DRAFT FINAL RESPONSE PLAN

SACRAMENTO TRAPSHOOTING CLUB

MARCH 2006

FOR:
CITY OF SACRAMENTO
ECONOMIC DEVELOPMENT DEPARTMENT

Y4368

5900 Hollis Street, Suite D • Emeryville, California 94608 • (510) 420-8686

BASELINE

ENVIRONMENTAL CONSULTING

31 March 2006
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Mr. Dean Peckham
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City of Sacramento
1030 15th Street, Suite 250
Sacramento, CA 95814

Subject: Draft Final Response Plan, Sacramento Trapshooting Club, Sacramento

Dear Mr. Peckham:

Enclosed please find the Draft Final Response Plan for the Sacramento Trapshooting Club. Should you have any questions or need additional information, please do not hesitate to contact us at your convenience.

Sincerely,

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cc: Charley Langer, Sacramento County Environmental Management Department

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1. BACKGROUND

This is a Draft Final Response Plan ("Plan") prepared by BASELINE Environmental Consulting ("BASELINE") on behalf of the City of Sacramento ("City") for the Sacramento Trapshooting Club leasehold ("leasehold") at 3701 Fulton Avenue in Sacramento. This Plan presents alternative remedies considered by the City for the leasehold and recommends a response action that is protective of human health and the environment.

In 2004, the City initiated investigations at the leasehold in response to future planned land uses. Specifically, the City is planning to convert the leasehold use from recreational to commercial land uses. The City is proposing to change the General Plan designation from Parks, Recreation and Open Space to Heavy Commercial or Warehouse and rezone the leasehold from R-1 to C-4. As part of the planning process, the City submitted an application to the California Environmental Protection Agency Site Designation Committee requesting that Sacramento County Environmental Management Department ("SCEMD") become the regulatory agency providing oversight regarding site remediation. On 26 August 2004, the Site Designation Committee approved SCEMD as the oversight agency for the leasehold.

BASELINE subsequently prepared a workplan for site characterization activities, which was approved by SCEMD on 5 November 2004. BASELINE then prepared a *Site Assessment and Preliminary Response Report*, dated February 2005, describing the results of site characterization activities. The SCEMD requested that additional work be conducted: 1) evaluation of potential effects of the trapshooting club's activities on surface soil quality outside the trapshooting club leasehold; 2) off-leasehold evaluation of background levels for arsenic; and 3) waste classification of on-leasehold clay pigeon debris. BASELINE prepared a workplan for these activities, dated 1 June 2005, which was subsequently approved by SCEMD on 13 June 2005. This Plan includes the results of background sampling for arsenic and the clay pigeon waste classification activities that were undertaken in accordance with the approved workplan in June 2005. The results of the sampling to determine effects of trapshooting on soil quality outside the leasehold are also included in this Plan.

2. SITE CHARACTERIZATION

2.1 Leasehold Location

The leasehold, parcel number APN-254-0011-027, is located immediately north of the Interstate 80 (I-80) Business Loop and east of the entrance to the Haggin Oaks Golf Complex (Figures 1 and 2) at 3701 Fulton Avenue. The Haggin Oaks Golf Complex and the leasehold are part of the greater Del Paso Park, a recreational area adjacent to Arcade Creek.

2.2 Leasehold History

The approximately 20-acre leasehold is owned by the City and has been leased to the Sacramento Trapshooting Club since the early 1900s. The Del Paso Park area was once a part of Rancho del Paso, a 40,000-acre ranch owned by Ben Ali Haggin and used for breeding racehorses. Historical maps indicate 828 acres (representing present day Del Paso Park) were reserved for a City park in 1910 and the City took ownership by 1916 (BASELINE, 2005). Aerial photographs from 1952 indicate that at least since that time, the alignment of the shooting stations and shooting range was the same as it is today (BASELINE, 2005).

2.3 Surrounding Land Use and Populations

Land uses surrounding the leasehold are recreational, commercial, and transportation related. Immediately adjacent to the leasehold to the north, east, and west are the golf course areas of Del Paso Park, consisting of fairways, putting greens, and parking lots. Interstate-80 and the I-80 business loop are located north and south of Del Paso Park, respectively, with the I-80 business loop right-of-way adjacent to the leasehold to the south. Watt Avenue and Roseville Road bracket the east and west sides of Del Paso Park. A Southern Pacific Railroad track is located adjacent to Roseville Road. Further from the leasehold, land uses are industrial and commercial and residential to the west and south. Additional parklands are located along Arcade Creek to the east.

2.4 Current Leasehold Description

The Sacramento Trapshooting Club is open to the public and operates ten trapshooting stations where shooters can practice shooting aerial targets. Clay pigeons are launched from trap houses for participants to shoot at with shotguns. The shotguns are loaded with shells containing lead pellets, which are referred to as "shot." The shooting stations are located along the southwestern edge of the shooting range and face northeast (Figure 2). In addition to the trapshooting range, the leasehold contains registration booths, restrooms, a paved parking area (about 2.5 acres), and a clubhouse, all located on the southwestern portion of the leasehold.

2.5 Leasehold Hydrogeology

The leasehold is at an elevation of approximately 60 feet above sea level and generally slopes from south to north. There is a break in slope just east of the firing range at about six to eight feet. Arcade Creek is located approximately 900 feet to the north. The creek watershed is part of the South American River subbasin, which is part of the larger Sacramento River Basin. The

South American River subbasin consists of continental deposits of younger alluvium (flood basin deposits, dredge tailings and Holocene stream channel deposits), older alluvium, and Miocene/Pliocene volcanics. The permeability of flood deposits is low, while dredge trailing and stream channel deposits are highly permeable and older alluvium is characterized as moderately permeable (DWR, 2004). Department of Water Resources ("DWR") data from a nearby well indicate the depth to groundwater ranged at that location from 66.3 to 107.6 feet below ground surface ("bgs") between 1963 and 1995.

The surface of the shooting range is vegetated and most stormwater is absorbed into the shallow soil. A contour map of the leasehold, produced by the City, indicates the surface runoff, if any, would flow north across the site and discharge into the downstream end of the drainage channel that traverses the property (BASELINE, 2005). The drainage channel was previously more centrally located on the leasehold, but because of concerns about the channel providing a potential pathway for off-site migration of contaminants, the channel was moved further away and east from the trapshooting firing line. The channel also conveys surface water runoff from an area south of I-80 and surface runoff from the I-80 road surface (Versar, 1995). Beyond the leasehold boundary to the north, the stormwater is conveyed through a subsurface storm drain that traverses the golf course area and discharges into Arcade Creek.

As part of the planning process for a change in land use, a wetlands delineation study was performed in 2005 by Gibson and Skordal, LLC. The delineation was performed in accordance with Army Corps of Engineers ("Corps") guidance. The study identified 0.6039 acre of waters and wetlands within the leasehold. About 0.4045 of those acres were characterized as seasonal wetland swales and 0.1994 acre as excavated channel. The report concluded that these features may be considered potentially jurisdictional waters of the United States, subject to Corps determination.

2.6 Meteorology

Hot dry summers and mild rainy winters characterize the Mediterranean climate of the Sacramento Valley. During the year the temperature may range from 20 to 115 degrees Fahrenheit with summer highs usually in the 90s and winter lows occasionally below freezing. Average annual rainfall is about 20 inches with snowfall being very rare. The prevailing winds are moderate in strength and vary from moist clean breezes from the south to dry land flows from the north (SCMAQD, 2004).

2.7 Historic Use of Hazardous Materials

The leasehold has been an active gun club since approximately 1915. The materials of concern used in trapshooting activities consist of lead shot and clay pigeons. The lead shot consists of lead with additions of arsenic, antimony, and nickel. Clay pigeons consist of crushed limestone and petroleum pitch, which typically include significant quantities of polynuclear aromatic hydrocarbons ("PAHs").

Little information is available on the volumes of materials used in the past. Based on clay pigeon usage between 30 August 2001 and 30 August 2003, it is estimated that trapshooting activities resulted in the deposition onto the surface of the leasehold of 85,000 pound of lead and 275,000 pound of clay pigeons per year (BASELINE, 2005).

In the past, removal of the lead shot[1] has been performed by rototilling and removing the top six inches of soil, removing the lead shot, which is recycled, and returning the soil to the leasehold (Versar, 1995). According to the City, the reclamation activities occurred only on the areas with high amounts of lead shot on the surface. Previous investigations have indicated that lead reclamation took place in 1992 and 1995 (Versar, 1995). The Sacramento Trapshooting Club has indicated that recycling also occurred in October 1998, 2001, and 2003. In 2003, 188,000 pounds of lead were recovered from the leasehold. Records of the amount of reclaimed lead shot for the previous reclamation efforts are not available.

The Sacramento Trapshooting Club has removed clay pigeon debris from the leasehold since 2001 in an amount generally equal to annual usage. Clay pigeon debris accumulated from years prior to 2001 has not been removed. An average of 290,200 pounds per year of clay pigeon debris were removed from the leasehold in 2001, 2002, and 2003.

2.8 Site Investigations Prior to 2005

Several investigations have been conducted at the leasehold prior to BASELINE's comprehensive 2004 investigation. The analytical data obtained from the previous investigations conducted by others were presented in the *Site Assessment and Preliminary Response Option Report* (BASELINE, 2005). The analytical results and data interpretations for the BASELINE 2004 investigation were also presented in the BASELINE 2005 report. The conclusions from the BASELINE 2004 investigation indicated that:

- Antimony and arsenic, associated with lead shot, were present in the surface soils (up to a maximum of two feet below ground surface) in concentrations exceeding residential and/or industrial Preliminary Remediation Goals ("PRGs").

- Lead was present in surface soils at concentrations exceeding residential and industrial PRGs. The depth of affected soils was less than or equal to two feet below ground surface bgs (except one location here lead exceeded the residential PRG at a depth of two feet).

- PAHs were present in surface soils (to about two feet in depth) at concentrations that equal or exceed residential and/or industrial PRGs in the western portion of the leasehold.

- Leachable concentrations of lead, antimony, nickel, and PAHs did not appear to have the capacity to affect the quality of groundwater underlying the leasehold at depth in excess of 63 feet bgs. Arsenic, present at depths of two feet bgs, was present at concentrations within background ranges for California. Using Central Valley Regional Water Quality Control Board ("RWQCB") conservative Designated Level Methodology, arsenic concentrations from a depth of two feet bgs was estimated to have the potential to affect the groundwater in concentrations exceeding the water quality goal.

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[1] For the past 35 years, the maximum size shot allowed has been No. 7½ or 8 shot (2.39 and 2.26 millimeter in diameter, respectively); currently, No. 7½ shot is the maximum size allowed

- Sediment samples from Arcade Creek at the point of discharge of runoff from the leasehold, and collected upstream and downstream from the point of discharge, did not indicate impacts from historic land uses at the leasehold.

- It is possible that PAHs could be present in concentrations exceeding residential and/or commercial/industrial PRGs beyond the northwestern boundary of the leasehold.

Following completion of the *Site Assessment and Preliminary Response Option Report*, BASELINE completed a fate and transport modeling effort to evaluate whether arsenic concentrations found in soils on the leasehold would reach the groundwater underlying the leasehold at concentrations exceeding the RWQCB water quality goals. The modeling was documented in a letter, dated 1 June 2005, from BASELINE to the SCEMD. The results of the modeling, using SESOIL, indicated that neither lead nor arsenic would leach to groundwater at concentrations exceeding RWQCB water quality goals.

2.9 BASELINE 2005 Investigation

In June 2005, BASELINE conducted field activities on and near the leasehold in accordance with an approved workplan from SCEMD. The objectives of the additional sampling were to:

- Assess potential effects from the historic trapshooting activities adjacent to the leasehold

- Assess background arsenic concentrations at a depth of two feet bgs and at the surface

- Classify the clay pigeon debris for potential off-site disposal purposes

The sampling locations for the off-leasehold sampling and the background sampling are shown on Figures 3 and 4, respectively. The analytical work performed on each soil sample is presented in Table 1. The analytical results are summarized in Tables 2 through 5 and the laboratory reports are included on a CD in Appendix B. Below is a discussion of the analytical results.

2.9.1 Sampling Activities Adjacent to Leasehold

Twenty-one surface soil samples were randomly collected within 100 feet from the leasehold boundary (Figure 3). The surface soil samples were analyzed for total lead, total arsenic, PAHs, and moisture.[2] The samples along the western leasehold boundary were collected adjacent to roadways and parking lots or landscaped areas along roadways; samples along the northern and eastern boundaries were collected from the "rough" areas of the fairways; and the samples to the south were collected from the landscaping adjacent to the I-80 Business Loop freeway.

The **total lead** concentrations in the 21 samples ranged from 3.7 to 2,900 mg/kg. Nineteen of the samples had concentrations less than 800 mg/kg[3] while the remaining two samples contained total lead above 800 mg/kg (at 2,900 and 1,200 mg/kg, respectively). The two samples with the

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[2] All analytical results are reported in dry weight.

[3] The industrial PRG is 800 mg/kg. The residential PRG is 150 mg/kg.

high total lead concentrations were collected along the northern leasehold boundary at locations STCOS-05 and -06 (Figure 3). During the sampling activity, the BASELINE geologist observed lead shot on the surface at the location of STCOS-06.

Total arsenic concentrations at the 21 off-leasehold locations ranged from 0.93 to 20 mg/kg. Two of the sampling locations, STCOS-05 and -06 had the highest concentrations of 20 and 10 mg/kg, respectively. Those two locations corresponded to the locations where the high total lead concentrations were encountered. The remaining samples had concentrations below 4.9 mg/kg. Those two locations appear to have been affected by the trapshooting club's activities. All off-leasehold surface arsenic concentrations exceeded the residential and industrial PRGs. A statistical evaluation of the off-leasehold surface soil concentrations and surface background concentrations was conducted (see discussion in Section 2.9.2 and Appendix B).

All 21 off-leasehold surface samples were also analyzed for **PAHs** (Table 3). The highest concentration of total PAHs was identified at location STCOS-05 (Figure 3), the same location that also had high total lead and arsenic concentrations. This suggests that the area around location STCOS-05 has been affected by trapshooting activities. Eleven of the 21 samples had concentrations of benzo(a)pyrene exceeding the residential PRGs and ten of the locations had concentrations exceeding the industrial PRGs.

The cumulative carcinogenic and non-carcinogenic human health risks were calculated for residential and industrial land use scenarios (Table 3), using the methodology described in U.S. Environmental Protection Agency ("U.S. EPA"), 2004. The cumulative excess carcinogenic risks for residential land uses at 20 of the sampling locations ranged from 9.9×10^{-5} to 1.1×10^{-7}, within the acceptable range of 1×10^{-4} to 1×10^{-6} developed by U.S. EPA. The cumulative excess risk for one of the locations, location STCOS-05, for residential land use was estimated to be 3.1×10^{-4}, in excess of the U.S. EPA target range. The cumulative excess carcinogenic risk for industrial land uses at all sampling locations were within the U.S. EPA target range. None of the non-carcinogenic risk exceeded a Hazard Index ("HI") of one for either residential or industrial land uses.

2.9.1.1 Conclusions

Location STCOS-05 and –06 had elevated concentrations of lead and arsenic and location STCOS-05 had elevated concentrations of PAHs. Lead, arsenic, and certain PAHs all exceeded industrial PRGs at the STCOS-05 and -06 locations. The elevated concentrations indicate that this area has been affected by trapshooting activities. Additional investigation(s) are warranted in this area north of the trapshooting club to further define the extent of the affected soil.

2.9.2 Background Sampling

Background samples were collected from eight locations around the leasehold within the adjacent golf course (Figure 4). Background samples were collected from the surface and from depths of 2.0 to 2.5 feet bgs. The samples were analyzed for total arsenic (Table 4).

The samples from a depth of 2.0 to 2.5 feet contained total arsenic ranging from less than reporting limits (0.92 mg/kg) to 8.1 mg/kg, and the surface background samples had concentrations ranging from 1.3 to 4.4 mg/kg.

2.9.2.1 Conclusions

The arsenic data collected from soils samples from a depth of two feet bgs on the leasehold were statistically compared to arsenic data collected from two feet bgs at background sampling locations. The statistical evaluation (Appendix B) indicates that the arsenic concentrations on the leasehold at two feet bgs are not different from background arsenic concentrations at two feet bgs.

The surface samples collected outside the leasehold were also evaluated statistically to assess whether those arsenic concentrations could be considered as background.[4] The statistical evaluation indicates that the surface samples analyzed for arsenic did not contain concentrations different from background surface samples.

2.9.3 Waste Classification of Clay Pigeon Debris

Five, five-gallon buckets of clay pigeon debris were randomly collected from the clay pigeon debris area on the leasehold. The purpose of sample collection was to classify the debris for potential off-site disposal at a permitted facility to assess whether it was a non-hazardous waste, a California hazardous waste, or a Federal hazardous waste.

Initially, one bucket of debris was screened through a ¾-inch screen. Ninety percent of the debris passed the ¾-inch screen. The finer fraction was analyzed for total and soluble[5] lead and arsenic and PAHs, and the coarser fraction was analyzed for toxicity using a fish bioassay. The four remaining five-gallon buckets of debris were each analyzed for total, WET, and TCLP lead, and subjected to a fish bioassay. A composite of the four sample buckets were also analyzed for extractable hydrocarbons and Title 22 metals. A summary of the analytical results is presented in Table 5.

2.9.3.1 Conclusions

The analytical results indicate that the debris is not a Federal hazardous waste, nor a California hazardous waste. The debris is therefore a non-hazardous waste that could be disposed of off-site at a Class II or III facility, depending on the specific facility's waste acceptance criteria.

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[4] The statistical analysis did not include data from locations STOS-05 and –06, since those locations are known to have been affected by trapshooting activities.

[5] Soluble concentrations were identified using the Waste Extraction Test ("WET") method and the Toxicity Characteristic Leaching Procedure ("TCLP").

3. EVALUATION OF RISKS

To evaluate the need for possible response options to accommodate future land uses at the leasehold (excluding off-leasehold locations), a screening level risk assessment was conducted for human health impacts for current and future site conditions.

The chemical concentrations found in the soil at the leasehold were compared to PRGs. The PRGs are risk-based screening levels for evaluating chemical impacts to a site assuming residential or industrial (which includes commercial workers) land uses. The PRGs use U.S. EPA toxicity values with accepted exposure factors to estimate contaminant concentration in environmental media (soil, air, and water) that the U.S. EPA considers protective of humans (including sensitive groups) over a lifetime. PRG concentrations are based on direct contact for which generally accepted methods, models, and assumption have been developed (i.e. ingestion, dermal contact, and inhalation) (U.S. EPA, 2004).

The PRGs are the concentration below which exposure to specific chemicals is not expected to result in an excess risk of one case of cancer in 1,000,000 individuals (i.e., 10^{-6}) exposed over a lifetime and a non-cancer Hazard Index (HI) of one, or the more stringent of the two.

The U.S. EPA has provided definitions of acceptable excess carcinogenic risks and non-carcinogenic risks in the National Contingency Plan ("NCP") (40 CFR 300.430). According to the NCP, an excess carcinogenic risk level within the range of 1×10^{-4} to 1×10^{-6} is considered protective of human health. The DTSC uses an excess carcinogenic risk of 1×10^{-6} as a point of departure for remediation as described in Preliminary Endangerment Assessment Guidance ("PEA") Manual, dated January 1994 and referenced in Chapter 6.8, Section 25319.5 of the Health and Safety Code ("HSC").

A non-carcinogenic risk level is measured using an HI. The HI is calculated by summing the hazard quotients for substances that affect the same target organ or organ system (e.g., respiratory system). The hazard quotient is the ratio of potential exposure to the substance and the level at which no adverse health effects are expected. An HI of less than 1 indicates no adverse health effects are expected as a result of exposure; an HI greater than 1 indicates adverse health effects are possible.

The contaminants on the leasehold were evaluated against both residential and industrial PRGs, as described in Section 3.2, below and presented in Tables 6 and 7.

3.1 Conceptual Site Model

To evaluate the potential risk to human health from contaminants of concern, BASELINE developed a conceptual site model ("CSM") for the leasehold. The contaminants of concern are those contaminants associated with trapshooting activities and consist of antimony, arsenic, lead, nickel, and PAHs. The CSM relates contaminant sources, relevant fate and transport mechanisms, routes of exposure, and potential receptors to determine exposure pathways. A complete exposure pathway generally consists of four elements: 1) a source and mechanism of chemical release; 2) a retention or transport medium; 3) a point of potential contact between the receptor and the contaminated medium; and 4) an exposure route by which the receptor is

exposed to chemicals at the contact point. An exposure pathway is incomplete if any of the above-mentioned elements is missing.

Potential human health risks may be associated with the leasehold in its current configuration as well as future configuration. Potential human receptors consist of current users of the trapshooting club, current employees, future site workers, and current and future construction/utility workers. Future risks to future receptors would be dependent on the level of remediation at the site; e.g., removal/treatment of contaminated soil or institutional and/or engineering controls.

Complete and incomplete exposure pathways are shown on Figure 5. Current complete exposure pathways are present for chemicals in the soil via ingestion, particulate inhalation, and dermal contact for current users of the site, current employees, and current utility workers. Complete exposure pathways in the future will depend on remedial actions performed at the site; however, irrespective of the remediation, the leasehold will be paved; therefore, for future on-site workers there will be no complete pathway. For on-site utility workers there may be complete pathways, if residual contamination remains on-site.

3.2 Human Health Risk Screening

During BASELINE's November 2004 site assessment activities (BASELINE, 2005), soil samples were collected on the leasehold at the locations shown on Figure 6. Samples were analyzed for lead, arsenic, antimony, nickel, and PAHs at various locations and depths. Tables 6 and 7 contain summaries of the metal and PAH results; these tables also include the residential and industrial PRGs. The tables indicate which analytical results exceed the residential and industrial PRGs.

Current users of the leasehold area (including trap shooters, on-site workers, and potential utility/construction workers) are exposed to lead, arsenic, antimony, and selected PAHs above the residential and industrial PRGs. The exposure may be through dermal contact, inhalation, and/or ingestion or soil and/or dust (Tables 6 and 7).

Future users of the leasehold would be commercial workers and utility/construction workers. There would be no complete pathways for future commercial workers. Future utility/construction workers could be exposed to residual contaminants consisting of metals and PAHs, if those were present following remediation; the potential pathways would be dermal contact, inhalation, and ingestion of contaminated soil and/or dust.

4. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Analysis of remedial alternatives includes an evaluation of the applicable or relevant and appropriate requirements ("ARARs") of federal and state environmental statutes and regulations that pertain to each alternative. Applicable requirements are cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under federal environmental or state environmental or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, or location. Relevant and appropriate requirements are laws or regulations, that, while not "applicable", address problems or situations sufficiently similar to those encountered that their use is well suited to the particular site. State requirements are ARARs only if they are more stringent than federal requirements.

In addition to ARARs, this analysis includes the evaluation of To-Be-Considered materials ("TBCs"). The TBCs are advisories, criteria, or guidance that may be considered for a particular action or specific issue, as appropriate. TBCs are not ARARs because they are neither promulgated nor enforceable and do not have to be achieved by remedial actions implemented at a site.

ARARs or TBCs may be chemical-, location-, or activity- specific. Chemical-specific ARARs or TBCs are usually health- or risk-based numerical values or methodologies used to determine acceptable concentrations of chemicals that may be found in, or discharged to, the environment. Location-specific ARARs or TBCs restrict actions or contaminant concentrations in certain environmentally sensitive areas. Examples of areas regulated under various federal laws include locations where endangered species or historically significant resources are present. Action-specific ARARs or TBCs are usually technology- or activity-based requirements, or limitations on actions or conditions involving specific chemicals of concern.

4.1 Chemical-Specific ARARs and TBCs

4.1.1 U.S. EPA Region IX Preliminary Remediation Goals

U.S. EPA Region IX PRGs are risk-based screening levels for evaluating a chemical's impacts to human health. The PRGs use U.S. EPA toxicity values with accepted exposure factors to estimate contaminant concentration in environmental media (soil, air, and water) that the agency considers protective of humans (including sensitive groups) over a lifetime. The PRG concentrations are based on direct contact pathways for which generally accepted methods, models, and assumption have been developed (i.e. ingestion, dermal contact, and inhalation) for specific land-use conditions; the PRGs do not consider impacts to groundwater or ecological receptors (U.S. EPA, 2004). The PRGs are or may be TBCs for this site.

4.1.2 RWQCB Recommended Numerical Limits

The document *A Compilation of Water Quality Goals*, (RWQCB, 2003) is a summary of generally applicable or relevant limits used to determine compliance with water quality standards. By determining applicable numerical water quality objectives from the RWQCB Water Quality Control Plan ("Basin Plan"), this list may be used to determine limiting values of

commonly encountered constituents and parameters necessary to protect beneficial uses of groundwater or surface water (RWQCB, 2004). This is or may be TBC for the site.

4.2 Location-Specific ARARs and TBCs

4.2.1 Clean Water Act

The Clean Water Act ("CWA") of 1972 is the principal federal law governing discharges to surface waters and adjoining shorelines. Even before passage of the CWA, the State of California was protecting its surface water and groundwater through enactment of the Porter-Cologne Water Quality Act ("Porter-Cologne") under the California Water Code in 1967. The SWRCB and nine regional boards are responsible for oversight of Porter-Cologne CWA requirements. Unlike the CWA, Porter-Cologne does not restrict water quality standards to surface waters and point source discharges authorized by National Pollutant Discharge Elimination System ("NPDES") permits. Porter-Cologne requires that each of the nine regional boards adopt Water Quality Control Plans, which are applicable to groundwater and non-point sources, as well. Water Quality Control Plans are often called Basin Plans because they apply to waters within specific watershed boundaries or drainage basins. The Basin Plan and SWRCB resolutions that have been promulgated to implement Porter-Cologne and CWA requirements, which pertain to the site, are discussed below.

4.2.2 RWQCB Water Quality Control Plan

Section 303 of the federal Clean Water Act requires states to adopt water quality standards, which "consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses" (RWQCB, 1998). The Basin Plan for the Central Valley Region defines the beneficial uses of surface waters and groundwater within the Sacramento River and San Joaquin River basins and sets water quality objectives to protect those uses. The Basin Plan is a regulatory reference for meeting the State and federal requirements for water quality control (RWQCB, 1998). This is or may be an applicable and relevant requirement.

4.2.3 California Toxics Rule

The U.S. EPA promulgated numeric water quality criteria for priority toxic pollutants and other water quality standards provisions to be applied to waters in the State of California. The California Toxics Rule is based on the U.S. EPA's determination that the numeric criteria are necessary in the State of California to protect human health and the environment. The U.S. EPA promulgated this rule to fill a gap in California water quality standards that was created in 1994 when a State court overturned the State's water quality control plans containing water quality criteria for priority toxic pollutants, leaving the State without numeric water quality criteria for many priority toxic pollutants as required by the CWA. These Federal criteria are legally applicable in the State for inland surface waters, enclosed bays and estuaries for all purposes and programs under the CWA. This is or may be an applicable requirement for this site

4.2.4 U.S. Army Corps of Engineers Section 404 Permit

Section 404 of the Clean Water Act requires that a Department of the Army Permit be obtained prior to discharging dredged or fill material into waters of the United States, including wetlands. As stated previously, the jurisdictional delineation by Gibson & Skordal found that

approximately 0.6039 acre of waters of the United States exist on the property. Any discharge of dredged or fill material into these waters will require that a permit be obtained from the Corps pursuant to Section 404. It is likely that any adopted removal action alternative will involve a discharge of dredged or fill material into these waters of the United States thus requiring Corps of Engineers authorization. The Corps of Engineers has issued a nationwide permit (Nationwide Permit No. 38) that authorizes discharges of dredged or fill material for specific activities required to effect the containment, stabilization, or removal of hazardous or toxic waste materials that are performed, ordered, or sponsored by a government agency with the established legal or regulatory authority provided that the Corps of Engineers is notified in accordance with established procedures, subject to certain conditions. It is likely that Nationwide Permit No. 38 will provide the required authorization.

4.2.5 Endangered Species Act

The seasonal wetlands existing within the project area are potential, albeit marginal, habitat for certain federally-listed branchiopods in that they have shallow depressions that pond water seasonally during the winter and early spring. They are marginal in that the wetlands have been substantially degraded and modified by past land use activities. Nonetheless, they do provide potentially suitable habitat for vernal pools fairy shrimp (Branchinecta lynchi) and vernal pool tadpole shrimp (Lepidurus packardi). The vernal pool fairy shrimp is federally-listed as a threatened species and the vernal pool tadpole shrimp is federally-listed as endangered.

Absent protocol level field surveys demonstrating otherwise, these species are assumed to be potentially present in suitable habitat. Because of this, Section 7 Consultation between the Corps of Engineers and the U.S. Fish and Wildlife Service will be required as part of the processing of an application for authorization to perform the remediation pursuant to Nationwide Permit No. 38 (Cleanup of Hazardous and Toxic Waste). The Section 7 Consultation must be concluded before the Corps confirms that the project can be constructed under the authority of this nationwide permit.

4.2.6 National Historic Preservation Act of 1966

The federal National Historic Preservation Act ("NHPA") requires consideration of the potential effects that remedial actions may have on historic properties included, or eligible for inclusion on the National Register of Historic Places ("National Register"). The National Register lists historic properties, including sites, buildings, structures, or objects that are significant in American history or culture. The NHPA established procedures (Section106) for determination of eligibility on the National Register. Section 106 requires consultation with the State Historic Preservation Officer. This is or may be an applicable requirement for remediation.

4.2.7 Lake or Streambed Alteration Agreement

Under CCR Title 14, Section 669.5, any person, governmental agency, or public utility proposing any activity that will divert or obstruct the natural flow or change the bed, channel, or bank of any river, stream, or lake, or proposing to use any material from a streambed, must first notify the California Department of Fish and Game ("DFG") of such proposed activity. Generally speaking, the notification requirement applies to any work undertaken within the annual high-water mark of a wash, stream, or lake, which contains or once contained fish and wildlife or supports or once supported riparian vegetation. The DFG may propose reasonable modifications in the proposed construction to allow for the protection of the fish and wildlife

resources. Lake or Streambed Alteration Agreements that pertain to a private applications are commonly referred to as “1603” Agreements. Agreements that pertain to public agency applications are called “1601” Agreements. This is or may be an applicable requirement.

4.3 Action-Specific ARARs and TBCs

4.3.1 SWRCB Resolution No. 92/49

Section 13304 of the CWC authorizes the Regional Boards "to require complete cleanup of all waste discharged and the restoration of affected water to background conditions (i.e., the water quality that existed before the discharge)." If background conditions of affected water cannot be attained, then the water shall be restored to the best quality that is reasonable. To assist Regional Boards with oversight of this law, SWRCB promulgated Resolution No. 92-49 - Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304. This resolution establishes policies and procedures for investigating and remediating chemical releases that affect or threaten water quality. Resolution No. 92-49 is an applicable requirement that is or may be relevant for the site.

4.3.2 Hazardous Waste Requirements under CCR Title 22 and HSC Section 25157.8

The Resource Conservation and Recovery Act (“RCRA”) Subtitle C (40 CFR Sections 260-299) sets forth criteria for defining federal hazardous wastes, and specifies minimum national requirements for facilities that generate, transport, store, or dispose of hazardous wastes. The DTSC has promulgated regulations in California Code of Regulations (“CCR”) Title 22 that govern the management of wastes that are hazardous under RCRA or are hazardous under criteria specific to California. These latter types of hazardous wastes are referred to as non-RCRA hazardous wastes, and include wastes that may contain metals or organic compounds at concentrations greater than their respective Total Threshold Limit Concentration (“TTLC”) or Soluble Threshold Limit Concentration (“STLC”), as measured by the Waste Extraction Test (“WET”). These definitions are or may be relevant and appropriate for certain remedial actions considered at the site.

Pursuant to HSC Section 25157.8, additional criteria pertain to the management of lead, copper, or nickel contaminated waste. Waste containing total lead greater than 350 mg/kg, copper greater than 2,500 mg/kg, or nickel greater than 2,000 mg/kg must be disposed of at a permitted hazardous waste management facility, unless the waste discharge requirements and solid waste facility permit of a non-hazardous waste management facility specifically allow for the disposal of these types of wastes. The HSC Section 25157.8 remains in effect until 1 July 2006, and as of that date is repealed unless a later statute is enacted that repeals or extends the 1 July 2006 sunset provision.

The federal and state waste classification and management provisions are or may be appropriate for this site.

4.3.3 Non-hazardous Waste Requirements under CCR Title 27

RCRA Subtitle D (40 CFR Section 257-258) specifies minimum national requirements for municipal solid waste landfills that apply to new and existing waste management units that have received such wastes after 9 October 1991. The CCR Titles 14 and 23 were amended to

incorporate RCRA Subtitle D and approved for implementation by U.S. EPA. California subsequently consolidated most of the requirements in Titles 14 and 23 that relate to non-hazardous wastes under CCR Title 27. Non-hazardous waste management requirements under CCR Title 27 are or may be relevant and appropriate for the site.

4.3.4 Cal/OSHA

Cal/OSHA requires that workers exposed to contaminants above permissible exposure limits at hazardous waste sites have undergone appropriate training (CCR Title 8 Section 5192). Workers involved in remedial activities that would get into contact with contaminated soil would be required to have the applicable training. In addition, CCR Title 8 Section 1532.1 applies to all construction work where an employee may be exposed to lead. These are applicable requirements that are or may be pertinent to the site.

4.3.5 California Environmental Quality Act

California Environmental Quality ACT ("CEQA") requires that a project receiving a discretionary permit by a permit-issuing agency must undergo environmental review in accordance with CCR Title 14 Sections 15000-515387. Remediation activities may be subject to CEQA review; this is or may be an appropriate and relevant requirement.

4.3.6 NPDES Permits

Federal regulations for controlling discharges of pollutants from municipal separate sewer systems, construction sites, and industrial activities, were brought under the NPDES permit process by the 1987 amendments to the CWA, and the subsequent 1990 promulgation of Federal storm water regulations issued by the U.S. EPA. The U.S. EPA regulations require municipal and industrial storm water discharges to comply with an NPDES permit. In California, the U.S. EPA delegated its authority to issue NPDES permits to the RWQCB.

Construction activity resulting in a land disturbance of one acre or more must obtain the Construction Activities Storm Water General Permit ("General Permit"). Remedial activities may be subject to his requirement. A complete Notice of Intent ("NOI") application must be submitted to the RWQCB and a Storm Water Pollution Prevention Plan ("SWPPP") must be prepared in accordance with Section A of the General Permit prior to the commencement of soil disturbing activities. This is or may be an applicable and relevant requirement for the site.

4.3.7 Land Use Controls ("LUCs")

One or more of the alternatives evaluated in this document would result in residual contaminants in soil that will prevent unrestricted use of the site. As such, LUCs would need to be incorporated into the remedial alternatives to prevent or minimize exposure to the residual contaminants. The LUCs are physical or legal tools that can be implemented as part of a response action for an impacted site. The primary purposes of LUCs are to: 1) restrict activity at and/or access to properties in order to protect the public health and the environment from residual contamination after cleanup; 2) provide notice to interested parties regarding the presence of residual contamination and restrictions; and 3) specify long-term responsibilities to assure compliance with the restrictions.

In California, DTSC, through their management memo #EO-02-002-MM, "Response Action for Sites Where Future Use May Include Sensitive Uses," provides guidance for evaluating LUCs as part of remedial alternatives. The DTSC expects that any remedial alternative that includes leaving contaminants at levels not suitable for unrestricted use, include LUCs that protect human health and the environment. The guidance states that when evaluating incorporation of LUCs into a remedial alternative, an alternative of cleanup to unrestricted use must be developed and evaluated. The use of LUCs for the site is or may be a TBC.

5. EVALUATION OF REMOVAL ACTION ALTERNATIVES

This section presents alternative response options considered to protect human health. The data collection from the site and the evaluation of those data indicated that impacts to surface water and groundwater were not occurring as a result of trapshooting activities (BASELINE, 2005). The groundwater would not be expected to be affected by contaminants of concern and sediment sampling from Arcade Creek indicated that contaminants of concern were not accumulating in the creek.

The human health screening evaluation for the leasehold and the area north of the leasehold indicated that the surface soil has been affected by lead, arsenic, and selected PAHs at concentrations above residential risk-based PRGs as well as industrial PRGs. The response alternatives presented below have been selected and evaluated to determine the most effective, implementable, and cost-effective alternative to reduce health risks to future site users, including future utility/construction workers, to acceptable levels. The comparison of the alternatives have been conducted in accordance with the following criteria:

> **Effectiveness.** Determination based on the alternative's ability to be protective of public health, protective of workers during implementation, and compliance with ARARs in the short and long term.
>
> **Implementability.** Evaluation based on the technical feasibility of the removal action, the availability of personnel and services needed to perform the removal action, and the administrative feasibility, such as permit requirements.
>
> **Costs.** Estimation of the capital costs to implement the alternative and the long-term costs, if any.

Seven response alternatives have been developed for evaluation. These alternatives were selected because they would reduce the toxicity and/or mobility of the contaminants of concern, reduce exposures, or allow for unrestricted use of the site.

- Alternative 1: No Action
- Alternative 2: Excavation and off-site disposal
- Alternative 3: Thermal desorption
- Alternative 4: Soil washing
- Alternative 5: Soil stabilization
- Alternative 6: Soil solidification

- Alternative 7: Institutional Controls and Engineering Controls ("IC/EC")

  7A: Imported clean fill
  7B: Reuse of clay pigeons

- Alternative 8: Consolidation with IC/EC

It should be noted that for all alternatives, except the No Action Alternative, it is assumed that reclamation of lead shot will occur as part of the trapshooting club operations. A commercial recycler would conduct reclamation of lead shot. There is no cost for reclamation, since the recycler will sell the lead shot to a smelter. Lead reclamation would occur prior to remediation. Alternatives 2, 3, 4, 5, 6, 7A, and 8 include the removal of the clay pigeon debris to an off-site permitted facility. Table 8 summarizes the effectiveness, implementability, and cost for each alternative, which is discussed in further detail, below. The cost estimates are order-of-magnitude estimates for the purpose of comparing the alternatives, only. It should be noted that "the site" is assumed to consist of the leasehold for all alternatives, except Alternative 8, which includes all areas on and off the leasehold that have been affected by past trapshooting activities ("area of contamination"). For all alternatives, except Alternative 8, a separate investigation would be required to determine the extent of off-leasehold contamination and associated remediation.

5.1 Alternative 1: No Action

The No Action Alternative would result in the leasehold not being remediated or having no engineering or institutional controls. The lead shot and clay pigeons would remain on the leasehold, as would contaminated soils. The trapshooting activities may continue on the leasehold, which would result in the generation of additional clay pigeon debris and additional lead shot on the leasehold. If the leasehold were developed for another land use without remediation or engineering and institutional controls, future users of the leasehold could be adversely affected by on-site contaminants, including lead, arsenic, and PAHs.

This alternative would not be effective in the short- or the long-term and would not be protective of public health (and possibly the environment). This alternative would be easily implementable and would have no cost (except for costs associated with any potential leasehold development where workers would be required to work in accordance with site-specific health and safety plans and any off-site disposal of contaminated soils, required for development, would require special handling and management). It would not comply with chemical-specific ARARs.

5.2 Alternative 2: Excavation and Off-Site Disposal

This alternative consists of excavation and off-site disposal of the top two feet of soil on the leasehold, which contains elevated levels of lead, arsenic, and/or PAHs. The volume of soil that would be excavated and off-hauled is approximately 53,000 cubic yards. In addition to soil, the clay pigeon debris, about 14,000 cubic yards, would be removed and disposed of off-site. The waste classification of the debris indicates that the debris is a non-hazardous waste and can be disposed of at Class II or III landfill.

This alternative would be protective of human health since contaminants of concern would be removed from the leasehold. Excavating and relocating the soil and debris off-site would result

in the contaminated materials being disposed of at a permitted facility. Regulations governing landfills would ensure no adverse impacts from these contaminants in the future. This alternative would also allow for unrestricted future use of the leasehold.

Excavation and off-site disposal of contaminated soil/debris is a proven technology and can be readily implemented. There are a variety of construction companies in Northern California with experience in performing this kind of work, which can be performed using standard construction equipment. These firms have personnel with the appropriate training to perform hazardous waste cleanups.

The cost estimate assumes that the soil could be disposed of as non-RCRA hazardous waste and the debris as a non-hazardous waste, and that clean soil would be imported to bring the surface elevation of the property up to a level grade. The cost to excavate and dispose of soil and debris and then import soil to bring the leasehold up to a level grade is estimated to be $8.18 million (Table 9). This does not include paving the leasehold for development.

5.3 Alternative 3: Thermal Desorption

This technology involves processing the soil through a treatment unit that heats the soil to high temperatures to volatilize the organic contaminants. The resultant vapors may then be treated using granular activated carbon or thermal oxidation prior to discharge to the atmosphere. The air discharge would require a permit from the Sacramento Metropolitan Air Quality Management District. The technology could be used for removing the PAHs from the soil. It has been assumed that the top two feet of soil at 50 percent at the leasehold, or approximately 26,500 cubic yards, would require excavation and handling through the treatment process. After treatment, verification samples would be collected to ensure the treatment obtained the treatment goals at residential PRGs. Assuming the treatment was successful, the soil would be acceptable for reuse on the leasehold, with respect to PAH levels, but would still contain elevated metals concentrations.

Thermal desorption has been successfully used at several Superfund sites to remediate PAHs in soil to below cleanup levels (FRTR, 2002). Thermal desorption systems have demonstrated the ability to clean over 20 tons of polluted soil per hour (U.S. EPA, 2001). The time it takes to clean up a site using thermal desorption depends on the amount of polluted soil, the moisture content of the soil, amount of debris in the soil, and the type and amounts of other chemicals present.

The cost to remediate soil using thermal desorption at three sites reviewed by the EPA ranged from $50 to $125 per ton (EPA, 2005). Using the median value of $87.50 per ton, the cost to remediate the PAHs at the site using thermal desorption is estimated to be $34.77 million (Table 10), not including IC/ECs.

This alternative would not be protective of human health unless it was used in conjunction with another technology since this alternative would only remove the PAHs from the shallow site soils, and not the metals. The alternative would not meet chemical-specific ARARs for metals for unrestricted or industrial use. IC/ECs would be required if the metals contaminated soils were to remain on the leasehold (see Alternatives 7 and 8).

5.4 Alternative 4: Soil Washing

This technology involves removal of contaminants from soil using leaching agents, surfactants, or chelating[6] agents. Physical separation of PAHs or metals from the soil matrix can be achieved by mixing the soil with a chemical agent that will flush out the contaminants. This process requires changes in the physical and chemical characteristics of the contaminants to increase their solubility. Different agents may be required for the organics and inorganics and pilot testing would be needed to determine the appropriate agents. After the contaminants are extracted in solution, they must be removed using precipitation, electrochemical exchange, or ion exchange systems. Contaminants have been successfully removed using different aqueous solutions at a U.S. EPA Superfund site (U.S. EPA, 1997).

Soil washing may also incorporate particle size separation during the washing process. Particle size separation is usually effective treatment step since many organic and inorganic contaminants have a tendency to bind to clay, silt, and organic soil particles. Washing separates fine clay and silt particles from the coarser sand and gravel, effectively separating and concentrating the contaminants into a smaller volume consisting of the clay and silt fraction. This fraction can be managed by further treatment or disposal. Additional treatment of the sand fraction through scrubbing, flotation, surfactant washing, density separation, magnetic separation or chemical extraction is used as needed to meet site-specific treatment standards. The cleaned sand and gravel fraction can be returned to a site.

This alternative would protective of human health since the soil contaminants would be removed from the leasehold. The alternative would also allow for unrestricted future use of the property. This alternative would comply with chemical-, location-, and action-specific ARARs.

Assuming that 53,000 cubic yards, or 80,000 tons would require treatment, the cost to remediate the soil at the leasehold using soil washing is estimated to be $8.1 million (Table 11). This cost does not include paving for development of the leasehold.

5.5 Alternative 5: Soil Stabilization

Stabilization treatment processes convert contaminants into less mobile forms through chemical additives, most commonly a quicklime-sulfate salt treatment. Soil containing metals can be stabilized using trisodium phosphate. Soluble metals will precipitate into lead phosphate, which is insoluble in water. The addition of chemicals into the shallow soil at the leasehold to stabilize metals may be performed in-situ using standard construction equipment.

Stabilization would provide reduced mobility of the metals in the soil; however, stabilization is not a technology used for the treatment of PAH impacted soil. Therefore, this alternative would not be protective of human health unless it was used in conjunction with another technology or IC/ECs were implemented to eliminate exposures to residual PAHs in the soils.

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[6] To combine a metal ion with a chemical compound to form a heterocyclic ring.

The U.S. ARC estimates that soil stabilization would be $230.04 per ton (U.S. ARC, 2003). The cost to remediate the soil at the leasehold using soil washing is estimated to be $17.36 million (Table 12), without specific IC/ECs, but including paving of the leasehold.

5.6 Alternative 6: Solidification

Solidification treatment processes change the physical characteristics of a soil to reduce the mobility of the contaminants. This process also acts to reduce the hydraulic conductivity of the soil. Metals are commonly remediated by solidification with conventional pozzolans[7] such as Portland cement. The solidification process can also be effective in binding PAHs in the resulting matrix. The addition of chemicals into the shallow soil at the leasehold may be performed ex-situ or in-situ using standard construction equipment. Because of the relatively shallowness of the impacted soil, for cost estimating, it was assumed that the process would be performed in-situ. The long-term stability of the solidified soil is uncertain, as the solidification agent may weather over time.

While this alternative would provide protection to the environment by limiting the ability of contaminants to migrate in the short term, weathering of the solidification agent may compromise the long-term effectiveness. Future construction/utility workers could therefore be exposed to contaminants of concern. This alternative would comply with applicable ARARs, but would require IC/ECs to protect future construction/utility workers.

The cost to remediate soil using solidification is estimated to cost $9.54 million (Table 13), not including specific IC/ECs, except paving the leasehold.

5.7 Alternative 7: Institutional Controls and Engineering Controls

This alternative would entail the placement of IC/EC on the leasehold to eliminate and/or control future users' exposure to contaminants. The soil affected by lead, arsenic, and PAHs would remain in-situ, but exposure to the contaminants would be eliminated by placement of fill on top of the existing ground surface to level the leasehold. On top of the fill, an asphalt cap would be constructed in areas not occupied by building foundations. Utility trenches, constructed as part of future leasehold development, would be backfilled with clean imported soil. In addition, a risk management plan ("RMP") would govern construction activities associated with leasehold development and utility installations and maintenance. The RMP would provide procedures for breaching the cap to protect worker health and safety, soil management, and dust control. Further, a deed restriction would be placed on the entire leasehold restricting future residential land uses or land uses associated with sensitive receptors, including hospitals, schools, senior centers, and day care facilities.

Two subalternatives for this IC/EC alternative were considered: A) Use of imported fill for placement directly on top of the existing ground surface after removal and off-site disposal of the clay pigeon debris; and B) use of the clay pigeon debris as a fill layer (up to one foot in

[7] Any of various artificially produced substances resembling pozzuolana ash, a siliceous volcanic ash used to produce hydraulic cement

thickness) across most of the leasehold on top of the existing soil surface followed by placement of clean fill to final grade.

5.7.1 Subalternative 7A: IC/EC with Clean Fill

The clay pigeon debris would be hauled off-site to a permitted facility accepting non-hazardous waste. In accordance with the characterization of the debris (discussed in Section 2 of this report), the debris is not a RCRA, nor a California hazardous waste. During removal of debris, an air monitoring strategy would be developed as part of and RMP to ensure that dust generation would not exceed specified thresholds.

Clean fill would be imported and placed on the leasehold to the grade required for leasehold development, and asphalt would be placed on top of the clean fill in areas not occupied by building foundations. The fill may reach up to five to six feet in depth in the eastern portion of the leasehold and be shallower in the western portion.

A deed restriction would be recorded with the County to prohibit future residential development and sensitive land uses. The deed restriction would run with the land. The City currently owns the land and current plans are to lease all or portions of the leasehold for commercial development; the lease terms would likely be 30 years with options for renewal. There are no plans for the City to sell the property.

An RMP would be prepared for SCEMD review and approval prior to leasehold development. The RMP would delineate health and safety requirements for construction workers breaching the cap. Depending on the final fill thicknesses, the RMP may provide specific requirements for areas underlain by different fill thicknesses. For example, if clean fill is up to five feet thick in certain areas of the leasehold and utility workers were only placing utilities or irrigation lines at depths of two feet, the health and safety requirements would be different compared to workers placing utilities at depths greater than five feet, where residual contaminated soil could be encountered. The RMP would also delineate protocols for management of soil that would be excavated below the clean fill (i.e., the residual contaminated soil containing arsenic, lead, and PAHs) in future utility corridors and require placement of clean fill in all utility trenches after installation of specific utilities.

This subalternative would be effective in eliminating future commercial workers' exposure to site contaminants and would provide protection to future construction and utility workers through requirements for implementation of health and safety provisions in accordance with site-specific health and safety plans. This subalternative would be implementable by using known technology in placement of fill and construction of a cap. The City is experienced in administering deed restrictions and risk management plans. On other sites in the City where there are deed restrictions, the zoning map is amended with a "T" for the specific parcel(s), indicating "Toxics", and the City's parcel database is amended with "Permit Plus", indicating the presence of a deed restriction. This subalternative would comply with applicable ARARs. The cost for implementing this subalternative would be $6.27 million (Table 14); this estimate includes costs for implementing estimated RMP provisions for 20 years, including managing soils from utility excavation, cap inspections, and reporting to SCEMD.

5.7.2 Subalternative 7B: IC/EC with Reuse of Clay Pigeon Debris

This subalternative would be similar to subalternative 7A, except that the clay pigeon debris would not be transported off-site for disposal. The debris would be used as part of the fill to be placed immediately above the existing soil surface to a maximum thickness of one foot. The City has evaluated the suitability of the debris for use as engineered fill (Appendix C contains a report prepared by ENGEO, Inc on the suitability of the debris for use of fill). The geotechnical evaluation concluded that the debris, mixed at a ration of 3:1 (debris to soil) could be used as fill without increased future settlement of the constructed site surface. The placement of the debris and mixing with soils on the leasehold would occur in accordance with the requirements of the RMP; the RMP would be submitted to the SCEMD for review and approval prior to construction.

This alternative's effectiveness and implementability would be similar to subalternative 7A. It would eliminate placement of wastes in an off-site permitted landfill, thereby increasing the life of the landfill. Future commercial workers would not be subject to increased risks from this alternative compared to Subalternative 7A since there would be no exposure. Future construction and utility workers would be protected from residual contaminants in accordance with the requirements of a site-specific health and safety plan. This Subalternative would comply with applicable ARARs. The cost for implementing this Subalternative would be $6.19 million.

5.8 Alternative 8: Consolidation and IC/EC

This alternative would include the removal and off-site disposal of clay pigeon debris as a non-hazardous waste at a permitted facility. This alternative was developed in response to comments from DTSC on a draft of the Response Plan, dated November 2005 (the DTSC comment letter is included in Appendix D.

This alternative would entail the consolidation of contaminated soil onto one of two parcels that would be created at the area of contamination. The two parcels would consist of Parcels A and B, about 11.5 and 6.5 acres, respectively. About two feet of contaminated soil from across Parcel A would be consolidated onto Parcel B. In addition, Parcel B would receive contaminated soil identified north of the leasehold; the extent of affected soil in that area would be defined and the affected soil exceeding residential PRGs and/or background concentrations of lead, arsenic and PAHs would be consolidated with other contaminated soil in Parcel B. The consolidated contaminated soil would be capped with two feet of clean fill and an asphalt cap. All grading activities would be undertaken in accordance with health and safety plan requiring proper training (HAZWOPER) for workers and monitoring of air quality for workers and the community as required by Title 8 CCR.

Following removal of contaminated soil from Parcel A and north of the leasehold, verification sampling would be completed in Parcel A and north of the leasehold to demonstrate that the cleanup standards had been met.

Parcel A would have no engineering or institutional controls, since the parcel would have been remediated to unrestricted standards (i.e. residential PRGs or background levels). Parcel B would have IC/ECs similar to Alternative 7. These controls would include a deed restriction, enforced by Sacramento County, limiting future land uses to ensure only commercial/industrial

land use and prohibition on sensitive land uses (e.g., schools, hospitals, and residential). When Parcel B is developed, all utility corridors would contain clean backfill and excavated contaminated soil would be required to be hauled off-site at a permitted facility. HAZWOPER health and safety training would be required for construction workers engaged in initial utility corridor excavation. In addition, a Risk Management Plan (RMP) would be prepared to guide construction and maintenance activities at Parcel B. The RMP would delineate measures to be undertaken to protect human health and the environment (e.g., health and safety training, dust control, soil management procedures), and the procedures for annual cap maintenance (and repairs, if necessary). The RMP would also delineate reporting requirements to SCEMD.

This alternative would reduce the footprint of contamination and comply with applicable ARARs. The cost to implement this alternative would be $3.16 million. The detailed cost estimate is included in Table 16.

6. CONCLUSIONS AND RECOMMENDATIONS

The investigations conducted by BASELINE in November 2004 and June 2005 were designed to characterize contamination of the leasehold from the past and current trapshooting activities, assess whether surface waters were or could be affected, evaluate whether groundwater has been or could be affected by lead and arsenic concentrations in on-leasehold soils at a depth of two feet, evaluate any off-leasehold contamination from contaminants of concern, evaluate whether arsenic concentrations in the soils on the leasehold at a depth of two feet were similar to background concentrations, evaluate whether off-leasehold surface soil concentrations of arsenic were similar to background surface soil concentrations, and to classify the clay pigeon debris. Based on those data collection efforts, BASELINE evaluated the feasibility of alternative response actions to protect public health and the environment. The following conclusions have been made based on the data collection and data analyses:

- The upper two feet of soil on the leasehold have been affected by lead, arsenic and certain PAHs above residential and industrial PRGs.

- Sediment sampling in Arcade Creek and at the drainage channel traversing the leasehold indicate no adverse impacts.

- Fate and transport modeling indicates that lead and arsenic concentrations in soils on the leasehold would not result in groundwater concentrations above the Basin Plan water quality goals.

- Surface soils within 100 feet of the leasehold perimeter have not been affected by lead above residential PRGs except at two locations along the northern leasehold boundary.

- Surface soils within 100 feet of the leasehold perimeter do not contain arsenic concentrations that are significantly different from background surface soil concentrations, except at two locations along the northern leasehold perimeter.

- Concentrations of arsenic in the soil on the leasehold, at a depth of two feet bgs, are not significantly different from arsenic concentrations at background locations at a depth of two feet.

- The clay pigeon debris is classified as a non-hazardous waste.

A comparison of eight response alternatives, including the No Action Alternative, was performed to determine the most effective, implementable, and cost-effective alternative that complied with applicable ARARs. Alternative 8 is the alternative that is effective in protection of public health. That alternative consists of institutional and engineering controls to be imposed on one parcel to protect public health and the environment. The response action consists of off-site disposal of clay pigeon debris and consolidation of contaminated soil into one parcel; this would result in one parcel that has been remediated to unrestricted levels and one parcel where IC/EC would be implemented. The parcel with consolidation of contaminated soils would be capped with about two feet of clean imported soil and overlain by an asphalt cap in areas not covered by building foundations. Utility corridors would be backfilled with clean fill. Leasehold development and future construction, maintenance, and/or utility work would be undertaken in accordance with

the requirements of an RMP (which would include requirements for health and safety plans, soil management, dust control, annual cap inspection, and five-year reviews of the adequacy of the response action). The RMP would be submitted to SCEMD for review and approval. In addition, a deed restriction would be placed on one parcel and recorded with the County to prohibit future residential development or development for sensitive land uses.

The investigation conducted in June 2005 and described in this report identified off-leasehold effects of the trapshooting activities along the northern leasehold perimeter. It is recommended that a workplan be submitted to the SCEMD for an investigation to delineate the extent and magnitude of that area's contamination. After this workplan's approval and implementation, it is recommended that the area's contaminated soil identified by the investigation be excavated and consolidated with contaminated soil from the leasehold onto one of the parcels.

7. LIMITATIONS

The conclusions presented in this report are professional opinions based on the indicated data described in this report. They are intended only for the purpose, site, and project indicated. Opinions and recommendations presented herein apply to site conditions existing at the time of our study. Changes in the conditions of the subject property can occur with time, because of natural processes or the works of man, on the subject sites or on adjacent properties. Furthermore, it would be extremely expensive and perhaps impossible, to conduct a site investigation that would ensure detection of materials, which now or in the future, might be considered hazardous substances. Our failure to discover hazardous substances through a reasonable and mutually agreed upon limited scope-of-work does not guarantee that hazardous substances do not occur in an area. Similarly, an area which in part is unaffected by hazardous substances at the time of our investigation, may later, due to natural phenomena or human intervention, become contaminated. Changes in applicable standards can also occur as the result of legislation or from the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or in part, by changes beyond our control.

8. REFERENCES

Anlab Analytical Laboratory, 1995, Laboratory Report for Sample “Haggin Oak Gun Club #1", 20 October.

BASELINE, 2005, Site Assessment and Preliminary Response Option Report, Sacramento Trapshooting Club, February.

Caltest Analytical Laboratory, 1996, FAX submittal to Tony Bertrand, City of Sacramento Department of Utilities, Engineering Services Division, 21 November.

Capital City Golf, 2001, Letter Transmittal of Laboratory Data From Ann Weaver to Ava Langston-Kenney and Bill Busath, 13 August.

City of Sacramento, 2004, Memorandum from Mark Elliott, Utilities Engineering Services to Barbara Bonebrake Concerning Sampling of Stormwater Runoff at Haggin Oaks Trap Club and Arcade Creek, 2 April.

Department of Water Resources (“DWR”), 2004, Sacramento Valley Groundwater Basin, South American Subbasin, Bulletin 118, 27 February.

Federal Remediation Technologies Roundtable (FRTR), 2002, Abstracts of Remediation, Case Studies, Volume 6, June.

Gibson & Skordal, LLc, 2005 Jurisdictional Delineation Report, Sacramento Trap Rqnge Property, February.

Lawrence Berkeley National Laboratory, 2002, Analysis of Background Distributions of Metals in the Soil at Lawrence Berkeley National Laboratory, June.

National Oceanic and Atmospheric Association, 1999, Screening Quick Reference Table, September.

Neil O. Anderson Associates, 2004, Fax Transmittal of Laboratory Data to Jim Elliott of Sacramento Trapshootting Club, 4 March.

Regional Water Quality Control Board Central Valley Region (RWQCB), 1998, Water Quality Control Plan (Basin Plan), Fourth Edition Revised September 2004.

RWQCB, 2003, A Compilation of Water Quality Goals, August.

RWQCB, 2004, Recommended Numerical Limits to Translate Water Quality Objectives, 19 May.

RSMeans, 2004, Environmental Remediation Cost Data-Unit Price, 10th Annual Edition.

Sacramento Metropolitan Air Quality Management District (SMAQMD), 2004, Guide to Air Quality Assessment in Sacramento County, July.

U.S. Environmental Protection Agency (U.S.EPA), 1997, Recent Developments for In Situ Treatment of Metal Contaminated Soil, 5 March.

U.S. EPA, 2001, A Citizen's Guide to Thermal Desorption, 542-F-01-003, April.

U.S.EPA, 2004, Region IX Preliminary Remediation Goals (PRGs) as updated; by Stanford Smucker, Ph.D.

U.S. EPA, 2005, Remediation and Characterization Innovative Technology, website: www.epareachit.org, June.

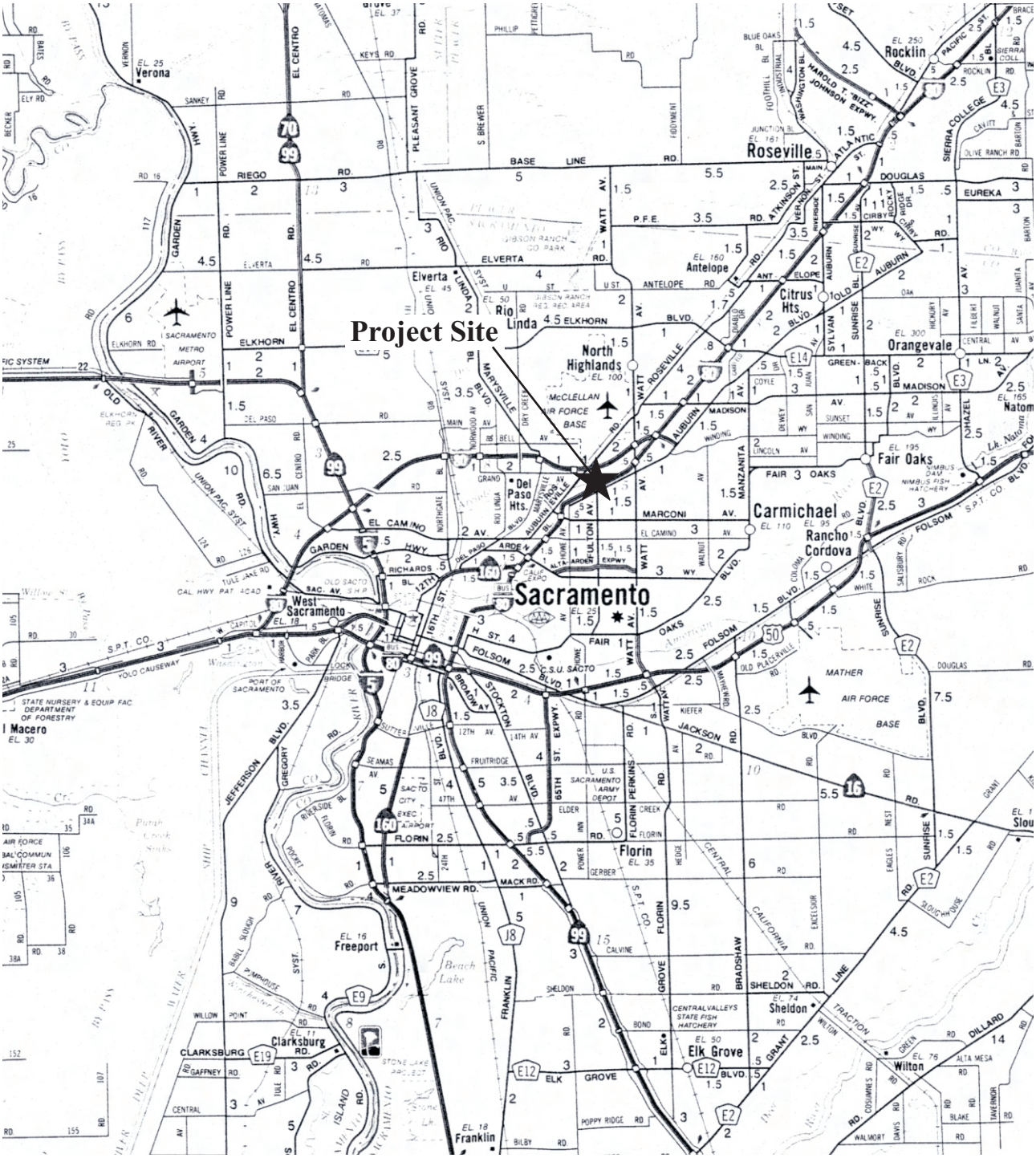
Versar, Inc., 1995, Environmental Investigation of Sacramento Trap Shoot Club, 29 September.

U.S. Army Remediation Center (U.S. ARC), Soil Washing for Small Arms Range Remediation and Maintenance, 1 October 2003.

FIGURES

REGIONAL LOCATION

Figure 1



Sacramento Trapshooting Club
Sacramento, California

0 4 Miles

BASELINE

Y4368.00152.Rev3.Fig1.RL .cdr 3/24/06

SITE MAP

Figure 2

Sacramento Trapshooting Club
Sacramento, California

Source: City of Sacramento, 2004.

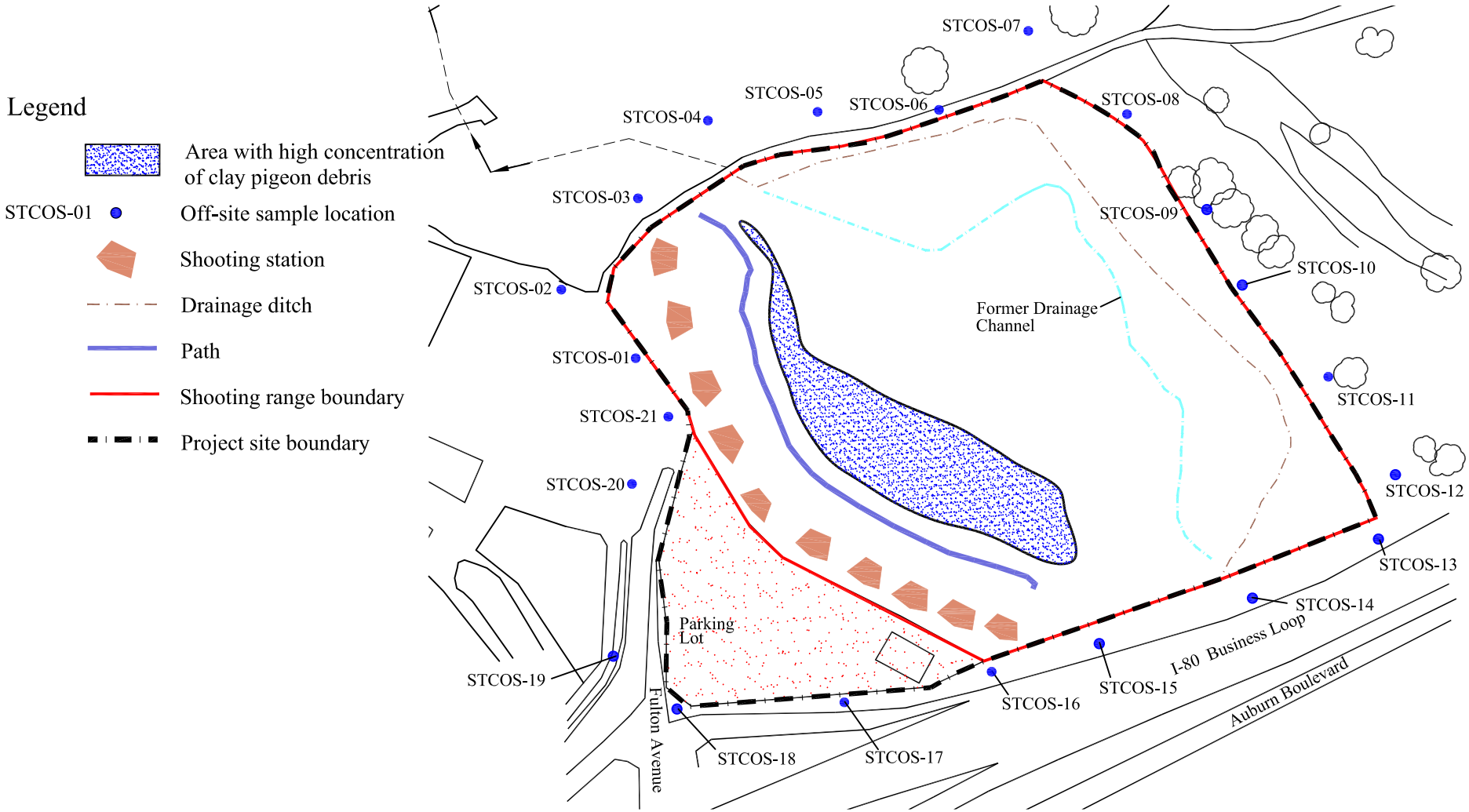
0 200 Feet

BASELINE

Y4368.00152.Rev3.Fig2.cdr.7/15/05

OFF-LEASEHOLD SAMPLE LOCATIONS

Figure 3



Sacramento Trapshooting Club
Sacramento, California

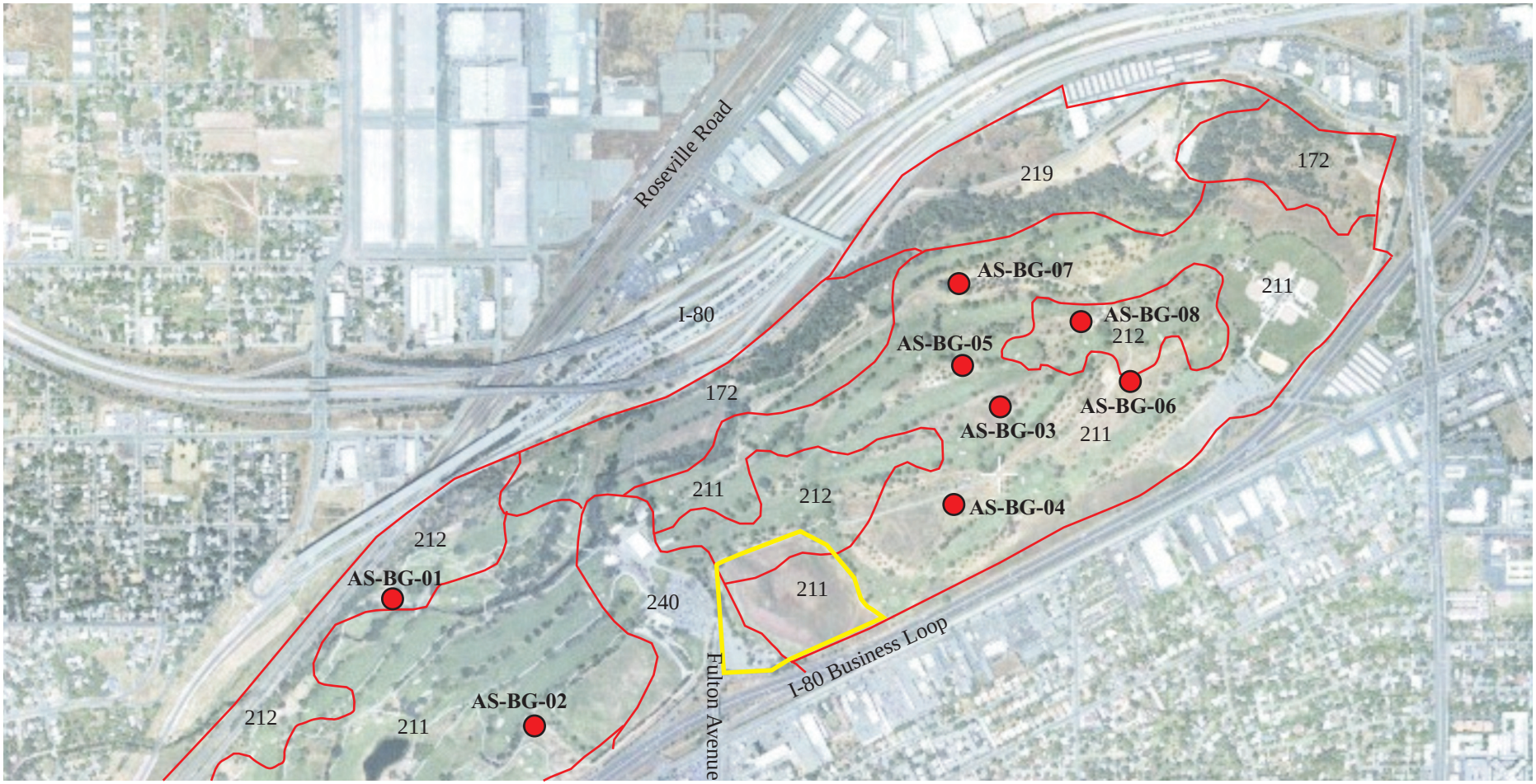
0 250 Feet

BASELINE

Y4368.00152.Fig3Rev3.dwg 3/23/06

BACKGROUND ARSENIC SAMPLING LOCATIONS

Figure 4



Legend

- Sample Location
- Boundary of Soil Types
- Project Site Boundary

US Department of Agriculture Soil Types

149 - Fiddy-Urban land complex, 1 to 8 percent slope
172 - Liveoak sandy clay loam, 0 to 2 precent slope
211 - San Joaquin fine sandy loam, 0 to 3 percent slope
212 - San Joaquin fine sandy loam, 3 to 8 percent slope
229 - Urban land-xeraents-Fiddyment complex, 0 to 8 percent
240 - Xerarents-urban land-San Joaquin complex, 0 to 5 percent

Source
Aerial photograph: WWW.terrafly.com
Soil types: US Dept. of Agriculture, 1993, Soil Survey of Sacramento County

0 1525 Feet

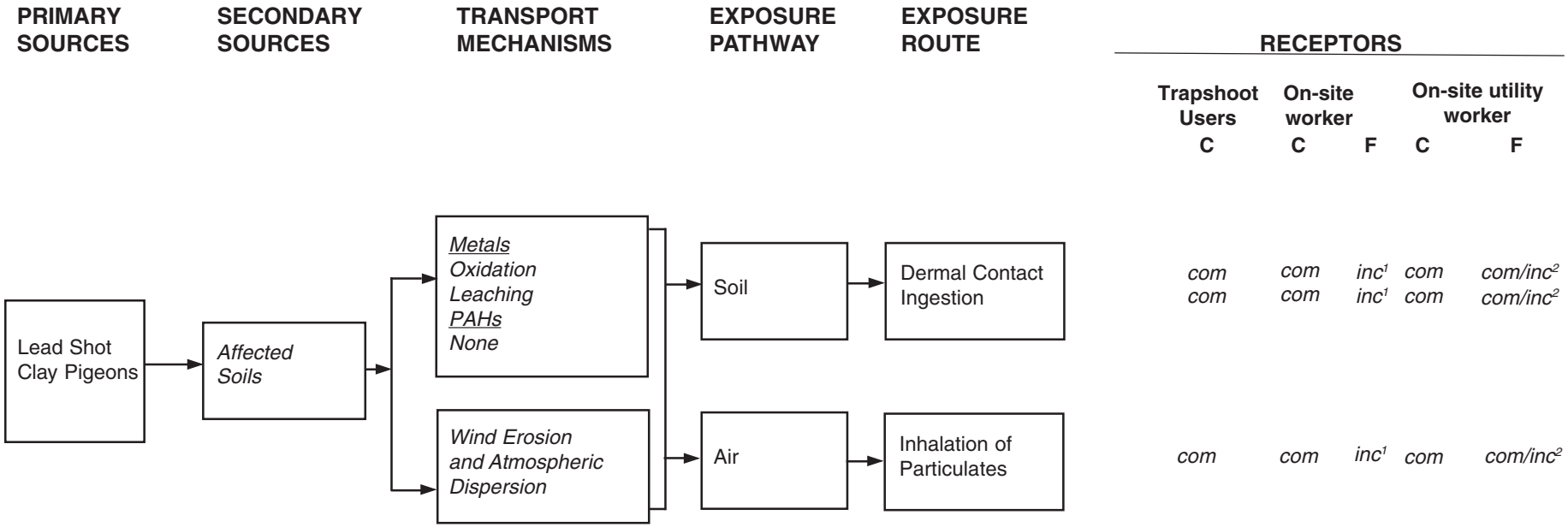
BASELINE

Sacramento Trapshooting Club
Sacramento, California

Y4368.00152.Rev3.Fig4.cdr 3/24/06

CONCEPTUAL SITE MODEL FOR HUMAN HEALTH

Figure 5



[1] Exposure pathways for the future on-site worker would be incomplete either through removal of contaminated soil or through capping of the site.

[2] Exposure pathways for the future on-site utility worker could be complete if the contaminants were left in-place and the site capped; the pathway would be incomplete if contaminated soils were removed.

Legend
C = Current receptor
F = Future receptor
inc = Incomplete pathway
com = Compete pathway

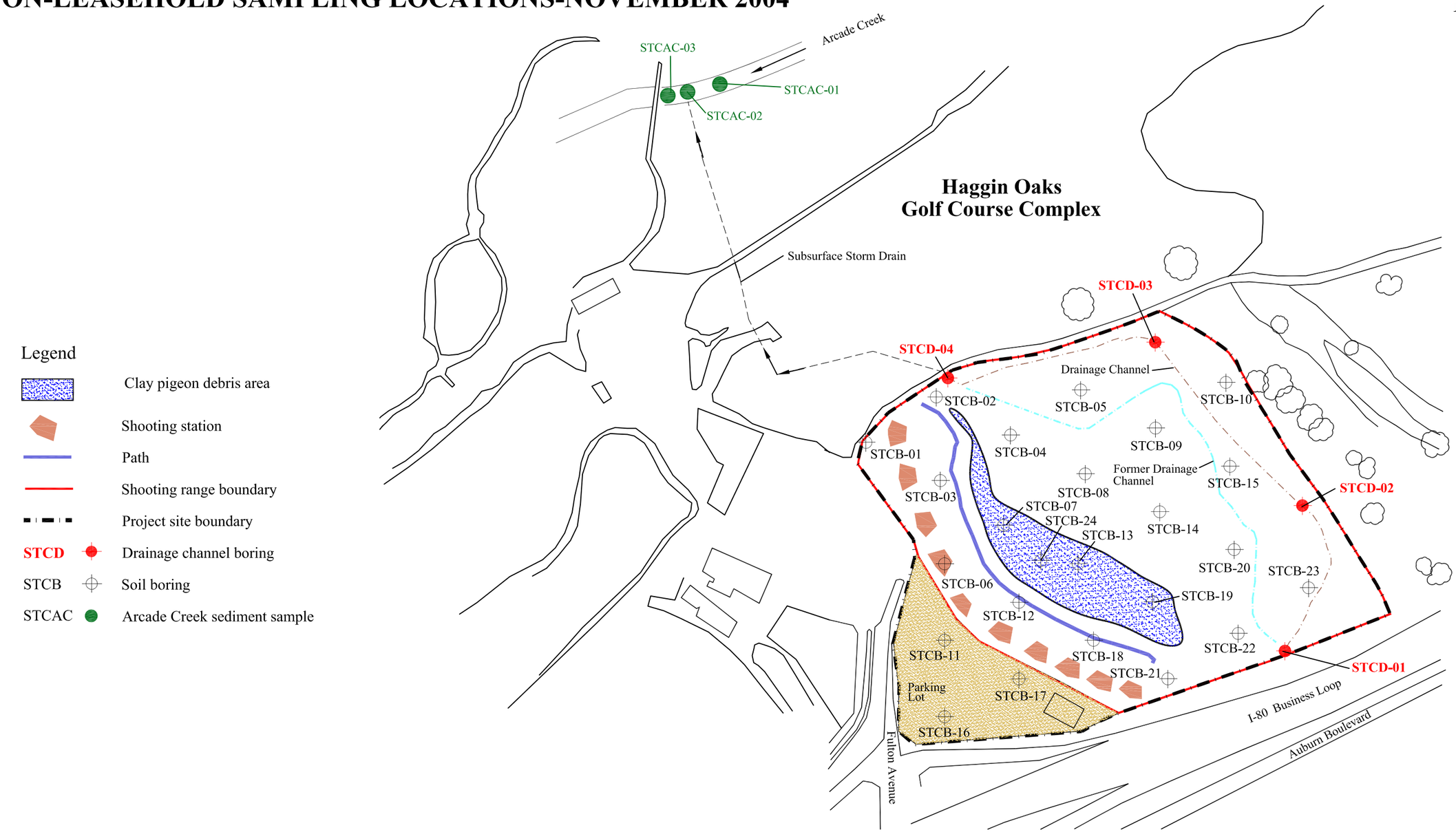
Sacramento Trap Shooting Club
Sacramento, California

BASELINE

Y4368.00152.Rev3.Fig5.ste.mdl-3/24/06

ON-LEASEHOLD SAMPLING LOCATIONS-NOVEMBER 2004

Figure 6



Sacramento Trapshooting Club
Sacramento, California

BASELINE

Y4368.00152.Fig6.Rev3 3/23/06

TABLES

TABLE 1: **Analyses Performed on Soil Samples**
Sacramento Trapshooting Club
June 2005

Sample ID	Matrix	Date Sample Collected	Total Pb	Total As	PAHs	STLC (WET) Pb	STLC (WET) As	TCLP Pb	TCLP As	96-Hr Fish Bioassay	TPH - diesel and motor oil	Title 22 Metals	Moisture
Background Samples													
AS-BG-01@SURFACE	Soil	06/16/05		X									X
AS-BG-01@2-2.5	Soil	06/16/05		X									X
AS-BG-02@SURFACE	Soil	06/16/05		X									X
AS-BG-02@2-2.5	Soil	06/16/05		X									X
AS-BG-03@SURFACE	Soil	06/16/05		X									X
AS-BG-03@2-2.5	Soil	06/16/05		X									X
AS-BG-04@SURFACE	Soil	06/16/05		X									X
AS-BG-04@2-2.5	Soil	06/16/05		X									X
AS-BG-05@SURFACE	Soil	06/16/05		X									X
AS-BG-05@2-2.5	Soil	06/16/05		X									X
AS-BG-06@SURFACE	Soil	06/16/05		X									X
AS-BG-06@2-2.5	Soil	06/16/05		X									X
AS-BG-07@SURFACE	Soil	06/16/05		X									X
AS-BG-07@2-2.5	Soil	06/16/05		X									X
AS-BG-08@SURFACE	Soil	06/16/05		X									X
AS-BG-08@2-2.5	Soil	06/16/05		X									X
Off-Site Samples, Surface													
STCOS-01	Soil	06/16/05	X	X	X								X
STCOS-02	Soil	06/16/05	X	X	X								X
STCOS-03	Soil	06/16/05	X	X	X								X
STCOS-04	Soil	06/16/05	X	X	X								X
STCOS-05	Soil	06/16/05	X	X	X								X
STCOS-05; re-analyzed	Soil	06/16/05	X	X									X
STCOS-06	Soil	06/16/05	X	X	X								X
STCOS-06; re-analyzed	Soil	06/16/05	X	X									X
STCOS-07	Soil	06/16/05	X	X	X								X
STCOS-08	Soil	06/16/05	X	X	X								X
STCOS-09	Soil	06/16/05	X	X	X								X
STCOS-10	Soil	06/16/05	X	X	X								X
STCOS-11	Soil	06/16/05	X	X	X								X
STCOS-12	Soil	06/16/05	X	X	X								X
STCOS-13	Soil	06/16/05	X	X	X								X
STCOS-14	Soil	06/16/05	X	X	X								X
STCOS-15	Soil	06/16/05	X	X	X								X
STCOS-16	Soil	06/16/05	X	X	X								X
STCOS-17	Soil	06/16/05	X	X	X								X
STCOS-18	Soil	06/16/05	X	X	X								X
STCOS-19	Soil	06/16/05	X	X	X								X
STCOS-20	Soil	06/16/05	X	X	X								X
STCOS-21	Soil	06/16/05	X	X	X								X

TABLE 1: **Analyses Performed on Soil Samples**
Sacramento Trapshooting Club
June 2005

Sample ID	Matrix	Date Sample Collected	Total Pb	Total As	PAHs	STLC (WET) Pb	STLC (WET) As	TCLP Pb	TCLP As	96-Hr Fish Bioassay	TPH - diesel and motor oil	Title 22 Metals	Moisture
Waste Classification Samples, Clay Pigeon Debris													
STC-CP-01	Clay Pigeon > 3/4"	06/16/05								X			
STC-CP-02	Clay Pigeon < 3/4"	06/16/05	X	X	X	X	X	X	X				
CP-01	Clay Pigeon	06/28/05	X			X		X		X			
CP-02	Clay Pigeon	06/28/05	X			X		X		X			
CP-03	Clay Pigeon	06/28/05	X			X		X		X			
CP-04	Clay Pigeon	06/28/05	X			X		X		X			
Composite: CP-01, CP-02, CP-03, CP-04	Clay Pigeon	06/28/05									X	X	
STC-ERB	Rinsate Water	06/16/05	X	X	X								

Notes:
@ x-x indicates the depth below ground surface at which the sample was collected
Pb = lead
As = arsenic
PAHs = polynuclear aromatic hydrocarbons
Bioassay with fathead minnows
Title 22 Metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc)
STLC = soluble threshold limit concentration
TCLP = toxicity characteristic leachate procedure
TPH = total petroleum hydrocarbons
WET = waste extraction test

TABLE 2: **Summary of Off-Leasehold Sampling Results**
Surface Soils
Lead and Arsenic
(mg/kg dry weight)
Sacramento Trapshooting Club
June 2005

Sample ID	Lead	Arsenic
STCOS-01	62	**1.8**
STCOS-02	**150**	**1.9**
STCOS-03	25	**1.1**
STCOS-04	140	**2.1**
STCOS-05[1]	**1,200/1,000**	**8.4/10**
STCOS-06[1]	**2,900/2,500**	**19/20**
STCOS-07	**270**	**3.4**
STCOS-08	110	**2.0**
STCOS-09	25	**0.98**
STCOS-10	**690**	**4.9**
STCOS-11	9.0	**1.1**
STCOS-12	33	**1.2**
STCOS-13	3.7	**0.93**
STCOS-14	44	**1.3**
STCOS-15	110	**1.7**
STCOS-16	**200**	**4.2**
STCOS-17	49	**1.8**
STCOS-18	**280**	**1.4**
STCOS-19	8.0	**1.5**
STCOS-20	38	**2.0**
STCOS-21	**160**	**3.6**
Residential PRGs	150 [2] nc	0.0.62 [2] ca
Industrial PRGs	800 nc	0.25 [2] ca

Notes:
Samples collected at surface to a depth of six inches.
Samples collected on 16 June 2005
Analyzed by EPA Method 6020
mg/kg = milligram per kilogram
Sampling locations are shown on Figure 2.
Laboratory reports are included in Appendix B.
ca = based on cancer risk
nc = based on non-cancer risk
PRGs = U.S. EPA Region IX Preliminary Remediation Goals, 2004
Industrial PRGs are for commercial or industrial land use
Residential PRGs are for residential land use
Bold values equal or exceed the residential PRGs
Shaded values equal or exceed the industrial PRGs

[1] Reanalyzed to confirm levels reported by laboratory
[2] California modified PRGs using California Environmental Protection Agency toxicity values.

TABLE 3: **Summary of Off-Leasehold Sampling**
Surface Soils
PAH Results
(mg/kg dry weight)
Sacramento Trapshooting Club
June 2005

Analyte	Residential PRGs			Industrial PRGs			STCOS-01	STCOS-02	STCOS-03	STCOS-04	STCOS-05	STCOS-06
Acenaphthene	3,700		nc	29,000		nc	0.042	0.059	0.014	0.12	0.66	ND<0.0052
Acenaphthylene	NA			NA			ND<0.026	ND<0.052	ND<0.0054	ND<0.053	ND<0.51	ND<0.0052
Anthracene	22,000		nc	100,000		max	0.031	0.086	0.011	0.22	1.2	ND<0.0052
Benzo(a)anthracene	0.62		ca	2.1		ca	0.36	**1.3**	0.11	**4.1**	**14**	ND<0.0052
Benzo(a)pyrene	0.062		ca	0.21		ca	**0.57**	**1.8**	**0.22**	**4.6**	**14**	0.006
Benzo(b)fluoranthene	0.62		ca	2.1		ca	0.61	**2.0**	0.24	**5.4**	**17**	0.0059
Benzo(g,h,i)perylene	NA			NA			0.38	0.87	0.13	2.0	6.7	ND<0.0052
Benzo(k)fluoranthene	0.38	[1]	ca	1.3	[1]	ca	0.24	**0.69**	0.089	**1.8**	**5.9**	ND<0.0052
Chrysene	3.8	[1]	ca	13	[1]	ca	0.47	2.0	0.16	**6.4**	**22**	0.006
Dibenz(a,h)anthracene	0.062		ca	0.21		ca	ND<0.026	ND<0.052	ND<0.0054	ND<0.053	ND<0.51	ND<0.0052
Fluoranthene	2,300		nc	22,000		nc	0.35	1.4	0.097	4.7	18	ND<0.0052
Fluorene	2,700		nc	26,000		nc	ND<0.026	ND<0.052	ND<0.0054	ND<0.053	ND<0.51	ND<0.0052
Indeno(1,2,3-c,d)pyrene	0.62		ca	2.1		ca	0.35	**0.77**	0.12	**1.8**	**6.8**	ND<0.0052
Naphthalene	1.7		nc	4.2		nc	ND<0.026	ND<0.052	ND<0.0054	ND<0.053	ND<0.51	ND<0.0052
Phenanthrene	NA			NA			0.12	0.35	0.04	1.1	5.7	ND<0.0052
Pyrene	2,300		nc	29,000		nc	0.43	2.0	0.13	1.0	23	ND<0.0052
Cumulative Cancer Risk Residential Land Use							1.2E-05	3.9E-05	4.7E-06	1.0E-04	3.2E-04	1.7E-07
Cumulative Cancer Risk Industrial Land Use							3.6E-06	1.1E-05	1.4E-06	3.0E-05	9.3E-05	4.9E-08
Cumulative Non-Cancer Hazard Index Residential Land Use							8.0E-03	1.7E-02	1.7E-03	1.8E-02	1.7E-01	1.5E-03
Cumulative Non-Cancer Hazard Index Industrial Land Use							3.1E-03	6.3E-03	6.5E-04	6.6E-03	6.2E-02	6.2E-04

TABLE 3: **Summary of Off-Leasehold Sampling**
Surface Soils
PAH Results
(mg/kg dry weight)
Sacramento Trapshooting Club
June 2005

Analyte	Residential PRGs			Industrial PRGs			STCOS-07	STCOS-08	STCOS-09	STCOS-10	STCOS-11	STCOS-12
Acenaphthene	3,700		nc	29,000		nc	ND<0.006	ND<0.0055	ND<0.0053	ND<0.0053	0.019	ND<0.0051
Acenaphthylene	NA			NA			ND<0.006	ND<0.0055	ND<0.0053	ND<0.0053	ND<0.0052	ND<0.0051
Anthracene	22,000		nc	100,000		max	0.0088	ND<0.0055	ND<0.0053	ND<0.0053	0.009	ND<0.0051
Benzo(a)anthracene	0.62		ca	2.1		ca	0.11	0.041	0.016	0.018	0.18	0.0091
Benzo(a)pyrene	0.062		ca	0.21		ca	**0.10**	0.056	0.027	0.028	**0.29**	0.014
Benzo(b)fluoranthene	0.62		ca	2.1		ca	0.13	0.077	0.033	0.032	0.34	0.024
Benzo(g,h,i)perylene	NA			NA			0.045	0.037	0.024	0.024	0.16	0.015
Benzo(k)fluoranthene	0.38	[1]	ca	1.3	[1]	ca	0.049	0.023	0.014	0.013	0.12	ND<0.0051
Chrysene	3.8	[1]	ca	13	[1]	ca	0.16	0.056	0.025	0.026	0.29	0.016
Dibenz(a,h)anthracene	0.062		ca	0.21		ca	ND<0.006	ND<0.0055	ND<0.0053	ND<0.0053	ND<0.0052	ND<0.0051
Fluoranthene	2,300		nc	22,000		nc	0.15	ND<0.0055	0.021	0.021	0.16	0.014
Fluorene	2,700		nc	26,000		nc	ND<0.006	ND<0.0055	ND<0.0053	ND<0.0053	ND<0.0052	ND<0.0051
Indeno(1,2,3-c,d)pyrene	0.62		ca	2.1		ca	0.047	0.037	0.025	0.024	0.16	0.016
Naphthalene	1.7		nc	4.2		nc	ND<0.006	ND<0.0055	ND<0.0053	ND<0.0053	ND<0.0052	ND<0.0051
Phenanthrene	NA			NA			0.052	0.015	0.0072	0.0073	0.043	0.0059
Pyrene	2,300		nc	29,000		nc	0.19	0.055	0.023	0.023	0.21	0.017
Cumulative Cancer Risk Residential Land Use							2.3E-06	1.3E-06	6.5E-07	6.6E-07	6.3E-06	3.6E-07
Cumulative Cancer Risk Industrial Land Use							6.9E-07	3.8E-07	1.9E-07	1.9E-07	1.8E-06	1.1E-07
Cumulative Non-Cancer Hazard Index Residential Land Use							1.9E-03	1.6E-03	1.6E-03	1.6E-03	1.7E-03	1.5E-03
Cumulative Non-Cancer Hazard Index Industrial Land Use							7.3E-04	6.6E-04	6.3E-04	6.3E-04	6.3E-04	6.1E-04

TABLE 3: **Summary of Off-Leasehold Sampling**
Surface Soils
PAH Results
(mg/kg dry weight)
Sacramento Trapshooting Club
June 2005

Analyte	Residential PRGs			Industrial PRGs			STCOS-13	STCOS-14	STCOS-15	STCOS-16	STCOS-17	STCOS-18
Acenaphthene	3,700		nc	29,000		nc	ND<0.026	ND<0.0053	ND<0.0053	0.0093	0.013	0.015
Acenaphthylene	NA			NA			ND<0.026	ND<0.0053	ND<0.0053	ND<0.0061	ND<0.0061	ND<0.0053
Anthracene	22,000		nc	100,000		max	ND<0.026	ND<0.0053	ND<0.0053	0.011	0.012	0.014
Benzo(a)anthracene	0.62		ca	2.1		ca	ND<0.026	0.018	0.016	0.15	0.15	0.18
Benzo(a)pyrene	0.062		ca	0.21		ca	ND<0.026	0.03	0.022	**0.22**	**0.24**	**0.32**
Benzo(b)fluoranthene	0.62		ca	2.1		ca	ND<0.026	0.034	0.026	0.29	0.33	0.52
Benzo(g,h,i)perylene	NA			NA			0.078	0.021	0.011	0.15	0.18	0.23
Benzo(k)fluoranthene	0.38	[1]	ca	1.3	[1]	ca	ND<0.026	0.01	0.0084	0.078	0.086	ND<0.0053
Chrysene	3.8	[1]	ca	13	[1]	ca	0.078	0.028	0.021	0.20	0.21	0.25
Dibenz(a,h)anthracene	0.062		ca	0.21		ca	ND<0.026	ND<0.0053	ND<0.0053	ND<0.0061	ND<0.0061	ND<0.0053
Fluoranthene	2,300		nc	22,000		nc	ND<0.026	0.027	0.02	0.15	0.18	0.18
Fluorene	2,700		nc	26,000		nc	ND<0.026	ND<0.0053	ND<0.0053	ND<0.0061	ND<0.0061	ND<0.0053
Indeno(1,2,3-c,d)pyrene	0.62		ca	2.1		ca	ND<0.026	0.021	0.014	0.12	0.15	0.19
Naphthalene	1.7		nc	4.2		nc	ND<0.026	ND<0.0053	ND<0.0053	ND<0.0061	ND<0.0061	ND<0.0053
Phenanthrene	NA			NA			ND<0.026	0.012	0.0066	0.054	0.058	0.061
Pyrene	2,300		nc	29,000		nc	ND<0.026	0.029	0.017	0.18	0.19	0.19
Cumulative Cancer Risk Residential Land Use							5.6E-07	6.8E-07	5.2E-07	4.8E-06	5.3E-06	6.8E-06
Cumulative Cancer Risk Industrial Land Use							1.6E-07	2.0E-07	1.5E-07	1.4E-06	1.6E-06	2.0E-06
Cumulative Non-Cancer Hazard Index Residential Land Use							7.7E-03	1.6E-03	1.6E-03	1.9E-03	2.0E-03	1.7E-03
Cumulative Non-Cancer Hazard Index Industrial Land Use							3.1E-03	6.3E-04	6.3E-04	7.4E-04	7.4E-04	6.5E-04

TABLE 3: **Summary of Off-Leasehold Sampling**
Surface Soils
PAH Results
(mg/kg dry weight)
Sacramento Trapshooting Club
June 2005

Analyte	Residential PRGs			Industrial PRGs			STCOS-19	STCOS-20	STCOS-21
Acenaphthene	3,700		nc	29,000		nc	ND<0.0053	ND<0.0053	0.079
Acenaphthylene	NA			NA			ND<0.0053	ND<0.0053	ND<0.0056
Anthracene	22,000		nc	100,000		max	ND<0.0053	ND<0.0053	0.027
Benzo(a)anthracene	0.62		ca	2.1		ca	0.0069	ND<0.0053	0.14
Benzo(a)pyrene	0.062		ca	0.21		ca	0.013	ND<0.0053	**0.21**
Benzo(b)fluoranthene	0.62		ca	2.1		ca	0.022	ND<0.0053	0.27
Benzo(g,h,i)perylene	NA			NA			0.0065	ND<0.0053	0.14
Benzo(k)fluoranthene	0.38	[1]	ca	1.3	[1]	ca	ND<0.0053	ND<0.0053	0.087
Chrysene	3.8	[1]	ca	13	[1]	ca	0.011	ND<0.0053	0.20
Dibenz(a,h)anthracene	0.062		ca	0.21		ca	ND<0.0053	ND<0.0053	ND<0.0056
Fluoranthene	2,300		nc	22,000		nc	0.0074	ND<0.0053	0.22
Fluorene	2,700		nc	26,000		nc	ND<0.0053	ND<0.0053	0.032
Indeno(1,2,3-c,d)pyrene	0.62		ca	2.1		ca	0.0076	ND<0.0053	0.11
Naphthalene	1.7		nc	4.2		nc	ND<0.0053	ND<0.0053	ND<0.0056
Phenanthrene	NA			NA			ND<0.0053	ND<0.0053	0.14
Pyrene	2,300		nc	29,000		nc	0.0091	ND<0.0053	0.21
Cumulative Cancer Risk Residential Land Use							3.2E-07	1.1E-07	4.6E-06
Cumulative Cancer Risk Industrial Land Use							9.5E-08	3.1E-08	1.4E-06
Cumulative Non-Cancer Hazard Index Residential Land Use							1.6E-03	1.6E-03	1.9E-03
Cumulative Non-Cancer Hazard Index Industrial Land Use							6.3E-04	6.3E-04	6.9E-04

Notes:

ca = based on cancer risk

nc = based on non-cancer risk

mg/kg = micrograms per kilogram

NA = not available

ND = not reported above the value following the less-than sign

PRGs = U.S. EPA Region IX, Preliminary Remediation Goals (U.S. EPA, 2004)

Residential PRGs are for residential land use

Industrial PRGs are for commercial or industrial land use

PAHs analyzed by EPA Method 8270SIM

Samples collected on 16 June 2005

Shaded cells contain values that equal or exceed the industrial PRGs

Bold values equal or exceed the residential PRGs

Sampling locations are shown on Figure 3

Laboratory reports are included in Appendix B

[1] California modified PRGs using California Environmental Protection Agency toxicity values.

TABLE 4: **Summary of Background Sampling**
Soil Samples
Arsenic (mg/kg dry weight)
Sacramento Trapshooting Club
June 2005

Sample ID	Arsenic Results
Samples from Surface; 0.0-0.5 feet bgs	
AS-BG-01@SURFACE	1.7
AS-BG-02@SURFACE	1.9
AS-BG-03@SURFACE	1.9
AS-BG-04@SURFACE	2.4
AS-BG-05@SURFACE	4.4
AS-BG-06@SURFACE	2.0
AS-BG-07@SURFACE	2.1
AS-BG-08@SURFACE	1.3
Samples from 2.0-2.5 feet bgs	
AS-BG-01@2-2.5	8.1
AS-BG-02@2-2.5	1.4
AS-BG-03@2-2.5	1.2
AS-BG-04@2-2.5	1.9
AS-BG-05@2-2.5	0.96
AS-BG-06@2-2.5	1.5
AS-BG-07@2-2.5	ND<0.92
AS-BG-08@2-2.5	2.0

Notes:
Samples collected on 16 June 2005
Analyzed by EPA Method 6020
mg/kg = milligram per kilogram
Sampling locations are shown on Figure 4.
Laboratory reports are included in Appendix B.
ND = not detected above the laboratory reporting limit, which is the value following the less-than sign.
bgs = below ground surface

TABLE 5: **Summary Results of Waste Classification**
Clay Pigeon Debris
Sacramento Trapshooting Club
June 2005

Sample ID	Arsenic Total (mg/kg)	Arsenic STLC (mg/L)	Arsenic TCLP (mg/L)
STC-CP-02	ND<0.80	ND<0.50	ND<0.50

Sample ID	Lead Total (mg/kg)	Lead STLC (mg/L)	Lead TCLP (mg/L)
STC-CP-02	7.0	ND<0.50	1.7
CP-01	3.9	ND<0.50	ND<0.50
CP-02	4.7	ND<0.50	ND<0.50
CP-03	3.8	ND<0.50	ND<0.50
CP-04	5.5	ND<0.50	ND<0.50

Sample ID	PAHs (mg/kg)
STC-CP-02	
Acenaphthene	54
Acenaphthylene	ND<25
Anthracene	55
Benzo(a)anthracene	630
Benzo(a)pyrene	840
Benzo(b)fluoranthene	880
Benzo(g,h,i)perylene	540
Benzo(k)fluoranthene	250
Chrysene	780
Dibenzo(a,h)anthracene	ND<25
Fluoranthene	600
Fluorene	ND<25
Indeno(1,2,3-c,d)pyrene	420
Naphthalene	ND<25
Phenanthrene	230
Pyrene	720

TABLE 5: **Summary Results of Waste Classification**
Clay Pigeon Debris
Sacramento Trapshooting Club
June 2005

Sample ID	Title 22 Metals (mg/kg)
Composite: CP-01, CP-02, CP-03,CP -04	
Barium	2.8
Antimony	ND<2.0
Arsenic	ND<1.0
Vanadium	ND<1.0
Selenium	ND<2.0
Lead	8.3
Silver	ND<1.0
Zinc	7.2
Thallium	ND<1.0
Chromium	ND<1.0
Copper	1.2
Beryllium	ND<0.50
Cadmium	ND<0.50
Nickel	ND<1.0
Cobalt	ND<1.0
Molybdenum	ND<1.0
Mercury	ND<0.050
Sample ID	**TEPH (mg/kg)**
Composite: CP-01, CP-02, CP-03,CP -04	
Diesel Range Organics	18,000
Motor Oil	71,000
Sample ID	**Fish Bioassay Survival Rate**
STC-CP-01	100%
CP-01	100%
CP-02	100%
CP-03	100%
CP-04	100%

Notes:

mg/L = milligrams per liter

mg/kg = micrograms per kilogram

ND = not reported above the value following the less-than sign.

PAH = polynuclear aromatic hydrocarbons

Laboratory reports are included in Appendix B

[1] Quantification of unknown hydrocarbon(s) in sample based on motor oil.

TABLE 6: **Total Metals in On-Leasehold Soils**
(mg/kg dry weight)
Shooting Range, Parking Lot, Drainage Channel,
Sacramento Trapshooting Club
November 2004

Sample ID	Lead	Arsenic	Antimony	Nickel
Drainage Channel				
STCD-01@0-0.5	8.4	**5.1**	ND<3.9	50
STCD-01@2-2.5	7.9	**3.4**	ND<3.0	42
STCD-02@0-0.5	6.3	**3.3**	ND<3.2	31
STCD-02@2-2.5	4.4	**1.4**	ND<2.1	19
STCD-03@0-0.5	6.6	**2.6**	ND<2.6	30
STCD-03@2-2.5	5.9	**1.9**	ND<3.7	45
STCD-04@0-0.5	7.7	**2.7**	ND<2.4	9.4
STCD-04@2-2.5	7.9	**2.2**	ND<2.2	14
Shooting Range and Parking Lot				
STCB-01@0-0.5	48	--	--	--
STCB-01@2-2.5	6.2	--	--	--
STCB-02@0-0.5	90	--	--	--
STCB-02@2-2.5	7.8	--	--	--
STCB-03@0-0.5	92	--	--	--
STCB-03@2-2.5	7.2	--	--	--
STCB-04@0-0.5	89	--	--	--
STCB-04@2-2.5	8.6	--	--	--
STCB-05@0-0.5	**2,100**	--	--	--
STCB-05@2-2.5	3.9	--	--	--
STCB-06@0-0.5	**790**	--	--	--
STCB-06@2-2.5	4.8	--	--	--
STCB-07@0-0.5	**340**	**4.1**	--	--
STCB-07@1.5-2.0	55	**3.0**	ND<2.3	20
STCB-07@5.5-6	6.7	**1.9**	ND<3.0	24
STCB-08@0-0.5	**4,700**	**36**	**39**	5.3
STCB-08@2-2.5	4.6	**1.3**	ND<1.7	--
STCB-09@0-0.5	**3,100**	--	--	--
STCB-09@2-2.5	5.4[1]	--	--	--
STCB-10@0-0.5	17	--	--	--
STCB-10@2-2.5	4.9	--	--	--
STCB-11@0-0.5	15	**2.5**	--	--
STCB-11@2-2.5	39	**3.6**	ND<3.5	22
STCB-11@5.5-6.0	3.5	**1.8**	ND<3.2	15
STCB-12@0-0.5	**180**	**3.9**	--	--
STCB-12@2-2.5	**520**	**4.2**	7.4	10
STCB-12@5.5-6.0	4.0	**3.0**	ND<2.9	15
STCB-13@0-0.5	7.7	--	--	--
STCB-13@4-4.5	4.3	--	--	--
STCB-14@0-0.5	**5,700**	**33**	30	5.0
STCB-14@2-2.5	15	**2.4**	ND<1.8	--
STCB-15@0-0.5	**5,300**	**28**	22	7.0

TABLE 6: **Total Metals in On-Leasehold Soils**
(mg/kg dry weight)
Shooting Range, Parking Lot, Drainage Channel,
Sacramento Trapshooting Club
November 2004

Sample ID	Lead	Arsenic	Antimony	Nickel
STCB-15@2-2.5	5.9	**1.4**	ND<1.8	--
STCB-16@0-0.5	20	--	--	--
STCB-16@2-2.5	3.6	--	--	--
STCB-17@0-0.5	**200**	--	--	--
STCB-17@2-2.5	5.4	--	--	--
STCB-18@0-0.5	**410**	**7.9**	--	--
STCB-18@2-2.5	27	**2.7**	ND<2.7	18
STCB-18@5.5-6.0	4.8	**1.4**	ND<3.0	7.3
STCB-19@0-0.5	97	--	--	--
STCB-19@2-2.5	4.3	--	--	--
STCB-20@0-0.5	**9,000**	**49**	**55**	5.9
STCB-20@2-2.5	17	**3.5**	ND<2.8	--
STCB-21@0-0.5	**1,000**	--	--	--
STCB-21@2-2.5	9.6	--	--	--
STCB-22@0-0.5	**1,900**	--	--	--
STCB-22@2-2.5	19	--	--	--
STCB-23@0-0.5	24	--	--	--
STCB-23@2-2.5	3.7	--	--	--
STCB-24@0-0.5	4.4	--	--	--
STCB-24@2-2.5	4.3	--	--	--
Residential PRGs	150[2] nc	0.062 [2] ca	31 nc	1,600 nc
Industrial PRGs	800 nc	0.25 [2] ca	410 nc	20,000 nc

Notes: ca = based on cancer risk
Metals analyzed by EPA Method 6010
mg/kg = milligrams per kilogram
NA = not available
nc = based on non-cancer risk
ND = not detected above the value following the less-than sign.
PRGs = U.S. EPA Region IX Preliminary Remediation Goals (U.S. EPA
x.x = values exceed industrial PRGs
-- = Not analyzed
Industrial PRGs are for commercial or industrial land use
Residential PRGs are for residential land use
Samples collected on 8 and 9 November 2004.
Shaded cells contain values that exceed the industrial PRGs
Sampling locations are shown on Figure 6.

[1] Results were not reported in dry weight due to laboratory error. Based on the moisture content of the other samples, the results on a dry weight basis are likely to be between 3 and 30 percent higher, or range from 5.6 to 7.0 mg/kg.
[2] California modified PRGs using California Environmental Protection Agency toxicity values.

TABLE 7: **PAHs in On-Leasehold Soils**
(mg/kg dry weight)
Shooting Range, Parking Lot, and Drainage Channel
Sacramento Trapshooting Club
November 2004

				Sample ID	**STCD-01@0-0.5**	**STCD-01@2-2.5**	**STCD-02@0-0.5**	**STCD-02@2-2.5**	**STCD-03@0-0.5**	**STCD-03@2-2.5**
Analyte	**Residential PRGs**		**Industrial PRGs**		**Drainage Channel**					**I**
Acenaphthene	3,700	nc	29,000	nc	ND<0.041	ND<0.04	ND<0.041	ND<0.04	ND<0.042	ND<0.042
Acenaphthylene	NA		NA		ND<0.082	ND<0.081	ND<0.081	ND<0.08	ND<0.085	ND<0.083
Anthracene	22,000	nc	100,000	max	0.0052	ND<0.004	ND<0.0041	ND<0.004	ND<0.0042	ND<0.0042
Benzo(a)anthracene	0.62	ca	2.1	ca	0.028	ND<0.004	ND<0.0041	ND<0.004	ND<0.0042	ND<0.0042
Benzo(a)pyrene	0.062	ca	0.21	ca	0.041	ND<0.004	ND<0.0041	ND<0.004	ND<0.0042	ND<0.0042
Benzo(b)fluoranthene	0.62	ca	2.1	ca	0.053	ND<0.0081	ND<0.0081	ND<0.008	ND<0.0085	ND<0.0083
Benzo(g,h,i)perylene	NA		NA		0.029	ND<0.0081	ND<0.0081	ND<0.008	ND<0.0085	ND<0.0083
Benzo(k)fluoranthene	0.38	ca [1]	1.3	ca [1]	ND<0.0041	ND<0.004	ND<0.0041	ND<0.004	ND<0.0042	ND<0.0042
Chrysene	3.8	ca [1]	13	ca [1]	0.029	ND<0.004	ND<0.0041	ND<0.004	ND<0.0042	ND<0.0042
Dibenz(a,h)anthracene	0.062	ca	0.21	ca	0.036	0.019	ND<0.0081	ND<0.008	ND<0.0085	ND<0.0083
Fluoranthene	2,300	nc	22,000	nc	0.034	ND<0.0081	ND<0.0081	ND<0.008	ND<0.0085	ND<0.0083
Fluorene	2,700	nc	26,000	nc	ND<0.0082	ND<0.0081	ND<0.0081	ND<0.008	ND<0.0085	ND<0.0083
Indeno(1,2,3-cd)pyrene	0.62	ca	2.1	ca	0.035	ND<0.004	ND<0.0041	ND<0.004	ND<0.0042	ND<0.0042
Naphthalene	1.7	nc	4.2	nc	ND<0.041	ND<0.04	ND<0.041	ND<0.04	ND<0.042	ND<0.042
Phenanthrene	NA		NA		0.018	0.0079	ND<0.0041	ND<0.004	ND<0.0042	ND<0.0042
Pyrene	2,300	nc	29,000	nc	0.041	ND<0.004	ND<0.0041	ND<0.004	ND<0.0042	ND<0.0042
Total PAHs					0.349	0.027	ND	ND	ND	ND

TABLE 7: **PAHs in On-Leasehold Soils**
(mg/kg dry weight)
Shooting Range, Parking Lot, and Drainage Channel
Sacramento Trapshooting Club
November 2004

				Sample ID	**STCD-04@0-0.5**	**STCD-04@2-2.5**	**STCB-01@0-0.5**	**STCB-02@0-0.5**	**STCB-02@2-2.5**	**STCB-03@0-0.5**
Analyte	**Residential PRGs**		**Industrial PRGs**		**Drainage Channel**		**Shooting Range and Parking Lot**			**Shooti**
Acenaphthene	3,700	nc	29,000	nc	ND<0.8	ND<0.038	ND<1.7	ND<7.8	ND<0.038	ND<0.23
Acenaphthylene	NA		NA		ND<1.6	ND<0.076	ND<3.5	ND<16	ND<0.076	ND<0.46
Anthracene	22,000	nc	100,000	max	ND<0.08	ND<0.0038	0.18	7.5	0.014	0.041
Benzo(a)anthracene	0.62	ca	2.1	ca	0.084	ND<0.0038	**0.91**	**31**	0.079	0.25
Benzo(a)pyrene	0.062	ca	0.21	ca	**0.17**	0.0046	**2.6**	**36**	**0.13**	**0.47**
Benzo(b)fluoranthene	0.62	ca	2.1	ca	ND<0.16	ND<0.0076	**1.5**	**41**	0.13	0.45
Benzo(g,h,i)perylene	NA		NA		0.20	0.0076	1.9	18	0.11	0.38
Benzo(k)fluoranthene	0.38	ca [1]	1.3	ca [1]	0.087	ND<0.0038	**0.74**	**19**	0.06	0.21
Chrysene	3.8	ca [1]	13	ca [1]	0.11	0.0042	1.3	**31**	0.085	0.29
Dibenz(a,h)anthracene	0.062	ca	0.21	ca	**0.20**	0.013	**10**	**21**	**0.10**	**0.33**
Fluoranthene	2,300	nc	22,000	nc	ND<0.16	ND<0.0076	0.62	45	0.094	0.31
Fluorene	2,700	nc	26,000	nc	ND<0.16	ND<0.0076	ND<0.35	ND<1.6	ND<0.0076	ND<0.046
Indeno(1,2,3-cd)pyrene	0.62	ca	2.1	ca	0.097	0.007	0.39	**23**	0.08	0.3
Naphthalene	1.7	nc	4.2	nc	ND<0.8	ND<0.038	ND<1.7	**14**	ND<0.038	ND<0.23
Phenanthrene	NA		NA		ND<0.08	0.0065	0.43	28	0.044	0.12
Pyrene	2,300	nc	29,000	nc	0.12	0.0046	0.86	48	0.11	0.37
Total PAHs					1.07	0.048	21	363	1.0	3.5

TABLE 7: **PAHs in On-Leasehold Soils**
(mg/kg dry weight)
Shooting Range, Parking Lot, and Drainage Channel
Sacramento Trapshooting Club
November 2004

					Sample ID	**STCB-04@0-0.5**	**STCB-05@0-0.5**	**STCB-06@0-0.5**	**STCB-07@0-0.5**	**STCB-07@1.5-2.0**	**STCB-08@0-0.5**
Analyte	**Residential PRGs**		**Industrial PRGs**		**ng Range and Parking Lot**				**Shooting Range and Park**		
Acenaphthene	3,700	nc	29,000	nc		ND<0.4	ND<0.036	ND<0.047	ND<7.1	ND<14	ND<0.039
Acenaphthylene	NA		NA			ND<0.8	ND<0.073	ND<0.094	ND<14	ND<27	ND<0.077
Anthracene	22,000	nc	100,000	max		0.18	0.004	0.0092	ND<0.71	6.1	ND<0.0039
Benzo(a)anthracene	0.62	ca	2.1	ca		**1.1**	0.012	0.073	**6.7**	**26**	0.007
Benzo(a)pyrene	0.062	ca	0.21	ca		**2.2**	0.022	**0.12**	**10**	**46**	0.014
Benzo(b)fluoranthene	0.62	ca	2.1	ca		**2.0**	0.018	0.12	**11**	**40**	0.01
Benzo(g,h,i)perylene	NA		NA			1.6	0.02	0.095	6.6	23	0.015
Benzo(k)fluoranthene	0.38	ca [1]	1.3	ca [1]		**1.0**	0.0099	0.056	**5.1**	**21**	0.006
Chrysene	3.8	ca [1]	13	ca [1]		1.3	0.014	0.082	**6.9**	**29**	0.0084
Dibenz(a,h)anthracene	0.062	ca	0.21	ca		**1.6**	0.012	**0.083**	**6.6**	**220**	0.017
Fluoranthene	2,300	nc	22,000	nc		1.1	0.014	0.1	7.7	29	ND<0.0077
Fluorene	2,700	nc	26,000	nc		ND<0.08	ND<0.0073	ND<0.0094	ND<1.4	ND<2.7	ND<0.0077
Indeno(1,2,3-cd)pyrene	0.62	ca	2.1	ca		**1.9**	0.014	0.11	**8.2**	**22**	0.016
Naphthalene	1.7	nc	4.2	nc		ND<0.4	ND<0.036	ND<0.047	ND<7.1	ND<14	ND<0.039
Phenanthrene	NA		NA			0.51	0.0069	0.029	ND<0.71	16	ND<0.0039
Pyrene	2,300	nc	29,000	nc		1.5	0.017	0.11	9.1	34	0.0083
Total PAHs						16	0.16	1.0	78	512	0.10

TABLE 7: **PAHs in On-Leasehold Soils**
(mg/kg dry weight)
Shooting Range, Parking Lot, and Drainage Channel
Sacramento Trapshooting Club
November 2004

					Sample ID	**STCB-10@0-0.5**	**STCB-11@0-0.5**	**STCB-12@0-0.5**	**STCB-12@2-2.5**	**STCB-13@0-0.5**	**STCB-14@0-0.5**
Analyte	**Residential PRGs**		**Industrial PRGs**		**ing Lot**			**Shooting Range and Parking Lot**			
Acenaphthene	3,700	nc	29,000	nc	ND<0.041	ND<0.039		ND<7.4	ND<36	ND<3.7	ND<0.035
Acenaphthylene	NA		NA		ND<0.081	ND<0.078		ND<15	ND<72	ND<7.3	ND<0.071
Anthracene	22,000	nc	100,000	max	ND<0.0041	0.0041		1.9	21	ND<0.37	ND<0.0035
Benzo(a)anthracene	0.62	ca	2.1	ca	0.0089	0.011		**12**	**70**	**5.3**	0.0099
Benzo(a)pyrene	0.062	ca	0.21	ca	0.015	0.018		**20**	**96**	**9.7**	0.015
Benzo(b)fluoranthene	0.62	ca	2.1	ca	0.015	0.018		**21**	**90**	**8.2**	0.016
Benzo(g,h,i)perylene	NA		NA		0.017	0.017		14	44	5.8	0.017
Benzo(k)fluoranthene	0.38	ca [1]	1.3	ca [1]	0.0072	0.0077		**9.7**	**43**	**4.2**	0.0072
Chrysene	3.8	ca [1]	13	ca [1]	0.0096	0.013		**13**	**68**	**6.0**	0.012
Dibenz(a,h)anthracene	0.062	ca	0.21	ca	0.012	0.015		**9.9**	**380**	**5.8**	ND<0.0071
Fluoranthene	2,300	nc	22,000	nc	0.01	0.013		17	91	5.8	0.0099
Fluorene	2,700	nc	26,000	nc	ND<0.0081	ND<0.0078		ND<1.5	ND<7.2	ND<0.73	ND<0.0071
Indeno(1,2,3-cd)pyrene	0.62	ca	2.1	ca	0.012	0.013		**15**	**39**	**7.8**	0.01
Naphthalene	1.7	nc	4.2	nc	ND<0.041	ND<0.039		ND<7.4	ND<36	ND<3.7	ND<0.035
Phenanthrene	NA		NA		0.0083	0.0075		9.5	56	ND<0.37	0.0063
Pyrene	2,300	nc	29,000	nc	0.013	0.016		20	100	7.3	0.014
Total PAHs					0.13	0.15		163	1,098	66	0.12

TABLE 7: **PAHs in On-Leasehold Soils**
(mg/kg dry weight)
Shooting Range, Parking Lot, and Drainage Channel
Sacramento Trapshooting Club
November 2004

					Sample ID	**STCB-16@0-0.5**	**STCB-17@0-0.5**	**STCB-18@0-0.5**	**STCB-18@2-2.5**	**STCB-19@0-0.5**	**STCB-20@0-0.5**
Analyte	**Residential PRGs**		**Industrial PRGs**			**Shooting Range and Parking Lot**					
Acenaphthene	3,700	nc	29,000	nc	ND<0.034	ND<0.035	ND<4.1	ND<7.2	ND<0.37	ND<0.04
Acenaphthylene	NA		NA		ND<0.069	ND<0.07	ND<8.1	ND<14	ND<0.74	ND<0.079
Anthracene	22,000	nc	100,000	max	0.022	ND<0.0035	ND<0.41	0.8	ND<0.037	ND<0.004
Benzo(a)anthracene	0.62	ca	2.1	ca	0.14	0.0068	**6.4**	**3.5**	0.14	ND<0.004
Benzo(a)pyrene	0.062	ca	0.21	ca	**0.29**	0.0066	**12**	**7.9**	**0.27**	ND<0.004
Benzo(b)fluoranthene	0.62	ca	2.1	ca	0.27	0.013	**12**	**6.7**	0.22	ND<0.0079
Benzo(g,h,i)perylene	NA		NA		0.24	ND<0.007	9.1	6.3	0.24	ND<0.0079
Benzo(k)fluoranthene	0.38	ca [1]	1.3	ca [1]	0.13	ND<0.0035	**5.7**	**3.2**	0.12	ND<0.004
Chrysene	3.8	ca [1]	13	ca [1]	0.18	0.025	**7.4**	**4.4**	0.16	ND<0.004
Dibenz(a,h)anthracene	0.062	ca	0.21	ca	**0.17**	0.043	**8.2**	**43**	**0.18**	ND<0.0079
Fluoranthene	2,300	nc	22,000	nc	0.18	0.011	8.0	2.7	0.14	ND<0.0079
Fluorene	2,700	nc	26,000	nc	ND<0.0069	ND<0.007	ND<0.81	ND<1.4	ND<0.074	ND<0.0079
Indeno(1,2,3-cd)pyrene	0.62	ca	2.1	ca	0.17	0.0045	**10**	**4.7**	0.19	ND<0.004
Naphthalene	1.7	nc	4.2	nc	ND<0.034	ND<0.035	ND<4.1	ND<7.2	ND<0.37	ND<0.04
Phenanthrene	NA		NA		0.089	ND<0.0035	4.3	ND<0.72	0.077	ND<0.004
Pyrene	2,300	nc	29,000	nc	0.21	0.0061	9.5	3.6	0.19	ND<0.004
Total PAHs					2.1	0.12	93	87	1.9	ND

TABLE 7: **PAHs in On-Leasehold Soils**
(mg/kg dry weight)
Shooting Range, Parking Lot, and Drainage Channel
Sacramento Trapshooting Club
November 2004

					Sample ID	**STCB-21@0-0.5**	**STCB-22@0-0.5**	**STCB-23@0-0.5**	**STCB-24@0-0.5**
Analyte	**Residential PRGs**		**Industrial PRGs**		**Shooting Range and Parking Lot**				
Acenaphthene	3,700	nc	29,000	nc		ND<0.037	ND<0.74	ND<0.038	ND<0.036
Acenaphthylene	NA		NA			ND<0.074	ND<1.5	ND<0.076	ND<0.072
Anthracene	22,000	nc	100,000	max		ND<0.0037	0.43	ND<0.0038	ND<0.0036
Benzo(a)anthracene	0.62	ca	2.1	ca		0.013	**1.9**	0.0052	0.011
Benzo(a)pyrene	0.062	ca	0.21	ca		0.021	**2.4**	0.011	0.017
Benzo(b)fluoranthene	0.62	ca	2.1	ca		0.02	**3.1**	0.01	0.013
Benzo(g,h,i)perylene	NA		NA			0.022	1.4	ND<0.0076	0.016
Benzo(k)fluoranthene	0.38	ca [1]	1.3	ca [1]		0.01	**1.4**	0.0078	0.0072
Chrysene	3.8	ca [1]	13	ca [1]		0.016	2.1	0.0082	0.013
Dibenz(a,h)anthracene	0.062	ca	0.21	ca		**0.18**	**1.5**	0.032	0.012
Fluoranthene	2,300	nc	22,000	nc		0.013	3.2	ND<0.0076	0.012
Fluorene	2,700	nc	26,000	nc		ND<0.0074	ND<0.15	ND<0.0076	ND<0.0072
Indeno(1,2,3-cd)pyrene	0.62	ca	2.1	ca		0.016	**1.7**	0.0046	0.018
Naphthalene	1.7	nc	4.2	nc		ND<0.037	1.0	ND<0.038	ND<0.036
Phenanthrene	NA		NA			ND<0.0037	1.7	0.0059	0.0076
Pyrene	2,300	nc	29,000	nc		0.017	3.3	0.0087	0.016
Total PAHs						0.33	25	0.093	0.14

Notes:

x.x = values equal or exceed residential PRGs

ca = based on cancer risk

nc = based on non-cancer risk

mg/kg = micrograms per kilogram

NA = not available

ND = not reported above the value following the less-than sign.

PAH = polynuclear aromatic hydrocarbons

PRGs = U.S. EPA Region IX, Preliminary Remediation Goals for Residential Land Use

Industrial PRGs are for commercial or industrial land use

PAHs analyzed by EPA Method 8310

Samples collected on 8 and 9 November 2004.

Shaded cells contain values that equal or exceed the industrial PRGs

Sampling locations are shown on Figure 6.

[1] California modified PRGs using California Environmental Protection Agency toxicity values.

TABLE 8: **Evaluation of Alternatives**
Sacramento Trapshooting Club

Alternative	Effectiveness	Implementability	Compliance with ARARs	Cost
1: No Action	Would not be effective in reducing risks to users of the site under current or future development conditions.	No actions would occur.	Would not comply with chemical-specific ARARs.	None (except any potential incremental development costs due to health and safety requirements for future construction and utility workers and soil management)
2: Excavation and Off-site Disposal	Short-and long-term effectiveness by removal of all contaminated materials from the site.	Would employ known technology with trained workers.	Would comply with applicable chemical-, location-, and action-specific ARARs	$8.18 million
3: Thermal Desorption	Short- and long-term effectiveness in remediating PAHs in soil, Not effective in remediating metals in soil.	Known technology that is implementable.	Would achieve reduction in toxicity of PAHs but would not meet chemical-specific ARARs for metals.	$34.77 million; would need to be combined with IC/ECs.
4: Soil Washing	Short- and long-term effectiveness in remediating both PAHs and metals.	Known technology that is implementable.	Would comply with applicable chemical-, location-, and action-specific ARARs.	$8.1 million
5: Soil Stabilization	Effective in stabilizing metals, but not effective for stabilizing PAHs.	Known technology for metals stabilization.	Would not comply with chemical-specific ARARs for PAHs.	$17.35 million; would need to be combined with IC/ECs
6: Soil Solidification	Short-term effectiveness in immobilizing contaminants; in the long-term the solidification agent may weather reducing the ability for the contaminants to remain immobilized.	Known technology that is implementable.	Would comply with applicable chemical-, location-, and action-specific ARARs.	$9.54; would need to be combined with IC/ECs
7A: IC/EC with clean fill	Effective in protection of public health.	The City has in-place administrative controls to implement the IC/ECs.	Would comply with applicable ARARs.	$6.27 million
7B: IC/EC with Reuse of Clay Pigeon Debris	Effective in protection of pubic health.	The City has in-place administrative controls to implement the IC/ECs.	Would comply with applicable ARARs.	$6.19 million
8: Consolidation and EC/IC	Effective in protection of pubic health.	The City has in-place administrative controls to implement the IC/ECs.	Would comply with applicable ARARs.	??

TABLE 9: **Cost Estimate**
Alternative 2: Soil Excavation and Off-Site Disposal
Sacramento Trapshooting Club

Quantities	Source		
Shooting range area [1]		18	acres
Depth of soil excavation		2	feet
Volume of excavation [2]		52,662	cy
Mass of excavation [3]		78,993	tons
Fill Volume [4]		138,808	cy
Clay Pigeon Debris			
Area [5]		73,150	ft^2
Depth		5	feet
Volume		13,546	cy
Mass [6]		3,725	tons

Task			Unit Cost	Unit	Amount		Total
Loading clay pigeons	a	$	6.00	cy	13,546	$	81,278
Removal and off-haul of clay pigeons [7]	a	$	45	ton	3,725	$	167,635
Health and Safety	b	$	10,000	ls	1	$	10,000
Excavation of soil [8]	a	$	3.66	cy	52,662	$	192,742
Waste profiling [9]	a	$	300	1,000/cy	53	$	15,799
Off-haul and disposal of soil [10]	a	$	75	ton	78,993	$	5,924,443
Confirmation sampling [11]	a	$	500	each	39	$	19,603
Import clean soil [12]	b	$	9.69	cy	138,808	$	1,345,052
Final grading [13]	b	$	0.21	sqy	87,120	$	18,374
Soil density testing, nuclear method	b	$	42.50	ea	139	$	5,899
Closure report	a	$	10,000	ls	1	$	10,000
Project Management (5% of project costs)						$	389,541
Remediation Total [14]						$	8,180,365

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[1] The area of the Site minus the parking lot.
[2] Area of excavation in the shooting range does not include the clay pigeon debris area.
[3] One cubic yard of soil equals 1.5 tons.
[4] These costs include bringing the site grade up the level of the parking lot; volume estimated to be volume of soil excavated plus soil to bring one-half of the Site and the clay pigeon area an average of five feet.
[5] The area shown on Figure 3 plus ten percent.
[6] One cubic yard of clay pigeon equals 0.275 tons.
[7] Transport and disposal at Class II landfill as non-hazardous waste.
[8] Crawler mounted hydraulic excavator with two cy bucket, excavate and load.
[9] Includes sampling, analyses, and reporting.
[10] Transport and disposal as non-RCRA hazardous waste.
[11] Includes sample collection, chemical analyses.
[12] Unclassified fill, 6-inch lifts, includes delivery, spreading, and compaction.
[13] Two Passes
[14] This alternative does not include paving the site.

Notes:
cy = cubic yard
ls = lump sum
sqyd = square yard
ft^2 = square feet
a = Engineer's estimate
b = RS Means

TABLE 10: **Cost Estimate**
Alternative 3: Thermal Desorption
Sacramento Trapshooting Club

Quantities	Source		
Shooting range area [1]		18	acres
Depth of impacted soil		2	feet
Volume of soil to be treated [2]		52,662	cy
Mass of soil to be treated [3]		78,993	tons
Fill volume [4]		86,147	cy
Clay Pigeon Debris			
Area [5]		73,150	ft^2
Depth		5	feet
Volume		13,546	cy
Mass [6]		3,725	tons

Task			Unit Cost	Unit	Amount		Total
Loading clay pigeons	a	$	6.00	cy	13,546	$	81,278
Removal and off-haul of clay pigeons [7]	a	$	45	ton	3,725	$	167,635
Health and Safety	a	$	10,000	ls	1	$	10,000
Excavation of soil [8]	b	$	3.66	cy	52,662	$	192,742
Permitting/Trial Burn/Engineering	b	$	130,659	each	1	$	130,659
Mobilization/Demobilization	b	$	457,000	each	1	$	457,000
Rotary kiln incinerator, operation	b	$	330	ton	78,993	$	26,067,548
Replace soil	a	$	8	cy	52,662	$	421,294
Confirmation sampling [9]	a	$	500	each	25	$	12,500
Import clean soil [10]	b	$	9.69	cy	86,147	$	834,760
Final grading [11]	b	$	0.21	sqy	87,120	$	18,374
Soil density testing, nuclear method [12]	b	$	42.50	ea	86	$	3,661
Construction of cap [13]	c	$	6.00	ft^2	784,083	$	4,704,499
Closure report	a	$	10,000	ls	1	$	10,000
Project Management (5% of project costs)						$	1,655,597
Remediation Total [14]						$	34,767,547

Assumptions:

[1] The area of the Site minus the parking lot.
[2] Area of excavation in the shooting range does not include the clay pigeon debris area.
[3] One cubic yard of soil equals 1.5 tons.
[4] These costs include bringing the site grade up the level of the parking lot; volume estimated to be volume of soil excavated plus soil to bring one-half of the Site and the clay pigeon area up five feet.
[5] The area shown on Figure 3 plus ten percent.
[6] One cubic yard of clay pigeon equals 0.275 tons.
[7] Transport and disposal at Class II landfill as non-hazardous waste.
[8] Crawler mounted hydraulic excavator with one cy bucket, excavate and load.
[9] Includes sampling, analyses, and reporting.
[10] Unclassified fill, 6-inch lifts, includes delivery, spreading, and compaction.
[11] Two Passes
[12] ASTM D2922-71, one test per 1,000 cy
[13] Four inches of asphalt concrete over four inches of aggregate base, surface treated with water sealant.
[14] This estimate does not include additional IC/EC requirements for residual metals in the soil.

Notes:
cy = cubic yard
ls = lump sum
sqyd = square yard
ft^2 = square feet
a = Engineer's estimate
b = RS Means
c = City estimate

TABLE 11: **Cost Estimate**
Alternative 4: Soil Washing
Sacramento Trapshooting Club

Quantities	Source		
Shooting range area [1]		18	acres
Depth of impacted soil		2	feet
Volume of soil to be treated [2]		52,662	cy
Mass of soil to be treated [3]		78,993	tons
Fill volume [4]		86,147	cy
Clay Pigeon Debris			
Area [5]		73,150	ft^2
Depth		5	feet
Volume		13,546	cy
Mass [6]		3,725	tons

Task			Unit Cost	Unit	Amount		Total
Loading clay pigeons [7]	a	$	6.00	cy	13,546	$	81,278
Removal and off-haul of clay pigeons [8]	a	$	45	ton	3,725	$	167,635
Health and Safety	a	$	10,000	ls	1	$	10,000
Excavation of material [9]	b	$	2.54	cy	52,662	$	133,861
Pilot Test	a	$	50,000	each	1	$	50,000
Mobilization/Demobilization	b	$	28,506	each	1	$	28,506
Startup/Shakedown	b	$	17,025	each	1	$	17,025
Soil washing treatment [10]	b	$	80.28	ton	78,993	$	6,341,524
Decontaminate Soil Washing System	b	$	240.22	each	1	$	240
Confirmation sampling [11]	a	$	500	each	25	$	12,500
Import clean soil [12]	b	$	9.69	cy	86,147	$	834,760
Final grading [13]	b	$	0.21	sqy	87,120	$	18,374
Soil density testing, nuclear method [14]	b	$	42.50	ea	86	$	3,661
Closure report	a	$	10,000	ls	1	$	10,000
Project Management (5% of project costs)						$	385,468
Remediation Total [15]						$	8,094,832

Assumptions:

[1] The area of the Site minus the parking lot.
[2] Area of excavation in the shooting range does not include the clay pigeon debris area.
[3] One cubic yard of soil equals 1.5 tons.
[4] These costs include bringing the site grade up the level of the parking lot; volume estimated to be volume of soil excavated plus soil to bring one-half of the Site and the clay pigeon area up five feet.
[5] The area shown on Figure 3 plus ten percent.
[6] One cubic yard of clay pigeon equals 0.275 tons.
[7] Includes sample collection, chemical analyses, and bioassay.
[8] Transport and disposal at Class II landfill.
[9] Crawler mounted hydraulic excavator with two cy bucket.
[10] Including residual water.
[11] Includes sampling, analyses, and reporting.
[12] Unclassified fill, 6-inch lifts, includes delivery, spreading, and compaction.
[13] Two Passes
[14] ASTM D2922-71, one test per 1,000 cy
[15] This alternative does not include paving the site.

Notes:
cy = cubic yard
ls = lump sum
sqyd = square yard
ft^2 = square feet
a = Engineer's estimate
b = RS Means
c = City estimate

TABLE 12: **Cost Estimate**
Alternative 5: Soil Stabilization
Sacramento Trapshooting Club

Quantities	Source		
Shooting range area [1]		18	acres
Depth of impacted soil		2	feet
Volume of soil to be treated [2]		52,662	cy
Mass of soil to be treated [3]		78,993	tons
Fill volume [4]		86,147	cy
Clay Pigeon Debris			
Area [5]		73,150	ft^2
Depth		5	feet
Volume		13,546	cy
Mass [6]		3,725	tons

Task			Unit Cost	Unit	Amount		Total
Loading clay pigeons	a	$	6.00	cy	13,546	$	81,278
Removal and off-haul of clay pigeons [7]	a	$	45	ton	3,725	$	167,635
Health and Safety	a	$	10,000	ls	1	$	10,000
Soil Stabilization [8]	b	$	203.04	cy	52,662	$	10,692,434
Confirmation Sampling [9]	a	$	555	each	25	$	13,875
Import Clean Soil [10]	b	$	9.69	cy	86,147	$	834,760
Final Grading [11]	b	$	0.21	sqy	87,120	$	18,374
Soil density testing, nuclear method [12]	b	$	42.50	ea	86	$	3,661
Construction of cap [13]	c	$	6.00	ft^2	784,083	$	4,704,499
Closure Report	b	$	10,000	ls	1	$	10,000
Project Management (5% of project costs)						$	826,826
Remediation Total						$	17,363,342

Assumptions:

[1] The area of the Site minus the parking lot.
[2] Area of excavation in the shooting range does not include the clay pigeon debris area.
[3] One cubic yard of soil equals 1.5 tons.
[4] These costs include bringing the site grade up the level of the parking lot; volume estimated to be volume of soil required to bring one-half of the Site and the clay pigeon area up five feet.
[5] The area shown on Figure 3 plus ten percent.
[6] One cubic yard of clay pigeon equals 0.275 tons.
[7] Transport and disposal at Class II landfill as non-hazardous waste.
[8] Lime Stabilization with grader.
[9] Includes sampling, analyses, and reporting.
[10] Unclassified fill, 6-inch lifts, includes delivery, spreading, and compaction.
[11] Two passes.
[12] ASTM D2922-71, one test per 1,000 cy
[13] Four inches of asphalt concrete over four inches of aggregate base, surface treated with water sealant.

Notes:
cy = cubic yard
ls = lump sum
sqyd = square yard
ft^2 = square feet
a = Engineer's estimate
b = RS Means

TABLE 13: **Cost Estimate**
Alternative 6: Soil Solidification
Sacramento Trapshooting Club

Quantities	Source		
Shooting range area [1]		18	acres
Depth of impacted soil		2	feet
Volume of soil to be treated [2]		52,662	cy
Mass of soil to be treated [3]		78,993	tons
Fill volume [4]		86,147	cy
Clay Pigeon Debris			
Area [5]		73,150	ft^2
Depth		5	feet
Volume		13,546	cy
Mass [6]		3,725	tons

Task			Unit Cost	Unit	Amount		Total
Loading clay pigeons	a	$	6.00	cy	13,546	$	81,278
Removal and off-haul of clay pigeons [7]	a	$	45	ton	3,725	$	167,635
Health and Safety	a	$	10,000	ls	1	$	10,000
Bench scale test	a	$	20,000	ls	1	$	20,000
Mobilization/Demobilization	b	$	1,047	ls	1	$	1,047
Soil solidification [8]	c	$	60	cy	52,662	$	3,159,703
Performance testing [9]	a	$	750	cy	105	$	78,993
Import clean soil [10]	b	$	9.69	cy	86,147	$	834,760
Final grading [11]	b	$	0.21	sqy	87,120	$	18,374
Soil density testing, nuclear method [12]	b	$	42.50	ea	86	$	3,661
Construction of cap [13]	d	$	6.00	ft^2	784,083	$	4,704,499
Closure report	a	$	10,000	ls	1	$	10,000
Project Management (5% of project costs)						$	454,497
Remediation Total						$	9,544,447

Assumptions:

[1] The area of the Site minus the parking lot.
[2] Area of excavation in the shooting range does not include the clay pigeon debris area.
[3] One cubic yard of soil equals 1.5 tons.
[4] These costs include bringing the site grade up the level of the parking lot; volume estimated to be volume of soil excavated plus soil to bring one-half of the Site and the clay pigeon area up five feet.
[5] The area shown on Figure 3 plus ten percent.
[6] One cubic yard of clay pigeon equals 0.275 tons.
[7] Transport and disposal at Class II landfill as non-hazardous waste.
[8] Auger/Caisson and Reagent/Injector Head System.
[9] Includes sampling, analyses, and reporting.
[10] Unclassified fill, 6-inch lifts, includes delivery, spreading, and compaction.
[11] Two Passes
[12] ASTM D2922-71, one test per 1,000 cy
[13] Four inches of asphalt concrete over four inches of aggregate base, surface treated with water sealant.

Notes:
cy = cubic yard
ls = lump sum
sqyd = square yard
ft^2 = square feet
a = Engineer's estimate
b = RS Means
c = www.sludgestabilization.com
d = City estimate

TABLE 14: **Cost Estimate**
Alternative 7A: Capping, Clean Fill Import
Sacramento Trapshooting Club

Quantities	Source		
Shooting range area [1]		18	acres
Fill volume [2]		86,147	cy
Clay Pigeon Debris			
Area [3]		73,150	ft^2
Depth		5	feet
Volume		13,546	cy
Mass [4]		3,725	tons

Task			Unit Cost	Unit	Amount		Total
Loading clay pigeons	a	$	6.00	cy	13,546	$	81,278
Removal and off-haul of clay pigeons [5]	a	$	45	ton	3,725	$	167,635
Health and Safety	a	$	10,000	ls	1	$	10,000
Import clean soil [6]	b	$	9.69	cy	86,147	$	834,760
Final grading [7]	b	$	0.21	sqy	87,120	$	18,374
Soil density testing, nuclear method [8]	b	$	42.50	ea	86	$	3,661
Soil disposal - utility trenches [9]	a	$	100	ton	833	$	83,333
Import clean soil for utility trenches [10]	b	$	9.69	cy	779	$	7,546
Construction of cap [11]	c	$	6.00	ft^2	784,083	$	4,704,499
Closure report	a	$	10,000	ls	1	$	10,000
Project management (5% of project costs)						$	283,609
Remediation Total						$	6,123,418
Future Cost - 20 Years							Worth [12]
Incremental Health and Safety cost	a	$	2,500	yr	20		$38,017
Incremental soil disposal cost [13]	a	$	100	ton/yr	3,333		$30,414
Import clean soil for utility trenches [10]	b	$	9.69	ton/yr	3,279		$2,947
Cap inspections [14]	a	$	5,000	yr	20		$76,034
Future cost subtotal						$	147,412
TOTAL						$	6,270,830

Assumptions:

[1] The area of the Site minus the parking lot.
[2] These costs include bringing the site grade up the level of the parking lot, fill volume estimated to be the volume of soil necessary to bring one-half of the site and the clay pigeon area up five feet.
[3] The area shown on Figure 3 plus ten percent.
[4] One cubic yard of clay pigeon equals 0.275 tons.
[5] Transport and disposal at Class II landfill as non-hazardous waste.
[6] Unclassified fill, 6-inch lifts, includes delivery, spreading, and compaction.
[7] Two passes.
[8] ASTM D2922-71, one test per 1,000 cy.
[9] Assumes 2,500 ft by 3 ft by 2 ft of impacted trench soil, which will be California hazardous waste.
[10] Assumes 2-inch utility pipe.
[11] Four inches of asphalt concrete over four inches of aggregate base, surface treated with water sealant.
[12] Assumes 3 percent discount rate.
[13] Assume one 500 ft by 2 ft by 3 ft trench per year, which will be California hazardous waste.
[14] Once a year with written summary report to County.

Notes:
cy = cubic yard
ls = lump sum

Notes:
cy = cubic yard
ls = lump sum
sqy = square yard
ft = feet
ft^2 = square feet
a = Engineer's Estimate
b = RS Means
c = Estimate from City

TABLE 15: **Cost Estimate**
Alternative 7B: Capping, Reuse of Clay Pigeon Debris
Sacramento Trapshooting Club

Quantities	Source		
Shooting range area [1]		18	acres
Fill volume [2]		72,600	cy
Clay Pigeon Debris			
Area [3]		73,150	ft^2
Depth		5	feet
Volume		13,546	cy
Mass [4]		3,725	tons

Task			Unit Cost	Unit	Amount		Total
Health and Safety	a	$	10,000	ls	1	$	10,000
Import clean soil [5]	b	$	9.69	cy	72,600	$	703,497
Soil and clay pigeon mixing [6]	a	$	12	cy	17,610	$	211,322
Final grading [7]	b	$	0.21	sqy	87,120	$	18,374
Soil density testing, nuclear method [8]	b	$	42.50	ea	73	$	3,086
Soil disposal - utility trenches [9]	a	$	100	ton	833	$	83,333
Import clean soil for utility trenches [10]	b	$	9.69	cy	779	$	7,546
Construction of cap [11]	c	$	6.00	ft^2	784,083	$	4,704,499
Closure report	a	$	10,000	ls	1	$	10,000
Project management (5% of project costs)						$	287,583
Remediation Total						$	6,039,240
Future Cost - 20 Years							Net Present Worth [13]
Incremental Health and Safety cost	a	$	2,500	yr	20		$38,017
Incremental soil disposal cost [13]	a	$	100	ton/yr	3,333		$30,414
Import clean soil for utility trenches [10]	b	$	9.69	ton/yr	3,279		$2,947
Cap inspections [14]	a	$	5,000	yr	20		$76,034
Future cost subtotal						$	147,412
TOTAL						$	6,186,652

Assumptions:

[1] The area of the Site minus the parking lot.
[2] These costs include bringing the site grade up the level of the parking lot, fill volume estimated to be the volume of soil necessary to bring one-half of the site and the clay pigeon area up five feet.
[3] The area shown on Figure 3 plus ten percent.
[4] One cubic yard of clay pigeon equals 0.275 tons.
[5] Unclassified fill, 6-inch lifts, includes delivery, spreading, and compaction.
[6] 3:1 ratio, clay pigeons to soil
[7] Two passes.
[8] ASTM D2922-71, one test per 1,000 cy.
[9] Four inches of asphalt concrete over four inches of aggregate base, surface treated with water sealant.
[10] Assumes 2,500 ft by 3 ft by 2 ft of impacted trench soil, which will be California hazardous waste.
[11] Assumes 2-inch utility pipe.
[12] Assumes 3 percent discount rate.
[13] Assume one 500 ft by 2 ft by 3 ft trench per year, which will be California hazardous waste.
[14] Once a year with written summary report to County.

Notes:
cy = cubic yard
ls = lump sum
sqy = square yard
ft = feet
ft^2 = square feet
a = Engineer's Estimate
b = RS Means
c = Estimate from City

TABLE 16: **Cost Estimate**
Alternative 8: Consolidate and Cap under Two Feet of Clean Fill
Sacramento Trapshooting Club

Quantities	Source		
Shooting range area [1]		18	acres
Post remdiation clean area [2]		11.5	acres
Consolidation area [3]		6.5	acres
Off-leasehold impacted soil [4]		1,500	cy
Fill volume [5]		20,973	cy
Clay Pigeon Debris			
Area [6]		73,150	ft^2
Depth		5	feet
Volume		13,546	cy
Mass [7]		3,725	tons

Task			Unit Cost	Unit	Amount		Total
Health and Safety	a	$	10,000	ls	1	$	10,000
Loading clay pigeons	a	$	6.00	cy	13,546	$	81,278
Removal and off-haul of clay pigeons [8]	a	$	45	ton	3,725	$	167,635
Excavation of soil	a	$	3.66	cy	38,105	$	139,465
Confirmation Sampling	a	$	57,000	ls	1	$	57,000
Place and consolidate soil		$	1.31	cy	38,105	$	49,910
Geofabric	a	$	1.85	ft^2	283,141	$	523,811
Import clean soil [9]	b	$	9.69	cy	22,473	$	217,767
Final grading [10]	b	$	0.21	sqy	35,904	$	7,572
Soil density testing, nuclear method [11]	b	$	42.50	ea	21	$	891
Excavation utility trenches [12]	b	$	4.59	cy	222	$	1,020
Trench soil disposal cost [13]	a	$	75.00	ton/yr	1,667		
Import clean soil for utility trenches [14]	b	$	9.69	cy	200	$	1,942
Construction of cap [15]	c	$	6.00	ft^2	283,141	$	1,698,847
Closure report	a	$	10,000	ls	1	$	10,000
Project management (5% of project costs)						$	148,357
Remediation Total						$	3,024,218
Future Cost - 20 Years							Net Present Worth [16]
Incremental Health and Safety cost	a	$	2,500	yr	20		$38,017
Incremental soil disposal cost [17]	a	$	75	ton/yr	1,667		$22,810
Import clean soil for utility trenches [18]	b	$	9.69	ton/yr	1,612		$2,947
Cap inspections [19]	a	$	5,000	yr	20		$76,034
Future cost subtotal						$	139,809
TOTAL						$	3,164,027

TABLE 16: **Cost Estimate**
Alternative 8: Consolidate and Cap under Two Feet of Clean Fill
Sacramento Trapshooting Club

Assumptions:

[1] The area of the Site minus the parking lot.
[2] Two feet of impacted soil will be removed from the western 11 acres of the site.
[3] The impacted soil from the eastern portion will be consolidated on the six acre potion, which will then be capped with asphalt.
[4] Impacted soil off beyond the northern boundary of the leasehold, will be excavated and consolidated with other soil.
[5] Two feet over western 6-acre portion.
[6] The area shown on Figure 2 plus ten percent.
[7] One cubic yard of clay pigeon equals 0.275 tons.
[8] Transport and disposal at Class II landfill as non-hazardous waste.
[9] Unclassified fill, 6-inch lifts, includes delivery, spreading, and compaction.
[10] Two passes.
[11] ASTM D2922-71, one test per 1,000 cy.
[12] Assumes 1,000 ft by 3 ft by 2 ft of impacted trench soil, which will be California hazardous waste.
[13] Assume California hazardous waste.
[14] Assumes 2-inch utility pipe.
[15] Four inches of asphalt concrete over four inches of aggregate base, surface treated with water sealant.
[16] Assumes 3 percent discount rate.
[17] Assume one 250 ft by 2 ft by 3 ft trench per year, which will be California hazardous waste.
[18] Assumes 2-inch utility pipe.
[19] Once a year with written summary report to County.

Notes:
cy = cubic yard
ls = lump sum

Notes:
cy = cubic yard
ls = lump sum
sqy = square yard
ft = feet
ft^2 = square feet
a = Engineer's Estimate
b = RS Means
c = Estimate from City

Note:
Remediation of the 11.5-acre parcel does not include import of a clean fill to bring the site up to grade.

APPENDICES

APPENDIX A

LABORATORY REPORTS
(on CD-ROM)

APPENDIX B

STATISTICAL EVALUATION

APPENDIX B:
STATISTICAL ANALYSIS OF ARSENIC DATA FROM THE SHOOTING RANGE AT THE SACRAMENTO TRAPSHOOING CLUB SACRAMENTO CALIFORNIA

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Aeolus, Inc.
August 1, 2005

INTRODUCTION

Soil samples collected from the shooting range at depths of two-feet below ground surface were analyzed for arsenic. The total arsenic concentrations observed were generally above corresponding U.S.EPA, Region 9 Preliminary Remediation Goals for residential and industrial use. However, the range of arsenic concentrations observed at a depth of two feet were not inconsistent with the range of arsenic concentrations generally reported for California soil[1]. Therefore, a comparable set of local background samples were collected and analyzed for arsenic and a statistical analysis was conducted to evaluate whether arsenic concentrations observed at a depth of two feet at the site can be considered to exceed local background levels. In addition, a set of offsite surface samples were collected in an annular area surrounding the site and compared to surface background samples to evaluate whether offsite arsenic concentrations are consistent with local background.

Details describing the locations from which all samples were collected and describing the broader considerations addressed during this project are provided in the main body of the text of this report. The procedures employed to compare arsenic concentrations in onsite and offsite surface samples with background concentrations of arsenic are described below along with presentation of the results of the evaluation.

PROCEDURES FOR COMPARING ONSITE AND OFFSITE CONCENTRATIONS WITH BACKGROUND CONCENTRATIONS OF ARSENIC

The strategy adopted here for comparing onsite and offsite concentrations with background concentrations of arsenic is the one described as “background test form 2” in the U.S.EPA guide for comparing site and background concentrations[2]. By this approach, the distributions of arsenic concentrations observed on site and those observed at an offsite area (selected to represent local background) are compared by:

- evaluating whether the spread (variance) of each data set can be considered to be similar; and

- if the spread of each data set is similar, evaluating whether the central value (the mean median) of each data set is similar.

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[1] Kearney, 1996, “Background Concentrations of Trace and Major Elements in California Soils.”, *Fundamental Soil Science,* 1996.

[2] U.S. EPA, 2002, *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites*, EPA 540-R-01-003, Sept.

For the first of the above, an F-test is used to compare the variances of two data sets (i.e. the site data and the corresponding background data). A description of the F-test can be found in most standard statistical tests[3]. If the variances of the two data sets are not found to be significantly different, then comparison of the central values of the data sets provides a good indication of whether the two data sets can be considered to be different.

So that an appropriate statistical test can be selected for application to compare the central values of the two data sets, goodness-of-fit tests are first conducted to evaluate whether each data set can be adequately described by a normal or lognormal distribution. If the two data sets can both be adequately described by either a normal or lognormal distribution, a (parametric) two-sample t-test is applied either to the unaltered data (for normally distributed data) or to the log-transformed data (for lognormally distributed data)[4]. If the data cannot be adequately described by either distribution, a (non-parametric) Wilcoxon Rank Sum Test must be applied.

Due to the superior power of the parametric t-test (i.e. the superior ability to detect subtle differences among the data sets), this test is preferred whenever it can be justified by goodness-of-fit tests. Descriptions of both the two-sample t-test and the Wilcoxon Rank Sum Test can be found in any standard statistical text[5].

To determine whether a particular data set can be adequately described by a normal distribution, the *unaltered* concentration measurements are subjected to a goodness-of-fit test (the W Test) by Shapiro-Wilk[6]. Because few of the data sets evaluated in this study can be so described, each data set was then transformed (by taking the natural log of each observed concentration) and the W-Test was then applied to the transformed data to determine whether the data set could be adequately described by a lognormal distribution.

When applying the "background test form 2", one first defines a null hypothesis in which the mean (or median) for site concentrations is assumed to exceed the corresponding central value for background by more than a fixed, minimum value. Thus, the null hypothesis is represented as:

$$M_{site} - M_{bck} \geq S \qquad \text{(B-1)}$$

where:

M_{site} is the mean (or median) value of the observed concentrations onsite;
M_{bck} is the mean (or median) value of the observed background concentrations; and

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[3] Devore, Jay L., 2004, *Probability and Statistics for Engineering and Science*, 6th Edition, Duxbury Press.

[4] When a two-sample t-test is applied to log-transformed data, formally, the test becomes a comparison of the medians rather than the means of the two data sets. However, if the variances of the two data sets are also comparable and both data sets can be adequately described as lognormal, testing for a difference between the medians of the two data sets is equivalent to testing for a difference in the means.

[5] Devore, 2004, op. cit.

[6] U.S. EPA, 2004, *ProUCL Version 3.0 User Guide*, EPA/600/R04/079, April.

S is the minimum difference by which site concentrations are assumed to exceed background.

In this case, the difference "S" is chosen to indicate a value representing the expected magnitude of random variation so that differences smaller than S would not constitute strong evidence that site and background concentrations are indeed different. Thus, "S" is set equal to twice the observed standard deviation for the pooled data sets. This is done because, assuming that site and background are no different, the most precise estimate of the variance for these data sets that can be derived from the available data is from the pooled data.

Once S is defined from the data, the null hypothesis is evaluated using the appropriately selected statistical test (i.e. the two-sample t-test or the Wilcoxon Rank Sum Test) to evaluate whether the null should be rejected in favor of an alternate hypothesis, which is that the difference between the mean (or median) concentrations of the site and background data sets is smaller than S so that we can confidently conclude that the two data sets are not different.

To assure that the chance of falsely rejecting the null hypothesis is kept adequately small, an appropriately derived 95% lower confidence bound (LCL_{95}) on the difference between the means (or medians) of the site and background data sets is employed while testing the null hypothesis. Provided that the true distribution from which each data set derives can be adequately described in the manner indicated, use of the LCL_{95} assures that there will be no more than a 5% chance that the null hypothesis will be falsely rejected (meaning that there will be no more than a 5% chance that site concentrations will be falsely determined to be consistent with background).

RESULTS FROM COMPARING SITE AND BACKGROUND CONCENTRATIONS OF ARSENIC

Comparisons between site concentrations and local background were completed for two cases. In the first case, the set of arsenic concentrations observed on site at a depth of two feet were compared to a set of arsenic concentrations observed among samples collected in similar but undisturbed soil (local background soil) also at a depth of two feet. In the second case, the set of arsenic concentrations representing local background concentrations at the surface (collected in the same locations as the background set described above) were compared to a set of arsenic concentrations observed among surface perimeter samples collected from an area immediately surrounding the portion of the site previously determined to be contaminated.

Results from the statistical analyses are described below:

Goodness-of-Fit Tests

Results of goodness-of-fit tests (application of the W Test) are summarized in Table B-1. In Table B-1, the first column indicates the identity of each sample set. The next two columns respectively indicate the number of samples in each sample set and the corresponding critical values for the W Test.

Columns four and five of Table B-1 indicate the values of the test statistic for the W Test calculated for each data set and the corresponding determination as to whether the data

can be described by a normal distribution (based on whether a test statistic exceeds the corresponding critical value). The last two columns of the table respectively indicate the test statistic calculated for log-transformed data from each data set and the corresponding determination as to whether the data can be described as lognormal.

As can be seen in Table B-1, all of the four data sets evaluated can be adequately described by a lognormal distribution. This is also consistent with the characteristics of the distribution of general background concentrations for arsenic that are reported for the State of California[7]. Therefore (following an evaluation of their relative variance), the paired (site and background) data sets among those listed in Table B-1 will be compared using a two-sample t-test applied to the log-transformed concentrations from each data set.

Although it is noted that the set of arsenic concentrations representing onsite samples collected from a two-foot depth can also be adequately described by a normal distribution, this simply suggests that the variation among this data set is sufficiently small so that the data can be fit using either a normal or lognormal distribution. Thus, this finding in no way affects the findings indicated in the previous paragraph.

F-tests to Compare Variance

Results of the F-tests conducted to compare the variance of surface perimeter to surface background samples and of two-foot site samples to two-foot background samples, respectively, are presented in Table B-2. In this table, the first column indicates the identity of each sample set. Note that, in addition to the four data sets of interest, various data characteristics are also calculated in this table for each of two, pooled data sets. The first of the pooled data sets comprises results from the site and background samples collected at two feet and the second of the pooled data sets comprises results from the perimeter and background samples collected at the surface.

The second column of Table B-2 indicates the number of samples in each data set. The third, fourth, and fifth columns, respectively, indicate the mean, variance, and standard deviation for the log-transformed data from each data set. The next two columns of the table provide estimates of the mean concentration for the untransformed data set calculated using the standard procedure and a simplified maximum likelihood estimator procedure that is specifically appropriate for lognormal data. The eighth column of the table presents the geometric mean of each data set (which, for lognormally distributed data, also represents the median of the untransformed data set). The ninth column of Table B-2 presents estimates of the coefficient of variation for each data set determined using the simplified maximum likelihood estimator that is appropriate for lognormal data.

Column 10 of Table B-2 presents the largest of the two ratios of variance estimated for site over background data (or background over site data), respectively. This is the test statistic appropriate for the F-Test. The appropriate critical values for the F-test are determined for each pair of data sets as a function of two variables respectively representing the number of degrees of freedom for each data set (and equal to one less than the number of samples in each data set). The critical values are presented in Column 11 of the table. Correspondingly, Column 12 of the table indicates whether the variances for each site and background pair of sample sets should be considered to be

[7] Kearney , op. cit.

significantly different (i.e. whether the test statistic for the F-Test exceeds the corresponding critical value).

As indicated in Table B-2, the values in Columns 10, 11, and 12 are determined based on the log-transformed data from each data set. This was done because, as previously indicated, all of the data sets were shown to be adequately described by a lognormal distribution.

As can be seen in Table B-2, the variances for site and background samples collected at two feet should be considered to be significantly different. In contrast, the variances for perimeter and background surface samples should be considered to be similar.

T-Tests to Compare Central Values (Means or Medians)

Results of the application of two-sample t-tests conducted to evaluate whether the central values of site and background data sets are comparable are also presented in Table B-2. Thus, Column 13 indicates the value for "S" (which, as indicated above, is the smallest difference between the central values for site and background data sets that can be considered suggestive of a true difference between the two data sets. The value for S is calculated as two times the standard deviation estimated for the pooled (site and background) data. Assuming that site and background data are consistent, than the estimate of the standard deviation based on the pooled data represent the most robust estimate that can be derived for these data.

Columns 14, 15, and 16 respectively indicate the number of degrees of freedom appropriate for each t-test, the value of the test statistic calculated for each pair of site and background data sets, and the appropriate critical value for each test. The last column of Table B-2 indicates whether the central values of the corresponding pair of site and background data sets should be considered to be smaller than S (the minimum difference of concern).

As can be seen in Table B-2, the difference in the central values (medians) of the offsite and background surface data can be considered to be significantly smaller than the value of S calculated using the pooled data from these two data sets. This is because the value of the test statistic is smaller (more negative) than the corresponding critical value. Thus, the null hypothesis (that the difference in the medians is at least as large as S) is rejected. Coupled with the observations that the variances for these two data sets are consistent and that both data sets are adequately described by a lognormal distribution, there is no evidence that the concentrations observed in the offsite samples differ from the concentrations observed in background surface samples.

The situation with the site and background samples at two feet is somewhat more complicated. Because the variances for the site and background data at two feet are significantly different, an alternate form of the two-sample t-test (Satterthwaite's t-test) was applied to evaluate the comparability of these data[8]. This is the appropriate version of the t-test to employ when comparing two data sets exhibiting differing variances. However, applying this test to transformed data has additional consequences, as described below.

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[8] U.S. EPA, 2000, *Guidance for Data Quality Assessment*, EPA/600/R-96/084, July.

As can be seen by the values presented in Table B-2, based on Satterthwaite's t-test, the medians of the site and background data at two feet can be considered to differ by an amount that is significantly less than the value for S that has been estimated for these data sets. However, when the variance of a lognormal distribution changes, the ratio of the mean to the median of that distribution also changes. Therefore, because the variances of site and background samples have been shown to be significantly different in this case, a test of comparability of medians may not be considered equivalent to a test of comparability of means. At the same time, *for this specific case*, it can be shown that the comparison of medians is in fact a more severe test of the differences in the central values of these data sets than a test comparing the means.

Among other things, the equation for the simplified maximum likelihood estimator for the mean of a lognormal distribution[9] can be used to define the relationship between the geometric mean (i.e. the median) and the true mean of a lognormally distributed data set:

$$X_{bar} = \exp(Y_{bar} + s_y^2/2) \qquad \text{(B-2)}$$

where:

X_{bar} is the true mean of the distribution;
Y_{bar} is the mean of the log-transformed data; and
s_y is the standard deviation for the log-transformed data.

Note that, assuming that the data are lognormally distributed, Y_{bar} is also the median of the log-transformed data because the mean of a normal distribution is also the median of the distribution and the log-transformed data from a lognormal distribution by definition are normally distributed.

Equation B-2 can be re-written as:

$$X_{bar} = \exp(Y_{bar})*\exp(s_y^2/2) \qquad \text{(B-3)}$$

where:

$\exp(Y_{bar})$ is the geometric mean of the distribution. It is also the median of the untransformed data because it is the median of the log-transformed data and the relative rank of the values of the data does not change by taking the exponential.

Solving Equation B-3 for the ratio of the mean to the median of the untransformed distribution, one finds:

$$X_{bar}/\exp(Y_{bar}) = \exp(s_y^2/2) \qquad \text{(B-4)}$$

where all values have been previously defined.

Examining Equation B-4, it is clear that the ratio of the true mean to the median of any lognormal distribution increases as the standard deviation of the log-transformed data

[9] Gilbert, Richard O.,1987, *Statistical Methods for Environmental Pollution Monitoring*, Van Nostrand Reinhold.

increases. Thus, given that the variance for the log-transformed background data at two feet has been shown to be significantly greater than the variance for the log-transformed site data at two feet (Table B-2), this indicates that the ratio of the mean to the median of the background data will be relatively larger than the ratio of the mean to the median of the site data. The consequences of this finding must now be evaluated with regard to the null hypothesis being tested.

Recalling Equation B-1:

$$M_{site} - M_{bck} \geq S \qquad \text{(B-1)}$$

Applying this to the true means of each data set, results in:

$$Xbar_{site} - Xbar_{bck} \geq S \qquad \text{(B-5)}$$

Similarly, applying this to the medians of each data set, results in:

$$\exp(Ybar)_{site} - \exp(Ybar)_{bck} \geq S \qquad \text{(B-6)}$$

Remembering that the ratio of $Xbar_{bck}$:$\exp(Ybar)_{bck}$ has been shown to be larger than the ratio of $Xbar_{site}$:$\exp(Ybar)_{site}$ and comparing Equations B-5 and B-6 for this case, we see that the difference between estimated medians (in Equation B-6), if anything, will be larger (more positive) than the differences in estimated means (in Equation B-5). Therefore, *in this specific case*, the t-test used to compare medians is *less* likely to result in a conclusion that the difference in medians is smaller than S (resulting in rejection of the null hypothesis) than a comparison of the means. Thus, *in this specific case*, the comparison of medians is a more severe test of the magnitude of the difference in the two data sets than a comparison of the means.

Given the above and coupled with the finding reported in Table B-2 that the differences in medians for the site and background samples from two feet is significantly smaller than S (so in fact, they may be the same), it is reasonable to similarly conclude that the differences in the means is smaller than S. Thus, there is no evidence from these data sets that site and background concentrations of arsenic determined at two feet are different.

It should also, finally, be noted that because the variances of the site data at two feet and the background data at two feet were found to significantly differ, the appropriate manner for estimating the value of S needs to be addressed. When the variances of two data sets are found to be consistent and the two data sets are expected to derive from the same distribution (i.e. the background distribution), which is what is being evaluated here, the most appropriate value to use for S is that derived from the standard deviation for the pooled data. This is what was done, for example, when comparing the offsite surface samples to surface background.

However, if the central value of two data sets differ radically, than pooling the data sets may result in estimates for standard deviation that are even greater than the standard deviations estimated for either data set alone. Because the estimate of the standard deviation for the pooled data at two feet falls between the estimates for the standard

deviations from either data set alone (Table B-2), this suggests that the central values do not differ radically so that the problem does not arise. Thus, the estimate of the standard deviation from the pooled data, in this case, can be considered to be a reasonable *averaged* value from the two data sets at two feet, even though the variances for these data sets were shown to vary significantly from one another.

That the variance observed among the background data is greater than that observed from site data (for the data sets from two feet) simply suggests, among other possibilities, that the concentrations observed on site do not represent the full range of possible values that otherwise represent background in California. Therefore, the difference in variances observed between these two data sets does not alone suggest a difference in site and background concentrations.

TABLE B-1:
RESULTS OF GOODNESS-OF-FIT TESTS FOR DATA FROM AND NEAR THE SACRAMENTO TRAPSHOOTING CLUB
SACRAMENTO, CALIFORNIA

		Results of Shapiro-Wilk Tests				
Data Set Description	**Number of Samples**	**Critical Value**	**Test Statistic for Data**	**Are Data Normal?**	**Test Statistic for Transformed Data**	**Are Data Lognormal?**
Onsite Samples at 2 ft depth	15	0.881	0.947	Yes	0.948	Yes
Background at 2 ft depth	8	0.818	0.620	No	0.911	Yes
Perimeter surface samples	19	0.901	0.819	No	0.928	Yes
Background surface samples	8	0.818	0.741	No	0.873	Yes

TABLE B-2:
CHARACTERISTICS OF THE SETS OF ARSENIC CONCENTRATIONS OBSERVED AT AND NEAR THE SACRAMENTO TRAPSHOOTING CLUB
SACRAMENTO, CALIFORNIA[a]

		For Log-transformed Data								Based on Log-transformed Data						
Data Set Description	**Number of Samples (N)**	**Mean (Y_{bar})**	**Variance (V_y)**	**Standard Deviation (s_y)**	**Standard Mean[b] (X_{bar})**	**Simplified MLE-Mean[c] (X'_{bar})**	**Geometric Mean[d] [exp(Y_{bar})]**	**MLE Coefficient of Variation[e] (CV_x)**	**Largest F-Test Ratio**	**F-Test Critical Value**	**Are Variances Different?**	**S[f]**	**t-Test Statistic[g]**	**df[h] for t-Test**	**t-Test Critical Value[g]**	**Is (M_{smpl}-M_{bck}) Smaller than "S"?**
Onsite Samples at 2 ft depth	15	0.85	0.14	0.38	2.5	2.5	2.35	0.39	4.68	3.35	No	1.2	-2.49	9	-1.83	Yes
Background at 2 ft depth	8	0.44	0.66	0.81	2.2	2.2	1.56	0.97								
Pooled data set	23	0.71	0.34	0.58	2.4	2.4	2.03	0.64								
Perimeter surface samples	19	0.59	0.24	0.49	2.0	2.0	1.81	0.52	1.95	4.51	Yes	0.90	-5.43	25	-1.71	Yes
Background surface samples	8	0.73	0.12	0.35	2.2	2.2	2.08	0.36								
Pooled data set	27	0.64	0.20	0.45	2.1	2.1	1.89	0.47								

Notes:

[a] As previously indicated (see text and Table A-1), all of the above data sets are adequately described by lognormal distributions. Therefore, the characteristics of each data set is determined based on log-transformed data.

[b] This is the mean calculated using the standard procedure (summing the data and dividing by the number of samples). Such a procedure provides an unbiased estimate of the mean of a data set no matter what the overall distribution. For small data sets, however, it may not converge to the mean as quickly as other estimators of the mean that are appropriate for the particular distribution being evaluated.

[c] This is the mean calculated using the simplified maximum likelihood estimate that is appropriate for lognormally distributed data (Gilbert 1987). It is determined as: $\exp[M_{LN} + 0.5(SD_{LN})^2]$.

[d] This is the geometric mean of the data set, which is determined as $\exp(M_{LN})$. For lognormally distributed data, it is equivalent of the median of the untransformed data.

[e] This is the coefficient of variation calculated using the simplified maximum likelihood estimate for lognormally distributed data (Gilbert 1987). It is determined as: $[\exp(SD_{LN})^2] - 1$.

[f] As indicated in the accompanying text, "S" is the minimum difference between the central values of site and background data sets that should be considered to suggest a true difference in site and background concentrations.

[g] Because the variances are shown to be consistent, the test statistic and critical value employed to compare the median's for the surface samples are based on a standard two-sample t-Test (see, for example, Devore 2004). However, because the variances are shown to be inconsistent, the test statistic and critical value employed to compare the medians of the two-foot samples is based on a t-Test that is adjusted to account for differing variances across the data sets (EPA, 2000). Note that this also has consequences concerning the comparison of the medians (as opposed to the means) -- see accompanying text.

[h] "df" means degrees of freedom.

D. Wayne Berman, Aeolus, Inc.

APPENDIX C

GEOTECHNICAL REPORT

ENGEO INCORPORATED

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Project No.
6876.5.001.01

July 11, 2005

Yane Nordhav
Baseline Environmental Consulting
5900 Hollis Street, Suite D
Emeryville, CA 94608-2008

Subject: Trap Shooting Range
Sacramento, California

REUSE OF CLAY PIGEON DEBRIS AS ENGINEERED FILL

Dear Yane:

In accordance with our agreement dated June 30, 2005, we prepared this letter to summarize our findings regarding reuse of clay pigeon debris as engineered fill at the Sacramento Trapshooting Club facility in Sacramento, California.

We summarize below the project description, laboratory test data, and our conclusions and recommendations with regard to the pigeon debris as engineered fill.

BACKGROUND

According to the information provided to us, an estimated 13,500 cubic yards of clay pigeon debris has accumulated on this the 17-acre trap shooting range. The debris reportedly covers an area of approximately 73,000 square feet with an estimated average thickness of 5 feet. We understand that the clay pigeons generally consist of crushed lime bound together with pitch.

The northeastern portion of the site is about 5 feet below the grade of the southwestern half. The site may be redeveloped for office buildings and parking lots, which would require grades on the northeast portion of the property to be raised. This area is where the clay pigeon debris is proposed as fill to supplement any imported fill soil and avoid costs associated with off hauling the pigeon debris from the site.

LABORATORY TESTING

We visited the site on June 30, 2005 to observe the current site conditions and gather samples of native soil and clay pigeon debris. We obtained bulk samples of soil and debris and returned them to our laboratory for visual examination and laboratory testing.

To explore potential reuse of the clay pigeon debris as engineered fill, we prepared two "batches" of clay pigeon debris mixed with native soil in our laboratory. We mixed the materials in ratios of 4:1 and 3:1 (clay pigeon debris to soil) by weight. We then performed resistance value testing and compaction testing on each batch to evaluate potential compaction and engineering characteristics. We present the resistance value data in Table 1 and the compaction data in Table 2.

Table 1
Resistance Value Data

Clay pigeon/soil ratio	Resistance Value	Expansion Pressure (psi)
3:1	78	0
4:1	74	0

Table 2
Laboratory Compaction Data

Clay pigeon/soil ratio	Maximum Dry Density (pcf)	Optimum Moisture Content
3:1	112	5.7
4:1	111	5.7

Resistance value testing is commonly used in pavement design to assess the quality of subgrade materials. It is essentially a measure of "stiffness" under saturated conditions with values ranging from 5 for poor quality clays to 78 for high quality sand and gravel mixtures. The resistance value test data indicate that the batched materials created in the laboratory have relatively good pavement subgrade properties with negligible expansion pressures.

The compaction data show that the maximum dry density is similar for both batched material ratios. The compacted specimens were fairly consistent in density and did not show significant voids when cut apart.

CONCLUSIONS AND RECOMMENDATIONS

From a geotechnical engineering perspective, it is our opinion that the clay pigeon debris may be used as engineered fill provided it is mixed with native soil to provide a well graded mixture for compaction. Our preliminary lab test data indicate that the clay pigeon debris mixed at ratios of 3:1 and 4:1 with native soil show minimal shrink/swell potential and appear to have relatively good pavement subgrade properties.

On a preliminary basis, we recommend that the clay pigeon debris be mixed with native or approved import soils in an approximate ratio of 3:1 (clay pigeon debris to soil) by weight. The handling, mixing and compacting of the pigeon debris fill can likely be accomplished with conventional earthwork equipment. On a preliminary basis, moisture condition each lift of

engineered fill to at least 1 percentage point above the optimum moisture content, place in loose lifts that do not exceed 8 inches, and compact to a minimum of 90 percent relative compaction.

We anticipate that the relative compaction of the clay pigeon fill will be testable with standard nuclear gage methods in the field. However, if field density test results show variable and inconsistent results, it may be necessary to utilize a performance-based compaction specification. A performance-based compaction specification would likely require a minimum of five passes with a CAT 815 compactor or equivalent to achieve 90 percent relative compaction.

It may be desirable to cap any clay pigeon fill in future building areas with native or import soil. This will minimize disturbance of the fill materials during construction of improvements associated with the planned office buildings.

CLOSURE

This letter includes our laboratory test data and conclusions with regard to reuse of clay pigeon debris as engineered fill at the above referenced location. We have only evaluated the suitability of the clay pigeon debris from a geotechnical engineering standpoint and not with regard to possible environmental concerns.

This letter was prepared for the sole use of Baseline Environmental Consulting for the Sacramento Trapshooting Club in Sacramento, California. We strived to perform our services in accordance with generally accepted geotechnical engineering practices at this time and location. No warranty is expressed or implied.

We recommend that a geotechnical report be prepared for design of any proposed site improvements. This would normally include subsurface exploration, laboratory testing, engineering analysis, and preparation of a report.

If you have any questions or comments regarding this letter, please call and we will be glad to discuss them with you.

Sincerely,

ENGEO Incorporated

Jonathan C. Boland, PE
Project Engineer

Reviewed by:

Mark M. Gilbert, GE
Principal

REGISTERED PROFESSIONAL ENGINEER
MARK M. GILBERT
NO. 2191
Exp. 3-31-06
GEOTECHNICAL
STATE OF CALIFORNIA

Attachments: Laboratory Test Data

COMPACTION TEST REPORT

Curve No.: 1

Project No.: 6876.5.001.01 **Date:** 7/9/05

Project: Sacramento Trap Club

Location:

Elev./Depth: **Sample No.** 1

Remarks:

MATERIAL DESCRIPTION

Description: 3:1 Ratio Clay Pigeon to Soil (SM)

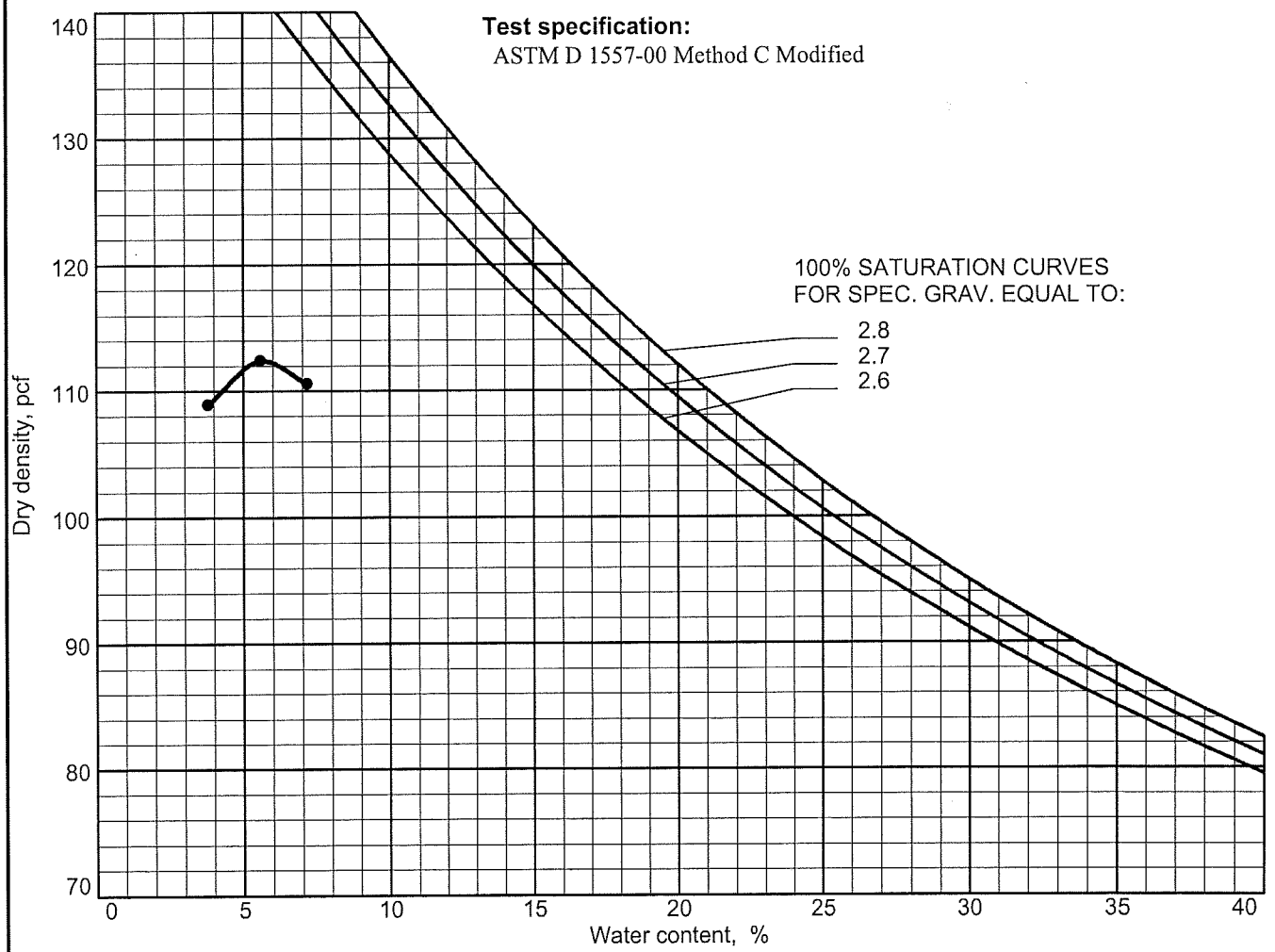
Classifications - **USCS:** **AASHTO:**

Nat. Moist. = **Sp.G. =**

Liquid Limit = **Plasticity Index =**

% > 3/4 in. = % **% < No.200 =**

TEST RESULTS
Maximum dry density = 112.4 pcf
Optimum moisture = 5.7 %



Figure

COMPACTION TEST REPORT

Curve No.: 2

Project No.: 6876.5.001.01 **Date:** 7/9/05

Project: Sacramento Trap Club

Location:

Elev./Depth: **Sample No.** 2

Remarks:

MATERIAL DESCRIPTION

Description: 4:1 Ratio Clay Pigeon to Soil (SM)

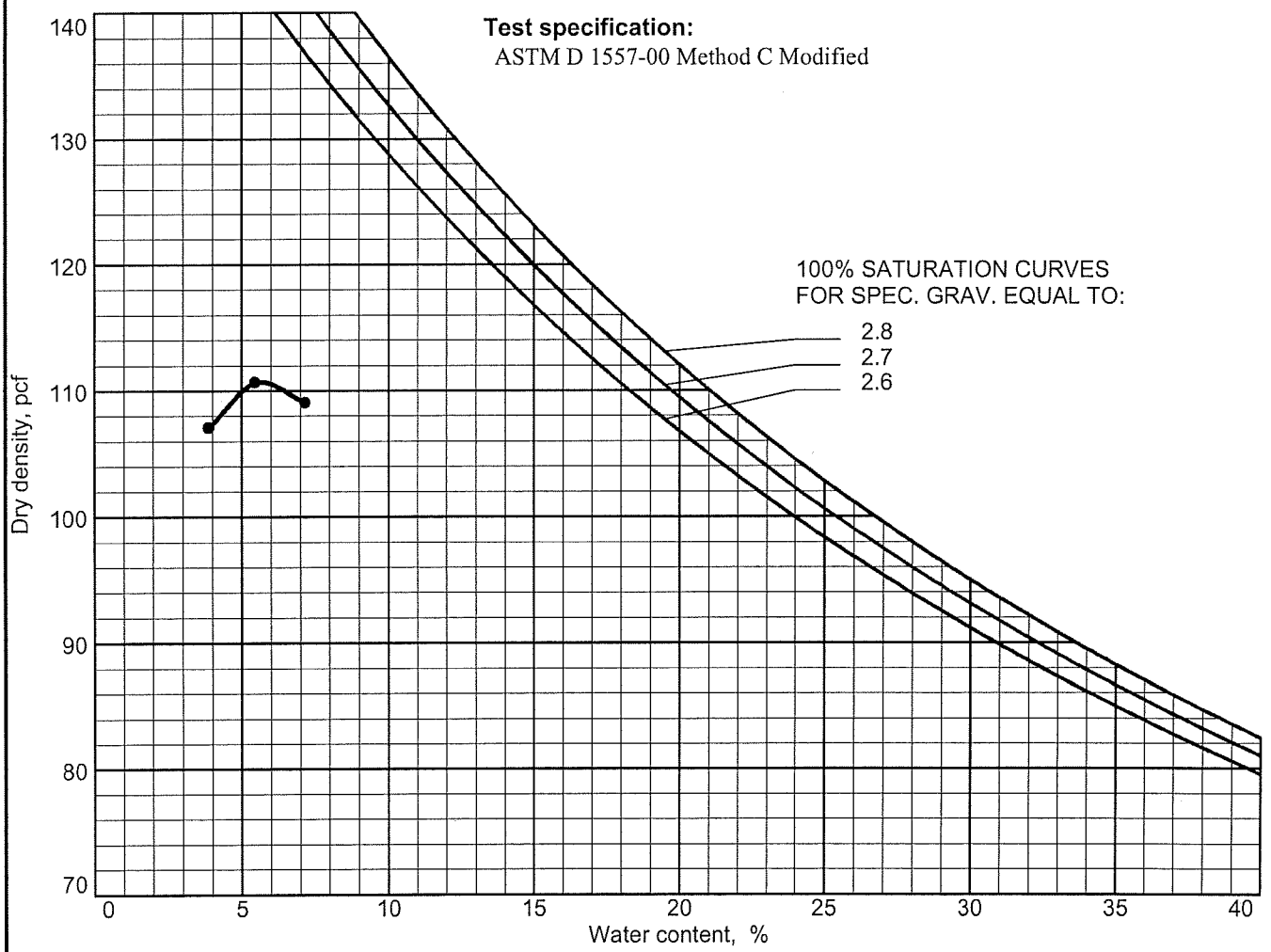
Classifications - **USCS:** **AASHTO:**

Nat. Moist. = **Sp.G. =**

Liquid Limit = **Plasticity Index =**

% > 3/4 in. = % **% < No.200 =**

TEST RESULTS
Maximum dry density = 110.7 pcf
Optimum moisture = 5.7 %



Figure

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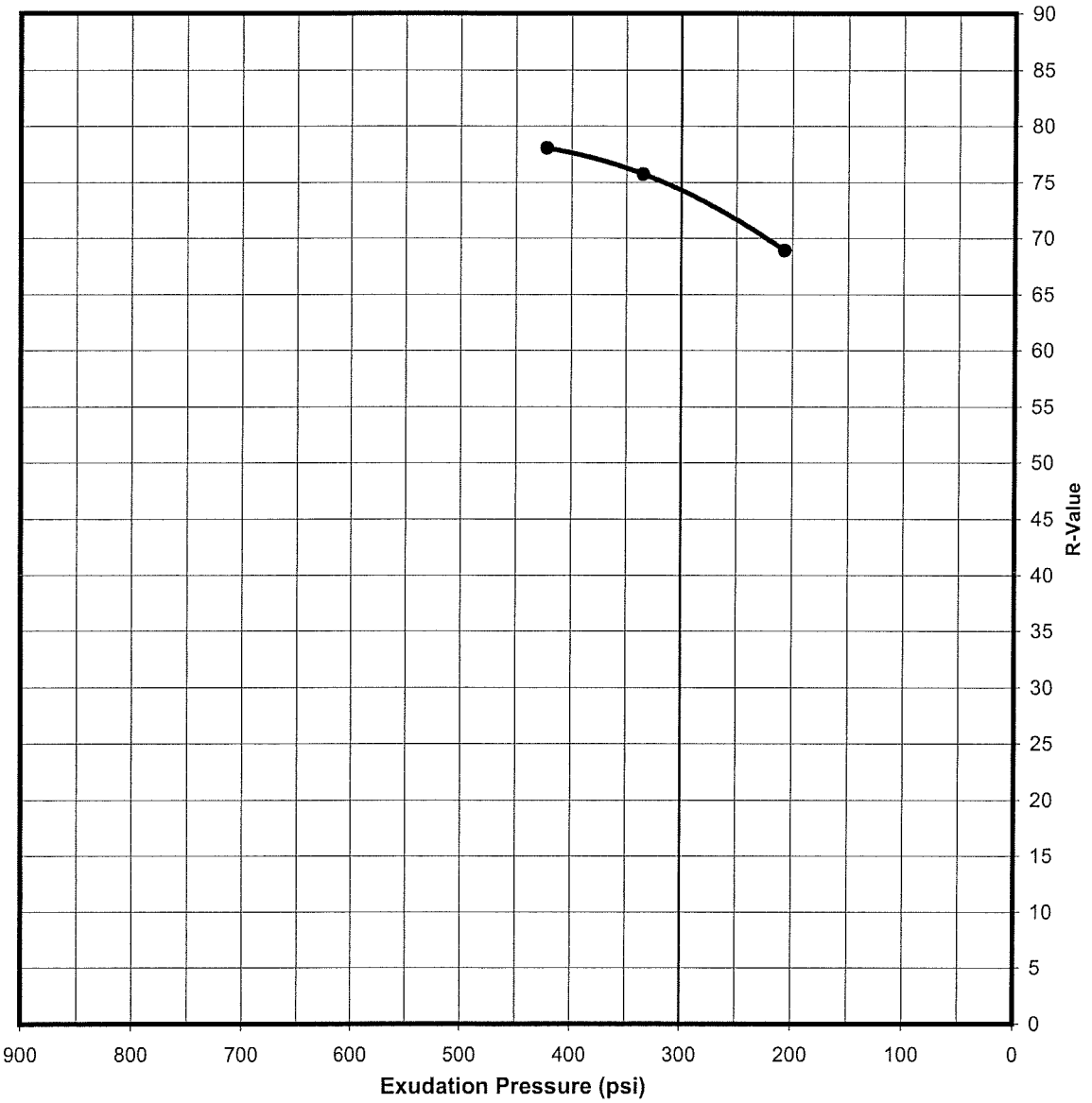
R VALUE TEST REPORT
CAL-301

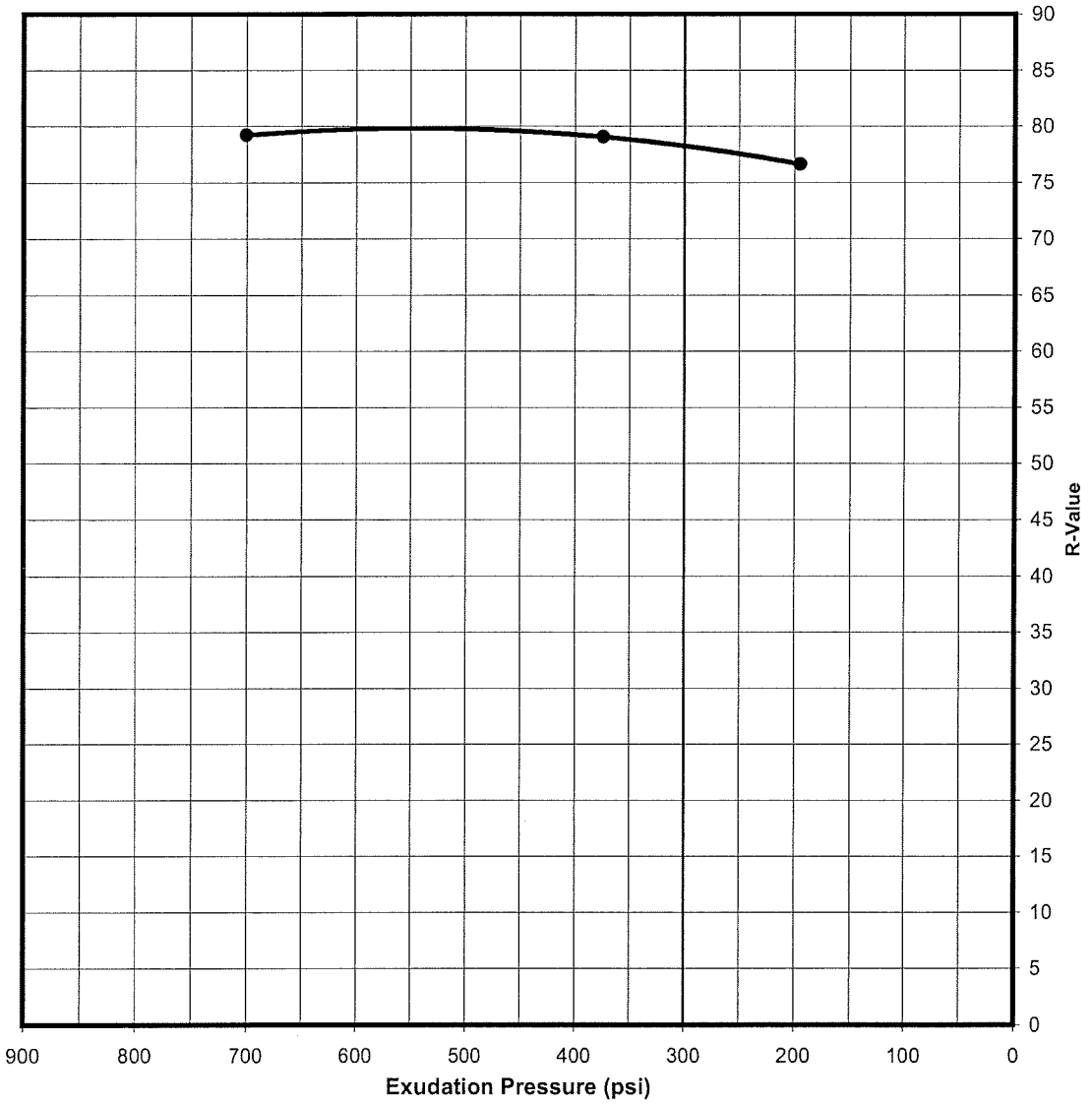


Date: 7/9/2005
Project Name: Sacramento Trap Club
Project Number: 6876.5.001.01
Sample: RV-2
Description: 4:1 Mix; -3/4" Clay Pigeon to Soil (SM)

Specimen	A	B	C
Exudation Pressure, p.s.i.	422	334	207
Expansion dial (.0001")	0	0	0
Expansion Pressure, p.s.f.	0	0	0
Resistance Value, "R"	78	76	69
% Moisture at Test	6.5	7.7	8.1
Dry Density at Test, p.c.f.	101.8	100.6	99.7
"R" Value at 300 p.s.i., Exudation Pressure	74		

ENGEO INCORPORATED

R VALUE TEST REPORT
CAL-301



Date: 7/8/2005
Project Name: Sacramento Trap Club
Project Number: 6867.5.001.01
Sample: RV-1
Description: 3:1 Mix; -3/4" Clay pigeon debris to soil (SM)

Specimen	A	B	C
Exudation Pressure, p.s.i.	700	374	195
Expansion dial (.0001")	0	0	0
Expansion Pressure, p.s.f.	0	0	0
Resistance Value, "R"	79	79	77
% Moisture at Test	6.0	6.9	7.7
Dry Density at Test, p.c.f.	104.9	104.5	104.0
"R" Value at 300 p.s.i., Exudation Pressure	78		

APPENDIX D

DTSC COMMENT LETTER ON DRAFT RESPONSE PLAN DATED NOVEMBER 2005

Alan C. Lloyd, Ph.D.
Agency Secretary
Cal/EPA

Department of Toxic Substances Control

Maureen F. Gorsen, Director
8800 Cal Center Drive
Sacramento, California 95826-3200

Arnold Schwarzenegger
Governor

March 20, 2006

Mr. Charley Langer
Sacramento County Environmental Management Department
8475 Jackson Road, Suite 230
Sacramento, California 95826

RESPONSE PLAN-SACRAMENTO TRAPSHOOTING CLUB

Dear Mr. Langer:

The Department of Toxic Substances Control (DTSC) has reviewed the Response Plan-Sacramento Trapshooting Club dated November 2005. The Sacramento Trapshooting Club (Site) is approximately 20 acres of land owned by the City of Sacramento which has been operated as a skeet shooting range since about 1915. The Site is a portion of the City of Sacramento's Del Paso Park golf course and is located at the northeast corner of the intersection of Fulton Avenue and Interstate 80. Site characterization indicates site soil is impacted with total and soluble lead and arsenic from lead shot and polyaromatic hydrocarbons (PAHs) from clay pigeon debris. Site characterization also indicates that groundwater has not been impacted and surface water may be impacted by site conditions.

The City of Sacramento requested the Site Designation Committee to designate Sacramento County as Administrating Agency to oversee site investigation and remedial action at the Site in July 2004. The Site Designation Committee considered the application and designated Sacramento County as the Administrating Agency on August 26, 2004. Sacramento County and the City of Sacramento have developed this Response Plan and requested a Consultative Work Group meeting on February 15, 2005 to allow DTSC and the Regional Water Quality Control Board (RWQCB) to provide comments on the preferred alternative 7A.

The RWQCB provided comment in a letter dated February 8, 2005 and agrees with the Response Plan that groundwater is not now and should not be impacted in the future by Site conditions. RWQCB staff further agrees that while there may currently be impacts to surface water, once alternative 7A is implemented, those potential impacts should be eliminated.

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Response Plan

The Response Plan includes additional Site characterization work conducted by the City of Sacramento to determine if trapshooting activities have resulted in soil contamination on adjacent portions of the golf course. The investigation work identified approximately two additional acres of golf course land which is impacted by total lead, arsenic and PAHs.

The Response Plan also looked at the clay pigeon debris to determine the correct disposal alternative. The debris was analyzed for soluble and total lead, arsenic and PAHs. A fish bioassay was also performed. The Response Plan concludes that the clay pigeon debris is not a Federal or State hazardous waste and can be disposed of at a Class II of III facility depending on acceptance criteria of the individual facility.

The Response Plan evaluated six response alternatives in addition to the No Action alternative. The six alternatives include Excavation and Off-Site Disposal, Thermal Desorption, Soil Washing, Soil Stabilization, Solidification, and Institutional and Engineering Controls (IC/EC).

The preferred alternative includes the IC/EC approach. This response action consists of reclamation of lead shot from the Site, off-site disposal of clay pigeon debris and import of clean fill to an average depth of five feet to level the Site and, an asphalt cap over all areas not covered by building foundations. Utility corridors are to be backfilled with clean fill. The entire Site is to be Deed Restricted to preclude exposure and residential use. A risk management plan is to be developed that places requirements for health and safety plans, soil management plans, dust control, annual cap inspections, and five year reviews of the remedy. This long-term risk management plan will be implemented by the City of Sacramento under the supervision of Sacramento County. The City of Sacramento has not included the additional 2 acres of contaminated golf course in this Response Plan action.

This proposal relies on the Area of Contamination (AOC) concept which is discussed in the preamble to the National Contingency Plan (NCP) (55 FR 8758-8760, March 8, 1990). U.S. Environmental Protection Agency (EPA) has clarified that certain discrete areas of generally dispersed contamination are "areas of contamination". The AOC is delineated by the areal extent of contiguous contamination. Such contamination must be continuous, but may contain varying types and concentrations of hazardous substances. The NCP further states that "placement does not occur when wastes are left in place, or moved within a single AOC". If waste is not "placed" then Land Disposal

Restrictions are not triggered. Therefore, the movement of contaminated soil within a single AOC does not constitute the generation of hazardous waste.

Recommendations

DTSC supports the preferred alternative as protective of public health and the environment. However, DTSC recommends that the City of Sacramento consider consolidation of contaminated soil within the lease property in order to reduce the size of the contamination foot print, to reduce the amount of clean fill required and to free some portion of the Site from deed restrictions.
DTSC further recommends that the City of Sacramento characterize the approximately two acres of golf course which are contiguous with the discussed lease property so that contaminated soil on the golf course may be included as fill on the lease property. If the two acres remain as a separate issue, the City of Sacramento will need to haul the waste to a Class I facility and pay for disposal and pre-treatment. The cost differential between the more expensive off-site disposal and on-site consolidation is substantial and should be considered before any decision is made.

The Deed Restriction is essential to the remedy. The Deed Restriction must run with the land, inure to the benefit of and pass with each and every portion of the property, must be for the benefit of, and enforceable by Sacramento County and is imposed in perpetuity on the entire property unless expressly stated as applicable only to a specific portion thereof. DTSC recommends that Sacramento County use the DTSC Deed Restriction model and revise the authority statement, to include a discussion of the Site Designation process, as the basis of enforcement by the County.

The Deed Restriction identifies the continuing presence of hazardous materials and describes the use limitations imposed on the property. DTSC recommends that Sacramento County also implement an enforceable Operations and Maintenance (O&M) Agreement (draft enclosed) to ensure the overall remedy is maintained. The O&M Agreement is referenced and attached to the Deed Restriction in order to ensure future owners are aware of the site-wide remedy and to allow continued access by the City of Sacramento for O&M efforts. Copies of our model Deed Restriction and O&M Agreement are attached.

As the proposed remedy leaves hazardous substances onsite which represent a continuing potential public health risk, DTSC will need to review any subsequent modified Response Plan, consolidation and capping designs, the Deed Restrictions and Operations and Maintenance Plan. Pursuant to the provisions of the Designation

Process and requirements of state law, DTSC will be submitting invoices for its costs for review of the issues identified above.

If you have any questions regarding these recommendations, please call Mr. Ed Cargile at (916) 255-3703.

Sincerely,

James L. Tjosvold, P.E., Chief
Northern California-Central Cleanup Operations Branch

Enclosures

cc: Mr. Dean Peckham
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City of Sacramento
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Sacramento, California 95814

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California Regional Water Quality Board
Central Valley Region
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8800 Cal Center Drive
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