REMEDIATION WORKPLAN
VERDESE CARTER PARK

OAKLAND, CALIFORNIA

Prepared for

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

October 20, 1993

Prepared by

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Woodward-Clyde Consultants

Engineering & sciences applied to the earth & its environment

October 20, 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 remediation workplan for Verdese Carter Park. This workplan describes the criteria and procedures that will be used for remediation of the metals contamination found in some shallow soil areas of the site. This workplan addresses comments by city staff and Alameda County Department of Environmental Health to the draft workplan of September 29.

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

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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 basketball courts and pathways 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 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 associated sidewalk and planter area 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 on site 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 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 minimized 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 lead cleanup criterion 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 lead cleanup criterion will be 500 mg/kg.

The 200 mg/kg lead criterion 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 covered 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 less significant. In this case the cleanup criterion is based only on groundwater protectiveness. While also being reasonable, the 18-inch cover thickness is specified because it was also specified by DHS and ACDEH after the 1978 soil removal action.

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 clayey and the depth to groundwater is approximately 30 feet. Thus, a criterion of 500 mg/kg is probably conservative. 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.

A cleanup criterion for arsenic of 7 mg/kg is proposed. The 95 percent upper confidence level of the mean natural background concentration is estimated to be 4.1 mg.kg (Appendix E). This concentration is below the analytical detection limit for arsenic of 5 mg/kg. A cleanup criterion of 7 mg/kg is close to background levels, is detectable, and accounts to some degree for the lower analytical accuracy when measuring near the detection limit.

No cleanup criterion for zinc is proposed because it was not found at levels high enough to pose a significant human health or environmental threat. With regards to groundwater protection, zinc is not of concern since there is no health-based or primary Maximum Concentration Limit (MCL) for zinc in drinking water, only an aesthetic-based secondary MCL.

3.3 APPROACH AND RATIONALE FOR CONFIRMATION SAMPLING

The purpose of confirmation sampling is to determine if the cleanup standards have been met in an excavation area. The confirmation sampling includes collection and analysis of soil samples from the bottom of the excavations. The contaminant concentrations detected in the samples are then compared to the concentration-based cleanup criteria. If the sampling confirms that the standards have been met, then the remedial soil excavation work is complete and the excavation can be closed. If the sampling indicates that the standards have not been met, then further excavation of contaminated soil will be required.

The particular objective for the proposed approach for locating confirmation samples is to detect, with a reasonable degree of confidence, contamination "hot spots" larger than a certain size. Depending on the general shape of an excavation area, the sampling to accomplish this will be grid-based or lineament-based.

In all but narrow excavation areas, the confirmation sample location scheme will be grid-based. The sampling will be based on a 50-foot square grid system (2,500 square feet per grid cell). In cases where a grid cell is completely occupied by an excavation, the sample will be obtained from a random location within that cell. Where a number of grid cells are each only partially occupied by an excavation, but the total excavation area within the cells is approximately 2,500 square feet, i.e., equivalent to one full grid cell, then a sample will be randomly located within the excavation area in one of those cells. This approach is proposed because grid sampling promotes representative coverage of excavation areas and random locations within grids reduce sample bias and enhance the statistical validity of the results. Construction plans indicate that a 50-foot square grid system was used for designing the park; because of this a 50 foot grid is a "natural fit" with the layout of the park and the location and extent of many of the planned excavation areas (this same grid system will be used for the confirmation sampling grid). From a probabilistic standpoint, the 50-foot grid size will also accomplish detection of "hot spots" greater than approximately 56 feet in diameter with 90 percent confidence. This precision is better than the 100-foot grid size often recommended by the Environmental Protection Agency for residential site sampling.

For relatively narrow excavation areas, e.g., pathways, the sampling will be lineament-based, which is more appropriate for the excavation area geometry. Confirmation samples will be located every 50 feet along these areas.

At the 98th Avenue Frontage Area the confirmation sampling will be grid-based, but will also include additional samples at locations where the previous screening-level samples encountered high lead concentrations in the surface soil. This additional sampling is recommended since the depth extent of vertical contamination there is not known and may be highly localized given the likelihood that it was caused by spills during battery factory operation. The arsenic contamination due to the aggregate cover material is expected to be relatively uniform in lateral and vertical extent.

The planned depth of the excavations is based on the results of the site characterization regarding the depth of contamination. Confirmation sampling will not be performed until the planned depth is reached. If the confirmation sampling indicates that additional excavation is required, then the depth of overexcavation prior to reconfirmation sampling will be at the judgement of the Project Engineer.

In instances where overexcavation is conducted because of confirmation sample results, the lateral extent of overexcavation will be approximately midway between the complying and noncomplying sampling locations. Reconfirmation sampling will be conducted at the same location as the initial noncomplying confirmation sample locations. This, rather than random resampling, will be done to provide a deterministic-based evaluation that the cleanup standards were met by overexcavation.

Based on the relative concentrations and extent of contaminants encountered during the site characterization, the metals analyses that will be included in the confirmation sampling will vary by operable unit. At the Knolls Operable Unit the confirmation samples will be analyzed for lead, only, since it is the primary contaminant of concern with arsenic only intermittently present, at much lower concentrations, and extending to lesser depths than the lead contamination. At the Paved Areas Operable Unit the confirmation samples will be analyzed for arsenic and lead, the primary contaminants related to the rhyolite aggregate material. At the 98th Avenue Operable Unit the analyses will also be for arsenic and lead because of the joint presence of aggregate-related and battery factory related contamination.

Details regarding sample locations, methods, and analysis are presented in the Confirmation Field Sampling Plan (Appendix D).

4.0 PROPOSED REMEDIAL ACTION

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 is below 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. 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, compliance of onsite personnel with health and safety procedures will be monitored. Air quality sampling and airborne dust measurements to monitor the effectiveness of dust suppression measures will also be conducted. Full time site security against trespassers will be maintained, including a perimeter fence with a mesh wind barrier and view ports provided at regular intervals. The security procedures will also include an after-hours security service.

Confirmation sampling of provisionally completed excavations will be conducted. Based on the results, the excavation will be certified as completed or supplemental overexcavation will be ordered.

The details of the proposed confirmation sampling approach are described in the Confirmation Field Sampling Plan (Appendix D). The general approach for confirmation sampling is described in Section 3.3. 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 civil 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. Dust suppression by water sprays will be conducted during breakup of the asphalt and concrete. For convenience, the concret and asphalt will probably be disposed of with the contaminated soil, rather than be segregated and disposed of as standard construction debris.

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 5 feet wide and 475 feet long 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 basketball 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), the subgrade edge of the building will be exposed 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 it does not meet the cleanup standard. This is expected to be the case in the former battery factory aboveground storage tank and rail spur area beneath the knoll near Bancroft Avenue and possibly in other areas.

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 5 feet (to Elevation 30 City of Oakland datum). 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 8 inches to accommodate the new sidewalk. At least a further 6 inches will be subexcavated in the road and sidewalk areas to provide an uncontaminated working platform for later road and sidewalk 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.

5.0
ANALYSIS OF THE REMEDIAL ACTION

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 is not anticipated to 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 anticipated to be too deep or otherwise inaccessible to children to pose an ingestion hazard. The uncontaminated soil or pavements which will be placed over completed excavations will minimize 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 by persons and companies meeting OSHA training and medical monitoring requirements for working at contaminated sites.

6.0
REMEDIATION SCHEDULE

Remediation services contracting has been completed. It is planned to begin excavation activities on October 25, 1993. Barring delays due to weather or other circumstances, it is anticipated that the remediation will be completed within two months. The remedial construction will generally be conducted on weekdays between 8 am and 4:30 pm. Excavation work along 98th Avenue will be conducted on weekends to minimize disruptions to traffic (the street will be closed to accomodate the construction) and Cox Elementary School across the street.

7.0
CLOSURE CERTIFICATION

At the conclusion of the soil remediation activities, a closure certification report will be submitted in accordance with Alameda County Department of Environmental Health requirements. The report will document the remedial activities, including the results of the confirmation sampling. A site survey of the final extent and depth of excavations and confirmation sample locations will be performed. The report will certify that the remediation was conducted in accordance with the approved workplan and any approved modifications, and will be signed by a representative of the City as site owner and a California registered professional civil engineer in responsible charge of the remediation construction.

8.0
LIMITATIONS AND CERTIFICATION

The findings, recommendations, specifications, or professional opinions are presented, within the limits prescribed by the client, after being prepared in accordance with generally accepted engineering practice in Northern California at the time this investigation was performed. No other warranty is either expressed or implied.

CERTIFICATION

This workplan was prepared under the supervision of:

Signature:

Name:
Michael P. McGuire, P.E.

Title:
Project Engineer

Professional License Number:
Registered Civil Engineer No. 42565

REGISTERED PROFESSIONAL ENGINEER
MICHAEL P. McGUIRE
No. 42565
Exp. 3-31-96
CIVIL
STATE OF CALIFORNIA

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	6.98	30.7	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	38.5	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	50.9	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	8.87	<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	8.91	38.7	4.97	<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	44	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	58.7	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	1.9	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	602	6.28	16.6	3.1	3.4	9.8	62.1	2.9	443
CRACK-1			14.4							5.5	<0.25							7540

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
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
B-04-3	3	6.69		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

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	139	13.7	464	OF
B-08-3	3	6.80	<5	6.49	38.4	OF
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
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	41.6	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

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. The City initiated this field investigation due to observations of a yellow precipitate-like material found in cracks of the asphalt-paved basketball courts 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.

2.0
SITE CHARACTERISTICS

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 Department of Environmental Health (ACDEH), 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 ACDEH, 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 accordance with the "Initial Soil Investigation Work Plan," dated April 29, 1993. The workplan and modifications were reviewed and approved by ACDEH.

Twenty soil borings for the initial soil investigation (WCB-1 through -20) were drilled 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 thought to have been placed for development of the park and at the following depth intervals beneath the assumed fill/natural soil interface (pre-park soil): 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. The fill/natural soil interface was visually identified by an experienced WCC geologist.

CAM (California Analytical Method) 17 metals scans by Environmental Protection Agency (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 advanced on July 24, 1993. Samples of soil were obtained at depths of approximately 0.5-1, 2-2.5, 5-5.5, and 7-7.5 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 small portions of the basketball courts and paths 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, composite samples of the aggregate base material (Court 2) and of the precipitate substance (Crack 1) from various locations at the basketball courts were 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 basketball courts 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. The screening-level soil sampling was performed to address concerns that the gravel cover layer over much of 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. Soil samples were obtained from five locations (98-1 through -5) distributed across the unpaved frontage area. The sampling included four samples of the gravel cover material and seven samples (six primary and one duplicate) of the upper 2 or 3 inches of the underlying pre-park soil. The 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. 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

<u>Background Levels</u>

"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 elevated levels of lead in shallow soils at locations across the street from the park. These elevated concentrations could have been due to a variety of causes not necessarily related to the site and could be a source of uncertainty if included in an anthropogenic background evaluation. Instead, this 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. The calculation of estimated background levels of arsenic, lead, and zinc is summarized in Appendix E. The 95 percent upper confidence level for the mean concentration for natural background arsenic, lead, and zinc was estimated to be 4 mg/kg, 12 mg/kg, and 61 mg/kg, respectively.

<u>Arsenic</u>

Soil samples were analyzed for arsenic by the Graphite Furnace Atomic Adsorption (GFAA) method. The results of the arsenic analyses are summarized on Table 2. Arsenic concentrations in soil samples above 7 mg/kg are graphically presented on Figure 2.

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 basketball 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 within the aggregate.

The 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 in the next sample at a depth of 3 feet.

Arsenic is 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

associated with wet cell battery manufacturing and recycling, although at levels much less than lead). Arsenic concentrations above background levels 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 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. Many of the elevated arsenic levels measured in samples obtained from Boring WCB-24 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 the apparently elevated arsenic 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 are 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 from the modified WET test was significantly less (less than 0.05 mg/L) than from the standard WET test.

Lead

Soil samples were analyzed for lead by EPA Method 6010. The results of the lead analyses are summarized on Table 2. 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 than the natural background levels. For this reason, "elevated" concentrations of lead for this investigation were arbitrarily defined as 100 mg/kg or higher.

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, 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.

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 basketball 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, the vertical extent of lead contamination at these areas is not currently known. However data at other areas of the battery factory indicate that the vertical 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 by rain water, an important consideration for development of remedial cleanup criteria protective of groundwater quality. Selected samples with reported total lead concentrations in the range of 200 mg/kg to 500 mg/kg were selected for analysis. 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.

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 basketball 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 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, and generally about 7.5. 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 fragments noted in the samples of 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

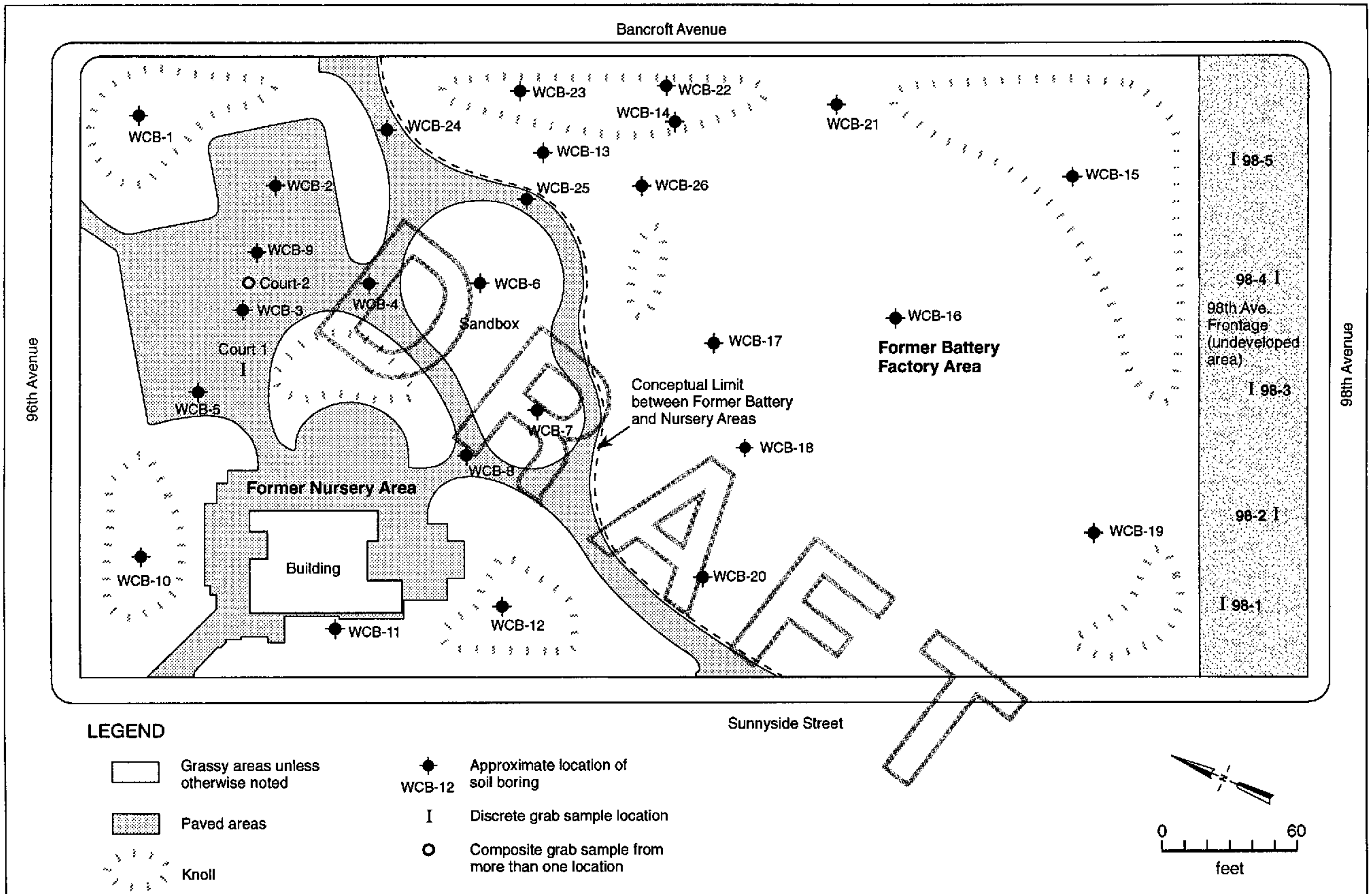
There appear to be three distinct types or general patterns of contamination at the site. The first pattern is attributable to the aggregate base material beneath the basketball courts and pathways in the north half of the park. This material, which has tentatively been identified as a mixture of rhyolite 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 the east side of the site 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.

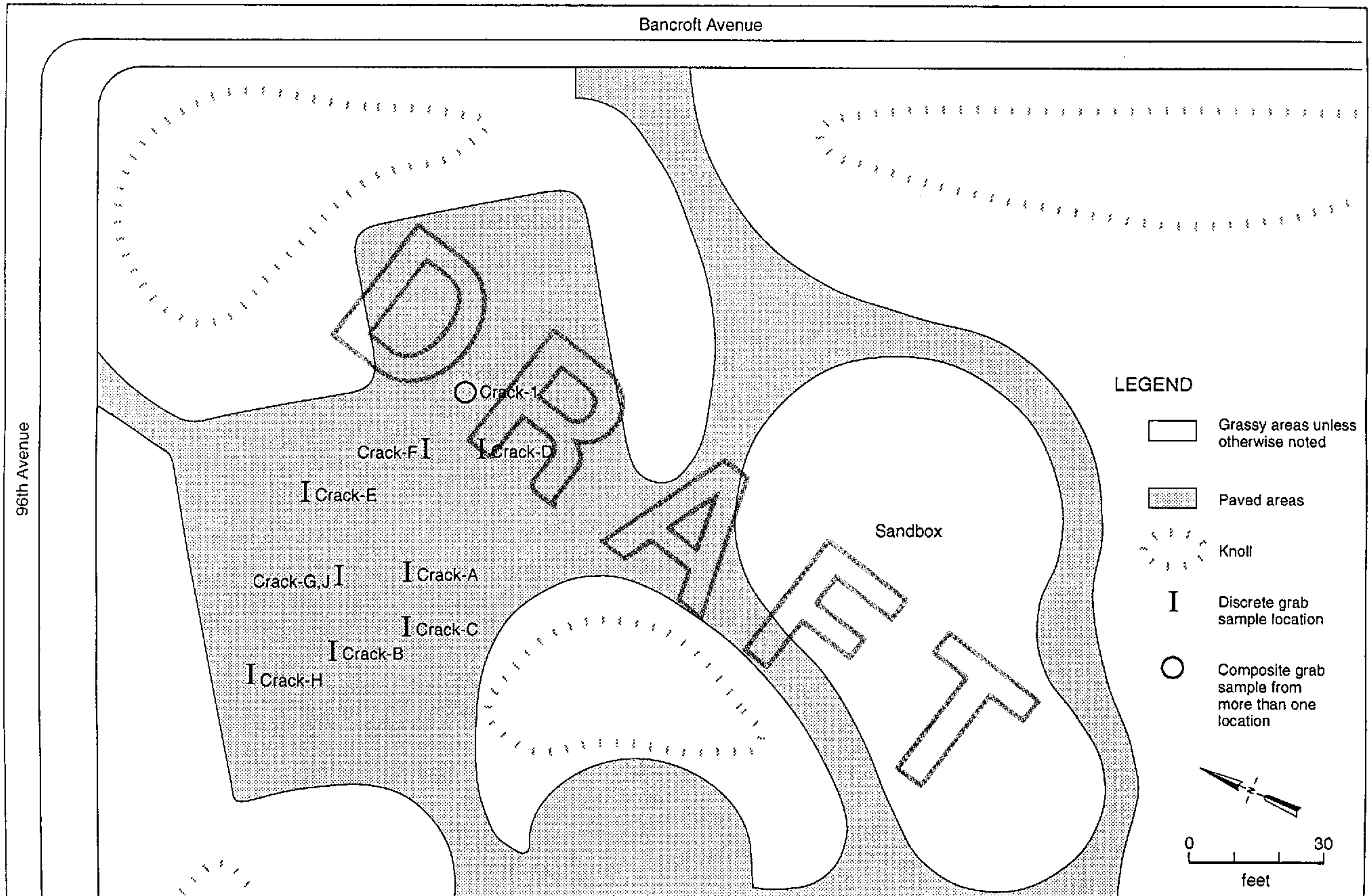
<u>Groundwater</u>

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.



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			

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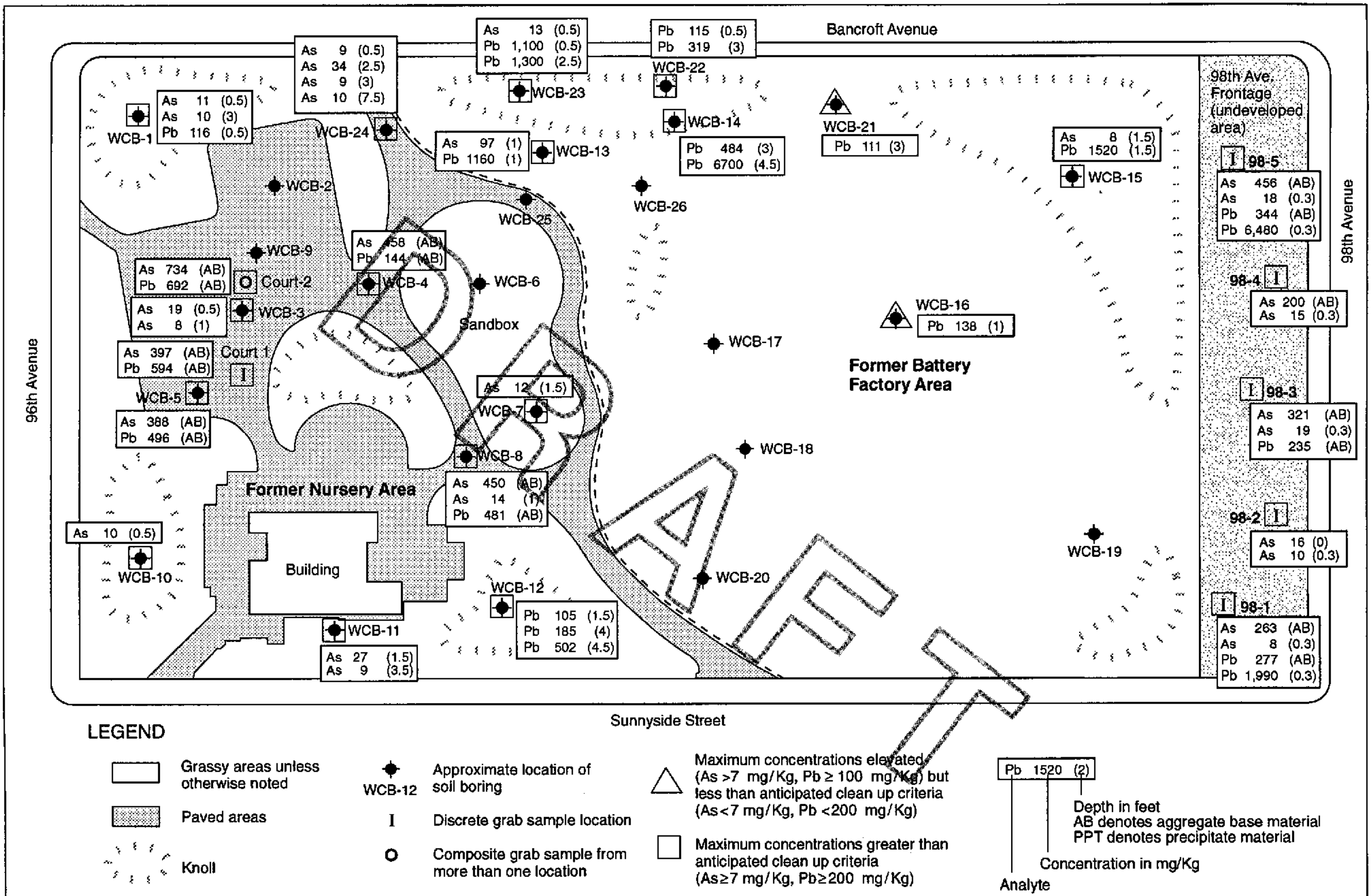

Project No. 93C0243A	Verdese Carter Park Oakland, California	SUMMARY OF ELEVATED SOIL ARSENIC AND LEAD CONCENTRATIONS	Figure 3
Woodward-Clyde Consultants			

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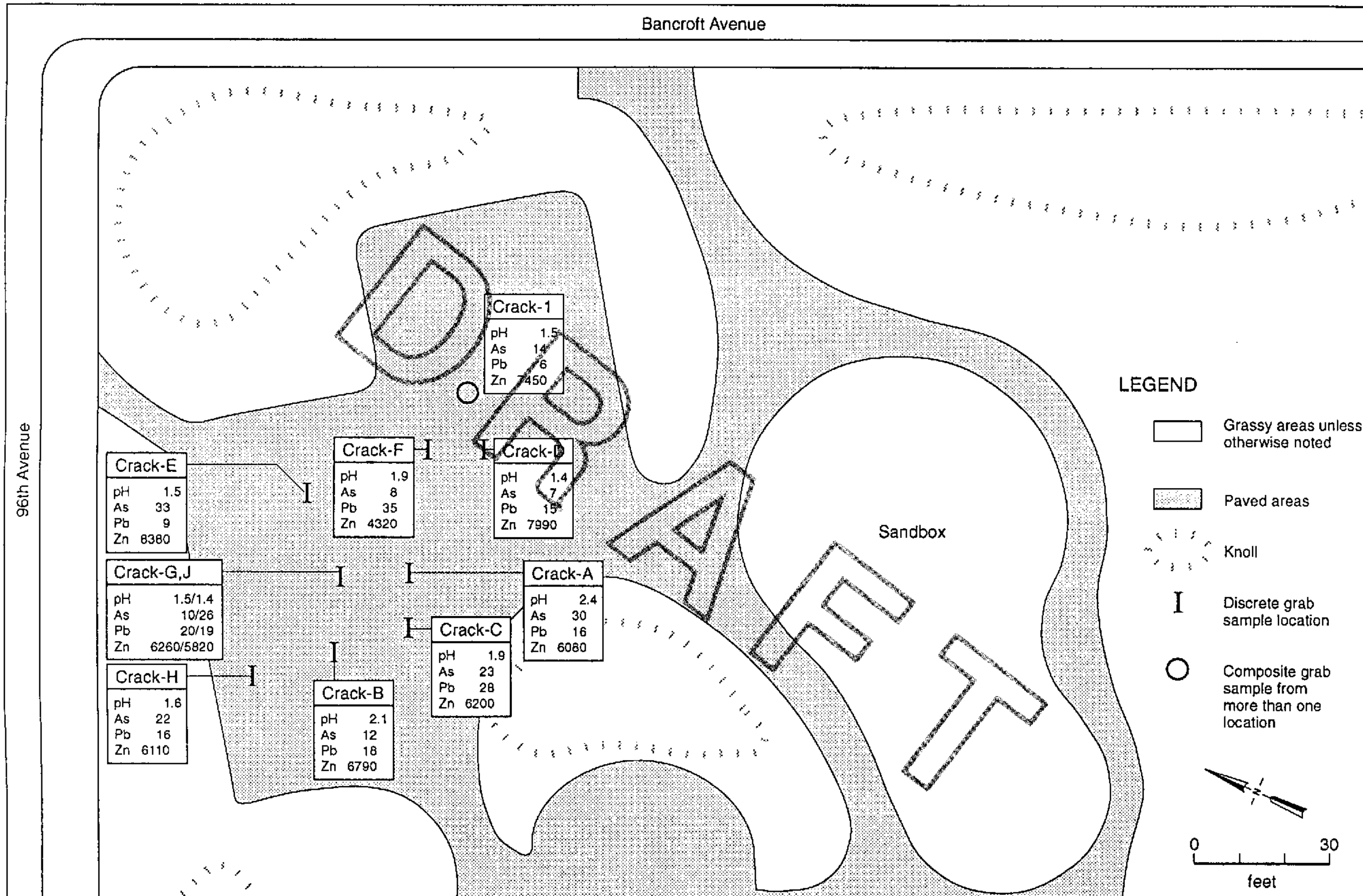

Project No. 93C0243A	Verdese Carter Park Oakland, California	SUMMARY OF PRECIPITATE pH, ARSENIC, LEAD, AND ZINC CONCENTRATIONS (mg/kg)	Figure 4
Woodward-Clyde Consultants			

93C0243A-3000/072093

APPENDIX A
SITE SAFETY PLAN

SITE SAFETY PLAN
VERDESE CARTER PARK
98TH & SUNNYSIDE
OAKLAND, CA

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SCA ENVIRONMENTAL PROJECT NO. BI-777

1.0 FACILITY BACKGROUND & WORKPLAN

This site safety plan (SSP) is for remediation of lead- and arsenic-containing soils at Verdese Carter Park (the park) in Oakland, California. The park is located between 96th and 98th Avenues and between Sunnyside Street and Bancroft Avenues (see Figures 1 and 2 of this report). The remediation project will involve removal of lead- and arsenic-containing soils from the site. All lead and arsenic-containing soils which contain concentrations above a project limit (to be set) will be removed.

This SSP is designed as a comprehensive document. Procedures and requirements listed in this document are mandatory for all site personnel, including contractors, subcontractors, engineering personnel, health and safety personnel, etc. In some sections of this SSP, due to the highly specialized nature of the information, the SSP's of individual contractors, subcontractors, etc. are included by reference. A safe and accident-free job can only occur with good communications between groups. All site personnel are encouraged to develop good communication practices with all DECON-workers at the site.

Previous operations at the site include a wet-cell battery manufacturing operation and a plant nursery. Site characterization studies by Woodward-Clyde Consultants (WCC) have identified elevated lead and arsenic levels at various soil depths throughout much of the park (reference: *Site Characterization Report for Verdese Carter Park*, dated July 19, 1993, WCC Project No. 93CO243A).

Concentrations of lead and arsenic, as measured by WCC, are tabulated in the following table. For more detailed information of WCC's soil sample results, see Appendix 1 of this report.

Analyte and Matrix	Range of Results Measured by WCC Site Characterization Study	Method(s)
Lead in Soil	<5 mg/kg to 6700 mg/kg	CAM 17 (EPA 6010)
Arsenic in Soil	<5 mg/kg to 734 mg/kg	EPA 6010

Other metals detected in the soil samples include mercury, chromium, antimony, copper, molybdenum, nickel, selenium, silver, vanadium, and zinc, and are generally present as background elements. In all cases, the metals were well below the Federal EPA and California EPA levels for hazardous wastes, and are not considered a significant human health threat. Note that no sulfuric acid has been found on this site.

Exposure to the lead and arsenic by workers at the site would be through one of two primary routes:

- Inhalation of dust which contained lead and/or arsenic; this inhalation could occur at the site due to dusty conditions. In addition, it could occur after the worker has left the site and is exposed to dust which has settled on clothing, tools, vehicles, etc.
- Ingestion (swallowing) of dust which contained lead and/or arsenic; swallowing the dust could occur at the park or near the park after accidental contamination of food, beverages, cigarettes, or due to contamination of plates, silverware, drinking glasses, etc. Contamination of food items could also occur after the worker has left the site, from lead and arsenic dust on a worker's face, hands, hair, etc. if the worker does not thoroughly decontaminate prior to eating.

The lead and arsenic at the site are thought to occur only in a mixture with the soils. Unlike hydrocarbon-contaminated soils, which may have a tell-tale stained appearance, the lead- and arsenic-contaminated soils at the park may not be visibly different from the non-contaminated soils.

The remediation project has as its goals the safe removal and disposal of lead- and arsenic-containing soils at the park. The project will be considered a success only if this work is completed without safety or health impacts to the workers at the site, the surrounding communities, and the general environment.

2.0 KEY PERSONNEL AND RESPONSIBILITIES

Key personnel on the project are listed as follows:

Title	Name	Firm	Phone Number	Pager Number
City of Oakland Project Manager	Joseph Cotton, Office of Environmental Affairs	OPW	(510) 238-7371	
Project Engineers	Mike McGuire, PE Linda Locke, PE	WCC	(510) 893-3600	
Site Safety Officer	Steve Valladolid, EIT	SCA	(510) 848-0390	(510) 678-6216
Industrial Hygienist	Chuck Siu, CIH	SCA	(510) 848-0390	(510) 678-6592

Woodward-Clyde's Project Engineers are Mike McGuire and Linda Locke, who will be responsible for remediation engineering design and construction oversight, and who are representing the City of Oakland as remediation managers.

The Site Safety Officer (SSO) will be Steve Valladolid of SCA Environmental. Mr. Valladolid will:

- verify, based on spot checks, routine observations, and unannounced audits, that all site personnel are following procedures outlined in this SSP and in the project workplan;
- collect fenceline air samples and meteorological data to ascertain the extent of airborne emissions from the remediation project;
- be present at the project site during all times of the project when contractor employees are working;
- collect and store all contractors' Illness and Injury Prevention Plans (IIPP) on site;
- have the authority to temporarily suspend work in the event that a flagrant violation of the work procedures is observed, or if air sampling data or weather conditions so dictate.

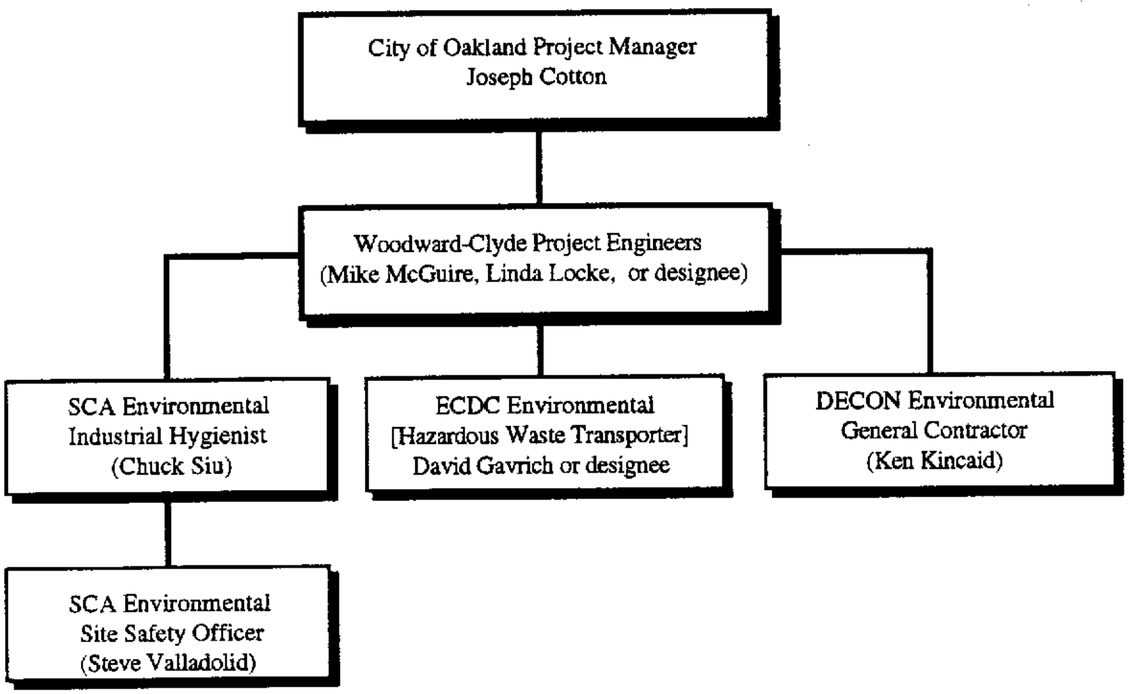
Note that each employer (contractor, WCC, SCA) will collect personal samples for lead, arsenic, and other materials as required by the various OSHA regulations which they operate under, unless other acceptable data are available for use, such as having the contractor's workers' exposures data for extrapolation.

The project Industrial Hygienist will be Chuck Siu, CIH of SCA Environmental. Mr. Siu will:

- design air sampling protocols and personal protective equipment requirements; and
- review air sampling data, meteorological data, and daily reports on work activities and compliance with designated work procedures.

All personnel are responsible for following all procedures outlined in this SSP and in the workplan created by Woodward-Clyde Consultants. In addition, all personnel are responsible for bringing to the attention of the Site Safety Officer (SSO), Project Engineer, or the City of Oakland Project Manager any suspected unsafe or hazardous working conditions.

Reporting procedures and chain of command will be as follows:



3.0 JOB HAZARD ANALYSIS

The remediation project at the park may potentially expose workers to a variety of hazards. Each employer is responsible for safety aspects of its employees work. Tailgate-type safety meetings will be held at the start of the project, and will also be conducted for new staff coming to the site.

For purposes of discussion, the potential hazards at the park are divided into chemical and physical in this SSP.

Chemical hazards:
Primary chemical hazards at the site include lead and arsenic metals found in the soils. These materials are found in a soil matrix only. Soils containing these metals are indistinguishable from soils which do not, so all soil should be treated as potentially lead- and arsenic-containing.

Negative health effects of lead exposure include damage to the brain, nervous systems, and digestive systems. In addition, lead is a suspected teratogen, meaning that it can cause birth defects when pregnant women are exposed to it in sufficient quantities. Lead is cumulative in the body's tissues. Acute effects of lead exposure include irritation of the intestinal tract, leg cramps, muscle weakness, depression, coma, and even death in extreme cases. Chronic effects of lead exposure include facial pallor (paleness), a dark "lead line" on the gums, anemia, jaundice, and nerve damage.

Negative health effects of arsenic exposure include lung cancer and skin irritation. Acute effects of arsenic exposure include acute gastritis (irritation and pain of the gastrointestinal tract), as well as headache, vertigo, muscle spasm, and deliriums. Chronic effects of arsenic exposure include severe neural damage and crippling, and lung cancer..

Regulatory and recommended limits for airborne exposure to lead are listed in the table which follows:

Reference	Exposure Limit	Comment
California OSHA Lead Safety Standard 8 CCR 5216	Action Level: 30 µg/cubic meter as an 8-hour time-weighted average Permissible Exposure Level (PEL): 50 µg/cubic meter as an 8-hour time-weighted average	Where workers' exposures exceed the action level, employers are required by OSHA to provide training, biological monitoring, respiratory protection, and periodic exposure monitoring.
National Institute of Occupational Safety and Health	100 µg/cubic meter	Recommended level only, not enforceable by statute
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values	150 µg/cubic meter	Recommended level only, not enforceable by statute

Regulatory and recommended limits for airborne exposure to arsenic are listed in the table which follows:

Reference	Exposure Limit	Comments
California OSHA Arsenic Standard: 8 CCR 5214	Action Level: 5 µg/cubic meter as an 8-hour time-weighted average Permissible Exposure Level (PEL): 10 µg/cubic meter as an 8-hour time-weighted average	Where workers' exposures exceed the action limit, employers are required by OSHA to provide training, biological monitoring, respiratory protection, and periodic exposure monitoring.
National Institute of Occupational Safety and Health	2 µg/cubic meter 15-minute "ceiling" exposure	Recommended level only, not enforceable by statute
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values	200 µg/cubic meter 8-hour time-weighted average	Recommended level only, not enforceable by statute

For reference purposes, the CALOSHA 8-hour Permissible Exposure Level (PEL), ACGIH TLV and the Proposition 65 listing status for all the metals detected in the soil are tabulated below:

Metals	CALOSHA 8-hr PEL (mg/M³)	ACGIH TLV (mg/M³)	Prop 65 List?
Antimony	0.5	0.5	
Arsenic	**0.01**	**0.2**	√
Chromium	1.0	0.5	√
Copper	1.0	1.0	
Lead	**0.05**	**0.15**	√
Mercury	0.05	0.05	√
Molybdenum	10	10	
Nickel	1.0	1.0	√
Selenium	0.2	0.2	
Silver	0.1	0.1	
Vanadium	0.05	0.05	
Zinc	5	10	

Physical Hazards:

A variety of physical hazards may be encountered on the project. The list given here is not meant to be comprehensive, but is meant to reflect the nature and type of physical hazards which may be encountered.

Heat Cramps, Heat Stress, and Heat Stroke

Heat-related injuries are a potential hazard on the job due to the required personal protective equipment. Heat cramps, stress, and stroke are all caused by continuous heavy exertion in warm environments. This continued exertion can exceed the body's ability to cool itself. The symptoms range from fairly mild symptoms (in the case of heat cramps) to incapacitation, brain damage, and/or death in the case of heat stress or heat stroke.

Anticipated weather conditions for the project are 50-80 F° during working hours, with relative humidities of 75% and below. Sunny weather will increase the heat load to the worker.

All companies with personnel at the site are required to have established rest procedures for employees engaged in heavy, continuous, manual labor. In addition, all companies are expected to have in-house policies for personal and area monitoring, where required by regulation.

Underground Utilities

Underground utilities carrying natural gas or high-voltage electricity can be encountered when digging or trenching. Accidental digging of these services can lead to disruption of electrical or gas service for households served by the underground utility. In addition, there is a risk to site personnel of electrocution and natural gas explosions.

DECON personnel will be responsible for ascertaining the location of underground utilities prior to operating any digging or trenching equipment at the site. Remediation activities that require removing soil immediately adjacent to any utility lines will be performed by hand, and will be coordinated with the company which owns the utility lines

Trenching Activities

All trenching operations, if needed, will require shoring trench walls as required by OSHA construction regulations.

Explosion hazards

Gasoline and other fuels can form an explosion hazard. Explosions caused by these materials on other construction projects have led to serious injury or death.

Gasoline or other fuels should not be stored at the site, as far as is feasible. If their use is essential to the project and no alternative is available, they will be stored in containers designed for the purpose, and will be clearly labelled as flammable and gasoline-containing.

Noise

Construction equipment in use at the project should be expected to emit high noise levels. High noise levels can cause temporary and permanent hearing loss, fatigue, and disorientation.

Contractors and subcontractors on the site who operate the machinery or are otherwise exposed to high noise levels will be enrolled in a Hearing Conservation Plan as defined by Federal OSHA standard 29 CFR 1910.95. Non-contractor personnel may be required to enroll in a Hearing Conservation Plan if their exposure at the jobsite warrants it.

Moving Equipment Hazards

Heavy equipment in use at the site will pose a safety hazard to all personnel working nearby. In addition, to a source of high noise levels, heavy equipment can cause serious or deadly bodily harm

Heavy machinery operated by DECON or their subcontractors will need to have appropriate back-up audible warning alarms which are loud enough to be heard by workers wearing hearing protection. Areas where heavy equipment is operating should be cordoned off with caution tape or construction barriers.

A DECON supervisor must be present at the site any time that heavy equipment is in use. The supervisor is responsible to ensure that safety risks associated with use of the equipment are minimized. The supervisor must be able to reach the equipment operators by radio at all times.

Any workers at the site who need to access the areas where the heavy equipment is operating (for example, a geologist who needs to take a soil sample or make observations of soil) must first speak to the supervisor. The supervisor will contact the equipment operator by radio or hand signals in order to temporarily stop the equipment from operating during the time that the individual is in the area.

Waste Transporter Trucks

ECDC Environmental, the waste transporter, will use tractor-trailer trucks to remove contaminated soils from the site. These trucks are a potential hazard to workers at the site due to the possibility of a worker being struck or injured by a moving truck.

These trucks must remain in identified areas of the site during pick-up of soils. The pick-up route will be set up so that the trucks will not need to backup (a potentially dangerous operation) but can enter from one side of the site and exit out the other.

Ultraviolet light hazards

Sunlight can cause high exposures to ultraviolet light in personnel who are exposed to it for long durations. Ultraviolet light may cause skin cancers (melanomas) and premature aging of the skin.

Project personnel will wear clothing which covers the entire body for the majority of the project. For work which does not take place in full-body protective clothing, workers will use a combination of clothing and waterproof sun-screen lotion with an appropriate SPF rating to limit exposure to ultraviolet light.

Miscellaneous Safety Hazards

Miscellaneous safety hazards, such as falling objects, trip hazards, sharp objects on equipment, moving equipment parts, etc. are expected due to the nature of the project.

Various protective equipment will be worn to minimize injury from these safety hazards. This safety equipment will be worn at the site at all times:

- Leather Gloves;
- Steel-toed and steel-shanked boots;
- Long sleeved shirts or coveralls;
- Long pants or coveralls;
- Eye protection as required (based on dusty activities);

4.0 JOB HAZARD SUMMARY

Community Risks:
Risks to the surrounding community are expected to consist primarily of the movement of lead- and arsenic-containing dust off-site during excavation of soil, movement of soil to stockpile areas, storage of soil in stockpile areas, loading of soil into transporter trucks, and movement of transporter trucks off the site and through the neighborhood.

The extent of dust generation and movement during the remediation project will be controlled by wetting and by covering loose dirt with tarpaulins. See the following section of this site safety plan (Exposure Monitoring Plan) for details on air sampling, meteorological monitoring, and reporting procedures.

Offsite movement of lead and arsenic-containing water could also pose a potential environmental threat to the surrounding community. Water use at the site will be carefully monitored by the contractor to ensure that flowing water does not move off-site.

The health effects of lead and arsenic are detailed in section 3 of this report (Job Hazard Analysis).

Additional risks to the community will include increased noise levels during remediation activities. Contractor equipment at the site will be in compliance with City of Oakland community noise standards, however, it is expected that some increase in perceptible noise levels will still occur. High community noise levels can have negative health impacts, including increased stress levels.

Worker Risks:
All personnel at the site will be exposed to the physical and chemical hazards listed in section 3 of this report.

The primary chemical hazards are lead and arsenic in the soil. These materials are present in high enough quantities to potentially cause exposures above the Cal/OSHA action levels, based on sample results from WCC's initial site characterization report.

Physical risks include all the items listed in section 3, including heat-related conditions, underground utilities, trenching activities, explosion hazards, noise, moving equipment hazards, waste transporter truck movements, etc.

5.0 EXPOSURE MONITORING PLAN

Three types of air quality and related monitoring will be conducted as part of the project, they are listed as follows:

Type of Monitoring	Agents	Responsibility	Reference Section of Exposure Monitoring Plan
Daily Fence line	Arsenic, Lead	SCA	1.0
Direct readout dust monitor	Generally respirable dusts	SCA	3.0
Personal monitoring	Arsenic, Lead, heat stress	mainly DECON	4.0

Sampling locations, frequency, and methodology are listed in the Air Monitoring Plan appendix to Woodward-Clyde's Workplan for the Verdese Carter remediation project.

6.0 PERSONAL PROTECTIVE EQUIPMENT AND ENGINEERING CONTROLS

The area of the site where active excavation is occurring will be considered as a Level C work area (i.e., requiring respiratory protection). All personal protective equipment requirements are in effect for anyone entering this work area. The work area must be clearly established by use of barrier fences and clear labelling to prevent accidental entry into the work area by unprotected individuals. Under no circumstances will the work area be entered by any personnel who are not wearing the appropriate personal protective equipment. Personal protective equipment to be worn during work activities involving the excavation or movement of soil will include:

- At the beginning of the project, until the time when an adequate personal lead and arsenic exposure profiling has been completed, full-face negative pressure respirators equipped with HEPA-filtered cartridges will be used. All components will be NIOSH-approved for use against dusts, fumes, and mists. All users will have to have been fit-tested with documentations on file, and that negative and positive pressure tests be used each time when a respirator is donned. All personnel will be required to be clean-shaven and to have current medical, training, and fit test documentation relevant to wearing a respirator.

- For personnel whose estimated personal exposures have been documented to be less than 10 times the PEL: Half-face negative pressure respirators equipped with HEPA-filtered cartridges. All components will be NIOSH-approved for use against dusts, fumes, and mists. All users will have to have been fit-tested with documentations on file, and that negative and positive pressure tests be used each time when a respirator is donned. All personnel will be required to be clean-shaven and to have current medical, training, and fit test documentation relevant to wearing a respirator.

- For personnel whose estimated personal exposures have been documented to be less than 50 times the PEL: full-face negative pressure respirators equipped with HEPA-filtered cartridges. All components will be NIOSH-approved for use against dusts, fumes, and mists. All users will have to have been fit-tested with documentations on file, and that negative and positive pressure tests be used each time when a respirator is donned. All personnel will be required to be clean-shaven and to have current medical, training, and fit test documentation relevant to wearing a respirator.

- As an elective, and for personnel whose exposures have been documented as less than 100 times the PEL: full-face powered air-purifying respirators (PAPR) equipped with HEPA-filtered cartridges. All components will be NIOSH-approved for use against dusts, fumes, and mists. All PAPR's will be checked prior to entering the work area each time, and after exiting. This check will be conducted with a flow rate checking device compatible with the PAPR. The PAPR flow rate must be at least 4 cubic feet per minute, otherwise the PAPR will be considered damaged or undercharged. A hardcopy record of this PAPR flow-rate check will be maintained at the entrance to the work area. All personnel entering the work area will sign in their names, company affiliation, and will check to confirm that a PAPR flow check was performed. with adequate results. All personnel will be required to be clean-shaven and to have current medical, training, and fit test documentation relevant to wearing a PAPR.

- Disposable Tyvek® coveralls will be worn. For workers excavating the soil, the coveralls will be worn double-layered. The coveralls will be disposed of following each use. Ripped coveralls will be replaced promptly by the worker. Coveralls will be worn with the sleeves rolled down to meet gloves. The interface between the sleeve and the glove will be taped with several layers of overlapping duct tape so that dust can not penetrate into the interior of the garments. Similarly, the hood of the coverall will be taped to the face of the PAPR so that dust will not seep into the interior of the suits, and the leg of the coverall will be taped to the top of the outer boot.

- Impermeable, disposable gloves and outer boots will be worn and will be disposed of during each shift.

- Chemical resistant steel-toe and steel-shank boots will be worn under the outer boots.

Note that no downgrade of respiratory protection level is anticipated during the excavation phase.

Donning procedures will include inspection of disposable coveralls for tears and rips, taping of coveralls, inspection and flow checking of PAPR's, and signing the work area sign-in log. A buddy system is recommended for the doffing procedures in order to achieve better taping of the coveralls.

Doffing procedures will include:

- Removal and disposal of outer coveralls and outer boot covers, and washing of gross debris off of boots in one location;

- Walking over clean planking or masonite to a second location, where boots are detail cleaned and second coverall is removed and disposed of;

- Walking to the washing chamber, where body surfaces previously unprotected by the coverall are washed with soap; respirator is removed following thorough wetting of respirator surface; respirator cartridges are either disposed of or taped closed to prevent emissions from filters; and

- Proceeding from the washing chamber to dressing area on "clean" side of site, outside of work zone. Dressing area will be visually isolated from surrounding community and will have private change areas for males and females. At this point all personnel will recheck the flow rate of PAPR's, sign work area sign-out log, and recharge PAPR batteries.

The contractor shall use at the minimum, these engineering controls for suppressing airborne dust levels:

1. Dust suppressants and surfactants continuously applied from a "fertilizer aspirator" via active misting of the soil during all soil handling activities, on active soil stockpiles, and during active excavations.

2. Cover with tarps inactive excavations and stockpiles, and during temporary cessation of work at active excavations and stockpiles, so as to reduce the rate of drying and aerosolization.

3. Washing of the truck tires, wheels, and mud-flaps before releasing a truck into the traffic.

4. Collecting any runoffs at the sources, minimizing the size of the areas these runoffs cover.

7.0 SITE CONTROL (WORK ZONES AND SECURITY MEASURES)

Work zones will be clearly indicated by use of barrier fence and posting of signs. Access to the work zones should be through a washing area for personnel. During off-hours, access to the work zone should be controlled by use of a padlock. A security guard may be required during off-hours.

8.0 DECONTAMINATION PROCEDURES

Exact locations of work zones and decontamination facilities are to be determined. Each discrete work zone will have a minimum of one decontamination chamber/washing facility immediately adjacent to it. All equipment leaving the work area is required to be thoroughly decontaminated by use of water with an added surfactant (such as TSP® or similar material). Heavy equipment, prior to leaving the site, will be required to be decontaminated using water, surfactant, applied using a scrub-brush. All personnel leaving the work zone, even for a short duration, are required to remove ("doff") personal protective clothing, and fully decontaminate themselves prior to eating, smoking, drinking, and leaving the site.

Doffing procedures will include

- Removal and disposal of outer coveralls and outer boot covers, and washing of gross debris off of boots in one location;
- Walking over clean planking or masonite to a second location, where boots are detail cleaned and second coverall is removed and disposed of;
- Walking to the washing chamber, where body surfaces previously unprotected by the coverall are washed with soap; respirator is removed following thorough wetting of respirator surface; respirator cartridges are either disposed of or taped closed to prevent release of loose dusts from filters;
- Decontamination of any small equipment items, such as sampling vials, small tools, cameras, etc. can be conducted in the washing chamber; and
- Proceeding from the washing chamber to dressing area on "clean" side of site, outside of work zone. Dressing area will be visually isolated from surrounding community and will have private change areas for males and females. At this point all personnel will recheck the flow rate of PAPR's, sign work area sign-out log, and recharge PAPR batteries.

Coveralls, gloves, outer boots, and other disposable items will be disposed of as hazardous waste materials. The water used to decontaminate people and equipment will be captured and drummed by the contractor, pending its characterization as hazardous due to lead, arsenic, or other metals content. Note that if waste water is to be stored on site for any length of time, a bacteriostatic agent will be added to avoid fermentative activity in the drum (alternately, an offgassing hole or bung will be installed on the drum).

9.0 GENERAL SAFE WORK PRACTICES

The hazards to site workers, which are detailed elsewhere in this report, will be minimized with the following work practices and procedures:

Heat Cramps, Heat Stress, and Heat Stroke	All contractor personnel are expected to be informed on the dangers and potential risks of heat-related conditions. All contractors are expected to address the heat-related conditions in their respective site-specific health and safety plans. This may include personal or area monitoring for heat exposure. While data may be available from the SSO, the individual contractor supervisor is responsible for implementing any safety and health supervision and management.
Underground Utilities	DECON personnel will be responsible for ascertaining the location of underground utilities prior to operating any digging or trenching equipment at the site. Underground Service Alert (USA) should be contacted for information on the presence and location of underground utilities.
Trenching Activities	While the excavation depth is not expected to trigger the CALOSHA trenching requirements, any trenching operations will involve shoring trench walls as required by OSHA construction regulations. DECON personnel are responsible for the safe implementation of this shoring, and for labelling or posting trench areas to minimize other contractors' risk of entering a trench prior to its being shored.
Explosion hazards	Gasoline or other fuels should will not be stored at the site, as far as is feasible. If their use is essential to the project and no alternative is available, they will be stored in containers designed for the purpose, and will be clearly labelled as flammable and gasoline-containing. Where their use is required, fire extinguishers rated for gasoline fires will be available.
Noise	Contractors and subcontractors on the site who operate the machinery or are otherwise exposed to high noise levels are expected to be enrolled in a Hearing Conservation Plan as defined by Federal OSHA standard 29 CFR 1910.95. Non-contractor personnel may be required to enroll in a Hearing Conservation Plan if their exposure at the jobsite warrants it. Note that in all cases, 29 CFR 1910.95 requires personal exposure monitoring for noise where there is a possibility of overexposure, as defined by the regulation.

Moving Equipment Hazards

Heavy machinery operated by DECON or their subcontractors will need to have appropriate back-up audible warning alarms which are loud enough to be heard by workers wearing hearing protection. Areas where heavy equipment is operating should be cordoned off with caution tape or construction barriers.

A DECON supervisor will be present at the site any time that heavy equipment is in use. The supervisor is responsible to ensure that safety risks associated with use of the equipment are minimized. This includes coordinating site activities such as sampling, transporter truck filling, excavating, etc. The supervisor will be able to reach the equipment operators by radio at all times in order to expedite this coordination.

Any workers at the site who need to access the areas where the heavy equipment is operating (for example, a geologist who needs to take a soil sample or make observations of soil) will first speak to the supervisor. The supervisor will contact the equipment operator by radio or hand signals in order to temporarily stop the equipment from operating during the time that the individual is in the area.

Waste Transporter Trucks

ECDC Environmental, the waste transporter, will use tractor-trailer trucks to remove contaminated soils from the site. These trucks are a potential hazard to workers at the site due to the possibility of a worker being struck or injured by a moving truck.

These trucks must remain in identified areas of the site during pick-up of soils. The pick-up route will be set up so that the trucks will not need to back up (a potentially dangerous operation) but can enter from one side of the site and exit out the other.

Transporter truck drivers will be briefed on site layout and safety considerations when first arriving at the site.

Ultraviolet light hazards

Sunlight can cause high exposures to ultraviolet light in personnel who are exposed to it for long time durations. Ultraviolet light may cause skin cancers (melanomas) and premature aging of the skin.

Project personnel will wear clothing which covers the entire body for the majority of the project. For work which does not take place in full-body protective clothing, workers will use a combination of clothing and waterproof sun-screen lotion with an appropriate SPF rating to limit exposure to ultraviolet light.

Miscellaneous Safety Hazards

Miscellaneous safety hazards, such as falling objects, trip hazards, sharp objects on equipment, moving equipment parts, etc. are expected due to the nature of the project.

Various protective equipment will be worn to minimize injury from these safety hazards. This safety equipment will be worn at the site at all times:

- Leather Gloves;
- Steel-toed and steel-shanked boots;
- Long sleeved shirts or coveralls;
- Long pants or coveralls;
- Hard hats;
- orange safety vests;
- Eye protection (safety glasses) as required (based on dusty activities);

10.0 SANITATION

The water used to decontaminate people and equipment will be captured and drummed by the contractor, pending its characterization as hazardous due to lead, arsenic, or other metals content. Note that if waste water is to be stored on site for any length of time, a bacteriostatic agent will be added to avoid fermentative activity in the drum (alternately, an offgassing hole or bung will be installed on the drum). Any bacteriostatic agent added must be compatible with treatment procedures conducted if the material is considered hazardous. For example, if chlorine bleach is to be added as a bacteriostatic agent, the contractor will ensure that the precipitation process used to treat the water is compatible with the chlorine bleach.

If the water is approved as a non-hazardous material, disposal to a sanitary sewer is required, along with the applicable permits from the City of Oakland.

Restrooms will be provided in the form of porta-Johns or similar temporary, portable, private outhouse facilities. These facilities will be maintained with regular emptying and odor-suppressant materials such that no odors will be noticeable at the fenceline.

Any water supplies accessed to provide potable water to the site will be connected to using backflow prevention devices (BPD's) which are in compliance with City of Oakland code requirements.

All drinking, eating, smoking, chewing tobacco, chewing gum, etc. are forbidden inside the work zones (where respiratory protection is required). Outside the work zones, but still on the park site, drinking, eating, smoking, etc. is allowed only in designated areas.

11.0 STANDARD OPERATING PROCEDURES

These procedures will, in most instances, be established by each company which has workers on the site. Note that SCA's Site Safety Officer may review these protocols in circumstances where workers are not observed to be following good health and safety procedures.

- For decontamination protocols, see section 8 of this report;
- For fit testing protocols, all companies with workers on the site are referred to Federal OSHA regulation 29 CFR 1910.134. All companies with workers on site are responsible for having a written respiratory protection plan in place, including all medical monitoring, training, respirator selection, and other requirements;
- Equipment calibration should follow manufacturer's specifications, in the case of direct-read air monitoring and meteorological equipment, and OSHA recommended protocols, in the case of pump-driven air sampling equipment;
- Drill rig checkouts are a standard item to be addressed in DECON's site-specific health and safety plan.
- Confined spaces are not expected to be encountered on the site.

12.0 EMERGENCY RESPONSE PLANS

In the event of medical emergencies, the nearest medical facility is San Leandro hospital at the corner of 136th street and East 14th street. A map of a route from the park to the hospital is included as Figure 2 of this SSP.

If a medical emergency occurs, 911 should be dialed, and the nature of the emergency described. If there is a potential for the individual to be contaminated with lead- or arsenic-containing soil, the emergency service must be alerted to this possibility.

If the medical problem is minor, and the injured person is being driven to the hospital, the hospital should be telephoned to alert them to the nature of the medical problem.

A list of emergency phone numbers is given below:

Emergency Medical Service (ambulance, police, etc.)	911
San Leandro Hospital Emergency Room 13855 E. 14th, San Leandro, CA 94578	510-357-6500

Personnel at the site who have CPR/First Aid training include (to be filled in at time of site mobilization):

Name	Company	Contact Means (Pager Number, Cellular Phone Number, or typical location)

In the event of a medical emergency, cellular phones or site telephones will be used to contact the appropriate emergency medical service provider (911 or hospital). Cellular phones and site telephones are available in the following locations:

To be filled in by SSO at time of site mobilization: ____________________

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In the event of a medical emergency, affected personnel will be decontaminated to the maximum extent possible. For injured persons with heart attacks, severe trauma, heat stroke, etc. who need immediate medical attention, decontamination will be performed only after the medical condition is stabilized. Following the stabilization, contaminated vehicles, clothing, etc. would be decontaminated or disposed.

For injured personnel with non-critical injuries, full decontamination would be performed with the assistance of other workers, prior to leaving the work zones.

For fire fighters or medical personnel responding to site emergencies, WCC and SCA onsite representatives will coordinate, inform, and direct the procedure of decontamination and protection needed for the emergency response personnel, on a case by case basis, with the intent of providing the needed medical attention with limited delays.

In the event of a fire, fire extinguishers are located in the following locations:

To be filled in by SSO at time of site mobilization: ______________________________

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Material spills are not considered to be a condition of high risk for workers or for the surrounding areas, since the material being transported does not have a strong vapor phase (i.e., does not become a vapor or gas readily) and is not liquid. In the worst case scenario (if a transporter truck carrying lead- and arsenic-contaminated soil overturns while leaving the site or while proceeding through streets), the following emergency response actions are to be followed:

- Medical attention will be sought for any injured personnel;
- The area around the spilled soil will be cordoned off and secured from unprotected citizens or personnel;
- The soil will be covered with a tarpaulin to minimize any dispersion due to wind;
- Appropriate regulatory agency personnel will be contacted, including the Alameda County Health Department;
- The soil will be transferred to another transporter truck as soon as is feasible. All residual soil in the area will be removed with a wet-sweeping or wet-mopping procedure. The damaged transporter truck would likewise be decontaminated with wet-sweeping or wet-mopping procedures.

13.0 TRAINING REQUIREMENTS

A variety of training requirements exist for personnel working on the site. Individual companies with personnel at the project are expected to provide this training to all employees who require it. Documentation of this training must be available for audit by the SSO at all times. A summary of the training requirements is listed as follows:

- Hazardous Waste Site Operator, 40-hour training as defined in 29 CFR 1910.120 for all personnel in the work zone;
- Hazardous Waste Site Personnel, 24-hour training as defined in 29 CFR 1910.120 for all personnel visiting the site for brief periods and not required to enter the work zone;
- Site-specific hazard awareness training, as defined in 29 CFR 1910.120 for all personnel at the site;
- Respiratory Maintenance and Use training as defined in 29 CFR 1910.134;
- Hazard Communication Training, as defined in 29 CFR 1910.1200;
- Lead Awareness Training, as defined in 29 CFR 1926.62 and 8 CCR 5216;
- Arsenic Awareness Training, as defined in 29 CFR 1910.1018 and 8 CCR 5214; and
- Training on the safe operation of various types of mobile equipment, as required by 29 CFR 1926 (various sections).

14.0 MEDICAL SURVEILLANCE PROGRAMS

Medical surveillance will be conducted on the basis of personal monitoring results which indicate potential exposure to elevated levels of airborne lead or arsenic (as conducted by the contractors and subcontractors for their own personnel), as required by the pertinent CALOSHA regulations. All contractor and subcontractor companies onsite are expected to have an in-house personal exposure monitoring and medical surveillance programs.

Contractors and subcontractors exposed to elevated levels of noise are expected to have a hearing conservation plan (HCP) with baseline and annual audiograms performed by qualified physicians.

15.0 DOCUMENTATION

All contractor and subcontractor companies onsite are expected to have an in-house record-keeping system for personal exposure monitoring, medical surveillance results, training conducted, injuries recorded, etc. These data will be submitted to the SSO for review and data management, and for project close-out documentation.

APPENDIX 1 - WOODWARD-CLYDE SOIL SAMPLING RESULTS

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	3.3	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	-	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	6.98	30.7	11.8	<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	51.8	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	33.5	[illegible]	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	50.9	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	8.87	<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	8.91	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	58.7	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		10.7	397	612	<0.5	<0.5	3.2	<1.0	48.3	594	4.72	11.9	1.1	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

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
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
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

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
B-08-3	3	6.80	<5	6.49	38.4	OF
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
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	41.6	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.

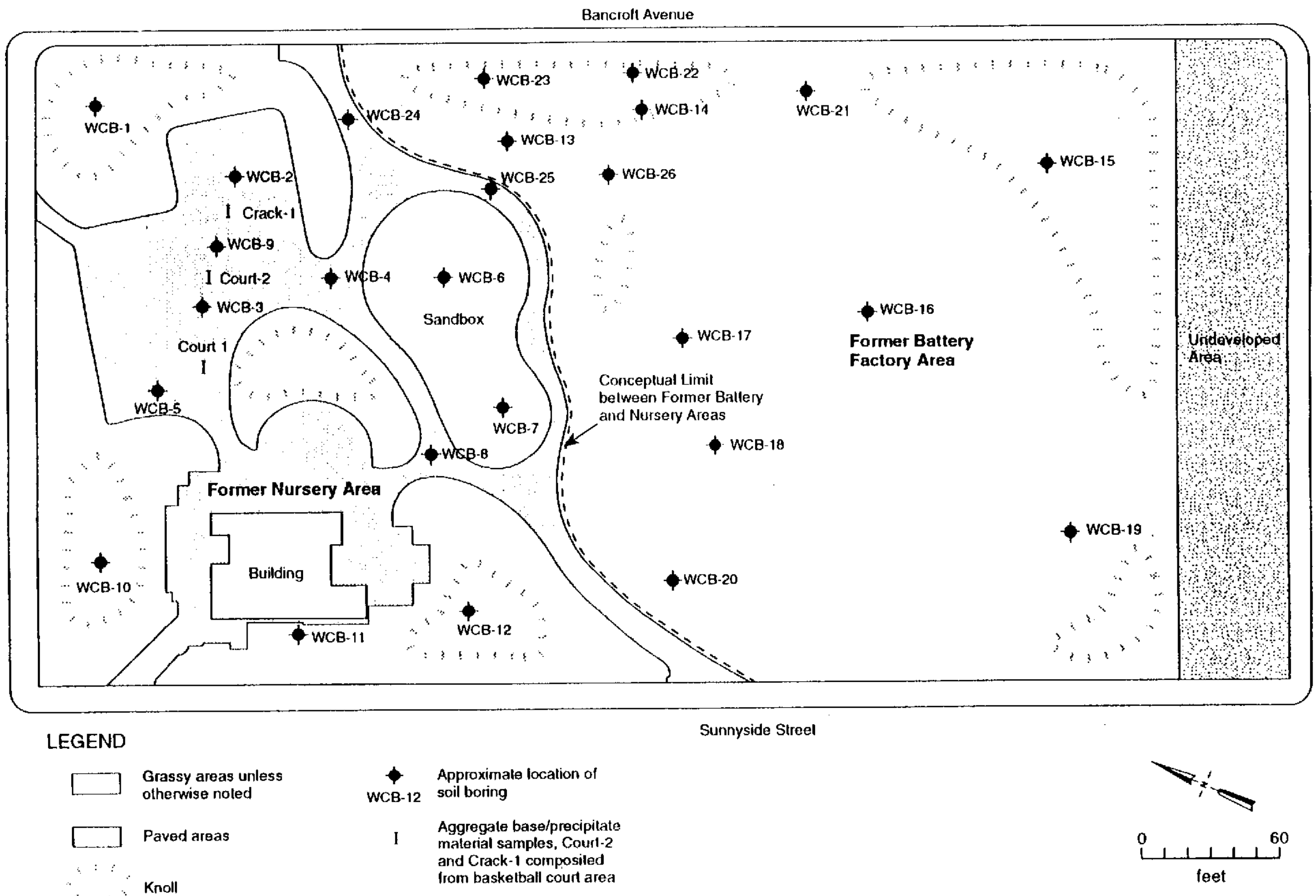
AB= Aggregate Base Material
PF= Park Fill
OF= Intact Old Fill
1978= 1978 Fill
No note for native soil.

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			397	594	291	AB
COURT-2		2.8	734	692	443	AB
CRACK-1		1.5	14.4	5.5	7450	PPT

Note: Shading indicates result greater than TTLC.

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



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

93C0243A-3000/071993

SITE D
HOSPITAL
SAN LEANDRO
Lake Chabot Municipal Golf Course
Lake Chabot Park
Lake Chabot
Alameda Co. Juvenile Hall
Viejo
Thrasher Park
City Hall
Cherry Grove Park
BAY FAIR MALL
GREENHOUSE MARKET PLACE
MacARTHUR
ESTUDILLO
FAIRMONT
FOOTHILL
EAST SHORE

APPENDIX B
EXPOSURE MONITORING PLAN

EXPOSURE MONITORING PLAN
VERDESE CARTER PARK
98TH & SUNNYSIDE
OAKLAND, CA

TABLE OF CONTENTS

SCA ENVIRONMENTAL PROJECT NO. BI-777

1.0 Introduction

Several types of air, noise, heat stress and related monitoring will be conducted as part of the project, they are listed as follows and discussed further in the sections shown:

Type of Monitoring	Agents	Responsibility	Section
Daily Fence line	Arsenic, Lead	SCA	2.0
Direct readout dust monitor	Generally respirable dusts	SCA	4.0
Personal exposure monitoring	Arsenic, Lead, noise, heat stress	mainly DECON	5.0

2.0 Daily Fence Line Monitoring

The purpose of fence line monitoring is to document the project's daily air quality impact to the environment and the human populations immediately off site, with the results available for assessment within 24 hours. In addition, to assess the air quality impact from the entire project duration of 4 weeks, two additional samples will be collected running for the entire duration of 4 weeks. Results of these two high volume samples will be used to compare against the background lead and arsenic levels reported by the California Air Resources Board (CARB) for this region:

Fremont, CA monitoring station:

<0.0005 - 0.003 μg/M³ for arsenic (from California Air Resources Board's Ambient Toxics Metals Data (1985-1990, Preliminary)), and

0.01 - 0.1 μg/M³ for lead (from California Air Resources Board's 1991 and 1992 Criteria Lead Data from the SF Bay Area).

Project Fenceline Action Levels (PFAL) have been established as indices above which additional control measures will be required from the Contractor (DECON), in order to minimize the potential health hazards to the neighboring populations, and liability to the City of Oakland. These PFAL have taken into account of the applicable standards; the feasible sampling and analytical methods with a reasonably rapid (daily) turnaround time of 24 hours.

Two agents have been selected for sampling and analysis because of their known toxicity, and relatively high levels measured in soil samples at the site: lead and arsenic. In addition, the respirable dust levels (PM10) will be monitored using a direct readout instrument as a means to provide instant feedbacks to the contractor, with the objective of halting or modifying work if necessary, thus minimizing the chance of exceeding the PFALs of lead and arsenic. The overall dust levels for the project duration are not expected to exceed the US EPA or California PM10 standards, and will therefore not measured separately.

In the event that the PFALs are exceeded, the SSO will call for an emergency meeting reviewing with the key participants the necessary actions to prevent recurrence of the situation. Other actions will be dependent on the levels measured.

Four sampling stations will be set up to envelope the site. Specific siting of the samples will take into account of the local conditions, including equipment security, ingress and egress of the Contractor's machinery and vehicles, terrain, local meteorological conditions, etc. Samples will be collected on a daily basis, and submitted for analysis with the results made available by 5 PM the following work day. The sampling parameters and the PFAL are listed below:

Element	Arsenic (As)	Lead (Pb)	Dust (PM10)
Method Reference #	NIOSH 7901	NIOSH 7082	none
Analytical Technique	Graphite AA	Flame AA	Miniram
Sampling Media	37 mm 0.8 μ MCEF	37 mm 0.8 μ MCEF	direct readout
Daily sample volume	1,000 liter (2-2.5 LPM)	1,000 liter (2-2.5 LPM)	na
Hours	7 AM - 330 PM	7 AM - 330 PM	7 AM - 330 PM
Detection Limit	0.06 μg/M³	0.6 μg/M³	
Number of Samples	4/day + 1 blank/day	4/day + 1 blank/day	one unit on site
max total dust loading	< 2 mg/filter	na	–
30-day Integrated Sample	108,000 L (2.5 LPM)	108,000 L (2.5 LPM)	none
Detection Limit	0.0006 μg/M³	0.006 μg/M³	–
Laboratory Accreditation	AIHA	AIHA	–
Turnaround Time	≤24 hours upon receipt (generally before 5 PM the next day)*	≤24 hours upon receipt (generally before 5 PM the next day)*	instantaneous
Sample Delivery	Daily, via courier	Daily, via courier	na

* results for the first day of work will be made available within 8 hours of sample arrival at the laboratory

Standards	Arsenic in μg/M³	Lead in μg/M³	mg/M³
EPA NAAQS	na	1.5 (quarterly calendar average)	0.15 (24-hr avg, Primary) 0.15 (24-hr avg, Secondary)
CARB	na	1.5 (30-Day avg)	0.05 (30-Day avg)
Project Fenceline Action Level (PFAL)	0.06 μg/M³ based on detection limit of sampling and analytical method	1.5 μg/M³ based on EPA NAAQS & CARB Standard	0.2 to 1.0 mg/M³, to ensure airborne lead is <1.5 μg/M³; 0.06 to 0.12 mg/M³, to ensure airborne arsenic is <0.06 μg/M³; see Section 4.0

Calibration will be performed prior to beginning sampling, and at the conclusion of sampling in each case. Calibration will be via BGI-brand rotameter that has been recently calibrated against a primary standard (Gilibrator-brand soap bubble burette).

3.0 Not Used

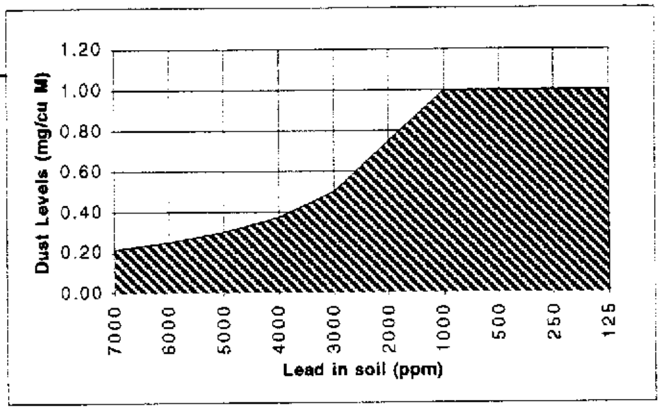
4.0 Direct Readout Dust Monitor

To provide immediate feedbacks to the Contractor (DECON), SCA will use a direct readout PM10 dust monitor so that the levels of respirable dust can be determined onsite without waiting for the lab results of lead and arsenic, which would lag for a period of as long as 1.5 days. Knowing the lead and arsenic contents of the soil (obtained from WCC's 7/19/93 Site Characterization Report), SCA will take spot and cumulative readings of the dust levels, and over time, establish additional guidelines for the Contractor to minimize chances of elevation of lead and arsenic levels. The following table summarizes the Dust Levels permissible as a function of the soil lead and arsenic levels, in order to ensure that the airborne lead and arsenic levels maintain below the Project Fenceline Action Levels, based on these formulae:

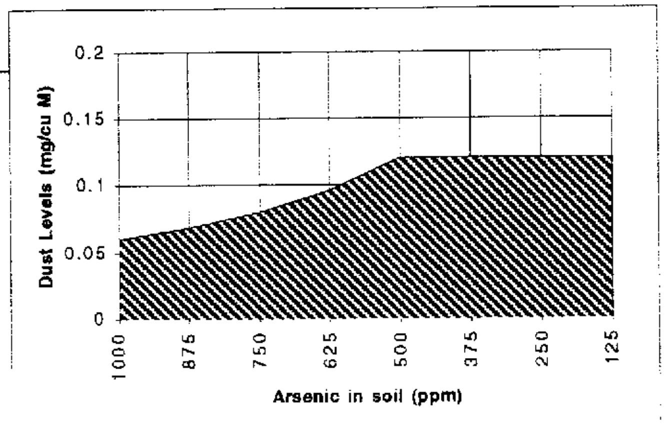
Dust (mg/m³) = 1.5 μg/m³ ÷ Pb (ppm) x 10^6, or 1.0 mg/M³, whichever is lower; and

Dust (mg/m³) = 0.06 μg/m³ ÷ As (ppm) x 10^6, or 0.12 mg/M³, whichever is lower.

Soil Pb (ppm)	Dust (mg/m^3)	Pb (1.5 µg/M^3)
7000	0.21	1.5
6000	0.25	1.5
5000	0.30	1.5
4000	0.38	1.5
3000	0.5	1.5
2000	0.75	1.5
1000	1	1.5
500	1	1.5
250	1	1.5
125	1	1.5



Soil As (ppm)	Dust (mg/m^3)	As (0.06 µg/M^3)
1000	0.06	0.06
875	0.07	0.06
750	0.08	0.06
625	0.10	0.06
500	0.12	0.06
375	0.12	0.06
250	0.12	0.06
125	0.12	0.06



The monitor in use will be a PDM-3 "Mini-Ram," mfg. MIE, Inc., without a datalogger. Calibration will be performed on a periodic basis as per manufacturer's instructions. For use in extremely dusty conditions, the PDM-3 will be calibrated daily. For less dusty conditions, calibration will be performed on a twice-weekly or weekly basis. During calibration procedures, the PDM-3 optical chamber will be disassembled, cleaned with a compressed air source, and reassembled. The unit will be calibrated to a zero point and to a constant "span" point. Records of this calibration will be recorded in SCA's project log book or on data sheets devised for the purpose.

5.0 Personal Monitoring for Lead, Arsenic, Noise and Heat Stress

Initial Personal Exposure Monitoring: Current CALOSHA regulations require that an employer conduct personal monitoring for lead, arsenic and noise when such potential exposures are reasonably expected to approach the action levels, so that evaluation of work practices and proper personal protective equipment can be made to reduce exposures, or to trigger additional actions, such as training, biological monitoring.

In this project, the Contractor (DECON) will be required to sample and analyze such agents for its workers. Other parties, including SCA, WCC, and ECDC may also be required to conduct such monitoring for their workers pending the work conditions. SCA will notify the parties involved of the sampling necessity, or the validity of pooling monitoring data from various parties so as to satisfy the monitoring requirements at a reasonable cost.

5.1 Lead and Arsenic Workers Exposures Sampling Parameters

The required sampling parameters for lead and arsenic are tabulated below:

Element of concern	**Arsenic (As)**	**Lead (Pb)**
Method Reference #	NIOSH 7901	NIOSH 7082
Monitoring frequency	10% of employees until the exposure profiles have been established, and whenever there is a change of procedures and operating personnel	
Analytical Technique	Graphite AA	Flame AA
Sampling Media	37 mm 0.8 μ MCEF	37 mm 0.8 μ MCEF
Daily sample volume	about 1,000 liter	about 1,000 liter
Sample durations	7 AM - 330 PM	7 AM - 330 PM
Detection Limit	0.06 $\mu g/M^3$	0.6 $\mu g/M^3$
Laboratory Accreditation	AIHA	AIHA
Turnaround Time	within one week of collection	
Occupational Standards	$\mu g/M^3$	$\mu g/M^3$
CALOSHA 8-hr TWA	10	50
CALOSHA 8-hr AL	5	30
NIOSH Recommended	2 (15 minute ceiling)	100
ACGIH Recommended	200	150

Calibration should be performed following good industrial hygiene practices. At the minimum, a primary standard such as a clean soap-bubble burette should be used to directly calibrate sampling pumps in the field. Calibration should be performed prior to sampling, and at the conclusion of sampling. Alternately, a secondary standard (BGI-brand rotameter or equivalent) can be calibrated periodically against the primary standard and used in the field.

5.2 Noise Exposure Monitoring

The Contractor (DECON) will be required to conduct the initial noise exposure monitoring to comply with 8 CCR 5095, Control of Noise Exposure. If the 8-hour time weighted average exposure is greater than the Action Level (85 dBA, slow response), the Contractor will institute the necessary Hearing Conservation Program (HCP), including the supervised use of hearing protection. DECON is allowed to rely on previous noise monitoring results from similar operations for determining the elements of the HCP.

5.3 Heat Stress Monitoring

The Contractor (DECON) will be required to monitor for the Wet Bulb Globe Temperature Index (WBGT), inclusive of the solar loading, and taking into account of the use of the respirators and semi-permeable disposable coveralls. Refer to the following ACGIH guidance for both monitoring and use of the index to determine the necessary work-rest regimen:

HEAT STRESS

Note: Materials on the Notice of Intended Changes have been incorporated into the text and are indicated by a † preceding the revision/addition and by a vertical rule in the margin. [See pages 91, 92, and 98.]

he heat stress TLVs specified in Table 1 and Figure 1 refer to heat stress conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse health effects. These TLVs are based on the assumption that nearly all acclimatized, fully clothed (e.g., lightweight pants and shirt) workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38°C (100.4°F).

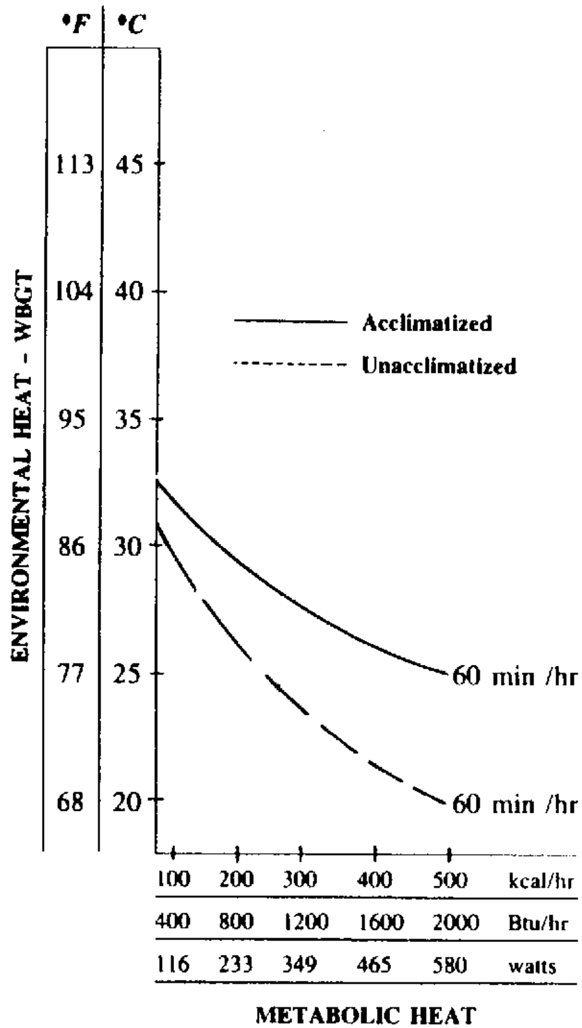
†Where there is a requirement for protection against other harmful substances in the work environment and additional personal protective clothing and equipment must be worn, a correction to the WBGT TLV values, as presented in Table 1 and Figure 1, must be applied. The values in Figure 1 are approximations and are not intended as a substitute for physiological monitoring.

Since measurement of deep body temperature is impractical for monitoring the workers' heat load, the measurement of environmental factors is required which most nearly correlate with deep body temperature and other physiological responses to heat. At the present time, the Wet Bulb Globe Temperature Index (WBGT) is the simplest and most suitable technique to measure the environmental factors. WBGT values are calculated by the following equations:

TABLE 1. Examples of Permissible Heat Exposure Threshold Limit Values [Values are given in °C and (°F) WBGT]*

	Work Load		
Work—Rest Regimen	**Light**	**Moderate**	**Heavy**
Continuous work	30.0 (86)	26.7 (80)	25.0 (77)
75% Work — 25% Rest, each hour	30.6 (87)	28.0 (82)	25.9 (78)
50% Work — 50% Rest, each hour	31.4 (89)	29.4 (85)	27.9 (82)
25% Work — 75% Rest, each hour	32.2 (90)	31.1 (88)	30.0 (86)

* For unacclimatized workers, the permissible heat exposure TLV should be reduced by 2.5°C.



†**Figure 1** — Permissible heat exposure Threshold Limit Values for heat acclimatized and unacclimatized workers.

Note: Figure 1 has been modified from the 1990-91 TLV/BEI Booklet by deletion of "Xs" on the two curves and the addition of marks on the x and y axes for the numerical indices.

1. Outdoors with solar load:
   WBGT = 0.7 NWB + 0.2 GT + 0.1 DB
2. Indoors or Outdoors with no solar load:
   WBGT = 0.7 NWB + 0.3 GT

where:

WBGT = Wet Bulb Globe Temperature Index
NWB = Natural Wet-Bulb Temperature
DB = Dry-Bulb Temperature
GT = Globe Temperature

The determination of WBGT requires the use of a black globe thermometer, a natural (static) wet-bulb thermometer, and a dry-bulb thermometer.

Higher heat exposures than those shown in Table 1 and Figure 1 are permissible if the workers have been undergoing medical surveillance and it has been established that they are more tolerant to work in heat than the average worker. Workers should not be permitted to continue their work when their deep body temperature exceeds 38°C (100.4°F).

Evaluation and Control

I. *Measurement of the Environment*

The instruments required are a dry-bulb, a natural wet-bulb, a globe thermometer, and a stand. The measurement of the environmental factors should be performed as follows:

A. The range of the dry and the natural wet bulb thermometer should be −5°C to +50°C (23°F to 122°F) with an accuracy of ± 0.5°C. The dry bulb thermometer must be shielded from the sun and the other radiant surfaces of the environment without restricting the airflow around the bulb. The wick of the natural wet-bulb thermometer should be kept wet with distilled water for at least 1/2 hour before the temperature reading is made. It is not enough to immerse the other end of the wick into a reservoir of distilled water and wait until the whole wick becomes wet by capillarity. The wick should be wetted by direct application of water from a syringe 1/2 hour before each reading. The wick should extend over the bulb of the thermometer, covering the stem about one additional bulb length. The wick should always be clean and new wicks should be washed before using.

B. A globe thermometer, consisting of a 15-cm (6-inch) diameter hollow copper sphere painted on the outside with a matte black finish or equivalent, should be used. The bulb or sensor of a thermometer (range −5°C to +100°C [23°F to 212°F] with an accuracy of ± 0.5°C) must be fixed in the center of the sphere. The globe thermometer should be exposed at least 25 minutes before it is read.

C. A stand should be used to suspend the three thermometers so that they do not restrict free air flow around the bulbs, and the wet-bulb and globe thermometer are not shaded.

D. It is permissible to use any other type of temperature sensor that gives a reading identical to that of a mercury thermometer under the same conditions.

E. The thermometers must be placed so that the readings are representative of the conditions under which the employees work or rest, respectively.

II. *Work Load Categories*

Heat produced by the body and the environmental heat together determine the total heat load. Therefore, if work is to be performed under hot environmental conditions, the workload category of each job should be established and the heat exposure limit pertinent to the workload evaluated against the applicable standard in order to protect the worker exposure beyond the permissible limit.

A. The work load category may be established by ranking each job into light, medium, or heavy categories on the basis of type of operation:

(1) light work (up to 200 kcal/hr or 800 Btu/hr): e.g., sitting or standing to control machines, performing light hand or arm work,

(2) moderate work (200–350 kcal/hr or 800–1400 Btu/hr): e.g., walking about with moderate lifting and pushing, or

(3) heavy work (350–500 kcal/hr or 1400–2000 Btu/hr): e.g., pick and shovel work.

Where the work load is ranked into one of said three categories, the permissible heat exposure TLV for each workload can be estimated from Table 1 or calculated using Tables 2 and 3.

B. The ranking of the job may be performed either by measuring the worker's metabolic rate while performing a job or by estimating the worker's metabolic rate with the use of Tables 2 and 3. Additional tables available in the literature[1–4] may be utilized also. When this method is used, the permissible heat exposure TLV can be determined by Figure 1.

III. *Work-Rest Regimen*

The TLVs specified in Table 1 and Figure 1 are based on the assumption that the WBGT value of the resting place is the same or very close to that of the workplace. Where the WBGT of the work area is different from that of the rest area, a time-weighted average value should be used for both environmental and metabolic heat.

The time-weighted average metabolic rate (M) should be determined by the equation:

TABLE 2. Assessment of Work Load

Average values of metabolic rate during different activities.

A. Body position and movement	kcal/min
Sitting	0.3
Standing	0.6
Walking	2.0-3.0
Walking up hill	add 0.8 per meter (yard) rise

B. Type of Work		Average kcal/min	Range kcal/min
Hand work	*light*	0.4	0.2-1.2
	heavy	0.9	
Work with one arm	*light*	1.0	0.7-2.5
	heavy	1.7	
Work with both arms	*light*	1.5	1.0-3.5
	heavy	2.5	
Work with body	*light*	3.5	2.5-15.0
	moderate	5.0	
	heavy	7.0	
	very heavy	9.0	

$$\text{Av. } M = \frac{M_1 \times t_1 + M_2 \times t_2 + \ldots + M_n \times t_n}{t_1 + t_2 + \ldots + t_n}$$

where M_1, M_2...and M_n are estimated or measured metabolic rates for the various activities and rest periods of the worker during the time periods t_1, t_2...and t_n (in minutes) as determined by a time study.

The time-weighted average WBGT should be determined by the equation:

$$\text{Av. WGBT} = \frac{WBGT_1 \times t_1 + WBGT_2 \times t_2 + \ldots + WBGT_n \times t_n}{t_1 + t_2 + \ldots + t_n}$$

where $WBGT_1$, $WBGT_2$ ... and $WBGT_n$ are calculated values of WBGT for the various work and rest areas occupied during total time periods; t_1, t_2 ... and t_n are the elapsed times in minutes spent in the corresponding areas which are determined by a time study. Where exposure to hot environmental conditions is continuous for several hours or the entire work day, the time-weighted averages should be calculated as an hourly time-weighted average, i.e., $t_1 + t_2 + \ldots t_n = 60$ minutes. Where the exposure is intermittent, the time-weighted averages should be calculated as two-hour time-weighted averages, i.e., $t_1 + t_2 + \ldots + t_n = 120$ minutes.

The TLVs for continuous work are applicable where there is a work-rest regimen of a 5-day work week and an 8-hour work day with a short morning and afternoon break (approximately 15 minutes) and a longer lunch break (approximately 30 minutes). Higher exposure values are permitted if additional resting time is allowed. All breaks, including unscheduled pauses and administrative or operational waiting periods during work, may be counted as rest time when additional rest allowance must be given because of high environmental temperatures.

TABLE 3. Activity Examples

- Light hand work: writing, hand knitting
- Heavy hand work: typewriting
- Heavy work with one arm: hammering in nails (shoemaker, upholsterer)
- Light work with two arms: filing metal, planing wood, raking of a garden
- Moderate work with the body: cleaning a floor, beating a carpet
- Heavy work with the body: railroad track laying, digging, barking trees

Sample Calculation

Assembly line work using a heavy hand tool.

A.	Walking along	2.0 kcal/min
B.	Intermediate value between heavy work with two arms and light work with the body	3.0 kcal/min
	Subtotal:	5.0 kcal/min
C.	Add for basal metabolism	1.0 kcal/min
	Total:	6.0 kcal/min

IV. *Water and Salt Supplementation*

During the hot season or when the worker is exposed to artificially generated heat, drinking water should be made available to the workers in such a way that they are stimulated to frequently drink small amounts, i.e., one cup every 15–20 minutes (about 150 ml or 1/4 pint).

The water should be kept reasonably cool, 10°C to 15°C (50°F to 60°F) and should be placed close to the workplace so that the worker can reach it without abandoning the work area.

The workers should be encouraged to salt their food abundantly during the hot season and particularly during hot spells. If the workers are unacclimatized, salted drinking water should be made available in a concentration of 0.1% (1 g NaCl to 1.0 liter or 1 level tablespoon of salt to 15 quarts of water). The added salt should be completely dissolved before the water is distributed, and the water should be kept reasonably cool.

V. *Other Considerations*

A. *Clothing:* The permissible heat exposure TLVs are valid for light summer clothing as customarily worn by workers when working under hot environmental conditions. If special clothing is required for performing a particular job and this clothing is heavier or it impedes sweat evaporation or has higher insulation value, the worker's heat tolerance is reduced, and the permissible heat exposure TLVs indicated in Table 1 and Figure 1 are not applicable. For each job category where special clothing is required, the permissible heat exposure TLV should be established by an expert.

†Table 4 identifies TLV WBGT correction factors for representative types of clothing.

B. *Acclimatization and Fitness:* Acclimatization to heat involves a series of physiological and psychological adjustments that occur in an individual during the first week of exposure to hot environmental conditions. The recommended heat stress TLVs are valid for acclimated workers who are physically fit. Extra caution must be employed when unacclimated or physically unfit workers must be exposed to heat stress conditions.

C. *Adverse Health Effects:* The most serious of heat-induced illnesses is heat stroke because of its potential to be life threatening or result in irreversible damage. Other heat-induced illnesses include heat exhaustion which in its most serious form leads to prostration and can cause serious injuries as well. Heat cramps, while debilitating, are easily reversible if properly and promptly treated. Heat disorders due to excessive heat exposure include electrolyte imbalance, dehydration, skin rashes, heat edema, and loss of physical and mental work capacity.

If during the first trimester of pregnancy, a female worker's core temperature exceeds 39°C (102.2°F) for extended periods, there is an increased risk of malformation to the unborn fetus. Additionally, core temperatures above 38°C (100.4°F) may be as-

†TABLE 4. TLV WBGT Correction Factors in °C for Clothing

Clothing Type	Clo Value*	WBGT Correction
Summer work uniform	0.6	0
Cotton coveralls	1.0	-2
Winter work uniform	1.4	-4
Water barrier, permeable	1.2	-6

*Clo: Insulation value of clothing. One clo unit = 5.55 kcal/m²/hr of heat exchange by radiation and convection for each °C of temperature difference between the skin and adjusted dry bulb temperature.

Note: Deleted from Table 4 are trade names and "fully encapsulating suit, gloves, boots, & hood," including its Clo value of 1.2 and WBGT correction of -10.

sociated with temporary infertility in both females and males.

References

1. Astrand, P-O.; Rodahl, K.: Textbook of Work Physiology. McGraw-Hill Book Co., New York, San Francisco (1970).
2. Ergonomics Guide to Assessment of Metabolic and Cardiac Costs of Physical Work. Am. Ind. Hyg. Assoc. J. 32:560 (1971).
3. Energy Requirements for Physical Work. Research Progress Report No. 30. Purdue Farm Cardiac Project, Agricultural Experiment Station, West Lafayette, IN (1961).
4. Durnin, J.V.G.A.; Passmore, R.: Energy, Work and Leisure. Heinemann Educational Books, Ltd., London (1967).

APPENDIX C
SUPPORTING EVALUATION OF AIRBORNE ARSENIC ACTION LEVELS

C.1 PURPOSE

This Appendix presents estimated particulate airborne arsenic concentrations for specified human health risk levels and the human health risk associated with a specified airborne arsenic concentration. Particulate airborne arsenic concentrations that would pose an one in a million (1E-6) and an one in one-hundred thousand (1E-5) carcinogenic risk to children (age 10) were estimated. The carcinogenic risk to children from 0.06 micrograms per cubic meter (ug/m^3) of arsenic in airborne particulate dust also was estimated. The concentration of 0.06 ug/m^3 of particulate airborne arsenic was chosen because it is the detection limit of the air monitoring instrument that may be used during soil remediation at the site.

C.2 METHODOLOGY

The methodology used to estimate the desired values is based on the Risk Assessment Guidance for Superfund (RAGS) Volume I Human Health Evaluation Manual (EPA 1989a). The equations and input parameter values are shown on the attached worksheet (Table C-1). Exposure parameter input values were chosen from the EPA Exposure Factors Handbook (EPA 1989b) or a best conservative estimate was made. Toxicity data for arsenic was recorded from EPA's data-base Integrated Risk Information System (IRIS) (EPA 1993).

C.4 EXPOSURE SCENARIO

The only exposure pathway evaluated as being potentially complete or significant to offsite receptors was in the inhalation of contaminated particulate dust. Other pathways, such as ingestion of soil, were evaluated as incomplete or insignificant pathways to offsite receptors since the remediation are will be fenced. Also the remediation is expected to occur over a relatively short time (2 months), thus the time in which exposure can occur is relatively minimal. Note that onsite receptors (i.e., remediation workers) are not included in this exposure scenario because they are expected to be covered under the site safety plan and will be wearing protective gear.

The hypothetical exposure scenario evaluated in this study assumed the reasonable worst case receptor was a 10 year old child. The child was assumed to be exposed to airborne arsenic particulate form the site for 24 hours a day for 14 days. The scenario and input parameters used to estimate the carcinogenic risk and airborne arsenic levels was conservative, thus probably overestimating the actual risk and arsenic concentrations. As mentioned above, the specific exposure factor values are shown on Table C-1.

C.5 RESULTS

The results of the evaluation are presented below. An airborne arsenic concentration of 1.7E-5 mg/m^3 is estimated to result in an one in a million (1E-6) carcinogenic risk to the evaluated receptor. An airborne arsenic concentration of 1.7E-4 mg/m^3 is estimated to result in an one in one-hundred thousand (1E-5) carcinogenic risk. The human health carcinogenic risk posed by 0.06 ug/m^3 of arsenic in particulate dust was estimated to be approximately four in a million (3.5E-6). The results are shown on spreadsheet Table C-1. Note that since the airborne arsenic concentration posing a 1E-5 risk is linearly proportional to the arsenic concentration posing a 1E-6 risk, only the calculations for the 1E-6 are presented on Table C-1.

C.6 ASSUMPTIONS

Some of the main assumptions involved with the above evaluation are listed below:

- All the particulate dust is inhaled. In reality only a fraction of the dust can be inhaled by the lungs (only the smaller particles can get into the lungs). Thus, this assumptions overestimates risk.

- No other exposure pathways (dermal, soil ingestion, etc.) contribute significantly to the risk. This probably causes a slight under estimation of risk.

- Assumed the child was near the site 24 hours a day for 14 days. This probably overestimates the actual risk.

C.7 RECOMMENDATIONS

The calculated arsenic concentrations numbers are relatively conservative compared to OSHA and NIOSH, which allow 1E-2 mg/m^3 8-hr Time Weighted Average (TWA) and 2E-3 ug/m^3 for 15 minute ceiling, respectively. Using the detection limit (0.06 ug/m^3) of the air monitoring equipment for off-site receptors is recommended. This is conservative and should sufficiently protect potential offsite receptors.

C.8 REFERENCES

U.S. Environmental Protection Agency (EPA). 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation, Part A. Interim Final (RAGS). EPA/540/1-89/002.

U.S. Environmental Protection Agency (EPA). 1989b. Exposure Factors Handbook. May.

U.S. Environmental Protection Agency (EPA). 1993. IRIS (Integrated Risk Information System) Search.

TABLE C-1. RISK DUE TO INHALATION OF ARSENIC IN AIR PARTICULATE

Risk = SF * DI

Where:

Risk = Excess Cancer Risk [unitless]
SF = Slope factor [1/(mg/kg-day)]
DI = Daily Intake (mg/kg-day)

DI = Conc * IF = Conc * IR * ET * EF * ED / (BW * AT)

Where:

Conc = Arsenic Concentration in Air [mg/m^3]
IF = Intake Factor [m^3/kg-day]
IR = Inhalation Rate [m^3/hr]
ET = Exposure Time [hours/day]
EF = Exposure Frequency [days/year]
ED = Exposure Duration [years]
BW = Body Weight [kg]
AT = Average Lifetime [period over which exposure is averaged -- days]

Exposure factors for residential children receptor exposed to arsenic in air particulate

parameter	units	value	Remarks
Inhalation Rate	[m^3/hr]	3.2	EPA Exp. Fac. Handbook
Exposure Time	[hours/day]	24	best estimate
Exposure Frequency	[days/year]	14	best estimate
Exposure Duration	[years]	1	best estimate
Body Weight	[kg]	36	average child - EFH
Average Lifetime	[days]	25550	70 years average lifetime
Intake Factor	[m^3/kg-day]	1.17E-3	calculated from the above
Slope Factor	[1/(mg/kg-day)]	50	IRIS toxicity database for arsenic

Estimation of arsenic air concentration that equals 1E-6 risk

parameter	units	value	Remarks
Risk	[-]	1.00E-6	reference value
Concentration	[mg/m^3]	1.71E-5	calculated As conc. in air

Estimation of risk associated to arsenic air concentration at the minimum detection limit (MDL)

parameter	units	value	Remarks
Concentration	[mg/m^3]	6.00E-5	MDL (0.06 µg/m^3)
Risk	[-]	3.51E-6	calculated risk for As at the MDL

APPENDIX D
CONFIRMATION FIELD SAMPLING PLAN

D.1 INTRODUCTION

The purpose of this appendix is to provide the methodology for collecting soil confirmation samples after excavation. The objective of the confirmation samples is to indicate if the predetermine remediation levels of arsenic and lead have been reached. The approach and design rational for the confirmation sampling are present in Section 3.3 of the report.

There are three operable units (Knolls, Paved Areas, and 98th Avenue) where soil remediation will occur. The methodology for selecting the soil confirmation sample locations is presented Section D.2. Section D.3 presents information about potential additional sample collection and QA/QC samples. Sample collection procedures and laboratory analyses are discussed in Section D.4. Decontamination procedures are presented in Section D.5.

D.2 SELECTION OF SAMPLE LOCATIONS

The general approach for selection of confirmation sample locations is presented, then specifics and variations associated with each Operable Unit are discussed under the appropriate subheadings below. To collect sufficient soil samples, a 50-foot by 50-foot grid system was used to help divide the site into "cells". In general, if an operable unit occupies 50 percent or more of a grid cell, then one sample location will be randomly selected within that cell. However, due to the overlap of operable units in the same grid cell, variations in operable unit geometry, and lack of knowledge of underlying material in some operable units, some sample locations also will be chosen based on other criteria. For cells which are occupied by less than 50 percent of an operable unit or units, one sample will be collected for each equivalent grid cell area (2,500 square feet). For example, if three grid cells are each one-quarter occupied by an operable unit or units, then one sample would be collected from one of the these three grid cells. The sample location will be selected based on engineering judgement.

The grid approach presented above is not well suited for excavation areas which are linear in geometry (i.e., paved walkways). Thus, in the linear type operable units soil sample locations will at 50-foot intervals along a transect line through the excavated area. Lines perpendicular to the transect line will be drawn at the 50-foot intervals, and the sample location will be randomly selected along the perpendicular lines.

Before excavation begins at the site, the sample collector will be given a map of the site indicating the operable units locations and grid cells. Due to uncertainty in the extent of the operable units and since excavation will help define the limits of the units, selection of sample location will be made in the field during excavation. If a question arises concerning if a sample should be collected in a certain location, then it is recommended that the sample be collected and then the decision as whether to analyze the sample be made by the Project Engineer at a later time.

D.2.1 Knolls Operable Unit

There are eight knolls (A-H) knolls to be excavated in the Knolls Operable Unit. The soil sample collect locations are basically as described above for the grid system. One sample will be collected in each cell that is 50 percent or more occupied by a knoll. The location of these samples will be based on random selection within the portion of the grid occupied by the unit. For cells occupied by less than 50 percent of the knolls, one soil sample should be collected for the equivalent of entire occupied cell. The location of the soil sample(s) from the partially occupied cells should be based on engineering judgement.

D.2.2 Paved Area Operable Unit

The Paved Area Operable Unit consists of five different types of subunits, which are the asphalt basketball court, asphalt walkways, concrete patios, planter strip, and sand box. These five subunits are discussed below.

D.2.2.1 Asphalt Basketball Court

Soil confirmation sampling for the asphalt basketball court should proceed in the same manner as described for the Knolls Operable Unit.

D.2.2.2 Asphalt Walkways

The asphalt walkways are long and relatively narrow, thus soil samples locations are based on the transect line method described in the introduction.

D.2.2.3 Concrete Patio

The concrete patio area is irregularly shaped and sample locations will be chosen based on the transect method as described in the introduction. Note that the Concrete Patio Area includes the concrete walk at the northwestern side of the Concrete Patio Area.

D.2.2.4 Planter Strip

The Planter Strip is located along the western edge of the site and is long and narrow. Sample collection locations will be based on the transect method described in the introduction. Although the Planter Strip area is not paved, it is included the Paved Operable Unit because aggregate base material is known to exist over the Planter Strip.

D.2.2.5 Sand Box

A prescribed sample location method is not applicable for the Sand Box because it is not known whether the aggregate exists under the Sand Box. Thus, soil sample locations in the Sand Box will be chosen based on the judgement of the Project Engineer after the overlying sand has been removed.

D.2.3 98th Avenue Frontage Area Operable Unit

The 98th Avenue Frontage Area is located adjacent to 98th Avenue is approximately 50 feet wide and 300 feet long. One of two methods of choosing soil sample locations will be implemented depending on if this area is excavated continuously or if the excavation operation is staged in two increments. Both methods of choosing samples location are based on the grid system and will result in approximately the same number of samples. If the entire area is excavated in one mobilization, then the samples will be collected based on the grid system. One sample will be randomly located within each gird cell that is 50 percent or more occupied by the unit. For cells occupied by less than 50 percent of the unit, one soil sample should be collected for the equivalent of entire occupied cell. The location of the soil sample(s) from the partially occupied cells should be based on engineering judgement.

Additional soil samples also will be collected at the 98th Avenue Frontage Area in approximately the same horizontal locations where some of the previous surface soil samples were collected. If a previously collected pre-park soil sample exceeded lead cleanup levels, then another sample will be collected from the excavation at the approximately same horizon location where the initial sample was collected as a deterministic check that the contamination was removed.

D.3 ADDITIONAL SAMPLING AND QA/QC SAMPLES

Field conditions or engineering judgment may warrant additional sampling during the excavation. Approximately 10 percent of the samples will be collected for quality assurance and quality control (QA/QC). These QA/QC samples will consist of field duplicates.

D.4 SAMPLE COLLECTION AND ANALYSES

Confirmation soil samples should be collected within 24 hours of completion of a phase or subphase of excavation activates. Samples will be collected at the wetted surface of the excavation using clean soil tools (e.g., decontaminated garden trowel). Samples will be retained in labeled, laboratory-prepared glass jars with teflon lined, screw-type lids, and will be place in chilled ice chest immediately after collection. The samples will be transported under Chain-of-Custody procedures to a WCC-approved chemical analytical laboratory.

Confirmation samples from the Knolls Operable Unit will be analyzed for lead. Confirmation samples from the Paved Areas Operable Unit and the 98th Avenue Frontage Operable Unit will be analyzed for lead and arsenic. However, samples from the 98th Avenue Frontage Operable Unit that are collected to compare with previously collected samples that exceeded lead cleanup levels will only be analyzed for lead. Lead samples will be analyzed by EPA Method 6010 and arsenic sample by GFAA.

D.5 DECONTAMINATION PROCEDURES

The following procedures for decontamination will be followed. Sampling equipment will be cleaned prior to used, between uses, and prior to leaving the site. Prior to each use, the sampling equipment (i.e., trowels, etc.) will be wiped clean, washed in Alconox (or equivalent) solution and rinsed in clean water.

APPENDIX E

ESTIMATION OF BACKGROUND ARSENIC, LEAD, AND ZINC SOIL CONCENTRATIONS

E.1 INTRODUCTION

This Appendix presents methodology and results of the estimation of background soils constituents concentration for arsenic (As), lead (Pb), and zinc (Zn) at Verdese Carter Park at 98th and Bancroft in Oakland, California. Results of this estimation provide a basis for the characterization of naturally occurring levels of chemicals at the site (uncontaminated native soils), and could be used as a reference for the development of site-specific soil cleanup levels for remediation.

E.2 METHODOLOGY

Quantitative estimation of constituent concentration in soil must rely on statistical methods to address natural variability (which is inherent in the physical nature of soil constituents concentration, and therefore cannot be reduced by increased precision of measurement) and uncertainty of estimation (which is related to the accuracy of our measurements, and could be reduced by increased precision). The arithmetic average of concentrations measured in samples from uncontaminated soils at the site provides a first order approximation of background soil concentration. The arithmetic average represents only a rough estimate of the "true mean" of the population (i.e., the actual average soil concentration, which could only be measured by sampling all the uncontaminated native soil at the site), because it is usually estimated based on samples of limited size and precision, and because of the natural variability inherent in soil constituents concentration. A better method to estimate background soil constituent concentrations is to account for uncertainty and natural variability in soil samples by estimating the 95th percentile Upper Confidence Level (95% UCL) for the mean of the constituent concentration. The estimated 95% UCL thus represents an upper bound estimate of the mean background constituent soil concentration.

The 95% UCL of the mean is defined as the concentration that, when calculated repeatedly for a randomly drawn subset of site-specific concentration data, equals or exceeds the "true mean" 95% of the time (i.e., the 95% UCL is the 95th percentile of the probability distribution of the sample mean). An excellent description of estimating the 95% UCL of the mean is presented in the U.S. EPA Memorandum "Supplemental Guidance to RAGS: Calculating the Concentration Term" (U.S. EPA 1992). Although the 95% UCL of the mean provides a higher estimate than the arithmetic average (or mean) concentration, it should not be confused with the 95th percentile of the site concentration data.

The following steps were followed to calculate the background soil 95% UCL of the mean for As, Pb, and Zn:

1) Preparation of the data sets, by compiling a table of total soil concentration data for As, Pb, and Zn, from selected samples of the native uncontaminated soils at the site, as reported in Table 2 of the Site Characterization Report (WCC 1993).

2) Replacement of non-detects with 1/2 the detection limit (also used to calculate averages) for Pb and Zn. For As, due to the high number of non-detects, the non-detects were replaced with a distribution of values between 1 mg/kg and the detection limit (5 mg/kg), to ensure that the resulting probability distribution was lognormal (see next step).

3) Performance of statistical distributional tests on the data sets for As, Pb, and Zn. This was done because the methodology for estimating the 95% UCL of the mean assumes the data is a random sample from a normal or lognormal distribution. All of the constituents failed to pass the initial normality test. The data sets were then log-transformed to check for lognormality. Logarithms of Pb and Zn data passed the normality test, indicating that the data is lognormally distributed (logs of the data are normally distributed). Logs of As data failed to pass the normality test, due to the fact that the large percentage (17 out of 22) of non-detects in the data set where initially approximated as one single value (1/2 the detection limit). To ensure that the probability distribution for As was lognormal, the non-detects were replaced with an appropriate distribution of values between 1 mg/kg and the detection limit (5 mg/kg). These substitutions made sure the data set for As was fit for the estimation, while the arithmetic average of As did not change significantly. The data sets for the estimation are presented in Table E-1.

4) Calculation of mean and standard deviation of the data.

5) Selection of the appropriate value for the H-statistic, tabulated in Gilbert, 1987.

6) Calculation of the 95% UCL of the mean (see Highlight 5 of EPA 1992 for the equation).

Steps 4, 5, and 6 were performed automatically with Jump! (SAS 1993), a state-of-the-art statistical software program, and the results are presented in Table E-1 and Figure E-1.

E.3 RESULTS AND CONCLUSIONS

Estimated background soil concentrations based on the 95% UCL of the mean concentrations for As, Pb, and Zn for Verdese Carter Park are presented below:

Estimated background soil concentrations based on 95% UCL of the arithmetic mean for lognormally distributed data

Arsenic = 4.1 mg/kg
Lead = 11.9 mg/kg
Zinc = 60.5 mg/kg.

Arithmetic averages for As, Pb, and Zn are provided below for comparison:

Arithmetic average soil concentrations

Arsenic = 3.7 mg/kg
Lead = 11.0 mg/kg
Zinc = 55.9 mg/kg

Conclusions

The estimated 95% UCL represent an upper bound estimate of the background constituent soil concentrations for As, Pb, and Zn. The 95% UCL provides a basis for the characterization of naturally occurring levels of chemicals at the site (uncontaminated native soils). It should be noted that the 95% UCL of 4.1 mg/kg estimated for arsenic is a concentration below detection limit (5 mg/kg). This is due to the large percentage of non detects occurring in the arsenic data set.

E.4 ASSUMPTIONS

Assumptions in estimating background soil constituents concentrations are:

- Total soil concentration data from selected samples of native material beneath the site are assumed to be representative of background soil conditions at the site. The data was extracted from Table 2 of the Site Characterization Report (WCC 1993).

- Non-detects were substituted with 1/2 the detection limit, or appropriately distributed below the detection limit (for As).

- For the 95% UCL calculation, the data are assumed to be approximately lognormally distributed.

E.5 REFERENCES

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold. New York, NY.

SAS 1993. Jump!, Statistical Analysis Software Program for the Macintosh Computer. SAS Institute.

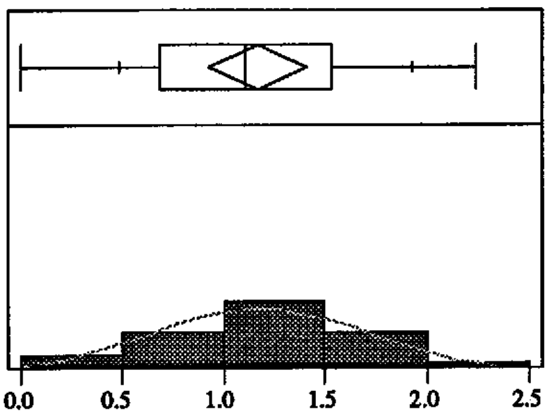
U.S. Environmental Protection Agency (U. S. EPA 1992). Memorandum Transmittal of Interim Bulletin Volume 1, Number 1 "Supplemental Guidance to RAGS: Calculating the Concentration Term". June 22.

Woodward-Clyde Consultants (WCC 1993). Site Characterization Report, Verdese Carter Park Characterization Project 98th and Bancroft Avenues, Oakland, July 19.

TABLE E-1 DATA FOR ESTIMATION OF SOIL BACKGROUND CONCENTRATIONS

Sample ID	Original Data (see Table 2 WCC 1993)			Data After Substitution of Non Detects		
	Arsenic	Lead	Zinc	Arsenic	Lead	Zinc
B-10-4	6.64	13.8	53.7	6.64	13.8	53.7
B-11-4	9.38	41.6	67.1	9.38	41.6	67.1
B-13-2	<5	6.05	39.8	2	6.05	39.8
B-13-3	<5	<5	42.6	3	2.5	42.6
B-13-4	<5	6.22	55.9	2	6.22	55.9
B-15-3	<5	8.1	44	2.5	8.1	44
B-15-4	<5	9.61	75	4	9.61	75
B-16-2	<5	8.87	52.4	3	8.87	52.4
B-16-3	<5	6.97	49.7	3.5	6.97	49.7
B-17-2	<5	10.4	67	1.5	10.4	67
B-18-2	<5	7.47	68.4	4.5	7.47	68.4
B-19-1	<5	11.6	64.4	3	11.6	64.4
B-19-2	<5	20.2	72.4	3	20.2	72.4
B-20-2	5.14	13.6	73.2	5.14	13.6	73.2
B-21-4	5.89	8.61	41.4	5.89	8.61	41.4
B-21-6	<5	5.68	47	3	5.68	47
B-22-3	<5	18	47.9	2	18	47.9
B-23-4	<5	6.21	33.8	4	6.21	33.8
B-26-1	6.91	12.6	83	6.91	12.6	83
B-26-2	<5	8.07	54.5	3	8.07	54.5
B-26-3	<5	8.09	44.4	2	8.09	44.4
B-26-4	<5	6.83	51.7	1	6.83	51.7
			Average	3.68	10.96	55.88

Logs of Arsenic w/Normalized NDs



Test for Normality

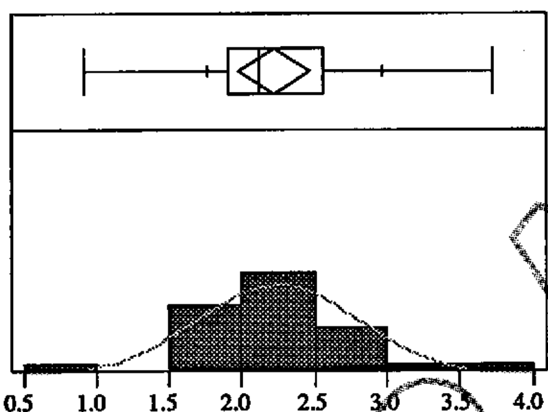
Shapiro-Wilk W Test

W	Prob<W
0.976792	0.8442

Moments

Mean	1.16775
Std Dev	0.53447
Std Err Mean	0.11395
upper 95% Mean	1.40471
lower 95% Mean	0.93078
N	22.00000
Sum Wgts	22.00000

Logs of Lead



Test for Normality

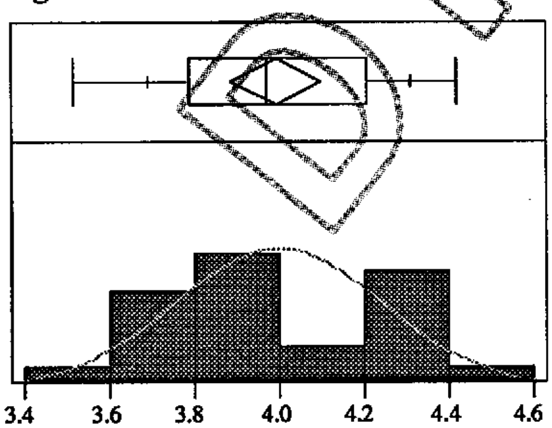
Shapiro-Wilk W Test

W	Prob<W
0.937762	0.1764

Moments

Mean	2.22889
Std Dev	0.55673
Std Err Mean	0.11869
upper 95% Mean	2.47572
lower 95% Mean	1.98205
N	22.00000
Sum Wgts	22.00000

Logs of Zinc



Test for Normality

Shapiro-Wilk W Test

W	Prob<W
0.969733	0.6930

Moments

Mean	3.99567
Std Dev	0.24055
Std Err Mean	0.05129
upper 95% Mean	4.10233
lower 95% Mean	3.88902
N	22.00000
Sum Wgts	22.00000

FIGURE E-1 RESULTS OF STATISTICAL ANALYSES ON LOG-TRANSFORMED DATA