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Interim Guidance for Sampling Agricultural Properties (Third Revision)

California Department of Toxic Substances Control
California Environmental Protection Agency

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Preface

In June 2000, DTSC issued "Interim Guidance for Sampling Agricultural Soils" to provide a uniform approach for evaluating former agricultural properties where pesticides have been applied, and DTSC issued the revised Version 2 in August 2002. Over the last seven years, DTSC has reviewed several hundred former agricultural properties across California. DTSC has been committed to revising and updating the approach to these properties as new information and issues emerge. This revised guidance, Version 3, incorporates and refines the sampling and risk assessment approach to former agricultural properties.

This guidance is intended to supplement the DTSC Preliminary Endangerment Assessment (PEA) Guidance Manual, CalEPA 1994 (Second Printing, June 1999). Data obtained from the investigations should be evaluated for potential health risks according the PEA Manual. This guidance is not intended to diminish the need to take focused, authoritative samples at site locations commonly associated with hazardous substances releases nor replace guidance provided by the PEA Guidance Manual. This guidance is not applicable to areas where pesticides were mixed, stored, disposed, or areas where pesticides may have accumulated, such as ponds and drainage ditches.

The scope of this document is limited to evaluating only agricultural properties during a PEA or other initial sampling investigation. This applies to proposed new and/or expanded school sites or other project where new land use could result in increased human exposure, especially residential use. Agricultural properties are lands where pesticides were uniformly applied for agricultural purposes consistent with normal application practices, and where other non-agriculturally related activities have been absent. Data obtained from the sampling analyses will be incorporated into the PEA Report, including performing a risk analysis in accordance with the guidance in the PEA Manual.

This guidance does not apply to disturbed land, such as, land that has been graded in preparation for construction, areas where imported soil has been brought in, or any other activity

that would redistribute or impact the soil, other than normal agricultural practices, such as disking and plowing.

This guidance is an on-going effort to streamline the characterization of agricultural properties. As additional knowledge and experience is obtained, DTSC may modify this guidance, as appropriate.

1.0 PURPOSE

This guidance was initially prepared for use in evaluating soil at proposed new school sites and existing schools undergoing expansion projects where the property was currently or previously used for agricultural activities. This guidance is now expanded to include any project with DTSC oversight and is intended to supplement the DTSC PEA, and provide a uniform and streamlined approach for evaluating agricultural properties. This guidance can be used to assist environmental assessors in designing initial investigations or developing PEA Workplans for properties with agricultural uses. The analytical data obtained are to be incorporated into a risk analysis and PEA Report performed in accordance with the guidance in the PEA Manual.

2.0 AGRICULTURAL PROPERTIES

2.1 Eligible Agricultural Properties

This guidance is specific to agricultural properties where pesticides and/or fertilizers were presumably applied uniformly, for agricultural purposes consistent with normal application practices. It is applicable to agricultural properties that are currently under cultivation with row, fiber or food crops, orchards, or pasture. It is also applicable to fallow and former agricultural properties that are no longer in production and have not been disturbed beyond normal disking and plowing practices. Each field of the same crop is assumed to have been watered, fertilized and treated with agricultural chemicals to the same degree across the field. Because of this homogeneous application, contaminant levels are expected to be similar at any given location within the field. This is the underlying premise of the guidance, and one that must be verified at the scoping stage of the PEA process.

2.2 Properties not covered by this Guidance

This guidance does not apply to former agricultural property that has been graded for construction or other purposes, that has received fill, or has had parking lots or structures placed on it following active use as an agricultural field. An urban residential area that was agricultural property in the past does not qualify for this guidance since the construction of the residences would have resulted in the disturbance and redistribution of potential agricultural contaminants in the soil. These areas may require biased, discrete sampling as opposed to the sampling for agricultural properties discussed in this document.

2.3 Grazing Land and Dry-Land Farmed Agricultural Properties

2.3.1 Grazing Land and Pasture

Agricultural sampling is not required for property used exclusively as grazing lands or pasture, where the topography is not conducive to pesticide application, or the application of pesticides is not economically feasible. Aerial photographs, topographic maps, and a site visit should be used to evaluate the topography of the proposed school site and past land use. Sites that are suitable for animal grazing will often have irregular topography and often a cover of native trees,

brush and range grasses. In keeping with the definition of agricultural soils, the site must not have contained any structures, or been used for any commercial or manufacturing activities.

2.3.2 Dry-Land Farmed Agricultural Soils

Dry-land farming is the practice of growing a crop without irrigation. Many dry-land farming fields are not treated with pesticides or infrequently treated, since the lack of water does not provide a desirable habitat for most agricultural pests. Properties that clearly qualify as dry-land farming do not need further investigation for pesticides or metals. For properties where there is uncertainty regarding dry-land farming, limited sampling may be conducted at a rate of four discrete samples per site, with one sample collected in each quadrant.

Some production crops such as winter wheat and barley can be grown under dry-land farming conditions. If the site has been planted in a dry-land farming production crop, every assurance should be made to determine that the crop was not irrigated and pesticides were not applied. This information may be obtained from interviews with farmers in the area, records that the County Agricultural Commissioner may have, and information the Commissioner may have about the irrigation practices for that crop in the specific county. If it cannot be clearly shown that irrigation did not take place and pesticides were not applied, limited sampling for organochlorine pesticides (OCPs) and arsenic may be necessary. At a minimum, this should include four samples per site, one sample per quadrant.

2.4 Agricultural Properties Prior to 1950

A review of 35 proposed school sites along with the historical background of OCP use in California indicates that sites with agricultural usage ending prior to 1950 do not need to be evaluated for OCPs. Organochlorine pesticides were first introduced into California agriculture in 1944 and reached peak usage in the 1960's. In 1974 the use of the DDT was banned for agricultural purposes, and the elimination of remaining OCPs in California agriculture quickly followed. Data from 35 proposed school sites where agricultural use ended prior to 1950 indicates that OCPs were not identified as chemicals of potential concern. In those cases where OCPs were identified, the source appears to have been the application to structures on the property, and not the agricultural crops grown prior to 1950. It is recommended that former agricultural properties that terminated operation prior to 1950 not be evaluated for agriculturally related OCPs. Arsenic should still be evaluated as a chemical of potential concern (COPC) since its use as arsenical pesticides and herbicides predates 1950.

2.5 Continued Agricultural Use After PEA Sampling

Chemicals associated with agricultural activities may result in potential risks to human health or the environment. If agricultural activities continue on the subject site after DTSC issues a no further action determination on the PEA, DTSC cannot ensure the no further action determination will remain in effect.

This may have impacts for school projects where the school districts elect to postpone school construction and allow continued agricultural use of the property. The most recent chemical use documentation (e.g., local Agricultural Commissioner Pesticide Application Permits) regarding the quantity and types of agricultural chemicals used on the property should be provided in the PEA report. If the type of agricultural chemicals applied to the site change after DTSC's no further action determination, DTSC recommends submittal of the chemical use documentation to DTSC at least three months prior to commencement of grading or other construction activities at the school site. DTSC will review the information, and if necessary, may recommend additional sample collection and analyses to assess potential impacts and ensure school site safety.

2.6 Other Areas of Concern on Agricultural Properties

In many cases, agricultural properties may include other areas of concern such as operations yards, storage areas, fuel tanks, residences, irrigation systems, and animal facilities. Examples of areas of concern may include:

- Structures such as homes, garages, equipment sheds, barns, and other out-buildings
- Pesticide storage, mixing/loading, and wash-down areas
- Ecological habitats, or rare, threatened, or endangered species
- Irrigation ditches/canals, containment berms, and low-lying swales or drainage areas
- Irrigation water containment ponds and collection/recirculation sumps
- Production wells and pumps
- Pole- or pad-mounted transformers
- Waste oil areas
- Animal pens, barns, and manure and disposal piles
- Burn piles
- Underground and above ground storage tanks
- Properties in dibromochloropropane (DBCP) study areas

Although agricultural-related, these targeted areas should be considered during the PEA scoping meeting and investigated using standard PEA protocols. The following DTSC guidance documents may be considered in these investigations:

- Interim Guidance: Evaluating Total Petroleum Hydrocarbons (TPH) (DTSC 2008) (The draft TPH guidance document is being revised at this time and will not be available to the public until DTSC finalizes the document.)
- Interim Guidance: Evaluation of School Sites with Potential Contamination from Lead Based Paint, Termiticides, and Electrical Transformers (DTSC, June 9, 2006)
- Arsenic Strategies for Determination of Arsenic Remediation: Development of Arsenic Cleanup Goals for Proposed and Existing School Sites (DTSC 2007)
- Advisory: Methane Assessment and Common Remedies at School Sites (DTSC, June 2005)
- Advisory: Active Soil Gas Investigations (DTSC, January 2003)
- Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion into Indoor Air (DTSC 2004)
- Fact Sheet: Information Advisory, Clean Imported Fill Material (DTSC, October 2001)
- Guidance Manual: Preliminary Endangerment Assessment (DTSC, January 1999)
- Data Validation Memorandum , Summary of Level II Data Validation (DTSC, May 2006)
- Guidance: Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities (DTSC, July 4, 1996)

3.0 SAMPLING STRATEGIES

3.1 Chemicals of Concern

3.1.1 Pesticides

When the property is under active agricultural production, the operator should be interviewed to determine the types and amounts of pesticides historically used on the property. The County Agricultural Commissioner should also be consulted to verify pesticide usage on the property. The Agricultural Commissioner is required to maintain this information for three years, but often will have extensive knowledge of the farming practices over many years. A local or specialized farm advisor such as the University of California Cooperative Extension Agent is another source of information for farming practices in the area. These consultations should occur during the scoping phase of the investigation. For those properties that have not been actively farmed in the past three years, obtaining accurate information is more difficult. Information from surrounding or neighboring agricultural operations on the types of crops grown in the area during the time of active farming can provide clues on what chemicals may have been applied.

Based on data from former agricultural properties over the past seven years, the only pesticide class requiring analyses at agricultural properties are OCPs, such as DDT, toxaphene, dieldrin, etc. OCPs are biopersistent and bioaccumulate in the environment. Most other classes of pesticides have relatively short half-lives and have not been found in the agricultural fields. While paraquat does have a longer half-life in soil, it has either not been detected or detected rarely at trace levels at sites which DTSC has had oversight, therefore routine analyses for paraquat is not required for field areas. Analyses for paraquat may be required in storage and mixing/loading areas.

3.1.2 Metals

Based on data from former agricultural properties, the only heavy metal required for routine analyses for these properties is arsenic. Arsenic in the form of arsenical herbicides has been applied to many agricultural properties and elevated levels of arsenic have been reported in the evaluation of these properties.

Other heavy metals may be required on a case by case basis depending on history of the property and the surrounding environment. Certain counties, such as Kern and Merced in the Central Valley, allow the application of municipal sludge on agricultural properties with or without a permit. Municipal sludge has been often shown to have elevated levels of heavy metals. These metals concentrations can impact vadose soils and often may migrate to groundwater. If there is a history of sludge application, or if sludge application is suspected on an agricultural property, Title 22 metals (former CAM 17 metals) should be evaluated.

Copper compounds were generally applied directly to select crops (e.g. vineyards) to prevent or reduce mildew. Vineyards and grain storage areas may have elevated copper due to the use of copper compounds as fungicides. To date, DTSC has not found elevated copper in any agricultural property. However, analyzing soil or sediment samples for copper may be appropriate at agricultural properties with the potential to impact aquatic ecological habitats (e.g. a creek or stream which runs through site).

3.1.3 Additional Chemicals of Concern

3.1.3.1 Mixing/Loading/Storage Areas

Focused sampling in mixing/loading/storage areas, drainage ditches, farm houses, or outbuilding areas may require analyses for a number of other constituents besides OCPs and arsenic, including other classes of pesticides/herbicides, paraquat, metals, and petroleum related compounds (see Section 2.6).

3.1.3.2 Smudge Pots

If smudge pots have been routinely used on agricultural properties, for example in citrus groves, additional sampling for PAHs and TPH may be required.

3.2 Sampling Frequency

Sampling frequency may vary depending on the size of the site and conditions found. When the site has been used for agricultural crop, the presumption is that agricultural chemicals were applied uniformly across the site in any given year and that the variation across the site will be relatively small. An analysis of several hundred former agricultural properties by DTSC has supported the general use of the assumption of uniform application.

The assumption of uniform application may not apply to areas cultivated in different crops, adjoining or adjacent properties with different owners or operators. The uniform application assumption does not apply for non-cultivated areas (e.g. drainage ditches, farm houses and other structures, mixing/loading areas, storage sheds, etc.)

In general, the sampling pattern should be sufficient to characterize the site. Recommended numbers of borings or sampling locations and composite analyses are provided in Table 1 for both OCPs and arsenic analyses for sites up to 50 acres. DTSC should be consulted for sites greater than 50 acres. For these sites, the sampling frequency may be reduced based on documentation that verifies consistent owner, operator, and use. If different parcels of the property have different owners, operators or crops, the number of samples shown in Table 1 should be applied for each different parcel.

Table 1: Recommended Number of Sampling Locations

Site Acres	Number of Borings	OCP Analyses (Composites)	Arsenic Analyses (Discrete only)
1	4	4 (Discrete analyses)	4
2	4	4 (Discrete analyses)	4
3	4	4 (Discrete analyses)	4
4	8	4	4
5	10	4	4
6	12	4	4
7	14	4	4
8	16	4	4
9	18	5	5
10	20	5	5
11	21	6	6
12	22	6	6
13	23	6	6
14	24	6	6
15	25	7	7
16	26	7	7
17	27	7	7
18	28	7	7
19	29	8	8
20	30	8	8
21	31	8	8
22	32	8	8
23	33	9	9
24	34	9	9
25	35	9	9
26	36	9	9
27	37	10	10

Site Acres	Number of Borings	OCP Analyses (Composites)	Arsenic Analyses (Discrete only)
28	38	10	10
29	39	10	10
30	40	10	10
31	41	11	11
32	42	11	11
33	43	11	11
34	44	11	11
35	45	12	12
36	46	12	12
37	47	12	12
38	48	12	12
39	49	13	13
40	50	13	13
41	51	13	13
42	52	13	13
43	53	14	14
44	54	14	14
45	55	14	14
46	56	14	14
47	57	15	15
48	58	15	15
49	59	15	15
50	60	15	15
>50	Consult with DTSC		

3.3 Composite Samples

Since this guidance assumes a relatively even distribution of chemicals across the agricultural field portion of a site, compositing of discrete samples allows for increased sampling coverage for a site, while not significantly increasing the number of analytical samples. Composite surface samples may be made up of a maximum of four discrete surface samples from adjacent sampling locations. Compositing may occur in the field or at the laboratory. In cases where two crops were grown on the site, only discrete samples from within the same crop area may be composited.

Specify the method of selecting the discrete samples to be composited and the compositing factor (e.g. 3 to 1: three discrete samples composited to one) in the workplan. Compositing requires that each discrete sample be the same in terms of volume or weight, and that the discrete sample be thoroughly homogenized prior to compositing. The detection level does not need to be reduced since the composite sampling area is assumed to be homogeneous in concentration.

If compositing is not chosen, analyses will be performed on all the discrete samples and the number of analyses will correspond to the number of borings.

For more information on composite samples, see the references provided in Section 6.0.

3.4 Discrete Sampling for Arsenic

A minimum of four discrete on-site surface samples must be analyzed for arsenic. When samples are composited for OCP analysis, one discrete sample from each composite must be analyzed for arsenic. When more than four composite samples are analyzed for OCPs, the total number of discrete samples analyzed for arsenic does not need to be greater than the number of total composite samples used for OCP analysis (see Table 1).

3.5 Sampling Depth

Based on the extensive data DTSC has reviewed for agricultural properties, only surface samples will be required for the screening assessment. Each location should be sampled to include one surface sample (0 to 6 inches). [Note: 0 inches means first encountered soil. Thick mats of vegetable material, roots, and other extraneous material should not be sampled. The locations can be staked and surveyed using a sub-meter global positioning system. This will facilitate collection of supplemental site investigation samples, such as subsurface or step out sampling, if necessary.

3.6 Sample Collection

Sampling both the furrows and beds of existing rows will detect the greatest variability in the residuals. Some methods of pesticide application will favor residuals in the beds while others favor the furrows. In fields where rows remain, roughly half of the samples should be gathered from the furrows and half from the beds in an alternating pattern. Orchards should have the sampling locations placed at the current drip line for the trees, under the canopy, between the tree rows, and between the trees within a row. For sites with slopes, swales, or other uneven topography, sampling from centers should be modified to include samples from those areas where surface water would be expected to flow and accumulate.

3.7 Field Duplicates

Field duplicates should be collected at a rate of 10 percent (or a minimum of one). For arsenic, a discrete co-located sample should be collected and analyzed for every 10 arsenic samples collected. For OCPs where composite samples will be prepared and analyzed, every 10th

composite sample should be prepared (independently) in duplicate and analyzed. See Section 4.1 for a description on preparation of composite samples.

3.8 Requirements for Collection of Background Metal Samples

Consult with the DTSC project manager regarding the need for collecting background arsenic samples. In general, with the exception of arsenic, background samples for metals will not be necessary if all metals are below their respective California Human Health Screening Levels (CHHSLs). If all the arsenic results for the site are at or below 12 mg/kg, then collection of background samples will not be required. For sites where either arsenic or other metals are above their respective screening values, either collection of a background data set or use of an appropriate background data set may be required.

3.8.1 Sampling for Background Metals

If samples are needed to determine background levels of arsenic and/or other heavy metals (if additional metals are required for the PEA), a minimum of four onsite locations should be sampled at non-impacted areas, or samples may be collected at a depth of 5 to 5.5 feet bgs. In order to use background samples from 5 to 5.5 feet bgs, a licensed professional must make the determination that the background soils are similar enough geologically to the surface soils as to be representative.

Other background data sets may be substituted for on site sampling on a case by case basis in consultation with DTSC.

4.0 LABORATORY ANALYSES

4.1 Preparation of Composite Samples

Each discrete sample should be homogenized and uniformly split by trained field staff prior to compositing. A portion of each discrete sample should be frozen and archived in case additional analysis is warranted based on the composite results. Compositing requires that each discrete sample be the same in terms of volume or weight, and that the discrete sample be thoroughly homogenized prior to compositing. Excess sample from the homogenized composite sample shall be archived by the lab and/or used as a duplicate, as appropriate, for that composite set. The samples may be discarded when the PEA process has been completed and approved by the DTSC.

4.2 Methods

The analytes of primary concern are OCPs, arsenic, and, in some cases, Title 22 metals. Depending on the site history, analysis of other types of pesticides may be required. OCPs should be analyzed using U.S. EPA 8081A or equivalent. Metals must be analyzed using the U.S. EPA 6000/7000 series. If the site history indicates other classes of persistent pesticides should be evaluated, DTSC should be consulted for the acceptable method of analysis and appropriate detection limits. Highly organic topsoil may interfere with proper extraction of pesticides.

Sample holding times should be consistent with U.S. EPA SW-846. Variances to holding times and affects on data results must be discussed in the data validation section of the report.

Please note, for comparison of chlordane concentrations against the CHHSL, chlordane must be quantified against a ***technical chlordane*** standard. For purposes of the PEA, DTSC will not

allow quantitation of the individual alpha and gamma isomers, with a total concentration determined by addition of those concentrations.

4.3. Detection Limits

The actual detection limits obtained will vary depending on the particular analyte. For OCPs, the analytes typically causing detection limit concerns in agricultural fields are aldrin, dieldrin, and toxaphene. The detection limits should be 0.005 mg/kg for aldrin, dieldrin, and 0.05 mg/kg for toxaphene. Table 2 lists the detection limits for several OCPs.

In samples with elevated DDT, the detected concentration may be above the range of calibration. This can result in the analytical laboratory diluting the sample for reanalysis, and then reporting only the final result. In these cases, the reported detection limits for aldrin, dieldrin, and toxaphene may exceed the detection limits needed for determining potential health effects. Ideally the laboratory should be asked to report if those three analytes were detected in the first analysis prior to dilution. Multiple analyses of the same samples may be required to obtain the data necessary for risk assessment purposes.

Table 2. Analytical Methods and Detection Limits for Selected OCPs

Pesticide	Methods[2]	CAS No.[3]	DL[4] mg/kg
Aldrin	8081A	309-00-2	0.005
a-BHC	8081A	319-84-6	0.005
b-BHC	8081A	319-85-7	0.005
g-BHC (Lindane)	8081A	58-89-9	0.005
d-BHC	8081A	319-86-8	0.005
Total Chlordane[1]	8081A	57-74-9	0.05
DBCP[5]	8081A	96-12-8	0.01
DDD	8081A	72-54-8	0.05
DDE	8081A	72-55-9	0.05
DDT	8081A	50-29-3	0.05
Dieldrin	8081A	60-57-1	0.005
Endosulfan I	8081A	959-98-8	0.005
Endosulfan II	8081A	33213-65-9	0.005
Endosulfan sulfate	8081A	1031-07-8	0.005
Endrin	8081A	72-20-8	0.05
Endrin aldehyde	8081A	7421-93-4	0.05
Endrin ketone	8081A	53494-70-5	0.05
Heptachlor	8081A	76-44-8	0.05
Heptachlor epoxide	8081A	1024-57-3	0.005
Hexachlorobenzene (HCB)	8081A	118-74-1	0.3
Hexachlorocyclopentadiene	8081A	77-47-4	0.5
Methoxychlor	8081A	72-43-5	0.005
Toxaphene	8081A	8001-35-2	0.05

Notes:

1 = Report total Chlordane (based on a Technical Chlordane standard)
2 = Although other methods may be used to quantify OPCs, DTSC recommends the use of 8081A as the primary method of quantitation
3 = Chemical Abstract Service registry number
4 = Detection Limit recommended for risk assessment purposes
5 = If sampling for this compound is indicated, inclusion in the method must be requested in the workplan and/or QAPP

4.4 Pesticide Analyses

Surface samples, discrete or composite, must be analyzed for OCPs. Analysis for other classes of persistent pesticides may be required as indicated by the agricultural history of the site. If the composite sample result exceeds the health risk screening criteria (see Section 5.3), analyze each discrete sample that made up the composite sample.

4.5 Sub-surface sample analysis

In consultation with DTSC, analyses of sub-surface samples may be required if surface samples results exceed specified screening levels. This sampling may be a part of the PEA or included in a Supplemental Site Investigation. If subsurface samples were collected during the PEA sampling event, those samples may be taken off "hold" and analyzed by the laboratory. If subsurface samples were not collected during the PEA, a Supplemental Site Investigation Workplan or Technical Memorandum should be prepared identifying appropriate step-out (vertical and horizontal) sampling locations.

4.6 Quality Control

Quality control (QC) procedures specified in SW-846 must be followed. A matrix spike/matrix spike duplicate on one soil sample per batch of 20 samples must be performed to demonstrate that the targeted pesticide(s) can be recovered from the soil investigated. The laboratory data package must include a summary of the quality control sample results: blanks, matrix spike/ matrix spike duplicate, surrogate recoveries, laboratory control samples, etc., as specified by the method. The laboratory should provide a signed narrative stating whether the QC was met and listing any discrepancies. The consultant should perform a supplementary evaluation of the data, also referred to as data validation, and present the results of that evaluation in the PEA report. For an example of what to included in the data validation section, see the example data validation memorandum at the DTSC website:
http://www.dtsc.ca.gov/Schools/upload/Data_Validation.pdf

5.0 REPORTING

5.1 Format

The results of the sampling effort are to be reported in a PEA report as described in the DTSC PEA Guidance Manual.

5.1.1 Summary Tables

Include data tables in the PEA report to summarize the results of the investigation. Summary tables should include the analytes of interest, the reported concentrations or the reporting limit for non-detect results, and indicate whether a reported concentration exceeds its respective CHHSL screening level (if a CHHSL comparison is being conducted). In addition, for samples analyzed at multiple dilutions for purposes of reporting concentrations within calibration ranges (as described in Section 4.3), summary tables should either present the results for all of the dilution analyses indicating the appropriate result for each analyte, or a combined analysis indicating which results are being reported after a dilution. Sample results should also be flagged with appropriate qualifiers, where necessary, after data validation.

5.2 Evaluating Metals (Inorganic Elements) Data

Using a robust statistical procedure to determine if on-site metal concentrations are indicative of background conditions or the result of site-related activities can be problematic because of the limited number of background samples collected at any one site. Local site background may be used if the data is approved for use by the DTSC project manager and toxicologist. If DTSC

background levels are not available, then a defensible procedure for comparing on-site with background metals should be used. The DTSC project manager and DTSC toxicologist assigned to the project should be consulted on the most appropriate method of comparison.

5.2.1 Arsenic Evaluations

The DTSC Schools Program evaluated data from a large number of school sites across California. The data evaluation indicates that 12 mg/kg maybe a useful screening number for the Schools Program when evaluating arsenic as a COPC. If the proposed school property has been adequately characterized for arsenic and all the arsenic data are equal to or less than 12 mg/kg, then arsenic will be not be considered a COPC. This decision does not require collection and comparison to a background data set. If arsenic concentrations are greater than 12 mg/kg, then comparisons to background data will be required. In some cases additional sampling may also be required.

5.2.2 Strategy for Comparison of Background Metals

If background samples are necessary, follow the procedures provided in Section 3.8.
The following strategy may be used for comparing site data to background data:

1. Compare the highest site concentration with the highest background concentration. If the site concentration is equal to or less than the background, the metal may be eliminated as a COPC. If the onsite maximum is greater than the background maximum, go to 2).

2. Compare the site and background arithmetic mean concentrations. If the means are comparable, and if the highest site concentration is below the concentration associated with unacceptable risk or hazard, the metal may be eliminated as a COPC. If the site mean is greater than the maximum background, go to 3).

3. Two approaches may be used, depending on the size of the background data set.
   - If the background data set is of sufficient size, statistically evaluate the overlap of the background and onsite distributions to determine if they come from the same population. If they do, and if the highest site concentration is below the concentration associated with unacceptable risk or hazard, the metal may be eliminated as a COPC. If not, include the metal as a COPC in the risk evaluation.

   - If the background data set is limited (n=4), the onsite data can be evaluated statistically using probability plots to determine if one or more populations are present. If only one population is present, and if the highest site concentration is below the concentration associated with unacceptable risk or hazard, the metal may be eliminated as a COPC. If there are two or more populations present, then include the metal as a COPC.

4. Additional information on eliminating metals as COPCs can be found in "*Selecting Inorganic Constituents as Chemicals of Potential Concern at Risk Assessments at Hazardous Waste Sites and Permitted Facilities – Final Policy* (DTSC/HERD 1997),

5.3 Human Health Risk Assessment

All detected pesticides and any onsite metals above background should be evaluated as COPCs in a human health risk assessment as described in the DTSC PEA Guidance Manual or in comparison to CHHSLs. In the initial screening analysis, the highest

concentration of each detected pesticide and metal above background must be used as the exposure point concentration in the risk assessment.

Since agricultural properties are assumed to have uniform application of pesticides, DTSC has allowed compositing of samples for OCP analyses (Sections 3.3 and 4.1). The concentration from the composited sample can be used directly in the risk assessment without adjusting the toxicity screening numbers, such as the CHHSLs. The review of the former agricultural properties over the past seven years has supported the assumption of uniform application. This is in contrast to other DTSC guidance, such as the *Lead-Based Paint, Termiticide and PCB Guidance*, (DTSC, June, 2006), where adjustments to the CHHSLs are required for composite samples because applications were not necessarily uniform.

5.3.1 Application of PEA Risk Assessment Equations and CHHSLs

Chemicals of potential concern are evaluated either by comparison to the CHHSL, or by calculating the excess cancer risk and hazard index based on equations in the PEA Guidance.

Note: CHHSLs may not be used to "screen out" COPCs.

5.3.1.1 CHHSLs

CHHSLs are soil and/or soil gas concentrations for selected chemicals developed by Cal-EPA with a target threshold of a 1E-06 risk for carcinogens, and a hazard quotient of one for non-carcinogens. CHHSLs were developed using models and exposure assumptions similar to those used in the PEA Guidance Manual, with the exception of the concentrations for volatile organic compounds (VOCs), which were developed using the vapor intrusion model for addressing the inhalation of contaminated indoor air. CHHSLs may be used as a soil screening value at school sites if all of the chemicals detected at the site have a listed CHHSL, if it is agreed upon by all parties concerned, and if it is agreed that the screening document will be reviewed by a toxicologist from the Human and Ecological Risk Division. For school sites, only the residential-based CHHSLs may be used. The exposure pathways used in calculating the CHHSLs are incidental soil ingestion, dermal absorption, and inhalation of dusts in indoor air for non-volatile soil-bound chemicals, and the inhalation of indoor air pathway for VOCs. Direct exposures to VOCs are not included in the calculation of the CHHSLs and CHHSLs do not take into consideration the leaching of contaminants from soil to groundwater. CHHSLs are not appropriate if ecological receptors are the most sensitive species on the site. Lead should be evaluated using the most current DTSC LeadSpread Model or the school site lead screening level of 255 mg/kg.

5.3.1.2 Human Health Risk Assessment with CHHSLs

Independent of whether sites were analyzed with discrete samples or with composite samples, the evaluation is similar. Note that the CHHSL values are not adjusted for the number of discrete samples that comprise a composite. The rationale behind this comparison to un-adjusted CHHSL is that application of pesticides is assumed to be uniform throughout the field, and large variations in the pesticide concentrations are not expected. This rationale applies only to the agricultural portion, not to mixing areas, storage sites, structures, etc.

5.3.2 Procedure for Human Health Risk Assessment with CHHSL or PEA Guidance

- Determine that all of the chemicals detected at the site have the appropriate CHHSLs for soil and/or soil vapor. If they do not, then a PEA risk assessment must be conducted. A DTSC toxicologist will evaluate if the CHHSL screening is appropriate for the site

- The screening document, PEA or equivalent, will be reviewed by a toxicologist from the Human and Ecological Risk Division.

- The most recently published CHHSLs should be used. This may be found at: http://www.calepa.ca.gov/Brownfields/documents/2005/CHHSLsGuide.pdf.
- The exposure pathways at the site must match the exposure pathways used to develop the CHHSLs.
  Use the maximum concentration of each contaminant detected at the site and compare to unrestricted (residential) CHHSL or PEA risk calculations.
- Background metal concentrations can be used to screen metals as COPC. Construct a table listing the COPC (see Section 5.2.2 for discussion on background metals).
- The risk and hazard for each COPC should be calculated using the following equations:

$$\text{RISK} = \frac{[\text{maximum detected concentration}]}{\text{CHHSL}} \times 10^{-6}$$

$$\text{HQ} = \frac{[\text{maximum detected concentration}]}{\text{CHHSL}}$$

  - If there are multiple COPCs, calculate the cumulative risk and/or hazard. An Excel calculator is provided on the Cal/EPA website for CHHSLs: (http://www.calepa.ca.gov/Brownfields/documents/2005/Calculator.xls).
  - Complete a Risk Characterization Section where the total risk and hazard are presented and discussed along with the need for any further action.
  - If the maximum concentrations detected on site pose an unacceptable risk or hazard, a spatial analysis should be conducted to determine if the elevated levels represent a "hot spot", or are representative of concentrations across the site. In those cases where the elevated concentrations are determined to be one or more "hot spots", risk or concentration isopleths should be constructed to differentiate between those areas of the site in need of further action, and those where no further action is required. Any deviations from these analyses must be approved by the DTSC toxicologist assigned to the project.

Note: For evaluation of composite samples, the CHHSL values are not adjusted for the number of discrete samples that comprise a composite. The rationale behind this comparison to un-adjusted CHHSL is that application of pesticides is assumed to be uniform throughout the field, and large variations in the pesticide concentrations are not expected. Note that this rationale applies only to the agricultural portion, not to mixing areas, storage sites, structures, etc.

6.0 ADDITIONAL SOURCES OF INFORMATION

Pesticide Physical Properties and Half-Lives

http://ace.orst.edu/info/extoxnet/pips/ghindex.html
http://www.arsusda.gov/rsml/ppdb1.html

Active Pesticide Ingredient by Brand Name

http://www.cdpr.ca.gov/docs/label/prodnam.htm
http://www.cdpr.ca.gov/ - see databases
Farm Chemicals Handbook, current edition, Meister Publishing Company,

Willoughby, Ohio.

Maximum Application Rates

http://ace.orst.edu/info/extoxnet/
Agricultural Chemicals – Thomas Publications, Fresno, CA

Pesticide Usage by Year, County, and Crop

http://www.ipm.ucdavis.edu/PUSE/puse1.html
http://www.cdpr.ca.gov/ - see databases

Composite Sampling

http://www.clu-in.org/download/char/SF_Rep_Samp_Guid_soil.pdf
U.S.EPA. 1995a*. Superfund Program Representative Sampling Guidance, Volume 1: Soil, Interim Final,* OSWER Directive 9360.4-10, EPA 540/R-95/141, PB96-963207. Environmental Response Team, Office of Emergency and Remedial Response, Office of Solid Waste and Emergency Response. December 1995, Page 28.

http://clu-in.org/download/stats/composite.pdf
U.S.EPA. 1995b. *EPA Observational Economy Series, Volume 1: Composite Sampling*, EPA-230-R-95-005. Policy, Planning, and Evaluation (2163). August 1995.

Test Methods

http://www.epa.gov/epaoswer/hazwaste/test/
SW-846: U.S. EPA, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition, Current Revision*

Pesticide Toxicology Information

http://ace.orst.edu/info/extoxnet/ghindex.html
http://www.state.nj.us/health/eoh/rtkweb/rtkhsfs.htm

CHHSLs

http://www.calepa.ca.gov/Brownfields/documents/2005/CHHSLsGuide.pdf
http://www.calepa.ca.gov/Brownfields/documents/2005/Calculator.xls

Acronym List

bgs	Below Ground Surface
CalEPA	California Environmental Protection Agency
CHHSL	California Human Health Screening Levels
COPC(s)	Chemicals of Potential Concern
DBCP	Dibromochloropropane
DTSC	Department of Toxic Substances Control
NFA	No Further Action
OCP(s)	Organochlorine Pesticides
PAH	Polyaromatic Hydrocarbon
PEA	Preliminary Endangerment Assessment
QC	Quality Control
TPH	Total Petroleum Hydrocarbon
U.S. EPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds