L001TR006, L001TR007, and L001TR008 contain clay and silty clay with medium to low plasticity and an organic odor at depths ranging from 3.5 to 7 feet bgs. The soil profiles encountered in the trenches and test pits at Fillsite 2 are characterized by loose unconsolidated fill material overlying native undisturbed soil and sandstone bedrock (Paleocence Vine Hill Sandstone). The fill material consists of clayey silt with gravel, sandy silt with gravel, sandy silt, and silty sand. The underlying material consists of either sandstone bedrock (both weathered and competent), or sandy silt, and silty clay with gravel. Some small pieces of asphalt material are present in fill in L002TR001, L002TR007, and L002TP002 at a depth of surface to 3 feet bgs. The asphalt material is approximately 0.5 to 2 inches in diameter.

The thickness of the fill material and depths to the native soil and sandstone bedrock vary at each location. At L002TR004 sandstone is at 2.5 feet bgs, and at L002TP002 (located approximately 40 feet east), sandstone is present at approximately 9.5 feet bgs. Where present, the sandstone bedrock is weathered and increases in competence with depth.

The soil profiles in the three borings at Fillsite 2 include artificial fill overlying alluvial/fluvial material, which consists of native silt with minor amounts of sand. The fill material is characterized as well to moderately graded sandy silt with gravel. The fill material is dry, and ranges in color from brownish yellow to reddish gray. The thickness of the fill material in the three borings ranges from 5 to 11 feet thick. The native soil encountered in the borings is primarily homogeneous bluish gray sandy silt that is dry and moderate to poorly graded. Water was not encountered in any of the borings to a depth of 37 feet. All of the borings were abandoned in place with a cement grout mixture.

At Quarry 1, five trenches were excavated to the bedrock surface, which varies in depth from 3 to 8 feet bgs. The soil in the trenches is dark brown sandy silt. Trench Q001TR001 contains wood pieces and white, course-grained gravel sized blocky material, which crumbles easily when handled. No additional anthropogenic refuse material was observed in the trenches at Quarry 1, with the exception of some brick fragments and a metal pipe in Q001TR002.

Five trenches were excavated to bedrock at Quarry 3. These trenches vary in depth from 3 to 10 feet bgs. Soil encountered in the trenches at Quarry 3 consists of loose unconsolidated fill and sandstone bedrock material. The fill material is characterized as well graded silty sand with gravel. Small fragments and pieces of concrete and asphalt are present in all the trenches at Quarry 3 along with some additional debris (e.g. pieces of metal, PVC pipe, and chain link fence). The sandstone bedrock is weathered and increases in competence with depth.

4.4 Regional Hydrogeology

The hydrogeology of the former Arsenal is described in detail in the CHM (FA/BC, 2003b). A brief overview of the hydrogeology is presented here.

California's groundwater basins usually include one or a series of alluvial aquifers (coarse-grained sand and gravel) with intermingled aquitards (fine-grained silt and clay). Bedrock material, such as the Great Valley Sequence in the Benicia area, underlies the alluvial sediments, has relatively low permeability, and forms the boundaries of the groundwater basins (DWR, 2003). The permeability

and extent of water-yielding deposits vary considerably within the basins (Planert and Williams, 1995).

The groundwater gradient is generally steeper in the Highland area (ranges from 0.045 to 0.0053 feet/feet) than the gradients in the Lowland areas (about 0.0016 feet/feet), which is due to the steeper terrain in the Highlands (FA/BC, 2003b). The hydraulic conductivity of the alluvial material present mainly in the Highlands varies from under 1 to just over 10 feet/day. The hydraulic conductivity of the Bay Mud and clayey fill material in the Lowland area is generally less than 1-foot per day (FA/BC, 2003b). In general the shallow groundwater in the Lowland areas is brackish to saline (>1,000 mg/L total dissolved solids) and the groundwater in the Highland areas is fresh. The freshwater-saltwater interface along the coast is probably somewhere near the boundary between the Highland area and the Lowland area (FA/BC, 2003b). Groundwater flow on the former Arsenal is generally similar to the surface water flow direction, from high elevations in the topography to low elevations in the topography, or from the Highlands to the Lowlands.

4.5 Hydrogeology of the Fillsites and Quarries

Groundwater samples were collected from the trenches to assess groundwater quality and elevation, and were analyzed for water quality parameters. Water quality results are presented in Table 4-1.

Groundwater entered the L001TR001, L001TR007, and L001TR008 trenches at Fillsite 1 at an approximate depth of 3 feet bgs. After enough groundwater entered the trench to collect a sample, groundwater samples were collected from these trenches with a clean, disposable bailer.

Groundwater samples were also collected from Fillsite 2. Grab groundwater samples were collected at trenches L002TR004, L002TR006, and L002TP002 by lowering the laboratory supplied containers into the trench by hand and collecting the groundwater.

Table 4-1. Water Quality Parameters at Fillsites 1 and 2

Trench	Depth (feet bgs)	Temperature (Fahrenheit)	pH	TDS (mg/L)	Conductivity (µS/cm)
L001TR001	3	59.1	6.16	564	1210
L001TR007	3	63.8	8.9	795	1130
L001TR008	3	56.5	6.42	735	1040
L002TR003	0			2004	
L002TR004	1	54.9	4.60		3590
L002TR005	1.5			3370	
L002TR006	4	56.8	3.28		4190
L002TP002	9.5	56.8	4.06		4780

Although no groundwater was encountered during trenching activities at Quarries 1 or 3, piezometer PZ-19 was installed a few hundred feet west of Quarry 1 in the draw of an adjacent small valley as part of the development of the CHM (FA/BC, 2003b). Groundwater was encountered during drilling of the borehole at 17 feet bgs. The static water level in PZ-19 ranged from 73.97 to 75.95 feet above msl (depth to groundwater ranged 15.33 to 17.31 feet bgs), between January 2002 and October 2002.

Results of the water quality analyses detected total dissolved solids (TDS) values at Fillsite 1 below 1,000 mg/L and at Fillsite 2 above 1,000 mg/L (Table 4-1 and Figure 6-9). TDS values within the range of 0 to 1,000 mg/L are characterized as fresh water and values from 1,000 to 10,000 mg/L are characterized as brackish water (Driscoll, 1986). Water with TDS values above 10,000 mg/L is considered to be saline. The TDS values suggest the groundwater at Fillsite 1 is freshwater while the groundwater at Fillsite 2 is brackish. This change from freshwater to brackish water is supported by the CHM which stated that groundwater in the Lowland areas is brackish to saline and the groundwater in the Highland areas is fresh (FA/BC, 2003a). Figure 4-2 approximates the line that separates the Highlands, composing the western portion of Fillsite 1, to the swampy, brackish Lowlands composing the eastern portion of Fillsite 1.

5.0 DATA USABILITY

This section summarizes the data quality assessment of analytical results reported for soil and water samples collected during this investigation. Only significant data quality issues are summarized. More detailed information and discussions, including verification/validation of the analytical results, are found in the Quality Control Summary Report (QCSR) for the fillsites and quarries (FA/BC, 2003c). Validation and/or verification of the laboratory analytical data was performed per the criteria specified in the Benicia QAPP (FA/BC, 1999a).

Soil and water samples were collected by FA/BC in three mobilizations that took place in February 2001, June and July 2001, and October and November 2002. Soil and water samples were analyzed by EMAX Laboratories, Inc. (EMAX) in Torrance, California. Data was received in both hard copy and electronic formats. In general, the data collected in support of this investigation are considered usable for the purpose of engineering decision making.

The following were the most significant data quality issues identified in the data quality assessment. A summary of primary samples and associated quality control (QC) samples are included in Table 5-1.

- One trace result for thallium (SW7841) in soil sample L002TR002-A-S03 was rejected due to associated matrix spike recovery below 10 percent.

- Results for all sixteen PAH analytes (SW8310) in soil sample L002SC001-A-S02 were rejected due to associated matrix spike/matrix spike duplicate recoveries that were either below 10 percent or above 200 percent. Ten of the sixteen results were non-detect. The six detected results were for anthracene, benzo(a)anthracene, benzo(a)pyrene, phenanthrene, and pyrene.

- One planned groundwater field duplicate was not collected. Water was not encountered at the primary location where the field duplicate collection was planned (Fillsite 1). The requirement for collecting a field duplicate was inadvertently not transferred to another sample. It was therefore not possible for precision in a water matrix to be evaluated by the contractor during the data verification/validation process.

- Two quality assurance split samples were collected in soil (L002SC002-C-S01/S02 and L002TR003-C-S01/S02).

- Sample L002TR003-A-S02 was extracted for total petroleum hydrocarbons as diesel and motor oil (SW8015B) one day past the hold time. The sample was analyzed within the established hold time. The results were qualified as estimated.

Overall, the non-rejected data are of acceptable quality and are suitable for the purposes of this project.

Table 5-1. QC Sample Summary Fillsites 1 and 2, Quarries 1 and 3

	Soil			Water		
Analytical Methods	Number of Primary Samples	Number of Field Duplicate Samples	Number of USACE QA Samples	Number of Primary Samples	Number of Field Duplicate Samples	Number of USACE QA Samples
VOCs (8260B)	22	4	2	5	0	0
SVOCs (8270C)	31	5	2	5	0	0
Organochlorine Pesticides (8081A)	24	5	2	5	0	0
PCBs (8082)	24	5	2	5	0	0
PAHs (8310)	24	5	2	5	0	0
Explosives (8330)	24	5	2	NC	NC	NC
TPH-gasoline range (8015B)	8	2	1	5	0	0
TPH-diesel range/motor oil (8015B)	16	2	1	5	0	0
Metals (6010B/7000)	34	5	2	5	0	0
Cyanide (9014)	NC	NC	NC	5	0	0
Alkalinity (A2320)	NC	NC	NC	5	0	0
Total Dissolved Solids (E160.1)	NC	NC	NC	5	0	0
Anions (E300)	NC	NC	NC	5	0	0
Total number of analyses	207	38	16	60	0	0

NC – None Collected

6.0 RESULTS AND ANALYSIS

The following sections summarize the trenching and laboratory results for the Fillsite and Quarry SI and present an analysis of those results. Fillsite 1, Fillsite 2, Quarry 1 and Quarry 3 were investigated to evaluate the presence and if present, the extent of refuse and fill material. If refuse was present, FA/BC attempted to ascertain whether soil and groundwater contamination resulted from past DoD activities and to determine potential surface soil contamination.

A total of 41 soil samples and 5 grab groundwater samples were collected from all four sites. Appendix F contains a legend for the soil and groundwater analytical results included as Appendix G and H, respectively. A comparison of data from previous investigations is included in this section for Fillsite 2 (HLA, 1988) and for investigations conducted near Fillsite 1, the 50 Series Complex (FA/BC, 2003d), underground storage tank (UST) sites (FA/BC, 2000c and FA/BC, 2002a), and the CHM Piezometers (FA/BC, 2003b).

Analytical results of each fillsite/quarry that have values greater than Method Detection Limits (MDLs) are provided at the end of this report in a separate section titled "Hits Reports". These tables are organized by analyte type (i.e., VOCs, SVOCs, PAHs, TPH) and then by matrix (i.e., VOCs for soil and groundwater).

6.1 Fillsite 1

The stratigraphy is comprised of gravelly sandy silt fill overlying the clay of the former "swamp". The thickness of the fill ranges from 3 to 8 feet thick, but more commonly 3 to 4 feet thick. The deeper areas of fill may be attributed to construction activities to reinforce former Building 71. An asphalt-like layer was found at 3 to 4 feet below grade in trenches L001TR001, L001TR006, L001TR008, L001TR010 and L001TR015 (as highlighted in Table 6-1 and shown in Photo 4), which are all located in the western 1/3 of the site and corresponds to ferrous magnetic anomalies (Figure 3-1). The aggregate is likely metallic rich and the discontinuous ferrous anomalies in this area represent the remnants of buried pavement. During the excavation of L001TR005, a concrete support or buttress was found. The concrete was the cause for the anomaly at this location. Trenching determined no buried refuse at Fillsite 1.

Photo 4: Fillsite 1 showing asphalt layer in L001TR001 at 3 feet below grade. The total depth of the trench is 8 feet. Photo taken 2/13/2001.

The rationale of each trench was discussed in Section 3.2.1. Table 6-1 lists the results from the trenching at Fillsite 1.

Table 6-1. Fillsite 1 Trenching Results (see Figure 3-1)

Trench Name	Location	Objective	Trenching Results
L001TR001	Western 1/3 of site: positioned west-east in the center of a north-south linear magnetic and ferrous anomaly	To assess the presence and extent of refuse/fill material.	Fill comprised of gravelly sandy silt encountered to a depth of 8 feet bgs. Groundwater entered the trench at 3 feet bgs. Pieces of asphalt and brick found deeper than 3 feet bgs. Asphalt-like layer at 3 feet bgs. No refuse or metal found. Total depth of trench = 8 feet.
L001TR002	Eastern 2/3 of site: positioned in a highly conductive area (shown as two circular diagonally striped anomalies) in the east central portion of the site	To assess the presence and extent of refuse/fill material.	Fill comprised of gravelly sandy silt encountered to a depth of 5 feet bgs. Pieces of asphalt in fill. Clay below 5 feet bgs. No refuse found. Total depth of trench = 14 feet.
L001TR003	Western border: positioned west-east along the boundary of an magnetic anomaly	To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of gravelly sandy silt encountered to a depth of 4 feet bgs. Gravel on south sidewall and pieces of timbers at 2-2.5 ft bgs (representing railroad bed material). Culvert found on east side of trench at 2 ft bgs. Clay at 4 feet bgs. No refuse found. Total depth of trench = 4 feet
L001TR005	Southern side: positioned north-south along the boundary of a magnetic anomaly	To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of gravelly sandy silt encountered to a depth of 7 feet bgs. Concrete buttress encountered on north side of trench at 0.5 feet bgs. Groundwater entering trench 3 ft bgs. Clay below 5 feet bgs. No refuse found. Total depth of trench = 7 feet.
L001TR006	Eastern 1/3 of site: positioned northeast-southwest within a magnetic and across ferrous anomalies	To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of gravelly sandy silt encountered to a depth of 3 feet bgs. Asphalt-like layer at 3-3.5 feet bgs extends from the southwest side of the trench to approximately 2 feet before northeast side. Clay underlying asphalt. Groundwater entering trench below asphalt layer. No refuse found. Total depth of trench = 6 feet.
L001TR007	Northern side: positioned north-south along the boundary of a magnetic and ferrous anomaly	To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of gravelly sandy silt encountered to a depth of 7 feet bgs. Clay underlying fill. Groundwater entering trench at 3 feet bgs. No refuse found. Total depth of trench = 8 feet.
L001TR008	Western 1/3 of site: positioned west-east across magnetic and ferrous anomalies	To assess the presence or absence of refuse/fill material.	Fill comprised of gravelly sandy silt encountered to a depth of 7 feet bgs. Asphalt-like layer at 3.5 to 4 feet bgs. Clay at 7 feet bgs. No refuse found. Total depth of trench = 8 feet.
L001TR010	Western 1/3 of site: positioned west-east in the center of a north-south linear magnetic an ferrous anomaly	To assess the presence or absence of refuse/fill material.	Fill comprised of gravelly sandy silt encountered to a depth of 4 feet bgs. Asphalt-like layer at bottom of trench. Groundwater entering trench at 3 feet bgs. No refuse found. Total depth of trench = 4 feet.
L001TR015	Western 1/3 of site: positioned west-east to explore the lateral extent of the magnetic and ferrous anomaly west of TR001	To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of gravelly sandy silt encountered to a depth of 3 feet bgs. Clay underlying fill. Asphalt-like layer at bottom of trench. Groundwater entering trench at 3 feet bgs. No refuse found. Total depth of trench = 3 feet.

Trenches with an asphalt-like layer encountered at depth are shaded gray.

6.1.1 Analytical Results

Nine trenches were dug at Fillsite 1 and construction debris such as bricks and a buried asphalt layer were identified. Soil samples were collected beneath this asphalt layer and groundwater was collected from three trenches. Figures 6-1 and 6-2 show the sampling locations and detected concentrations at Fillsite 1. There was no visual evidence of staining, discoloration, or elevated photo ionization detector (PID) readings that would indicate an impact to soil or groundwater at this location. No pesticides, explosives, PCBs, or cyanide were detected in any soil or groundwater samples collected.

Surface Soil

Fillsite 1 is currently paved; therefore, no surface soil samples were collected.

Subsurface Soil

Diesel fuel and motor oil were detected in soil samples collected from trench L001TR007. Table 6-2 shows that diesel fuel and motor oil concentrations decrease with depth.

Table 6-2. Fillsite 1 Diesel Fuel and Motor Oil Concentrations at L001TR007

Analyte	Matrix	Depth Sampled (feet bgs)	Concentration
Diesel Fuel	Soil	4.6	510 mg/kg
Diesel Fuel	Soil	7	340 mg/kg
Diesel Fuel	Groundwater	3	56 µg/L
Motor Oil	Soil	4.6	2,900 mg/kg
Motor Oil	Soil	7	87 mg/kg
Motor Oil	Groundwater	3	<39 µg/L

mg/kg = milligrams per kilogram
µg/L = micrograms per liter

Although no refuse was encountered at this fillsite, the reported fuel concentrations may indicate that fuel/oil is leaching from the buried asphalt.

Four organic compounds were also detected in soil samples collected from trench L001TR008 at a depth of 6-6.5 feet bgs: diesel fuel (8.9 mg/kg), motor oil (36 mg/kg), acetone (0.033 mg/kg), and benzo(b)fluoranthene (0.015 mg/kg).

Lead was detected in trench L001TR007 at two depths, 4.6 and 7 feet bgs (Figure 6-2). There is a decrease in concentration with depth from 4.6 feet (70 mg/kg) to 7 feet bgs (31.5 mg/kg).

Grant Road

BUILDING 120

BUILDING 163/60(B)

50 Series Complex

BUILDING 68/69

20

15

25

10

L001TR007

Analyte	Depth	Value	Units
DIESEL RANGE ORGANICS	3	56	UG/L
cis-1,2-DICHLOROETHYLENE	3	11	UG/L
METHYLENE CHLORIDE	3	18	UG/L
NAPHTHALENE	3	0.4	UG/L
TRICHLOROETHYLENE (TCE)	3	1.5	UG/L
ISOPROPYL ETHER	3	0.63	UG/L
CHLORIDE (AS CL)	3	86.8	MG/L
ALKALINITY, TOTAL (AS CaCO3)	3	363	MG/L
SULFATE (AS SO4)	3	97.3	MG/L
NITROGEN, NITRATE (AS N)	3	1.28	MG/L
TOTAL DISSOLVED SOLIDS (RESIDUE, FILTERABLE)	3	795	MG/L
ALKALINITY, BICARBONATE (AS CACO3)	3	363	MG/L
BENZO(b)FLUORANTHENE	3	0.11	UG/L

L001TR007

Analyte	Depth	Value	Units
DIESEL RANGE ORGANICS	4.6	510	MG/KG
DIESEL RANGE ORGANICS	7	340	MG/KG
MOTOR OIL	4.6	2900	MG/KG
MOTOR OIL	7	87	MG/KG
ACETONE	4.6	0.023	MG/KG
BENZO(a)PYRENE	7	0.0074	MG/KG
PYRENE	7	0.016	MG/KG
BUTYLCYCLOPENTANE	7	0.59	MG/KG
DECAHYDRO-2-METHYL-NAPHTHALENE	7	0.41	MG/KG
N-HEXADECANE (C16)	7	0.52	MG/KG
2-BUTYL-1,1,3-TRIMETHYL-CYCLOHEXANE	7	0.52	MG/KG
1,1,3-TRIMETHYL-2-(3-METHYL)-CYCLOHEXANE	7	0.96	MG/KG

L001TR001

Analyte	Depth	Value	Units
MOTOR OIL	3	450	UG/L
TRICHLOROETHYLENE (TCE)	3	21	UG/L
METHYLENE CHLORIDE	3	10	UG/L
tert-BUTYL METHYL ETHER	3	0.64	UG/L
cis-1,2-DICHLOROETHYLENE	3	18	UG/L
ACETONE	3	11	UG/L
P-CYMENE (p-ISOPROPYLTOLUENE)	3	0.37	UG/L
ALKALINITY, BICARBONATE (AS CACO3)	3	304	MG/L
ALKALINITY, TOTAL (AS CaCO3)	3	304	MG/L
CHLORIDE (AS CL)	3	76.6	MG/L
NITROGEN, NITRATE (AS N)	3	1.54	MG/L
SULFATE (AS SO4)	3	129	MG/L
TOTAL DISSOLVED SOLIDS (RESIDUE, FILTERABLE)	3	564	MG/L
PHENANTHRENE	3	0.088	UG/L
BENZO(g,h,i)PERYLENE	3	0.12	UG/L

L001TR008

Analyte	Depth	Value	Units
DIESEL RANGE ORGANICS	6.5	8.9	MG/KG
MOTOR OIL	6.5	36	MG/KG
ACETONE	6	0.033	MG/KG
BENZO(b)FLUORANTHENE	6.5	0.015	MG/KG

L001TR008

Analyte	Depth	Value	Units
MOTOR OIL	3	67	UG/L
DIESEL RANGE ORGANICS	3	50	UG/L
cis-1,2-DICHLOROETHYLENE	3	17	UG/L
METHYLENE CHLORIDE	3	20	UG/L
TRICHLOROETHYLENE (TCE)	3	21	UG/L
NAPHTHALENE	3	0.55	UG/L
ALKALINITY, BICARBONATE (AS CACO3)	3	386	MG/L
ALKALINITY, TOTAL (AS CaCO3)	3	386	MG/L
CHLORIDE (AS CL)	3	60.4	MG/L
NITROGEN, NITRATE (AS N)	3	1.13	MG/L
NITROGEN, NITRITE (AS N)	3	0.159	MG/L
TOTAL DISSOLVED SOLIDS (RESIDUE, FILTERABLE)	3	735	MG/L
SULFATE (AS SO4)	3	119	MG/L
FLUORANTHENE	3	0.15	UG/L
PYRENE	3	0.19	UG/L

L001TR010

L001TR015

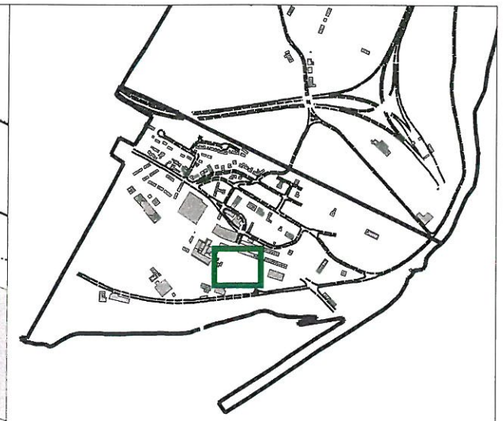
L001TR006

L001TR002

L001TR003

L001TR005

Suspected Outline of Fillsite 1
(as shown on 1918 map)



LEGEND

- Surface Scrape
- Trenches
- Fence
- Roads
- Buildings
- Topographic Contours (Interval = 5 Feet)

NOTE: Only detectable concentrations are shown.

SOIL

GROUNDWATER

N

0 60 Feet

FACILITY

Benicia Arsenal, Benicia, California

TITLE

Fillsite 1 - Soil and Groundwater Results-
TPH, VOCs, Wet Chemistry, PAHs, and SVOCs

FORSGREN ASSOCIATES / BROWN and CALDWELL
A Joint Venture

PROJECT 00736

DATE 12/2003

FIGURE 6-1

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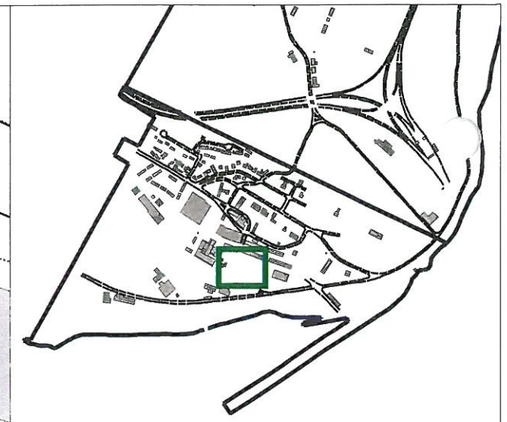

Grant Road

BUILDING 163/60(B)

BUILDING 120

50 Series Complex

BUILDING 68/69

20
15
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L001TR010
L001TR015
L001TR006
L001TR003
L001TR005

L001TR007

Analyte	Depth	Value	Units
ALUMINUM	4.6	12500	MG/KG
ALUMINUM	7	15800	MG/KG
ARSENIC	4.6	5.2	MG/KG
ARSENIC	7	19.2	MG/KG
BARIUM	4.6	69.5	MG/KG
BARIUM	7	67.9	MG/KG
BERYLLIUM	4.6	0.467	MG/KG
BERYLLIUM	7	0.726	MG/KG
CALCIUM	4.6	4870	MG/KG
CALCIUM	7	1890	MG/KG
CADMIUM	4.6	0.392	MG/KG
CADMIUM	7	0.304	MG/KG
COBALT	4.6	10.2	MG/KG
COBALT	7	7.66	MG/KG
CHROMIUM, TOTAL	4.6	24.8	MG/KG
CHROMIUM, TOTAL	7	44	MG/KG
COPPER	4.6	22.4	MG/KG
COPPER	7	8.76	MG/KG
IRON	4.6	20100	MG/KG
IRON	7	25800	MG/KG
MERCURY	4.6	0.048	MG/KG
MERCURY	7	0.079	MG/KG
POTASSIUM	4.6	637	MG/KG
POTASSIUM	7	2330	MG/KG
MAGNESIUM	4.6	2530	MG/KG
MAGNESIUM	7	4590	MG/KG
MANGANESE	4.6	642	MG/KG
MANGANESE	7	149	MG/KG
MOLYBDENUM	7	1.14	MG/KG
SODIUM	4.6	643	MG/KG
SODIUM	7	819	MG/KG
NICKEL	4.6	18.9	MG/KG
NICKEL	7	28.5	MG/KG
LEAD	4.6	70	MG/KG
LEAD	7	31.5	MG/KG
ANTIMONY	7	6.82	MG/KG
SELENIUM	4.6	0.182	MG/KG
SELENIUM	7	0.443	MG/KG
TIN	4.6	4.41	MG/KG
TIN	7	6.21	MG/KG
THALLIUM	4.6	0.382	MG/KG
THALLIUM	7	0.535	MG/KG
VANADIUM	4.6	54.5	MG/KG
VANADIUM	7	64.1	MG/KG
ZINC	4.6	89.1	MG/KG
ZINC	7	65.4	MG/KG

L001TR007

Analyte.na	Depth	Value	Units
ANTIMONY	0	0.00132	MG/L
BARIUM	0	0.0557	MG/L
CALCIUM	0	87.4	MG/L
IRON	0	0.00949	MG/L
MAGNESIUM	0	26.9	MG/L
MANGANESE	0	0.372	MG/L
POTASSIUM	0	2.19	MG/L
SODIUM	0	103	MG/L
ZINC	0	0.0081	MG/L

L001TR001

Analyte.na	Depth	Value	Units
ARSENIC	3	0.00316	MG/L
BARIUM	3	0.102	MG/L
CALCIUM	3	84.2	MG/L
IRON	3	0.106	MG/L
MAGNESIUM	3	33	MG/L
MANGANESE	3	2.12	MG/L
POTASSIUM	3	1.24	MG/L
SODIUM	3	131	MG/L
ZINC	3	0.00568	MG/L

L001TR008

Analyte	Depth	Value	Units
ALUMINUM	6.5	29400	MG/KG
ARSENIC	6.5	7.64	MG/KG
BARIUM	6.5	496	MG/KG
BERYLLIUM	6.5	0.828	MG/KG
CALCIUM	6.5	15600	MG/KG
CADMIUM	6.5	0.152	MG/KG
COBALT	6.5	17	MG/KG
CHROMIUM, TOTAL	6.5	55	MG/KG
COPPER	6.5	44.9	MG/KG
IRON	6.5	34800	MG/KG
MERCURY	6.5	0.028	MG/KG
POTASSIUM	6.5	2540	MG/KG
MAGNESIUM	6.5	8540	MG/KG
MANGANESE	6.5	976	MG/KG
MOLYBDENUM	6.5	0.984	MG/KG
SODIUM	6.5	381	MG/KG
NICKEL	6.5	57.8	MG/KG
LEAD	6.5	16.9	MG/KG
SELENIUM	6.5	0.203	MG/KG
TIN	6.5	8.47	MG/KG
THALLIUM	6.5	0.608	MG/KG
VANADIUM	6.5	72.7	MG/KG
ZINC	6.5	85.5	MG/KG

L001TR008

Analyte.na	Depth	Value	Units
ANTIMONY	3	0.00138	MG/L
BARIUM	3	0.0424	MG/L
CALCIUM	3	96.8	MG/L
IRON	3	0.0561	MG/L
MAGNESIUM	3	35.4	MG/L
MANGANESE	3	0.107	MG/L
SODIUM	3	126	MG/L

L001TR002

Analyte	Depth	Value	Units
ALUMINUM	3	15000	MG/KG
ALUMINUM	8.5	25200	MG/KG
ARSENIC	3	7.62	MG/KG
ARSENIC	8.5	7.76	MG/KG
BARIUM	3	54.8	MG/KG
BARIUM	8.5	70.7	MG/KG
BERYLLIUM	3	0.775	MG/KG
BERYLLIUM	8.5	0.539	MG/KG
CALCIUM	3	2410	MG/KG
CALCIUM	8.5	3900	MG/KG
CADMIUM	3	0.128	MG/KG
CADMIUM	8.5	0.308	MG/KG
COBALT	3	8	MG/KG
COBALT	8.5	20.8	MG/KG
CHROMIUM, TOTAL	3	35.2	MG/KG
CHROMIUM, TOTAL	8.5	75.9	MG/KG
COPPER	3	2.75	MG/KG
COPPER	8.5	46.8	MG/KG
IRON	3	32600	MG/KG
IRON	8.5	38900	MG/KG
MERCURY	3	0.021	MG/KG
MERCURY	8.5	0.058	MG/KG
POTASSIUM	3	2030	MG/KG
POTASSIUM	8.5	2660	MG/KG
MAGNESIUM	3	5850	MG/KG
MAGNESIUM	8.5	13800	MG/KG
MANGANESE	3	236	MG/KG
MANGANESE	8.5	387	MG/KG
MOLYBDENUM	8.5	1.91	MG/KG
SODIUM	3	1040	MG/KG
SODIUM	8.5	2780	MG/KG
NICKEL	3	19.6	MG/KG
NICKEL	8.5	93.5	MG/KG
LEAD	3	11.6	MG/KG
LEAD	8.5	8.45	MG/KG
ANTIMONY	8.5	4.41	MG/KG
SELENIUM	3	0.265	MG/KG
SELENIUM	8.5	0.366	MG/KG
TIN	3	7.56	MG/KG
TIN	8.5	9.04	MG/KG
THALLIUM	3	0.542	MG/KG
THALLIUM	8.5	0.553	MG/KG
VANADIUM	3	61.8	MG/KG
VANADIUM	8.5	80.8	MG/KG
ZINC	3	61.9	MG/KG
ZINC	8.5	87.1	MG/KG

Suspected Outline of Fillsite 1
(as shown on 1918 map)

LEGEND

- Surface Scrape
- Trenches
- Fence
- Roads
- Buildings
- Topographic Contours (Interval = 5 Feet)

NOTE: Only detectable concentrations are shown.

SOIL

GROUNDWATER

N

0 60 Feet

FACILITY

Benicia Arsenal, Benicia, Californi

TITLE

Fillsite 1 - Soil and Groundwater Results-Metals

FORSGREN ASSOCIATES / BROWN and CALDWELL
A Joint Venture

PROJECT 00736

DATE 12/2003

FIGURE 6-2

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Groundwater

Groundwater was encountered during trenching and grab groundwater samples were collected from three trenches, L001TR001, L001TR007, and L001TR008. Methylene chloride, MTBE, cis-1,2-DCE and TCE were detected in all three groundwater samples. TCE concentrations ranged from 1.5 µg/L to 21 µg/L while cis-1,2-DCE ranged from 11 µg/L to 17 µg/L (Figure 6-1). Other volatile organics detected in groundwater samples include acetone, isopropyl ether, naphthalene, and P-cymene.

Petroleum hydrocarbons, diesel fuel and motor oil, were also detected in the grab groundwater samples. Concentrations of analytes detected are shown in Table 6-3. The asphalt debris/layer encountered in trenches L001TR001 and L001TR008 are a likely source of the heavy organic concentrations reported in soil and groundwater. The detection of MTBE (0.64 µg/L in L001TR001) in the groundwater is from post-Arsenal contamination.

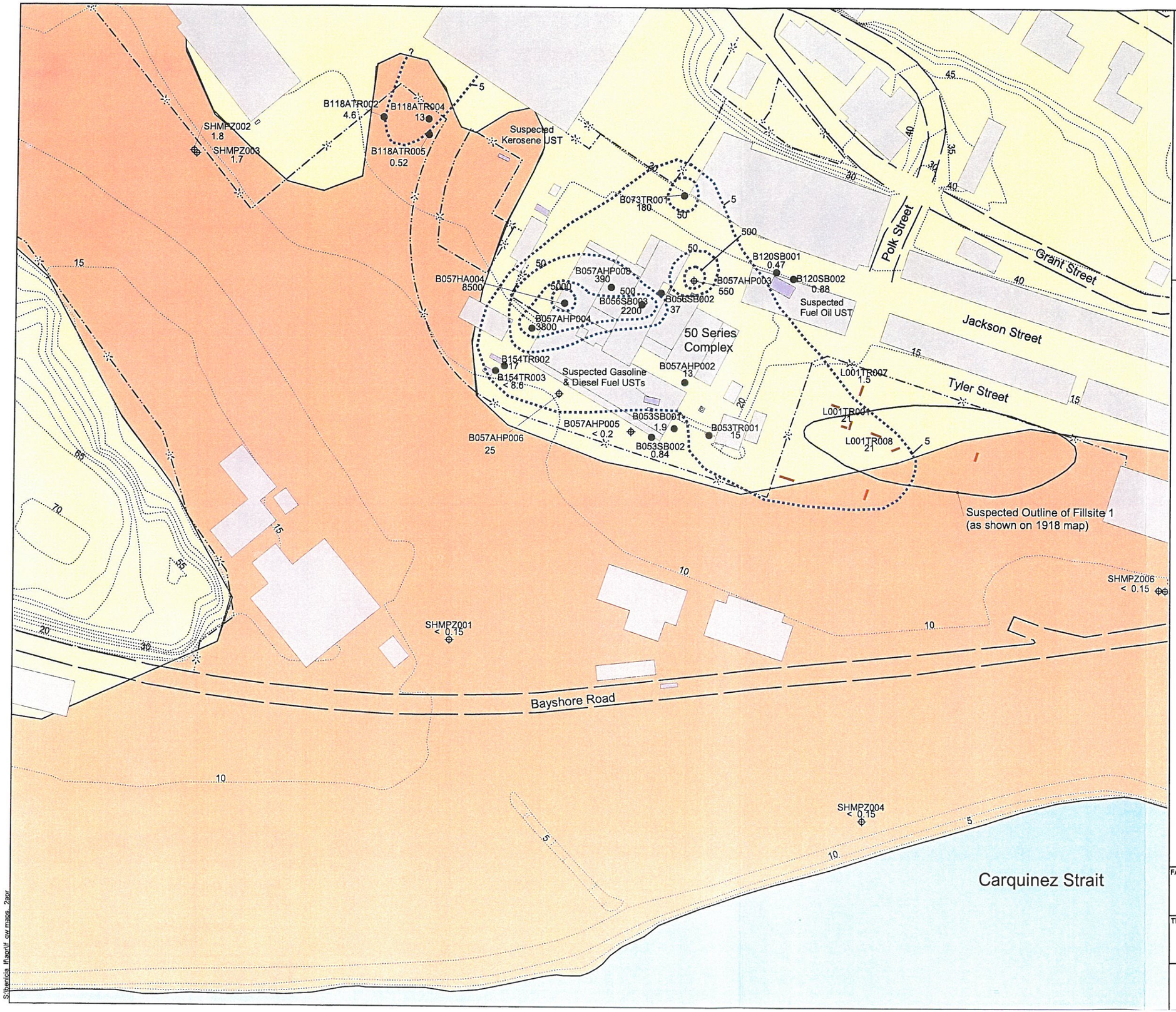
Table 6-3. Fillsite 1 Diesel Fuel and Motor Oil Concentrations in Groundwater

Sample Location	Diesel Fuel Concentration (µg/L)	Motor Oil Concentration (µg/L)
L001TR001	<15	450
L001TR007	56	<39
L001TR008	50	67

PAHs detected in water samples collected from Fillsite 1 include benzo(b)fluoranthene (0.11 µg/L), benzo(g,h,i)perylene (0.12 µg/L), fluoranthene (0.15 µg/L), phenanthrene (0.088 µg/L), and pyrene (0.19 µg/L).

The source of the solvents is not well understood. Solvents were commonly used in manufacturing during World War II, after Building 71 was constructed in 1920. Since Fillsite 1 was covered by Building 71 in the 1920's and then the area was paved, the source of the solvents is probably another location. The fillsite is approximately 299 feet west of the 50 Series Complex where a variety of fuels and solvents were used when the Arsenal was operational. Solvents have been reported in groundwater beneath the complex. Locally, groundwater in this area flows radially away from the complex with an southwest gradient. The source of the solvents in groundwater could be from the complex or from an unidentified source upgradient (e.g. Building 120) (north/northeast of Fillsite 1).

Previous investigations in the area of Fillsite 1 (i.e. the former underground storage tanks (USTs), the 50 Series Complex, and the CSM Piezometers) indicates the presence of multiple and isolated plumes of TPH and solvents in groundwater. The Lowland area, as shown on Figures 6-3 through 6-8 and discussed in Section 4, is the area associated with the former marshlands or "swamp" located in Area I (FA/BC, 2003b). The lowlands in Area I include Fillsite 1 and the other areas previously investigated. Chlorinated solvents, predominantly TCE, were detected in soil and groundwater at Fillsite 1. Other locations near Fillsite 1 where chlorinated solvents were detected in the groundwater include the 50 Series Complex, former USTs near Buildings 53, 73, 103, 154, former AST location at Building 118A and the north/northeast of the 50 Series Complex (Figure 6-3).



LEGEND

- Soil Boring Location
- Piezometer
- Trenches
- Concentration Contours
- Former Underground Storage Tanks (unless otherwise noted)
- Roads
- Fence
- Buildings
- Topographic Contours (Interval = 5 Feet)
- Former "Swamp" - Marshlands
- 1.1 Groundwater concentration (micrograms per liter)

N

0 160 Feet

Source: 50 Series Complex Site Inspection Report (FA/BC, 2003d).

FACILITY

Benicia Arsenal, Benicia, California

TITLE

Area I Lowlands - TCE Groundwater Results

BROWN AND CALDWELL

PROJECT 00736

DATE 12/2003

FIGURE 6-3

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LEGEND

- Soil Boring Location
- Piezometer
- Trenches
- Concentration Contours
- Former Underground Storage Tanks (unless otherwise noted)
- Roads
- Fence
- Buildings
- Topographic Contours (Interval = 5 Feet)
- Former "Swamp" - Marshlands
- 1.1 Groundwater concentration (micrograms per liter)

N

0 160 Feet

Source: 50 Series Complex
Site Inspection Report (FA/BC, 2003d).

FACILITY
Benicia Arsenal, Benicia, California

TITLE
Area I Lowlands - cis-1,2,-DCE
Groundwater Results

BROWN AND CALDWELL

PROJECT 00736

DATE 12/2003

FIGURE 6-4

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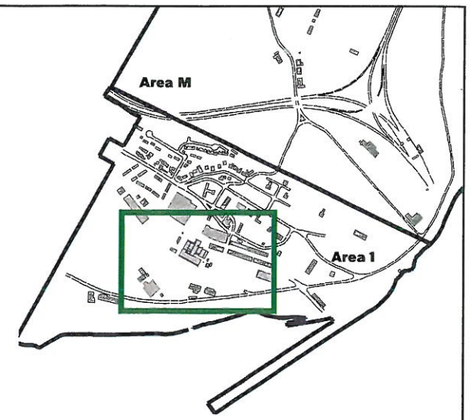

LEGEND

- Soil Boring Location
- Piezometer
- Trenches
- Concentration Contours
- Former Underground Storage Tanks (unless otherwise noted)
- Roads
- Fence
- Buildings
- Topographic Contours (Interval = 5 Feet)
- Former "Swamp" - Marshlands
- 1.1 Groundwater concentration (micrograms per liter)

N

0 160 Feet

Source: 50 Series Complex Site Inspection Report (FA/BC, 2003d).

FACILITY

Benicia Arsenal, Benicia, California

TITLE

Area I - Vinyl Chloride Groundwater Results

BROWN AND CALDWELL

PROJECT 00736

DATE 12/2003

FIGURE 6-5

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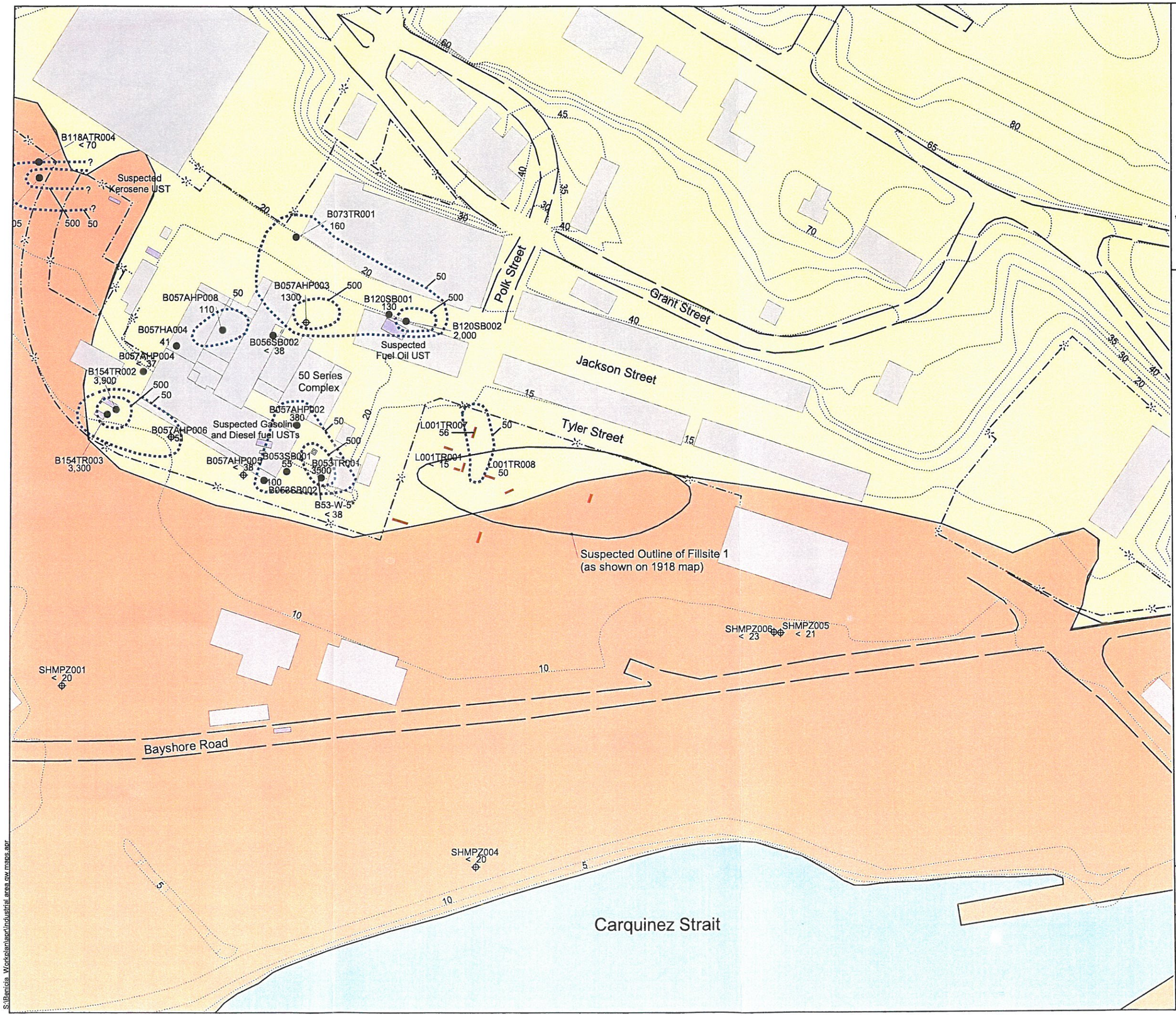


LEGEND

- Soil Boring Location
- Piezometer
- Trenches
- Concentration Contours
- Former Underground Storage Tanks (unless otherwise noted)
- Roads
- Fence
- Buildings
- Topographic Contours (Interval = 5 Feet)
- Former "Swamp" - Marshlands
- 1.1 Groundwater concentration (micrograms per liter)

N

0 160 Feet

Source: 50 Series Complex Site Inspection Report (FA/BC, 2003d) and Geofon (2003).

FACILITY

Benicia Arsenal, Benicia, California

TITLE

Area I Lowlands - Diesel Fuel Groundwater Results

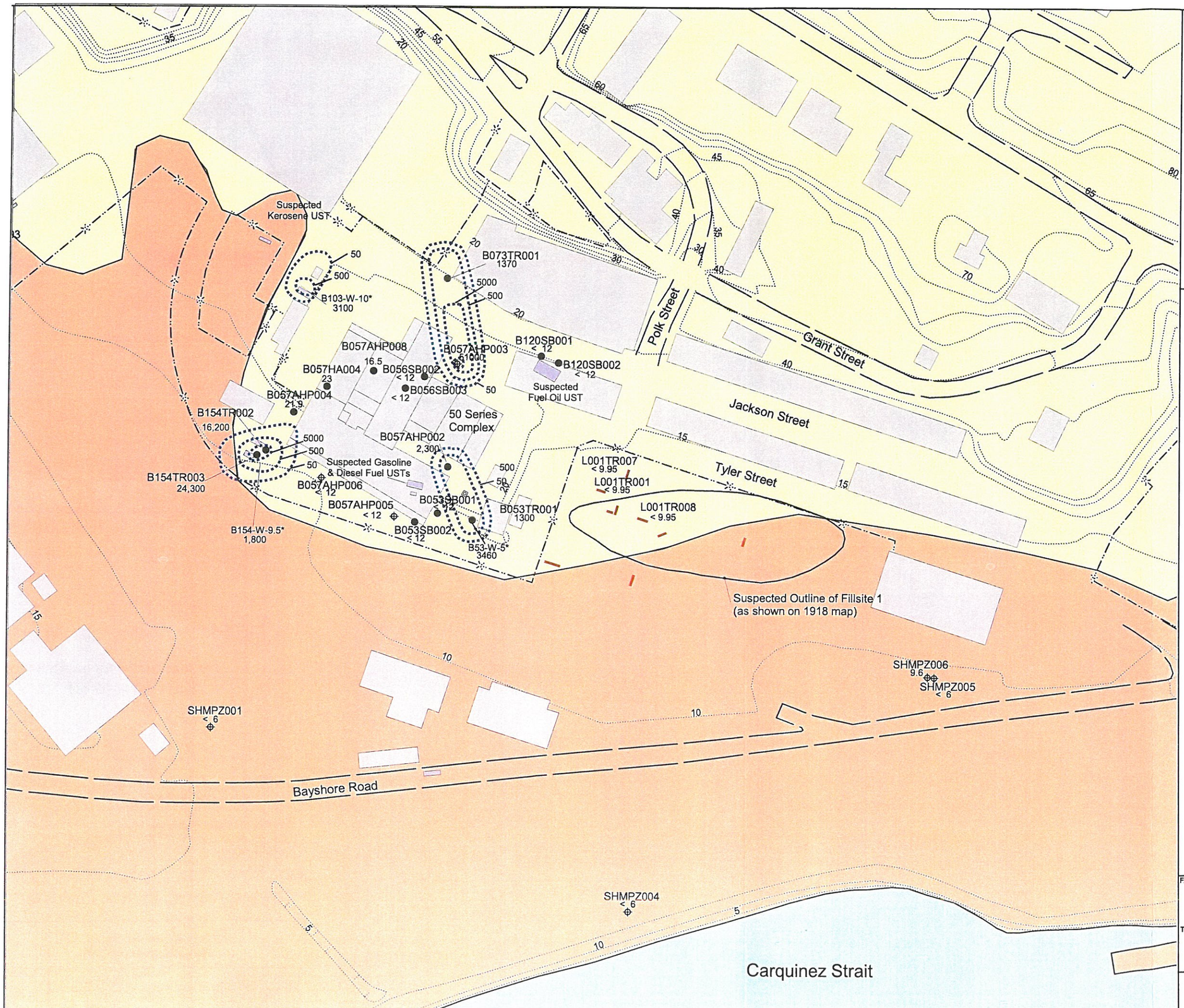
BROWN AND CALDWELL

PROJECT 00736

DATE 12/2003

FIGURE 6-6

S:\Benicia_Worksite\arc\Industrial area cw maps.apr



LEGEND

- Soil Boring Location
- Piezometer
- Trenches
- Concentration Contours
- Former Underground Storage Tanks (unless otherwise noted)
- Roads
- Fence
- Buildings
- Topographic Contours (Interval = 5 Feet)
- Former "Swamp" - Marshlands
- 1.1 Groundwater concentration (micrograms per liter)

N

0 160 Feet

Source: 50 Series Complex Site Inspection Report (FA/BC, 2003d) and Geofon (2003).

FACILITY

Benicia Arsenal, Benicia, California

TITLE

Area I Lowlands - Gasoline Groundwater Results

BROWN AND CALDWELL

PROJECT 00736

DATE 12/2003

FIGURE 6-7

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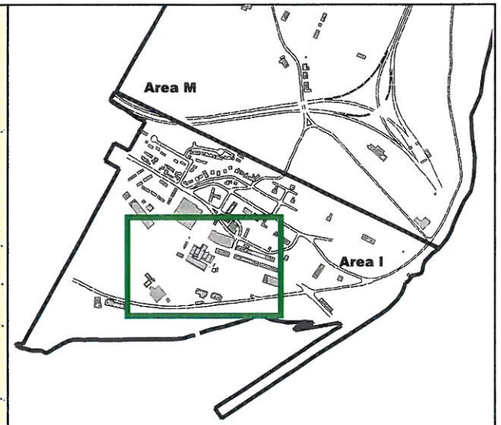


LEGEND

- Soil Boring Location
- Piezometer
- Trenches
- Concentration Contours
- Former Underground Storage Tanks (unless otherwise noted)
- Roads
- Fence
- Buildings
- Topographic Contours (Interval = 5 Feet)
- Former "Swamp" - Marshlands
- 1.1 Groundwater concentration (micrograms per liter)

N

0 160 Feet

Source: 50 Series Complex Site Inspection Report (FA/BC, 2003d) and Geofon (2003).

FACILITY

Benicia Arsenal, Benicia, California

TITLE

Area I Lowlands - Motor Oil Groundwater Results

BROWN AND CALDWELL

PROJECT 00736

DATE 12/2003

FIGURE 6-8

S:\Benicia_Workplan\arl\industrial area.ovr maps.apr

The chlorinated volatile organic compounds (CVOCs), TCE, cis-1,2-DCE, and vinyl chloride were detected in groundwater throughout the Area I Lowlands (Table 6-4 and Figures 6-3 through 6-5). The highest CVOC detections in groundwater were reported for samples collected at the 50 Series Complex. At this location, TCE was reported at 8,500 µg/L, cis-1,2-DCE at 10,000 µg/L, and vinyl chloride at greater than 97 µg/L (estimated).

Table 6-4. Highest TCE, cis-1,2-DCE and Vinyl Chloride Groundwater Concentrations at the Area I Lowlands (µg/L)

	Fillsite 1	50 Series Complex	Former UST Building 53	Former USTs Building 154	Northeast of the 50 Series Complex	Former ASTs Building 118A
TCE	21 (L001TR001)	8,500 (B057HA004)	15 (B053TR001)	17 (B154TR002)	0.88 (B120SB002)	4.6 (B118ATR002)
Cis-1,2-DCE	18 (L001TR001)	10,000 (B057AHP003)	14 (B053TR001)	200 (B154TR002)	74 (B120SB001)	24 (B118ATR002)
Vinyl chloride	<0.2	>97* (B057HA004)	<5.4	<11	70 (B120SB001)	<0.2

*value represents an estimated number. The lab did not dilute the sample in order to determine a more precise concentration.

The data may indicate either or both biotic and abiotic degradation of TCE into the diagnostic "daughter products," cis-1,2-DCE and vinyl chloride. The relative concentration of the three CVOCs in groundwater, with cis-1,2-DCE generally predominating, suggests that the origins are not recent.

Varying groundwater flow conditions are influencing the distribution of solvent contaminants in groundwater. In general, groundwater flow in the Area I Lowlands is to the southwest and toward the Carquinez Strait, away from the hills. Localized radial flow is also occurring in the area of the 50 Series Complex due to recharge to groundwater beneath the 50 Series Complex, which sits on an isolated hill of sandstone. This radial flow is causing a circular shape distribution of the solvents in the area surrounding the 50 Series Complex (Figures 6-3 through 6-5). A typical shape is oval with the long axis in the direction of groundwater flow. Based on the data at Building 118A and PZ-2/PZ-3, solvents in groundwater are reflecting the more typical oval shape and indicate groundwater may be flowing in a westerly direction in this area of the former marshland (Figures 6-3 and 6-4).

In addition to the detection of solvents in groundwater at Fillsite 1, concentrations of diesel fuel and motor oil were also detected. Other nearby sites in the Area I Lowlands also detected diesel fuel, gasoline and motor oil in groundwater samples analyzed. Petroleum hydrocarbons were detected at Fillsite 1, the 50 Series Complex, former USTs at Buildings 53, 103, 118A, 154 and the northeast of 50 Series Complex. Figures 6-6 through 6-8 show the detected values for TPH in groundwater at Area I Lowlands.

Diesel fuel was reported in groundwater samples from Fillsite 1 at concentrations ranging from below MDL to 56 µg/L. Elevated concentrations of diesel fuel were also detected around the 50 Series Complex near former USTs at Buildings 53, 103 and 154, the northeast of the 50 Series

Complex, at the former ASTs of Building 118A and near a Parkerizing vat in Building 57A. Table 6-5 presents the highest concentrations of diesel fuel detected in the Area I Lowland.

Table 6-5. Highest Diesel Fuel, Motor Oil and Gasoline Groundwater Concentrations at Area I Lowlands (µg/L)

	Fillsite 1	50 Series Complex	Former UST Building 103	Former UST Building 53	Former USTs Building 154	Northeast of the 50 Series Complex	Former ASTs Building 118A
Diesel fuel	56 (L001TR007)	1,300 (B057AHP003)	Not analyzed	3,500 (B053TR001)	3,900 (B154TR002)	2,000 (B120SB002)	2,700 (B118ATR005)
Motor oil	450 (L001TR001)	<53 (B057AHP003)	Not analyzed	<240 (B053TR001)	4,100 (B154TR003)	2,800 (B120SB001)	860 (B118ATR005)
Gasoline	<9.95	51,000 (B057AHP003)	3,100* (B103-W-10)	3,460* (B53-W-5)	24,300 (B154TR003)	<12	Not analyzed

*Collected from the excavation during the UST removal (Geofon, 2003).

Gasoline was not detected in any groundwater samples collected at Fillsite 1 (Table 6-5). Gasoline hydrocarbons were the only fuel related hydrocarbons detected in piezometers PZ-2, PZ-3, and PZ-6. These piezometers were installed during the CHM investigation. Piezometers PZ-2 and PZ-3 are located 800 feet east of the 50 Series Complex while piezometers PZ-5 and PZ-6 are located approximately 600 feet west of the 50 Series Complex (Figure 6-7). PZ-2, PZ-3, and PZ-6 detected low gasoline concentrations of 10, 6.1, and 9.6 µg/L. Isolated areas of gasoline impacted groundwater are also associated with the former USTs (Table 6-5, Table 6-6 and Figure 6-7).

Detections of motor oil were less wide-spread than diesel fuel or gasoline in the Area I Lowlands. Fillsite 1 reported concentrations of motor oil from below MDL to 450 µg/L. Groundwater samples collected around former USTs at Buildings 53 and 154 and north/northeast of the 50 Series Complex reported concentrations of motor oil ranging from below MDL to 4,100 µg/L (Table 6-5 and Figure 6-8).

There are nine (9) areas where petroleum hydrocarbons are detected in groundwater at the Area I Lowlands (Figures 6-6 through 6-8). These areas are located at Buildings 53, 103, 120, 154, south of Building 55, Building 118A, Fillsite 1, Building 57A and north of the 50 Series Complex. These areas were identified based on data from this investigation and other investigations at these locations. Table 6-6 lists the nine locations and probable sources.

Table 6-6. Petroleum Hydrocarbon Areas in Groundwater and Probable Sources at Area I Lowlands

Location	Probable Source	Highest Concentration (µg/L)
Building 53	Former USTs- leaks, spills	3,500 diesel fuel
Building 103	Former USTs- leaks, spills	3,100 gasoline
Building 154	Former USTs- leaks, spills	24,300 gasoline
South of Building 55	Former foundry	2,300 gasoline
North of the 50 Series Complex	Not yet identified	51,000 gasoline
Northeast of the 50 Series Complex	Suspected USTs	2,800 motor oil
Fillsite 1	Asphalt Debris/Layer	450 motor oil
Building 57A	Former Maintenance	110 diesel fuel and 17 MTBE
Building 118A	Former ASTs or another upgradient source	2,700 diesel fuel

Diesel fuel was detected in groundwater beneath Building 57A at 110 µg/L. MTBE, a fuel oxygenate was detected at 17 µg/L. MTBE was also detected in groundwater samples B053SB002 and B057AHP005 at concentrations of 0.59 µg/L, 0.52 µg/L and 17 µg/L, respectively. An MTBE concentration of 0.64 µg/L was detected at Fillsite 1 (Figure 6-1). Also, a water sample from the Building 57A vat contained MTBE at 4.7 µg/L. No additional fuel oxygenates were detected in the water samples. MTBE was first used as a fuel additive in the 1970s, after Arsenal closure. Therefore, the presence of MTBE indicates that releases occurred after the Army left the site.

6.1.2 Fillsite 2

The trenches and test pit locations were chosen based on anomalies detected during the geophysical survey. Table 6-7 lists the results from the trenching at Fillsite 2. The trenches and test pit locations are shown on Figure 3-2. Fill material consisting of gravelly silt to sand, was found overlying buried refuse material. The source of the fill material, north and south of Adams Street is unknown. Refuse was encountered south of Adams Street. Construction-like debris was also encountered at the ferrous anomaly as reported in the geophysical survey. No refuse was found in the area of the large anomaly (Figure 3-2). Ash, broken pieces of pottery, slag, Cosmoline and pieces of metal were found in L002TP001, L002TP004 and L002TP005 as shown in Photos 5 and 6.

During the excavation of L002TP001 and L002TP005, a sandstone wall was found buried beneath the fill (see Photos 6 and 7). The wall is orientated approximately N75W and nearly parallel to Adams Street. The stones were rounded and comprised of the same sandstone used to build the historic buildings around the Arsenal. The wall was likely the former road edge and used as a retaining wall. The refuse found in this area was likely dumped along the side of the old road. Test pit L002TP006 was dug on the north side of Adams Street to confirm that the refuse did not extend north of Adams Street. The lateral extent of the refuse is shown on Figure 3-2 and 6-9. The volume of the refuse was estimated to be approximately 60 cubic yards based on an average thickness of approximately 4 feet as observed in L002TP005 and the lateral extent observed from test pits L002TP001, L002TP004, and L002TP005.

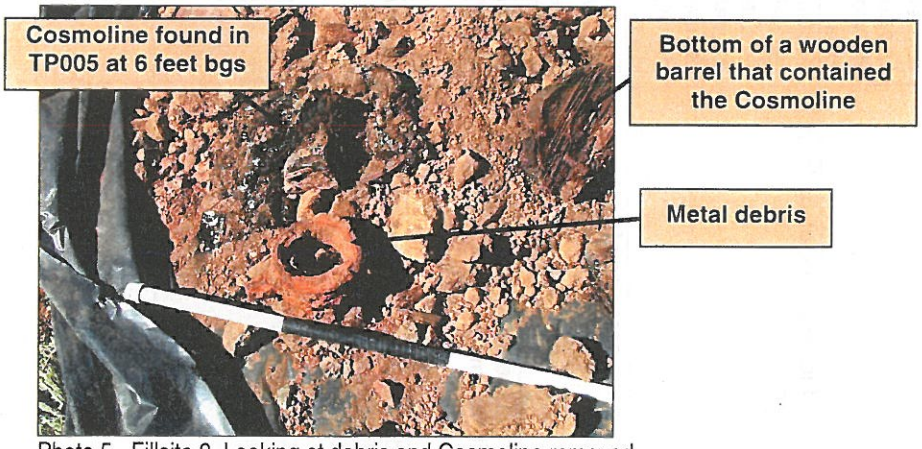


Photo 5. Fillsite 2. Looking at debris and Cosmoline removed during the excavation of L002TP005. Scale is marked every foot. Photo taken 2/7/2001.

Table 6-7. Fillsite 2 Trenching Results (see Figure 3-2) (continued)

Trench Name	Location	Objective	Trenching Results
L002TR008	Positioned west of L002TR003.	To assess the lateral extent of refuse/fill material found in L002TR003 (a metal pipe and a concrete block).	Fill comprised of sandy silt encountered to a depth of 2.5 feet bgs. Sandstone at bottom of trench. No refuse found. Total depth of trench = 2.5 feet.
L002TR009	Positioned on the west side of the vertical magnetic anomaly along the northern border of the site.	To assess the presence or absence of refuse/fill material.	Fill comprised of sandy silt encountered to a depth of 6 feet bgs. Sandstone at bottom of trench. Groundwater entering trench at 6 feet bgs. No refuse found. Total depth of trench = 6 feet.
L002TP001	Positioned south of Adams Street at the conductivity anomaly.	To assess the presence and extent of refuse/fill material.	Fill comprised of gravelly sandy silt encountered to a depth of 8.5 feet bgs. Refuse found at 4 to 8.5 feet bgs and comprised of slag, ash and pieces of pottery. Stone wall on the north side of the trench (3.5 feet bgs and 2.5 feet tall), parallel to Adams Street. Sandy silt at 8.5 to 11 feet bgs. Total depth of trench = 11 feet.
L002TP002	Positioned in the area of a conductivity anomaly.	To assess the presence and extent of refuse/fill material.	Fill comprised of sandy silt encountered to a depth of 2 feet bgs. Silty clay at 2 to 10 feet bgs. Sandstone at bottom of trench. Groundwater entering trench at 8 feet bgs. No refuse found. Total depth of trench = 10 feet.
L002TP003	Positioned south of Adams Street and west of L002TP004.	To assess the presence and extent of refuse/fill material.	Fill comprised of silty sand encountered to a depth of 6.5 feet bgs. Sandstone at 6.5 to 8 feet bgs. No refuse found. Total depth of trench = 8 feet.
L002TP004	Positioned south of Adams Street and west of L002TP001.	To assess the lateral extent of refuse/fill material (ash, pottery) in L002TP001.	Fill comprised of silty sand encountered to a depth of 4.5 feet bgs (north side) to 5.5 feet bgs (south side). Underlying sandy silt encountered to 7.5 feet bgs. Sandstone at 7.5 to 8 feet bgs. White powdery material on western side wall at 4.5 to 5 feet bgs. No refuse found. Total depth of trench = 8 feet.

Table 6-7. Fillsite 2 Trenching Results (see Figure 3-2) (continued)

Trench Name	Location	Objective	Trenching Results
L002TP005	Positioned south of Adams Street and east of L002TR001.	To assess the lateral extent of refuse/fill material (ash, pottery) in L002TP001.	Fill comprised of gravelly sandy silt encountered to a depth of 8 feet bgs. Refuse found at 4.5 to 7 feet bgs and comprised of white chalky material, ash, pieces of concrete and sandstone, and a small broken container of Cosmoline. Stone wall exposed in L002TP001 found on the north side of L002TP005 (removed a portion during excavation). Sandy silt at 8 to 9 feet bgs. Total depth of trench = 9 feet.
L002TP006	Positioned along the northern side of Adams Street.	To assess the lateral extent of refuse/fill material found in L002TP001 and L002TP005.	Fill comprised of silty sand encountered to a depth of 1 feet bgs (south side) to 7 feet bgs (north side). Underlying silty clay to 10 feet bgs. No refuse found. Total depth of trench = 10 feet.
L002TP007	Positioned north of L002TR003.	To assess the lateral extent of refuse/fill material found in L002TR003 (a metal pipe and a concrete block).	Fill comprised of gravelly sandy silt encountered to a depth of 7.5 feet bgs. Asphalt pieces found at east end of trench at 1.5 feet bgs. Groundwater entering trench at 6.5 feet bgs. Sandstone at bottom of trench. No refuse found. Total depth of trench = 10 feet.
L002TP008	Positioned east of L002TR006.	To assess the lateral extent of construction debris (pieces of metal pipes) found in L002TR006 and to investigate the near surface anomalies from the EM61 in the area.	Fill comprised of gravelly silt encountered to a depth of 2 feet bgs. Pieces of metal found in fill at 1.5 feet to 2.5 bgs. Sandstone encountered at 2 feet bgs. No refuse found. Total depth of trench = 4 feet.
L002TP009	Positioned west of L002TR006.	To assess the lateral extent of construction debris (pieces of metal pipes) found in L002TR006.	Fill comprised of silt encountered to a depth of 4.5 feet bgs. Pieces of wood, rebar found in fill at 1 feet bgs. Sandstone at bottom of trench. Groundwater entering trench at 4.5 feet bgs. No refuse found. Total depth of trench = 4.5 feet.
L002TP010	Positioned north of L002TR006.	To assess the lateral extent of construction debris (pieces of metal pipes) found in L002TR006.	Fill comprised of sandy silt encountered to a depth of 6.5 feet bgs. Pieces of asphalt and rebar found in fill at 2 feet bgs. Sandstone encountered at 6.5 feet bgs. No refuse found. Total depth of trench = 7 feet.

Refuse and construction debris encountered in trenches/test pits.

Photo 6. Looking northwest at wall of L002TP005. Scale is marked every foot. Photo taken 2/7/2001.

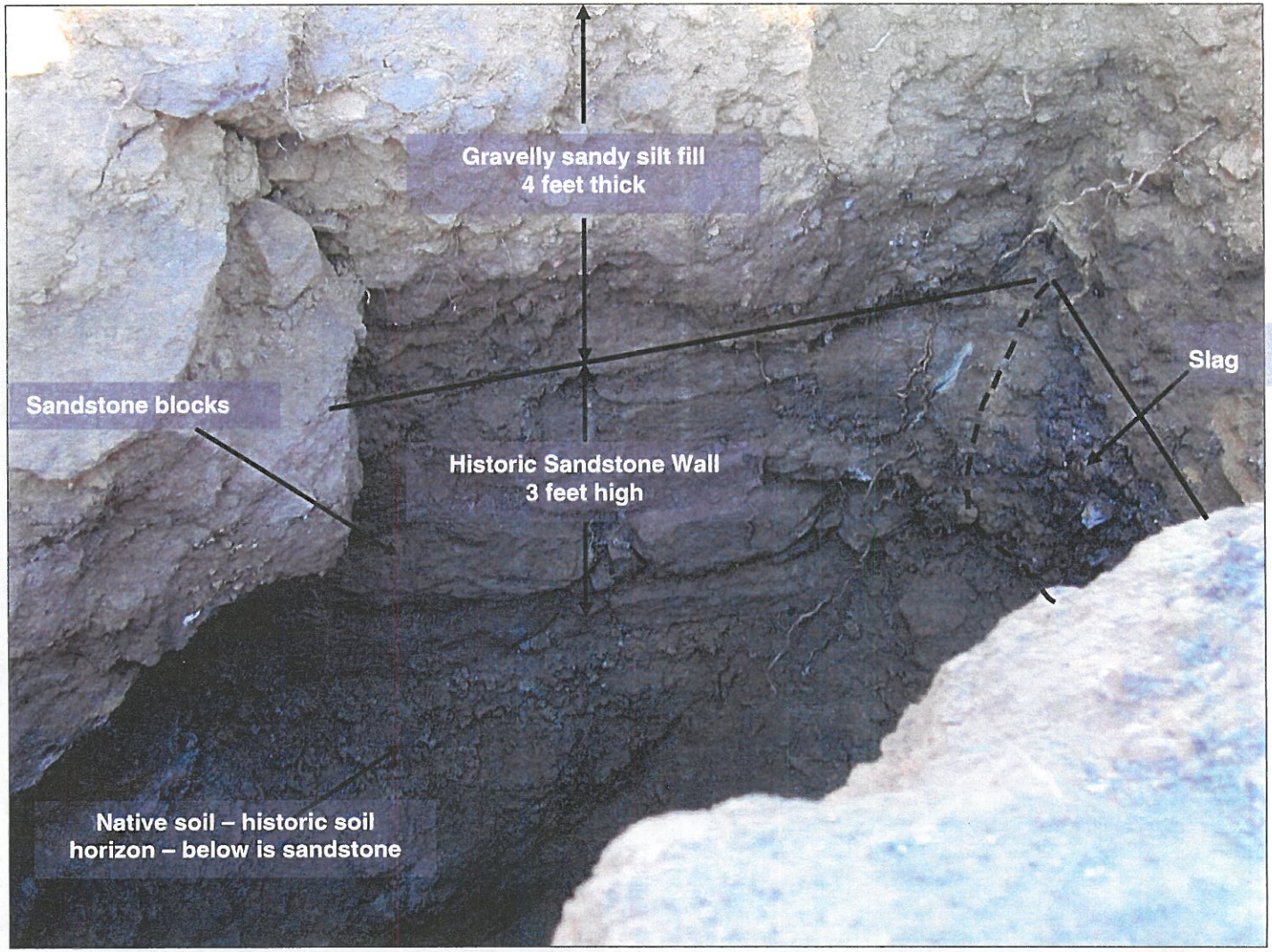


Photo 7. Looking on the northeast wall of test pit L002TP001. Shows fill material, some refuse and a sandstone wall that was a retaining wall for an old road that was used in the early 20th century. Photo taken 2/7/2001.

Analytical Results

Nineteen trenches/test pits were dug and ten surface scrapes were collected and analyzed at Fillsite 2 (Figures 6-9 and 6-10). Five soil samples and two grab groundwater samples were collected from these trenches/test pits. PCBs, explosives, and cyanide were not reported in soil or groundwater samples at Fillsite 2.

Surface Soil

Ten surface soil samples were collected throughout Fillsite 2 with the majority of samples collected where refuse/debris was encountered. Numerous fuels and fuel related compounds were reported (Figures 6-9 and 6-10).

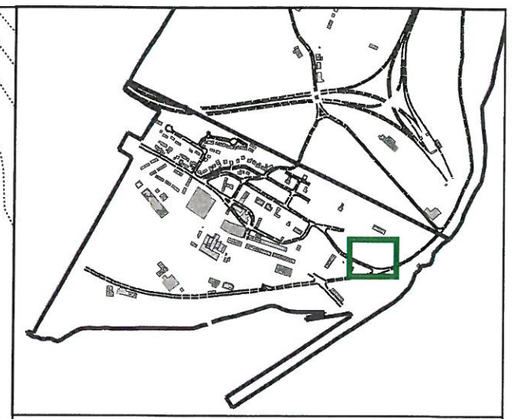
Six surface soil samples collected south of Adams Street detected elevated lead concentrations (Table 6-8). Lead concentrations in samples collected south of Adams Street were much higher than north of Adams Street (Table 6-8).

Table 6-8. Fillsite 2 Lead Concentrations in Soil (see Figure 6-10)

Sample Location	Lead Concentration (mg/kg)	
	North of Adams Street (0.25 feet bgs)	South of Adams Street (0.25 feet bgs)
L002TP001		813[a]
L002SC004		152
L002SC005		142
L002SC006		225
L002SC007		109
L002SC008		190
L002TR002	5.78[b]	
L002SC001	12.8	
L002SC002	28.9	
L002SC009	9.92[c]	
L002SC010	9.71	

[a] - sample collected 8.5 feet bgs
[b] - sample collected at 9.5 feet bgs
[c] – sample collected where HLA investigation reported elevated lead concentrations
All samples were collected at 0.5 feet bgs, unless otherwise noted.

BUILDING 29
(Clock Tower)



L002TR003

Analyte	Depth	Value	Units
MOTOR OIL	0	77	UG/L
METHYLENE CHLORIDE	4.5	12	UG/L
NITROGEN, NITRATE (AS N)	0	0.286	MG/L
TOTAL DISSOLVED SOLIDS (RESIDUE, FILTERABLE)	0	2004	MG/L
CHLORIDE (AS CL)	0	336	MG/L
SULFATE (AS SO4)	0	660	MG/L
ALKALINITY, TOTAL (AS CaCO3)	0	84.7	MG/L
ALKALINITY, BICARBONATE (AS CACO3)	0	84.7	MG/L

L002TR003

Analyte	Depth	Value	Units
DIESEL FUEL (C10-C24)	2.5	16	MG/KG
MOTOR OIL (C20-C36)	2.5	72	MG/KG
BENZO(b)FLUORANTHENE	2.5	0.026	MG/KG
PYRENE	2.5	0.016	MG/KG

L002SC001

Analyte	Depth	Value	Units
BENZALDEHYDE	0	0.0056	MG/KG
N-VALERALDEHYDE	0	0.0064	MG/KG
N-BUTYRALDEHYDE	0	0.0054	MG/KG
ACETONE	0	0.087	MG/KG
TRICHLOROFLUOROMETHANE	0	0.0014	MG/KG
METHYL ETHYL KETONE (2-BUTANONE)	0	0.018	MG/KG
N-EICOSANE (C20)	0.5	0.49	MG/KG
7-HEXYLEICOSANE	0.5	0.32	MG/KG
N-HEXACOSANE (C26)	0.5	0.35	MG/KG
N-HEXATRIACONTANE (C36)	0.5	0.39	MG/KG
1-DOTRIACONTANOL	0.5	0.38	MG/KG

L002SC003

Analyte	Depth	Value	Units
N-VALERALDEHYDE	0.25	0.008	MG/KG
ACETONE	0.25	0.16	MG/KG
TRICHLOROFLUOROMETHANE	0.25	0.0036	MG/KG
METHYL ETHYL KETONE (2-BUTANONE)	0.25	0.012	MG/KG
BENZO(a)PYRENE	0.25	0.0065	MG/KG
CHRYSENE	0.25	0.011	MG/KG
DIBENZ(a,h)ANTHRACENE	0.25	0.0012	MG/KG
FLUORANTHENE	0.25	0.027	MG/KG
1-DOCOSENE	0.25	0.66	MG/KG
CYCLOTETRADECANE	0.25	0.32	MG/KG
1-EICOSANOL	0.25	0.42	MG/KG
N-HEXATRIACONTANE (C36)	0.25	0.38	MG/KG

L002TP007
L002TR009
L002TP010
L002TR008
L002TP006
L002TP009
L002TP008
L002TR002
L002SC009
L002TR001

55
45
35
25

L002SC002

Analyte	Depth	Value	Units
ACETONE	0	0.015	MG/KG
METHYL ETHYL KETONE (2-BUTANONE)	0	0.0028	MG/KG
ACENAPHTHYLENE	0.25	0.053	MG/KG
BENZO(a)ANTHRACENE	0.25	0.0024	MG/KG
BENZO(a)PYRENE	0.25	0.0058	MG/KG
CHRYSENE	0.25	0.0071	MG/KG
PYRENE	0.25	0.0076	MG/KG
1-HEXADECENE	0.25	0.29	MG/KG
N-HEXATRIACONTANE (C36)	0.25	0.37	MG/KG
5-BUTYLHEXADECANE	0.25	0.38	MG/KG

L002TP005

Analyte	Depth	Value	Units
DIESEL FUEL (C10-C24)	8	9.4	MG/KG
MOTOR OIL (C20-C36)	8	21	MG/KG
ACETONE	8	0.048	MG/KG

L002TP001

Analyte	Depth	Value	Units
DIESEL RANGE ORGANICS	8.5	7	MG/KG
MOTOR OIL	8.5	32	MG/KG
ACETONE	8.5	0.1	MG/KG
FLUORANTHENE	8.5	0.048	MG/KG
PHENANTHRENE	8.5	0.039	MG/KG

L002SC010
L002TR004
L002TP002

L002TR005

Analyte	Depth	Value	Units
METHYLENE CHLORIDE	1.5	14	UG/L
CHLORIDE (AS CL)	1.5	309	MG/L
NITROGEN, NITRATE (AS N)	1.5	1.05	MG/L
TOTAL DISSOLVED SOLIDS (RESIDUE, FILTERABLE)	1.5	3370	MG/L
SULFATE (AS SO4)	1.5	2260	MG/L

25
20
15

L002SC005

Analyte	Depth	Value	Units
ACETONE	0.25	0.075	MG/KG
BENZENE	0.25	0.00055	MG/KG
TRICHLOROFLUOROMETHANE	0.25	0.0014	MG/KG
METHYL ETHYL KETONE (2-BUTANONE)	0.25	0.0083	MG/KG
BENZO(a)PYRENE	0.25	0.0085	MG/KG
BENZO(b)FLUORANTHENE	0.25	0.014	MG/KG
BENZO(k)FLUORANTHENE	0.25	0.0057	MG/KG
CHRYSENE	0.25	0.014	MG/KG
FLUORANTHENE	0.25	0.041	MG/KG
INDENO(1,2,3-c,d)PYRENE	0.25	0.015	MG/KG
PYRENE	0.25	0.03	MG/KG
N-EICOSANE (C20)	0.25	0.13	MG/KG
1-PENTADECENE	0.25	0.14	MG/KG
1-DOCOSENE	0.25	0.2	MG/KG
N-OCTADECANE (C18)	0.25	0.14	MG/KG
N-HEPTADECANE (C17)	0.25	0.16	MG/KG
N-HEXATRIACONTANE (C36)	0.25	0.45	MG/KG
N-PENTATRIACONTANE (C35)	0.25	0.14	MG/KG
N-TETRACOSANE (C24)	0.25	0.22	MG/KG

L002TP006
L002TP004
L002TP003
L002TR007

Adams Street

Bayshore Road

FCI Construction
(building removed)

L002SC004

Analyte	Depth	Value	Units
N-VALERALDEHYDE	0.25	0.01	MG/KG
N-BUTYRALDEHYDE	0.25	0.0078	MG/KG
ACETONE	0.25	0.16	MG/KG
TOLUENE	0.25	0.00096	MG/KG
METHYL ETHYL KETONE (2-BUTANONE)	0.25	0.011	MG/KG
BENZO(a)ANTHRACENE	0.25	0.009	MG/KG
BENZO(a)PYRENE	0.25	0.035	MG/KG
BENZO(k)FLUORANTHENE	0.25	0.013	MG/KG
CHRYSENE	0.25	0.035	MG/KG
FLUORANTHENE	0.25	0.12	MG/KG
PHENANTHRENE	0.25	0.053	MG/KG
PYRENE	0.25	0.057	MG/KG
CYCLOHEXADECANE	0.25	0.67	MG/KG
1-EICOSANOL	0.25	3.1	MG/KG
N-HEXATRIACONTANE (C36)	0.25	3.3	MG/KG
GAMMA-SITOSTEROL	0.25	2.2	MG/KG

L002SC006

Analyte	Depth	Value	Units
N-VALERALDEHYDE	0.25	0.021	MG/KG
N-BUTYRALDEHYDE	0.25	0.011	MG/KG
EXO-FRENCHOL	0.25	0.017	MG/KG
1R-.ALPHA.-LIMONENE	0.25	0.024	MG/KG
1R-.ALPHA.-PINENE	0.25	0.052	MG/KG
CAMPHENE	0.25	0.019	MG/KG
ACETONE	0.25	0.26	MG/KG
BENZENE	0.25	0.00072	MG/KG
TOLUENE	0.25	0.006	MG/KG
P-CYMENE (p-ISOPROPYLTOLUENE)	0.25	0.0077	MG/KG
METHYL ETHYL KETONE (2-BUTANONE)	0.25	0.021	MG/KG
BENZO(a)ANTHRACENE	0.25	0.063	MG/KG
BENZO(a)PYRENE	0.25	0.22	MG/KG
BENZO(b)FLUORANTHENE	0.25	0.4	MG/KG
BENZO(g,h,i)PERYLENE	0.25	0.055	MG/KG
BENZO(k)FLUORANTHENE	0.25	0.06	MG/KG
CHRYSENE	0.25	0.14	MG/KG
FLUORANTHENE	0.25	0.54	MG/KG
PHENANTHRENE	0.25	0.18	MG/KG
PYRENE	0.25	0.39	MG/KG
1-DOCOSENE	0.25	0.93	MG/KG
1-HEXADECENE	0.25	0.6	MG/KG
N-HENICOSANE (C21)	0.25	0.7	MG/KG
1-EICOSANOL	0.25	2.4	MG/KG
N-HEXATRIACONTANE (C36)	0.25	5	MG/KG
HEXADECYLOXIRANE	0.25	0.53	MG/KG
1R-.ALPHA.-PINENE	0.25	0.83	MG/KG
GAMMA-SITOSTEROL	0.25	0.99	MG/KG
CARYOPHYLLENE	0.25	0.44	MG/KG

L002SC007

Analyte	Depth	Value	Units
N-VALERALDEHYDE	0.25	0.016	MG/KG
N-BUTYRALDEHYDE	0.25	0.0072	MG/KG
EUCALYPTOL (LIMONENE OXIDE)	0.25	0.11	MG/KG
ACETONE	0.25	0.11	MG/KG
TOLUENE	0.25	0.00095	MG/KG
P-CYMENE (p-ISOPROPYLTOLUENE)	0.25	0.0016	MG/KG
METHYL ETHYL KETONE (2-BUTANONE)	0.25	0.0099	MG/KG
BENZO(a)ANTHRACENE	0.25	0.014	MG/KG
BENZO(a)PYRENE	0.25	0.02	MG/KG
BENZO(b)FLUORANTHENE	0.25	0.022	MG/KG
BENZO(k)FLUORANTHENE	0.25	0.009	MG/KG
CHRYSENE	0.25	0.03	MG/KG
FLUORANTHENE	0.25	0.083	MG/KG
INDENO(1,2,3-c,d)PYRENE	0.25	0.014	MG/KG
PHENANTHRENE	0.25	0.026	MG/KG
PYRENE	0.25	0.055	MG/KG
1-OCTADECENE	0.25	0.25	MG/KG
GERMACRENE B	0.25	0.86	MG/KG
CYCLOOCTACOSANE	0.25	1.2	MG/KG
N-DOTRIACONTANE (C32)	0.25	0.23	MG/KG
N-HEXADECANOIC ACID	0.25	0.18	MG/KG
N-HEPTADECANE (C17)	0.25	0.41	MG/KG
N-NONADECANE (C19)	0.25	2.5	MG/KG
N-HEXATRIACONTANE (C36)	0.25	1.2	MG/KG
HEPTADECYLOXIRANE	0.25	0.18	MG/KG
GAMMA-SITOSTEROL	0.25	0.47	MG/KG

L002SC008

Analyte	Depth	Value	Units
ACETONE	0.25	0.11	MG/KG
TRICHLOROFLUOROMETHANE	0.25	0.0017	MG/KG
METHYL ETHYL KETONE (2-BUTANONE)	0.25	0.012	MG/KG
BENZO(a)PYRENE	0.25	0.0079	MG/KG
PHENANTHRENE	0.25	0.028	MG/KG
CHOLESTANE	0.25	0.58	MG/KG
5.ALPHA.,8.ALPHA.,14.BETA.-CHOLESTANE	0.25	0.57	MG/KG
N-OCTADECANE (C18)	0.25	0.68	MG/KG
N-NONADECANE (C19)	0.25	0.91	MG/KG
1-EICOSANOL	0.25	0.7	MG/KG
N-HENTRIACONTANE (C31)	0.25	1.6	MG/KG
9-HEXACOSENE	0.25	1.3	MG/KG

LEGEND

- Surface Scrape
- Trenches
- Refuse (ash, slag, pottery, metal, cosmoline)
- Fence
- Roads
- Buildings
- Topographic Contours (Interval = 5 Feet)

NOTE: Only detectable concentrations are shown.

SOIL

GROUNDWATER

N

0 60 Feet

FACILITY

Benicia Arsenal, Benicia, California

TITLE

Fillsite 2 - Soil and Groundwater Results- TPH, VOCs, Wet Chemistry, PAHs, and SVOCs

FORSGREN ASSOCIATES / BROWN and CALDWELL A Joint Venture

PROJECT 00736

DATE 12/2003

FIGURE 6-9

BUILDING 29
(Clock Tower)

L002TR002

Analyte	Depth	Value	Units
ALUMINUM	3.5	15600	MG/KG
ALUMINUM	4.5	9260	MG/KG
ALUMINUM	9.5	10900	MG/KG
ARSENIC	3.5	3.52	MG/KG
ARSENIC	4.5	7.89	MG/KG
ARSENIC	9.5	5.71	MG/KG
BARIUM	3.5	18.7	MG/KG
BARIUM	4.5	25.2	MG/KG
BARIUM	9.5	42.8	MG/KG
BERYLLIUM	3.5	0.514	MG/KG
BERYLLIUM	4.5	0.493	MG/KG
BERYLLIUM	9.5	0.492	MG/KG
CALCIUM	3.5	1670	MG/KG
CALCIUM	4.5	2100	MG/KG
CALCIUM	9.5	5770	MG/KG
CADMIUM	3.5	0.179	MG/KG
CADMIUM	4.5	0.254	MG/KG
CADMIUM	9.5	0.47	MG/KG
COBALT	3.5	2.92	MG/KG
COBALT	4.5	4.97	MG/KG
COBALT	9.5	9.65	MG/KG
CHROMIUM, TOTAL	3.5	23	MG/KG
CHROMIUM, TOTAL	4.5	28.1	MG/KG
CHROMIUM, TOTAL	9.5	13.3	MG/KG
COPPER	3.5	11.1	MG/KG
COPPER	4.5	5.84	MG/KG
COPPER	9.5	10.9	MG/KG
IRON	3.5	15400	MG/KG
IRON	4.5	24600	MG/KG
IRON	9.5	27300	MG/KG
POTASSIUM	3.5	980	MG/KG
POTASSIUM	4.5	965	MG/KG
POTASSIUM	9.5	2020	MG/KG
MAGNESIUM	3.5	3420	MG/KG
MAGNESIUM	4.5	3400	MG/KG
MAGNESIUM	9.5	5740	MG/KG
MANGANESE	3.5	80.7	MG/KG
MANGANESE	4.5	186	MG/KG
MANGANESE	9.5	250	MG/KG
MOLYBDENUM	3.5	1.14	MG/KG
MOLYBDENUM	4.5	1.89	MG/KG
MOLYBDENUM	9.5	1.58	MG/KG
SODIUM	3.5	808	MG/KG
SODIUM	4.5	755	MG/KG
SODIUM	9.5	609	MG/KG
NICKEL	3.5	10.5	MG/KG
NICKEL	4.5	16.4	MG/KG
NICKEL	9.5	21.4	MG/KG
LEAD	3.5	3.85	MG/KG
LEAD	4.5	6.77	MG/KG
LEAD	9.5	5.78	MG/KG
SELENIUM	3.5	0.274	MG/KG
SELENIUM	4.5	0.357	MG/KG
SELENIUM	9.5	0.666	MG/KG
TIN	3.5	7.66	MG/KG
TIN	4.5	4.22	MG/KG
TIN	9.5	6.07	MG/KG
THALLIUM	3.5	0.164	MG/KG
THALLIUM	4.5	0.118	MG/KG
VANADIUM	3.5	28.8	MG/KG
VANADIUM	4.5	39.9	MG/KG
VANADIUM	9.5	34.2	MG/KG
ZINC	3.5	59	MG/KG
ZINC	4.5	49.9	MG/KG
ZINC	9.5	84.1	MG/KG

L002TR003

Analyte	Depth	Value	Units
ALUMINUM	2.5	10400	MG/KG
ARSENIC	2.5	6.48	MG/KG
BARIUM	2.5	88.4	MG/KG
BERYLLIUM	2.5	0.313	MG/KG
CADMIUM	2.5	0.153	MG/KG
CALCIUM	2.5	7170	MG/KG
CHROMIUM, TOTAL	2.5	31.1	MG/KG
COBALT	2.5	7.13	MG/KG
COPPER	2.5	19.2	MG/KG
IRON	2.5	20300	MG/KG
LEAD	2.5	23.3	MG/KG
MAGNESIUM	2.5	4290	MG/KG
MANGANESE	2.5	280	MG/KG
MERCURY	2.5	0.111	MG/KG
MOLYBDENUM	2.5	1.6	MG/KG
NICKEL	2.5	21.8	MG/KG
POTASSIUM	2.5	1220	MG/KG
SELENIUM	2.5	0.805	MG/KG
SODIUM	2.5	360	MG/KG
THALLIUM	2.5	0.0972	MG/KG
TIN	2.5	4.81	MG/KG
VANADIUM	2.5	39.9	MG/KG
ZINC	2.5	59.5	MG/KG

L002TR003

Analyte	Depth	Value	Units
BARIUM	0	0.0104	MG/L
CALCIUM	0	154	MG/L
IRON	0	0.00877	MG/L
MAGNESIUM	0	102	MG/L
MANGANESE	0	0.172	MG/L
MOLYBDENUM	0	0.00877	MG/L
POTASSIUM	0	6.09	MG/L
SELENIUM	0	0.00205	MG/L
SODIUM	0	222	MG/L
ZINC	0	0.0244	MG/L

L002SC001

Analyte	Depth	Value	Units
ALUMINUM	0.5	16000	MG/KG
ARSENIC	0.5	8.93	MG/KG
BARIUM	0.5	72.7	MG/KG
BERYLLIUM	0.5	0.861	MG/KG
CALCIUM	0.5	7380	MG/KG
CADMIUM	0.5	0.426	MG/KG
COBALT	0.5	23.3	MG/KG
CHROMIUM, TOTAL	0.5	35.6	MG/KG
COPPER	0.5	21	MG/KG
IRON	0.5	33100	MG/KG
MERCURY	0.5	0.117	MG/KG
POTASSIUM	0.5	1980	MG/KG
MAGNESIUM	0.5	6120	MG/KG
MANGANESE	0.5	920	MG/KG
MOLYBOENUM	0.5	3.19	MG/KG
SODIUM	0.5	725	MG/KG
NICKEL	0.5	51.6	MG/KG
LEAD	0.5	12.8	MG/KG
ANTIMONY	0.5	3.17	MG/KG
SELENIUM	0.5	2.23	MG/KG
TIN	0.5	2.76	MG/KG
THALLIUM	0.5	0.83	MG/KG
VANADIUM	0.5	53.7	MG/KG
ZINC	0.5	105	MG/KG

L002SC002

Analyte	Depth	Value	Units
ALUMINUM	0.25	14400	MG/KG
ARSENIC	0.25	6.18	MG/KG
BARIUM	0.25	96.6	MG/KG
BERYLLIUM	0.25	0.632	MG/KG
CALCIUM	0.25	3420	MG/KG
CADMIUM	0.25	0.442	MG/KG
COBALT	0.25	11.9	MG/KG
CHROMIUM, TOTAL	0.25	47.6	MG/KG
COPPER	0.25	17.4	MG/KG
IRON	0.25	25900	MG/KG
MERCURY	0.25	0.032	MG/KG
POTASSIUM	0.25	2530	MG/KG
MAGNESIUM	0.25	5700	MG/KG
MANGANESE	0.25	420	MG/KG
MOLYBDENUM	0.25	2.57	MG/KG
SODIUM	0.25	714	MG/KG
NICKEL	0.25	28.9	MG/KG
LEAD	0.25	17.6	MG/KG
ANTIMONY	0.25	3.39	MG/KG
SELENIUM	0.25	0.778	MG/KG
TIN	0.25	4.81	MG/KG
THALLIUM	0.25	0.615	MG/KG
VANADIUM	0.25	48.8	MG/KG
ZINC	0.25	90	MG/KG

L002SC009

Analyte	Depth	Value	Units
ALUMINUM	0.25	22300	MG/KG
ARSENIC	0.25	5.22	MG/KG
BARIUM	0.25	56.9	MG/KG
BERYLLIUM	0.25	0.604	MG/KG
CALCIUM	0.25	24500	MG/KG
CADMIUM	0.25	0.255	MG/KG
COBALT	0.25	19.9	MG/KG
CHROMIUM, TOTAL	0.25	31.5	MG/KG
COPPER	0.25	36.1	MG/KG
IRON	0.25	46500	MG/KG
MERCURY	0.25	0.344	MG/KG
POTASSIUM	0.25	1390	MG/KG
MAGNESIUM	0.25	11100	MG/KG
MANGANESE	0.25	647	MG/KG
MOLYBDENUM	0.25	2.25	MG/KG
SODIUM	0.25	911	MG/KG
NICKEL	0.25	25.1	MG/KG
LEAD	0.25	9.92	MG/KG
ANTIMONY	0.25	3.74	MG/KG
SELENIUM	0.25	0.663	MG/KG
TIN	0.25	4.52	MG/KG
THALLIUM	0.25	0.653	MG/KG
VANADIUM	0.25	121	MG/KG
ZINC	0.25	88.3	MG/KG

L002SC010

Analyte	Depth	Value	Units
ALUMINUM	0.25	19500	MG/KG
ARSENIC	0.25	3.46	MG/KG
BARIUM	0.25	54.9	MG/KG
BERYLLIUM	0.25	0.408	MG/KG
CALCIUM	0.25	24000	MG/KG
CADMIUM	0.25	0.307	MG/KG
COBALT	0.25	22.2	MG/KG
CHROMIUM, TOTAL	0.25	18.1	MG/KG
COPPER	0.25	38	MG/KG
IRON	0.25	46000	MG/KG
MERCURY	0.25	0.339	MG/KG
POTASSIUM	0.25	804	MG/KG
MAGNESIUM	0.25	11600	MG/KG
MANGANESE	0.25	830	MG/KG
MOLYBDENUM	0.25	1.86	MG/KG
SODIUM	0.25	1890	MG/KG
NICKEL	0.25	23.4	MG/KG
LEAD	0.25	9.71	MG/KG
ANTIMONY	0.25	3.47	MG/KG
SELENIUM	0.25	1.02	MG/KG
TIN	0.25	4.93	MG/KG
THALLIUM	0.25	0.574	MG/KG
VANADIUM	0.25	118	MG/KG
ZINC	0.25	84	MG/KG

L002TP002

Analyte	Depth	Value	Units
ALUMINUM	1.5	10800	MG/KG
ALUMINUM	3.5	9780	MG/KG
ALUMINUM	9	8450	MG/KG
ARSENIC	1.5	7.84	MG/KG
ARSENIC	3.5	6.84	MG/KG
ARSENIC	9	8.75	MG/KG
BARIUM	1.5	127	MG/KG
BARIUM	3.5	154	MG/KG
BARIUM	9	87.5	MG/KG
BERYLLIUM	1.5	0.391	MG/KG
BERYLLIUM	3.5	0.435	MG/KG
BERYLLIUM	9	0.335	MG/KG
CALCIUM	1.5	6160	MG/KG
CALCIUM	3.5	2720	MG/KG
CALCIUM	9	2120	MG/KG
CADMIUM	1.5	0.258	MG/KG
CADMIUM	3.5	0.14	MG/KG
CADMIUM	9	0.137	MG/KG
COBALT	1.5	4.76	MG/KG
COBALT	3.5	3.54	MG/KG
COBALT	9	2.3	MG/KG
CHROMIUM, TOTAL	1.5	30	MG/KG
CHROMIUM, TOTAL	3.5	25.3	MG/KG
CHROMIUM, TOTAL	9	23.8	MG/KG
COPPER	1.5	17.1	MG/KG
COPPER	3.5	14.6	MG/KG
COPPER	9	11.2	MG/KG
IRON	1.5	23900	MG/KG
IRON	3.5	18600	MG/KG
IRON	9	35000	MG/KG
MERCURY	1.5	0.054	MG/KG
POTASSIUM	1.5	2040	MG/KG
POTASSIUM	3.5	1410	MG/KG
POTASSIUM	9	2660	MG/KG
MAGNESIUM	1.5	4670	MG/KG
MAGNESIUM	3.5	3770	MG/KG
MAGNESIUM	9	3410	MG/KG
MANGANESE	1.5	190	MG/KG
MANGANESE	3.5	59.2	MG/KG
MANGANESE	9	67	MG/KG
MOLYBDENUM	1.5	2.69	MG/KG
MOLYBDENUM	3.5	2.39	MG/KG
MOLYBDENUM	9	3.34	MG/KG
SODIUM	1.5	1530	MG/KG
SODIUM	3.5	1080	MG/KG
SODIUM	9	648	MG/KG
NICKEL	1.5	17.8	MG/KG
NICKEL	3.5	11.6	MG/KG
NICKEL	9	5.92	MG/KG
LEAD	1.5	11.1	MG/KG
LEAD	3.5	10.2	MG/KG
LEAD	9	7.69	MG/KG
SELENIUM	1.5	1.73	MG/KG
SELENIUM	3.5	1.01	MG/KG
SELENIUM	9	3.99	MG/KG
TIN	1.5	3.04	MG/KG
TIN	3.5	6.81	MG/KG
TIN	9	3.74	MG/KG
THALLIUM	1.5	0.228	MG/KG
THALLIUM	3.5	0.206	MG/KG
THALLIUM	9	0.108	MG/KG
VANADIUM	1.5	33.5	MG/KG
VANADIUM	3.5	25.1	MG/KG
VANADIUM	9	29.8	MG/KG
ZINC	1.5	60.2	MG/KG
ZINC	3.5	68.8	MG/KG
ZINC	9	34.7	MG/KG

L002TR005

Analyte	Depth	Value	Units
ALUMINUM	1.5	35.8	MG/L
BARIUM	1.5	0.00906	MG/L
BERYLLIUM	1.5	0.00798	MG/L
CADMIUM	1.5	0.00706	MG/L
CALCIUM	1.5	339	MG/L
COBALT	1.5	0.124	MG/L
COPPER	1.5	0.0251	MG/L
IRON	1.5	0.377	MG/L
MAGNESIUM	1.5	240	MG/L
MANGANESE	1.5	3.27	MG/L
MOLYBDENUM	1.5	0.0159	MG/L
NICKEL	1.5	0.437	MG/L
POTASSIUM	1.5	5.85	MG/L
SELENIUM	1.5	0.00446	MG/L
SODIUM	1.5	165	MG/L
VANADIUM	1.5	0.00247	MG/L
ZINC	1.5	0.922	MG/L

L002TP001

Analyte	Depth	Value	Units
ALUMINUM	8.5	9200	MG/KG
ARSENIC	8.5	9.31	MG/KG
BARIUM	8.5	189	MG/KG
BERYLLIUM	8.5	0.462	MG/KG
CALCIUM	8.5	11600	MG/KG
CADMIUM	8.5	0.145	MG/KG
COBALT	8.5	9.67	MG/KG
CHROMIUM, TOTAL	8.5	26.9	MG/KG
COPPER	8.5	51.2	MG/KG
IRON	8.5	52100	MG/KG
MERCURY	8.5	0.931	MG/KG
POTASSIUM	8.5	1240	MG/KG
MAGNESIUM	8.5	3100	MG/KG
MANGANESE	8.5	319	MG/KG
SODIUM	8.5	385	MG/KG
NICKEL	8.5	21.9	MG/KG
LEAD	8.5	813	MG/KG
ANTIMONY	8.5	12.9	MG/KG
SELENIUM	8.5	0.328	MG/KG
TIN	8.5	1120	MG/KG
VANADIUM	8.5	37.1	MG/KG
ZINC	8.5	61.6	MG/KG

L002SC003

Analyte	Depth	Value	Units
ALUMINUM	0.25	16800	MG/KG
ARSENIC	0.25	9.42	MG/KG
BARIUM	0.25	90.5	MG/KG
BERYLLIUM	0.25	0.636	MG/KG
CALCIUM	0.25	4730	MG/KG
CADMIUM	0.25	0.462	MG/KG
COBALT	0.25	7.74	MG/KG
CHROMIUM, TOTAL	0.25	43.4	MG/KG
COPPER	0.25	17.2	MG/KG
IRON	0.25	30100	MG/KG
MERCURY	0.25	0.104	MG/KG
POTASSIUM	0.25	2540	MG/KG
MAGNESIUM	0.25	6240	MG/KG
MANGANESE	0.25	290	MG/KG
MOLYBDENUM	0.25	1.54	MG/KG
SODIUM	0.25	101	MG/KG
NICKEL	0.25	18.2	MG/KG
LEAD	0.25	58.3	MG/KG
ANTIMONY	0.25	5.96	MG/KG
SELENIUM	0.25	0.837	MG/KG
TIN	0.25	4.21	MG/KG
THALLIUM	0.25	0.72	MG/KG
VANADIUM	0.25	60.9	MG/KG
ZINC	0.25	91.1	MG/KG

L002SC005

Analyte	Depth	Value	Units
ALUMINUM	0.25	17200	MG/KG
ARSENIC	0.25	9.52	MG/KG
BARIUM	0.25	97	MG/KG
BERYLLIUM	0.25	0.767	MG/KG
CALCIUM	0.25	4030	MG/KG
CADMIUM	0.25	0.361	MG/KG
COBALT	0.25	15.1	MG/KG
CHROMIUM, TOTAL	0.25	61.7	MG/KG
COPPER	0.25	24.5	MG/KG
IRON	0.25	31500	MG/KG
MERCURY	0.25	0.127	MG/KG
POTASSIUM	0.25	2630	MG/KG
MAGNESIUM	0.25	6410	MG/KG
MANGANESE	0.25	383	MG/KG
MOLYBDENUM	0.25	2.08	MG/KG
SODIUM	0.25	153	MG/KG
NICKEL	0.25	26.7	MG/KG
LEAD	0.25	142	MG/KG
ANTIMONY	0.25	3.54	MG/KG
TIN	0.25	6.34	MG/KG
THALLIUM	0.25	0.731	MG/KG
VANADIUM	0.25	65.6	MG/KG
ZINC	0.25	88.3	MG/KG

L002SC006

Analyte	Depth	Value	Units
ALUMINUM	0.25	15200	MG/KG
ARSENIC	0.25	9.52	MG/KG
BARIUM	0.25	159	MG/KG
BERYLLIUM	0.25	0.737	MG/KG
CALCIUM	0.25	8180	MG/KG
CADMIUM	0.25	0.714	MG/KG
COBALT	0.25	8.3	MG/KG
CHROMIUM, TOTAL	0.25	40.5	MG/KG
COPPER	0.25	94.6	MG/KG
IRON	0.25	26900	MG/KG
MERCURY	0.25	0.324	MG/KG
POTASSIUM	0.25	2970	MG/KG
MAGNESIUM	0.25	4360	MG/KG
MANGANESE	0.25	441	MG/KG
MOLYBDENUM	0.25	1.3	MG/KG
SODIUM	0.25	104	MG/KG
NICKEL	0.25	20.2	MG/KG
LEAD	0.25	225	MG/KG
ANTIMONY	0.25	5.2	MG/KG
TIN	0.25	18.8	MG/KG
THALLIUM	0.25	0.678	MG/KG
VANADIUM	0.25	55.9	MG/KG
ZINC	0.25	138	MG/KG

L002TP005

Analyte	Depth	Value	Units
ALUMINUM	8	13200	MG/KG
ARSENIC	8	4.03	MG/KG
BARIUM	8	87.1	MG/KG
BERYLLIUM	8	0.418	MG/KG
CALCIUM	8	2730	MG/KG
COBALT	8	6.23	MG/KG
CHROMIUM, TOTAL	8	30.9	MG/KG
COPPER	8	12.4	MG/KG
IRON	8	21700	MG/KG
MERCURY	8	0.386	MG/KG
POTASSIUM	8	1250	MG/KG
MAGNESIUM	8	5440	MG/KG
MANGANESE	8	219	MG/KG
SODIUM	8	303	MG/KG
NICKEL	8	13.8	MG/KG
LEAD	8	45.5	MG/KG
SELENIUM	8	0.161	MG/KG
TIN	8	6.98	MG/KG
VANADIUM	8	54.1	MG/KG
ZINC	8	44.3	MG/KG

L002SC007

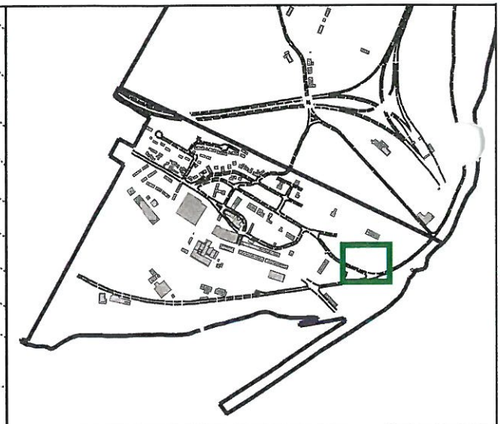
Analyte	Depth	Value	Units
ALUMINUM	0.25	19600	MG/KG
ARSENIC	0.25	10.3	MG/KG
BARIUM	0.25	104	MG/KG
BERYLLIUM	0.25	0.742	MG/KG
CALCIUM	0.25	4880	MG/KG
CADMIUM	0.25	0.557	MG/KG
COBALT	0.25	8.31	MG/KG
CHROMIUM, TOTAL	0.25	46.2	MG/KG
COPPER	0.25	29.2	MG/KG
IRON	0.25	29700	MG/KG
MERCURY	0.25	0.106	MG/KG
POTASSIUM	0.25	2740	MG/KG
MAGNESIUM	0.25	5160	MG/KG
MANGANESE	0.25	444	MG/KG
MOLYBDENUM	0.25	1.59	MG/KG
SODIUM	0.25	100	MG/KG
NICKEL	0.25	18.9	MG/KG
LEAD	0.25	109	MG/KG
ANTIMONY	0.25	3.82	MG/KG
SELENIUM	0.25	0.787	MG/KG
TIN	0.25	15.4	MG/KG
THALLIUM	0.25	0.787	MG/KG
VANADIUM	0.25	65.9	MG/KG
ZINC	0.25	106	MG/KG

L002SC008

Analyte	Depth	Value	Units
ALUMINUM	0.25	17700	MG/KG
ARSENIC	0.25	10.9	MG/KG
BARIUM	0.25	87.1	MG/KG
BERYLLIUM	0.25	0.602	MG/KG
CALCIUM	0.25	3920	MG/KG
CADMIUM	0.25	1.25	MG/KG
COBALT	0.25	7.63	MG/KG
CHROMIUM, TOTAL	0.25	47.7	MG/KG
COPPER	0.25	38.3	MG/KG
IRON	0.25	28000	MG/KG
MERCURY	0.25	0.109	MG/KG
POTASSIUM	0.25	1990	MG/KG
MAGNESIUM	0.25	6070	MG/KG
MANGANESE	0.25	381	MG/KG
MOLYBDENUM	0.25	1.57	MG/KG
SODIUM	0.25	142	MG/KG
NICKEL	0.25	21.8	MG/KG
LEAD	0.25	190	MG/KG
ANTIMONY	0.25	8.19	MG/KG
TIN	0.25	4.9	MG/KG
THALLIUM	0.25	0.81	MG/KG
VANADIUM	0.25	61.6	MG/KG
ZINC	0.25	170	MG/KG

L002SC004

Analyte	Depth	Value	Units
ALUMINUM	0.25	15500	MG/KG
ARSENIC	0.25	10.4	MG/KG
BARIUM	0.25	96.2	MG/KG
BERYLLIUM	0.25	0.646	MG/KG
CALCIUM	0.25	7800	MG/KG
CADMIUM	0.25	0.985	MG/KG
COBALT	0.25	7.22	MG/KG
CHROMIUM, TOTAL	0.25	42.6	MG/KG
COPPER	0.25	30	MG/KG
IRON	0.25	26000	MG/KG
MERCURY	0.25	0.168	MG/KG
POTASSIUM	0.25	3440	MG/KG
MAGNESIUM	0.25	4810	MG/KG
MANGANESE	0.25	321	MG/KG
MOLYBDENUM	0.25	1.4	MG/KG
SODIUM	0.25	101	MG/KG
NICKEL	0.25	19.6	MG/KG
LEAD	0.25	152	MG/KG
ANTIMONY	0.25	4.66	MG/KG
SELENIUM	0.25	0.565	MG/KG
TIN	0.25	5.58	MG/KG
THALLIUM	0.25	0.795	MG/KG
VANADIUM	0.25	59.2	MG/KG
ZINC	0.25	138	MG/KG



LEGEND

- Surface Scrape
- Trenches
- Refuse (ash, slag, pottery, metal, cosmoline)
- Fence
- Roads
- Buildings
- Topographic Contours (Interval = 5 Feet)

NOTE: Only detectable concentrations are shown.

SOIL

GROUNDWATER

N

0 60 Feet

FACILITY

Benicia Arsenal, Benicia, California

TITLE

Fillsite 2 - Soil and Groundwater Results- Metals

FA/BC FORSGREN ASSOCIATES / BROWN and CALDWELL A Joint Venture

PROJECT 00736

DATE 6/17/03

FIGURE 6-10

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Lead was detected in soil samples collected during a previous investigation by HLA at concentrations up to 1,500 mg/kg at 1.0 foot bgs in the northwest section of Fillsite 2, north of Adams Street (HLA, 1988) (Figure 1-3). During FA/BC's investigation, a surface soil sample (L002SC009) was collected at that approximate location to confirm HLA's result. As shown in Table 6-8, FA/BCs single sample reported 9.92 mg/kg of lead. The variable results may suggest sporadic occurrence of lead in the area.

The only pesticide detected in surface soil samples collected was dichlorodiphenyltrichloroethane (DDT) ranging from 0.007 mg/kg to 0.026 mg/kg. These low DDT concentrations are consistent with the normal application of this product for pest control.

Subsurface Soil

Subsurface soil samples collected from trenches L002TP001 and L002TP005, located south of Adams Street where refuse was found, reported the only diesel fuel and motor oil concentrations at Fillsite 2 (Table 6-9). These samples were collected at 8 and 8.5 feet bgs. Surface soil samples collected within ten feet of those trenches did not report diesel fuel or motor oil above laboratory MDLs. Sample L002TP005, was collected at 8 feet bgs, approximately 1 foot below the depth where Cosmoline was encountered.

Table 6-9. Fillsite 2 Diesel Fuel and Motor Oil Concentrations in Soil

Sample Location	Sample Depth (feet bgs)	Diesel Fuel Concentration (mg/kg)	Motor Oil Concentration (mg/kg)
L002TP001	8.5	7	32
L002TP005	8	9.4	21

Soil samples collected from L002TP001 and L002TR003 also detected several different types of pesticides at low or trace concentrations (see Hits Reports). The highest concentration detected was DDT at 0.042 mg/kg in L002TP001 at a depth of 8.5 feet bgs. The samples that detected pesticides were all collected in the fill material and were likely brought to Fillsite 2 from another location.

Groundwater

Grab groundwater samples were collected from trenches L002TR003 and L002TR005. Methylene chloride was reported in L002TR005 and L002TR003 at concentrations of 14 and 12 µg/L, respectively. Motor oil was also detected in a grab groundwater sample collected from L002TR003 at a concentration of 77 µg/L. Metal and concrete debris were encountered in trench L002TR003, the motor oil range organics and methylene chloride could be associated with this refuse. The area is unpaved and has been used as storage and to park vehicles.

6.1.3 Quarry 1

FA/BC oversaw the excavation of five trenches, which encompass the entire area of Quarry 1. Table 6-10 lists the results from the trenching at Quarry 1. The trenches and test pit locations are shown on Figure 3-3.

Construction debris such as bricks and small sections of pipe were observed in Q001TR002. There was no visual evidence of staining or discoloration, or elevated PID readings that would indicate an impact to soil or groundwater at this location. No refuse was encountered.

Table 6-10. Quarry 1 Trenching Results (see Figure 3-3)

Trench Name	Location	Objective	Trenching Results
Q001TR001	Positioned on the south side of the quarry floor.	To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of sandy silt encountered to a depth of 3 to 5 feet bgs. Sandstone at bottom of trench. No refuse found. Total depth of trench = 5 feet.
Q001TR002	Positioned in the southwest corner of the quarry floor.	To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of sandy silt encountered to a depth of 3 feet bgs. Sandstone at bottom of trench. Pieces of brick and a metal pipe found at 2 to 3 feet bgs. No refuse found. Total depth of trench = 3 feet.
Q001TR003	Positioned on the west side of the quarry.	To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of sandy silt encountered to a depth of 4.5 feet bgs. Sandstone at bottom of trench. No refuse found. Total depth of trench = 4.5 feet.
Q001TR004	Positioned on the east side of the quarry.	To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of sandy silt encountered to a depth of 4.5 feet bgs. Sandstone at bottom of trench. No refuse found. Total depth of trench = 4.5 feet.
Q001TR005	Positioned on the east side of the quarry entrance.	To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of sandy silt encountered to a depth of 4 feet bgs. Sandstone at bottom of trench. No refuse found. Total depth of trench = 4 feet.

Construction debris found.

Analytical Results

Five trenches were advanced at Quarry 1. Six surface soil samples and one deep soil sample were collected at Quarry 1. Analytical results are shown on Figures 6-11 and 6-12.

Surface Soil

Low concentrations of acetone and bis(2-ethylhexyl) phthalate were detected in most samples collected. Bis(2-ethylhexyl) phthalate and acetone are common laboratory contaminants which are the likely source of the low detections in the samples collected. Bis(2-ethylhexyl) phthalate is also used ubiquitously in plastic materials and is often detected where surface water collects.

BUILDING 9

BUILDING 10

120
115
110
105
105
115
120
130
135
140
145

Q001SC005

Analyte	Depth	Value	Units
ACETONE	0.5	0.11	MG/KG
P-CYMENE (p-ISOPROPYLTOLUENE)	0.5	0.021	MG/KG
TRICHLOROFLUOROMETHANE	0.5	0.0045	MG/KG
bis(2-ETHYLHEXYL) PHTHALATE	0.5	0.055	MG/KG

Q001SC006

Analyte	Depth	Value	Units
ACETONE	0.5	0.12	MG/KG
TRICHLOROFLUOROMETHANE	0.5	0.0032	MG/KG
BENZO(e)ANTHRACENE	0.5	0.0012	MG/KG
BENZO(e)PYRENE	0.5	0.0024	MG/KG
CHRYSENE	0.5	0.0037	MG/KG
bis(2-ETHYLHEXYL) PHTHALATE	0.5	0.084	MG/KG

Q001SC003

Analyte	Depth	Value	Units
ACETONE	0.5	0.16	MG/KG
TRICHLOROFLUOROMETHANE	0.5	0.0064	MG/KG
bis(2-ETHYLHEXYL) PHTHALATE	0.5	0.054	MG/KG

Q001SC001

Analyte	Depth	Value	Units
ACETONE	0.5	0.1	MG/KG
BENZO(e)PYRENE	0.5	0.0015	MG/KG
CHRYSENE	0.5	0.0018	MG/KG
bis(2-ETHYLHEXYL) PHTHALATE	0.5	0.06	MG/KG

Q001TR002

Analyte	Depth	Value	Units
ACETONE	3	0.05	MG/KG

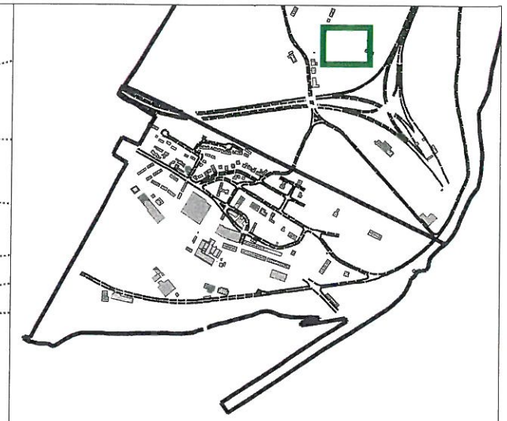
Q001TR003
Q001TR005
Q001TR004
Q001TR001

Q001SC002

Analyte	Depth	Value	Units
ACETONE	0.5	0.096	MG/KG
TRICHLOROFLUOROMETHANE	0.5	0.0039	MG/KG

Q001SC004

Analyte	Depth	Value	Units
ACETONE	0.5	0.2	MG/KG
METHYL ETHYL KETONE	0.5	0.019	MG/KG
TRICHLOROFLUOROMETHANE	0.5	0.013	MG/KG
BENZO(a)ANTHRACENE	0.5	0.00083	MG/KG
BENZO(e)PYRENE	0.5	0.0027	MG/KG
CHRYSENE	0.5	0.0039	MG/KG
bis(2-ETHYLHEXYL) PHTHALATE	0.5	0.1	MG/KG



LEGEND

- Surface Scrape
- Trenches
- Fence
- Roads
- Buildings
- Topographic Contours (Interval = 5 Feet)

NOTE: Only detectable concentrations are shown.

SOIL

GROUNDWATER

N

0 60 Feet

FACILITY

Benicia Arsenal, Benicia, California

TITLE

Quarry 1 - Soil Results-
TPH, VOCs, PAHs, and SVOCs

FORSGREN ASSOCIATES / BROWN and CALDWELL
A Joint Venture

PROJECT 00736

DATE 12/2003

FIGURE 6-11

S:\Benicia_if\apr\figure1_lf2.apr

BUILDING 9

BUILDING 10

Q001SC005

Analyte	Depth	Value	Units
ALUMINUM	0.5	24400	MG/KG
ANTIMONY	0.5	2.91	MG/KG
ARSENIC	0.5	7.62	MG/KG
BARIUM	0.5	237	MG/KG
BERYLLIUM	0.5	0.474	MG/KG
CADMIUM	0.5	0.29	MG/KG
CALCIUM	0.5	4060	MG/KG
CHROMIUM, TOTAL	0.5	40.9	MG/KG
COBALT	0.5	13.6	MG/KG
COPPER	0.5	33.9	MG/KG
IRON	0.5	26200	MG/KG
LEAD	0.5	19	MG/KG
MAGNESIUM	0.5	4830	MG/KG
MANGANESE	0.5	609	MG/KG
MERCURY	0.5	0.0506	MG/KG
NICKEL	0.5	27.9	MG/KG
POTASSIUM	0.5	1710	MG/KG
SODIUM	0.5	231	MG/KG
THALLIUM	0.5	0.346	MG/KG
VANADIUM	0.5	67.8	MG/KG
ZINC	0.5	51.3	MG/KG

Q001SC003

Analyte	Depth	Value	Units
ALUMINUM	0.5	31300	MG/KG
ANTIMONY	0.5	3.45	MG/KG
ARSENIC	0.5	7	MG/KG
BARIUM	0.5	274	MG/KG
BERYLLIUM	0.5	0.572	MG/KG
CADMIUM	0.5	0.343	MG/KG
CALCIUM	0.5	4830	MG/KG
CHROMIUM, TOTAL	0.5	50.5	MG/KG
COBALT	0.5	11.3	MG/KG
COPPER	0.5	44.8	MG/KG
IRON	0.5	32200	MG/KG
LEAD	0.5	22.6	MG/KG
MAGNESIUM	0.5	6250	MG/KG
MANGANESE	0.5	488	MG/KG
MERCURY	0.5	0.0701	MG/KG
NICKEL	0.5	33.1	MG/KG
POTASSIUM	0.5	2670	MG/KG
SODIUM	0.5	139	MG/KG
THALLIUM	0.5	0.292	MG/KG
VANADIUM	0.5	82	MG/KG
ZINC	0.5	66.3	MG/KG

Q001SC006

Analyte	Depth	Value	Units
ALUMINUM	0.5	27800	MG/KG
ANTIMONY	0.5	2.33	MG/KG
ARSENIC	0.5	6.39	MG/KG
BARIUM	0.5	265	MG/KG
BERYLLIUM	0.5	0.537	MG/KG
CADMIUM	0.5	0.248	MG/KG
CALCIUM	0.5	4850	MG/KG
CHROMIUM, TOTAL	0.5	47.4	MG/KG
COBALT	0.5	15.2	MG/KG
COPPER	0.5	38.8	MG/KG
IRON	0.5	30600	MG/KG
LEAD	0.5	18.3	MG/KG
MAGNESIUM	0.5	5780	MG/KG
MANGANESE	0.5	639	MG/KG
MERCURY	0.5	0.0372	MG/KG
NICKEL	0.5	32.6	MG/KG
POTASSIUM	0.5	1580	MG/KG
SODIUM	0.5	453	MG/KG
THALLIUM	0.5	0.365	MG/KG
VANADIUM	0.5	76.4	MG/KG
ZINC	0.5	58.3	MG/KG

Q001SC001

Analyte	Depth	Value	Units
ALUMINUM	0.5	30800	MG/KG
ANTIMONY	0.5	2.75	MG/KG
ARSENIC	0.5	9.12	MG/KG
BARIUM	0.5	255	MG/KG
BERYLLIUM	0.5	0.609	MG/KG
CADMIUM	0.5	0.427	MG/KG
CALCIUM	0.5	5600	MG/KG
CHROMIUM, TOTAL	0.5	49.3	MG/KG
COBALT	0.5	7.61	MG/KG
COPPER	0.5	44	MG/KG
IRON	0.5	31400	MG/KG
LEAD	0.5	25.9	MG/KG
MAGNESIUM	0.5	6130	MG/KG
MANGANESE	0.5	328	MG/KG
MERCURY	0.5	0.0832	MG/KG
NICKEL	0.5	31	MG/KG
POTASSIUM	0.5	1860	MG/KG
SELENIUM	0.5	0.143	MG/KG
SODIUM	0.5	159	MG/KG
THALLIUM	0.5	0.363	MG/KG
VANADIUM	0.5	79.8	MG/KG
ZINC	0.5	67.7	MG/KG

Q001TR002

Analyte	Depth	Value	Units
ALUMINUM	3	29300	MG/KG
ARSENIC	3	6.76	MG/KG
BARIUM	3	335	MG/KG
BERYLLIUM	3	0.555	MG/KG
CALCIUM	3	4600	MG/KG
CADMIUM	3	0.168	MG/KG
COBALT	3	26.5	MG/KG
CHROMIUM, TOTAL	3	52	MG/KG
COPPER	3	38.9	MG/KG
IRON	3	31400	MG/KG
MERCURY	3	0.0294	MG/KG
POTASSIUM	3	1350	MG/KG
MAGNESIUM	3	5840	MG/KG
MANGANESE	3	1500	MG/KG
SODIUM	3	161	MG/KG
NICKEL	3	42.3	MG/KG
LEAD	3	18.4	MG/KG
ANTIMONY	3	3.45	MG/KG
THALLIUM	3	0.718	MG/KG
VANADIUM	3	81	MG/KG
ZINC	3	56.8	MG/KG

Q001SC004

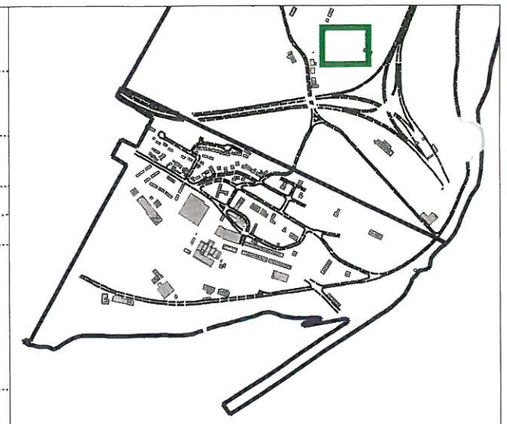
Analyte	Depth	Value	Units
ALUMINUM	0.5	25600	MG/KG
ARSENIC	0.5	6.1	MG/KG
BARIUM	0.5	307	MG/KG
BERYLLIUM	0.5	0.518	MG/KG
CADMIUM	0.5	0.367	MG/KG
CALCIUM	0.5	4490	MG/KG
CHROMIUM, TOTAL	0.5	43.8	MG/KG
COBALT	0.5	15	MG/KG
COPPER	0.5	39	MG/KG
IRON	0.5	28600	MG/KG
LEAD	0.5	35.2	MG/KG
MAGNESIUM	0.5	5450	MG/KG
MANGANESE	0.5	682	MG/KG
MERCURY	0.5	0.0611	MG/KG
NICKEL	0.5	30.8	MG/KG
POTASSIUM	0.5	2570	MG/KG
SODIUM	0.5	97.4	MG/KG
THALLIUM	0.5	0.323	MG/KG
VANADIUM	0.5	72.5	MG/KG
ZINC	0.5	64.6	MG/KG

Q001SC002

Analyte	Depth	Value	Units
ALUMINUM	0.5	31000	MG/KG
ANTIMONY	0.5	3.36	MG/KG
ARSENIC	0.5	7.98	MG/KG
BARIUM	0.5	497	MG/KG
BERYLLIUM	0.5	0.655	MG/KG
CADMIUM	0.5	0.315	MG/KG
CALCIUM	0.5	5080	MG/KG
CHROMIUM, TOTAL	0.5	52.7	MG/KG
COBALT	0.5	38.9	MG/KG
COPPER	0.5	44.8	MG/KG
IRON	0.5	39500	MG/KG
LEAD	0.5	23.3	MG/KG
MAGNESIUM	0.5	6740	MG/KG
MANGANESE	0.5	1600	MG/KG
MERCURY	0.5	0.0391	MG/KG
NICKEL	0.5	49.1	MG/KG
POTASSIUM	0.5	2150	MG/KG
SELENIUM	0.5	0.109	MG/KG
SODIUM	0.5	138	MG/KG
THALLIUM	0.5	0.421	MG/KG
VANADIUM	0.5	85.6	MG/KG
ZINC	0.5	66	MG/KG

Q001TR003
Q001TR005
Q001TR002
Q001TR004
Q001TR001

120
115
110
105
105
115
120
130
135
140
145



LEGEND

- Surface Scrape
- Trenches
- Fence
- Roads
- Buildings
- Topographic Contours (Interval = 5 Feet)

NOTE: Only detectable concentrations are shown.

SOIL

GROUNDWATER

N

0 60 Feet

FACILITY
Benicia Arsenal, Benicia, California

TITLE
Quarry 1 - Soil Results- Metals

FORSGREN ASSOCIATES / BROWN and CALDWELL
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PROJECT 00736

DATE 12/2003

FIGURE 6-12

S:\Benicia_ifap\fig\figure1_lf2.apr

Trichlorofluoromethane was detected in five of the six surface soil samples collected at concentrations up to 0.0032 mg/kg.

Only one sample collected detected pesticides at a concentration above trace levels. The sample detected Beta BHC at a concentration of 0.01 mg/kg from Q001SC004. Pesticides detected at Quarry 1 appear to be limited to the surface soil and may be the result of products used for pest control.

Diesel fuel and motor oil were not detected in any soil samples collected in this area.

Subsurface Soil

One subsurface soil sample was collected from Q001TR002, where construction debris was found. Acetone was the only analyte reported above laboratory method detection limits at a concentration of 0.05 mg/kg at a depth of 3 feet bgs.

Groundwater

Groundwater was not encountered in any trenches.

6.1.4 Quarry 3

Five trenches were excavated in areas where geophysical anomalies were identified (see Section 3.0). Table 6-11 summarizes the results from the trenching. The trench locations are shown on Figure 3-4.

Table 6-11. Quarry 3 Trenching Results (see Figure 3-4)

Trench Name	Location	Objective	Trenching Results
Q003TR001		To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of silty sand and pieces of sandstone encountered to a depth from 9 to 10 feet bgs. Pieces of concrete and asphalt from surface to 2 feet bgs. Sandstone at bottom of trench. No refuse found. Total depth of trench = 10 feet.
Q003TR002		To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of silty sand encountered to a depth of 8 feet bgs. Pieces of concrete, PVC pipe and a metal pipe from surface to 3.5 feet bgs. Sandstone at bottom of trench. No refuse found. Total depth of trench = 8 feet.

Table 6-11. Quarry 3 Trenching Results (see Figure 3-4) (continued)

Trench Name	Location	Objective	Trenching Results
Q003TR003		To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of silty sand encountered to a depth from 3 to 6 feet bgs. Pieces of concrete, brick and asphalt from surface from 3 to 6 feet bgs. Sandstone at bottom of trench. No refuse found. Total depth of trench = 6 feet.
Q003TR004		To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of silty sand encountered to a depth from 4 to 5 feet bgs. Sloped asphalt layer at 2 to 4 feet bgs. Sandstone at bottom of trench. No refuse found. Total depth of trench = 5 feet.
Q003TR005		To assess the presence or absence of refuse/fill material. To determine the boundary of the refuse/fill material.	Fill comprised of silty sand encountered to a depth of 8 feet bgs. Pieces of concrete, chain link fence, a metal pipe and plastic from 3 to 5 feet bgs. Sandstone at bottom of trench. No refuse found. Total depth of trench = 8 feet.

Construction debris found.

The fill material encountered was comprised of silty sand overlying sandstone at a depth from 3 to 10 feet bgs. The fill material also contained debris ranging from plastic, PVC pipe, asphalt and concrete. It appeared that some of the fill was slough from the adjacent hillside from recent dumping.

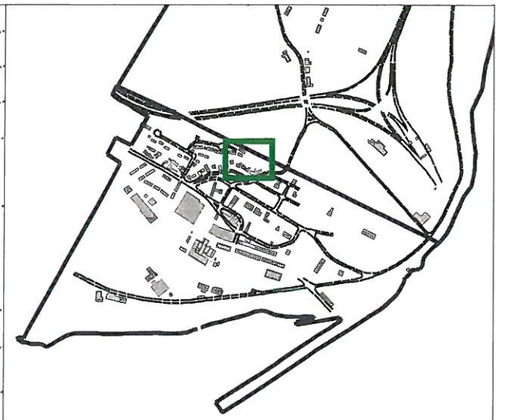
Construction debris such as bricks, plastic debris, rolled chain link fence, asphalt and concrete pieces were identified. No refuse or native soil was encountered. There was no visual evidence of staining or discoloration, or elevated PID readings that would indicate an impact to soil or groundwater at this location. However, there were an abundance of eucalyptus tree roots encountered, which could affect organic concentrations.

Analytical Results

Five trenches were advanced at Quarry 3. Seven surface soil samples and three deep soil sample were collected. Analytical results are shown on Figures 6-13 and 6-14.

Surface Soil

Two SVOCs were reported in surface soil samples, bis(2-ethyhexyl) phthalate and 4-methylphenol (Figure 6-13).



Q003TR005

Analyte	Depth	Value	Units
DIESEL (C10-C24)	4	830	MG/KG
MOTOR OIL (C20-C36)	4	1100	MG/KG
EUCALYPTOL (LIMONENE OXIDE)	4	0.016	MG/KG
BENZENE	4	0.00086	MG/KG
TOLUENE	4	0.00081	MG/KG
BENZO(a)PYRENE	4	0.0088	MG/KG
BENZO(b)FLUORANTHENE	4	0.0083	MG/KG
BENZO(k)FLUORANTHENE	4	0.0057	MG/KG
2-METHYL-5-91-METHYLETHYL) BICYCLO[3.1.0]HEX-2-ENE	4	7.5	MG/KG
1H-CYCLOPROPA[A]NAPHTHALENE, 1a,2,3,3a,4,5,6,7b-OCTAHYDRO-1,	4	1.4	MG/KG
1,5,5-TRIMETHYL-6-METHYLENE-CYCLOHEXENE	4	1.5	MG/KG
N-HEXACOSANE (C26)	4	1.2	MG/KG
N-NONACOSANE (C29)	4	1	MG/KG
TRIDECANOIC ACID	4	1.3	MG/KG
1H-CYCLOPROP[e]AZULENE, DECAHYDRO-1,1,7-TRIMETHYL-4	4	3.7	MG/KG
p-CYMENE	4	1.2	MG/KG
4-METHYLPHENOL (p-CRESOL)	4	0.12	MG/KG

Q003SC001

Analyte	Depth	Value	Units
DIESEL (C10-C24)	0	18	MG/KG
MOTOR OIL (C20-C36)	0	27	MG/KG

Q003TR001

Analyte	Depth	Value	Units
DIESEL (C10-C24)	8	2.6	MG/KG

Q003SC007

Analyte	Depth	Value	Units
DIESEL (C10-C24)	0	260	MG/KG
MOTOR OIL (C20-C36)	0	150	MG/KG
4-METHYLPHENOL	0	0.14	MG/KG

Q003SC002

Analyte	Depth	Value	Units
DIESEL (C10-C24)	0	17	MG/KG
MOTOR OIL (C20-C36)	0	25	MG/KG

Q003SC003

Analyte	Depth	Value	Units
DIESEL (C10-C24)	0	99	MG/KG
MOTOR OIL (C20-C36)	0	71	MG/KG

Q003SC006

Analyte	Depth	Value	Units
DIESEL (C10-C24)	0	120	MG/KG
MOTOR OIL (C20-C36)	0	160	MG/KG
bis(2-ETHYLHEXYL) PHTHALATE	0	0.33	MG/KG

Q003SC004

Analyte	Depth	Value	Units
DIESEL (C10-C24)	0	8.3	MG/KG
MOTOR OIL (C20-C36)	0	27	MG/KG

Q003TR002

Analyte	Depth	Value	Units
DIESEL (C10-C24)	4.5	6.4	MG/KG
MOTOR OIL (C20-C36)	4.5	13	MG/KG
ACETONE	4.5	0.023	MG/KG
TOLUENE	4.5	0.00053	MG/KG
2-METHYL-5-91-METHYLETHYL) BICYCLO[3.1.0]HEX-2-ENE	4.5	0.66	MG/KG
.GAMMA.ELEMENE	4.5	0.36	MG/KG
1H-CYCLOPROPA[A]NAPHTHALENE, 1a,2,3,3a,4,5,6,7b-OCTAHYDRO-1,	4.5	0.17	MG/KG
PARA RED DYE	4.5	0.25	MG/KG
1H-CYCLOPROP[e]AZULENE, DECAHYDRO-1,1,7-TRIMETHYL-4	4.5	0.84	MG/KG
4-AMINO-3-NITROTOLUENE (FAST RED DYE BASE)	4.5	0.2	MG/KG

Q003SC005

Analyte	Depth	Value	Units
DIESEL (C10-C24)	0	150	MG/KG
MOTOR OIL (C20-C36)	0	110	MG/KG

Q003TR004
Q003SC008
Q003TR003

155
145
140
130
120
95

BUILDING 106
Jefferson Street
Park Road
Park Road

LEGEND

- Surface Scrape
- Trenches
- Fence
- Roads
- Buildings
- Topographic Contours (Interval = 5 Feet)

NOTE: Only detectable concentrations are shown.

SOIL

GROUNDWATER

N

0 60 Feet

FACILITY
Benicia Arsenal, Benicia, California

TITLE
Quarry 3 - Soil Results-
TPH, VOCs, PAHs, and SVOCs

FORSGREN ASSOCIATES / BROWN and CALDWELL
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FIGURE 6-13

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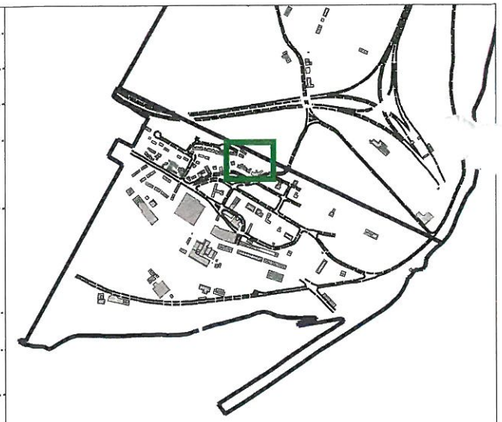

LEGEND

- Surface Scrape
- Trenches
- Fence
- Roads
- Buildings
- Topographic Contours (Interval = 5 Feet)

NOTE: Only detectable concentrations are shown.

SOIL

GROUNDWATER

N

0 60 Feet

Q003TR005

Analyte	Depth	Value	Units
ALUMINUM	4	17600	MG/KG
ARSENIC	4	7.33	MG/KG
BARIUM	4	116	MG/KG
BERYLLIUM	4	0.663	MG/KG
CALCIUM	4	18300	MG/KG
CADMIUM	4	0.529	MG/KG
COBALT	4	8.08	MG/KG
CHROMIUM, TOTAL	4	38.1	MG/KG
COPPER	4	10.5	MG/KG
IRON	4	27500	MG/KG
MERCURY	4	0.177	MG/KG
POTASSIUM	4	2580	MG/KG
MAGNESIUM	4	5640	MG/KG
MANGANESE	4	702	MG/KG
MOLYBDENUM	4	2.54	MG/KG
SODIUM	4	409	MG/KG
NICKEL	4	18.2	MG/KG
LEAD	4	29.1	MG/KG
SELENIUM	4	0.35	MG/KG
TIN	4	10.5	MG/KG
THALLIUM	4	0.436	MG/KG
VANADIUM	4	58.2	MG/KG
ZINC	4	81.6	MG/KG

Q003TR001

Analyte	Depth	Value	Units
ALUMINUM	8	18000	MG/KG
ARSENIC	8	39.1	MG/KG
BARIUM	8	158	MG/KG
BERYLLIUM	8	0.933	MG/KG
CALCIUM	8	1740	MG/KG
CADMIUM	8	1.85	MG/KG
COBALT	8	5.47	MG/KG
CHROMIUM, TOTAL	8	112	MG/KG
COPPER	8	8.3	MG/KG
IRON	8	65800	MG/KG
MERCURY	8	0.089	MG/KG
POTASSIUM	8	4470	MG/KG
MAGNESIUM	8	5350	MG/KG
MANGANESE	8	123	MG/KG
MOLYBDENUM	8	2	MG/KG
SODIUM	8	262	MG/KG
NICKEL	8	25.2	MG/KG
LEAD	8	24.5	MG/KG
ANTIMONY	8	5.54	MG/KG
SELENIUM	8	0.586	MG/KG
THALLIUM	8	0.139	MG/KG
VANADIUM	8	60.3	MG/KG
ZINC	8	146	MG/KG

Q003TR002

Analyte	Depth	Value	Units
ALUMINUM	4.5	10500	MG/KG
ARSENIC	4.5	20.2	MG/KG
BARIUM	4.5	85.7	MG/KG
BERYLLIUM	4.5	0.544	MG/KG
CALCIUM	4.5	2830	MG/KG
CADMIUM	4.5	0.81	MG/KG
COBALT	4.5	5.44	MG/KG
CHROMIUM, TOTAL	4.5	41.6	MG/KG
COPPER	4.5	11.2	MG/KG
IRON	4.5	28800	MG/KG
MERCURY	4.5	0.065	MG/KG
POTASSIUM	4.5	2090	MG/KG
MAGNESIUM	4.5	3790	MG/KG
MANGANESE	4.5	185	MG/KG
MOLYBDENUM	4.5	1.79	MG/KG
SODIUM	4.5	341	MG/KG
NICKEL	4.5	13.5	MG/KG
LEAD	4.5	62.9	MG/KG
SELENIUM	4.5	0.403	MG/KG
TIN	4.5	3.84	MG/KG
THALLIUM	4.5	0.17	MG/KG
VANADIUM	4.5	38.6	MG/KG
ZINC	4.5	98.4	MG/KG

155
145
140
130
120
95
Q003TR004
Q003TR003
BUILDING 106
Jefferson Street
Park Road
Park Road

FACILITY: Benicia Arsenal, Benicia, Californi

TITLE: Quarry 3 - Soil Results- Metals

FORSGREN ASSOCIATES / BROWN and CALDWELL A Joint Venture

PROJECT 00736

DATE 12/2003

FIGURE 6-14

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Diesel fuel and motor oil range hydrocarbons were reported in every soil sample analyzed. The following table lists the highest concentrations and their locations; Figure 6-13 shows all the concentrations and their locations.

Table 6-12. Quarry 3 Diesel Fuel and Motor Oil Concentrations in Surface Soil

Sample Location	Diesel Fuel Concentration (mg/kg)	Motor Oil Concentration (mg/kg)
Q003SC006	120	160
Q003SC007	260	150

The widespread occurrence of fuels in all surface soil samples indicates a surface impact and likely from recent releases based on recent dumpings.

Subsurface Soil

Three subsurface soil samples were collected and analyzed from trenches Q003TR001, Q003TR002, and Q003TR005. VOCs, SVOCs and fuels were reported above method detection limits in Q003TR001, Q003TR002, and Q003TR005.

Diesel fuel and motor oil range-organics were detected in all three trench soil samples. Table 6-13 lists reported detections of these analytes. Analysis of the samples from this area resulted in the detection of some tentatively identified compounds (TICs) (e.g. eucalyptol [limonene oxide]), which suggests the presence of natural products in the soil from sources such as the eucalyptus trees that are in the vicinity of Quarry 3. This data was evaluated to assess the possible contribution from the natural plant products, in whole or in part, to the TPH detections. However, we could not conclude from the data that there is not petroleum product in soil at Quarry 3. Additionally, the motor oil could also be related to buried asphalt found in the trenches.

Table 6-13. Quarry 3 Diesel Fuel and Motor Oil Concentrations in Soil

Sample Location	Depth (feet bgs)	Diesel Fuel Concentration (mg/kg)	Motor Oil Concentration (mg/kg)	Eucalyptol (limonene oxide) (mg/kg)
Q003TR001	8	2.6	<1.3	NA
Q003TR002	4.5	6.4	13	NA
Q003TR005	4	830	1100	0.016

NA – not analyzed

Soil samples collected from Q003TR002 reported a lead concentration of 62.9 mg/kg at 4.5 feet bgs. Metal scrap and debris were observed in the trenches and is the likely source of the lead concentrations.

Soil samples collected from Q003TR001, Q003TR002, and Q003TR005 detected several different types of pesticides at low or trace concentrations (see Hits Reports). Concentrations of pesticides ranged from 0.00061 mg/kg to 0.018 mg/kg. The highest concentration detected was DDT at Q003TR002 at a depth of 4.5 feet bgs. The samples that detected pesticides were all collected in the fill material and were likely brought to the quarry from another location.

Groundwater

Groundwater was not encountered during trenching activities.

7.0 HUMAN HEALTH RISK SCREENING

This section summarizes the approach and results of the Human Health Risk Screening (HHRS) to determine the COPC to human health for the fillsites and quarries investigation. COPCs are chemicals found during the HHRS to be present at maximum concentrations above health-based screening levels called Benicia Screening Levels (BSLs) (FA/BC, 2003b). The COPCs will then be the focus of additional investigation and future risk assessments. This section includes: a site description; an explanation of BSL values used; exposure scenarios; a brief description of how ambient metal concentrations were calculated; and screening evaluation results.

7.1 Site Description

The trenching and analytical results from the sampling (included in Section 6.0) indicates that the refuse south of Adams Street is the only site investigated that requires an HHRS for chemicals in soil. The other investigated areas indicate impacted groundwater (Fillsite 1) and contaminants in soil due to non-DoD activity (dumping) (Fillsite 2 [north of Adams Street], Quarry 1 and Quarry 3). Therefore an HHRS has only been prepared for Fillsite 2.

Refuse including burnt ash, broken pottery, slag, and Cosmoline were uncovered at the Fillsite 2 refuse area. Only a portion of the refuse was uncovered and any other types of materials disposed of in this area are not known. Refer to Section 2.0 for a detailed discussion of information on source areas and identification of chemicals of interest.

The refuse area at Fillsite 2 is located in portions of the Arsenal that predominantly support commercial/industrial uses, although the former Arsenal and surrounding areas also currently support residential and park/open space uses. Fillsite 2 is unpaved and has been used as storage and to park vehicles. The area where the refuse was encountered is just south of Adams Street (Figure 6-9) and is in an open area.

7.2 Overview of Updated BSLs

This section summarizes the methodology and assumptions used to develop the BSLs. BSLs are concentrations of chemicals that are unlikely to pose a significant risk of adverse health effects over a lifetime of exposure. COIs were identified in the Soil Assessment Criteria document and essential nutrients (magnesium, calcium, potassium, and sodium) were excluded (FA/BC, 2002b). The BSLs used in this HHRS are presented in Table 7-1. The following gives information on how these BSLs were calculated and what they represent.

Table 7-1. Fillsite 2 Refuse Area - Chemical of Potential Concern Selection Summary – Soil

Chemical of Interest (COI) (1)	COPC/ Status	Maximum Concentration (mg/kg)	Benicia Screening Levels (BSLs) (9)				
			Ambient Threshold (2) (Metals Only) (mg/kg)	Residents		Commercial/Industrial	
				Soil BSL (3) (mg/kg)	ca/nc	Soil PRG (mg/kg)	ca/nc
2-Hexanone (4) n-hexane		0.019					
Acetone		0.260		1.57E+03	nc	6.04E+03	nc
Aldrin		0.0016		0.029	ca	0.101	ca
Aluminum		19,600	26,300	76,142	nc	100,000	max
Antimony and compounds		12.9	8.5	31	nc	409	nc
Arsenic		10.9	16.9	0.390	ca	1.590	ca
Barium and compounds		189	224	5,375	nc	66,577	nc
Benz[a]anthracene		0.063		0.621	ca	2.11	ca
Benzene		0.0007		0.601	ca	1.315	ca
Benzo(g,h,i)perylene (5) pyrene		0.055		2,300	nc	29,000	nc
Benzo[a]pyrene	COPC	0.220		0.062	ca	0.211	ca
Benzo[b]fluoranthene		0.400		0.621	ca	2.11	ca
Benzo[k]fluoranthene		0.060		6.215	ca	21	ca
Beryllium and compounds		0.767	0.829	154	nc	1941 (8)	ca
Cadmium and compounds		1.250	0.866	37	nc	451 (8)	nc
Camphene		0.019		na	na	na	na
Chlordane		0.00055		1.624	ca	6.468	ca
Chromium, Total		62	75.3	210	ca	450 (8)	ca
Chrysene		0.140		62.146	ca	211	ca
Cobalt		15.1	13.3	903	ca	1,921	ca
Copper and compounds		94.6	40.5	3,129	nc	40,877	nc
DDD		0.018		2.437	ca	9.951	ca
DDE		0.006		1.720	ca	7.025	ca
DDT		0.042		1.720	ca	7.025	ca
Dieldrin		0.0036		0.030	ca	0.108	ca
Endosulfan		0.0051		367	nc	3,694	nc
Endrin		0.0034		18.331	nc	185	nc
Endrin Aldehyde		0.0019		18.331	nc	185	nc
Fluoranthene		0.540		2,294	nc	22,000	nc
HCH (beta)		0.0029		0.316	ca	1.258	ca
HCH (gamma) Lindane		0.0007		0.437	ca	1.741	ca
Heptachlor Epoxide		0.0004		0.053	ca	0.189	ca
Indeno[1,2,3-cd]pyrene		0.015		0.621	ca	2.110	ca
Iron		52,100	52,600	23,463	nc	100,000	max
Lead	COPC	813	20.1	150	nc	750 (Cal Modified)	nc
Manganese and compounds		444	1,070	1,762	nc	19,458	nc
Mercury (methyl)		0.931	0.287	6.110	nc	61.566	nc
Methoxychlor		0.012		306	nc	3,078	nc
Methyl ethyl ketone		0.021		7,325	nc	27,102	nc
Molybdenum		2.080	2.510	391	nc	5,110	nc
N-Butylalaldehyde		0.011		na	na	na	na
Nickel (soluble salts)		26.7	38.3	1,564	nc	20439	nc
p-Cymene (P-Isopropyltoluene) (6) cumene		0.008		570	nc	2,000	nc
Phenanthrene (10)		0.180		21,896	nc	100000	max
Pyrene		0.390		2,316	nc	29126	nc
Selenium		0.787	0.605	391	nc	5110	nc
Thallium and compounds		0.795	0.850	5.162	nc	67	nc
Tin		1,120	19.0	46,924	nc	100,000	max
Toluene		0.006		520	sat	520	sat
TPH-Diesel Range Organics		9.4		100(7)	nc	500(7)	nc
TPH-Motor Oil Range Organics		32.0		500(7)	nc	1000(7)	nc
Trichlorofluoromethane		0.0017		386	nc	2,000	sat
Vanadium and compounds		65.9	92.2	547	nc	7,154	nc
Zinc		170	126	23,463	nc	100,000	max

Notes and Abbreviations:

(1) COI = all chemicals detected except required nutrients

(2) Forsgren Associates/Brown and Caldwell, 2003a.

(3) U.S. EPA Region IX Preliminary Remediation Goal (PRG) (October 2002) used as BSL except as noted. See note (8)

(4) PRG not available; n-Hexane used as a surrogate

(5) PRG not available; pyrene used as a surrogate

(6) PRG not available; cumene used as a surrogate

(7) ESLs for TPH from RWQCB, 2003.

(8) Construction/Utility Worker BSLs are more stringent and were used

(9) Forsgren Associates/Brown and Caldwell, 2003.

(10) PRG not available; anthracene used as a surrogate

na = PRG not available

nc = PRG based on noncancer effects

ca = PRG based on a cancer end point

max = ceiling limit for PRG

sat = soil saturation

mg/kg = milligrams per kilogram

BSLs were developed in the Soil Assessment Criteria document in 2002 for both cancer and non cancer health effects (FA/BC, 2002b). The target risk level for carcinogenic effects was set at 1×10^{-6}. This value is at the lower end of the target risk range of 1×10^{-4} to 1×10^{-6} used by USEPA and DTSC. For noncarcinogens, a target hazard index was set at one. The assumptions used to calculate BSLs are designed to estimate a reasonable maximum exposure. For example, residents are assumed to ingest soil, inhale soil particles and vapor and contact soil with their skin for 350 days a year for 30 years. BSLs are levels considered safe for over a lifetime. The presence of chemicals at concentrations above BSLs does not indicate a potential health concern, only that further evaluation is warranted.

A conceptual representation of the potentially complete exposure pathways is provided as Figure 7-1. Large "Xs" represent complete pathways, while small "xs" indicate pathways potentially complete. For example, large "Xs" include commercial industrial workers and residents who would be in contact with the soil more often, while small "xs" include construction/utility workers and recreational visitors that are not likely to be exposed as much or as often. Based on land use, receptor, source areas, release mechanisms, and pathway information provided in Section 2.0, the following exposure pathways may be complete for current and future land uses at the refuse area at Fillsite 2:

- Residents: incidental ingestion of soil; dermal contact with soil; and inhalation of dust particles and vapors in outdoor air.
- Commercial/industrial workers: incidental ingestion of soil; dermal contact with soil; and inhalation of dust particles and vapors in outdoor air.
- Construction/utility workers: incidental ingestion of soil; dermal contact with soil; inhalation of vapors released from subsurface soil to indoor spaces; and inhalation of dust particles and vapors in outdoor air.
- Open space visitors: inhalation of dust particles and vapors released to outdoor air.

The BSLs published in the Soil Assessment Criteria document were used for this HHRS to reflect updated toxicity and exposure assumptions used in U.S. EPA Region IX Preliminary Remediation Goals (PRGs) of October 2002. The updated values for residential and industrial workers have been incorporated into this risk screening. The assumptions used in the Soil Assessment Criteria document are the same assumptions used during this risk screening except industrial soil ingestion levels were increased from 50 mg per workday to 100 mg per workday to be consistent with 2002 USEPA PRG guidance.

The updated BSLs for residential and industrial workers, incorporated into this risk screening, are the most protective exposure pathways. The concentrations considered protective of open space visitors and construction/utility worker exposure pathway values are higher than those for the residential and industrial values and therefore have been excluded. Three exceptions where construction/utility workers BSLs were more protective (lower concentrations) than industrial workers were beryllium, cadmium and total chromium. The more protective values of beryllium, cadmium and total chromium were used in this HHRS.

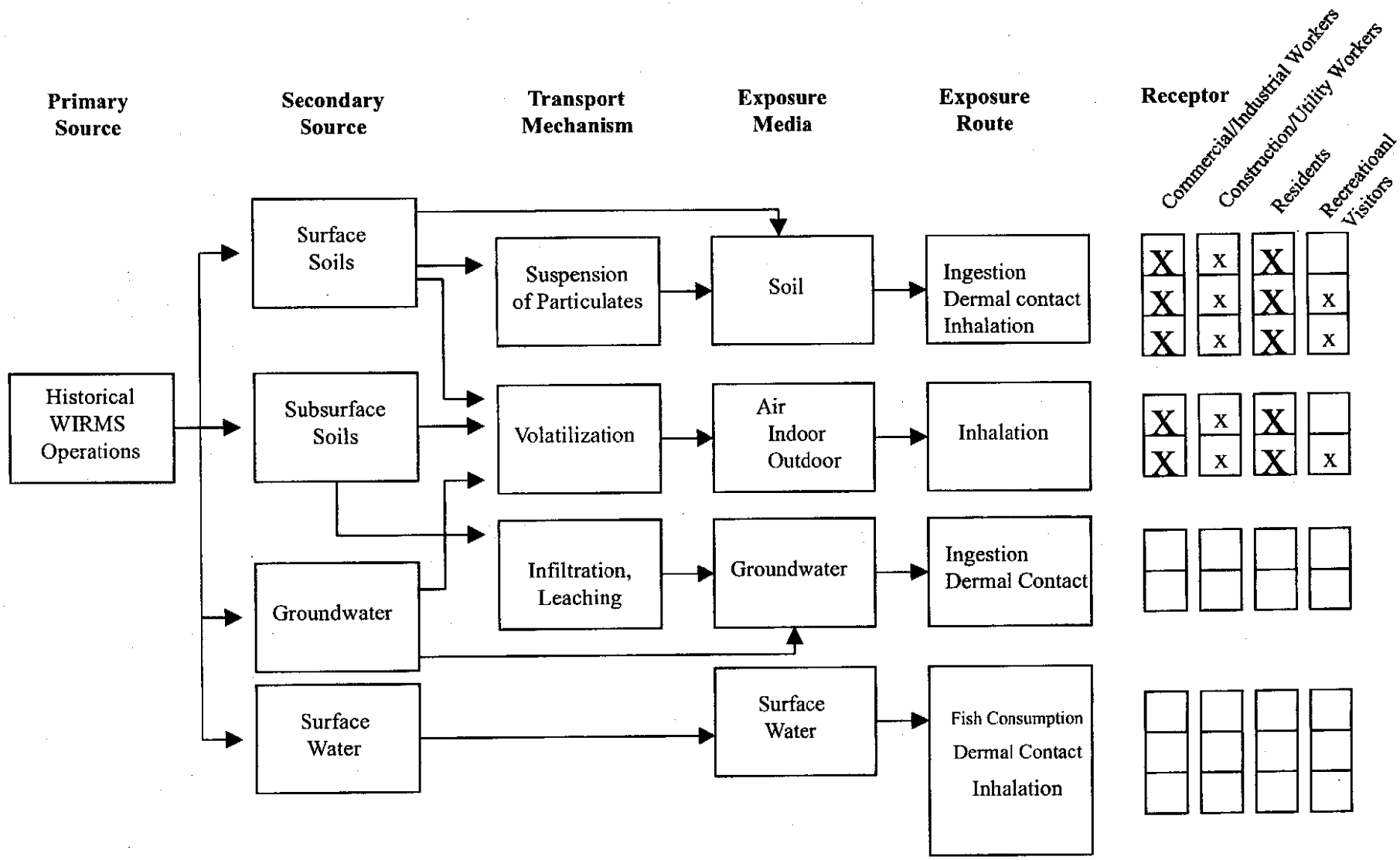

Figure 7-1
Conceptual Exposure Model
Human Health Screening
Fillsite 2 Refuse Area
Site Inspection Report
Former Benicia Arsenal, Benicia, CA

Toxicity data were not available for six organic chemicals (2-hexanone, benzo(g,h,i)perlyene, camphene, n-butyralaldehyde, p-cymene, and phenanthrene). Toxicity values from surrogate chemicals were identified based on chemical similarity (see Table 7-1) in regard to four chemicals (2-hexanone, benzo(g,h,i)perlyene, p-cymene, and phenanthrene. Two chemicals (camphene and n-butyralaldehyde) do not have BSLs.

Shallow groundwater is not found in the area where the refuse was found at Fillsite 2. Therefore, soil assessment criteria that are protective of groundwater quality were not developed in support of this HHRS. No soil gas samples were collected. Volatile chemicals were not considered chemicals of interest and were not included in the analyses. Therefore, the potential for chemicals to vaporize and move into indoor air is not included.

7.3 Data Evaluation

All results from trenching and analytical data in the refuse area from samples collected (described in Section 6.0) within the refuse area of Fillsite 2 (Figure 6-9) were included in this HHRS. A total of seven samples were used in this risk screening from the following test pits/surface scrapes:

- L002TP001;
- L002TP005;
- L002SC004;
- L002SC005;
- L002SC006;
- L002SC007; and
- L002SC008.

Refer to Section 3.0 for the complete listing of the chemical analytes for which these soil samples were analyzed.

7.4 Process to Select Chemicals of Potential Concern (COPCs)

The COPC selection procedure is graphically represented in Figure 7-2. Analytical chemical data from analyses performed on soil samples collected from the refuse area was compared to applicable BSLs (and ambient metal concentrations, where applicable) to determine which exceeded BSLs, and thus are selected as COPCs in soil.

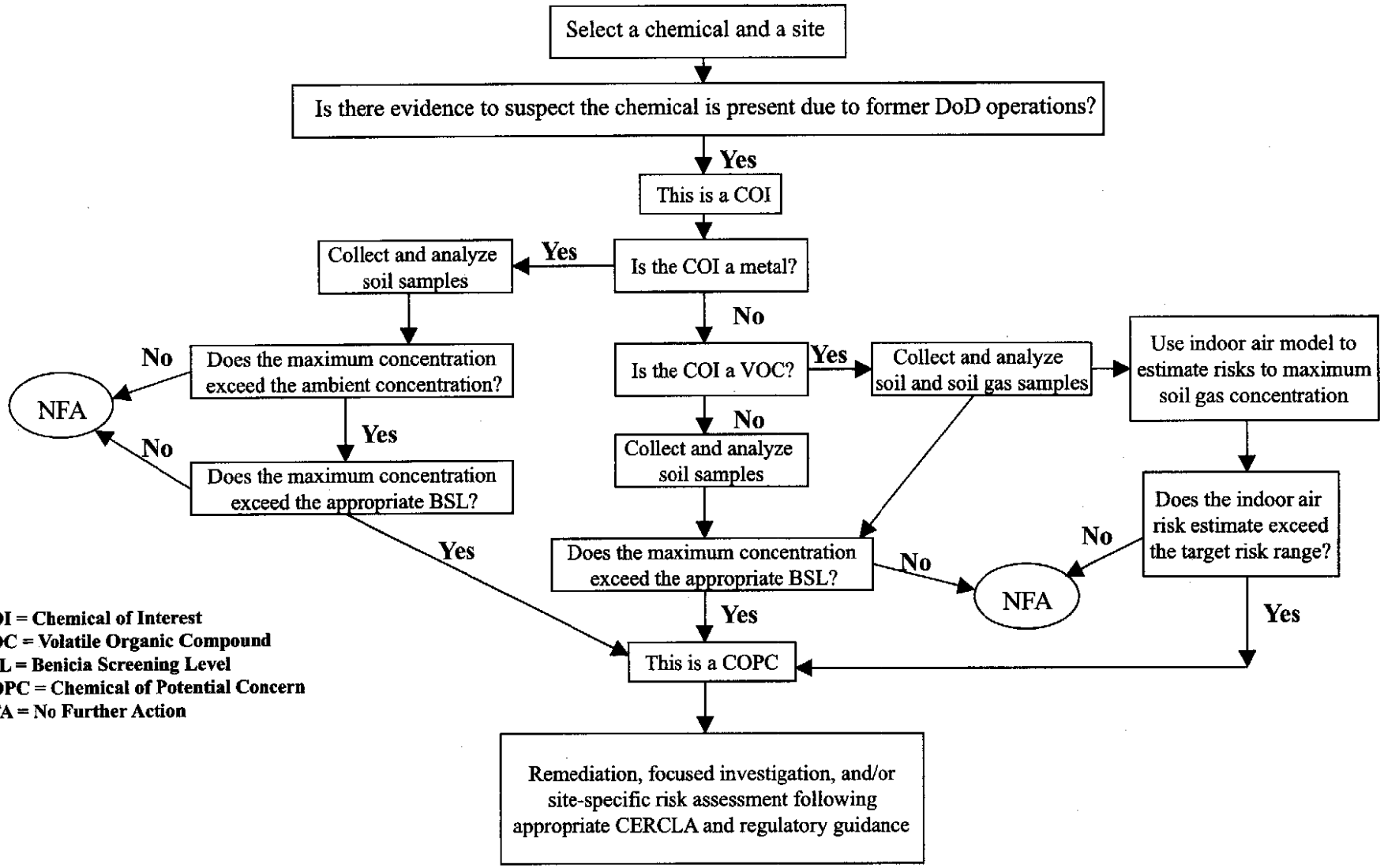

Figure 7-2
COPC Selection Process Flowchart
Human Health Screening
Fillsite 2 Refuse Area
Site Inspection Report
Former Benicia Arsenal, Benicia, CA

7.4.1 Comparison to Background for Metals

Metals with maximum concentrations below the background threshold are not included as COPCs. If the maximum concentration of the metal exceeds its ambient concentration, then it is compared to its applicable BSL (Section 7.4.2).

Metals with concentrations above the ambient background concentration in at least one sample are considered above background for this HHRS. However, additional statistical analysis at a later date could show that the population of data for that metal is not truly above background.

Preliminary ambient concentrations were developed for 21 metals and the procedures used are presented in the Site Inspection report for the Area I 50 Series Complex (FA/BC, 2003d). Only 20 of the 21 ambient concentrations calculated are listed in Table 7-1. Silver was not included in Table 7-1 because all results were less than method detection limits. A brief description of that process is presented below.

Ambient concentrations were calculated as the 95th percentile of the ambient data. Data from the following investigations conducted by FA/BC at the Arsenal were combined to form expanded data sets:

- Areas 53, 73, 103 and 154;
- Fuel Only Facilities;
- Fillsite 1, Fillsite 2, and Quarry 3;
- 50 Series Complex; and
- Site Hydrogeologic Model.

The preliminary ambient metals concentrations will be revised as additional data become available. Future calculations of ambient concentrations will consider other factors that were not included in the preliminary evaluation, such lithology and sample location.

7.4.2 Comparison to BSLs

The process for identifying COPCs for metals above background and semivolatile organic compounds is based on comparing the maximum reported concentration of the chemical to the BSLs. If the maximum concentration exceeds the BSLs, then that chemical is considered a COPC. If the maximum concentration is less than the BSL, then it is expected that no further action be warranted for that chemical.

BSLs were not calculated for "tentatively identified compounds" (e.g., "gamma-sitosterol", or "hexadecyloxirane"), generated by analysis of SVOCs, therefore these results were not carried through the screening process and are not included in Table 7-1.

7.5 Screening Evaluation Results

The results of COPC selection process for COI concentrations in soil samples taken in the area of the Fillsite 2 refuse area are summarized in Table 7-1. Two analytes were determined to be COPCs: lead and benzo(a)pyrene. The maximum concentration of lead detected was 813 mg/kg; above the ambient concentration of 20.1 mg/kg and the residential BSL of 150 mg/kg. A total of seven soil samples were analyzed in this risk screening for lead, and only one sample was reported to be above the lead BSL (the maximum concentration). All seven samples were detected at values greater than ambient background.

Benzo(a)pyrene was detected at a maximum concentration of 0.220 mg/kg. The residential BSL is 0.062 mg/kg. Six soil samples were analyzed for benzo(a)pyrene in this risk screening. Only one sample detected (the maximum concentration) was above the BSL.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The fillsites and quarries at the former Benicia Arsenal were investigated to determine if there is contamination related to past DoD activities. This section summarizes the conclusions of the investigation at the fillsites and quarries and provides recommendations for these sites.

A geophysical survey and trenching were performed during this investigation. Geophysics performed at Fillsite 1, Fillsite 2 and Quarry 3 identified metallic and non-metallic anomalies. These areas were trenched and debris was encountered. Trenching also confirmed that when the bedrock and the overlying base material is the same (a silty sand to sandy silt) the geophysical results indicated areas of low conductance. Conversely, in areas that are less resistive or higher conductance, silty clay with highly conductive salts was encountered at depth.

During trenching, perched groundwater was encountered at Fillsite 1 and Fillsite 2, but not at Quarry 1 or Quarry 3. Groundwater was also not encountered in three borings advanced to bedrock at Fillsite 2 at depths up to 37 feet bgs and at depths up to 8 feet bgs at Quarry 1 and 10 feet bgs at Quarry 3.

8.1 Fillsite 1

Nine trenches were advanced at Fillsite 1, which is located northeast of Buildings 55, 56, and 57. The encountered lithology consisted of artificial fill with underlying native clays (Bay Mud). Fill material included unconsolidated sandy silt with gravel and occasional wood and brick. A discontinuous buried asphalt layer was found beneath the western third of the site. No refuse was encountered in any trenches at Fillsite 1.

Analytical results showed that motor oil, diesel fuel and lead were detected in soil at Fillsite 1. All these constituents decrease in concentration with depth. Solvents were detected in groundwater. Petroleum hydrocarbons, diesel fuel and motor oil were also reported in groundwater samples.

Although no refuse was discovered at Fillsite 1, the detection of solvents and fuels is consistent with the CSM described in Section 2.0. Chemicals used for processing small arms at the nearby 50 Series Complex and Building 120, upgradient from Fillsite 1 included solvents. The source of solvents in groundwater at Fillsite 1 is not clearly understood, but since Building 71 covered the area from approximately the 1920s to the 1970s and then the area was paved, the source is likely to be at another location. Petroleum hydrocarbons were used throughout the Arsenal and could have been discarded at Fillsite 1. More likely, the petroleum hydrocarbons found in the samples collected at Fillsite 1 can be attributed to the decomposition of the buried asphalt layer.

Groundwater was encountered in three trenches at Fillsite 1 and samples were collected. MTBE was detected at a concentration of 0.64 µg/L. MTBE was first used as a fuel additive in the 1970s,

after Arsenal closure. The discovery of MTBE in groundwater at Fillsite 1 demonstrates that fuels were released after the Arsenal closed.

8.2 Fillsite 2

Fillsite 2 is situated southwest of Building 29. The lithology encountered in the nineteen trenches advanced during this investigation consisted of loose unconsolidated fill material with native undisturbed soils and sandstone. Debris and refuse material are present south of Adams Street. In the soil borings and trenches advanced at Fillsite 2, the thickness of the fill material ranges from 4.5 feet bgs to 8.5 feet bgs. Native silt with minor sand is moderately to poorly graded.

Refuse, including burnt ash, broken pottery, slag and Cosmoline were discovered at Fillsite 2 south of Adams Street. Construction debris such as asphalt pieces, culvert pipe, and concrete blocks were also encountered north of Adams Street. The refuse encountered at Fillsite 2 is consistent with the CSM discussed in Section 2.0.

Five soil samples and two groundwater samples were collected and analyzed. Elevated concentrations of lead in soil were reported at Fillsite 2 in locations where refuse was encountered. Motor oil and diesel fuel were also reported in soil and groundwater at Fillsite 2. Cosmoline impacted underlying soil at low concentrations (maximum concentration of 21 mg/kg motor oil). The area has a dirt surface and the area north of Adam Street has been used for storage of construction equipment. Two analytes were determined to be COPCs: lead and benzo(a)pyrene. This does not necessarily represent a human health risk. However, the finding does indicate that further evaluation may be warranted (e.g. additional sampling, consideration of ambient or background levels, or reassessment of exposure assumptions). These two COPCs will be addressed in a future remedial investigation to be performed at the Arsenal.

The contaminants detected in the soil samples currently do not pose a threat to human health or the environment. Groundwater in the area is below the refuse and is intermittent; it is therefore not transporting the reported contaminants.

8.3 Quarry 1

Five trenches were dug at Quarry 1 near the Camel Barn Museum. Soil was characterized as sandy silt fill (thickness ranging from 0 feet bgs to 4.5 feet bgs) overlying sandstone. No refuse was encountered, however, minor construction debris such as brick and a pipe was found in a corner of Quarry 1. This construction debris is from recent dumping activities.

One soil sample was collected from the trenches and six surface soil samples were collected. Laboratory analyses detected motor oil, diesel fuel, PAHs, beta-BHC (a pesticide) and lead in surface and subsurface samples. Groundwater was not encountered at Quarry 1.

The impact to soil at Quarry 1 is from recent activities and not associated with former DoD activities.

8.4 Quarry 3

Quarry 3 is located behind residences in Area I. Five trenches were excavated where geophysical anomalies were identified. The stratigraphy encountered in the trenches consisted of unconsolidated silty sand fill and sandstone bedrock. Small fragments and pieces of concrete and asphalt are present, but no refuse was encountered.

Three soil samples were collected from the trenches and seven surface soil samples were also collected. Laboratory results reported fuels, PAHs, and pesticides in the soil samples. TPH was detected in all soil samples analyzed. The widespread occurrence of fuels in the surface soil samples at Quarry 3 indicate a surface impact and are likely the result of recent activities. The samples that detected pesticides were all in the fill material and likely brought to Quarry 3 from another location. The impact to soil is not associated with former DoD activities. Groundwater was not encountered at Quarry 3.

8.5 Recommendations – Additional Investigation Activities

Based on the findings of this investigation, suspected DoD sources appear to have impacted soil or groundwater at Fillsite 1 and the Fillsite 2 refuse area. FA/BC recommends the following:

- Conduct additional groundwater testing to assess the lateral extent of solvents detected in groundwater at Fillsite 1 area. Assess whether the solvents in this area are from an upgradient source.

- Further evaluate lead and benzo(a)pyrene found in soil at the Fillsite 2 refuse area during the remedial investigation phase at the Arsenal.

8.6 Recommendations – No DoD Action Indicated (NDAI)

FUDS policy outlines four categories of NDAI (I, II, III, and IV). A Category I NDAI decision applies to the Preliminary Assessment (PA) process. Sites classified as Category I NDAI has been determined not have contamination and DoD is not liable for the hazardous condition. Sites that continue through the CERCLA process could be designated as Category II (after SI efforts), Category III (after RI/FS or Engineering Evaluation/Cost Analysis efforts) and Category IV (after Removal Action [RA] efforts) NDAI decisions. The sites that warrant no further action are considered Category I NDAI decisions.

The scope of this Site Inspection was based in large part on historical records and site surveys that identified several potential refuse locations. Although additional investigation is warranted at Fillsite 1 and Fillsite 2, the results of the Site Inspection indicate that Quarry 1 and Quarry 3, as identified in the historical record, have not resulted in contamination and do not warrant additional investigation. Therefore,

- Category II NDAI is recommended for the area north of Adams Street at Area I Fillsite 2.
- Category II NDAI is recommended for Area I Quarry 3.
- Category II NDAI is recommended for Area M Quarry 1.

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HITS REPORTS

Fillsite 1
Detected Analytes in Water

Detected Analytes in Water
PAHs (ug/L)

Location-ID	Sample Date	Depth(feet)	BENZO(b)FLUORANTHENE	BENZO(g,h,i)PERYLENE	FLUORANTHENE	PHENANTHRENE	PYRENE
L001TR001	February 13, 2001	3	< 0.088	0.12 NJ	< 0.11	0.088 NJ	< 0.052
L001TR007	February 14, 2001	0	0.11 J	< 0.083	< 0.11	< 0.049	< 0.058
L001TR008	February 14, 2001	3	< 0.087	< 0.083	0.15 NJ	< 0.049	0.19 J
Number of Detects:			1	1	1	1	1
Total Number of Analyses:			3	3	3	3	3
Minimum Concentration:			0.11	0.12	0.15	0.088	0.19
Maximum Concentration:			0.11	0.12	0.15	0.088	0.19
Mean Detected Concentration:			0.11	0.12	0.15	0.088	0.19
MCL:							
Number of Hits Above MCL:			1	1	1	1	1

QUALIFIER LEGEND:

(blank)	Unqualified result.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analyte identification is presumptive. Reported value is an estimated concentration.

Detected Analytes in Water
Wet Chem (ug/L)

Location-ID	Sample Date	Depth(feet)	ALKALINITY, BICARBONATE	ALKALINITY, TOTAL	CHLORIDE	NITRATE (AS N)	NITRITE (AS N)	SULFATE	TOTAL DISSOLVED SOLIDS
L001TR001	2/13/2001	3	304	304	76.6	1.54	< 0.008	129	564
L001TR007	2/14/2001	0	363	363	86.8	1.28	< 0.008	97.3	795
L001TR008	2/14/2001	3	386	386	60.4	1.13	0.159	119	735
Number of Detects:			3	3	3	3	1	3	3
Total Number of Analyses:			3	3	3	3	3	3	3
Minimum Concentration:			304	304	60.4	1.13	0.159	97.3	564
Maximum Concentration:			386	386	86.8	1.54	0.159	129	795
Mean Detected Concentration:			351	351	74.6	1.316667	0.159	115.1	698
MCL:									
Number of Hits Above MCL:			3	3	3	3	1	3	3

QUALIFIER LEGEND:
(blank) Unqualified result.

Detected Analytes in Water
VOCs (ug/L)

Location-ID	Sample Date	Depth(feet)	ACETONE	cis-1,2-DICHLOROETHENE	ISOPROPYL ETHER	METHYL tert-BUTYL ETHER	METHYLENE CHLORIDE	NAPHTHALENE	P-CYMENE (p-ISOPROPYLTOLUENE)	TRICHLOROETHENE
L001TR001	2/13/2001	3	11 J	18	< 0.39	0.64 J	10	< 0.36	0.37 J	21
L001TR007	2/14/2001	0	< 2.7 UJ	11	0.63 J	< 0.22	18	0.4 J	< 0.12	1.5
L001TR008	2/14/2001	3	< 2.7 UJ	17	< 0.39	< 0.22	20	0.55 J	< 0.12 UJ	21 J-
Number of Detects:			1	3	1	1	3	2	1	3
Total Number of Analyses:			3	3	3	3	3	3	3	3
Minimum Concentration:			11	11	0.63	0.64	10	0.4	0.37	1.5
Maximum Concentration:			11	18	0.63	0.64	20	0.55	0.37	21
Mean Detected Concentration:			11	15.33333	0.63	0.64	16	0.475	0.37	0.5
MCL:				6		5	5			5
Number of Hits Above MCL:			1	3	1	0	3	2	1	1

QUALIFIER LEGEND:

(blank)	Unqualified result.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
J-	The analyte was positively identified with low bias; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Detected Analytes in Water
TPHs (ug/L)

Location-ID	Sample Date	Depth(feet)	DIESEL (C10-C24)	MOTOR OIL (C20-C36)
L001TR001	2/13/2001	3	< 15	450 J
L001TR007	2/14/2001	0	56	< 39
L001TR008	2/14/2001	3	50	67 J

Number of Detects:	2	2
Total Number of Analyses:	3	3
Minimum Concentration:	50	67
Maximum Concentration:	56	450
Mean Detected Concentration:	53	258.5

MCL:		
Number of Hits Above MCL:	2	2

QUALIFIER LEGEND:

(blank)	Unqualified result.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

Detected Analytes in Water
Metals (ug/L)

Location-ID	Sample Date	Depth(feet)	ANTIMONY	ARSENIC	BARIUM	CALCIUM	IRON	MAGNESIUM	MANGANESE	POTASSIUM	SODIUM	ZINC
L001TR001	2/13/2001	3	< 0.0013	0.00316 J	0.102	84.2	0.106 J	33	2.12	1.24 J	131	0.00568 J
L001TR007	2/14/2001	0	0.00132 J	< 0.0018	0.0557	87.4	0.00949 J	26.9	0.372	2.19 J	103	0.0081 J
L001TR008	2/14/2001	3	0.00138 J	< 0.0018	0.0424	96.8	0.0561 J	35.4	0.107	< 1.07	126	< 0.0045
Number of Detects:			2	1	3	3	3	3	3	2	3	2
Total Number of Analyses:			3	3	3	3	3	3	3	3	3	3
Minimum Concentration:			0.00132	0.00316	0.0424	84.2	0.00949	26.9	0.107	1.24	103	0.00568
Maximum Concentration:			0.00138	0.00316	0.102	96.8	0.106	35.4	2.12	2.19	131	0.0081
Mean Detected Concentration:			0.00135	0.00316	0.0667	89.46667	0.05719667	31.76667	0.866333	1.715	120	0.00689
MCL:			0.006	0.05	1		0.3		0.05			5
Number of Hits Above MCL:			0	0	0	3	0	3	3	2	3	0

QUALIFIER LEGEND:

(blank) Unqualified result.

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

Fillsite 1
Detected Analytes in Soil

Detected Analytes in Soil
SVOCs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	1,1,3-TRIMETHYL-2-(3-METHYL)-CYCLOHEXANE	2-BUTYL-1,1,3-TRIMETHYL-CYCLOHEXANE	BUTYLCYCLOPENTANE	DECAHYDRO-2-METHYL-NAPHTHALENE	N-HEXADECANE (C16)
L001TR007	February 14, 2001	7 - 7.5	CH	0.96 NJ	0.52 NJ	0.59 NJ	0.41 NJ	0.52 NJ
Number of Detects:				1	1	1	1	1
Total Number of Analyses:				3	3	3	3	3
Minimum Concentration:				0.96	0.52	0.59	0.41	0.52
Maximum Concentration:				0.96	0.52	0.59	0.41	0.52
Mean Detected Concentration:				0.96	0.52	0.59	0.41	0.52

QUALIFIER LEGEND:

NJ The analyte identification is presumptive. Reported value is an estimated concentration.

Detected Analytes in Soil
VOCs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	ACETONE
L001TR007	2/14/2001	4.6 - 4.8	ML	0.023 J-
L001TR008	2/14/2001	6 - 6.5	CH	0.033 J-

Number of Detects:	2
Total Number of Analyses:	2
Minimum Concentration:	0.023
Maximum Concentration:	
Mean Detected Concentration:	-0.028

QUALIFIER LEGEND:

(blank)	Unqualified result.
J-	The analyte was positively identified with low bias; the associated numerical value is the approximate concentration of the analyte in the sample.

Detected Analytes in Soil
PAHs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	BENZO(a)PYRENE	BENZO(b)FLUORANTHENE	PYRENE
L001TR007	2/14/2001	7 - 7.5	CH	0.0074 J	< 0.008	0.016 J
L001TR008	February 14, 2001	6.5 - 7	CH	< 0.004	0.015 J	< 0.009

Number of Detects:	1	1	1
Total Number of Analyses:	3	3	3
Minimum Concentration:	0.0074	0.015	0.016
Maximum Concentration:	0.0074	0.015	0.016
Mean Detected Concentration:	0.0074	0.015	0.016

QUALIFIER LEGEND:

(blank) Unqualified result.

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

Detected Analytes in Soil
TPHs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	DIESEL (C10-C24)	MOTOR OIL (C20-C36)
L001TR007	2/14/2001	7 - 7.5	CH	340	87 NJ+
L001TR007	2/14/2001	4.6 - 5.1	ML	510 NJ	2900 J-
L001TR008	February 14, 2001	6.5 - 7	CH	8.9 NJ+	36

Number of Detects:	3	3
Total Number of Analyses:	5	5
Minimum Concentration:	8.9	36
Maximum Concentration:	510	87
Mean Detected Concentration:	286.3	-925.6667

QUALIFIER LEGEND:

(blank)	Unqualified result.
J-	The analyte was positively identified with low bias; the associated numerical value is the approximate concentration of the analyte in the sample.
J+	The analyte was positively identified with high bias; the associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analyte identification is presumptive. Reported value is an estimate concentration.

Detected Analytes in Soil
Metals (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM, TOTA	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	MOLYBDENUM	NICKEL	POTASSIUM	SELENIUM	SODIUM	THALLIUM	TIN	VANADIUM	ZINC
L001TR002	2/13/2001	3 - 3.5	ML	15000	< 3.29	7.62	54.8	0.775	0.128 J	2410	35.2	8	2.75 J	32600	11.6	5850	236	0.021 J	< 0.798	19.6	2030	0.265 J	1040	0.542	7.56 J	61.8	61.9
L001TR002	2/13/2001	8.5 - 9	CL	25200	4.41 J	7.76	70.7	0.539	0.308 J	3900	75.9	20.8	46.8	38900	8.45	13800	387	0.058 J	1.91 J-	93.5	2660	0.366 J	2780	0.553	9.04 J	80.8	87.1
L001TR007	2/14/2001	7 - 7.5	CH	15800	6.82 J	19.2	67.9	0.726	0.304 J	1890	44	7.66	8.76	25800	31.5	4590	149	0.079 J	1.14 J	28.5	2330	0.443 J	819	0.535	6.21 J	64.1	65.4
L001TR007	February 14, 2001	4.6 - 5.1	ML	12500	< 3.24	5.2	69.5	0.467	0.392 J	4870	24.8	10.2	22.4	20100	70	2530	642	0.048 J	< 0.786	18.9	637 J	0.182 J	643	0.382	4.41 J	54.5	89.1
L001TR008	February 14, 2001	6.5 - 7	CH	29400	< 3.95	7.64	496	0.828	0.152 J	15600	55	17	44.9	34800	16.9	8540	976	0.028 J	0.984 J	57.8	2540	0.203 J-	381	0.608 J-	8.47 J	72.7	85.5
Number of Detects:				5	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	5	5	5	5	5	5	5	5
Total Number of Analyses:				5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Minimum Concentration:				12500	4.41	5.2	54.8	0.467	0.128	1890	24.8	7.66	2.75	20100	8.45	2530	149	0.021	0.984	18.9	637	0.182	381	0.382	4.41	54.5	61.9
Maximum Concentration:				29400	6.82	19.2	496	0.828	0.392	15600	75.9	20.8	46.8	38900	70	13800	976	0.079	1.14	93.5	2660	0.443	2780	0.553	9.04	80.8	89.1
Mean Detected Concentration:				19580	5.615	9.484	151.78	0.667	0.2568	5734	46.98	12.732	25.122	30440	27.69	7062	478	0.0468	0.071333	43.66	2039.4	0.2106	1132.6	0.2808	7.138	66.78	77.8

QUALIFIER LEGEND:

(blank) Unqualified result.

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

J- The analyte was positively identified with low bias; the associated numerical value is the approximate concentration of the analyte in the sample.

Fillsite 2
Detected Analytes in Water

Detected Analytes in Water
Wet Chem (ug/L)

Location-ID	Sample Date	Depth(feet)	ALKALINITY, BICARBONATE	ALKALINITY, TOTAL	CHLORIDE	NITRATE (AS N)	SULFATE	TOTAL DISSOLVED SOLIDS
L002TR003	February 6, 2001	0	84.7	84.7	336	0.286	660	2004
L002TR005	February 5, 2001	1.5	< 0.469	< 0.469	309	1.05	2260	3370
Number of Detects:			1	1	2	2	2	2
Total Number of Analyses:			2	2	2	2	2	2
Minimum Concentration:			84.7	84.7	309	0.286	660	2004
Maximum Concentration:			84.7	84.7	336	1.05	2260	3370
Mean Detected Concentration:			84.7	84.7	322.5	0.668	1460	2687
MCL:								
Number of Hits Above MCL:			1	1	2	2	2	2

QUALIFIER LEGEND:
(blank) Unqualified result.

Detected Analytes in Water
VOCs (ug/L)

Location-ID	Sample Date	Depth(feet)	METHYLENE CHLORIDE
L002TR003	2/5/2001	4.5	12
L002TR005	2/5/2001	1.5	14

Number of Detects:	2
Total Number of Analyses:	2
Minimum Concentration:	12
Maximum Concentration:	14
Mean Detected Concentration:	13

MCL:	5
Number of Hits Above MCL:	2

QUALIFIER LEGEND:

(blank) Unqualified result.

Detected Analytes in Water
TPHs (ug/L)

Location-ID	Sample Date	Depth(feet)	MOTOR OIL (C20-C36)
L002TR003	2/6/2001	0	77 J

Number of Detects:	1
Total Number of Analyses:	1
Minimum Concentration:	77
Maximum Concentration:	77
Mean Detected Concentration:	77
MCL:	
Number of Hits Above MCL:	1

QUALIFIER LEGEND:

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

Detected Analytes in Water
Metals (ug/L)

Location-ID	Sample Date	Depth(feet)	ALUMINUM	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	COBALT	COPPER	IRON	MAGNESIUM	MANGANESE	MOLYBDENUM	NICKEL	POTASSIUM	SELENIUM	SODIUM	VANADIUM	ZINC
L002TR003	2/6/2001	0	< 0.0291	0.0104	< 0.0002	< 0.0008	154	< 0.0051	< 0.0015	0.00877 J	102	0.172	0.00877 J	< 0.005	6.09 J	0.00205 J	222	< 0.0023	0.0244
L002TR005	2/5/2001	1.5	35.8	0.00906 J	0.00798	0.00706	339	0.124	0.0251	0.377	240	3.27	0.0159 J	0.437	5.85 J	0.00446 J	165	0.00247 J	0.922
Number of Detects:			1	2	1	1	2	1	1	2	2	2	2	1	2	2	2	1	2
Total Number of Analyses:			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Minimum Concentration:			35.8	0.00906	0.00798	0.00706	154	0.124	0.0251	0.00877	102	0.172	0.00877	0.437	5.85	0.00205	165	0.00247	0.0244
Maximum Concentration:			35.8	0.0104	0.00798	0.00706	339	0.124	0.0251	0.377	240	3.27	0.0159	0.437	6.09	0.00446	222	0.00247	0.922
Mean Detected Concentration:			35.8	0.00973	0.00798	0.00706	246.5	0.124	0.0251	0.192885	171	1.721	0.012335	0.437	5.97	0.003255	193.5	0.00247	0.4732
MCL:			0.2	1	0.004	0.005			1	0.3		0.05		0.1		0.05		0.063	5
Number of Hits Above MCL:			1	0	1	1	2	1	0	1	2	2	2	1	2	0	2	0	0

QUALIFIER LEGEND:

(blank) Unqualified result.

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

Fillsite 2
Detected Analytes in Soil

Detected Analytes in Soil
SVOCs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	1-DOCOSENE	1-DOTRIACONTANO	1-EICOSANOL	1-HEXADECENI	1-OCTADECENI	1-PENTADECENI	1R-_ALPHA_-PINEN	5_ALPHA_,8_ALPHA_,14_BETA_-CHOLESTA	5-BUTYLHEXADECAN	7-HEXYLEICOSANI	9-HEXACOSENI	CARYOPHYLLENI	CHOLESTANE	CYCLOHEXADECAN	CYCLOOCTACOSAN	CYCLOTETRADECAN	GAMMA-SITOSTERO	GERMACRENE E	HEPTADECYLOXIRAN	HEXADECYLOXIRAN	N-DOTRIACONTANE (C3	N-EICOSANE (C2(	N-HENICOSANE (C2;	N-HENTRIACONTANE (C3	N-HEPTADECANE (C1;	N-HEXACOSANE (C2(	N-HEXADECANOIC ACI	N-HEXATRIACONTANE (C3	N-NONADECANE (C1(	N-OCTADECANE (C1(	N-PENTATRIACONTANE (C3	N-TETRACOSANE (C2.
L002SC001	June 28, 2001	0.5 - 1	ML		0.38 NJ								0.32 NJ												0.49 NJ				0.35 NJ		0.39 NJ				
L002SC002	June 28, 2001	0.25 - 0.75	ML				0.29 NJ					0.38 NJ																			0.37 NJ				
L002SC003	June 28, 2001	0.25 - 0.75	ML	0.66 NJ		0.42 NJ													0.32 NJ												0.38 NJ				
L002SC004	June 28, 2001	0.25 - 0.75	ML			3.1 NJ											0.67 NJ			2.2 NJ											3.3 NJ				
L002SC005	June 28, 2001	0.25 - 0.75	ML	0.2 NJ					0.14 NJ																0.13 NJ			0.16 NJ			0.45 NJ		0.14 NJ	0.14 NJ	0.22 NJ
L002SC006	June 28, 2001	0.25 - 0.75	ML	0.93 NJ		2.4 NJ	0.6 NJ			0.83 NJ					0.44 NJ					0.99 NJ			0.53 NJ		0.7 NJ					5 NJ				
L002SC007	June 28, 2001	0.25 - 0.75	ML					0.25 NJ										1.2 NJ		0.47 NJ	0.86 NJ	0.18 NJ		0.23 NJ			0.41 NJ		0.18 NJ	1.2 NJ	2.5 NJ			
L002SC008	June 28, 2001	0.25 - 0.75	ML			0.7 NJ					0.57 NJ			1.3 NJ		0.58 NJ										1.6 NJ					0.91 NJ	0.68 NJ		
Number of Detects:				3	1	4	2	1	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1	1	2	1	1	2	1	1	7	2	2	1	1
Total Number of Analyses:				11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Minimum Concentration:				0.2	0.38	0.42	0.29	0.25	0.14	0.83	0.57	0.38	0.32	1.3	0.44	0.58	0.67	1.2	0.32	0.47	0.86	0.18	0.53	0.23	0.13	0.7	1.6	0.16	0.35	0.18	0.37	0.91	0.14	0.14	0.22
Maximum Concentration:				0.93	0.38	3.1	0.6	0.25	0.14	0.83	0.57	0.38	0.32	1.3	0.44	0.58	0.67	1.2	0.32	2.2	0.86	0.18	0.53	0.23	0.49	0.7	1.6	0.41	0.35	0.18	5	2.5	0.68	0.14	0.22
Mean Detected Concentration:				0.596667	0.38	1.655	0.445	0.25	0.14	0.83	0.57	0.38	0.32	1.3	0.44	0.58	0.67	1.2	0.32	1.22	0.86	0.18	0.53	0.23	0.31	0.7	1.6	0.285	0.35	0.18	1.584286	1.705	0.41	0.14	0.22

QUALIFIER LEGEND:

NJ The analyte identification is presumptive. Reported value is an estimated concentration.

Detected A[illegible]es in Soil
PAHs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	ACENAPHTHYLENE	BENZO(a)ANTHRACENE	BENZO(a)PYRENE	BENZO(b)FLUORANTHENE	BENZO(g,h,i)PERYLENE	BENZO(k)FLUORANTHENE	CHRYSENE	DIBENZ(a,h)ANTHRACENE	FLUORANTHENE	INDENO(1,2,3-c,d)PYRENE	PHENANTHRENE	PYRENE
L002SC002	6/28/2001	0.25 - 0.75	ML	0.053 NJ	0.0024 NJ	0.0058 J	< 0.0014	< 0.0017	< 0.0012	0.0071 J	< 0.0014	< 0.0037	< 0.00065	< 0.0019	0.0076 J
L002SC003	6/28/2001	0.25 - 0.75	ML	< 0.042	< 0.0043	0.0065 J	< 0.0014	< 0.0017	< 0.0012	0.011 J	0.0012 NJ	0.027 J	< 0.003	< 0.0039	< 0.0022
L002SC004	6/28/2001	0.25 - 0.75	ML	< 0.042	0.009	0.035 J	< 0.0014	< 0.0017	0.013	0.035	< 0.0014	0.12 J	< 0.00063	0.053	0.057
L002SC005	6/28/2001	0.25 - 0.75	ML	< 0.043	< 0.0044	0.0085 J	0.014 J	< 0.0017	0.0057 J	0.014 J	< 0.0014	0.041 J	0.015	< 0.004	0.03 J
L002SC006	6/28/2001	0.25 - 0.75	ML	< 0.043	0.063	0.22 J	0.4 J	0.055 J	0.06	0.14 J	< 0.0014	0.54 J	< 0.00065	0.18 NJ	0.39 J
L002SC007	6/28/2001	0.25 - 0.75	ML	< 0.042	0.014	0.02	0.022	< 0.0017	0.009	0.03 J	< 0.0014	0.083 J	0.014	0.026	0.055
L002SC008	6/28/2001	0.25 - 0.75	ML	< 0.041	< 0.0043	0.0079 J	< 0.0067	< 0.0017	< 0.0011	< 0.0012	< 0.0013	< 0.018	< 0.00062	0.028 NJ	< 0.0022
L002TP001	2/7/2001	8.5 - 9	ML	< 0.081	< 0.0039	< 0.0038	< 0.0079	< 0.0057	< 0.003	< 0.0046	< 0.012	0.048	< 0.0039	0.039	< 0.0079
L002TR003	2/6/2001	2.5 - 3	CL	< 0.084	< 0.004	< 0.0039	0.026	< 0.0059	< 0.0039	< 0.0044	< 0.012 UJ	< 0.016	< 0.004	< 0.0036	0.016 J
Number of Detects:				1	4	7	4	1	4	6	1	6	2	5	6
Total Number of Analyses:				10	10	10	10	10	10	10	10	10	10	10	10
Minimum Concentration:				0.053	0.0024	0.0058	0.014	0.055	0.0057	0.0071	0.0012	0.027	0.014	0.026	0.0076
Maximum Concentration:				0.053	0.063	0.22	0.4	0.055	0.06	0.14	0.0012	0.54	0.015	0.18	0.39
Mean Detected Concentration:				0.053	0.0221	0.043386	0.1155	0.055	0.021925	0.039517	0.0012	0.143167	0.0145	0.0652	0.0926

QUALIFIER LEGEND:

(blank) Unqualified result.
J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
NJ The analyte identification is presumptive. Reported value is an estimated concentration.

Detected A[illegible]es in Soil
VOCs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	1R-_ALPHA_-LIMONENE	1R-_ALPHA_-PINENE	ACETONE	BENZALDEHYDE	BENZENE	CAMPHENE	EUCALYPTOL (LIMONENE OXIDE)	EXO-FRENCHOL	METHYL ETHYL KETONE	N-BUTYRALDEHYDE	N-VALERALDEHYDE	P-CYMENE (p-ISOPROPYLTOLUENE)	TOLUENE	TRICHLOROFLUOROMETHANE
L002SC001	6/28/2001	0 - 0.5	ML			0.087	0.0056 NJ	< 0.00043				0.018 J	0.0054 NJ	0.0064 NJ	< 0.00041	< 0.00058	0.0014 J
L002SC002	6/28/2001	0 - 0.25	ML			0.015 J		< 0.00045				0.0028 J			< 0.00043	< 0.00061	< 0.00087
L002SC003	6/28/2001	0.25 - 0.25	ML			0.16		< 0.00054				0.012 J		0.008 NJ	< 0.00051	< 0.00072	0.0036 J
L002SC004	6/28/2001	0.25 - 0.25	ML			0.16		< 0.00058				0.011 J	0.0078 NJ	0.01 NJ	< 0.00055	0.00096 J	< 0.0011
L002SC005	6/28/2001	0.25 - 0.25	ML			0.075		0.00055 J				0.0083 J			< 0.00044	< 0.00062	0.0014 J
L002SC006	6/28/2001	0.25 - 0.25	ML	0.024 NJ	0.052 NJ	0.26		0.00072 J	0.019 NJ		0.017 NJ	0.021 J	0.011 NJ	0.021 NJ	0.0077	0.006	< 0.0011
L002SC007	6/28/2001	0.25 - 0.25	ML			0.11		< 0.00049		0.11 NJ		0.0099 J	0.0072 NJ	0.016 NJ	0.0016 J	0.00095 J	< 0.00094
L002SC008	6/28/2001	0.25 - 0.25	ML			0.11		< 0.00054				0.012 J			< 0.00051	< 0.00073	0.0017 J
L002TP001	2/7/2001	8.5 - 9	ML			0.1 J		< 0.00048 UJ				< 0.0028 UJ			< 0.00046 UJ	< 0.00065 UJ	< 0.00092 UJ
L002TP005	2/7/2001	8 - 8.5	ML			0.048		< 0.00054				< 0.0032			< 0.00051	< 0.00072	< 0.001
Number of Detects:				1	1	10	1	2	1	1	1	8	4	5	2	3	4
Total Number of Analyses:				11	11	11	11	11	11	11	11	11	11	11	11	11	11
Minimum Concentration:				0.024	0.052	0.015	0.0056	0.00055	0.019	0.11	0.017	0.0028	0.0054	0.0064	0.0016	0.00095	0.0014
Maximum Concentration:				0.024	0.052	0.26	0.0056	0.00072	0.019	0.11	0.017	0.021	0.011	0.021	0.0077	0.006	0.0036
Mean Detected Concentration:				0.024	0.052	0.1125	0.0056	0.000635	0.019	0.11	0.017	0.011875	0.00785	0.01228	0.00465	0.002636667	0.002025

QUALIFIER LEGEND:

(blank) Unqualified result.

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

NJ The analyte identification is presumptive. Reported value is an estimated concentration.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Detected Analytes in Soil
TPHs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	DIESEL (C10-C24)	MOTOR OIL (C20-C36)
L002TP001	2/7/2001	8.5 - 9	ML	7 NJ+	32
L002TP005	2/7/2001	8 - 8.5	ML	9.4 NJ+	21
L002TR003	2/6/2001	2.5 - 3	CL	16 NJ	72 J-

Number of Detects:	3	3
Total Number of Analyses:	4	4
Minimum Concentration:	7	21
Maximum Concentration:	16	32
Mean Detected Concentration:	10.8	-6.33333

QUALIFIER LEGEND:

(blank)	Unqualified result.
J-	The analyte was positively identified with low bias; the associated numerical value is the approximate concentration of the analyte in th sample.
NJ	The analyte identification is presumptive. Reported value is an estimated concentration.

Detected Analytes in Soil
Metals (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM, TOTAL	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	MOLYBDENUM	NICKEL	POTASSIUM	SELENIUM	SODIUM	THALLIUM	TIN	VANADIUM	ZINC
L002SC001	6/28/2001	0.5 - 1	ML	16000	3.17 J-	8.93 J-	72.7	0.661	0.426 J	7380	35.6	23.3	21	33100	12.8	6120	920	0.117	3.19 J	51.6	1980	2.23	725	0.83	2.76 J	53.7	105
L002SC002	6/28/2001	0.25 - 0.75	ML	14400	3.39 J	6.18	96.6	0.632	0.442 J	3420	47.6	11.9	17.4	25900	17.6	5700	420	0.032 J	2.57 J	28.9	2530	0.778	714	0.615	4.81 J	48.8	90
L002SC003	6/28/2001	0.25 - 0.75	ML	16800	5.96 J	9.42	90.5	0.636	0.462 J	4730	43.4	7.74	17.2	30100	68.3	6240	290	0.104	1.54 J	18.2	2540	0.837	101	0.72	4.21 J	60.9	91.1
L002SC004	6/28/2001	0.25 - 0.75	ML	15500	4.66 J	10.4	96.2	0.646	0.885	7800	42.6	7.22	30	26000	152	4810	321	0.166	1.4 J	19.6	3440	0.565 J	101	0.795	5.58 J	59.2	138
L002SC005	6/28/2001	0.25 - 0.75	ML	17200	3.54 J	9.52	97	0.767	0.361 J	4030	61.7	15.1	24.5	31500	142	6410	383	0.127	2.08 J	26.7	2630	< 0.12	153	0.731	6.34 J	65.6	88.3
L002SC006	6/28/2001	0.25 - 0.75	ML	15200	5.2 J	9.52	159	0.737	0.714 J	8180	40.5	8.3	94.6	26900	225	4360	441	0.324	1.3 J	20.2	2970	< 0.12	104	0.678	18.8	55.9	138
L002SC007	6/28/2001	0.25 - 0.75	ML	19600	3.82 J	10.3	104	0.742	0.557 J	4880	46.2	8.31	29.2	29700	109	5160	444	0.106	1.59 J	18.9	2740	0.787	100	0.787	15.4	65.9	106
L002SC008	6/28/2001	0.25 - 0.75	ML	17700	8.19 J	10.9	87.1	0.602	1.25	3920	47.7	7.63	38.3	28000	190	6070	381	0.109	1.57 J	21.8	1990	< 0.12	142	0.81	4.9 J	61.6	170
L002SC009	6/28/2001	0.25 - 0.75	ML	22300	3.74 J	5.22	56.9	0.604	0.255 J	24500	31.5	19.9	36.1	46500	9.92	11100	647	0.344	2.25 J	25.1	1390	0.663 J	911	0.653	4.52 J	121	86.3
L002SC010	6/28/2001	0.25 - 0.75	CL	19500	3.47 J	3.46	54.9	0.408	0.307 J	24000	18.1	22.2	38	46000	9.71	11600	830	0.339	1.86 J	23.4	804 J	1.02	1890	0.574	4.93 J	118	84
L002TP001	2/7/2001	8.5 - 9	ML	9200	12.9	9.31	189	0.462	0.145 J	11600	26.9	9.67	51.2	52100	813	3100	319	0.931	< 0.844	21.9	1240	0.328 J	385	< 0.0776	1120	37.1	61.6
L002TP002	2/6/2001	9 - 9.5	CL	8450	< 3.5	8.75	87.5	0.335	0.137 J	2120	23.8	2.3	11.2	35000	7.69	3410	67	< 0.0197	3.34 J	5.92 J	2660	3.99	648	0.108 J	3.74 J	29.8	34.7
L002TP002	2/6/2001	3.5 - 4	CL	9780	< 3.57	6.84	154	0.435	0.14 J	2720	25.3	3.54	14.6	18600	10.2	3770	59.2	< 0.0202	2.39 J	11.6	1410	1.01	1080	0.206 J	6.81 J	25.1	68.8
L002TP002	2/6/2001	1.5 - 2	CL	10800	< 3.57	7.84	127	0.391	0.258 J	6160	30	4.76	17.1	23900	11.1	4670	190	0.054 J	2.69 J	17.8	2040	1.73	1530	0.228 J	3.04 J	33.5	60.2
L002TP005	2/7/2001	8 - 8.5	ML	13200	< 3.24	4.03	87.1	0.418	< 0.0836	2730	30.9	6.23	12.4	21700	45.5	5440	219	0.366	< 0.786	13.8	1250	0.161 J	303	< 0.0723	6.98 J	54.1	44.3
L002TR002	2/6/2001	9.5 - 10	SM	10900	< 3.43	5.71	42.8	0.492	0.47 J	5770 J+	13.3	9.65	10.9	27300	5.78	5740	250	< 0.0194	1.58 J	21.4	2020	0.666	609		6.07 J	34.2	84.1
L002TR002	2/6/2001	4.5 - 5	ML	9260	< 3.49	7.89	25.2	0.493	0.254 J	2100	28.1	4.97	5.84	24600	6.77	3400	186	< 0.0197	1.89 J	16.4	965	0.357 J	755	0.118 J	4.22 J	39.9	49.9
L002TR002	2/6/2001	3.5 - 4	ML	15600	< 3.39	3.52	18.7	0.514	0.179 J	1670	23	2.92	11.1	15400	3.85	3420	80.7	< 0.0191	1.14 J	10.5	960	0.274 J	808	0.164 J	7.66 J	28.8	59
L002TR003	2/6/2001	2.5 - 3	CL	10400	< 3.6	6.48	88.4	0.313	0.153 J	7170	31.1	7.13	19.2	20300	23.3	4290	280	0.111	1.6 J	21.8	1220	0.805	360	0.0972 J	4.81 J	39.9	59.5
Number of Detects:				19	11	19	19	19	18	19	19	19	19	19	19	19	19	14	17	19	19	16	19	16	19	19	19
Total Number of Analyses:				19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
Minimum Concentration:				8450	3.17	3.46	18.7	0.313	0.137	1670	13.3	2.3	5.84	15400	3.85	3100	59.2	0.032	1.14	5.92	804	0.161	100	0.0972	2.76	25.1	34.7
Maximum Concentration:				22300	12.9	10.9	189	0.767	1.25	24500	61.7	23.3	94.6	52100	813	11600	920	0.931	3.34	51.6	3440	3.99	1890	0.83	1120	121	170
Mean Detected Concentration:				14304.74	4.7	6.650526	91.29474	0.541474	0.410833	7098.947	34.06842	9.619474	26.30737	29610.53	98.08	5516.316	354.1	0.230714	1.998824	20.81684	1935.737	1.012563	601	0.507138	65.03053	54.36842	85.2

QUALIFIER LEGEND:

(blank)	Unqualified result.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
J+	The analyte was positively identified with high bias; the associated numerical value is the approximate concentration of the analyte in the sample.

Detected A[illegible]es in Soil
Pesticides-PCBs

Location-ID	Sample Date	Depth (feet)	Soil Code	ALDRIN	ALPHA-CHLORDANE	BETA BHC	BETA ENDOSULFAN	DIELDRIN	ENDRIN	ENDRIN ALDEHYDE	GAMMA BHC (LINDANE)	HEPTACHLOR EPOXIDE	METHOXYCHLOR	p,p'-DDD	p,p'-DDE	p,p'-DDT
L002SC001	June 28, 2001	0.5 - 1	ML	< 0.0013	< 0.00077	< 0.00041	< 0.00043	< 0.00065	< 0.00049	< 0.00039	< 0.00028	< 0.00051	< 0.0034	< 0.0018	< 0.00065 UJ	0.018 J+
L002SC002	June 28, 2001	0.25 - 0.75	ML	< 0.0065	< 0.00091	< 0.0066	< 0.0022	< 0.0032	< 0.002	< 0.0022	< 0.0014	< 0.0026	< 0.017	< 0.0043	< 0.0033	0.016 J
L002SC003	June 28, 2001	0.25 - 0.75	ML	< 0.0063	< 0.00088	< 0.0064	< 0.0021	< 0.0031	< 0.0019	< 0.0021	< 0.0013	< 0.0025	< 0.017	< 0.0041	< 0.0031	0.0066 J
L002SC004	June 28, 2001	0.25 - 0.75	ML	< 0.0063	< 0.0037	< 0.0064	< 0.0021	< 0.0031	< 0.0019	< 0.0019	< 0.0013	< 0.0025	< 0.017	< 0.0041	< 0.0031	0.0098 J
L002SC006	June 28, 2001	0.25 - 0.75	ML	< 0.0065	< 0.00091	< 0.0021	< 0.0039	< 0.0032	< 0.0024	< 0.0022	< 0.0014	< 0.0026	< 0.017 UJ	< 0.0088	< 0.0023 UJ	0.018 J+
L002SC007	June 28, 2001	0.25 - 0.75	ML	< 0.0063	< 0.0037	< 0.0064	< 0.0021	< 0.0031	< 0.0019	< 0.0021	< 0.0013	< 0.0025	< 0.017	< 0.0041	< 0.0031	0.007 J
L002SC008	June 28, 2001	0.25 - 0.75	ML	< 0.0062	< 0.0037	< 0.0063	< 0.0021	< 0.0031	< 0.0019	< 0.0021	< 0.0013	< 0.0025	< 0.016	< 0.0041	< 0.0031	0.0084 J
L002TP001	February 7, 2001	8.5 - 9	ML	0.0016 J	0.00055 J	0.0029 J	0.0051 J	0.0036	0.0034 J	0.0019 J	0.00071 J	0.00042 J	0.012 J	0.018	0.0058 J	0.042
L002TR003	February 6, 2001	2.5 - 3	CL	< 0.00032	0.00032 J	< 0.00041	< 0.00023	0.0015 J	0.00085 J	< 0.00024	< 0.00026	< 0.00018	< 0.0016	0.0014 J	0.0011 J	0.0072
Number of Detects:				1	2	1	1	2	2	1	1	1	1	2	2	9
Total Number of Analyses:				11	11	11	11	11	11	11	11	11	11	11	11	11
Minimum Concentration:				0.0016	0.00032	0.0029	0.0051	0.0015	0.00085	0.0019	0.00071	0.00042	0.012	0.0014	0.0011	0.0066
Maximum Concentration:				0.0016	0.00055	0.0029	0.0051	0.0036	0.0034	0.0019	0.00071	0.00042	0.012	0.018	0.0058	0.042
Mean Detected Concentration:				0.0016	0.000435	0.0029	0.0051	0.00255	0.002125	0.0019	0.00071	0.00042	0.012	0.0097	0.00345	0.014778

QUALIFIER LEGEND:

(blank) Unqualified result.

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

J+ The analyte was positively identified with high bias; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Quarry 1
Detected Analytes in Soil

Detected Analytes in Soil
SVOCs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	bis(2-ETHYLHEXYL) PHTHALATE
Q001SC001	November 6, 2002	0.5 - 1	ML	0.06 J
Q001SC003	November 6, 2002	0.5 - 1	ML	0.054 J
Q001SC004	November 6, 2002	0.5 - 1	ML	0.1 J
Q001SC005	November 6, 2002	0.5 - 1		0.055 J
Q001SC006	November 6, 2002	0.5 - 1		0.084 J

Number of Detects:	5
Total Number of Analyses:	6
Minimum Concentration:	0.054
Maximum Concentration:	0.1
Mean Detected Concentration:	0.0706

QUALIFIER LEGEND:

(blank)	Unqualified result.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

Detected Analytes in Soil
PAHs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	BENZO(a)ANTHRACENE	BENZO(a)PYRENE	CHRYSENE
Q001SC001	11/6/2002	0.5 - 1	ML	< 0.00075	0.0015 J	0.0018 J
Q001SC004	11/6/2002	0.5 - 1	ML	0.00083 J	0.0027 J	0.0039 J
Q001SC006	11/6/2002	0.5 - 1		0.0012 J	0.0024 J	0.0037 J

Number of Detects:	2	3	3
Total Number of Analyses:	6	6	6
Minimum Concentration:	0.00083	0.0015	0.0018
Maximum Concentration:	0.0012	0.0027	0.0039
Mean Detected Concentration:	0.001015	0.0022	0.003133

QUALIFIER LEGEND:

(blank) Unqualified result.

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

Detected Analytes in Soil
VOCs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	ACETONE	METHYL ETHYL KETONE	P-CYMENE (p-ISOPROPYLTOLUENE)	TRICHLOROFLUOROMETHANE
Q001SC001	11/6/2002	0.5 - 1		0.1	< 0.0035	< 0.00032	< 0.00034
Q001SC002	11/6/2002	0.5 - 1		0.096	< 0.0035	< 0.00032	0.0039 J
Q001SC003	11/6/2002	0.5 - 1	ML	0.16	< 0.0038	< 0.00034	0.0064 J
Q001SC004	November 6, 2002	0.5 - 1		0.2	0.019 J	< 0.00032	0.013
Q001SC005	November 6, 2002	0.5 - 1		0.11	< 0.0032	0.021	0.0045 J
Q001SC006	November 6, 2002	0.5 - 1		0.12	< 0.0035	< 0.00032	0.0032 J
Q001TR002	October 29, 2002	3 - 3.5		0.05	< 0.003	< 0.00027	< 0.00029
Number of Detects:				7	1	1	5
Total Number of Analyses:				7	7	7	7
Minimum Concentration:				0.05	0.019	0.021	0.0032
Maximum Concentration:				0.2	0.019	0.021	0.013
Mean Detected Concentration:				0.119429	0.019	0.021	0.0062

QUALIFIER LEGEND:

(blank) Unqualified result.

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

Detected Analytes in Soil
PCBs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	ALDRIN	ALPHA-CHLORDANE	BETA BHC	DELTA BHC	DIELDRIN	ENDRIN	P,P'-DDE
Q001SC002	November 6, 2002	0.5 - 1		0.001 J	< 0.00038	0.00081 J	0.00055 J	0.0011 J	0.0017 J	< 0.00072
Q001SC004	November 6, 2002	0.5 - 1	ML	< 0.00036	0.0015 J	0.01	< 0.00043	< 0.00068	< 0.00054	0.002 J
Q001SC006	November 6, 2002	0.5 - 1		< 0.00036	< 0.00038	< 0.00046	< 0.00043	0.0012 J	0.0012 J	< 0.00073
Number of Detects:				1	1	2	1	2	2	1
Total Number of Analyses:				7	7	7	7	7	7	7
Minimum Concentration:				0.001	0.0015	0.00081	0.00055	0.0011	0.0012	0.002
Maximum Concentration:				0.001	0.0015	0.01	0.00055	0.0012	0.0017	0.002
Mean Detected Concentration:				0.001	0.0015	0.005405	0.00055	0.00115	0.00145	0.002

QUALIFIER LEGEND:

(blank) Unqualified result.

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

Detected Analytes in Soil
Metals (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM, TOTAL	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL	POTASSIUM	SELENIUM	SODIUM	THALLIUM	VANADIUM	ZINC
Q001SC001	11/6/2002	0.5 - 1	ML	30800	2.75 J	9.12	255	0.609 J	0.427 J	5600	49.3	7.61	44	31400	25.9	6130	328	0.0832	31	1860	0.143 J	159	0.363 J	79.8	67.7
Q001SC003	11/6/2002	0.5 - 1	ML	31300	3.45 J	7.98	497	0.655 J	0.343 J	5080	52.7	38.9	44.8	39500	23.3	6740	488	0.0701 J	49.1	2670	0.109 J	139	0.421	85.6	66.3
Q001SC004	11/6/2002	0.5 - 1	ML	25600	< 1.91	6.1	307	0.518 J	0.367 J	4490	43.8	15	39	28600	35.2	5450	682	0.0611 J	30.8	2570	< 0.0822	97.4	0.323 J	72.5	64.6
Q001SC005	11/6/2002	0.5 - 1		24400	2.91 J	7.62	237	0.474 J	0.29 J	4060	40.9	13.6	33.9	26200	19	4830	609	0.0506 J	27.9	1710	< 0.0822	231	0.346 J	67.8	51.3
Q001SC006	11/6/2002	0.5 - 1		27800	2.33 J	6.39	265	0.537 J	0.248 J	4850	47.4	15.2	38.8	30600	18.3	5780	639	0.0372 J	32.6	1580	< 0.0822 UJ	453	0.365 J	76.4	58.3
Q001TR002	10/29/2002	3 - 3.5		29300	3.45 J	6.76 J+	335 J-	0.555 J	0.168 J	4600	52	26.5	38.9	31400	18.4 J-	5840	1500 J-	0.0294 J	42.3	1350	< 0.0925 UJ	161	0.718	81	56.8
Number of Detects:				6	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	2	6	6	6	6
Total Number of Analyses:				6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Minimum Concentration:				24400	2.33	6.1	237	0.474	0.168	4060	40.9	7.61	33.9	26200	18.3	4830	328	0.0294	27.9	1350	0.109	97.4	0.323	67.8	51.3
Maximum Concentration:				31300	3.45	9.12	497	0.655	0.427	5600	52.7	38.9	44.8	39500	35.2	6740	682	0.0832	49.1	2670	0.143	453	0.718	85.6	67.7
Mean Detected Concentration:				28200	2.978	7.328333	204.3333	0.558	0.307167	4780	47.68333	19.46833	39.9	31283.33	17.21667	5795	207.6667	0.055266667	35.61667	1956.667	0.126	206.7333	0.422667	77.18333	60.83333

QUALIFIER LEGEND:

(blank) Unqualified result.
J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
J- The analyte was positively identified with low bias; the associated numerical value is the approximate concentration of the analyte in the sample.
J+ The analyte was positively identified with high bias; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Quarry 3
Detected Analytes in Soil

Detected A[illegible]es in Soil
SVOCs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	GAMMA_ELEMENE	1,5,5-TRIMETHYL-6-METHYLENE-CYCLOHEXENE	1H-CYCLOPROP_e_AZULENE, DECAHYDRO-1,1,7-TRIMETHYL-4	1H-CYCLOPROPA_A_NAPHTHALENE, 1a,2,3,3a,4,5,6,7b-OCTAHYDR	2-METHYL-5-91-METHYLETHYL) BICYCLO_3_1_0_HEX-2-ENE	4-AMINO-3-NITROTOLUENE (FAST RED DYE BASE)	4-METHYLPHENOL	bis(2-ETHYLHEXYL) PHTHALATE	N-HEXACOSANE (C26)	N-NONACOSANE (C29)	PARA RED DYE	p-CYMENE	TRIDECANOIC ACID
Q003SC006	October 29, 2002	0 - 0.5								< 0.096	0.33 J					
Q003SC007	October 29, 2002	0 - 0.5								0.14 J	< 0.089					
Q003TR002	February 12, 2001	4.5 - 5	SM	0.36 NJ		0.64 NJ	0.17 NJ	0.66 NJ	0.2 NJ	< 0.14	< 0.15			0.25 NJ		
Q003TR005	February 15, 2001	4 - 4.5	ML		1.5 NJ	3.7 NJ	1.4 NJ	7.5 NJ		0.12 J-	< 1 UJ	1.2 NJ	1 NJ		1.2 NJ	1.3 NJ
Number of Detects:				1	1	2	2	2	1	2	1	1	1	1	1	1
Total Number of Analyses:				10	10	10	10	10	10	10	10	10	10	10	10	10
Minimum Concentration:				0.36	1.5	0.64	0.17	0.66	0.2	0.12	0.33	1.2	1	0.25	1.2	1.3
Maximum Concentration:				0.36	1.5	3.7	1.4	7.5	0.2	0.14	0.33	1.2	1	0.25	1.2	1.3
Mean Detected Concentration:				0.36	1.5	2.17	0.785	4.08	0.2	0.01	0.33	1.2	1	0.25	1.2	1.3

QUALIFIER LEGEND:

(blank)	Unqualified result.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
J-	The analyte was positively identified with low bias; the associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analyte identification is presumptive. Reported value is an estimated concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Detected Analytes in Soil
PAHs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	BENZO(e)PYRENE	BENZO(b)FLUORANTHENE	BENZO(k)FLUORANTHENE
Q003TR005	2/15/2001	4 - 4.5	ML	0.0088 NJ	0.0083 NJ	0.0057 NJ
Number of Detects:				1	1	1
Total Number of Analyses:				3	3	3
Minimum Concentration:				0.0088	0.0083	0.0057
Maximum Concentration:				0.0088	0.0083	0.0057
Mean Detected Concentration:				0.0088	0.0083	0.0057

QUALIFIER LEGEND:

NJ The analyte identification is presumptive. Reported value is an estimated concentration.

Detected Analytes in Soil
VOCs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	ACETONE	BENZENE	EUCALYPTOL (LIMONENE OXIDE)	TOLUENE
Q003TR002	2/12/2001	4.5 - 5	SM	0.023	< 0.00035		0.00053 J
Q003TR005	February 15, 2001	4 - 4.5	ML	< 0.0037 UJ	0.00086 J	0.016 NJ	0.00081 J
Number of Detects:				1	1	1	2
Total Number of Analyses:				2	2	2	2
Minimum Concentration:				0.023	0.00086	0.016	0.00053
Maximum Concentration:				0.023	0.00086	0.016	0.00081
Mean Detected Concentration:				0.023	0.00086	0.016	0.00067

QUALIFIER LEGEND:

(blank)	Unqualified result.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analyte identification is presumptive. Reported value is an estimated concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample

Detected Analytes in Soil
TPHs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	DIESEL (C10-C24)	MOTOR OIL (C20-C36)
Q003SC001	10/29/2002	0 - 0.5		18 J-	27 J-
Q003SC002	10/29/2002	0 - 0.5		17 J-	25 J-
Q003SC003	October 29, 2002	0 - 0.5		99 J	71 J
Q003SC004	October 29, 2002	0 - 0.5		8.3 J	27 J-
Q003SC005	October 29, 2002	0 - 0.5		150 J+	110 J+
Q003SC006	October 29, 2002	0 - 0.5		120 J+	160 J+
Q003SC007	October 29, 2002	0 - 0.5		260 J+	150 J+
Q003TR001	February 8, 2001	8 - 8.5	SM	2.6	< 1.3
Q003TR002	February 12, 2001	4.5 - 5	SM	6.4	13
Q003TR005	February 15, 2001	4 - 4.5	ML	830	1100

Number of Detects:	10	9
Total Number of Analyses:	11	11
Minimum Concentration:	2.6	13
Maximum Concentration:	830	1100
Mean Detected Concentration:	144.13	169.4444

QUALIFIER LEGEND:

(blank)	Unqualified result.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
J-	The analyte was positively identified with low bias; the associated numerical value is the approximate concentration of the analyte in the sample.

Detected Analytes in Soil
Metals (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM, TOTAL	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	MOLYBDENUM	NICKEL	POTASSIUM	SELENIUM	SODIUM	THALLIUM	TIN	VANADIUM	ZINC
Q003TR001	2/8/2001	8 - 8.5	SM	18000	5.54 J	39.1	158	0.933	1.85	1740	112	5.47	8.3	65600	24.5	5350	123	0.089 J	2 J	25.2	4470	0.586	262	0.139 J	< 1.79 UJ	60.3	146
Q003TR002	2/12/2001	4.5 - 5	SM	10500	< 2.94	20.2	85.7	0.544	0.81 J	2830	41.6	5.44	11.2	28800	62.9	3790	185	0.065 J	1.79 J	13.5	2090	0.403 J	341	0.17 J	3.84 J	38.6	98.4
Q003TR005	2/15/2001	4 - 4.5	ML	17600	< 3.13	7.33	116	0.663	0.529 J	18300	38.1	8.08	10.5	27500	29.1	5640	702	0.177	2.54 J	18.2	2580	0.35 J	409	0.436	10.5	58.2	81.6
Number of Detects:				3	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
Total Number of Analyses:				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Minimum Concentration:				10500	5.54	7.33	85.7	0.544	0.529	1740	38.1	5.44	8.3	27500	24.5	3790	123	0.065	1.79	13.5	2090	0.35	262	0.139	3.84	38.6	81.6
Maximum Concentration:				18000	5.54	39.1	158	0.933	1.85	18300	112	8.08	11.2	65600	62.9	5640	702	0.177	2.54	25.2	4470	0.586	409	0.436	10.5	60.3	146
Mean Detected Concentration:				15366.67	5.54	22.21	119.9	0.713333	1.063	7623.333	63.9	6.33	10	40633.33	38.83333	4926.667	336.6667	0.110333	2.11	18.96667	3046.667	0.446333	337.3333	0.248333	7.17	52.36667	108.6667

QUALIFIER LEGEND:

(blank) Unqualified result.

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

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Detected A[illegible]tes in Soil
PCBs (mg/kg)

Location-ID	Sample Date	Depth (feet)	Soil Code	ALPHA-CHLORDANE	BETA BHC	DELTA BHC	DIELDRIN	ENDRIN ALDEHYDE	GAMMA-CHLORDANE	p,p'-DDD	p,p'-DDE	p,p'-DDT
Q003TR002	February 12, 2001	3 - 4.5, 6 - 7	SM	0.0042	< 0.00034	0.00061 J	0.0044	0.0023 J	0.0018 J	0.0016 J	0.003	0.018
Q003TR005	February 15, 2001	1 - 4, 4.5 -	ML	< 0.00013	0.0026	< 0.00017	< 0.00031	< 0.00021	< 0.00068	< 0.00019	< 0.0003	< 0.011
Number of Detects:				1	1	1	1	1	1	1	1	1
Total Number of Analyses:				3	3	3	3	3	3	3	3	3
Minimum Concentration:				0.0042	0.0026	0.00061	0.0044	0.0023	0.0018	0.0016	0.003	0.018
Maximum Concentration:				0.0042	0.0026	0.00061	0.0044	0.0023	0.0018	0.0016	0.003	0.018
Mean Detected Concentration:				0.0042	0.0026	0.00061	0.0044	0.0023	0.0018	0.0016	0.003	0.018

QUALIFIER LEGEND:

(blank) Unqualified result.

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