WOODWARD-CLYDE CONSULTANTS

93 SEP 29 AM 8:49

TRANSMITTAL

Date: 9/28/93
Project: 93C0243A

TO: Ravi Arulanantham, Ph.D.
ACDEH - Hazardous Materials Div.
80 Swan Way, Room 200
Oakland, CA 94621
phone 510/271-4320

SUBJECT: Verdese Carter Park, Oakland

Transmitted herewith, is an advance draft of the remediation workplan for your early review. I must stress that this has not been fully reviewed by staff, but does state the basics of the proposed remediation and much of the detail. The discussion of the site characterization has been updated to include the results of the "dirt strip" sampling along 98th Avenue and the results of the solubility testing. The solubility results in particular deserve comment. I look forward to discussing this workplan with you.

Sincerely,

Michael McGuire, P.E.
Project Engineer
phone 510/874-3288

93 SEP 29 AM 8:49

CONFIDENTIAL. PRIVILEGED
ATTORNEY CLIENT COMMUNICATION
AND ATTORNEY WORK PRODUCT.
RESTRICT DISTRIBUTION.

DRAFT

REMEDIATION WORKPLAN
VERDESE CARTER PARK

OAKLAND, CALIFORNIA

Prepared for

City of Oakland
City Attorney's Office
505 14th Street, 12th Floor
Oakland, CA 94612

September 21, 1993

Prepared by

Woodward-Clyde Consultants
500 12th Street, Suite 100
Oakland, CA 94607-4014

September 28, 1993
93C0243C

Ms. Vivian O'Neal, Esq.
City of Oakland
City Attorney's Office
505 14th Avenue, 12th Floor
Oakland, CA 94612

Re: Remediation Workplan
Verdese Carter Park Site Characterization Project
98th and Bancroft Avenues, Oakland

Dear Ms. O'Neal:

Woodward-Clyde Consultants (WCC) is pleased to submit this draft remediation workplan for Verdese Carter Park. This workplan describes the proposed criteria and procedures for remediation of the metals contamination found in some shallow soil areas of the site. I look forward to the comments of yourself and City staff to this draft document.

It is a pleasure to be of service to the City. Please call me at 874-3288 if you have any questions.

Sincerely,

Michael McGuire, P.E.
Project Manager

Enclosure

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIXES

1.0
INTRODUCTION

1.1 PURPOSE

Woodward-Clyde Consultants (WCC) was retained by the City of Oakland to prepare a remediation workplan for the soil contamination at the Verdese Carter Park site in Oakland, California. The preparation of this plan follows the recent field investigation, performed in May through August 1993 to characterize the shallow soil contamination at the Park (WCC 1993). The City initiated this field investigation due to observations of a yellow precipitate-like material found in cracks of the asphalt paved playcourts at the park and because of the site's environmental history. The results of the investigation found that elevated levels of lead, arsenic and/or zinc exist in shallow soil and imported gravel fill material at the site.

The purpose of this workplan is to describe the proposed criteria and procedures for remediation of metals contamination in shallow soils and fill material and subsequent certified closure of the site.

1.2 SCOPE OF WORK

The activities to be performed for the site remediation include the following tasks:

- Develop remedial objectives and clean-up criteria for contamination at the site.
- Remediate the site, primarily by excavation and offsite disposal of contaminated soil and material.
- Perform confirmation sampling at excavation sites.
- Perform closure certification of the remedial actions.

Each of these tasks are described in this workplan.

2.1 SUMMARY OF RESULTS OF SITE CHARACTERIZATION

WCC was retained by the City of Oakland to perform a site characterization at the Verdese Carter Park site in Oakland, California. A summary of the investigation and results of the investigation are described in the following sections. More detailed descriptions of site characterization activities and discussions of their results are presented in the Site Characterization Report (WCC 1993a) and subsequent supplemental reports.

2.1.1 Present Site Development

Verdese Carter Park is located in Oakland, California between 98th and 96th Avenues, and Bancroft Avenue and Sunnyside Street. The park covers approximately 3 acres. Low knolls, up to about 6 feet high, of grass-covered and tree-planted fill generally line the north, east, and southern perimeters of the park. The south side of the park is bordered by a mostly gravel covered, undeveloped strip of land approximately 40 feet wide and 280 feet long along the 98th Avenue frontage.

The park currently consists of a grassy field area on the southern side of the park, while the northern side of the park contains two basketball courts, a children's sandbox area, and a community center building. The general layout of the park is presented on Figure 1.

2.1.2 Site History

The southern half of the park, fronting 98th Avenue, was occupied by a wet cell battery factory from at least 1912 (the date of the earliest Sanborn Map of the site) until it was demolished in 1977 for construction of the park.

The northern half of the park, i.e., fronting on 96th Avenue, was occupied by a commercial greenhouse nursery from at least 1912 until sometime between 1968 and 1973, according to aerial photos.

Construction plans for the park indicate that the landscaped knolls were to be built up by cut and fill earthwork on the site, i.e., by excavating soil from one part of the site and placing it at another.

The City of Oakland acquired the properties circa 1975 and converted the site to a park in 1978. After acquisition of the land now occupied by the park, the City reportedly removed several thousand cubic yards of contaminated soil from the site.

Several soil sampling and analysis programs were performed at the former battery factory area in the 1970s to determine concentrations of lead in soil. Sampling was conducted by the City of Oakland, Alameda County Health Department (County), the California Department of Health Services (DHS), the University of California at Berkeley, and by a private concerned citizens group. Elevated lead concentrations were measured in shallow soil samples collected in 1978 prior to the second removal of contaminated soil discussed below.

In 1978, under the supervision of DHS and the County, approximately 1,700 cubic yards of lead contaminated soils located previously beneath the floor slab of the battery factory were reportedly removed to a depth of 12 inches, and replaced with 18 inches of clean soil.

2.1.3 Field Investigation Activities

The initial soil investigation was conducted in substantial accordance with the "Initial Soil Investigation Work Plan," dated April 29, 1993 and subsequently reviewed and approved by the Alameda County Department of Environmental Health (ACDEH).

Twenty soil borings for the initial soil investigation (WCB-1 through -20) were advanced between May 10 and May 14, 1993 (WCC 1993a). The approximate boring locations are shown on Figure 1.

Soil samples were collected from each boring at one depth within the fill material and at the following depth intervals beneath the fill soil placed for development of the park: 0.5-1.0 ft, 2.0-2.5 ft, 5.0-5.5 ft, 7.0-7.5 ft, and 10.0-10.5 ft.

CAM 17 metals scans by EPA Methods 6010/7000 series were performed on samples collected approximately 6 inches below the transition between the park fill and underlying pre-park soil to provide a screening-level identification of specific metals for further investigation as contaminants of concern. On this basis lead and zinc, and to a somewhat lesser degree arsenic were the focus of subsequent analysis of the remaining soil samples obtained from each boring.

Supplemental soil borings, WCB-21 through -26 (see Figure 1) were installed to better delineate the extent of soil contamination encountered in Borings WCB-13 and -14. The six supplemental borings were installed on July 24, 1993. Samples of soil were obtained at depths of approximately 0.5, 2, 5, and 7 feet beneath the bottom of the imported topsoil layer, aggregate base material, or imported soil backfill used in the 1978 removal action, whichever was appropriate for the particular boring location. The design grading plans for the park construction and lithology encountered during the initial soil investigation program were consulted to guide the field sampling. The soil samples were analyzed for arsenic, lead, and zinc.

The selective removal of pavement from the playcourts area was performed by WCC personnel on June 28, 1993. The purpose was to expose more of the staining observed in the aggregate base material penetrated by soil borings in the pavement areas. A grab sample (Court 1) of the aggregate base material was obtained that day and analyzed for a wide range of parameters. On July 8, a composite sample of the aggregate base material (Court 2) and of the precipitate substance (Crack 1) from various locations at the play court area was obtained and analyzed for a variety of total and soluble metals. The location of aggregate base samples Court 1 and 2 are shown on Figure 1. The location of precipitate sample Crack 1 is shown on Figure 2.

On July 30, nine discrete samples (8 primary and one duplicate) of the precipitate substance were collected from locations widely distributed over the play court area. The locations of these precipitate samples are shown on Figure 2. The samples were analyzed for pH, sulfide, sulfate, arsenic, lead, and zinc.

On August 2, surficial soil samples were obtained from the undeveloped 98th Avenue frontage area (WCC 1993b). The screening-level soil sampling was performed to address concerns that the gravel cover layer over the area might consist of the same arsenic-rich rhyolite found in the aggregate base material beneath the paved areas of the park. The sampling was also performed because previous soil sampling programs in the 1970s apparently did not include this area, although it too was occupied by the battery factory. Eleven soil samples (10 primary and 1 duplicate) were obtained from five locations (98-1 through -5) distributed across the unpaved frontage area. The samples included, where present, the gravel cover material and the upper two or three inches of the underlying pre-park soil. The soil samples were analyzed for arsenic, lead, zinc, and pH.

Selected representative soil samples from the initial and supplemental investigations have also been analyzed for soluble metals by a variety of test methods (WCC 1993c). The solubility analyses were performed to determine the state and federal waste classification of the contaminated soils and to assess their in situ leaching potential and subsequent potential threat to groundwater quality.

2.2 SUMMARY OF FINDINGS

Background Levels

"Background" soil parameters or concentration levels can be defined two ways: levels due to the natural geologic composition of the soil, and levels including those due to human-related activity but not related to operations or activities specific to the site being studied. The first definition is often referred to a "natural" background and the second as "anthropogenic" background. As an example of natural background, soil naturally contains various metals such as arsenic, lead, and zinc. The concentrations of each individual metal will depend on the particular soil type. As an example of anthropogenic background, surficial and shallow soils in urban areas and near roads often contain relatively high concentrations of lead due in part to past air pollution from leaded gasoline.

Assessment of background concentrations for this investigation did not include collection of samples from off site. In part, this was due to the knowledge that previous sampling by DHS in 1978 found high levels of lead in shallow soils at locations across the street from the park. These elevated concentrations of level could have been due to a variety of causes not necessarily related to the site and would be an unacceptable source of uncertainty if included in an anthropogenic background evaluation. Instead, the assessment of background levels relied on samples obtained from the site but at apparently uncontaminated locations.

Because cleanup concentration criteria for lead and zinc at the site would likely not be related to background levels, the estimation of the background concentration range for these metals at the site was based on a semi-qualitative review of results from apparently uncontaminated locations. By this method, natural background for lead was estimated to range up to 40 mg/kg, and zinc up to 80 mg/kg. However, because the cleanup criteria for arsenic would probably be related to background concentrations at the site, a more rigorous, statistically based estimate of the natural range of arsenic concentrations was performed. The calculation of estimated background levels of arsenic is summarized in Appendix --. The 95 percent upper confidence level concentration for natural background arsenic was estimated to be approximately 7 mg/kg.

<u>Arsenic</u>

Soil samples were analyzed for arsenic by the GFAA method. The results of the arsenic analyses are summarized on Table 2. Natural background for arsenic was estimated to range up to approximately 7 mg/kg for a 95 percent confidence level. Arsenic concentrations in soil samples above 7 mg/kg (except for apparent anomalies) are graphically presented on Figure 2.

Highly elevated arsenic concentrations, typically on the order of 400 to 500 mg/kg were found in the imported aggregate base material beneath the asphalt pavement of play courts and pathways. The arsenic levels in the underlying soil generally decrease to near background levels within 6 to 12 inches beneath the bottom of the aggregate base layer. This same aggregate material is present over much of the 98th Avenue frontage area, with measured concentrations ranging from 200 to approximately 450 mg/kg.

The slightly elevated arsenic concentration in the pre-park soil beneath the sandbox at WCB-7 (12 mg/kg at a depth of 18 inches) may be due to leachable arsenic in water runoff from the aggregate base material into the sandbox, the possible presence of this aggregate base material in subdrains beneath the sandbox, or may be an isolated occurrence. Arsenic concentrations in this boring returned to background levels within a depth of 3 feet.

Elevated arsenic levels are a secondary contaminant at the lead "hot spot" around WCB-13, which appears to be associated with the former battery factory (arsenic is a contaminant that can be associated with wet cell battery manufacturing and recycling, although at levels much less than lead). Elevated arsenic concentrations in this area appear to be limited to a depth of 3 feet or less.

There were a number of slightly to moderately elevated arsenic measurements that appear anomalous. At Borings WCB-10 and -11, both located in knolls on the former nursery area of the site, elevated arsenic levels up to 27 mg/kg were measured in some samples (B-10-1 at 10 mg/kg, B-11-2 at 27 mg/kg, and B-11-4 at 9 mg/kg). The source of the elevated arsenic concentrations is not apparent given that these knolls do not contain the aggregate base material found beneath the pavements, nor were elevated lead concentrations measured as would be expected if the arsenic was related to the battery factory. The elevated arsenic concentration of 9 mg/kg measured in sample B-22-4 from Boring WCB-22 also appears to be anomalous since it occurred in native soil at depth with no associated elevated lead or zinc, and arsenic levels in the overlying soil appeared normal. The elevated arsenic levels measured in samples obtained from Boring WCB-24 at depth beneath a paved area are suspect given the lack of elevated lead or zinc concentrations, the erratic distribution of the concentrations with depth, and the depth of apparently elevated concentrations being several feet deeper than those encountered elsewhere at the site. The arsenic concentration of 17 mg/kg measured in sample B-25-6 obtained from a depth of 5 feet from WCB-25 in a paved area also appears suspect since aggregate base material was reportedly sloughing in the boring during drilling, thus possibly contaminating the sample of native soil with foreign material, and is suspect because of the significant depth of the sample and the lack of associated elevated lead or zinc concentrations. We recommend that these anomalous arsenic measurements be disregarded in the planning of the site remediation since, if valid, they are still generally only slightly elevated and at depths well removed from likely human exposure.

The precipitate-like substance found in pavement cracks contains elevated concentrations of arsenic (sample concentrations of 7 mg/kg to 33 mg/kg averaging 19 mg/kg), but at concentrations significantly below those found in the underlying aggregate base.

To support federal RCRA waste classification of contaminated soils should the site be remediated by their excavation and disposal, TCLP (Toxicity Characteristic Leaching

Procedure) tests for soluble arsenic were performed on representative samples of aggregate base material and soil. The results were well below the RCRA characteristic level for arsenic of 5 mg/l.

The California non-RCRA criteria for definition of hazardous waste for disposal purposes based on total metal concentration is the Total Threshold Limit Concentration (TTLC) contained in CCR Title 22. The TTLC criteria for arsenic is 500 mg/kg. Of all the samples obtained during this investigation, only the aggregate base material contained arsenic concentrations close to or exceeding the TTLC. Samples of the aggregate base material were generally in the range of 400 to 500 mg/kg with a highest sample concentration of 734 mg/kg. On this basis, it appears that the aggregate base material likely exceeds TTLC criteria overall.

A sample of the aggregate base material (sample Court-2) was analyzed for soluble arsenic using the California Analytical Method Waste Extraction Test (WET) for comparison to California CCR Title 22 Soluble Threshold Limit Concentration (STLC) criteria for identification of hazardous waste for disposal purposes. A summary of the results is presented in Table 4. The soluble arsenic concentration in the aggregate base material by this test was 8.8 mg/L, above the STLC soluble arsenic criteria of 5 mg/L.

A modified WET test of sample Court-2 using deionized water was also performed to more realistically assess the in-place or in situ leachability of arsenic due to rainfall and watering of the adjacent lawn areas of the park. The soluble arsenic concentration was significantly less (less than 0.05 mg/L).

Lead

Soil samples were analyzed for lead by EPA Method 6010. The results of the lead analyses are summarized on Table 2. Natural background for lead was semi-qualitatively estimated to range up to 40 mg/kg. Based on the site's location in a highly urban area and next to major thoroughfares, i.e., Bancroft and 98th Avenues it was anticipated that anthropogenic background lead levels in surface soil would probably be significantly higher. For this reason, "elevated" concentrations of lead for this investigation were defined as 100 mg/kg or higher.

Highly elevated lead concentrations were encountered beneath some of the landscape knolls, e.g., in the vicinity of Boring WCB-13. At other knolls no elevated lead concentrations were encountered, e.g., at WCB-10.

At the knoll in the vicinity of WCB-13 and WCB-23, about halfway along Bancroft Avenue in the general area of the former battery factory's aboveground storage tanks and rail spur the extent of contamination appears to include the entire knoll. Lead concentrations as high as 6,700 mg/kg were encountered, and were generally higher than the TTLC for lead of 1,000 mg/kg. The depth of contamination in this area ranges from 1 foot to approximately 6 feet beneath the ground surface, and includes the park fill material used to build up the knoll and also extends into the pre-park soil zone underneath.

Boring WCB-15 at another knoll in the former battery factory area also encountered elevated lead, 1,520 mg/kg at a depth of 2 feet but not deeper than 3 feet. This high lead concentration was in the park fill material. Lead concentrations at this location were not elevated in the pre-park soil underneath. It is not possible on the basis of a single boring to assess whether the contamination encountered at this location encompasses the entire knoll.

Significantly elevated lead concentrations were also encountered in one knoll in the former nursery area, i.e., not within the battery factory area. Here, WCB-12 encountered elevated lead concentrations as high as 502 mg/kg at a depth of 4.5 feet in the park fill. WCB-11, also located on this knoll, but behind the community center building, did not encounter elevated lead concentrations.

Elevated lead concentrations were also encountered in the aggregate base material beneath the asphalt paved play courts and pathways. Lead concentrations in this material were generally in the range of 400 to 600 mg/kg, with a highest measured concentration of 734 mg/kg in sample Court-2. The depth of significant contamination in the underlying soil appears to be limited to a depth of 6 to 12 inches beneath the bottom of the base material.

The precipitate-like substance found in the pavement cracks does not contain significant concentrations of lead (sample concentrations of 6 mg/kg to 35 mg/kg).

Elevated lead concentrations were encountered at the undeveloped 98th Avenue frontage area both in the gravel cover material and in the underlying pre-park soil. Lead concentrations in the gravel material, which appears to consist of the same rhyolite rock fragments used as aggregate base material in the paved areas of the park, were generally in the range of 200 to 300 mg/kg. Lead concentrations in the pre-park soil immediately beneath the gravel ranged from slightly to highly elevated. Significantly elevated lead concentrations in the soil were encountered at two sampling locations. At location 98-1, located toward the Sunnyside Street end of the frontage area, a lead concentration of 1,990 mg/kg was encountered. Sanborn Map and aerial photograph data for the battery factory show that this location may have been occupied by a narrow uncovered space between factory buildings or was within the main factory building and designated in at least one Sanborn Map as a "storage area". At location 98-5, located toward the Bancroft Avenue end of the frontage area, a lead concentration of 6,480 mg/kg was encountered. This area was once occupied by a loading area and rail spur for the battery factory. Since only surficial soil samples were obtained, it is not currently known the depth extent of lead contamination at these areas. However data at other areas of the battery factory indicate that the depth extent of significant lead contamination in pre-park soils was generally limited to a few feet.

A sample of the aggregate base material (sample Court-2) was analyzed for soluble lead using the WET test for comparison to the STLC criteria for soluble lead for California non-RCRA classification of hazardous waste for disposal purposes. The results are presented on Table 4. The soluble lead concentration in the aggregate base material by this test was 0.4 mg/L, well below the STLC criteria of 5 mg/L.

To support federal RCRA waste classification of contaminated soils should the site be remediated by their excavation and disposal, TCLP tests for soluble lead were performed on representative samples of aggregate base material and soil (see Table 5). Non-anomalous results were well below the RCRA characteristic level for lead of 5 mg/l.

Modified TCLP tests using deionized water were also performed on selected samples. These tests were performed to assess the in situ leachability of lead contamination, an important consideration for development of remedial cleanup criteria protective of groundwater quality. It was assumed that the groundwater protective cleanup level would be approximately 1,000 mg/kg. Selected samples with reported total lead concentrations in the range of 200 mg/kg to 500 mg/kg were selected for analysis (none in the range of 600 to 900 mg/kg were available). The results of the analyses are summarized on Table 6. The ratio of total to soluble lead (also called the leachability factor) was not consistent over the range of samples analyzed.

A modified WET test of sample Court-2 using deionized water was also performed to assess the in-place or in situ leachability of lead due to rainfall and watering of the adjacent lawn areas of the park (see Table 3). The soluble lead concentration was much less than the standard WET result; less than 0.03 mg/L.

Zinc

Soil samples were analyzed for zinc by EPA Method 6010. The results of the zinc analyses are summarized on Table 2. Natural background for zinc was semi-qualitatively estimated to range up to 80 mg/kg.

Slightly elevated zinc concentrations up to approximately 150 mg/kg were encountered in some of the park fill soil in the knolls and in the pre-park soil in the former battery factory area (including the 98th Avenue frontage area). A markedly higher zinc concentration of 515 mg/kg was detected at a depth of one foot in the pre-park soil at WCB-13, still well below the TTLC of 5,000 mg/kg.

Higher zinc concentrations were encountered in the aggregate base material beneath the play courts and asphalt pathways and in the underlying soil. Zinc concentrations in the aggregate base and immediately underlying soil were generally in the range of 300 to 600 mg/kg. The depth of significant contamination appears to be limited to a depth of 12 inches to 2-1/2 feet beneath the bottom of the base material. Zinc concentrations were similar in the gravel cover material at the 98th Avenue frontage area.

The precipitate-like substance found in some of the pavement cracks contains high levels of zinc generally in the range of 6,000 to 8,000 mg/kg.

TCLP tests for soluble zinc were not performed since zinc is not a RCRA toxicity characteristic metal. Also, modified TCLP test using deionized water were not performed since there is not a primary drinking water Maximum Concentration Level (MCL) for zinc, i.e., zinc is not a regulated contaminant in drinking water based on human health risk.

A sample of the aggregate base material (sample Court-2) was analyzed for soluble zinc using the WET test and a modified WET test using deionized water to assess the in situ leachability of zinc due to rainfall and watering of the adjacent lawn areas of the park (see Table 4). The soluble zinc concentration by the WET test was 4.1 mg/L. The soluble zinc concentration using deionized water, supposedly a much less aggressive leaching procedure, was not significantly less (3.3 mg/L).

pH

Selected samples of soil were analyzed for pH by EPA Method 9045. A summary of the pH results are presented on Table 2. Background or natural soil pH was estimated to range approximately between about 6 and 8.5. pH was included as an analytical parameter for several reasons:

- to identify possible acids contaminated soil that might pose a health or environmental threat;
- to distinguish between different sources of soil metals contamination on the basis of their characteristic correlation with pH; and
- as a relatively inexpensive screening-level parameter indicating possible metals contamination associated with acid, e.g., battery acid.

The pH of the precipitate material in the pavement cracks was very low i.e., acidic, with measured pHs as low as 1.4 and generally below 2. The regulatory hazardous materials criteria for corrosivity is pH 2 or below.

The pH of the aggregate base material and immediately underlying soil was generally 3 to 3.5, i.e., acidic, with pHs ranging from 2.8 in sample Court-2 to 4.1 in sample B24-1.

The pH of the other fill and native soil units at the park was generally within the apparent background range, with a few sample measurements well into the basic range (sample B14-3 with a pH of 11 and sample B16-1 with a pH of 9.5) and acidic range (B19-2 at pH 3.7, B19-4 at pH 4.1, and B22-4 at pH 3.6). The cause of the basic or high pH is suspected to be due to the presence of concrete debris in the fill material.

Data Correlations

The aggregate base material beneath paved areas of the park and used as gravel cover over the undeveloped 98th Avenue frontage area is typified by the joint presence of significantly elevated concentrations of arsenic, lead, and zinc, and low pH in the 3 to 4 range. Soil beneath this material that appears to be impacted by leaching is generally typified by significantly elevated zinc and low pH in the 3.5 to 5 range, although not by significantly elevated arsenic and lead concentrations except in very close proximity to the base material.

Contamination in the pre-park soil in the former battery factory area is typified by elevated lead concentrations with zinc and sometimes arsenic as secondary contaminants (the elevated arsenic concentrations in the pre-park soil at the 98th Avenue frontage area are probably due in large part to the overlying arsenic-rich gravel material). The same is true of contaminated fill material in some of the knolls across the park. This fill material in the knolls is also geotechnically similar to the identified pre-park soil consisting of an older fill unit pre-dating the battery factory or nursery.

With the exception of the aggregate base material and impacted underlying soil, pH does not correlate well with arsenic, lead, or zinc concentrations.

General Contamination Distribution

There appear to be three distinct types or general patterns of contamination at the site. The first pattern is attributable to the aggregate base material beneath the play courts and pathways in the north half of the park. This material, which has tentatively been identified as a mixture of rhyolite rock fragments and residual silt, is distinctively yellow in color, is highly acidic, and contains significantly elevated concentrations of arsenic and lead, and to a lesser extent, zinc. This material preferentially leaches zinc relative to arsenic and lead.

The depth of lead and arsenic contamination in the underlying soil is generally limited to a depth of 6 to 12 inches, while the depth of zinc contamination is between 12 inches and 2-1/2 feet. The precipitate substance in found in some of the pavement cracks is derived from this material, and is itself distinctively yellow, very acidic, and contains high concentrations of zinc but low concentrations of arsenic and lead.

The second pattern is lead contaminated soil in the fill material used to construct some of the landscaped knolls. Its contaminant profile and geotechnical characteristics are the same as the pre-park soil zone (the intact older fill unit) encountered beneath the former battery factory area. This suggests that the knolls were developed at least in part by "cut and fill" earthwork from the former battery factory area during grading construction of the park. The contaminated soil within the knolls is covered by at least the 6 inches of clean topsoil placed to support lawn growth.

The third pattern is lead contamination in the pre-park soil zone along a portion of Bancroft Avenue under the former battery factory area. This area corresponds to the former location of aboveground acid tanks and railroad spur noted in historic Sanborn maps and aerial photos. This area is now occupied by the knoll in the vicinity of Borings WCB-13, -14, -22, and -23, and apparently was not included in the 1978 soil removal activities. The contamination here is typified by elevated lead, slightly elevated arsenic and zinc, and normal soil pH. The extent of contamination below the park fill and pre-park soil interface is apparently only a few feet.

<u>**Groundwater**</u>

Groundwater was not a subject of this investigation. Groundwater was not encountered in any of the borings installed for this investigation. Reportedly, groundwater in the area is encountered at a depth of approximately 30 feet.

3.0
REMEDIAL OBJECTIVES

3.1 DEFINITION OF OPERABLE UNITS

For remediation, it is convenient to divide the project site into operable units defined on the basis of their distinct contaminants of concern, sources and patterns of contamination, degree of potential or perceived health threat, and appropriate remediation techniques. For remediation planning and implementation, the project site is divided into four operable units:

- Paved Areas Operable Unit
- Community Building Operable Unit
- Knolls Operable Unit
- 98th Avenue Frontage Area Operable Unit

The Paved Areas Operable Unit includes the asphalt paved play courts and paths of the park, and as explained in Section 4, may also include the concrete pavement area around the community center building, the children's sandbox, and the planter strip between the sidewalk and curb along the Sunnyside Street next to the park. This operable unit consists of those areas where the primary source of contamination is the metals-rich rhylote aggregate that was placed for construction of the park and associated areas. It includes areas where the aggregate is uncovered, or is covered by pavement or loose soil. The primary contaminants of concern are arsenic and lead. The extent of contamination into the underlying soil is shallow, typically less than 12 inches.

The Community Building Operable Unit includes the aggregate base material beneath the community center building floor slab. While this building was not investigated during the site characterization, the building plans indicate that the floor slab is underlain by four inches of aggregate material. It is possible that this material is the same metals-rich rhyolite aggregate found beneath the asphalt paved areas. If present, the primary contaminants of concern would be arsenic and lead. Distinct from the Paved Areas Operable Unit, the aggregate base material here is relatively inaccessible to people and is isolated from the elements, being covered by a floor slab and overlying structure. The community center building is currently in good condition and the cost to demolish and rebuild it in order to remove the aggregate would be considerable.

The Knolls Operable Unit includes the low, landscaped knolls at various locations of the park. These knolls range in height up to approximately five feet. The primary contaminant of concern is lead from the battery factory that formerly occupied a portion of the park site. Specifically, it includes the fill soil within the knolls derived from cut and fill earthwork construction of the park and includes intact soil beneath the knolls predating construction of the park. The site characterization indicates that significant lead contamination, where present, in the pre-park soil zone is generally limited to a depth of a few feet beneath the knolls. These areas were apparently not included in the 1978 soil removal.

As the name suggests, the 98th Avenue Frontage Area consists of the unpaved, undeveloped frontage area between the park and 98th Avenue. The contaminant sources here include both the metals-rich ryholite aggregate used as a 3-inch thick gravel cover layer and operation of the battery factory, a portion of which formerly occupied this area. The primary contaminants of concern include lead and arsenic. Since only surface sampling has been conducted to date, the depth of contamination is not known, but based on findings at other areas of the park is not expected to be more that a few feet for battery factory-related lead contamination nor more than 12 inches for aggregate-related arsenic contamination. Post-remediation use for this area will be as a road and sidewalk as part of the long-planned widening of 98th Avenue.

3.2 REMEDIAL OBJECTIVES AND CLEANUP CRITERIA

In general, the objectives of the proposed remediation of Carter Park are:

- to protect human health from site-related soil contamination, particularly for sensitive receptors such as children. This may be accomplished by either decreasing the concentration of the contamination in question or by limiting exposure to the soil contaminants.

- to protect groundwater quality due to surface water infiltration and subsequent leaching of soil contamination. Groundwater was not a subject of the site characterization. This remedial objective does not include direct remediation of existing or future groundwater contamination, if present, but is instead limited to source control. This may be accomplished by limiting soil contaminants concentrations, decreasing the solubility of the contaminants, or isolating the contaminants from surface water infiltration.

- to reasonably address public perception of existing or potential human and environmental threats at the park, whether or not supported by the results of the site characterization or current environmental engineering practice. It is recognized that the environmental history of Carter Park is controversial with segments of the community, and there is wide concern regarding actual and potential human health threats, especially to children.

- to use remediation strategies that minimize the need for continued monitoring and maintenance.

- to minimize the likelihood that additional investigation or remediation of soil contamination will be required at the park. Considering the previous inconclusive attempts to define and remediate contamination at the park, the proposed remediation should be final and comprehensive.

The remedial objectives at some operable units may be accomplished at least in part by limiting the concentration of contaminants in soil. The allowable concentrations are the cleanup criteria. This criteria will vary by contaminant depending on their chemical and toxicological characteristics, the environmental setting of the soil contamination, and the remedial objectives.

For lead, the cleanup criteria should recognize the following factors:

- anthrogenic background concentrations of lead in surface soils in the neighboring areas are probably high.

- the primary human receptors of concern would be children, given their relatively high sensitivity to lead and the site's current and future use as a playground.

- the primary route of exposure is ingestion, which can be prevented by a physical barrier between the contaminated soil and people. Such a barrier could be a significant cover layer of uncontaminated soil or hard, durable pavement.

On this basis a basic cleanup criteria of 200 mg/kg is proposed, except where the contamination is or will be covered by at least 18 inches of soil containing less than 200 mg/kg lead or will be covered by a hard, durable material unlikely to be breached by children's activities. Where the exemption conditions are met, the cleanup criteria will be 700 mg/kg.

The 200 mg/kg criteria is generally accepted as protective of children and pregnant women, which are the most sensitive potential receptors, in the event of regular soil ingestion. When the contaminated soil is by 18 inches or more of relatively uncontaminated soil or other durable barrier, the risk of children breaching the barrier, such as by play digging, and thus ingesting the soil is not significant. In this case the cleanup criteria is based only on groundwater protectiveness. While also being reasonable, the 18-inch cover thickness is specified because the 1978 soil removal zone was covered with 18 inches of imported fill material.

The modified TCLP test results using deionized water were too inconsistent to provide a meaningful basis for estimating a lead concentration threshold protective of groundwater. Instead, the proposed cleanup criteria for groundwater protection are based on other factors. Recent experience at other sites found that lead concentration in soil over 1,000 mg/kg were protective of groundwater quality, even at sites underlain be sandy soil and a depth to groundwater of 15 feet. The soils beneath Carter Park are clay and the depth to groundwater is approximately 30 feet. Thus, a criteria of 700 mg/kg is probably conservative (it is recognized that the chemistry of the lead contamination at park due to battery factory processes could be distinctly different from that encountered elsewhere). Also, anthrogenic background levels of lead in the park area at or above this concentration are probably not uncommon. It would be inconsistent from a risk management standpoint to require that soil conditions at the park be more protective of groundwater than is common in the vicinity.

3.3 APPROACH AND RATIONALE FOR CONFIRMATION SAMPLING

The approach for confirmation sampling is based on locating potential "hot spots" missed during remediation. The U.S. EPA document "Guidance for Data Useability in Risk Assessment (Part A) Final," (Section 4, Steps for Planning for the Acquisition of Useable Environmental Data in Baseline Risk Assessments), dated April 1992, suggests and explains the sampling plan based on "hot spot" detection that we recommend for implementation at the subject site.

In accordance with the EPA guidance document cited above, the proposed approach for Verdese Carter Park removal action confirmation sampling is a sampling design that considers the purpose of the removal action. The objective of this removal action is to excavate the contaminated soils from the three areas of concern or operable units, as described Section 4.0. The remaining soils at the excavation surface will have contaminant concentrations that meet the approved clean-up standards. The number and location of confirmation samples will therefore verify, within the approved confidence level, that no further localized concentrations or "hot spots" of contaminants of concern, remain within the excavated area.

As mentioned above, the method that will be applied to confirmation sampling site-wide is one that targets "hot spot" locations. The main assumption of this formula is estimating what the radius (R) of the hot spot is within the excavation. For Verdese Carter Park, a recommended radius (R) of 56 feet will be used for common residential lot sizes at a confidence level of 95% that no hot spot exists. The following equations are used to calculate the diameter of sampling locations based on the preferred radius (R) of 56 feet and a confidence level (P(H/E)) of 95%. The diameter of the hot spot target is D.

In general, samples will collected on an approximate 50-foot-by-50-foot grid system at Verdese Carter Park. The grid system itself will preferentially target remediation areas and will be selected by operable unit. Therefore, samples will be collected slightly more frequently than the 56 foot radius would otherwise dictate, providing more confirmation sampling.

The actual locations and precise number of confirmation samples will be determined in the field. ~~However, preselected random and preferred sampling locations are shown on Figure~~

~~D-1.~~ Additional samples may be collected in particularly suspect areas. All final sample locations will be recorded by a field survey.

4.1 GENERAL PROCEDURES

Remediation activities proposed for Verdese Carter Park include the removal and offsite disposal of contaminated soil from the Knolls, Paved Areas, and 98th Avenue Frontage Operable Units, and containment in place of any rhyolite gravel that may underlie the Community Center Building Operable Unit. This section describes the common or general procedures that will be implemented for the contaminated soil removals. Subsequent sections describe particular aspects of the remediation applied to the separate Operable Units.

In general, the removal of contaminated soils will include:

- excavation of contaminated soil and related materials;
- temporary stockpiling of excavated soil;
- offsite transport and disposal of stockpiled soil;
- dust suppression measures during all onsite soil handling and storage activities;
- decontamination of equipment and offsite transport vehicles;
- air quality and health and safety procedures monitoring during remediation;
- confirmation sampling of completed excavations;
- overexcavation if indicated by results of confirmation sampling;

Excavation is anticipated to involve standard earthmoving equipment such as backhoes and front end loaders. The maximum depth of excavation at any operable unit is not expected to be more than five feet below the surrounding grade, and generally much less (see below). The areas to be excavated will be staked prior to construction and excavation depth measured during construction.

Excavated soils and related materials will be temporarily stockpiled onsite. It is anticipated that the paved play courts area of the park will be used as much as possible as a stockpiling site.

Stockpiled soil will be loaded into fully covered, truck-borne volume containers such as rolloff bins or inter-modal transport containers. The trucks will approach and leave the site by an approved route and will enter and exit the site under traffic control.

While much of the contaminated soil that will be removed is classifiable as a California non-RCRA hazardous waste, it generally does not meet RCRA hazardous waste criteria. The excavated soil will be disposed at the permitted non-RCRA waste landfill operated by ECDC at East Carbon, Utah. If excavated soil is identified as a RCRA hazardous waste, it will instead be disposed at the permitted RCRA waste landfill operated by USPCI at Grassy Mountain, Utah.

Dust suppression measures will be employed during all earthmoving and soil storage operations and for exposed excavations. Specifically, large-volume water sprays will be directed onto active excavations and stockpiles and during all soil handling activities. Inactive excavations and stockpiles will be fully covered with weighted tarps. Surface water and sediment runoff from dust suppression activities will be contained onsite and managed in an approved manner.

All earthmoving equipment and vehicles leaving the site will first be decontaminated using water sprays at an onsite facility to be constructed. Personnel decontamination facilities will also be operated. The site-specific Health and Safety Plan (Appendix A) describes the proposed decontamination procedures in detail. Water and sediment runoff from decontamination activities will be contained and managed in an approved manner.

A site-specific Health and Safety Plan and Exposure Monitoring Plan has been developed for the remediation (Appendices A and B). As described in the Health and Safety Plan, we will monitor compliance of onsite personnel with health and safety procedures. We will also conduct air quality sampling and airborne dust measurements to monitor the effectiveness of dust suppression measures. Full time site security against trespassers will be maintained, including a perimeter fence with a mesh visual barrier and view ports provided at regular intervals. The security procedures will also include a 24-hour security service.

We will also conduct confirmation sampling of provisionally completed excavations. Based on the results, the excavation will be certified as completed or supplemental overexcavation will be ordered.

The particulars of the proposed confirmation sampling approach are described in the Confirmation Sampling Plan (Appendix E). If all of the confirmation samples obtained from the bottom of a provisionally completed excavation meet the cleanup criteria, then the project remedial objectives will have been satisfied in that area and the excavation will be backfilled as needed to support site restoration. If one or more samples in the excavation do not meet the cleanup criteria, then additional excavation and resampling will be required. The depth of overexcavation prior to resampling will be decided on a case-by-case basis by the Project Engineer. The lateral extent of the overexcavation will be approximately midway between the complying and noncomplying confirmation sampling locations. Confirmation resampling will occur at the same locations as the initial noncomplying samples.

Completed excavations will be lined with a durable, permeable geofabric prior to backfilling to serve as a long-term marker of the actual excavation limits. At the completion of the site remediation, a survey plat will be prepared of the location, extent and depth of the completed excavations. A notice will be entered into the deed of the park site of the remediation activities. Upon achievement of the project remedial objectives, site closure will be certified by a registered California engineer.

4.2 PAVED AREAS OPERABLE UNIT

The remedial action for this operable unit will include the removal of the aggregate base material beneath the asphalt pavement and removal of underlying soil not meeting the cleanup criteria. The remedial action will also include the removal of aggregate base material and underlying soil beneath the concrete pavement in the vicinity of the community building if the aggregate base material there is found to be similar to the aggregate material beneath the asphalt paved areas.

Removal activities of the asphalt paved areas will include lateral overexcavation of soil approximately 6 inches away from the edge of the pavement. This will be done to address possible soil contamination due to horizontal leaching from the contaminant source aggregate material. At least 6 inches of soil beneath the aggregate base layer will also be removed to address contamination due to horizontal or downward leaching of contaminants.

The site characterization did not include the concrete pavement around the community building. However, it is possible that the aggregate base material beneath this pavement is similar to the rhyolite aggregate beneath the asphalt areas. During removal of the adjoining asphalt pavement, the aggregate material beneath the edge of the concrete area will be exposed. If it appears to be rhyolite aggregate, the removal work will include the concrete pavement in the same fashion as the asphalt areas. If the exposed aggregate does not appear to be ryholite, a sample will be obtained for analysis for lead and arsenic. If the results exceed the cleanup criteria the concrete pavement area will be included in the removal.

Design plans for the park imply that rhyolite aggregate material was also placed in the open planter strip between the sidewalk and the curb along Sunnyside Street adjacent to the park. The planter strip has not yet been investigated, but will be during the mobilization of the remediation construction. This planter strip is approximately four feet wide and is expected to be overlain by a 3 inch thick layer of aggregate. If this material appears to be rhyolite or if screening level sampling and analysis detects high levels of arsenic or lead, the aggregate and underlying soil will be removed as the asphalt paved areas.

The sand from the sandbox area will be removed during the remediation activities for aesthetic reasons and because of public perceptions regarding health risks. If ryholite gravel is found beneath the sand, for example as subdrain rock, the gravel and the underlying soil will be removed in the same fashion as the asphalt areas.

As described in the Confirmation Sampling Plan, confirmation sampling will consist of grid based sampling in the courts areas and lineament-based sampling in the pathways and planter strip. If included in the remediation, sampling in the concrete paved area around the community building will be lineament-based. If included in the remediation, the basis for locating confirmation samples beneath the sandbox will depend on the distribution and extent of ryholite aggregate material that was found after removal of the overlying sand.

4.3 COMMUNITY BUILDING OPERABLE UNIT

While the community building was not included in the site characterization, it is possible that the building floor slab is underlain by the same rhyolite aggregate material as found at the asphalt paved areas, particularly if this material is found beneath the concrete pavement skirting the building. Even if present beneath the building, it is not practical or warranted to remove it at this time since it would necessarily involve removal of the floor slab. The floor slab and overlying building structure is currently in serviceable condition providing an effective barrier to potential exposure. During normal periods the building and associated drainage system also provides an effective barrier to possible surface water infiltration to the aggregate and subsequent leaching of contaminants. Saturation of the aggregate would probably only occur irregularly in the case of major plumbing leaks or flooding of the building. The rhyolite aggregate, if present, could be conveniently removed at some future time when the overlying building is demolished due to age or change in land use.

However, certain measures will be taken at the building during the remediation project to address public perceptions of health risks if it appears likely that the building is indeed underlain by rhyolite aggregate. If the adjacent concrete pavement is removed because ryholite aggregate is encountered beneath (see the discussion regarding contingent removal of concrete pavements in the Paved Areas Operable Unit), we will expose the subgrade edge of the building at selected locations. If a continuous strip foundation footing is observed then no further action will be taken since a high degree of lateral containment is already provided. If spread footings are encountered such that aggregate beneath the slab is exposed at the building edge, a sample of the aggregate will be obtained. If the aggregate appears visually to be rhyolite or if analysis detects high levels of arsenic or lead, then a subsurface concrete "skirt wall" will be constructed around the building to achieve the same containment as a continuous strip footing. Gaps in the skirtwall will be required to accommodate pipes and possible flood relief drains.

4.4 KNOLLS OPERABLE UNIT

The remedial action for this operable unit will include the removal of fill material within all the knolls at the park, except where impractical due to proximity to existing structures and utilities. Also, soil beneath the knolls will be selectively removed if not meeting the cleanup standard. This is expected to be the case only in the former battery factory aboveground storage tank and rail spur area beneath the knoll near Bancroft Avenue.

All knolls are proposed for removal, irrespective of the sampling results at individual knolls, for two reasons. One of the remedial objectives of the project is to minimize the likelihood that additional investigation or remediation will be required at the park at some later date. As much as possible, the proposed remediation is to result in final environmental site closure. Due to the irregular lateral distribution of contamination found during the site characterization, it is recognized that future sampling efforts could occasionally encounter additional significant contaminant concentrations in knolls or parts of knolls where none was detected earlier. Another remedial objective is to reasonably address public perceptions regarding potential human health threats at the park, whether or not supported by the results of the site characterization and current environmental engineering practice. The process that produced the knolls, i.e., the reuse of onsite soil, is likely perceived to have resulted in an inherent health threat by segments of the public.

The depth of excavation of the knoll fill will be guided by the results of a spot elevation survey that was performed before construction of the park. The results of that survey are shown on park design grading plans. The expected or nominal depth of the transition between the knoll fill and the pre-existing soil below as indicated by the design grading plan has been adjusted to account for removal of the battery factory floor slab (the preconstruction survey was performed before demolition of the factory floor slab) and the existing surface grade as measured by a recent survey. Since the knoll fill is generally the same geotechnically as the pre-existing soil beneath, lithology is not expected to be a reliable guide in the field for locating the actual fill unit transition at most knolls.

The knolls will be overexcavated approximately 6 inches beneath the nominal depth of the fill unit transition to account for measurement errors, differences between the nominal and actual depth of fill, and possible contamination of underlying soil due to mixing during fill placement or contaminant leaching.

A portion of the knoll along Bancroft Avenue in the former rail spur and aboveground storage tank area will be further overexcavated to remove preexisting lead contamination that was not addressed by the 1978 soil removal. The depth of overexcavation here will be guided by the boring logs and analytical results of the site characterization. The lateral extent of this overexcavation is expected be approximately midway between borings that encountered this deeper contamination and borings that did not. The depth of overexcavation is expected to be approximately 3 feet (to Elevation 32 COO). Further overexcavation at this and other knolls will depend on the results of the confirmation sampling.

Hydrocarbon-like odors and possibly hydrocarbon stained soils were noted during drilling at a depth of approximately five to nine feet at Boring WCB-21. Soil samples were not obtained from this zone for analysis. This zone may be located within the excavation. Health and Safety procedures during excavation will address the possibility that hydrocarbon contaminated soil will be encountered.

Confirmation sampling for the Knolls Operable Unit will be grid-based.

4.5 98TH AVENUE FRONTAGE AREA OPERABLE UNIT

The remedial action for this operable unit, which includes both rhyolite aggregate and battery factory related contamination will include the removal of the rhyolite gravel cover layer and soil not meeting the cleanup criteria. The remedial construction may also include subexcavation of soil to accommodate planned roadway and sidewalk construction.

The rhyolite gravel currently covers a large portion of the operable unit, primarily on the 98th Avenue side of the curb that was recently placed through the frontage area. This curb, which was constructed prior to inclusion of the 98th Avenue frontage area in the site characterization, is part of a long-planned widening of 98th Avenue. Remaining construction for the street widening project includes subexcavation of soil to place a new road pavement and a sidewalk. The depth of excavation in the frontage area to accommodate the new road is approximately 22 inches, and approximately 6 inches to accommodate the new sidewalk (**Joe Abron**- is this true?). At least a further 6 inches will be subexcavated in the road and sidewalk areas and backfilled with imported soil to provide an uncontaminated working platform for later road construction work. The depth of subexcavation will be increased if required by the confirmation sampling.

Confirmation sampling in this operable unit will be a combination of grid-based sampling and post-excavation resampling at the site characterization-phase surface sample locations.

5.1 OVERALL PROTECTIVENESS

The proposed remediation is protective in that it removes soil contamination posing a significant potential human health and groundwater quality threat. Containment in place of metals-rich aggregate beneath the community center building is also protective because the overlying building already provides a high degree of protection against human exposure and surface water infiltration or other agents of leaching and erosion. The aggregate beneath the building, if present, could be conveniently removed at a future time. Protection of the community and remediation workers during the remedial construction will be ensured by the procedures outlined in the Site Safety and Exposure Monitoring Plans, notably minimization of fugitive dust emmissions by keeping contaminated soil wetted during excavation and handling and monitoring the effectiveness of dust suppression efforts.

5.2 EFFECTIVENESS

5.2.1 Long-Term Effectiveness

Evaluation of long-term effectiveness includes consideration of the magnitude of human health and environmental risk after completion of the remediation, reliability of the engineering controls employed during construction, and maintenance requirements for the remedial actions.

Following the planned completion of the proposed remediation, some lead or arsenic contamination will remain in at least some areas. However the degree of contamination will not pose a significant human health or environmental threat. It is anticipated that the cleanup criteria will be satisfied at all excavation areas by a wide margin. The basic cleanup criteria for shallow soils is protective of children and groundwater. The cleanup criteria for deeper soils is protective of groundwater and the soil is too deep or otherwise inaccessible to children to pose an ingestion hazard. The uncontaminated soil or pavements wich will be placed over completed excavations will prevent erosion and migration of remaining contamination.

The remediation strategy is inherently reliable. The different operable units are clearly described and readily identifiable in the field. By removing all knolls and subexcavating a nominal 6 inches below into the pre-park soil zone, the contaminated soil encountered in the knolls will be remediated in as reliably complete manner as possible. The rhyolite aggregate base material is located in clearly distinct areas and is identifiable visually. Control of the depth and lateral extent of excavation is straightforward, relying on easily performed survey measurements. Confirmation that remedial objectives have been achieved is based on a sampling scheme tailored to individual operable units and is justifiable from a health risk basis and both statistically and deterministically, as well as being implementable in the field with good survey control.

The only post-remediation maintenance requirements are periodic inspections of the condition of the community center building, particularly the floor slab.

5.2.2 Short-Term Effectiveness

The evaluation of short-term effectiveness considers protection of the community and remedial workers and the time required to achieve the remedial objectives once construction begins. The community will be protected during the remediation by rigorous dust control measures and air quality testing to monitor their effectiveness as described in the Exposure Monitoring Plan. The community will also be protected by site access restrictions and an approved traffic plan for trucks hauling contaminated soil offsite. Remedial workers will be protected by personnel protection equipment such as respirators, decontamination procedures and facilities, and full time monitoring of compliance with the procedures mandated in the Site Safety Plan. Once construction is initiated, the remediation work should be completed in a matter of weeks. The remedial objectives will be met once the confirmation sampling demonstrates that excavation cleanup criteria have been achieved and the excavation sites are backfilled with clean soil or pavement.

5.3 FEASIBILITY

The proposed remediation is technically feasible. It employs standard earthworking, dust suppression, and monitoring techniques. Unanticipated conditions would probably consist of deeper than expected contamination or the presence of large debris left behind from the demolition of the former structures on the site. Deeper excavation and the presence of debris can be addressed by larger or specialized equipment. The required construction expertise and equipment is readily available in the Bay Area.

TABLES

93 SEP 29 AM 8:49

DRAFT

Table 1. Summary of Soil Results for pH and CAM 17 Metals (mg/kg).

Sample	pH	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
TTLC		500	500	1000	75	100	2500	8000	2500	1000	20	3500	2000	100	500	700	2400	5000
B-01-3	7.29	<15	5.09	194	<0.75	<1	44.6	8.31	25.4	88.7	0.1	<2.5	34	<15	<1	<20	56.8	72.3
B-02-1	6.26	<15	5.3	279	<0.75	<1	62.6	10.3	27	11.9	0.11	<2.5	51.7	<15	<1	<20	68.3	621
B-03-1	3.87	<15	18.8	224	<0.75	<1	59.1	4.78	78.3	13.2	<0.05	<2.5	30.6	<15	<1	<20	67.2	299
B-03-2	5.58	<15	8.1	244	<0.75	<1	60.5	9.2	38.5	10.9	0.06	<2.5	44.5	<15	<1	<20	66.7	326
B-04-2	3.41	<15	7.07	187	<0.75	1.51	53.6	7.05	84.6	10.9	<0.05	<2.5	37.4	<15	<1	<20	59.9	404
B-05-2	3.80	<15	5.02	106	<0.75	<1	57.8	12.6	29.9	12	<0.05	<2.5	52.5	<15	<1	<20	64	497
B-06-1	6.95	<15	<5	206	<0.75	<1	63.7	6.77	49	12.4	<0.05	<2.5	49.2	<15	<1	<20	75.1	62.7
B-07-1	6.85	<15	11.6	100	<0.75	<1	77.3	10.6	70.1	9.87	<0.05	<2.5	61.2	<15	<1	<20	72.1	76.5
B-08-2	4.79	<15	13.9	249	<0.75	1.09	56.2	13.4	30.9	13.7	<0.05	<2.5	50.2	<15	<1	<20	77.3	464
B-09-1	4.73	<15	7.24	150	<0.75	<1	56.8	9.42	24.9	8.14	<0.05	<2.5	48	<15	<1	<20	57.9	538
B-10-4	7.01	<15	6.64	176	<0.75	<1	55.6	8.98	30.9	13.8	<0.05	<2.5	36.5	<15	<1	<20	58.1	53.7
B-11-4	7.00	<15	9.38	222	<0.75	<1	54.8	10.3	30.8	41.6	0.17	<2.5	37.9	<15	<1	<20	64.1	67.1
B-12-3	7.44	<15	<5	260	<0.75	<1	53.8	19.9	33.6	95.1	0.11	<2.5	47.8	<15	<1	<20	67.2	103
B-13-1	7.66	<15	96.6	514	<0.75	1.13	49.6	7.86	49.4	1160	0.25	<2.5	35.7	<15	<1	<20	67.9	515
B-14-2	7.90	<15	5.89	239	<0.75	<1	60.9	4.79	34.5	484	0.07	<2.5	33.1	<15	<1	<20	49.6	65.6
B-15-4	7.43	<15	<5	156	<0.75	<1	64.3	12.4	81.4	9.61	<0.05	<2.5	57	<15	<1	<20	52.8	75
B-16-2	7.14	<15	<5	240	<0.75	<1	63	10.2	40.7	8.82	<0.05	<2.5	44.4	<15	<1	<20	62.5	52.4
B-16-3	6.99	<15	<5	148	<0.75	<1	52.4	10.1	38.7	6.97	<0.05	<2.5	39.2	<15	<1	<20	43.9	49.7
B-17-2	6.73	<15	<5	250	<0.75	<1	73.9	13.2	46.4	10.4	0.21	<2.5	73.3	<15	<1	<20	73.8	67
B-18-2	6.39	<15	<5	184	<0.75	<1	90.5	9.2	54	7.47	0.15	<2.5	54.7	<15	<1	<20	74.7	68.4
B-19-2	3.65	<15	<5	114	<0.75	1.8	72.5	8.12	58.9	20.2	0.11	<2.5	34.5	<15	<1	<20	64	72.4
B-20-2	7.37	<15	5.14	137	<0.75	<1	59.7	6.22	66.1	13.6	<0.05	<2.5	49.1	<15	<1	<20	51.7	73.2
COURT-1	3.0	10.7	397	612	<0.5	<0.5	3.2	<1.0	48.3	594	4.72	11.9	4.1	2.9	5.9	47.7	0.9	291
COURT-2	2.80	16.2	734	332	<0.5	<1.0	43.3	1.2	8.4	692	6.28	16.6	3.1	3.4	9.8	62.1	2.9	443
CRACK-1			14.4							5.5	<0.25							2540

Note: Shading indicates result was greater than TTLC.

Table 2. Summary of Soil Results for pH and Arsenic, Lead, and Zinc (mg/kg).

Sample	Depth (feet)	pH	Arsenic	Lead	Zinc	Comments	
TTLC			500	1000	5000		
B-01-1	0.5	7.25	11.1	116	94.7	PF	
B-01-2	3		10.4	39.9	140	PF	
B-01-3	4.5	7.29	5.09	88.7	72.3	OF	
B-01-4	6	7.25		8.21	41.8	OF	
B-01-5	7.5			<5	41.1	OF	
B-01-6	10.5	8.23					
B-01-7	11	8.25		7.57	54.2		
B-01-8	13.5	8.30					
B-01-9	16						
B-01-10	19						
B-02-1	1	6.26	5.3	11.9	621	OF	
B-02-2	3	7.25		5.78	44.1		
B-02-3	5.5	7.32		8.8	44.4		
B-02-4	6	7.30		8.94	48.3		
B-02-5	9	7.54		8.43	52.6		
B-02-6	11	7.94					
B-02-7	14						
B-03-1	0.5	3.87	18.8	13.2	299	AB	
B-03-2	1	5.58	8.1	10.9	326	OF	—RC-3-9"
B-03-3	3	7.08	<5	6.97	52.3	OF	
B-03-4	4	7.59	<5	9.49	51.2		
B-03-5	4.5	7.66	<5	6.86	54.5		
B-03-6	8.5	7.72	<5	9.73	59.9		
B-03-7	10.5	7.78					
B-03-8	13.5						
B-04-1	0.5		458	144	432	AB?	
B-04-2	1	3.41	7.07	10.9	404	OF	7C 6-12"
B-04-3	3	6.63		7.42	57.1	OF	
B-04-4	4.5	7.05		9.85	44.6	OF	
B-04-5	7.5	7.50		6.09	53		
B-04-6	8	7.36		6.37	62.9		
B-04-7	11	7.66					
B-04-8	13						
B-04-9	16						
B-05-1	0.5	3.31	388	496	328	AB?	
B-05-2	1	3.80	5.02	12	497	OF	- 5C 6-12"

Note: Shading indicates result greater than TTLC.

AB= Aggregate Base Material
PF= Park Fill
OF= Intact Old Fill
1978= 1978 Fill
No note for native soil.

Table 2. Summary of Soil Results for pH and Arsenic, Lead, and Zinc (mg/kg).

Sample	Depth (feet)	pH	Arsenic	Lead	Zinc	Comments	
TTLC			500	1000	5000		
B-05-3	2.5	7.11		7.45	36	OF	
B-05-4	4.5						
B-05-5	6.5	8.14		10.1	49.7		
B-05-6	7	8.14		8.4	51.2		
B-05-7	10			9.02	63.3		
B-05-8	12	8.10					
B-05-9	15						
B-06GRB	0.5	6.44	<5	<5	26.7	SAND	
B-06-1	1	6.95	<5	12.4	62.7	OF	
B-06-2	3	7.59					
B-06-3	5.5	7.90					
B-06-4	6	7.87					
B-06-5	9	7.54					
B-06-6	11	7.80					
B-06-7	14						
B-07GRB	0.5	6.34	<5	5.52	27.6	SAND	
B-07-1	1.5	6.85	11.6	9.87	76.5	OF	
B-07-2	3	7.00	<5	5.39	62	OF	
B-07-3	6	7.69	<5	<5	72.9		
B-07-4	6.5	7.71	<5	7.92	63.6		
B-07-5	9.5	7.51	<5	6.67	50.4		
B-07-6	11	7.50					
B-07-7	14						
B-08-1	0.5	3.25	450	481	309	AB?	
B-08-2	1	4.79	13.9	13.7	464	OF	–13c
B-08-3	3	6.80	<5	6.49	38.4	OF	–<5e
B-08-4	4.5	7.68	6.24	7.1	33	OF	
B-08-5	7	8.01	5.45	6.16	40.7		
B-08-6	7.5						
B-08-7	10.5	7.78					
B-08-8	12.5						
B-08-9	15.5						
B-09-1	1	4.73	7.24	8.14	538	OF	–7e
B-09-2	3	6.94		5.71	36.8	OF	
B-09-3	4.5	7.23		6.32	55.6		
B-09-4	7	7.37		7.14	43.3		

Note: Shading indicates result greater than TTLC.

AB= Aggregate Base Material

PF= Park Fill

OF= Intact Old Fill

1978= 1978 Fill

No note for native soil.

Table 2. Summary of Soil Results for pH and Arsenic, Lead, and Zinc (mg/kg).

Sample	Depth (feet)	pH	Arsenic	Lead	Zinc	Comments
TTLC			500	1000	5000	
B-09-5	9.5	7.66				
B-09-6	10					
B-09-7	12					
B-09-8	15					
B-10-1	0.5	7.21	10.2	52.7	164	PF
B-10-2	2.5					PF
B-10-3	4	7.23	7.43	37.6	75.7	PF
B-10-4	6	7.01	6.64	13.8	53.7	OF
B-10-5	7.5	7.07				OF
B-10-6	9					
B-10-7	10.5	7.84				
B-10-8	11					
B-10-9	14.5	7.70				
B-10-10	17	7.96				
B-10-11	20					
B-11-1	1					PF
B-11-2	1.5	6.71	27.4	46.3	108	PF
B-11-3	3					OF
B-11-4	3.5	7.00	9.38	41.5	67.1	OF
B-11-5	4					OF
B-11-6	6.5	7.16				OF
B-11-7	9	7.22				
B-11-8	11	7.77				
B-11-9	14	7.56				
B-12-1	0.5	6.87		29.1	61.7	PF
B-12-2	1.5	7.19	6.65	105	108	PF
B-12-3	3	7.44	<5	95.1	103	PF
B-12-4	4			185	127	PF
B-12-5	4.5	7.55		502	95.5	PF
B-12-6	6					OF
B-12-7	9	8.01		8.8	78.7	OF
B-12-8	11	7.94				
B-12-9	14	7.93				
B-13-1	1	7.66	96.6	1160	515	OF
B-13-2	3	7.56	<5	6.05	39.8	OF
B-13-3	4.5		<5	<5	42.6	OF

Note: Shading indicates result greater than TTLC.

AB= Aggregate Base Material
PF= Park Fill
OF= Intact Old Fill
1978= 1978 Fill
No note for native soil.

Table 2. Summary of Soil Results for pH and Arsenic, Lead, and Zinc (mg/kg).

Sample	Depth (feet)	pH	Arsenic	Lead	Zinc	Comments
TTLC			500	1000	5000	
B-13-4	7	7.93	<5	6.22	55.9	
B-13-5	8.5	8.05				
B-13-6	9	8.04				
B-13-7	12					
B-13-8	14					
B-13-9	17					
B-14-1	1	7.22		13.3	60.3	PF
B-14-2	3	7.90	5.89	484	65.6	OF
B-14-3	4.5	11.03		6700	132	OF
B-14-4	6.5	7.39		6.26	49.6	
B-14-5	8.5	7.57		7.6	51.7	
B-14-6	9	7.67				
B-14-7	12	7.74				
B-14-8	14					
B-14-9	16.5					
B-15-1	1					PF
B-15-2	1.5	7.10	8.4	1520	91.9	PF
B-15-3	3.5	6.35	<5	8.1	44	PF
B-15-4	4.5	7.43	<5	9.61	75	
B-15-5	5	7.58				
B-15-6	7	7.75				
B-15-7	10.5	7.49				
B-15-8	12	7.37				
B-15-9	15.5	7.26				
B-16-1	1	9.49		138	65.4	1978/OF
B-16-2	2.5	7.14	<5	8.87	52.4	OF
B-16-3	3	6.99	<5	6.97	49.7	OF
B-16-4	4	6.81				
B-16-5	4.5					
B-16-6	6.5	8.08				
B-16-7	10	7.59				
B-16-8	11.5	7.47				
B-16-9	15					
B-17-1	1	7.87				1978
B-17-2	2.5	6.73	<5	10.4	67	OF

Note: Shading indicates result greater than TTLC.

AB= Aggregate Base Material

PF= Park Fill

OF= Intact Old Fill

1978= 1978 Fill

No note for native soil.

Table 2. Summary of Soil Results for pH and Arsenic, Lead, and Zinc (mg/kg).

Sample	Depth (feet)	pH	Arsenic	Lead	Zinc	Comments
TTLC			500	1000	5000	
B-17-3	3					OF
B-17-4	4.5	7.76				
B-17-5	6	7.89				
B-17-6	9.5	7.94				
B-17-7	14.5					
B-18-1	1	8.08				1978
B-18-2	2.5	6.39	<5	7.47	68.4	OF
B-18-3	4					OF
B-18-4	4.5	7.03				
B-18-5	7.5	7.57				
B-18-6	10.5	7.43				
B-18-7	12.5	7.56				
B-18-8	15					
B-19-1	1	7.67	<5	11.6	64.4	1978
B-19-2	3	3.65	<5	20.2	72.4	OF
B-19-3	4.5					OF
B-19-4	5.5	4.10		7.48	61.5	OF
B-19-5	6					
B-19-6	8.5	7.10		8.22	44.3	
B-19-7	11	7.56				
B-19-8	13					
B-19-9	16					
B-20-1	0.5	7.61				OF
B-20-2	2	7.37	5.14	13.6	73.2	OF
B-20-3	3.5	7.48				
B-20-4	6	8.13				
B-20-5	6.5	8.10				
B-20-6	9.5	7.79				
B-20-7	11.5	7.92				
B-20-8	14.5					
B-21-1	0.5					PF
B-21-2	1.5	7.29	<5	91	56.7	OF
B-21-3	3	7.44	<5	111	60.1	OF
B-21-4	6	7.12	5.89	8.61	41.4	
B-21-5	6.5					

Note: Shading indicates result greater than TTLC.

AB= Aggregate Base Material
PF= Park Fill
OF= Intact Old Fill
1978= 1978 Fill
No note for native soil.

Table 2. Summary of Soil Results for pH and Arsenic, Lead, and Zinc (mg/kg).

Sample	Depth (feet)	pH	Arsenic	Lead	Zinc	Comments
TTLC			500	1000	5000	
B-21-6	8.5	7.49	<5	5.68	47	
B-22-1	0.5	6.93	6.81	115	133	PF
B-22-2	3	7.94	5.59	319	42.4	OF
B-22-3	3.5	7.86	<5	18	47.9	OF
B-22-4	7.5	3.63	8.81	<5	68.3	
B-22-5	8					
B-23-1	0.5	6.26	12.6	1100	113	PF
B-23-2	2.5	7.74	6.04	1310	73.1	PF
B-23-3	5.5	7.17	<5	10.4	38.7	OF
B-23-4	8	7.32	<5	6.21	37.8	
B-24-1	0.5	4.08	9.2	<5	177	AB?
B-24-2	2.5	5.27	34.2	10.7	51.7	
B-24-3	3	7.02	8.7	5.86	44.1	
B-24-4	5.5	7.12	6.5	5.87	46.8	
B-24-5	7.5	7.28	10.3	<5	52.1	
B-25-1	0.5	5.91	<5	8.0	65.5	AB?
B-25-2	1	6.85	<5	7.5	44.8	OF
B-25-3	2.5	7.20	<5	5.88	47.1	
B-25-4	3					
B-25-5	4.5*					
B-25-6	5	7.24	17.1	7.77	49.2	
B-25-7	7	7.70	6.04	6.62	53.8	
B-26-1	0.5	6.59	6.91	12.6	83	1978
B-26-2	3	7.30	<5	8.07	54.5	OF
B-26-3	6	7.73	<5	8.09	44.4	
B-26-4	8	7.52	<5	6.83	51.7	
COURT-1		3.0	397	594	291	AB
COURT-2		2.8	734	692	443	AB (C)

Note: Shading indicates result greater than TTLC.

AB= Aggregate Base Material
PF= Park Fill
OF= Intact Old Fill
1978= 1978 Fill
(C) = Composite sample
No note for native soil.

Table 2. Summary of Soil Results for pH and Arsenic, Lead, and Zinc (mg/kg).

Sample	Depth (feet)	pH	Arsenic	Lead	Zinc	Comments
TTLC			500	1000	5000	
98-1A	0	4.3	263	277	496	AB
98-1B	0.3	5.1	8.3	1990	198	OF
98-2A	0	7.6	16.0	24.7	58.3	OF
98-2B	0.3	5.6	10.0	96.2	114	OF
98-3A	0	3.6	321	235	404	AB (D)
98-3B	0.3	3.6	18.5	82.2	106	OF
98-4A	0	4.5	200	163	617	AB
98-4B	0.3	5.4	14.8	60.6	140	OF
98-5A	0	3.6	456	344	602	AB
98-5B	0.3	4.0	18.2	6480	217	OF
98-6A	0	3.6	249	215	374	AB (D)
CRACK-1		1.5	14.4	5.5	7450	PPT (C)
CRACK-A		2.4	29.6	16.1	6080	PPT
CRACK-B		2.1	11.7	18.3	6790	PPT
CRACK-C		1.9	23.0	28.2	6200	PPT
CRACK-D		1.4	7.4	14.9	7990	PPT
CRACK-E		1.5	33.0	9.3	8380	PPT
CRACK-F		1.9	8.4	35.1	4320	PPT
CRACK-G		1.5	9.7	19.7	6260	PPT (D)
CRACK-H		1.6	22.4	15.9	6110	PPT
CRACK-J		1.4	25.7	18.5	5820	PPT (D)

Note: Shading indicates result greater than TTLC.

AB = Aggregate Base Material
PF = Park Fill
OF = Intact Old Fill
PPT = Precipitate
1978 = 1978 Fill
(C) = Composite sample
(D) = Paired duplicate sample
No note for native soil.
* Sample contained slough from above; results are not representative of actual conditions.

Table 3. Summary of Results for Sulfide and Sulfate (mg/kg).

Sample	Sulfide	Sulfate	Comments
COURT-1	<0.20	2,160	AB (C)
CRACK-A	<1.0	245,000	PPT
CRACK-B	<1.0	295,000	PPT
CRACK-C	<1.0	320,000	PPT
CRACK-D	<1.0	279,000	PPT
CRACK-E	<1.0	294,000	PPT
CRACK-F	<1.0	289,000	PPT
CRACK-G	<1.0	366,000	PPT (D)
CRACK-H	<1.0	299,000	PPT
CRACK-J	<1.0	365,000	PPT (D)

Note:
AB = Aggregate Base Material
PPT = Precipitate
(C) = Composite sample
(D) = Paired duplicate sample

Table 4-"WET" Soluble Metals Results for Aggregate Base Material (mg/L).

Sample	Arsenic	Lead	Mercury	Zinc	Comments
STLC	5	5	0.2	250	
COURT2/WET	8.8	0.4	<0.005	4.1	AB
COURT2/DIWET	<0.05	<0.03	<0.005	3.31	AB

Note: Shading indicates result greater than STLC.
AB= Aggregate Base Material
WET= soluble metal concentrations by California Analytical Method Waste Extraction Test (WET Test)
DIWET= Modified WET test using deionized water instead of standard citrate solution.

Table 5. Results of TCLP Soluble Metals Analyses

SAMPLE	COMMENTS	TOTAL LEAD (mg/kg)	SOLUBLE LEAD (mg/L)	TOTAL ARSENIC (mg/kg)	SOLUBLE ARSENIC (mg/L)
98-1 B	soil	1,990	39.8*		
98-5B	soil	6,480	5.43		
COURT 2	AB	692	0.07	734	<0.05
B-15-2	soil	1,520	1.80		
B-13-1	soil	1,160	0.136	96.6	0.493
B-8-1	AB	481	<0.05	450	<0.075
B-14-2	soil	484	18.7*		
B-12-4	soil	185	0.019		

Note:

TCLP = Toxicity Characteristic Leaching Procedure

RCRA toxicity characteristic criteria for lead or arsenic = 5 mg/L

* apparent anamoly

AB = Aggregate Base Material

Table 6. Results of Modified* TCLP Soluble Metals Analyses

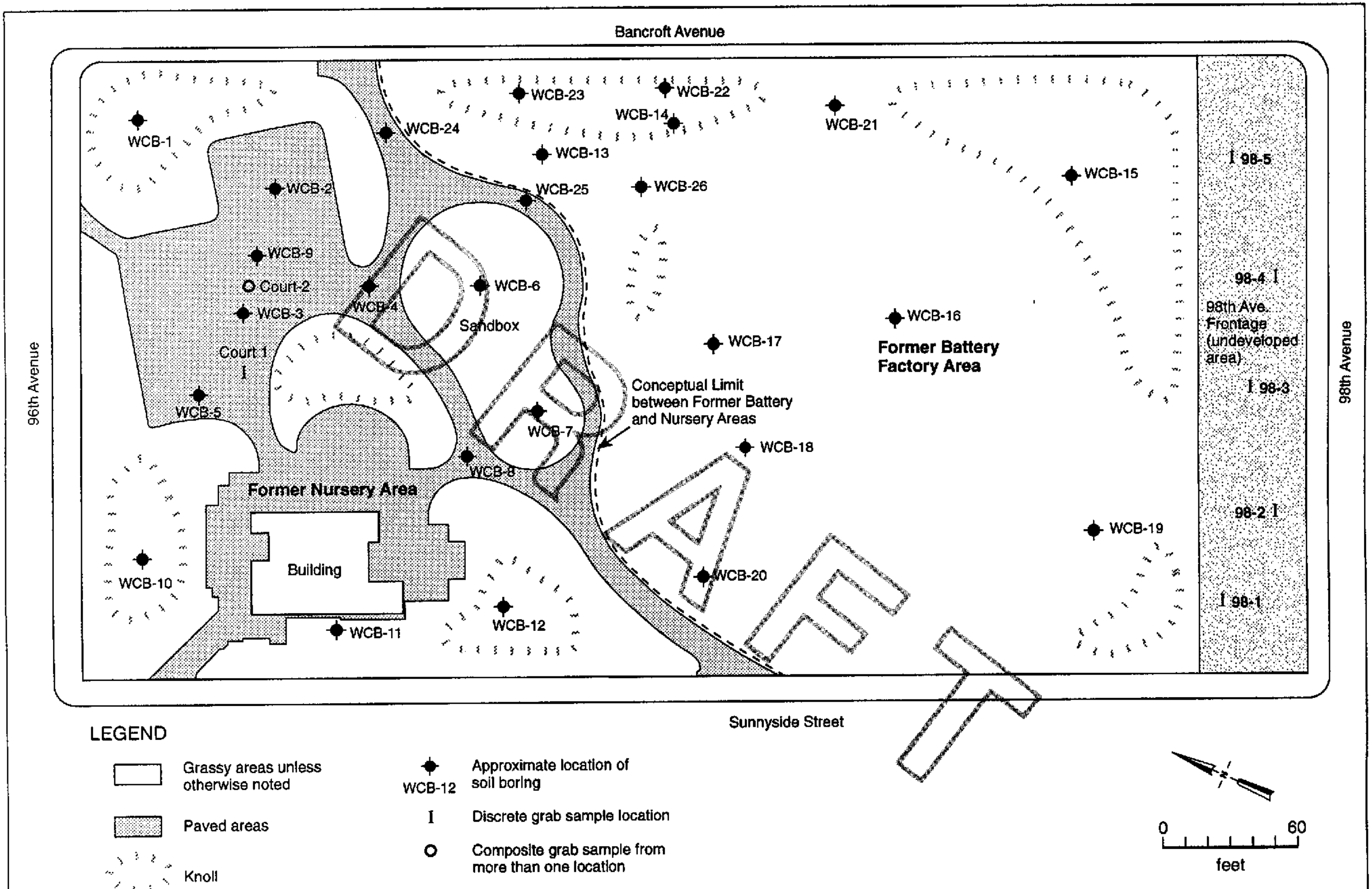
SAMPLE	COMMENTS	TOTAL LEAD (mg/kg)	SOLUBLE LEAD (mg/L)
B-16-1	soil	138	0.042
B-14-2	soil	484	0.544
B-12-4	soil	185	0.369
B-12-5	soil	502	0.414

Note: MCL for lead = 0.050 mg/L

* TCLP Method modified by using deionized water

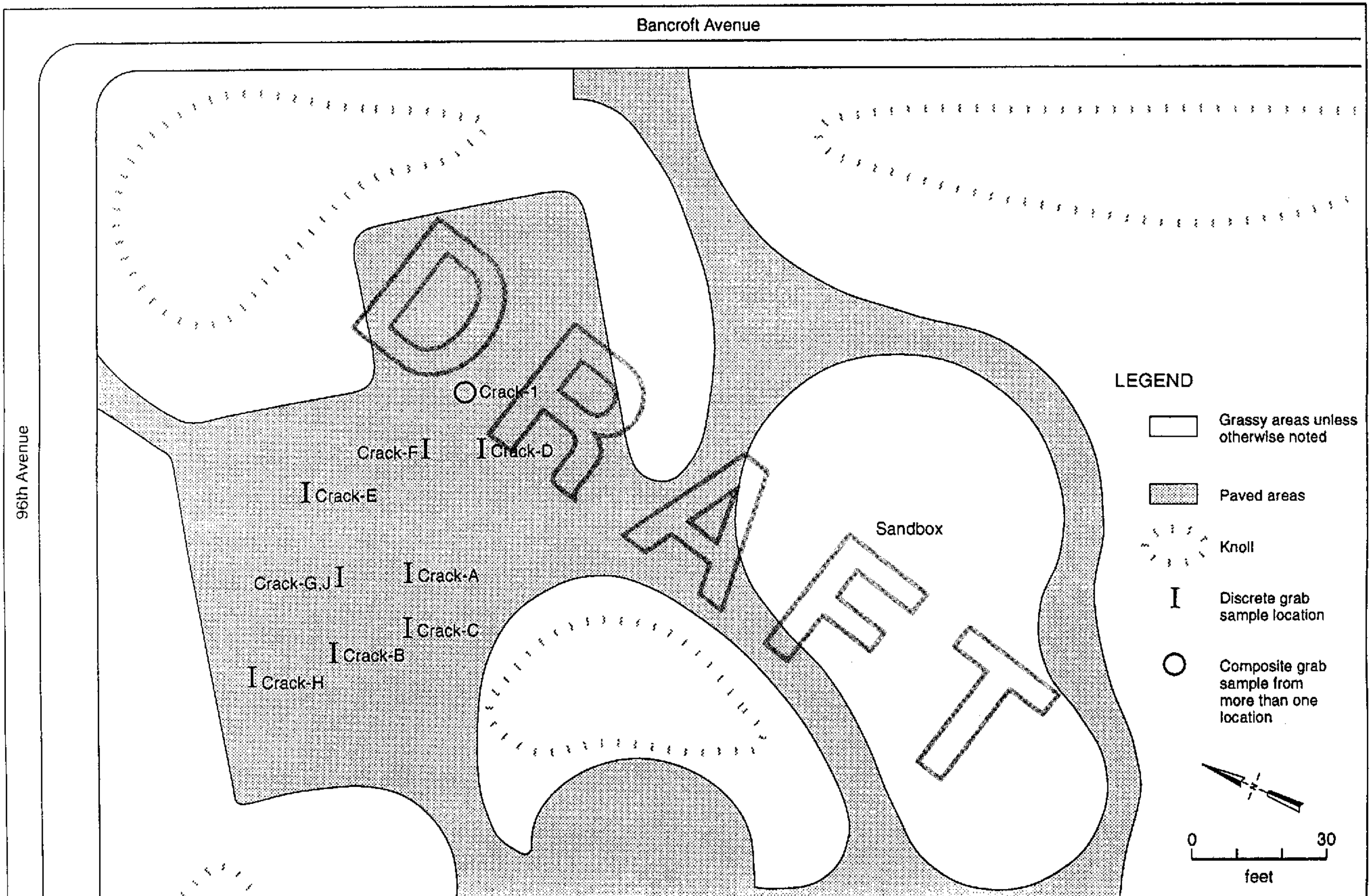
FIGURES

93 SEP 29 AM 8:50



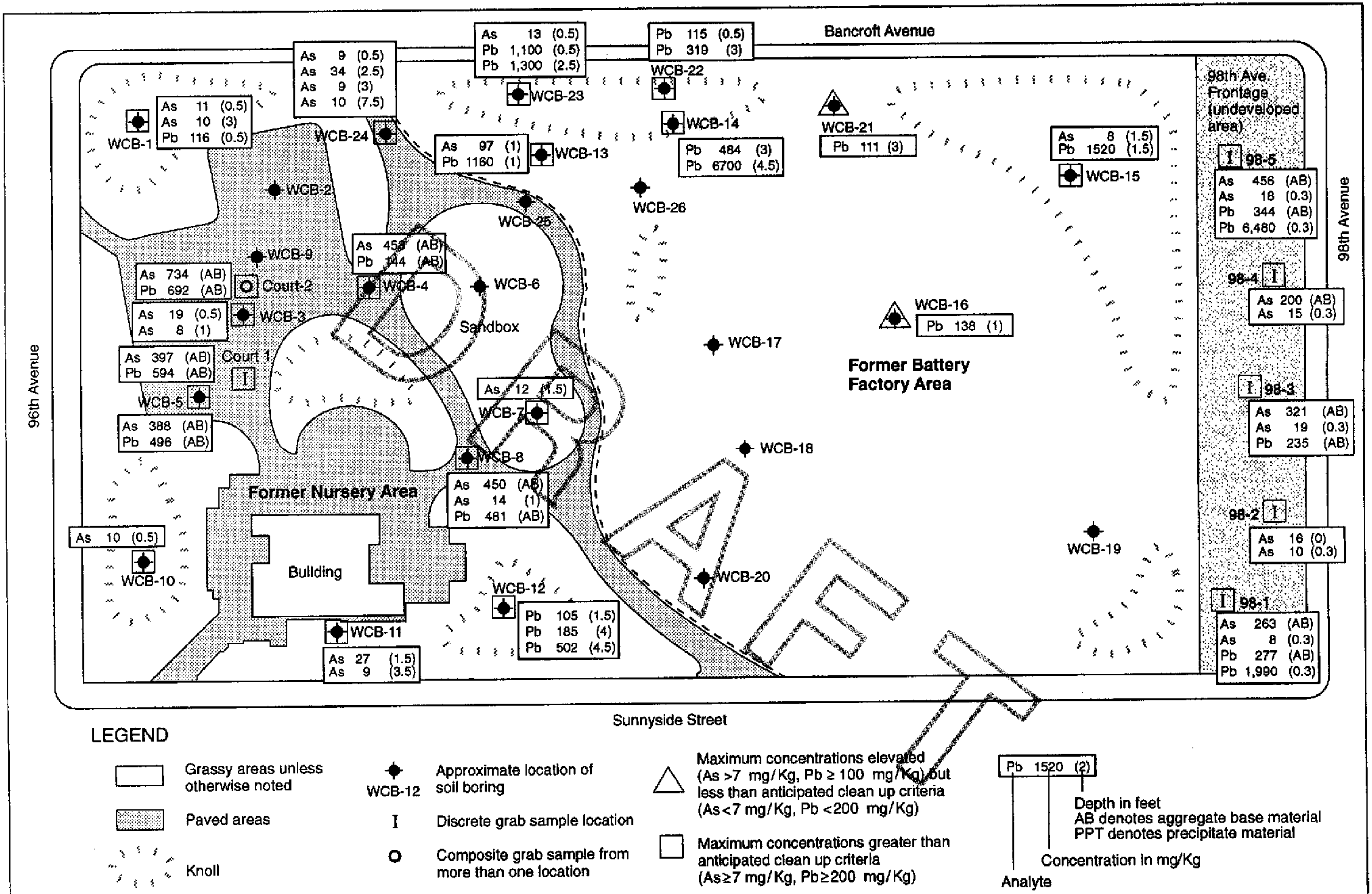
Project No. 93C0243A	Verdese Carter Park Oakland, California	SITE AND SOIL SAMPLE LOCATION PLAN	Figure 1
Woodward-Clyde Consultants			

93C0243A-6000/091093



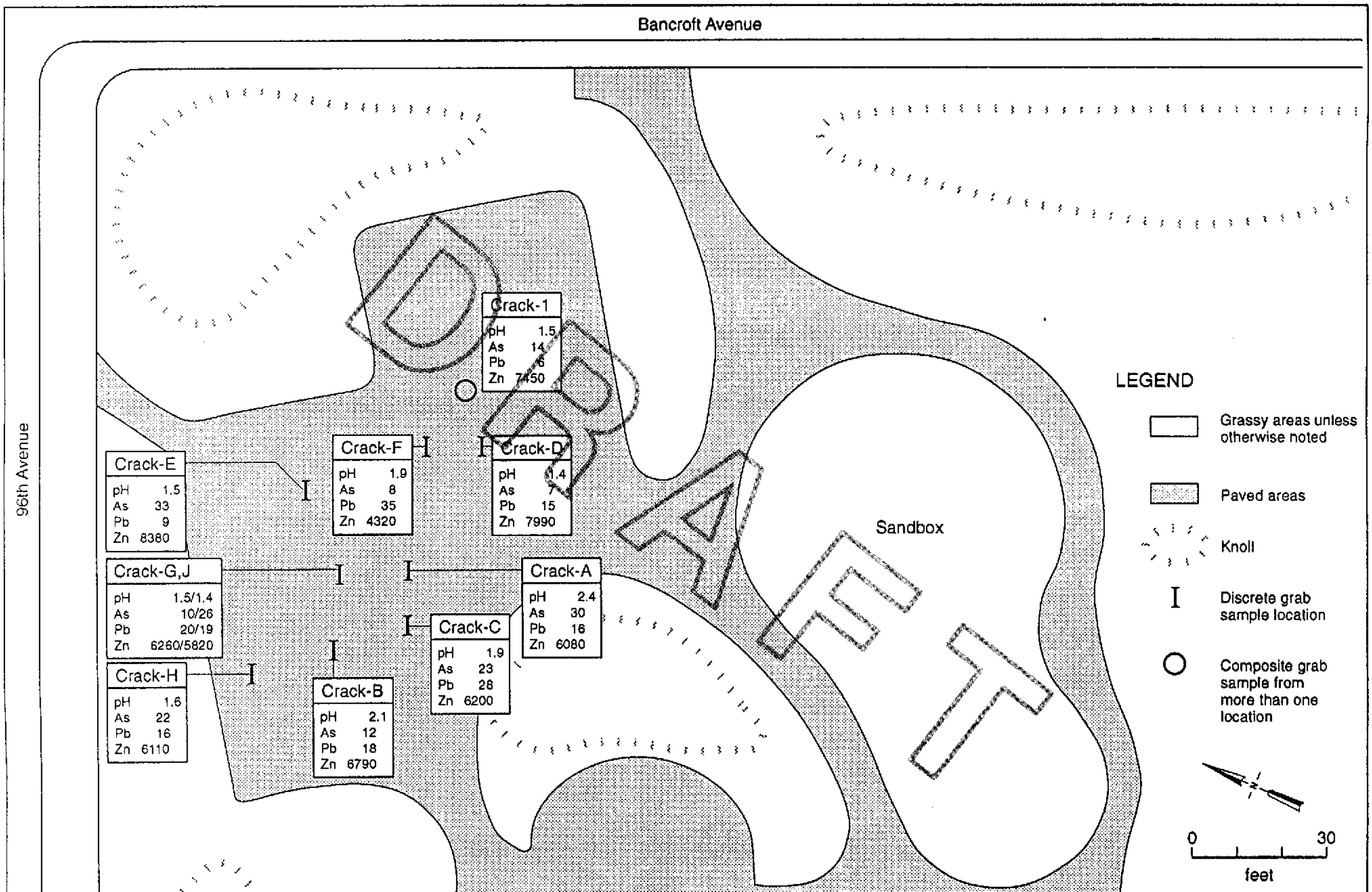
Project No. 93C0243A	Verdese Carter Park Oakland, California	PAVEMENT CRACK PRECIPITATE SAMPLE LOCATION PLAN	Figure 2
Woodward-Clyde Consultants			

93C0243A-3000/072093



Project No. 93C0243A	Verdese Carter Park Oakland, California	SUMMARY OF ELEVATED SOIL ARSENIC AND LEAD CONCENTRATIONS	Figure 3
Woodward-Clyde Consultants			

93C0243A-6000/092493



Project No. 93C0243A	Verdese Carter Park Oakland, California	SUMMARY OF PRECIPITATE pH, ARSENIC, LEAD, AND ZINC CONCENTRATIONS (mg/kg)	Figure 4
Woodward-Clyde Consultants			

93C0243A-3000/072093