Update to June 2006 Phase I Addendum Guidance

The screening value for lead in soil from lead-based paint at proposed school sites, as presented in Section 4.3 of the June 2006 *Interim Guidance Evaluation of School Sites with Potential Contamination from Lead Based Paint, Termiticides, and Electrical Transformers* (Phase I Addendum Guidance), has been changed. The Cal/EPA Office of Environmental Health and Human Assessment (OEHHA) revised its toxicity evaluation of lead in 2007 by replacing the threshold blood lead concentration of 10 microgram per deciliter (µg/dl) with a source-specific, benchmark change of one µg/dl for the protection of children. One µg/dl is the estimated incremental increase in the blood lead level in children that would reduce intelligence quotient (IQ) by up to one point. DTSC revised the Lead Risk Assessment spreadsheet (Version 8, 2011) to reflect this change in approach. Using this spreadsheet, **the recommended residential soil lead screening level is 80 milligrams per kilogram (mg/kg)**, as stated in the DTSC HHRA Note 3. For more information, see *User's Guide to Leadspread 8 and Recommendations for Evaluation of Lead Exposures in Adults*. DTSC is currently in the process of revising the 2006 Phase I Addendum Guidance.

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INTERIM GUIDANCE
EVALUATION OF SCHOOL SITES WITH POTENTIAL SOIL CONTAMINATION AS A RESULT OF LEAD FROM LEAD-BASED PAINT, ORGANOCHLORINE PESTICIDES FROM TERMITICIDES, AND POLYCHLORINATED BIPHENYLS FROM ELECTRICAL TRANSFORMERS

Revised 06/09/06 **(non-substantive revisions made 09/12/06)**

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1.0 PURPOSE

This guidance is intended to provide a uniform and streamlined approach to initially evaluate proposed school sites where lead from lead-based paint, organochlorine pesticides (OCPs) from termiticide application, and polychlorinated biphenyls (PCBs) from electrical transformers are potential sources of soil contamination. This guidance is not a substitute for professional judgment, supported by technical justification and rationale, of qualified environmental professionals. The purpose is to evaluate the potential soil contamination by lead, OCPs, and PCBs and determine if these levels pose a threat to human health.

This guidance is only intended for evaluating sites for potential human health concerns associated with direct exposure of humans to contaminants in soil through incidental soil ingestion, dermal contact, and inhalation of dust in outdoor air. The screening values contained herein do not consider impact to groundwater or address ecological concerns. If site information indicates that other exposure pathways may be complete or the environment (non-human biota or habitats) may be impacted, a more detailed evaluation should be conducted in consultation with DTSC in a Preliminary Environmental Assessment (PEA). If a school district is unclear or has questions regarding exposure pathways for the site or whether the site can be adequately addressed by this guidance, DTSC should be consulted.

If DTSC determines that results of sampling described in this guidance indicate that a contaminant may pose a risk to human health or the environment, DTSC may require additional characterization of the nature and extent of contamination in a PEA or Supplemental Site Investigation (SSI) (Ed. Code, § 17213.1, subsecs. (a)(4)(A) and (a)(10)).

This guidance supersedes the *Interim Guidance for Evaluating Lead-Based Paint and Asbestos-Containing Materials at Proposed School Sites* (DTSC 2001). The school district is responsible for complying with federal, state, and local requirements for mitigation, management, or removal of asbestos-containing material (ACM). Although DTSC will no longer provide guidance for specifically for ACM found in buildings and structures, DTSC will continue providing guidance for naturally-occurring asbestos.

2.0 BACKGROUND

Education Code sections 17210, 17210.1, 17213.1, and 17213.2, specify a comprehensive environmental review process under DTSC oversight for proposed new or expanding schools. Consistent with the Education Code, DTSC utilizes a three-step process for environmental review of school sites (1) Phase I Environmental Site Assessment (Phase I), (2) PEA, and (3) additional investigation and, if necessary, response action. The role of DTSC is to ensure protection of children, staff, community, and the environment from the potential harmful effects of exposure to hazardous materials.

To expedite the environmental review process and allow school districts to focus resources where they are most needed, regulations for Phase Is became effective on February 10, 2003 (Cal. Code Regs., tit. 22, div. 4.5, ch. 51.5, commencing with § 69100, as amended). The regulations enable school districts to submit limited soil sampling data for specific contaminants at a site in a Phase I or Phase I Addendum.

3.0 USE OF GUIDANCE

This guidance provides recommended sampling strategies, sample analyses, and health screening criteria for lead, OCPs, and PCBs. The information in this guidance may be used for investigations conducted as part of the environmental review process for school sites.

The Phase I regulations (Cal. Code Regs., tit. 22, div. 4.5, ch. 51.5, commencing with § 69100, as amended) should be consulted to determine whether sampling results may be submitted in a Phase I or Phase I Addendum. If sampling results are included in a Phase I or Phase I Addendum, submittal of a work plan for DTSC review and approval is not necessary if the strategies described herein are followed. However, if a school district prefers, DTSC is available to help develop a site-specific sampling strategy using this guidance before sampling at a site.

DTSC should be consulted for sites not addressed by this guidance or with deviations from the strategies described herein. If a school district is unclear or has questions as to whether their site can be adequately addressed by this guidance, DTSC should be consulted. Based on specific characteristics of a site, DTSC may recommend submittal of a work plan prior to conducting sampling activities. If evaluation of lead, OCPs, or PCBs from specific sources, as described, is conducted as part of a PEA or SSI, the strategies herein may be incorporated into an associated work plan.

In general, all potential contaminants associated with a site should be evaluated at the same time. When pre- and post-demolition strategies are presented, sampling should be conducted prior to demolition or renovation of structures (pre-demolition) since activities that disturb soil may spread contamination, if present. However, post-demolition sampling strategies are provided if circumstances beyond the control of the school district make pre-demolition sampling impractical. A consistent sampling strategy (either pre- or post-demolition) should be used for the entire site, even if it consists of multiple parcels. DTSC understands that sampling may become cost prohibitive for sites consisting of multiple parcels and is available to discuss adjustment to the number of sampling locations and samples recommended herein for such sites.

Screening values presented in the guidance are for initial assessment only and should not be construed as a required removal or remedial levels. If a response action is required for a school site, removal or remedial levels will be evaluated and approved by DTSC through a removal action work plan or remedial action plan.

4.0 LEAD FROM LEAD-BASED PAINT

Lead can impair the nervous system, affecting hearing, vision, and muscle control. Lead is also toxic to the kidneys, blood, and heart. Exposure of children to lead may cause irreversible learning deficits, mental retardation, and delayed neurological and physical development (ATSDR 1999).

In response to the potential harmful effects from lead, the United States Consumer Product Safety Commission (U.S. CPSC) banned the application of paint containing more than 0.06 percent (600 parts per million) lead by weight on residential structures in 1978 (DHS 1998, CDC 1991, U.S. CPSC 2005, and U.S. EPA 2004b). However, surplus lead-based paint was still used for more than a decade later and lead-containing paint (paint with a detectable amount of lead) is still available for industrial, military, and marine usage (DHS 1998 and CDC 1991).

Considering the U.S. CPSC action, California Code of Regulations, title 17, section 35043 defines presumed lead-based paint as "paint or surface coating affixed to a component in or on a structure, excluding paint or surface coating affixed to a component in or on a residential dwelling constructed on or after January 1, 1979, or a school constructed on or after January 1, 1993."

Based on this information, structures with paint or surface coatings, with the exception of residential structures constructed on or after January 1, 1979 or schools constructed on or after January 1, 1993, may have surfaces coated with lead-based paint. As a result, any commercial or industrial structures, regardless of construction date, may have surfaces coated with lead-based paint.

Abatement, mitigation, and management of lead-based paint on building surfaces are currently regulated by several federal, state, and local agencies. However, evaluation of potential lead contamination in soil is part of the environmental review process for school sites under DTSC oversight (Ed. Code, § 17213.1). Weathering, scraping, chipping, and abrasion may cause lead to be released to and accumulated in soil around these structures. If the site historically included or currently includes structures with potential lead-based paint, soil sampling for lead in soil should be conducted. A decision tree to evaluate whether lead in soil from lead-based paint may be a concern is provided in Figure 1. If a lead inspection was performed, it may be submitted for DTSC to evaluate in conjunction with site-specific information to determine if lead in soil may be a concern.

4.1 Soil Sampling

A decision tree to select the appropriate sampling strategy for sampling for lead in soil from lead-based paint is provided in Figure 2, and details for pre- and post-demolition sampling strategies are provided in the following sections. The pre-demolition sampling strategy may also be used to evaluate existing structures with potential lead-based paint that will remain on site and be incorporated into the school.

FIGURE 1
Determining If Lead in Soil is a Concern

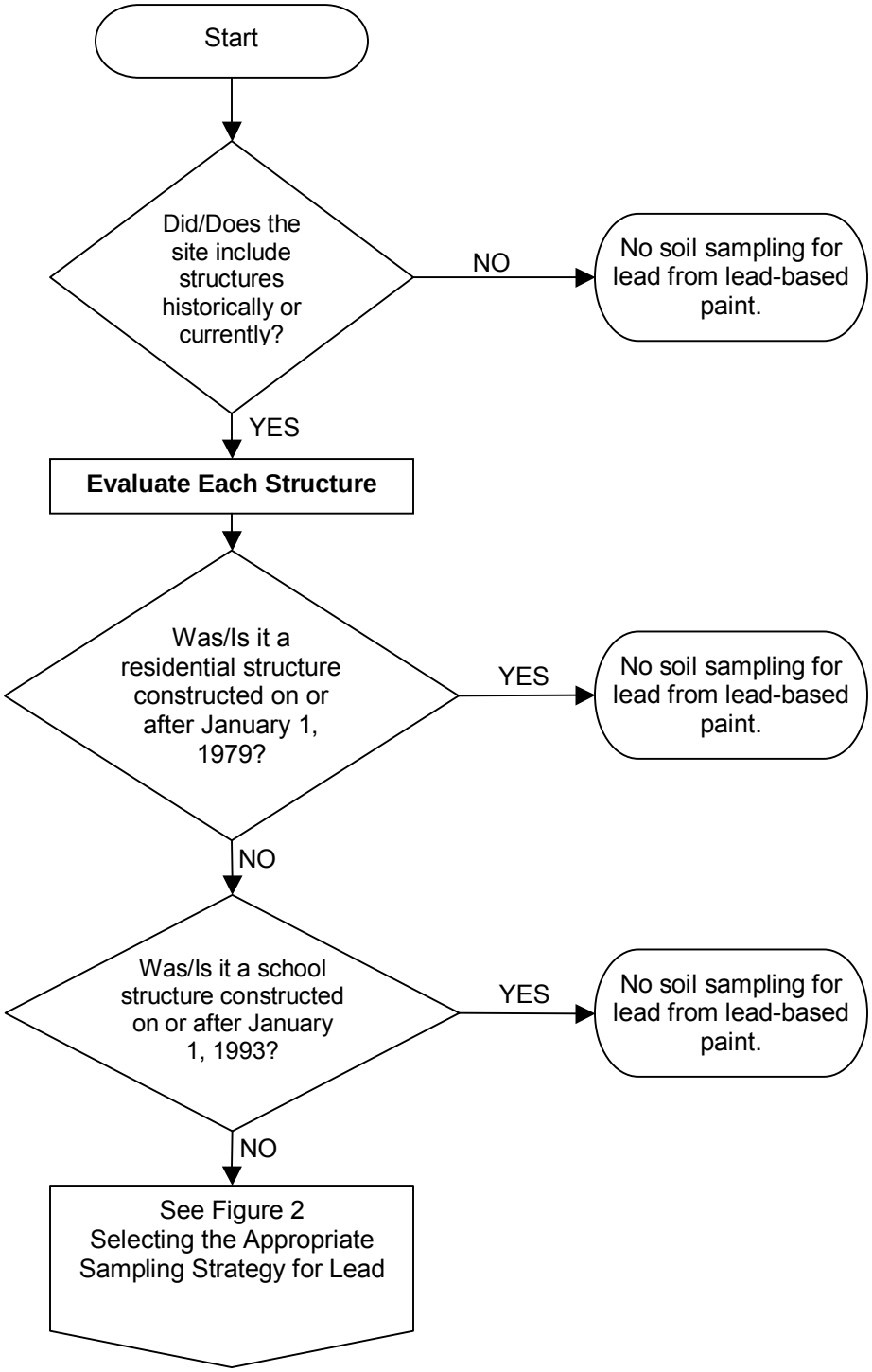
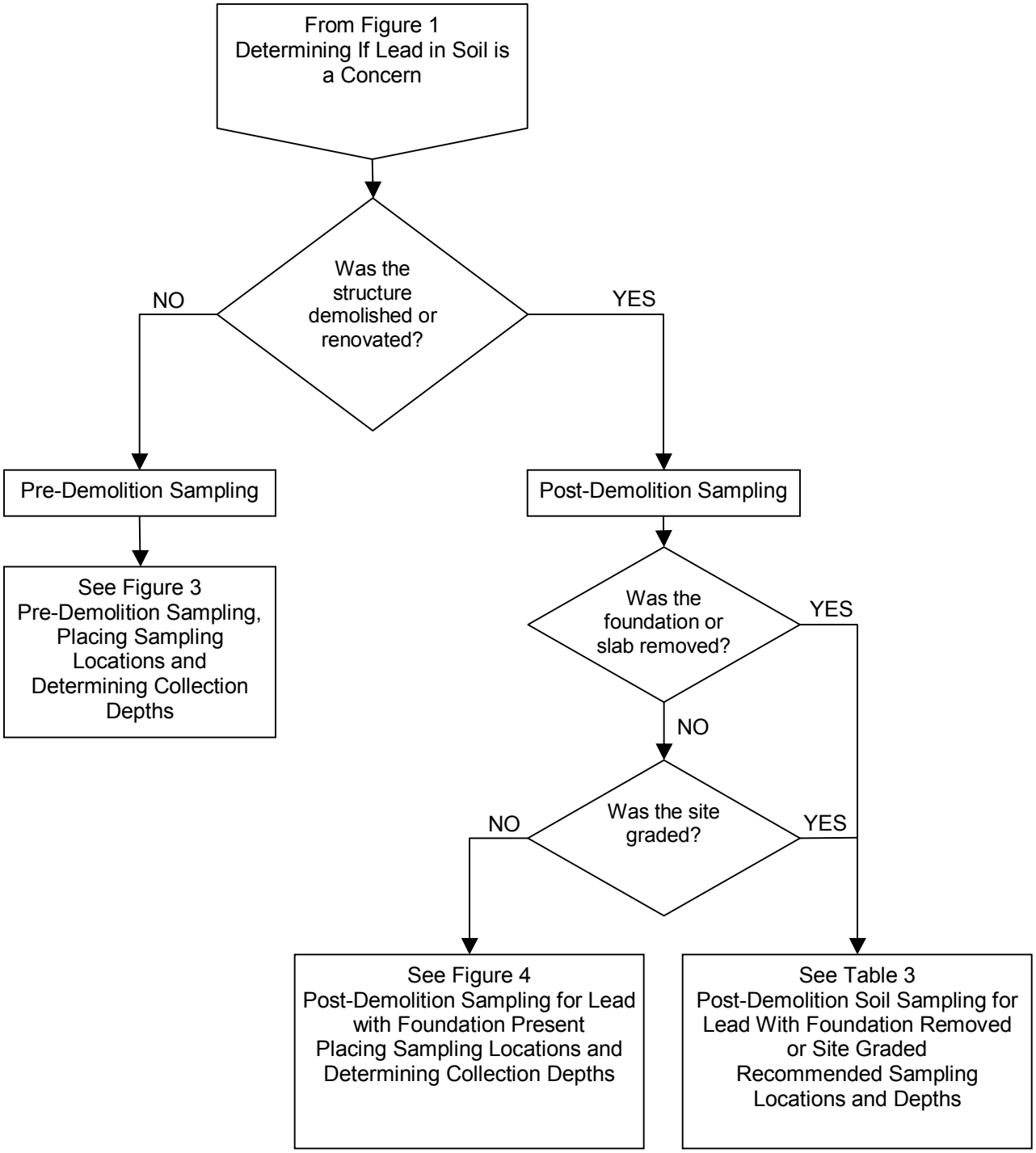


FIGURE 2
Selecting the Appropriate Sampling Strategy for Lead



4.1.1 PRE-DEMOLITION SAMPLING

A visual inspection of the site is useful to determine the presence, location, and extent of deteriorated paint. Any observations should be used to focus soil sampling around structure perimeters in areas with the highest potential for lead deposits.

The recommended number of sampling locations may vary depending on the type and number of structures, and conditions found. Table 1 provides a recommended minimum number of sampling locations for pre-demolition sampling. In general, more samples are recommended as the surface area of the structure increases.

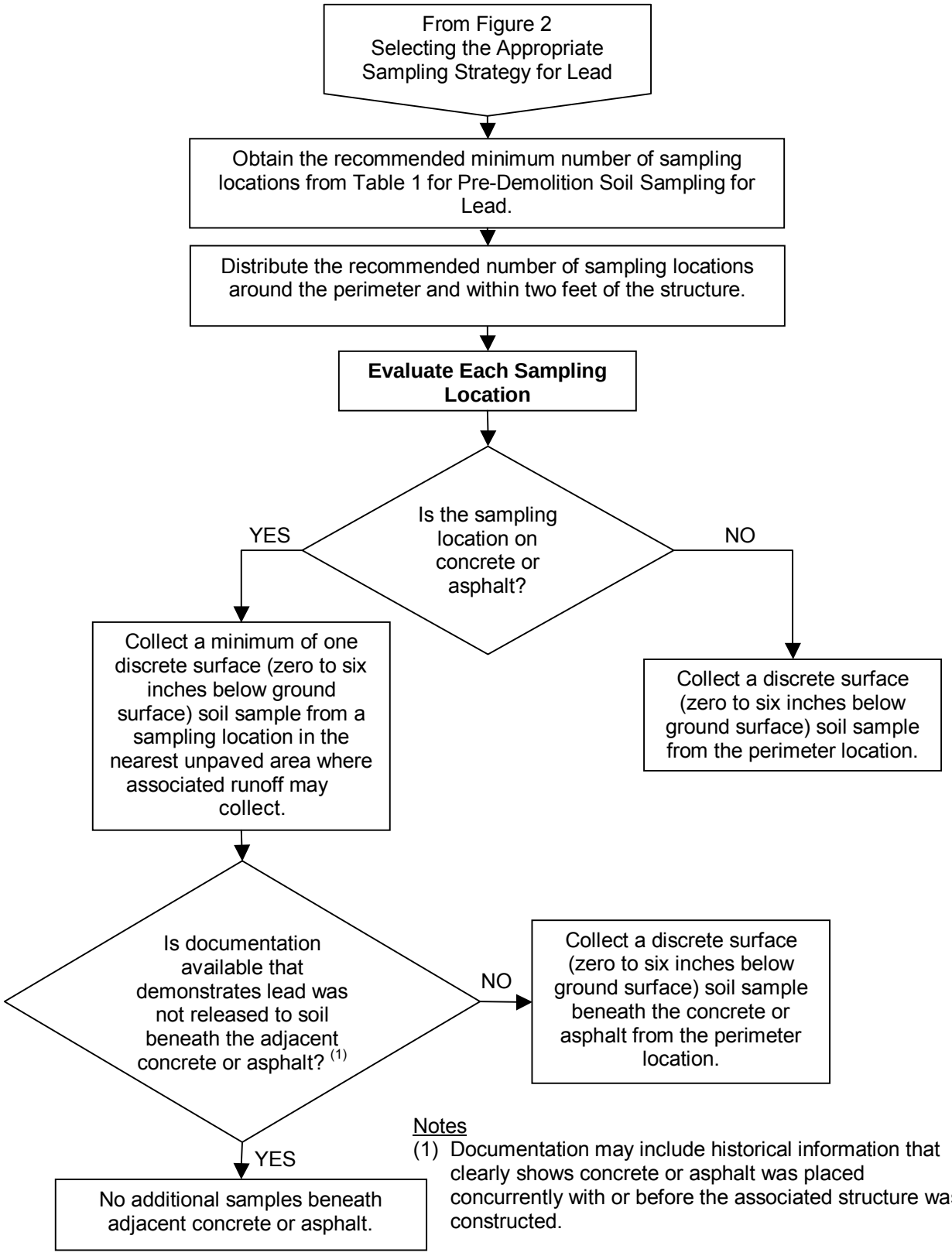
Sampling locations should be distributed around the perimeter within two feet of the structure. If concrete or asphalt borders the structure, sampling locations should be placed in the nearest unpaved areas where associated runoff may collect. Additional sampling locations may be used to evaluate potential releases of lead beneath adjacent concrete or asphalt placed after the structure was constructed. Discrete surface (zero to six inches below ground surface) soil samples should be collected from each sampling location. A decision tree is provided in Figure 3 for sampling location placement and sample collection depths.

TABLE 1
Pre-Demolition Soil Sampling for Lead
Recommended Minimum Number of Sampling Locations

Structure Type	Recommended Minimum Number of Sampling Locations (1)
Single-family housing, multi-family housing (up to and including four units), or detached carports/garages	Four locations for each structure.
Out buildings (shed or similar small structures)	Two locations for each structure.
Multi-family housing (more than four units), commercial structures, or barns	Six locations for each structure.

Notes
(1) Additional sampling locations may be used to evaluate potential releases of lead beneath adjacent concrete or asphalt placed after the structure was constructed. Refer to Figure 3 – Pre-Demolition Sampling, Placing Sampling Locations and Determining Collection Depths.

FIGURE 3
Pre-Demolition Sampling
Placing Sampling Locations and Determining Collection Depths



Notes
(1) Documentation may include historical information that clearly shows concrete or asphalt was placed concurrently with or before the associated structure was constructed.

4.1.2 POST-DEMOLITION SAMPLING

Two post-demolition (structure has been demolished or renovated) sampling strategies are provided for conditions that may be encountered on a site:

- Foundation Present (Section 4.1.2.1)
    - Foundation present and site not graded.
- Foundation Removed or Site Graded (Section 4.1.2.2)
    - Foundation present and site graded.
    - Foundation removed and site not graded.
    - Foundation removed and site graded.

Demolition or renovation activities may result in spreading of contamination resulting from removal of associated debris. To evaluate this possibility, samples at the extent soil disturbed by debris removal, inside the footprint of the former structure, and/or at depth are incorporated into the sampling strategies, as appropriate. The following sections detail sampling strategies for each condition.

4.1.2.1 Foundation Present

If the structure foundation or slab is present and the site has not been graded, a visual inspection of the site may be useful to help focus soil sampling around the structure foundation to sample areas with the highest potential for lead deposits.

The recommended number of sampling locations may vary depending on the type and number of structures, and conditions found. Table 2 provides a recommended minimum number of sampling locations for post-demolition sampling when the structure foundation is present. In general, more samples are recommended as the surface area of the structure increases.

Two sets of sampling locations should be distributed around the perimeter, one set within two feet of the structure foundation and the second corresponding set at the extent of soil disturbed by debris removal. Each of the sampling locations in the second set should be placed in line with one location in the first set. If concrete or asphalt borders the structure foundation, sampling locations should be placed in the nearest unpaved areas where associated runoff may collect. If soil is exposed within the footprint of the former structure, interior sampling locations should be distributed inside the footprint. Additional sampling locations may be used to evaluate potential release of lead beneath adjacent concrete or asphalt placed after the structure was constructed. Discrete surface (zero to six inches below ground surface) soil samples should be collected from each sampling location. A decision tree is provided in Figure 4 for placement of sampling locations and sample collection depths.

TABLE 2
Post-Demolition Soil Sampling for Lead with Foundation Present Recommended Minimum Number of Sampling Locations

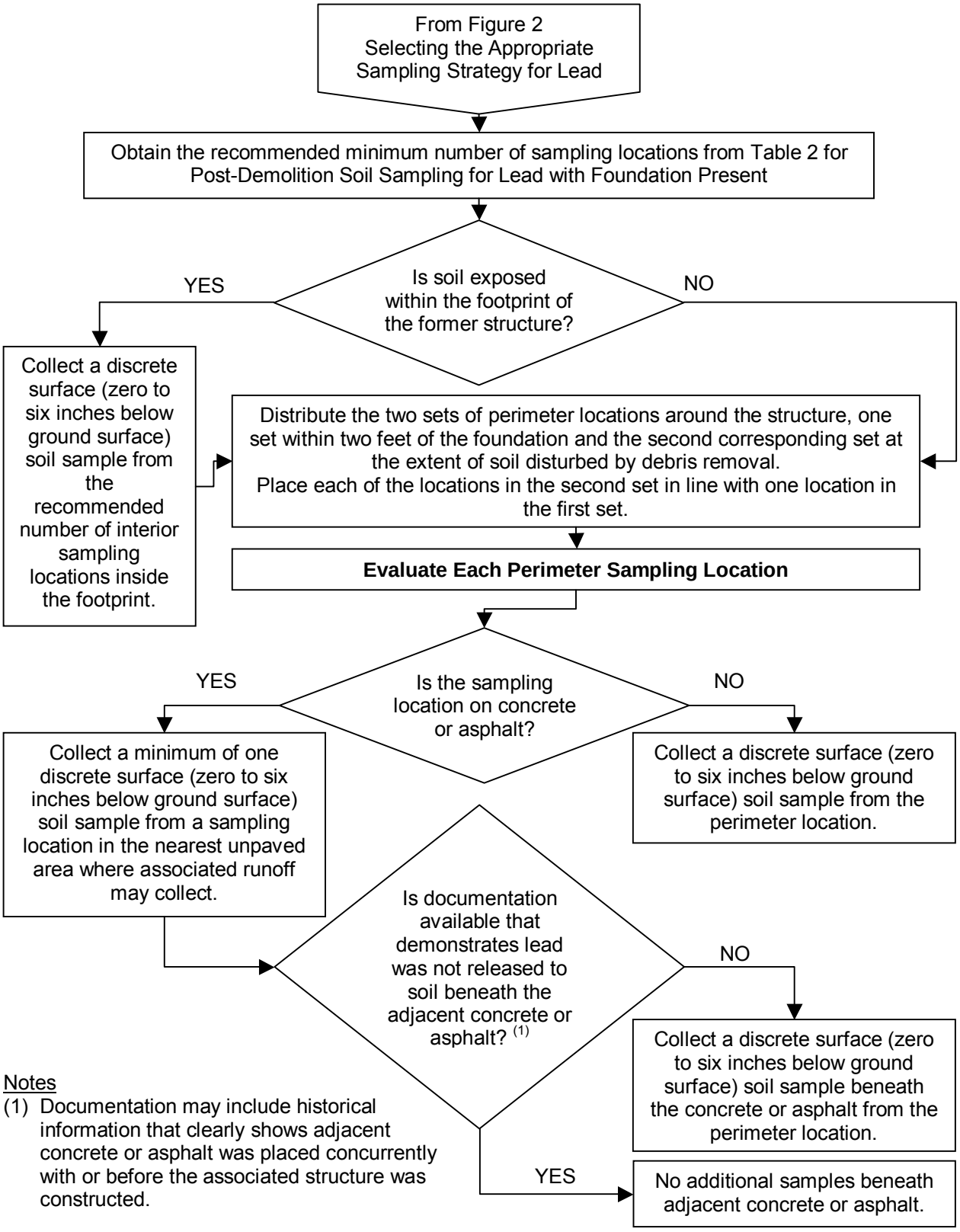
Structure Type	Recommended Minimum Number of Sampling Locations (1)
Single-family housing, multi-family housing (up to and including four units), or detached carports/garages	For each structure, two sets of four perimeter locations: • First set within two feet of the structure foundation. • Second set at the extent of soil disturbed by debris removal(2). If soil is exposed within the footprint of the former structure, two interior locations distributed inside the footprint.
Out buildings (shed or similar small structures)	For each structure, two sets of two perimeter locations: • First set within two feet of the structure foundation. • Second set at the extent of soil disturbed by debris removal(2). If soil is exposed within the footprint of the former structure, one interior location inside the footprint.
Multi-family housing (more than four units), commercial structures, or barns	For each structure, two sets of six perimeter locations: • First set within two feet of the structure foundation. • Second set at the extent of soil disturbed by debris removal(2). If soil is exposed within the footprint of the former structure, four interior locations distributed inside the footprint.

Notes

(1) Additional sampling locations may be used to evaluate potential release of lead beneath adjacent concrete or asphalt placed after the structure was constructed. Refer to Figure 4 – Post-Demolition Sampling for Lead with Foundation Present, Placing Sampling Locations and Determining Collection Depths.

(2) Place each sampling location in the second set in line with one location in the first set.

FIGURE 4
Post-Demolition Sampling for Lead with Foundation Present
Placing Sampling Locations and Determining Collection Depths



Notes
(1) Documentation may include historical information that clearly shows adjacent concrete or asphalt was placed concurrently with or before the associated structure was constructed.

4.1.2.2 Foundation Removed or Site Graded

If the structure foundation or slab was removed or the surrounding soil was graded, the following procedure should be used to collect samples from the site:

1. Determine the number of recommended sampling locations for each structure historically or currently present on site based on type (See Table 3).
2. Add up the number of recommended sampling locations for each structure to obtain the total number of sampling locations for the site.
1. Overlay a grid onto the site. The number of grid cells should correspond to the total number of sampling locations for the site. Place one sampling location at the center of each grid cell. For sites with distinct use areas, such as agriculture with a residential structure, the grid should be place over the area associated with the structure(s) and soil disturbed by demolition activities based on review of historical information.
2. Collect discrete surface (zero to six inches below ground surface) and subsurface (two to three feet below ground surface) soil samples from each sampling location.

The recommended number of sampling locations may vary depending on the type and number of structures, and conditions found. Table 3 provides recommended sampling locations and depths for post-demolition sampling when the structure foundation has been removed. In general, more samples are recommended as the surface area of the structure increases.

TABLE 3
Post-Demolition Soil Sampling for Lead
with Foundation Removed or Site Graded
Recommended Sampling Locations and Depths

Step 1:	**Determine the recommended number of sampling locations for each historic or current structure on site.**	
	Structure Type	**Recommended Number of Sampling Locations**
	Single-family housing, multi-family housing (up to and including four units), or detached carports/garages	Six locations for each structure.
	Out buildings (shed or similar small structures)	Four locations for each structure.
	Multi-family housing (more than four units), commercial structure, or barns	Eight locations for each structure.
Step 2:	**Add up the number of sampling locations for each structure to obtain the total number of sampling locations for the site.**	
Step 3:	**Overlay a grid onto the site. The number of grid cells should correspond to the total number of sampling locations for the site. Place one sampling location at the center of each grid cell.** **For sites with distinct use areas, such as agriculture with a residential structure, the grid should be placed over the area associated with the structure(s) based on review of historical information.**	
Step 4:	**Collect discrete surface (1) and subsurface (2) samples from each sampling location.**	

Notes
(1) Surface samples should be collected from zero to six inches below ground surface.
(2) Subsurface samples should be collected from two to three feet below ground surface.

4.2 Sample Analysis

Samples for lead in soil may be analyzed using field and/or laboratory methods. For analysis, subsamples of surface samples (zero to six inches below ground surface) should consist of the uppermost soil from the core (closest to ground surface). To assist the laboratory, the surface, or top of core, should be labeled in the field. Suggested analytical methods and quantitation limits for lead in soil are provided below.

It is advisable for soil samples to be analyzed pursuant to California Code of Regulations, title 22, section 69103, subsection (a)(2), which references United States Environmental Protection Agency (U.S. EPA) test methods available in “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,” EPA Publication SW-846 Third Edition, November 1986 (SW-846), as amended.

Preparation and analytical methods used should result in reporting the total lead concentration in the sample being analyzed. Quantitation limits for lead should be less than the reference concentration (e.g. screening value) used for comparison. Suggested quantitation limits are based on consideration of the applicable reference concentration and represent the level routinely achievable by the DTSC Environmental

Chemistry Laboratory. Suggested methods and quantitation limits for lead analysis are listed in Table 4.

TABLE 4
Methods and Quantitation Limits for Lead Analysis

Analyte	CASRN	Media	Analytical Method	Quantitation Limit (mg/kg or ppm)
Lead	7439-92-1	Soil	LABORATORY U.S. EPA Method 6010, 6020, or 7000 (AA only, not GFAA)	50
			FIELD U.S. EPA Method 6200 (1)	50

Abbreviations

AA	atomic absorption
CASRN	chemical abstracts registry number
GFAA	graphite furnace atomic absorption
mg/kg	milligrams per kilogram
ppm	parts per million
U.S. EPA	United States Environmental Protection Agency

Notes

(1) On-site field analyses for lead in soil may be conducted using portable x-ray fluorescence (XRF) in accordance with U.S. EPA Method 6200 and supplemental guidelines described in Section 4.2.

On-site field analyses for lead in soil may be conducted using portable x-ray fluorescence (XRF) in accordance with U.S. EPA Method 6200 and the following supplemental guidelines.

- In-situ XRF analyses (i.e. readings taken directly off the soil) of lead in soil are not acceptable for this initial assessment.
- Training and Licensing
  - XRF operators should possess a Radioactive Materials License issued by the California Department of Health Services.
  - XRF operators should be trained to operate the specific piece of equipment used.
- Sample Preparation
  - As long as the samples are well homogenized, use of a No. 60 (250 µm) as described in U.S. EPA Method 6200 (U.S. EPA 1998a and 1998b), Section 11.6, sieve is optional. A No. 10 (2.0 mm) sieve may be used to remove large debris and obtain a total soil sample that includes both coarse and fine fractions (rather than just the fine fraction that passes through a No. 60 (250 µm) sieve).
  - Consistent with U.S. EPA Method 6200 (U.S. EPA 1998a and 1998b), Sections 7.2.2 and 11.5, microwave drying is not recommended; however, other methods and times may be used to dry the sample. Moisture content above 20 percent may interfere with analysis, since moisture

alters the soil matrix for which the field-portable XRF has been calibrated. The effect of moisture on XRF results is site-specific. Accordingly, samples should be sufficiently dried to obtain an acceptable correlation coefficient as described in the bulleted item for confirmatory samples below.
    - Grinding of the sample as described in U.S. EPA Method 6200 (U.S. EPA 1998a and 1998b), Section 11.6, is optional and may not be necessary as long as the sample is sieved properly.
- Instrument Calibration
    - Initial and continuing calibration should be conducted in accordance with manufacturer's instructions for soil samples and a standard soil sample containing lead concentration near the screening value of 255 milligrams of lead per kilogram of soil (mg/kg) should be measured and documented. The development and use of the screening value for lead is presented in Section 4.3.
- Confirmatory Samples
    - A confirmatory sample should be a split sample from the well homogenized sample material. Confirmatory samples for 10 percent of the samples (but not less than five) should be forwarded for laboratory analysis. Consistent with U.S. EPA Method 6200 (U.S. EPA 1998a and 1998b), confirmatory samples should be selected from the lower, middle, and upper range measured using XRF. Samples with XRF results near the screening value of 255 mg/kg should also be included.
    - Consistent with U.S. EPA Method 6200, XRF results and laboratory analytical results for associated confirmatory samples should be evaluated with a least squares linear regression analysis (U.S. EPA 1998a and 1998b). The correlation coefficient (r^2) for the results should be 0.8 or greater for the XRF data to be considered valid for initial evaluation of lead in soil at the site (U.S. EPA 1995a).

4.3 Data Interpretation and Assessment

After verifying and validating the analytical data as specified in Section 7.0, detected concentrations of lead in soil from lead-based paint should be compared to the screening value to determine if further investigation is required. The screening value for lead in soil from lead-based paint at proposed school sites is 255 milligrams per kilogram (mg/kg or parts per million, ppm). The value is derived using the DTSC Lead Risk Assessment Spreadsheet, LeadSpread 7 (DTSC 1999), and represents the soil concentration that is predicted to result in a 99th percentile estimate of blood lead equal to 10 micrograms of lead per deciliter of blood (µg/dL) for a child. The threshold blood lead value of 10 µg/dL is the level of concern identified by the United States Department of Health and Human Services, Centers for Disease Control and Prevention (CDC). The value is subject to change and revision when the DTSC Lead Risk Assessment Spreadsheet is updated or other information is made available**.**

The following input values were used in the worksheet to obtain the screening value:

- Lead in air: Default value of 0.028 micrograms per cubic meter (µg/m^3) based on ambient air lead concentration data from the California Air Resources Board.
- Lead in water: Default value of 15 micrograms per liter (µg/L) based on the California Maximum Contaminant Level.
- Home-grown produce: Zero percent since this pathway is not considered a potential exposure pathway for school sites.
- Respirable dust: Default value of 1.5 µg/m^3 based on Table 3 in Appendix D of the U.S. EPA *Soil Screening Guidance: Technical Background Document* (U.S. EPA 1996b).

The maximum concentration of lead detected on the proposed school site should be compared to the screening value. Generally, sites with lead concentrations detected below the screening value will require no further action and those with lead concentrations detected at or above the screening value will require additional evaluation, investigation, or response action. However, these are general guidelines and DTSC will make a determination, such as additional evaluation for sites with lead concentrations approaching the screening value, based on site-specific information.

5.0 ORGANOCHLORINE PESTICIDES FROM TERMITICIDE APPLICATION

Organochlorine pesticides (OCPs) were commonly used as insecticides for termite control around structures. These OCPs included chlordane, lindane, heptachlor and aldrin, which readily converts to dieldrin in the environment.

OCPs were applied surficially to soil surrounding foundations and injected into the soil in an effort to isolate wood structures from termite nests (Ebeling 1975). Additionally, more recent federal requirements suggest that termite activity is generally limited to the upper four feet of soil (U.S. EPA 1996a). Historically, the following methods were used to apply OCPs for termite control:

- Pre-construction: Soil drenched with termiticides prior to construction of concrete slab foundations.
- Trenching: Trenches, approximately 12 inches deep, excavated around a structure near the foundation and filled with termiticide to saturate the soil to approximately 12 inches beneath the trench bottom.
- Spot treatment: Termiticide pumped into holes drilled into concrete foundations and surrounding soil in infested areas.
- Bait: Termiticide in food pellets placed underground.
- Homeowner: Termiticides applied surficially in and around structures.

Chlordane was used in the United States from 1948 until 1988, when it was banned by U.S. EPA. Because of evidence of human exposure and accumulation in body fat, as well as persistence in the environment and effects on wildlife, U.S. EPA prohibited the use of chlordane in 1988 to control termites around homes and structures. It is estimated that chlordane was applied to over 30 million homes in the United States,

often at concentrations far higher than those recommended by the manufacturer because of homeowner application (Kilburn and Thornton 1995). Chlordane is listed as one of the twelve persistent organic pollutants by U.S. EPA based on its resistance to chemical and biological degradation. When applied to soil around structures, chlordane adsorbs to organic matter and clay particles and slowly volatilizes into the atmosphere. The other OCPs which were also used as termiticides have also been banned by the U.S. EPA.

Chlordane is considered a Class B2 carcinogen by U.S. EPA (U.S. EPA 1997, 2002a), and is listed as a carcinogen by the State of California (OEHHA 2005). Chronic exposure of people to chlordane may also result in adverse effects on the nervous, respiratory, and cardiovascular systems, as well as the liver, blood, and lung. The other OCPs used as termiticides are also considered by both U.S. EPA and the State of California to be possible carcinogens.

Widespread application of chlordane and other OCPs is known to have occurred around structures in various regions (Colorado, Florida, Louisiana, Massachusetts, New Jersey, and Texas) throughout the United States. However, due to the lack of data on pesticide residues at residential properties in California and the prevalence of termites throughout the state (Ebeling 1975 and UC 2001), DTSC conducted an investigation of three proposed school sites with residential structures to evaluate the presence and prevalence of chlordane and other OCPs as a result of termiticide application. The results of this study are presented in the report, *Residential Pesticide Study, Final Report* (DTSC 2006).

The study focused on three proposed school sites with multiple housing units on each site in three Southern California counties (Los Angeles, San Bernardino, and San Diego). Risk-screening evaluation results indicated an unacceptable excess cancer risk for a residential, unrestricted land use scenario at all three sites, primarily associated with chlordane and dieldrin in surface soil. Approximately 50 percent of chlordane and dieldrin detections had an associated risk greater than one in a million ($>1x10^{-6}$), and approximately 20 percent of chlordane and dieldrin detections had an associated risk greater than one in 100,000 ($>1x10^{-5}$).

In addition to the three school sites included in the study, DTSC investigated OCPs from terimiticide application at residential properties proposed for school sites in various counties throughout California, including Alameda, Contra Costa, Fresno, Kern, Los Angeles, Merced, Riverside, San Diego, San Joaquin, Santa Cruz, and Stanislaus. Of a total of 23 sites (including three sites from the study), further investigation and/or removal actions were conducted for OCPs from termiticide application at approximately 70 percent of the sites evaluated (DTSC 2006).

The results of this study indicate that it is likely that significant concentrations of OCP residues may exist around structures with wood components built prior to January 1, 1989 and should be evaluated at school sites.

5.1 Soil Sampling

A decision tree to determine whether OCPs in soil from temiticide application may be a concern and the appropriate strategy is provided in Figure 5 and details for pre- and post-demolition sampling strategies are provided in the following sections. The pre-demolition sampling strategy may also be followed to evaluate existing wooden structures, constructed prior to January 1, 1989, that will remain on site and be incorporated into the school.

Locations and depths of soil samples to be collected for OCPs may coincide with those to be collected for lead. If this occurs, the same soil samples analyzed for lead may be analyzed for OCPs.

5.1.1 PRE-DEMOLITION SAMPLING

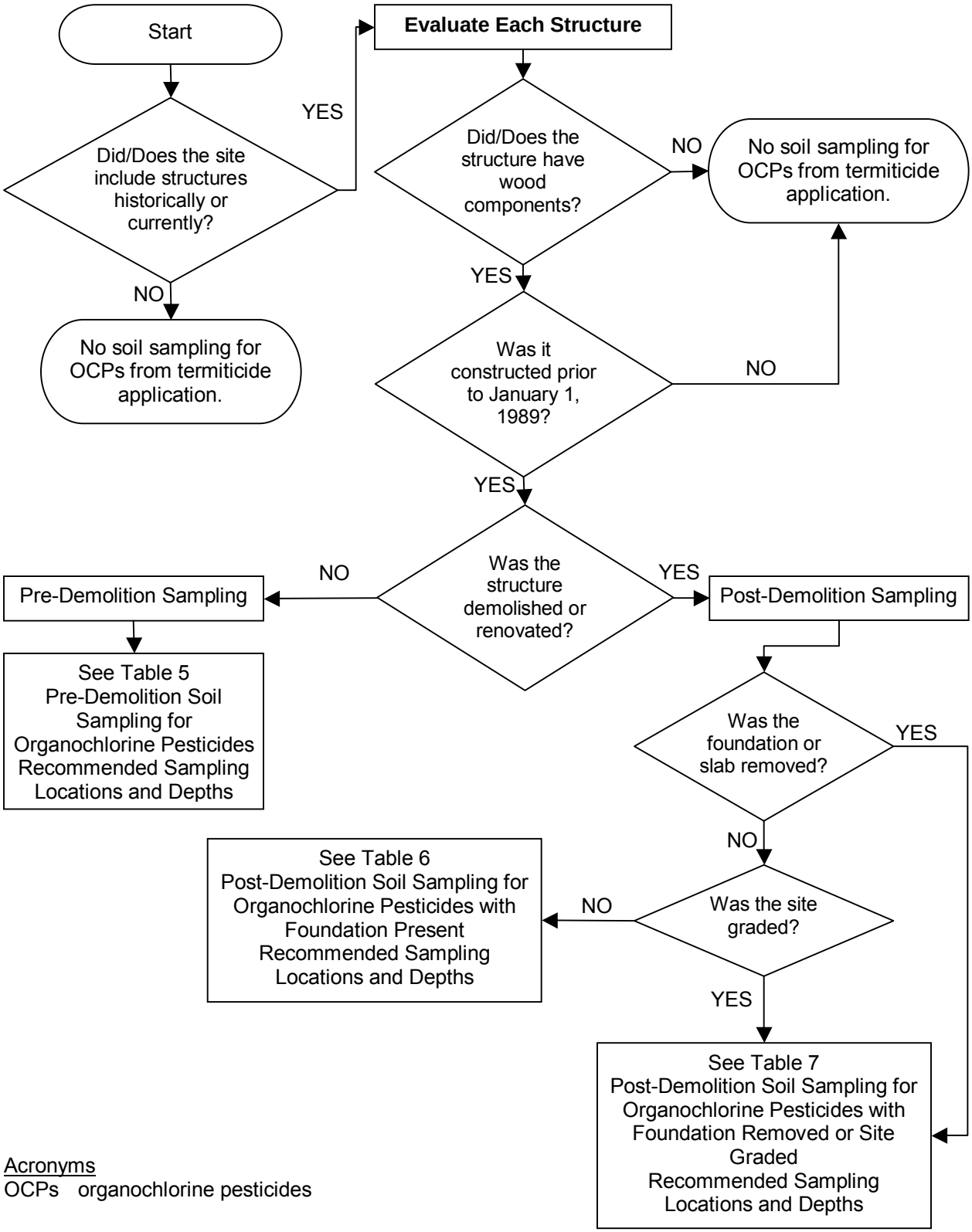
Soil sampling should be focused in areas with the highest potential for OCPs from termiticide application. The recommended number of sampling locations may vary depending on the type and number of structures, and conditions found. Table 5 provides recommended sampling locations, depths, and compositing guidelines for pre-demolition sampling. In general, more samples are recommended as the surface area of the structure increases.

Sampling locations should be distributed around the perimeter within two feet of the structure. Discrete surface (zero to six inches below ground surface) and subsurface (two to three feet below ground surface) soil samples should be collected from these perimeter locations. If concrete or asphalt borders the structure, samples should be collected beneath these paved areas. Termiticide was generally applied immediately adjacent to foundations, and in some cases, may have been injected around the foundation. DTSC is available to discuss collection of samples beneath existing paved areas if the integrity of a structure will be affected.

Additional sampling locations should be placed beneath a raised floors and/or porches, if present. Only discrete surface (zero to six inches below ground surface) soil samples should be collected from these interior locations.

The same type of sample (perimeter or interior) collected from a single structure at the same depth may be composited and analyzed instead of analyzing each discrete sample separately. A maximum of four discrete samples may be composited and analyzed. Guidelines for compositing samples are provided in Section 5.2.

FIGURE 5
Determining If Organochlorine Pesticides in Soil are a Concern and Selecting the Appropriate Sampling Strategy



Acronyms
OCPs organochlorine pesticides

TABLE 5
Pre-Demolition Soil Sampling for Organochlorine Pesticides
Recommended Sampling Locations and Depths

Structure Type	Recommended Locations and Depths
Single-family housing, multi-family housing (up to and including four units), or detached carports/garages	For each structure, collect discrete surface (1) and subsurface (2) soil samples from four perimeter locations within two feet of the structure, near the foundation, and beneath paved areas, if present. • Four discrete surface samples can be composited for analysis. • Four discrete subsurface samples can be composited for analysis. For each structure, collect discrete surface (1) soil samples from four interior locations placed beneath raised floors and/or porches, if present. • Four discrete surface samples may be composited for analysis.
Out buildings (shed or similar small structures)	For each structure, collect discrete surface (1) and subsurface (2) soil samples from two perimeter locations within two feet of the structure, near the foundation, and beneath paved areas, if present. • Both discrete surface samples can be composited for analysis. • Both discrete subsurface samples can be composited for analysis. For each structure, collect discrete surface (1) soil samples from two interior locations placed beneath raised floors and/or porches, if present. • Both discrete surface samples may be composited for analysis.
Multi-family housing (more than four units), commercial structures, or barns	For each structure, collect discrete surface (1) and subsurface (2) soil samples from six perimeter locations within two feet of the structure, near the foundation, and beneath paved areas, if present. • Three discrete surface samples can be composited for analysis. • Three discrete subsurface samples can be composited for analysis. For each structure, collect discrete surface (1) soil samples from six interior locations placed beneath raised floors and/or porches, if present. • Three discrete surface samples may be composited for analysis.

Notes
(1) Surface samples should be collected from zero to six inches below ground surface.
(2) Subsurface samples should be collected from two to three feet below ground surface.

5.1.2 POST-DEMOLITION SAMPLING

Two post-demolition (structure has been demolished or renovated) sampling strategies are provided for conditions that may be encountered on a site:

- Foundation Present (Section 4.1.2.1)
    - Foundation present and site not graded.
- Foundation Removed or Site Graded (Section 4.1.2.2)
    - Foundation present and site graded.
    - Foundation removed and site not graded.
    - Foundation removed and site graded.

Demolition or renovation activities may result in spreading of contamination resulting from removal of associated debris. To evaluate this possibility, samples at the extent soil disturbed by debris removal are incorporated into the sampling strategies, as appropriate. The following sections detail sampling strategies for each condition.

5.1.2.1 Foundation Present

Soil sampling should be focused in areas with the highest potential for OCPs from termiticide application. The recommended number of sampling locations may vary depending on the type and number of structures, and conditions found. Table 6 provides recommended sampling locations, depths, and compositing guidelines for post-demolition sampling when the structure foundation is present. In general, more samples are recommended as the surface area of the structure increases.

Two sets of sampling locations should be distributed around the perimeter, one set within two feet of the structure foundation and the second corresponding set at the extent of soil disturbed by debris removal. Each of the sampling locations in the second set should be placed in line with one location in the first set. If soil is exposed within the footprint of the former structure, interior sampling locations should be distributed inside the footprint. Discrete surface (zero to six inches below ground surface) and subsurface (two to three feet below ground surface) soil samples should be collected from these perimeter and interior locations. If concrete or asphalt borders the structure, samples should be collected beneath these paved areas. Termiticide was generally applied immediately adjacent to foundations, and in some cases, may have been injected around the foundation. DTSC is available to discuss collection of samples beneath existing paved areas if the integrity of a structure will be affected.

The same type of sample (first set of perimeter, second set of perimeter, or interior) collected from a single structure at the same depth may be composited and analyzed instead of analyzing each discrete sample separately. A maximum of four discrete samples may be composited for analysis. Guidelines for compositing samples are provided in Section 5.2.

TABLE 6
Post-Demolition Soil Sampling for Organochlorine Pesticides with Foundation Present
Recommended Sampling Locations and Depths

Structure Type	Recommended Sampling Locations and Depths
Single-family housing, multi-family housing (up to and including four units), or detached carports/garages	For each structure, collect discrete surface (1) and subsurface (2) soil samples from the following locations: • First set of four perimeter locations within two feet of the structure foundation. - Four discrete surface samples may be composited for analysis. - Four discrete subsurface samples may be composited for analysis. • Second set of four perimeter locations at the extent of soil disturbed by debris removal (3). - Four discrete surface samples may be composited for analysis. - Four discrete subsurface samples may be composited for analysis. • If soil is exposed within the footprint of the former structure, two interior locations distributed inside the footprint. - Two discrete surface samples may be composited for analysis. - Two discrete subsurface samples may be composited for analysis.
Out buildings (shed or similar small structures)	For each structure, collect discrete surface (1) and subsurface (2) soil samples from the following locations: • First set of two perimeter locations within two feet of the structure foundation. - Both discrete surface samples may be composited for analysis. - Both discrete subsurface samples may be composited for analysis. • Second set of two perimeter locations at the extent of soil disturbed by debris removal (3). - Both discrete surface samples may be composited for analysis. - Both discrete subsurface samples may be composited for analysis. • If soil is exposed within the footprint of the former structure, one interior location should be placed inside the footprint.
Multi-family housing (more than four units), commercial structures, or barns	For each structure, collect discrete surface (1) and subsurface (2) soil samples from the following locations: • First set of six perimeter locations within two feet of the structure foundation. - Three discrete surface samples may be composited for analysis. - Three discrete subsurface samples may be composited for analysis. • Second set of six perimeter locations at the extent of soil disturbed by debris removal (3). - Three discrete surface samples may be composited for analysis. - Three discrete subsurface samples may be composited for analysis. • If soil is exposed within the footprint of the former structure, four interior locations distributed inside the footprint. - Four discrete surface samples may be composited for analysis. - Four discrete subsurface samples may be composited for analysis.

Notes
(1) Surface samples should be collected from zero to six inches below ground surface.
(2) Subsurface samples should be collected from two to three feet below ground surface.
(3) Place each sampling location in the second set in line with one location in the first set.

5.1.2.2 Foundation Removed or Site Graded

If the structure foundation or slab was removed or the surrounding soil was graded, the following procedure should be used to collect samples from the site:

1. Determine the number of recommended sampling locations for each structure historically or currently present on site based on type (See Table 7).
2. Add up the number of recommended sampling locations for each structure to obtain the total number of sampling locations for the site.
3. Overlay a grid onto the site. The number of grid cells should correspond to the total number of sampling locations for the site. Place one sampling location at the center of each grid cell. For sites with distinct use areas, such as agriculture with a residential structure, the grid should be place over the area associated with the structure(s) and soil disturbed by demolition activities based on review of historical information.
4. Collect discrete surface (zero to six inches below ground surface) and subsurface (two to three feet below ground surface) soil samples from each location.
5. As an option, up to four adjacent discrete samples from the same depth can be composited and analyzed.

Adjacent samples collected from the same depth may be composited and analyzed instead of analyzing each discrete sample separately. A maximum of four discrete samples may be composited for analysis. Guidelines for compositing samples are provided in Section 5.2.

The recommended number of sampling locations may vary depending on the type and number of structures, and conditions found. Table 7 provides recommended sampling locations and depths for post-demolition sampling when the structure foundation has been removed. In general, more samples are recommended as the surface area of the structure increases.

TABLE 7
Post-Demolition Soil Sampling for Organochlorine Pesticides with Foundation Removed or Site Graded Recommended Sampling Locations and Depths

Step 1:	**Determine the recommended number of sampling locations for each historic or current structure on site.**	
Structure Type		**Recommended Number of Sampling Locations**
Single-family housing, multi-family housing (up to and including four units), or detached carports/garages		Six locations for each structure.
Out buildings (shed or similar small structures)		Four locations for each structure.
Multi-family housing (more than four units), commercial structures, or barns		Eight locations for each structure.
Step 2:	**Add up the number of sampling locations for each structure to obtain the total number of sampling locations for the site.**	
Step 3:	**Overlay a grid onto the site. The number of grid cells should correspond to the total number of sampling locations for the site. Place one sampling location at the center of each grid cell.** **For sites with distinct use areas, such as agriculture with a residential structure, the grid should be placed over the area associated with the structure(s) based on review of historical information.**	
Step 4:	**Collect discrete surface (1) and subsurface (2) samples from each sampling location.**	
Step 5:	**(Optional) Up to four adjacent discrete samples from the same depth can be composited for analysis.**	

Notes
(1) Surface samples should be collected from zero to six inches below ground surface.
(2) Subsurface samples should be collected from two three feet below ground surface.

5.2 Sample Compositing

A maximum of four discrete samples may be composited for analysis of OCPs around structures for the initial assessment in order to expedite the process and reduce associated analytical costs. However, compositing may increase labor and equipment costs due the additional time and equipment needed to prepare the composited samples. The following compositing guidelines are provided for each sampling strategy:

- Pre-demolition sampling – Discrete samples of the same type (perimeter or interior), collected from the same structure, at the same depth may be composited.
- Post-demolition sampling when the structure foundation is present – Discrete samples of the same type (first set of perimeter, second set of perimeter, or interior), collected from the same structure, at the same depth may be composited.

- Post-demolition sampling when the structure foundation is not present or site is graded – Discrete samples from adjacent locations, collected from the same depth, may be composited.

For compositing, discrete samples should be individually collected, homogenized, and split. A portion of the homogenized discrete sample should be preserved and archived in case additional analysis is necessary based on analytical results of the composited samples. Aliquots of equal amounts of soil from each homogenized discrete sample should be placed into a clean container, such as a bowl, and thoroughly homogenized. The resulting composited sample can be submitted for analysis.

To ensure the integrity of the samples and usability of the resulting data, it is recommended that sample handling and preservation follow SW-846 and subsequent amendments. Samples should be analyzed within the specified holding time. Soil samples collected in 250 milliliter (mL) wide-mouth glass containers with polytetrafluoroethylene (PTFE)-lined lids may be cooled to 4 Celsius (°C). Samples should be extracted within 14 days of collection, and extracts should be analyzed within 40 days following extraction (U.S. EPA 2000).

Adjustments to the screening values have been made to accommodate composited samples and are discussed in Section 5.4. The individual discrete samples should be analyzed when the results of a composited sample meets or exceeds the screening value.

5.3 Sample Analysis

It is advisable for soil samples to be analyzed using U.S. EPA test methods available in SW-846 (U.S. EPA 1986) and subsequent amendments, such as U.S. EPA Method 8081 or an equivalent method capable of attaining the quantitation limits listed in Table 8.

Quantitation limits for OCPs should be less than the reference concentration (e.g. screening value) use for comparison. Recommended quantitation limits for laboratory analysis of OCPs are listed in Table 8. These represent the lowest quantitation limits that can be routinely achieved by the DTSC Environmental Chemistry Laboratory.

TABLE 8
Quantitation Limits for Organochlorine Pesticides Analysis

Analyte	CASRN	Quantitation Limit (µg/kg or ppb)
Aldrin	309-00-2	5
gamma-BHC (Lindane)	58-89-9	5
alpha-Chlordane	5103-71-9	5
gamma-Chlordane	5103-74-2	5
Chlordane (not otherwise specified)	57-74-9	50
4,4'-DDD	72-54-8	5
4,4'-DDE	72-55-9	5
4,4'-DDT	50-29-3	5
Dieldrin	60-57-1	5
Heptachlor	76-44-8	5

Abbreviations and Acronyms

BHC	hexachlorocyclohexane, HCH
CASRN	chemical abstracts registry number
4,4'-DDD	p,p'-Dichlorodiphenyldichloroethane
4,4'-DDE	p,p'-Dichlorodiphenyldichloroethylene
4,4'-DDT	p,p'-Dichlorodiphenyltrichloroethane
µg/kg	micrograms per kilogram
ppb	parts per billion
U.S. EPA	United States Environmental Protection Agency

5.4 Data Interpretation and Assessment

After verifying and validating the analytical data as specified in Section 7.0, the detected concentrations of OCPs from termiticide application in soil should be compared to respective screening values to determine if further investigation is required. The screening values for OCPs are from the California Human Health Screening Levels (CHHSLs; Cal/EPA 2005) for soil for residential land use. CHHSLs are risk-based screening concentrations developed by the California Environmental Protection Agency (Cal/EPA) and are subject to change and revision as updated toxicological information is made available. An abbreviated list of CHHSLs for the most common OCPs used to control termites is provided in Table 9. Adjustments (screening value divided by the number of discrete samples in a composited sample) to the screening values for composited samples are also included in Table 9 (U.S. EPA 1995b).

The maximum concentration of each OCP detected on the proposed school site should be compared to the respective screening value. Generally, sites with OCP concentrations detected below the screening value will require no further action and those with OCP concentrations at or above the respective screening value will require additional evaluation, investigation, or a response action. However, these are general guidelines and DTSC will make a determination based on site-specific information, such

as additional evaluation for sites with concentrations of OCPs approaching the screening value.

TABLE 9
Soil Screening Values for Organochlorine Pesticides for Discrete and Composited Samples

Analyte	Discrete Sample Screening Value (µg/kg or ppb) (1)	Composited Sample Screening Value (µg/kg or ppb)		
	Composite Ratio (Composite:Discrete)	1:2	1:3	1:4
Aldrin	33	16	10	5
gamma-BHC (Lindane)	500	250	160	125
Chlordane (all forms)	430	215	140	105
4,4'-DDD	2,300	1,150	760	575
4,4'-DDE	1,600	800	530	400
4,4'-DDT	1,600	800	530	400
Dieldrin	35	16	10	5
Heptachlor	130	60	40	20

Abbreviations and Acronyms

BHC	hexachlorocyclohexane, HCH
CASRN	chemical abstracts registry number
4,4'-DDD	p,p'-Dichlorodiphenyldichloroethane
4,4'-DDE	p,p'-Dichlorodiphenyldichloroethylene
4,4'-DDT	p,p'-Dichlorodiphenyltrichloroethane
µg/kg	micrograms per kilogram
ppb	parts per billion

Notes

(1) California Human Health Screening Levels for soil for residential land use (Cal/EPA 2005).

(2) Screening values for composited samples are decreased in proportion to the number of discrete samples that makeup the composite sample in an effort to ensure hot spots are not missed (i.e. 100 percent of the measure concentration in a composited sample is from only one of the associated discrete samples).

6.0 POLYCHLORINATED BIPHENYLS FROM ELECTRICAL TRANSFORMERS

Polychlorinated biphenyls (PCBs) are man-made chemicals commonly used in the past as coolants and lubricants. PCBs are found as a clear to yellow, heavy oily liquid or waxy solid. PCBs were frequently used as insulation in electrical equipment because of their stablility, low water solubility, high boiling point, low flammability, and low electrical conductivity (ATSDR 2001, DTSC 2003, and U.S. EPA 2004a). PCBs were produced in the United States from approximately 1929 to 1977. Production of PCBs was banned in the United States by the Toxic Substances Control Act (TSCA) in 1978 due to evidence of accumulation in the environment and link to harmful health effects (DTSC 2003). U.S. EPA considers PCBs to be probable human carcinogens (U.S. EPA 2004c) and they are listed as carcinogens by the State of California (OEHHA 2005). PCBs may have serious effects on the immune, reproductive, nervous, and endocrine systems (U.S. EPA 2004c).

Prior to 1978, PCBs were often used in the manufacture of transformers and capacitors, and leaks or releases from transformers producing contaminated areas have been documented. The age of the transformer does not necessarily indicate the presence or absence of impacts to soil from PCBs, as releases of PCBs from a previous transformer may have occurred before its replacement. Once released to the environment, PCBs bind to soil particles and are very persistent.

Soil sampling is not necessary for transformers installed for the first time on or after January 1, 1979. Soil sampling should be conducted for any historical (removed or replaced by a newer transformer) or current transformers installed before January 1, 1979.

6.1 Soil Sampling

Since PCBs in soil generally do not migrate significantly, soil sampling should be focused around the base of each pole- or pad-mounted electrical transformer. Surface (zero to six inches below ground surface) and subsurface (two to three feet below ground surface) soil samples should be collected in the area with the highest potential for a release from the transformer. If a historical pad-mounted transformer, installed before January 1, 1979, was replaced by a newer transformer, samples should be collected beneath the replacement pad to evaluate potential releases from the historical transformer. Table 10 provides recommended sampling locations and depths.

TABLE 10
Recommended Soil Sampling Locations and Depths for Polychlorinated Biphenyls

Transformer Type	Sampling Locations	Sample Depths
Pole-mounted	One location within close proximity of the base of the pole or in areas of visible staining.	For each sampling location: • One discrete surface (1) soil sample. • One discrete subsurface (2) soil sample.
Pad-mounted	Two locations within close proximity of the transformer or in areas of visible staining.	For each sampling location: • One discrete surface (1) soil sample. • One discrete subsurface (2) soil sample.

Notes
(1) Surface samples should be collected from zero to six inches below ground surface.
(2) Subsurface samples should be collected from two to three feet below ground surface.

6.2 Sample Analysis

Initially surface samples may be analyzed for PCBs and subsurface samples may be preserved and archived. To ensure the integrity of the samples and usability of the resulting data, it is recommended that sample handling and preservation follow SW-846 and subsequent amendments. Samples collected in 250 mL wide-mouth glass containers with PTFE-lined lids may be cooled to 4°C with no specified holding time (U.S. EPA 2000). However, U.S. EPA Method 8082 recommends refrigerating extracts in the dark and analyzing with 40 days of extraction (U.S. EPA 2000). If PCBs are detected in surface samples, subsurface samples should be analyzed.

It is advisable for soil samples to be analyzed pursuant to California Code of Regulations, title 22, section 69103, subsection (a)(2), which references U.S. EPA test methods available in SW-846 (U.S. EPA 1986) and subsequent amendments, such as U.S. EPA Method 8082 or an equivalent method capable of attaining the quantitation limits listed in Table 11.

Quantitation limits for PCBs should be less than the reference concentration (e.g. screening value) use for comparison. Suggested methods and quantitation limits for laboratory analysis of PCBs are listed in Table 11. These represent the lowest quantitation limits that can be routinely achieved by the DTSC Environmental Chemistry Laboratory.

TABLE 11
Quantitation Limits for Polychlorinated Biphenyls Analysis

Analyte	CASRN	Quantitation Limit (mg/kg or ppm)
Aroclor-1016	12674-11-2	0.300
Aroclor-1221	11104-28-2	0.300
Aroclor-1232	11141-16-5	0.300
Aroclor-1248	12672-29-6	0.300
Aroclor-1254	11097-69-1	0.300
Aroclor-1260	11096-82-5	0.300

Abbreviations and Acronyms
CASRN chemical abstracts registry number
mg/kg milligrams per kilogram
ppm parts per million
U.S. EPA United States Environmental Protection Agency

6.3 Data Interpretation and Assessment

After verifying and validating the analytical data as specified in Section 7.0, the detected concentrations of PCBs (reported in concentrations of Aroclors) from electrical transformers in soil should be compared to the screening value to determine if further investigation is required. The soil screening value for PCBs from electrical transformers at proposed school sites is 0.300 mg/kg or ppm. This value corresponds to an approximate incremental cancer risk of 3.4×10^{-6}. Note that the CHHSL (Cal/EPA 2005) for PCBs in soil for residential land use is 0.089 mg/kg or ppm. However, this value cannot be routinely quantified through laboratory analysis.

The maximum concentration of each Aroclor detected on the proposed school site should be compared to the screening value. Unless sites have PCB concentrations detected above the screening value, no further action is required.

7.0 QUALITY ASSURANCE/QUALITY CONTROL

Site evaluation for lead, OCPs, and PCBs from specific sources described herein should include quality assurance/quality control (QA/QC) measures as part of sampling and analytical procedures. The purpose of these measures is to produce data of a known quality. The following QA/QC measures are recommended for cases in which limited number of samples are collected over a relatively short period of time.

- QA/QC samples
- Laboratory report
- Data validation memorandum

At a minimum, the QA/QC samples are listed in Table 12 should be used. These should be supplemented by additional laboratory QA/QC samples analyzed as part of standard laboratory practice.

TABLE 12
Quality Assurance/Quality Control Samples

Sample Type	Purpose	Preparation	Frequency
Field QA/QC Samples			
Collocated samples	Determine local variability of the soil and contamination at the site.	Collected within 0.5 to 3 feet of a field sample.	At least 10 percent of samples collected per event should be either collocated samples or field replicates. Minimum of one per matrix.
Field replicates (also known as field duplicates)	Assess error associated with sample heterogeneity, sample methodology and analytical procedures.	Split sample of a homogenized field sample.	
Equipment blanks (also known as rinsate blanks)	Assess cross-contamination resulting from improper decontamination procedures.	Run analyte-free water over decontaminated reusable sampling equipment to test for residual contamination.	One equipment blank per matrix per day, not to exceed one blank per 10 samples.
Field blanks	Evaluate contamination error associated with sampling methodology and laboratory procedures	Prepared in the field using clean sand or soil.	Minimum of one field blank sample per matrix per day if disposable sampling equipment is used and equipment blanks are not collected.
Temperature blank	Check the temperature of samples upon receipt at the laboratory.	40 milliliter VOA vial labeled, “temperature blank” in each cooler.	One per cooler.
Laboratory QA/QC Samples			
Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Samples	Used to check sample matrix interferences.	Field samples spiked in the laboratory with a known concentration of a target analyte to verify percent recoveries.	Minimum of one MS/MSD pair per 14 days or one per 20 samples (including blanks and duplicates), whichever is greater.

(DTSC 1994, U.S. EPA 2004d and 1995a)

A laboratory report should include the following information:

1. Environmental laboratory identification and verification that the laboratory is certified under the State of California Environmental Laboratory Accreditation Program (ELAP) or the National Environmental Laboratory Accreditation Program (NELAP) in the appropriate field of testing.
2. Case narrative signed by the laboratory manager, director, or designee that includes the following information:
   a. Client identification, project name, and site identification
   b. Sample designation
   c. Sample matrix

   d. Analytical method and analytes
   e. Dates of sample collection, preservation, preparation, extraction, and analysis
   f. Reporting units and quantitation limits
   g. Dilution factors
   h. Report page numbering system
   i. Holding times met or exceeded
   j. Description of problems
   k. Discussion of QA/QC criteria outside of acceptance limits and adverse impacts to sample integrity or data quality
   l. Discussion of sample handling.
3. Chain of custody forms
4. Holding times
5. Sample preservation
6. Field samples
7. Field QA/QC samples (e.g. collocated samples, field blanks, field replicates, rinsate blanks, as applicable)
8. Laboratory QA/QC samples (e.g. method blanks, laboratory control samples, matrix spike and matrix spike duplicate samples)
9. Surrogate spike recoveries (applicable for organic analyses only)
10. Summary of environmental results
11. Compound identification and quantification
12. Observations regarding any occurrences which may adversely affect sample integrity or data quality
13. Detailed description of all variances encountered during analysis, possible reasons, and corrective actions.

A data validation memorandum should be prepared by a qualified professional, such as a project manager, project QA/QC manager, or third-party QA/QC specialist. In addition to providing an evaluation of the information provided in the laboratory report, the memorandum should evaluate completeness of the laboratory report.

A data report for on-site field analysis for lead in soil using a portable XRF should include the following items:

1. XRF operator identification and verification that the operator has a Radioactive Materials License issued by the California Department of Health Services and training to operate the specific piece of equipment used.
2. Case narrative signed by the certified XRF operator performing the analyses that includes:
   a. Client identification, project name, and site identification
   b. Sample designation
   c. Sample matrix
   d. Analytical method and analytes
   e. Dates of sample collection, preparation, and analysis
   f. Reporting units and quantitation limits
   g. Report page numbering system
   h. Description of problems

i. Discussion of deviations from the recommended method and supplemental guidelines provided herein
j. Discussion of QA/QC criteria outside of acceptance limits and adverse impacts to sample integrity or data quality
k. Discussion of sample preparation and handling.

3. Chain of custody forms or field log sheets indicating sample collection dates and times.
4. Initial and continuing calibration.
5. Field samples
6. Field QA/QC samples (e.g. collocated samples, field blanks, field replicates, rinsate blanks, as applicable)
7. Compound identification and quantification.
8. Associated raw data

A data validation memorandum should be prepared by a qualified professional, such as a project manager, project QA/QC manager, or third-party QA/QC specialist. In addition to providing an evaluation of the information provided in the XRF data report, the memorandum should evaluate completeness of the report and correlation with associated laboratory analysis of confirmatory samples, and should include the following:

- Presentation and evaluation of laboratory analytical results for confirmatory samples.
    - Consistent with U.S. EPA Method 6200, XRF results and laboratory analytical results for associated confirmatory samples should be evaluated with a least squares linear regression analysis (U.S. EPA 1998a and 1998b). The correlation coefficient (r^2) for the results should be 0.8 or greater for the XRF data to be used considered valid for this initial assessment of the site (U.S. EPA 1995a).
- Determination regarding the validity of XRF for initial evaluation of lead.

8.0 PRESENTATION OF DATA

Sampling results and supporting information should be presented in a document such as a Phase I, Phase I Addendum, PEA, or SSI. The information included in the document should:

- Identify the recognized environmental concerns (lead-based paint, termiticides, or electrical transformers) being addressed and the related source of information.
- If DTSC provided a previous determination for the site, provide the date of the determination letter and include a copy of the letter in the appendix.
- Describe the results of visual inspections used to focus soil sampling.
- Describe the sampling approach.
- Identify sampling locations, depths, designation, and rationale.
- Describe the sample collection methods.
    - Sampling methods: Identify the standard operation method and step-by-step procedures of how each sample was collected, including equipment field quality controls.

    - Sample containers and preservation: Identify the types of containers and preservatives used for the different analyses and provide the pre-cleaning method used for the containers.
    - Sample packaging and shipment: Describe the methods for packaging, labeling, marking and shipping the samples.
    - Sample documentation: Describe the label and provide an example. Describe the unique number system used to positively identify each sample without distinguishing the QA/QC samples from other samples. Discuss the field documentation used and include field logs, photographs, and QC checklist or logs, and chain-of-custody forms in an appendix.
- Describe the sample preparation methods used to homogenize, split, and composite samples.
- Describe the QA/QC samples collected.
- List the analyses performed on each sample or group of samples, associated quantitation limits and holding times.
- Describe the field activities conducted in sufficient detail to demonstrate compliance with applicable requirements and to permit reconstruction by another environmental assessor.
    - Decontamination: Describe equipment decontamination procedures.
    - Field conditions: Include a qualitative summary of soil conditions with appropriate description of lithologic changes or evidence of fill material within a designated area. Discuss field variances from the guidance.
    - Health and Safety: Describe any health and safety procedures followed in the field, including safety equipment, personal protective equipment, level of protection, health and safety meetings, hazards encountered, and any instrument readings recorded. If XRF was used for lead analysis, include the qualifications of the operator, standard operating procedures, notes and compliance with radioactive safety requirements.
    - Waste management: Describe the management and disposition of wastes generated during the investigation, including soil cuttings, personal protective equipment, decontamination water, etc. Justification for the management and disposition of wastes should also be provided and should be consistent with the U.S. EPA Guide to Management of Investigation-Derived Wastes (IDW; U.S. EPA 1992).
- Discuss the analytical results.
- Evaluate the overall QA/QC used to ensure that sampling, field and laboratory chain-of custody, laboratory analyses, field and laboratory data measurements, and reporting activities provide data quality consistent with the intended use. As part of the project QA/QC evaluation, data validation should be performed for all submitted samples. Data quality should be defined by data quality indicators (accuracy, precision, method reporting limits, completeness, representativeness, and comparability). A summary of data validation should be included.
- Interpret the data and compare to screening values.
- Provide conclusions and recommendations based on comparison of sampling results to the provided health screening criteria.

- Include references to identify published referenced sources relied upon during the evaluation. Each referenced source shall be adequately annotated to facilitate retrieval by another party.
- Appendices should include site photographs, field logs, XRF data reports, analytical laboratory data reports, chain-of-custody documentation, and IDW disposal documentation, such as uniform hazardous waste manifests or bill of lading for non-hazardous waste.
- Figures
    - Site Vicinity Map – This map should include a north arrow, be to scale, and show the general location of the site relative to its surrounding area, including major highways, surface water bodies, land use, sensitive populations, and critical habitats.
    - Site Plan – This plan should include a north arrow, be to scale, and be of sufficient detail to show significant site features, including site boundaries, land use, paved areas, structures, drainage patters, current uses of the site, areas of known or suspected environmental conditions.
    - Sampling Locations with Analytical Results – This figure should show the samples collected and the associated analytical results overlaid onto the Site Plan. The figure should clearly show the sampling locations relative to the areas of recognized environmental conditions. The sampling locations, depths, matrices, analytes, detected concentrations, quantitation limit for non-detect concentrations, and concentration units should be clearly presented.
- Tables
    - Summary of analytical results, including analytical method, sampling locations, depths, matrix, detected concentrations, quantitation limit for non-detect concentrations, units, and comparison to screening values.

9.0 REFERENCES

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