DEPARTMENT OF TOXIC SUBSTANCES CONTROL
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

PROVEN TECHNOLOGIES AND REMEDIES GUIDANCE

REMEDIATION OF METALS IN SOIL

AUGUST 29, 2008

PREFACE

The Department of Toxic Substances Control (DTSC) is issuing this Proven Technologies and Remedies (PT&R) guidance document for immediate use on cleanups at hazardous waste facilities and Brownfields sites. The PT&R approach described herein is an option for expediting and encouraging the cleanup of sites with elevated concentrations of metals in soil. The approach described herein is designed to ensure safe, protective cleanup and to maintain DTSC's commitment to public involvement in our decision-making process. Please see Chapters 1 through 3 for details regarding the PT&R approach and how to determine whether this guidance is suitable for a given site.

DTSC fully expects that application of the PT&R approach to cleanup metals-impacted sites will identify areas that can be improved upon as well as additional ways to streamline the PT&R cleanup process. As the protocols in this document are implemented, issues may be identified which warrant document revision. DTSC will continue to solicit comments from interested parties for a period of one year (ending August 31, 2009). At that time, DTSC will review and incorporate changes as needed.

Comments and suggestions for improvement of *Remediation of Metals in Soil* should be submitted to:

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ACKNOWLEDGMENTS

This document was developed by the Department of Toxic Substance Control under the direction of: Ms. Maureen Gorsen, Director; Mr. Maziar Movassaghi, Deputy Director, Brownfields and Environmental Restoration Program; and Mr. Watson Gin, Chief Engineer. Each of these individuals has shown great vision, courage, and patience in allowing the Proven Technologies and Remedies (PT&R) Team to become an instrument of change for our Department. Without their steadfast support, completion of this document would not have been possible.

The PT&R Team members, Team Sponsors and Team Leader would also like to thank the following key authors for their many months of hard work and strong leadership in preparing this document:

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Document scope, technical review, and technical guidance were provided by the multi-disciplinary, cross-program members of the PT&R Team. These individuals are as follows:

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We would also like to thank Ms. Sharon Fair and the Voluntary Cleanup Program (VCP) Team for their strong support with preparation of the Sample Documents contained in Appendices C and F. The following individuals were key authors of the Sample Documents.

Ms. Yvette LaDuke, Public Participation Specialist (Appendices F1 and F2).
Ms. Janet Naito, Sr. Hazardous Substances Scientist (Appendices C2 and C3);
Ms. Maryam Tasnif-abbasi, Sr. Hazardous Substances Scientist (Appendix C3); and
Mr. Tedd Yargeau, Sr. Hazardous Substances Scientist (Appendix C2).

In addition, the Operation and Maintenance Plan Sample contained in Appendix E2 was modified from an earlier version developed by the Department's Schools Program.

The experience and technical knowledge that each of the individuals listed above provided during preparation of this document has resulted in a high quality analysis of California cleanup technologies for metals in soil and compilation of sample documents that can be used in the PT&R process. Their extensive project experience has also provided the clear road map needed to safely and efficiently clean up a wide variety of sites. Many thanks to each of you for your support on preparing this PT&R document.

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APPENDICES

ABBREVIATIONS AND ACRONYMS

AOC	Area of Contamination
ARARs	applicable or relevant and appropriate requirements
ASTM	American Society of Testing and Materials
bgs	below ground surface
Cal/EPA	California Environmental Protection Agency
Cal-OSHA	California Occupational Health and Safety Administration
CalTrans	California Department of Transportation
CAMU	Corrective Action Management Unit
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response and Liability Act
CHHSLs	California Human Health Screening Levels
CMS	Corrective Measures Study
cm/sec	centimeters per second
COPCs	chemicals of potential concern
CSM	conceptual site model
DTSC	Department of Toxic Substances Control
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ET	evapotranspiration
FML	flexible membrane liner
FS	Feasibility Study
GC	geosynthetic clay
HASP	health and safety plan
HDPE	high density polyethylene
HSAA	Hazardous Substances Account Act
HSC	California Health and Safety Code
HWCL	Hazardous Waste Control Laws
IC	institutional control
ITRC	Interstate Technology and Research Council
LCCA	life-cycle cost analysis
LDR	land disposal restriction
LUC	land-use covenant
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List

ABBREVIATIONS AND ACRONYMS (Continued)

O&M	operation and maintenance
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PEA	Preliminary Endangerment Assessment
PI	plasticity index
PT&R	proven technologies and remedies
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RAP	Remedial Action Plan
RAO	remedial action objective
RAW	Removal Action Workplan
RCRA	Resource Conservation and Recovery Act
RWQCB	Regional Water Quality Control Board
SVOCs	semi-volatile organic compounds
SWPPP	storm water pollution prevention plan
TPH	total petroleum hydrocarbons
UCL	upper confidence limit
USCS	Unified Soil Classification System
VCP	Voluntary Cleanup Program
VOCs	volatile organic compounds

EXECUTIVE SUMMARY

Elevated concentrations of metals in soil are encountered in approximately one-third of existing and former hazardous waste facilities and Brownfields sites in California. The Department of Toxic Substances Control (DTSC) has prepared this *Proven Technologies and Remedies Guidance – Remediation of Metals in Soil* (PT&R guidance) as an option for expediting and encouraging cleanup of sites with elevated concentrations of metals in soil. The approach may be applied at operating or closing hazardous waste facilities and at Brownfields sites. Although expediting cleanup is emphasized, the approach discussed in this guidance is designed to ensure safe, protective remediation and to maintain DTSC's commitment to public involvement in our decision-making process.

This PT&R guidance is applicable on a case-by-case basis at sites where the primary environmental concern involves soils contaminated with metals. This document is intended for use by any government agency, consultant, responsible party, project proponent, facility operator, and/or property owner addressing these types of soils. However, the PT&R guidance will not be applicable to all sites with metal contamination. For example, this guidance may not be applicable to sites contaminated with chemicals in addition to metals or where contamination has impacted groundwater or surface water. Therefore, prior to applying this PT&R guidance to a site cleanup process, the environmental regulatory oversight agency should be consulted and should concur with the use of this approach.

Cleanup of contaminated sites may be governed by one or more federal or state laws, depending on such factors as the source and cause of the contamination, the type of chemical contamination found, and the type of operations conducted. The PT&R approach is consistent with these laws and will yield technically and legally adequate environmental solutions. The remedy selected must be: (1) protective of human health and the environment; (2) able to achieve cleanup objectives and goals; and (3) able to control or remediate sources of releases.

DTSC conducted a study that reviewed and screened data for 188 sites where the primary contaminants were metals. This study found that "containment by capping" and "excavation and off-site disposal" were the most frequently selected cleanup alternatives. Therefore, this guidance was prepared to streamline the cleanup process for sites that are suitable for these PT&R alternatives.

The guidance streamlines the cleanup process by (1) limiting the number of evaluated technologies to two PT&R alternatives: excavation/disposal and containment/capping; (2) facilitating remedy implementation; and (3) facilitating documentation and administrative processes. To gain the maximum cost and time savings, the applicability of the PT&R approach could be discussed during the scoping meeting and initiated as early as possible in the cleanup processes (e.g., during the characterization phase).

The objectives of the PT&R guidance are to:

- Identify the types of sites that would be appropriate for application of the PT&R approach;
- Identify the site data that should be collected to support this approach;
- Provide guidance in establishing background concentrations, screening levels, and cleanup goals;
- Provide guidance for determining when cleanup goals are achieved; and
- Provide sample documents, annotated outlines, and examples for the documents prepared as part of the cleanup process.

This PT&R guidance is not intended to replace the evaluation of innovative and new technologies. DTSC continues to encourage the use and evaluation of emerging technologies.

OVERVIEW OF PT&R APPROACH

The following paragraphs and Figure ES-1 summarize the steps of the PT&R approach. The PT&R approach uses the public participation process identified in the *DTSC Public Participation Manual* (DTSC, 2003).

Determine Suitability for PT&R Approach. In order to determine whether the PT&R process is appropriate for your site, you should evaluate whether the site characteristics make it amenable to a streamlined scoping, site characterization, remedy selection, and remedy implementation. This PT&R guidance targets cleanup at sites where the primary environmental issue is metal contamination in shallow soils. The site characteristics that favor the PT&R approach are summarized in Table ES-1. Refer to Chapter 3 for details regarding these characteristics.

Table ES-1. Site Characteristics that Favor PT&R Approach

• Primarily metals contamination	• No emergency actions required
• Contamination < 15 feet bgs[1]	• Low potential for surface water impact[3]
• Metals in immobile form[2]	• Low potential for groundwater impact[2, 3]
• No ecological habitat or sensitive receptors impacted[3]	

1 Characteristic pertinent for excavation/disposal alternative. The 15-foot depth is a general frame of reference. The actual excavation depth that is feasible for a given cleanup is a site-specific decision.
2 Preferred characteristic for containment/capping alternative.
3 The approach recommended for selection of cleanup goals in this PT&R guidance considers the health impact endpoint, intended use of the property, and number of contaminants. If a site has potential impacts to ecological receptors, groundwater, or surface water, the PT&R approach for establishing cleanup goals is not applicable.

Characterization Phase. The characterization phase establishes the nature and extent of contamination in environmental media such as soil and, if needed, background or naturally-occurring concentrations of metals. Under the PT&R approach, sufficient data should be collected to determine that the PT&R approach is still applicable and to support remedy selection and the engineering design. As data are gathered, they are compared to screening levels to help determine whether further site characterization, risk assessment, or cleanup may be necessary.

Risk Screening. A human health screening evaluation for chemicals of potential concern (COPCs) is conducted to estimate the potential cancer risks and noncancer health hazards. The PT&R approach uses the risk screening evaluation guidance provided in: (1) *Preliminary Endangerment Assessment Guidance Manual* (DTSC, 1994); and (2) *Use of California Human Health Screening Levels (CHHSLs) in Evaluating Contaminated Properties* (Cal/EPA, 2005).

Site-Specific Evaluation and Selection of Remedial Alternatives. The remedy selection document is drafted in accordance with the requirements applicable to the site/facility. The results of the site investigation lay the groundwork for demonstrating the applicability of the PT&R approach to the project conditions. The analysis of alternatives should reference this guidance document and complete the evaluation of the alternatives that meet the remedial action objectives (RAOs). The alternatives would generally include the no action, excavation/disposal, and/or containment/capping alternatives. If appropriate, necessary documents for the California Environmental Quality Act (CEQA) may be prepared concurrently with the alternatives evaluation report. The remedy selection and CEQA documents are circulated for public comment.

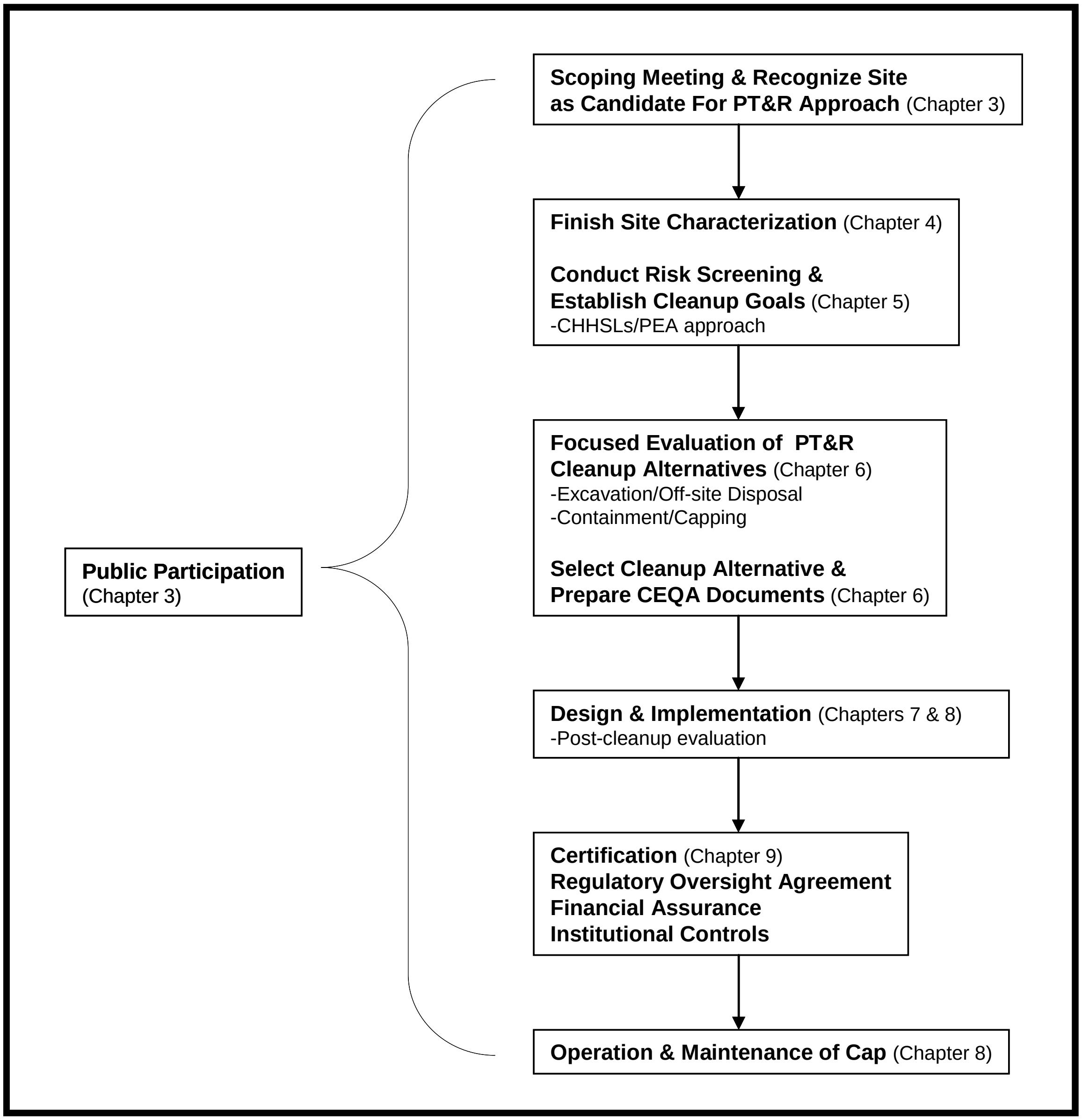
As shown in Figure ES-1, the excavation/disposal alternative has the potential to allow unrestricted use of the site whereas the containment/capping alternative will require long-term stewardship.

Cleanup Design and Implementation. The technical and operational plans for implementing the proposed alternative may be included in the remedy selection document, if appropriate, or prepared as a separate document once a final response action is approved. Once the final response action is implemented, a report documenting its implementation is submitted to DTSC.

Post-cleanup Evaluation for Lead. The PT&R approach recommends a post-cleanup evaluation for sites where lead is a COPC because cleanup approaches for lead may be changing. This evaluation of the residual lead concentrations across the entire site is recommended for risk communication purposes. Confirmation sample results and sampling data collected previously for soil remaining at the site are used to prepare a statistical summary that is included in the remedy completion report.

Certification of Remedy Completion. When the response action has been fully implemented, DTSC will certify the site. Before DTSC issues this certification letter, any requirements for a Land Use Covenant (LUC) or other institutional controls (ICs) and an Operation and Maintenance Agreement/Plan (including establishment of a financial assurance mechanism) must be met.

Figure ES-1. Summary of PT&R Approach for Sites with Metals-Contaminated Soils.



1.0 INTRODUCTION

The *Proven Technologies and Remedies Guidance – Remediation of Metals in Soil* (PT&R guidance) has been prepared to streamline the corrective action and remedial action processes, herein after referred to as the "cleanup process", at sites with soils*[1] contaminated with metals[2]. The proven technologies and remedies (PT&R alternatives) discussed in this document were determined to be effective based on:

- engineering and scientific analysis of performance data from past state and federal cleanups and
- review of the administrative records and procedures used to implement the technologies.

The PT&R guidance outlines an option for streamlining the cleanup process, thus increasing the number of acres that are cleaned up and put back into beneficial use. The approach discussed in subsequent sections can be applied at operating or closing hazardous waste facilities and at Brownfields* sites. Although expediting the cleanup process is emphasized, the approach discussed in this guidance is designed to ensure safe and protective remediation.

Elevated concentrations of metals in soil are encountered in approximately one-third of existing and former hazardous waste facilities and Brownfields sites. The most commonly encountered metal contaminants are arsenic, chromium, lead, and mercury. When released to the soil surface, metals tend to accumulate and persist in the shallow soil unless the metal retention capacity* of the soil is exceeded or geochemical conditions favor downward migration (McLean and Bledsoe, 1992). The depth of metals contamination is a function of several factors, such as how much material is released, the chemical oxidation state* of the metal when it is released, chemical reactions occurring within the soil, and whether the metal tends to solubilize* or form complexes* with more mobile constituents (e.g., organic ligands*). Although elevated levels of metals can occur naturally, metal contamination in soil is typically a result of:

- Mining and ore processing operations in mineralized zones;
- Industrial operations such as metal recycling and recovery, smelters, metal finishing, and plating shops;
- Agricultural applications of pesticides and herbicides (e.g., arsenic, lead);
- Burn piles and open burn pits;
- Dispersal from offsite or mobile sources along transportation corridors (e.g., aerially deposited lead from vehicle emissions); and
- Older buildings covered with lead-based paints.

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[1] If a term is annotated by an asterisk, a definition for the word is provided in the glossary.

[2] For the purposes of this guidance document, the term "metals" is used as a general reference for metallic elements and certain metalloids. Please refer to the glossary for the full definition of "metals" as used in this document.

1.1 PURPOSE AND OBJECTIVE

The purpose of this document is to encourage and support the use of DTSC's past experience and provide guidance on PT&Rs to expedite cleanup of sites with elevated concentrations of metal(s) in soil. The guidance document is intended for use by any government agency, consultant, responsible party and/or property owner addressing potential metal contamination at a site. Prior to applying this PT&R guidance to a site cleanup process, the oversight agency must be consulted and must concur with use of the PT&R approach.

The objectives of the PT&R guidance are to:

- Identify the characteristics that make a site conducive for application of the PT&R approach;
- Provide recommendations for characterizing the nature and extent of contamination and collecting data needed to support the cleanup alternative;
- Provide guidance in establishing background* concentrations, screening levels*, and cleanup goals*;
- Provide guidance for post-cleanup evaluation to characterize the residual concentrations of lead; and
- Provide guidance on associated administrative requirements, such as documentation and implementation of the cleanup alternative selection process.

1.2 TECHNICAL BASIS FOR PT&R APPROACH AT SITES WITH METAL CONTAMINATION IN SOIL

DTSC conducted a study that reviewed and screened data for 188 sites where the primary contaminants were metals (see Section 6.1 for details). The objective of the study was to identify the technologies that were consistently selected for evaluation and to determine the frequency at which these technologies were selected as the remedy. The results of the study revealed that "containment by capping" (containment/capping*) and/or "excavation and offsite disposal" (excavation/disposal) were the most frequently selected cleanup alternatives.

1.3 SCOPE AND APPLICABILITY

This document is applicable at sites where the primary environmental concern involves soils contaminated with metals. However, the approach outlined in the PT&R guidance is not applicable to all sites with metal contamination. Rather, this guidance is most applicable at sites where metals have accumulated in shallow soils[3] as a result of

[3] The term "shallow soils" generally implies depths that are less than 15 feet below ground surface (bgs). The actual depth that can be addressed under PT&R is a site-specific factor based on the constraints of the PT&R cleanup alternatives, site-specific considerations, and costs associated with increasing depth.

discharge to the surface and where site-specific conditions have limited downward migration of the metals.

This guidance may not be applicable to sites that require cleanup measures in addition to the PT&Rs or that may be more efficiently cleaned up by another approach. For example, sites with contamination at depths greater than 15 feet or where groundwater is shallow and the contamination extends to groundwater may require other cleanup approaches. Sites with metals that can be easily mobilized via solubilization*[4] or volatilization*[5] may also require a different approach. Unusual geologic and hydrogeologic conditions, multiple contaminants, or public concerns may require cleanup alternatives that are not included in this PT&R guidance. In these instances, the PT&Rs are not appropriate and a more extensive cleanup technology evaluation should be conducted.

In general, the PT&R approach may not be appropriate for:

- Complex sites (e.g., mining and milling sites);
- Sites where stakeholder concerns would be better addressed under a different cleanup process;
- Sites with metals impact to sensitive habitat or ecological receptors;
- Sites that may benefit from the use of innovative technologies;
- Sites with metal impacts to environmental media other than soil (e.g., groundwater, surface water, sediment, air);
- Sites impacted by multiple chemicals of concern* (i.e., chemicals of concern in addition to metals) that will impact the selection of the cleanup alternative; and
- Sites that treat soil, groundwater, and other environmental media as one operable unit*.

This PT&R guidance is not intended to replace the evaluation of innovative and new technologies. DTSC continues to encourage the use and evaluation of emerging technologies.

[4] e.g., organolead, hexavalent chromium, methyl mercury, ethyl mercury
[5] e.g., methyl mercury, ethyl mercury

2.0 OVERVIEW AND ORGANIZATION

Cleanup of contaminated sites may be governed by one of several federal or state laws[6], depending on such factors as the source and cause of the contamination and the DTSC program under which the site is being addressed. The PT&R approach operates consistently with these laws and will yield technically and legally adequate environmental solutions. Any procedural differences between cleanup authorities will not substantively affect the outcome of the cleanup. There are some differences such as review periods of final response actions and other administrative advantages that should be evaluated. Regardless of the cleanup process, the remedies evaluated and selected must be: (1) protective of human health and the environment; (2) able to achieve cleanup objectives and standards; and (3) able to control or remediate sources of releases.

The PT&R approach is consistent with DTSC's conventional cleanup processes. In a standard cleanup process, sites undergo:

- Site characterization* (also referred to as site investigation);
- Remedy screening and evaluation, such as under a Feasibility Study (FS*) or Corrective Measures Study (CMS*);
- Remedy selection; and
- Implementation of the corrective action and/or remedial action.

The PT&R approach streamlines the remedy screening, evaluation, and selection phases. In addition to being used as a guidance for selecting the final remedy for a site, the PT&R approach is also suitable for interim measures* or actions to prevent or minimize the spread of contamination while final cleanup action alternatives are being evaluated. Because the PT&R guidance identifies excavation/disposal and containment/capping as the preferred alternatives, the data needed to support the remedy selection phase are potentially focused and reduced, thus decreasing time and investigation costs.

The use of the guidance document may have the following benefits:

- **Time and cost savings**. The guidance streamlines the cleanup process by (1) limiting the number of evaluated technologies; (2) facilitating corrective action and/or remedial action implementation by providing sample documents; and, (3) facilitating documentation and administrative processes.

- **Focused site characterization to support cleanup design**. Data needed to support the cleanup design is collected during site characterization activities.

- **Focused remedy selection**. The evaluation of cleanup alternatives is focused on the two most commonly implemented alternatives.

[6] i.e., CERCLA*, RCRA*, HWCL*, HSAA*

As illustrated in Figure 1, the PT&R guidance follows the requirements of the standard cleanup processes. To gain the maximum cost and time savings, the PT&R approach should be initiated as early as possible in the assessment and/or characterization phase.

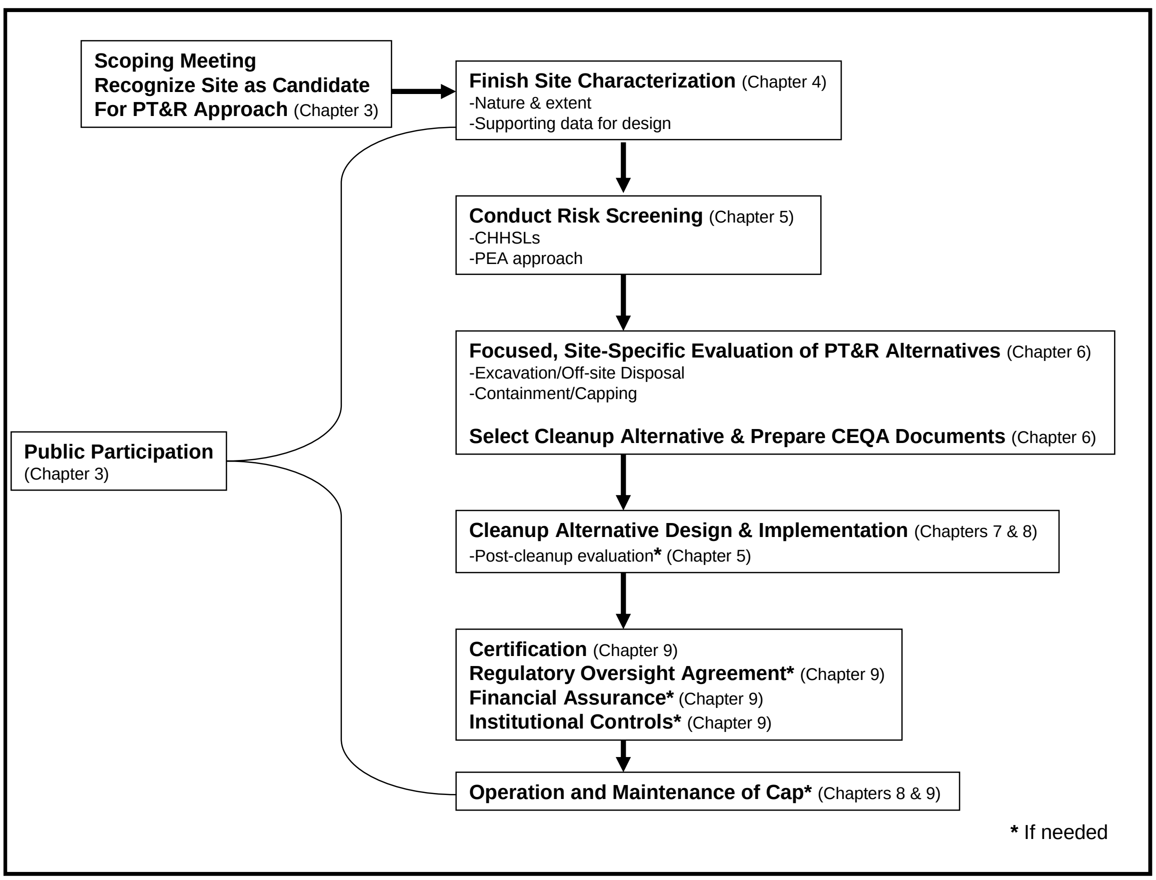
The PT&R guidance is organized into nine chapters:

Chapter 1 presents introductory information, including the purpose, objective, scope, and applicability of the guidance document.

Chapter 2 provides an overview of the PT&R process and summarizes the organization of the guidance document.

Chapter 3 summarizes the site and community assessment to determine if the site is suitable for the PT&R approach.

Figure 1. Overview of PT&R Approach for Sites With Metals-Contaminated Soils.



Chapter 4 summarizes the necessary site characterization data to support the cleanup process.

Chapter 5 presents the procedures for establishing health screening criteria and establishing site-specific cleanup goals.

Chapter 6 summarizes and documents the study and evaluation conducted by DTSC that is the basis for the PT&R guidance regarding metal-contaminated soils. This chapter also addresses the focused evaluation and selection of the cleanup alternative.

Chapter 7 summarizes the design and implementation considerations for the excavation/disposal alternative.

Chapter 8 summarizes the design and implementation considerations for the containment/capping alternative.

Chapter 9 addresses the site certification process.

Chapter 10 provides the references cited in this guidance document.

3.0 SITE ASSESSMENT

The PT&R approach is initiated by assessing whether this guidance document should be applied to a given site with metals contamination in soil. As discussed in Section 3.1, the decision to apply the PT&R approach can be made in a project scoping meeting between DTSC staff and project proponents. A potential outcome of the scoping meeting could be that the standard DTSC cleanup processes should be implemented and no further steps in the PT&R approach would be applied.

Because it was not realistic to develop a guidance document that addresses every possible site scenario, Sections 3.2 and 3.3 identify favorable site characteristics and potential limitations for applying the PT&R approach. The presence of limitations does not necessarily preclude use of the PT&R approach. If limitations are identified, DTSC staff and project proponents would need to make a determination as to whether it is appropriate and worthwhile to apply the PT&R approach with site-specific adjustments.

3.1 PROJECT SCOPING

The project scoping objectives under the PT&R approach are the same objectives that are used under any DTSC cleanup process. These objectives include:

- Establishing a management approach for the project;
- Developing a site cleanup strategy;
- Developing a project plan;
- Recognizing unique site conditions to be addressed during the cleanup process (e.g., cultural resources, sensitive receptors, endangered species);
- Identifying and assessing stakeholders; and
- Scoping public participation activities.

3.1.1 Scoping Meetings

DTSC staff and project proponents should hold one or more project scoping meetings. Typical discussion topics during these meetings include:

- Site background, physical setting, current/past land uses, and unique site characteristics;
- Status of site investigation and cleanup;
- Current conceptual site model (CSM*) for the site (i.e., types and locations of releases, affected environmental media, contaminant migration, potential risks);
- Regulatory framework for site cleanup;
- Initial scope of work for completing site characterization, filling data gaps, and cleaning up the site;
- Potentially applicable remedial technologies;

- Preliminary identification of response actions and the implications of these actions (e.g., restricted land use, long-term stewardship);
- Preliminary remedial action objectives (RAOs);
- Project planning, phasing, scheduling, and priorities; and
- Stakeholder identification and public participation activities.

The scoping meeting is also a forum for deciding whether the PT&R approach could be applied to all or part of the site cleanup, either as described in this guidance document or with site-specific adjustments (see Sections 3.4). If the PT&R approach may be applied, the scoping meeting should specifically address the potential for an unrestricted land use outcome that is offered by the excavation/disposal alternative versus the long-term stewardship associated with the containment/capping alternative.

Depending on the DTSC process applied to the site, the outcome of the scoping meeting(s) may be summarized in a scoping document that includes the following content:

- Analysis and summary of site background and physical setting;
- Analysis and summary of previous response actions, including all existing data;
- Presentation of the CSM and identification of data gaps;
- Scope and objectives of remaining characterization activities;
- Scope and objectives of the site cleanup;
- Preliminary identification of possible response actions and data needed to support the evaluation of cleanup alternatives; and
- Initial presentation of site remedial strategies (e.g., decision to apply the PT&R approach).

3.1.2 Stakeholder Identification and Assessment

Stakeholder involvement is considered essential for the success of any cleanup action. At the onset of the proposed project, stakeholders should be identified and contacted for input. Stakeholders include any individuals, government organizations, environmental and other public interest groups, academic institutions, and businesses with an interest in the project. The identification of stakeholders is largely based on those entities or individuals who are already involved in the project and contacting others with related interests or those who may be in close proximity to the site. Stakeholders provide information on the preferences of the community and may also identify unaddressed issues. Early identification of stakeholders is necessary to ensure effective and timely participation to meet stakeholder expectations and to improve the decision-making process.

3.1.3 Public Participation Activities

The PT&R approach uses the public participation process identified in the *DTSC Public Participation Manual* (DTSC, 2003). The manual addresses public participation components of the cleanup process and compliance with state and federal laws and regulations. The manual summarizes the public participation elements for each DTSC program, California Environmental Quality Act (CEQA*), and various public outreach activities. The manual provides checklists and recommended content for the public participation plan, fact sheets, public notices, and other public outreach activities. Samples for a fact sheet and other public participation documents are provided in Appendix F.

3.2 SITE CHARACTERISTICS THAT FAVOR THE PT&R APPROACH

This PT&R guidance is intended for cleanup at sites where the primary environmental issue is metal contamination in shallow soils[7]. The following site characteristics favor application of the PT&R approach. As discussed further in Section 3.3, the PT&R approach may also be applied to other sites if site-specific adjustments are made.

SITE CHARACTERISTICS THAT FAVOR PT&R APPROACH		
Favorable Characteristic	**Applicable PT&R Alternative(s)**	**Primary Rationale for Limiting Characteristic**
Primarily metals contamination	• Excavation/disposal • Containment/capping	This guidance document pertains to metals. Multiple contaminant groups may be better addressed by other cleanup approaches.
No emergency actions required		Emergency response actions will be subject to different regulatory requirements and will require a faster response than can be achieved under the PT&R approach.
Low potential for surface water impact		Impacts to surface water may have associated ecological risks. The screening levels recommended by this guidance document do not address ecological risk.
No ecological habitat or sensitive receptors		The screening levels recommended by this guidance document do not address ecological risk.
Low potential for groundwater impact		The screening levels recommended by this guidance document do not address protection of groundwater. Additional remedial measures may be required to address impacts to groundwater.
Shallow contamination[7]	• Excavation/disposal	The excavation alternative has depth constraints. The depth feasible for excavation is a site-specific decision.
Metals in immobile form	• Containment/capping	Metals in mobile forms may continue to migrate downward even after cap placement. The screening levels and RAOs recommended by this guidance document do not address protection of groundwater.

[7] As a general frame of reference, "shallow soils" or "shallow contamination" indicates depths that are less than about 15 feet below ground surface.

3.3 SITE CHARACTERISTICS THAT MAY LIMIT THE USE OF THE PT&R APPROACH

Multiple Contaminant Groups. This guidance may or may not be suitable for sites where metals are co-located with other contaminants. For example, the approach may be appropriate where multiple contaminant groups have a similar vertical and lateral distribution and can both be addressed by the same cleanup strategy. In other instances, multiple contaminant groups may be more effectively or efficiently cleaned up by other cleanup approaches. Additional types of contaminants may affect soil disposal options.

Metals in Mobile Forms. The PT&R approach applies to metals in forms that are largely immobile in soil and therefore have been retained in the upper portion of the soil profile. Any metal may become mobile under favorable geochemical conditions, when it forms soluble* complexes* with organic and inorganic ligands*, or when it is associated with mobile colloidal* materials. Some metals that form complexes with organic ligands can also be volatile*. Examples of mobile metals are summarized below.

METALS WITH HIGH SOLUBILITY**	
Arsenite (As^{3+})	Organometallic complexes
Cadmium chloride	Ethyl mercury
Hexavalent chromium (Cr^{6+})	Methyl mercury
Selenate (Se^{6+})	Tetraethyl lead (organolead)
	Organotins
VOLATILE FORMS OF METALS**	
Arsine (AsH_3)	Ethyl mercury
Methyl arsines	Methyl mercury
	Methyl selenides

**Not intended to be a comprehensive list.

If mobile metals are present in shallow soils and can be removed via the excavation/ disposal alternative, the PT&R approach may be appropriate. Soil containing some forms of mobile metals may require special measures and handling during excavation to manage short-term risks.

Mobile forms will have greater penetration depth, will be more difficult to stabilize, and/or will be more difficult to contain than can be addressed by the containment/capping alternative. If the containment/capping alternative is implemented where metals are present in mobile forms, cap performance objectives that require validation that metals are not migrating to groundwater (e.g., modeling, field measurements, groundwater monitoring) would be needed. These performance objectives are beyond the scope of the containment/capping objectives discussed in Chapter 8.

Shallow Groundwater. The PT&R alternatives are not intended to be the sole cleanup approach for sites where the metals-impacted soils are in contact with groundwater or where the contaminated soils extend to the top of the capillary fringe*. If the PT&R approach is applied to the soils, additional cleanup measures may be needed to address the metals impact to groundwater and consequently, PT&R may not be the most effective or efficient approach. This guidance document does not address cleanup measures for groundwater or recommend cleanup goals for the protection of groundwater.

Potential Ecological Risk. Sites located in areas that are designated as environmentally sensitive (e.g., wetland areas, wildlife refuges, endangered species habitat), or have other characteristics that suggest potential ecological impacts, are not candidates for the PT&R approach. Ecological risks may be present at sites where potential habitat, ecological receptors, surface water drainages, and/or surface water features are present. Because the cleanup process may be more complex, including the development of appropriate cleanup goals, these types of sites may not be suitable for the PT&R approach.

Surface Water Features. Sites with surface water features that are potentially impacted by runoff from metals-impacted soils may not be suitable for the PT&R approach because surface water impacts may be linked to ecological risk or have other risk considerations. The cleanup goals and alternatives recommended by this guidance document do not consider these risks.

Complex Sites. The PT&R approach may not be appropriate for complex sites that require a more elaborate cleanup strategy than is offered by this approach.

- Large sites or sites where more than one environmental medium is impacted may not be suitable for the PT&R approach. These sites may require integration of multiple cleanup approaches and may need to consider ecological risk when selecting the cleanup alternative.
- Sites associated with mining and milling activities have unique features that require a more sophisticated approach than is offered by PT&R. These sites tend to have unusual metals speciation, distribution, and characteristics, can be large in acreage, and can have sensitive ecosystems.
- Unusual geologic or hydrogeologic conditions may also limit the cleanup approaches that are appropriate for a site. For example, a site with shallow groundwater or a site located in a mineralized area with active hydrothermal vents likely would be too complex to be addressed using the PT&R approach.

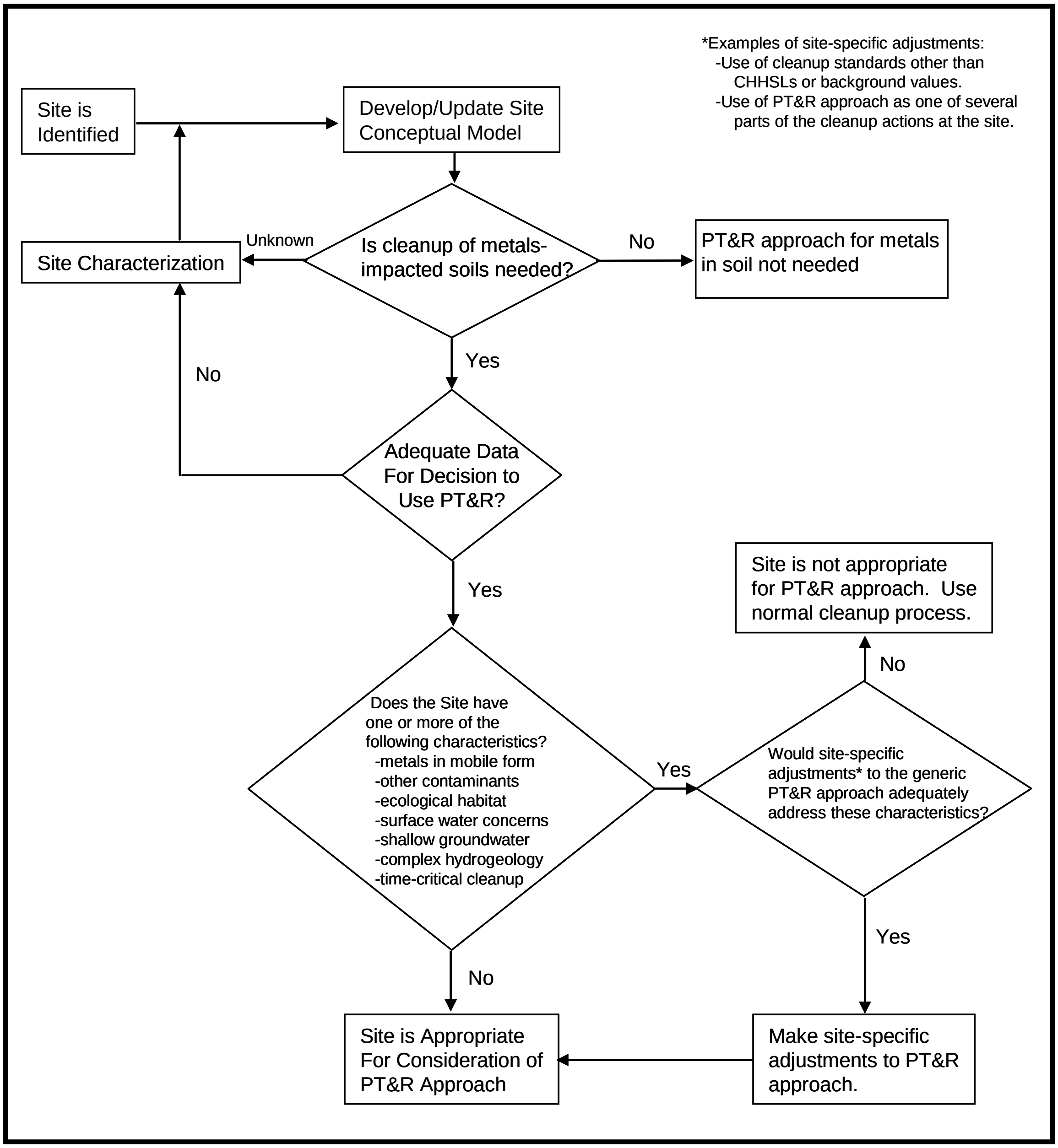
Time-Critical Cleanup/Emergency Response Actions. This guidance is appropriate for response actions where a planning period of at least six months is available before on-site activities must begin. The approach used for time-critical cleanup* or emergency response actions (i.e. removal actions that are imminent and must be carried out immediately) will be more streamlined than the PT&R approach and will be subject to different regulatory requirements than non-time critical cleanup actions.

3.4 DETERMINATION OF SUITABILITY FOR PT&R APPROACH

Figure 2 summarizes the recommended process for determining the suitability of the PT&R approach to a site. While a decision to apply the PT&R approach can be made at any point in the cleanup process, a site can be evaluated for suitability under the PT&R approach as soon as information is available that a response action is necessary.

A CSM should be developed to assist with the determination of suitability for the PT&R approach. The CSM is intended to summarize all currently available information about the site, develop a preliminary understanding of the site, and identify data gaps. An example of a CSM is provided in Appendix A1. The identified data gaps should be used to determine whether sufficient information is available to make a decision that a site is suitable for the PT&R approach.

Figure 2. Process for Determining if the PT&R Approach for Metals in Soil is Appropriate for a Given Site



4.0 SITE CHARACTERIZATION

The primary objective of the characterization phase is to establish the nature, extent, and distribution of contamination in soil and, if needed, background or naturally-occurring concentrations of metals. Under the PT&R approach, another objective of the characterization effort is to collect the data needed to support the engineering design. Sufficient data should be collected during this phase to move the project from the characterization phase through the design phase. The culmination of this step should be to prepare an updated CSM and to ensure that the PT&R approach is still applicable.

Site characterization activities should be conducted in accordance with a DTSC-approved workplan, including a field sampling plan and a quality assurance project plan (QAPP). Because numerous guidance documents are available to assist with the design and implementation of site investigations, this guidance document does not include an extensive discussion of site characterization. Rather, the reader is referred to resources available on the DTSC, U.S. Environmental Protection Agency (EPA), and Interstate Technology Regulatory Council (ITRC) Websites, including the following references:

- *Preliminary Endangerment Assessment Guidance Manual* (DTSC, 1994);
- *Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G-4* (EPA, 2006a);
- *Guidance on Choosing a Sampling Design for Environmental Data Collection, for Use in Developing a Quality Assurance Project Plan, EPA QA/G-5S* (EPA, 2002);
- *Data Quality Assessment: A Reviewer's Guide, EPA QA/G-9R* (EPA, 2006b);
- *Data Quality Assessment: Statistical Methods for Practitioners, EPA QA/G-9S* (EPA, 2006c); and
- *Technical and Regulatory Guidance for the Triad Approach: A New Paradigm for Environmental Project Management* (ITRC, 2003b).

In addition, this document provides the following resources to facilitate site characterization:

- Examples for a CSM (Appendix A1);
- Annotated outline for a characterization phase workplan (Appendix A2);
- Annotated outline for a site characterization report (Appendix A3);
- Suggested strategy for estimating background concentrations of metals in soil (Appendix B); and
- Discussion of data needed to support selection and design of the PT&R alternatives (Sections 7.1 and 8.2).

5.0 RISK SCREENING AND ESTABLISHMENT OF CLEANUP GOALS

Following the site characterization, a human health screening evaluation for chemicals of potential concern (COPCs*) should be conducted to estimate the potential cancer risks and noncancer health hazards. The potential risks and hazards associated with the COPCs are used in the risk management decision-making process to determine whether further site characterization, risk assessment*, or cleanup may be necessary for the site. The point of departure for risk management decisions for cancer risk is 1×10^{-6} and for noncancer risk is a hazard index of 1. Sites with risks from metal COPCs in excess of these points of departure may require remediation. Guidance for conducting a risk screening evaluation is provided in the following documents:

- *Preliminary Endangerment Assessment Guidance Manual* (PEA*; DTSC, 1994); and

- *Use of California Human Health Screening Levels (CHHSLs) in Evaluating Contaminated Properties* (Cal/EPA, 2005).

Several assumptions and exposure factors are used when conducting a risk screening*, including identification of the COPCs, land use, exposure pathways, and exposure point concentrations (EPCs*). The CHHSLs* were developed using standard exposure assumptions and chemical toxicity values published by the U.S. Environmental Protection Agency (EPA) and Cal/EPA. The CHHSLs are updated as needed to incorporate new toxicity information of referenced chemicals as well as new information regarding the exposure or potential exposure of humans to potentially hazardous chemicals in soils.

5.1 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN AND BACKGROUND METALS

Once the site has been characterized, the next step is to identify what COPCs are present at the site. Because metals occur naturally in the soil, metal concentrations should be compared to background and/or ambient levels to determine if the metals present on the site exceed these values and may therefore indicate a release. All COPCs present above background and/or ambient levels are retained for further evaluation to fully account for the potential cumulative risk (even if the COPCs do not pose a significant risk). The collection of background metal samples should, in general, occur in the vicinity of the site and in similar soil types. For some projects, existing background metal data sets may be applicable whereas others may require additional background sampling. Appendix B provides further discussions about estimating and using background concentrations of metals. A few metals, most notably arsenic, may pose potential health risk at or below background level. For additional discussion, please refer to Section 5.4.2.

There are a number of valid approaches for comparisons to background metals. The following is a simplified approach for comparisons to background for the determination of COPCs which may be applicable for screening purposes on smaller, less complex sites.

Step 1. Compare the highest site concentration with the highest background concentration. If the site concentration is equal to or less than the background concentration, the metal may be eliminated as a COPC. If the onsite maximum is greater than the background maximum and the detection frequency* is greater than 50 percent, proceed to Step 2. If the detection frequency is less than 50 percent, and the onsite maximum is greater than the background maximum, retain the metal as a COPC.

Step 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 metal is not eliminated by this screening, proceed to Step 3.

Step 3. Statistically evaluate the overlap of the background and onsite distributions to determine if they come from the same population. If determined to be from the same population, 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. Further discussion of the statistical comparison of background and onsite data sets is provided in Appendix B.

Additional information on identifying metals as COPCs can be found in Appendix B.

5.2 EXPOSURE POINT CONCENTRATIONS

Following the identification of COPCs, the appropriate soil concentrations to be used in the human health screening evaluation are determined. The DTSC *Preliminary Endangerment Assessment Guidance Manual* recommends the use of the maximum concentration for initial screening purposes. Other statistical approaches may also be appropriate, including the calculation of the 95 percent upper confidence limit (95% UCL*) on the arithmetic mean concentration. Statistical programs, such as EPA's ProUCL, can be used to calculate this level and data should be transformed where necessary. Censored data sets (i.e., data sets having one or more values reported as "not detected") should be added at one-half the detection limit, provided that the detection frequency* for the metal is greater than 50 percent. Appendix B identifies techniques for working with data sets that have a detection frequency less than 50 percent.

Use of this approach is dependent on the size of the data set (a minimum of ten samples are necessary), the distribution of contamination on the site, and the possible existence of localized hot spots. The selection of the exposure point concentrations (EPCs*) for the soil data should be justified based on whether soil contamination is limited to localized areas (hot spots), spread across the site, or contained within a defined area of concern. It is not appropriate to statistically minimize soil concentrations by including soil data from large areas of the site that are not impacted. If it is unclear whether the site characterization data supports the use of the 95% UCL, the maximum concentrations should be used in risk estimates. Consideration of overall risk from the whole site may be addressed in the post-cleanup evaluation (see Section 5.5).

5.3 HEALTH RISK SCREENING

All risk screening approaches should take into consideration the final end use of the property, such as residential, industrial, or commercial use. In addition, a CSM should be developed to determine all potential exposure pathways for inclusion in the health risk assessment (see example in Appendix A1). Either individual or cumulative cancer risks greater than 1×10^{-6} or noncancer hazards (hazard index) greater than one should be considered for further risk management evaluation.

Use of a risk screening approach other than CHHSLs/*Use of California Human Health Screening Levels (CHHSLs) in Evaluating Contaminated Properties* (Cal/EPA, 2005) and/or the *Preliminary Endangerment Assessment Guidance Manual* (DTSC, 1994) will require a site-specific adjustment to the PT&R approach. Consideration of other risk scenarios (i.e., other than residential, industrial, or commercial use) also requires a site-specific adjustment to the PT&R approach.

5.3.1 California Human Health Screening Levels (CHHSLs)

Health risk screening evaluation can be accomplished by comparing appropriate soil concentrations (see Section 5.2) to CHHSLs. The current list of CHHSLs can be found on the Cal/EPA website, and the accompanying *Use of California Human Health Screening Levels (CHHSLs) in Evaluating Contaminated Properties* (Cal/EPA, 2005) should be consulted. In addition, a spreadsheet calculator is available on the Cal/EPA website.

After the metal COPCs have been identified, appropriate soil concentrations (see Section 5.2) should be compared to CHHSLs. Cumulative cancer risks and noncancer hazards should be calculated according to the guidance. Either individual or cumulative cancer risks greater than 1×10^{-6} or noncancer hazards (hazard index) greater than one should be considered for further risk management evaluation.

5.3.2 DTSC Preliminary Endangerment Assessment (PEA)

An alternative risk screening assessment may be performed using the *Preliminary Endangerment Assessment Guidance Manual* (DTSC, 1994) instead of the comparison to the CHHSLs. The PEA guidance should be used if there are no CHHSLs available for a metal COPC.

After the metal COPCs have been identified, appropriate representative soil concentrations (see Section 5.2) should be used in the calculation of risks and hazards. Cumulative cancer risks and noncancer hazards should be calculated according to the guidance. Either individual or cumulative cancer risks greater than 1 x 10^{-6} or noncancer hazards greater than one should be considered for further risk management evaluation.

5.4 CLEANUP GOALS

Metals occur naturally in soil and therefore the elimination of all risks from metals at a contaminated site is not possible. Cleanup goals are generally developed based on concentrations that do not pose an unacceptable risk or hazard to human health and the environment. Exceptions to this approach include metals that occur naturally in soil at levels which may pose a potential health risk, such as naturally occurring arsenic in soil (see Section 5.4.2).

5.4.1 Health-Based Cleanup Goals

Factors that are considered in the development and selection of cleanup goals include the health impact endpoint (carcinogen vs. noncancer hazard), the intended use of the property (residential vs. industrial/commercial), and the number of COPCs. Cleanup goals based on anything other than unrestricted use (i.e., residential use) will require land use restrictions.

For the purposes of this PT&R guidance, several conditions are not considered in the selection of cleanup goals. These include potential impacts to ecological receptors, groundwater, and surface water. This recommended PT&R approach for establishing cleanup goals is not applicable if any of these conditions exist.

For potential carcinogenic metals, the generally accepted cleanup level for each individual metal should not be greater than 1 x 10^{-6} cancer risk. For metals with noncancer hazard, the generally accepted cleanup goal should not be greater than a cumulative hazard index of 1. If five or more metal COPCs present at a site require cleanup, the cleanup goals may need to be adjusted for cumulative risk or hazard in order to reduce the overall risk and/or hazard to the acceptable range. Risk management decisions that would allow cleanup goals with greater risks or hazards may be made on a site-by-site basis.

Selection of a cleanup goal is dependent on the most probable end use of the property. For the purpose of the PT&R, two future scenarios are considered. The first is a residential or unrestricted land use and the second is an industrial/commercial land use. Both of these future land use scenarios use standard exposure pathway assumptions for persons who may come into contact with the soil. For the purposes of the PT&R guidance, these exposure assumptions should be identical to either the assumptions used in the development of CHHSLs or the PEA guidance. When properties are remediated to commercial or industrial cleanup goals or waste is left in place under a cap, institutional controls (ICs*) are required in order to ensure the continued health protectiveness of the selected solution. Please refer to Section 9.3 for further discussion.

For sites where this PT&R guidance is applied, CHHSLs (see Section 5.3.1) may be considered as cleanup goals as a means of streamlining the selection process. CHHSLs for metals are based on the direct exposure of humans to contaminants in soil via incidental soil ingestion, dermal contact, and inhalation of dust in outdoor air. Development of a cleanup goal other than the CHHSL value may be necessary in the following instances:

- The CHHSL value for lead is subject to change. DTSC should be contacted for information regarding the appropriate risk-based value for lead remediation.

- CHHSL values for certain metals (e.g., arsenic) may be less than background concentrations (see Section 5.4.2), and therefore, the cleanup goal may be based on the estimated background and/or ambient levels. Appendix B provides a strategy for estimating background metals concentrations and for developing ambient cleanup goals.

- The regulatory oversight agencies do not concur with the proposed use of CHHSLs. The use of CHHSLs as cleanup goals requires concurrence of both the responsible party and regulatory oversight agencies.

- Instances may arise where a value less than the CHHSL is needed to address a regulatory requirement or environmental concern.

5.4.2 Background-Based Cleanup Goals

For some metals, establishment of a cleanup goal will need to consider the naturally-occurring concentrations of the metal in soil (i.e., background or ambient concentration). DTSC does not generally require cleanup of sites to concentrations that are less than background.

Although there are several metals in soil which may fall into this category, arsenic is the predominant metal where background concentrations usually need to be considered in developing appropriate cleanup goals. Remediation of arsenic contamination in soil has occurred at many sites, and the calculated health-based cleanup goal can be an order of magnitude below background levels. While DTSC recognizes that there are many outstanding scientific questions about the differing forms and sources of arsenic (including arsenic in water versus arsenic in soil) as well as the bioavailability and bioaccessibility of arsenic (particularly when it comes to soil considerations), they are not currently factored into this guidance. Several study groups are investigating these potential impacts on risk estimates and developing cleanup goals. As new DTSC guidance concerning arsenic becomes available, the approaches in this document will be modified.

DTSC has used a strategy for developing cleanup goals based on the entire site data set for arsenic which is described in *Arsenic Strategies, Determination of Arsenic Remediation Development of Arsenic Cleanup Goals for Proposed and Existing School Sites* (DTSC, 2007; included in Appendix B). The same approach may be used for other metals at sites where the health-based cleanup goals are significantly below background levels. Briefly, the strategy utilizes the complete data set from a site, including relevant background samples, in order to statistically determine feasible site-specific cleanup goals. Several statistical approaches are outlined in the guidance.

5.5 POST-CLEANUP EVALUATION FOR LEAD

Following the completion of the remediation, a post-cleanup evaluation may be required for sites where lead is one of the COPCs. Because cleanup approaches may be changing for lead, a more complete evaluation of the residual lead concentrations is recommended for risk communication purposes. When the PT&R cleanup alternative for soil is completed, residual levels of lead will remain at the site because lead occurs naturally in the soil. However, the overall remaining residual concentrations across the site should be lower than the established cleanup goal.

A statistical summary of the complete data set for the entire site remaining after mitigation, excluding the data from the removed or capped areas and including any confirmation samples, should be incorporated into the completion report (see Sections 7.11 and 8.7). For sites where capping has been selected as a remedial alternative, this summary should address the remaining uncapped areas and, where appropriate, data from the capping material. This summary should include the minimum and maximum values, the mean value, the 95% UCL, and the corresponding cleanup goal. Summaries of other metals may be recommended on a site-specific basis. An example of a post-cleanup evaluation for lead is provided in Appendix D4.

This step is different from the assessment and development of the cleanup goals described in Section 5.3. The evaluation more closely considers the expected land use, cumulative effects, and the complete site data set. For some sites where containment/capping are employed, metals concentrations would be the same as those prior to and following cleanup. However, the risk will have been reduced or eliminated by mitigation of the potential exposure pathways.

6.0 EVALUATION OF CLEANUP TECHNOLOGIES FOR METAL-IMPACTED SOIL

In a conventional clean up action, if the results of the risk screening process indicate that a cleanup action is warranted, the next step is an evaluation of the technologies appropriate for remediation of soils. This chapter provides the administrative record, technical basis, and evaluation necessary for streamlining the cleanup alternative evaluation. This chapter also addresses the site-specific evaluation and remedy selection process for cleanup of metal-contaminated soils. Much of the streamlining is achieved by the DTSC study summarized in Section 6.1. The streamlined approach for evaluating remedial alternatives can be documented by:

- including pertinent sections of this PT&R guidance in the administrative record[8] and
- including a discussion regarding the use of the PT&R approach for the cleanup alternative selection in the decision document.

6.1 TECHNICAL BASIS FOR PT&R GUIDANCE TO ADDRESS SITES WITH METAL SOIL CONTAMINATION

DTSC conducted a study of sites where the primary contaminants of concern were metals. The objective was to identify the technologies that were consistently evaluated as potential remedies and to identify the remedies that were subsequently selected at a site. The study is equivalent to the screening and evaluations conducted under a Feasibility Study (FS) or Corrective Measures Study (CMS).

The study included the following activities:

- Review of literature relevant to sites with metal soil contamination. A table summarizing the technologies applicable at sites with metals in soil is included in Appendix C1.
- Identification of a representative number of DTSC sites with metal contaminated soils.
- Review of the decision documents to determine which cleanup alternatives were routinely either screened out or selected for the remedy.
- Identification of the rationale for selection of remedy.

DTSC reviewed the Site Mitigation and Brownfields Reuse Program database (EnviroStor) and the Hazardous Waste Management Program database to identify sites with metal contaminated soils. The initial list of sites was reduced to 188 sites for which remedy selection or implementation occurred between January 2001 and January 2007. This timeframe was selected to narrow the review and to reflect the best management

[8] Alternatively, include the PT&R guidance as an electronic appendix to cleanup alternative evaluation document.

practices for cleanup of sites with metal contaminated soils. The types of DTSC sites included in this analysis are summarized in Table 1.

Table 1. Cleanup Options Selected for the Sites Evaluated by DTSC Study

DTSC Site Type (no. of sites)	Cleanup Option Selected (No. of Sites)							
	No Action	ICs	Capping in Place	Consolidation/ Capping	CAMU	Excavation/ Disposal	Reuse/ Recovery	Treatment
Schools Properties (32*)	0	0	0	1	0	32	0	0
Military Facilities (55*)	3	5	3	1	9	37	3	3
Voluntary Cleanup (51*)	0	1	8	5	0	40	5	1
State Response/ NPL (32*)	0	0	5	7	0	22	0	4
Corrective Action (7)	0	0	0	0	3	4	0	0
Facility Closure (11)	0	0	0	0	0	11	0	0

Notes:
* Some sites in this category selected multiple cleanup options (i.e., this number is not simply the sum of frequencies listed in this row).
CAMU is corrective action management unit
IC is institutional control

DTSC reviewed the cleanup alternative decision documents for the 188 sites identified in the database review. The review focused on the cleanup alternatives that were considered and the factors that led to the selected cleanup alternative. The document review also considered the project type, site activities, types of metals present, types of other contaminants present, other affected media, and impacted volume. Based on the data collected, DTSC evaluated three variables in detail:

- Frequency of selection of the cleanup alternatives provided in this document;
- Rationale for selection of the cleanup alternatives provided in this document; and
- Rationale for rejection of the cleanup alternatives considered by the selection process.

Based on the decision documents reviewed, lead and arsenic are the most frequently encountered metals requiring a response action. Lead-impacted soils had the widest variety of selected remedies and had the most number of sites that incorporated a treatment process into the selected remedy (see Table C1-1 in Appendix C1 for details).

The data indicates that excavation/disposal was the most frequently selected cleanup alternative. Containment/capping and consolidation/capping were the next most frequently chosen cleanup alternatives. The selection of the cleanup alternative as the preferred approach does not appear to be correlated with impacted volume, contaminant types present, or affected environmental media (see Table C1-1 in Appendix C1 for details). Rather, factors affecting selection of excavation/disposal and containment/capping included proven effectiveness, ability to meet the project timeframes, and the current and reasonably foreseeable future land use. The excavation/disposal alternative was selected if the objective was to allow unrestricted land use. Containment/capping or consolidation/capping was selected if a cap was compatible with the current and reasonably foreseeable future land use and the associated land use restrictions were not an issue with interested parties.

Table 2 summarizes the frequency of the National Contingency Plan (NCP*) criteria used to support selection and rejection of a particular cleanup alternative for the 188 sites. A detailed summary of the primary rationale for selecting and rejecting a given technology is provided in Appendix C1. The excavation/disposal alternative frequently was rejected based on cost. Containment/capping and consolidation/capping were most often rejected due to existing or planned land use, or because of the long-term operation and maintenance requirements. Solidification/stabilization* and chemical fixation* were rejected for several reasons, including costs, long-term effectiveness, soil volume increases, and time to conduct treatability studies*. Soil washing* was rejected because of uncertain effectiveness, associated costs, and implementability. Recovery/reuse applications typically were rejected because of the inability to implement within the timeframe of the project. If evaluated, other treatment alternatives could also be rejected because of the associated costs and ability to implement.

Table 2. Cleanup Options Considered for the Sites Evaluated by DTSC Study

Technology	Number of Site Alternatives Analyses Considering Technology	Number of Site Alternatives Analyses Rejecting Technology	Reason for Rejection During Cleanup Alternative Analysis						
			Overall Protection	Compliance with ARARs	Reduction of Toxicity, Mobility, Volume	Long-term Effectiveness	Short-term Effectiveness	Cost	Implementability
No Action/ ICs	188	181	172	11	0	6	0	0	0
Excavation/ Off-Site Disposal	183	36	4	0	0	2	1	30	6
Containment by Capping, Capping/Consolidation, Capping/CAMU	113	78	8	0	1	61	0	13	4
Solidification/Stabilization, Chemical Fixation	43	38	0	0	13	14	1	17	11
Reuse or Recovery	23	10	3	0	1	2	0	2	6
Soil Washing	21	21	0	0	1	11	0	7	6
Treatment (non-specific)	12	10	0	0	1	1	1	5	4
Vitrification	4	4	0	0	0	0	0	4	1
Soil Flushing / Leaching	3	3	0	0	0	0	0	2	3

Notes:
ARARs - applicable and or relevant and appropriate requirements
CAMU - corrective action management unit
ICs - institutional controls

6.2 FOCUSED EVALUATION AND SELECTION OF CLEANUP ALTERNATIVE

Under state and federal law, an analysis of alternatives is required for sites undergoing remediation. Following an initial evaluation, a more detailed and focused evaluation that considers the site characteristics must be conducted on the PT&R alternatives. Because the cleanup alternatives evaluation presented in Section 6.1 and Appendix C1 was conducted in accordance with the initial screening requirements of a FS and CMS, it may be used in lieu of a site-specific initial screening for sites undergoing the streamlined PT&R approach, provided that the use of the PT&R evaluation is cited in the administrative record.

The next step in the PT&R approach is to determine whether excavation/disposal or containment/capping is the most appropriate cleanup alternative. The alternatives evaluation may consist of a site-specific evaluation of the no action, excavation/ disposal, and containment/capping alternatives. Focusing on these PT&R alternatives is consistent with the NCP which provides that: the number of alternatives evaluated for a site should be reasonable; the number of alternatives evaluated should be based on the scope, characteristics, and complexity of the site; and detailed analyses need only be conducted on a limited number of alternatives that represent viable approaches to the cleanup. Application of the PT&R approach in this guidance does not preclude consideration of additional cleanup alternatives if determined to be appropriate for a site. However, use of the PT&R approach would still reduce the burden of the number of cleanup technologies to be screened and evaluated.

As illustrated in Figure 3, the excavation/disposal alternative has the potential to allow unrestricted use of the site whereas the containment/capping alternative will require ICs, long-term operation and maintenance and regulatory oversight.

The focused alternatives evaluation may be prepared under state or federal guidelines, as summarized in Table 3.

In addition to using the DTSC initial alternatives evaluation (Section 6.1), the following site-specific elements of the remedial alternative evaluation process should be addressed in the appropriate remedy selection document:

- Establishment of site-specific remedial action objectives (RAOs);
- Identification of applicable federal/state/local requirements (known as ARARs* under the CERCLA process); and

Figure 3. Summary of PT&R Cleanup Alternatives

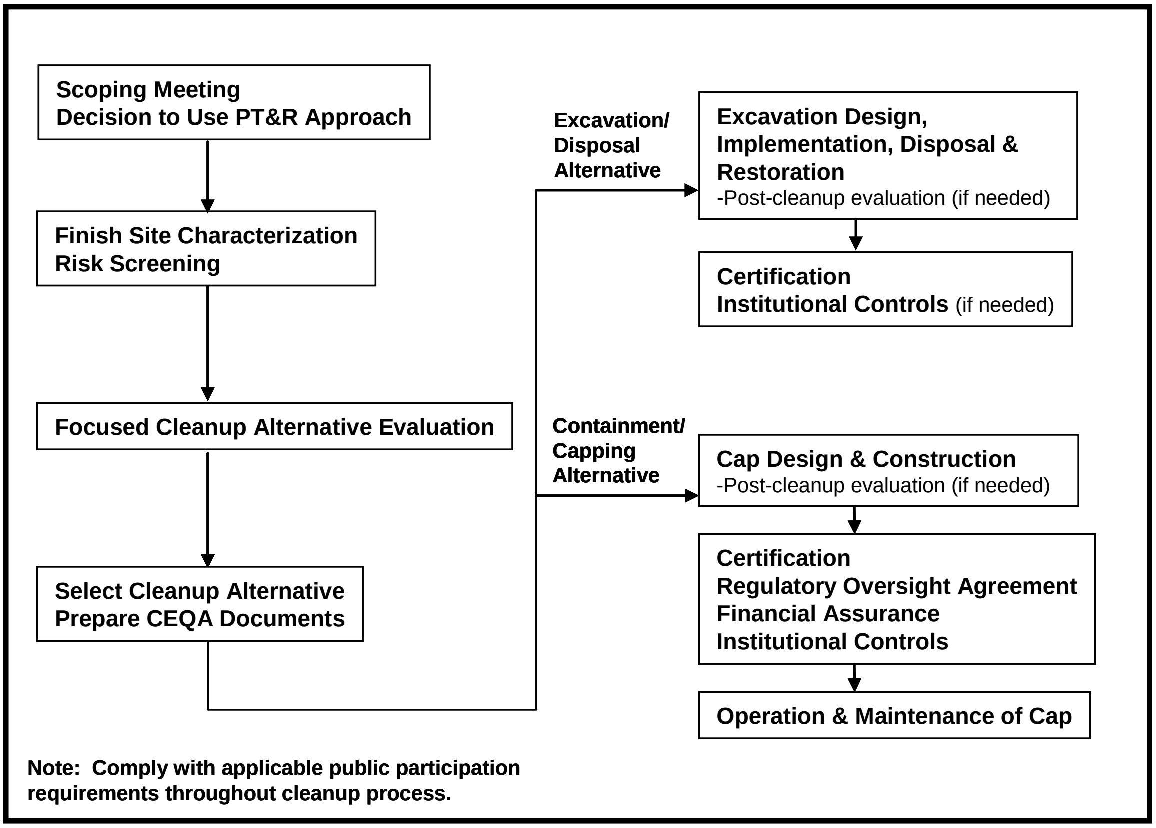


Table 3. State and Federal Guidelines for Focused Alternatives Evaluation

Law	Process	Description	Resource Provided in This Guidance Document	Suggested Reference(s)
HSAA	Remedial Action Plan (RAP)	Process for developing, screening, and detailed evaluation of alternative remedial actions for sites. Remedy selection document under HSC §25356.1.	A RAP Sample is provided in Appendix C2	DTSC, 1995
	Removal Action Workplan* (RAW)	Prepared when a proposed, non-emergency removal action or a remedial action is projected to cost less than $1,000,000. Remedy selection document under HSC §25356.1.	A RAW Sample is provided in Appendix C3	DTSC, 1993, 1998
CERCLA HSAA	Feasibility Study (FS)[1]	Process for the development, screening, and detailed evaluation of alternative remedial actions for sites.	--	EPA, 1988, 1999
	Engineering Evaluation/ Cost Analysis (EE/CA)	Analogous to, but more streamlined than, the FS. Identifies the objectives of the removal action and analyzes the effectiveness, implementability, and cost of various alternatives that may satisfy these objectives.	--	EPA, 1993
RCRA or HWCL	Corrective Measures Study (CMS)	Mechanism used by the corrective action process to identify, develop, and evaluate potential remedial alternatives.	A CMS Scope of Work is provided in Appendix C4. An example Statement of Basis is provided in Appendix C6.	EPA, 1991a, 1994, 1997a
HSAA, HWCL, RCRA, CERCLA	Interim Measures (IM) or Interim Actions	Actions to control and/or eliminate releases of hazardous waste and/or hazardous constituents from a facility prior to the implementation of a final corrective measure or remedy.	An IM Scope of Work is provided in Appendix C5.	

Notes:
1 A feasibility study is not required for RAW process.
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
HSAA – Hazardous Substance Account Act
HWCL – Hazardous Waste Control Law
RCRA – Resource Conservation and Recovery Act

- Evaluation of the PT&R cleanup alternatives and the no action alternative against the applicable NCP criteria[9]:

  Threshold Criteria
  1) overall protection of human health and the environment,
  2) compliance with federal/state/local requirements,

  Balancing Criteria
  3) long-term effectiveness and permanence,
  4) reduction of toxicity, mobility or volume through treatment,
  5) short-term effectiveness,
  6) implementability based on technical and administrative feasibility,
  7) cost,

  Modifying Criteria
  8) state and local agency acceptance,
  9) community acceptance.

Appendix C provides further guidance on the content of the RAW, FS/RAP, and CMS Report. Regardless of the process used to evaluate and select the cleanup alternative for a site, the alternatives evaluation report generally should:

- discuss and present documentation showing that the PT&R approach is appropriate;
- identify and provide the rationale for the preferred alternative for the site;
- document the site-specific RAOs, regulatory requirements, and the detailed alternatives analysis; and
- include preliminary design information for implementation of the final remedy.

Necessary documents for the California Environmental Quality Act (CEQA*) are usually prepared concurrently with the alternatives evaluation reports, if not sooner (see Section 6.4 for further discussion of CEQA requirements). Once approved by DTSC or a Regional Water Quality Control Board (RWQCB), the draft alternative analysis and draft CEQA documents are circulated for public comment (DTSC, 2003).

The administrative record for the site should, among other things, include the following elements:

- Copy of pertinent sections of this PT&R guidance. (Alternatively, include the PT&R guidance as an electronic appendix to cleanup alternative evaluation document);
- A bridging memorandum that describes how use of the PT&R approach differed from the conventional cleanup process; and
- Responses to any comments pertaining to the decision to use the PT&R approach.

[9] Only the effectiveness, implementability, and cost criteria apply to the DTSC RAW process.

An example for a bridging memorandum is included as Appendix C7.

6.3 DESIGN AND IMPLEMENTATION OF SELECTED CLEANUP ALTERNATIVE

The operational and technical plans for implementing the selected cleanup alternative should be prepared and submitted to DTSC, either in the remedy selection document (if appropriate) or provided as separate submittals. Examples of operational plans include the health and safety plan, transportation plans, and soil confirmation sampling plan. The technical plans contain the specific engineering design details of the proposed cleanup approach, including designs for any long-term structures (e.g., caps). As applicable, the design plans should include the design criteria, process diagrams, and final plans and specifications for the structures as well as a description of any equipment to be used to excavate, handle, and transport contaminated soil. Field sampling and analysis plans that address sampling during implementation and soil confirmation sampling to assess achievement of the cleanup objectives could also be prepared.

Chapters 7 and 8 provide further discussion of the design and implementation for the PT&R cleanup alternatives.

6.4 CALIFORNIA ENVIRONMENTAL QUALITY ACT

Site cleanups using the PT&R approach must meet all applicable local, state and federal requirements including the California Environmental Quality Act (CEQA*). Signed into law in 1970 (Public Resources Code, section 21000 et seq.) and updated in 1993, CEQA requires public agencies carrying out or approving a project to conduct an environmental analysis to determine if project impacts could have a significant effect on the environment. Public agencies must eliminate or reduce the significant environmental impacts of their decisions whenever it is feasible to do so.

All proposed projects for which the DTSC has discretionary decision-making authority are subject to CEQA if they potentially impact the environment. Examples of approval actions which require CEQA review and documentation include: RAPs, interim measures, RAWs, and corrective actions. As shown by these examples, certain steps in the PT&R approach are subject to CEQA.

For further information, DTSC's CEQA-related polices and procedures are available on the DTSC Internet site.

7.0 DESIGN AND IMPLEMENTATION OF EXCAVATION/DISPOSAL ALTERNATIVE

This chapter describes the approach that will be used to complete the soil removal action and the disposal requirements for the excavated soil and restoration of the excavated site. The objective is to remove soil contaminated at levels exceeding site cleanup goals. The excavation and disposal alternatives discussed in subsequent sections can be applied to either an interim action (i.e., early measure to reduce the risk of releases of hazardous substances before the initiation of more complicated, comprehensive, and long-term cleanup remedies) or the final remedy at a site.

7.1 DATA NEEDED TO SUPPORT EXCAVATION DESIGN

At a minimum, the following data is necessary to adequately address the excavation limits and design:

- Vertical and horizontal distribution of contaminants (i.e., areal extent of impacted soils, depth of impact) and volume of soils to be excavated;
- Identification of soil conditions that affect the selection of excavation equipment;
- Average depth to groundwater;
- Climatology/ seasonal variations;
- Survey map of site features (e.g., topography, existing structures, utilities, wells, surface water control measures, property boundaries, areas to be shored), if applicable;
- Geotechnical data for each soil type (i.e., USCS classification, Atterberg limits, moisture content, bulk density), if applicable; and
- Structural contour map of the top of competent bedrock, if applicable.

Ideally, these data will be collected during the characterization phase of the project (see Chapter 4) rather than requiring another field mobilization during the design phase.

7.2 EXCAVATION, DISPOSAL, AND RESTORATION PLAN

A workplan identifying the logistical procedures and site activities associated with excavation, disposal and site restoration should be prepared. The actual title of this plan will depend on the cleanup process applied to the site. For example, DTSC's RAW process incorporates the required plan elements into the RAW. DTSC's RAP and corrective action processes often require preparation of a separate plan. However, additional streamlining under the PT&R approach could be achieved if the plan is included in another document (e.g., as an appendix to the RAP). For the purposes of this chapter, the workplan is referred to as the "excavation, disposal, and restoration plan".

Major topics and elements of the excavation, design, and restoration plan include the following:

- site background, nature and extent of contamination;
- objectives and scope of plan;
- project organization and schedule;
- description of the technical basis for the approach (e.g., why excavation/disposal was selected as the cleanup alternative; estimated extent of excavation, estimated volume of soil to be excavated);
- pre-excavation activities;
- excavation activities;
- waste management;
- backfill and site restoration activities;
- quality assurance and quality control;
- health and safety monitoring; and
- reporting.

The excavation, design, and restoration plan should be supported by the following documents, as applicable. These documents can be submitted separately or as appendices to the plan.

- site-specific health and safety plan;
- storm water pollution prevention plan (SWPPP);
- community air monitoring plan;
- soil confirmation sampling plan;
- public participation plan;
- stockpile sampling plan; and
- transportation plan.

Selected topics related to the excavation, design, and restoration plan are discussed further in the following sections.

7.3 PRE- EXCAVATION ACTIVITIES

Prior to conducting fieldwork, a series of project management and regulatory tasks should be completed. The general areas that require preparatory activities include:

- site access;
- permits;

- location of underground utilities;
- health and safety;
- waste management;
- schedule for staff and equipment resources;
- coordination with laboratory for analysis and assessment;
- coordination with off-site disposal facility; and
- notifications.

Local jurisdictions, such as municipal public works departments and air districts, often require excavation or grading permits. In addition, depending on the amount of soil to be excavated or disturbed, the RWQCB may specify waste discharge requirements, preparation of a SWPPP, and/or an NPDES permit. The key elements of the permit application specific to the location of the excavation should be identified. Some municipalities have restrictions on the type of equipment that can be used within a specified distance from water mains, sewer lines, and utility lines. In addition, air districts may require a similar application that identifies the mitigation measures to reduce or eliminate air dispersal of contaminants.

7.3.1 Dust Control and Air Monitoring

The design should reiterate the actions (specified in the remedy selection document) that will be implemented to control fugitive dust and emissions during implementation of the remedy. Dust control is required during construction, demolition, excavation, and other earthmoving activities, including, but not limited to, land clearing, grubbing, scraping, travel on site, and travel on access roads to and from the site.

Most air districts have recommended or required dust mitigation measures and/or engineering controls. Applicable air pollution regulations, performance criteria and acceptable control strategies should be cited and described. The following items are generally considered:

- Wind breaks and barriers, or ceasing work when wind speeds are above a certain level;
- Frequent water applications;
- Application of soil additives;
- Control of vehicle access;
- Vehicle speed restrictions;
- Covering of piles;
- Use of gravel and rumble strips at site exit points to remove caked-on dirt from tires and tracks;

- Decontamination and tracking pad to thoroughly wash and decontaminate vehicles before leaving the site;
- Wet sweeping of public thoroughfares; and
- Cause for work stoppage.

The dust mitigation measures and/or engineering controls are intended to ensure that project activities will not have an adverse impact on the environment or the community.

7.3.2 Community Air Monitoring

Community air monitoring should be considered for activities occurring near residential communities, schools, and other sensitive receptors (e.g., elderly or high use community areas) to ensure that the implementation of the remedy does not pose a potential threat to off-site receptors. Site-specific risk-based action levels should be calculated, in consultation with DTSC, and included in the remedy design.

7.4 EXCAVATION ACTIVITIES

7.4.1 Safety Standards for Trenching and Excavations

The excavation, design, and restoration plan should address the applicable Cal-OSHA safety requirements for excavations (Cal. Code Regs., tit. 8, §1540, §1541, §1541.1). These requirements state that workers exposed to potential cave-ins must be protected by shoring, sloping, or benching the sides of the excavation, or placing a shield between the side of the excavation and the work area. These safety standards also provide for protection of the stability of adjacent structures. Any excavation four feet or deeper must have adequate means of access/egress every 25 feet of lateral travel from workers. Excavations greater than four feet deep require testing for hazardous atmospheres and protection from hazards associated with water accumulation. Entry into some excavations/ trenches may require a Cal-OSHA permit and compliance with Cal-OSHA regulations for trenching and excavation.

7.4.2 Surface Water Control Measures

If there is the potential for rainfall during the excavation activities, the excavation, design, and restoration plan should address surface water runoff, erosion control, and sediment control measures. These measures should conform to state and local requirements and should provide for segregation of surface water runoff from impacted and non-impacted areas.

7.5 WASTE MANAGEMENT

7.5.1 Management and Profiling of Excavated Soil

Contaminated soil that is excavated must be managed and disposed of as hazardous waste if it is identified as a RCRA listed or characteristic waste. If the waste is regulated under RCRA, it must be disposed of in a landfill authorized to accept RCRA hazardous waste. Soil identified as California only hazardous waste is generally disposed of in a Class I landfill.

Excavated soil may either be directly hauled off site for disposal, provided arrangements have been made with a disposal facility or may be stockpiled on site for further profiling. A schematic or scaled map of the areas to be excavated and the locations where soil will be stockpiled should be included. Excavated soil should be segregated and stockpiled based on the existing site data. The stockpiles should include any of the applicable categories summarized in Table 4.

Table 4. Disposal Alternatives for Excavated Soil

LEVEL OF CONTAMINATION	DISPOSAL ALTERNATIVES
Not impacted	Can remain on site and used for backfill
Impacted at levels above acceptable risk levels but below hazardous levels	Disposal at Class I or Class II landfill
Impacted at California only hazardous levels	Disposal at Class I or Class II landfill
RCRA hazardous waste	Stabilization before disposal at Class I landfill

Temporary stockpiles should be managed in accordance with the excavation, design, and restoration plan. The plan should be prepared in compliance with the applicable requirements of the California Code of Regulations, title 22, division 4.5. The excavation, design, and restoration plan should designate the locations for placement of stockpiles, should address measures to prevent migration and/or dispersal of the soil (e.g., liners, covers), and identify the appropriate distance from the upper edge of any excavation.

Composite samples should be collected and analyzed from the stockpiles to verify that the soil has been appropriately segregated. Disposal of soils will be based largely on the Land Disposal Restrictions (LDRs*). LDRs apply if the excavated soils are contaminated with a listed RCRA waste or if the contaminated soils exhibit a RCRA hazardous waste characteristic. If analytical data demonstrate that the soil is a RCRA hazardous waste, the soil must be treated to meet specific LDRs limits prior to land disposal. In addition, if the soil is a RCRA characteristic waste, all other underlying soil must meet its associated LDRs prior to disposal. If the excavated soil is below the specified LDR concentrations, the soils do not need to be treated prior to off-site land disposal and can be disposed of appropriately at a landfill.

The sampling results from the soil stockpiles must be included in the waste profile form for the landfill to review and determine if the profile meets its acceptance criteria. Upon acceptance by a landfill, the soil stockpiles are loaded into the transport container (e.g., truck, rail car, bin) and transported to either a Class I landfill under a hazardous waste manifest or a Class II landfill under a bill of lading. Soils not contaminated above the site cleanup goal may be left on site and reused to backfill the excavated areas.

7.5.2 Loading, Transportation, and Manifesting

Soil transported for offsite management or disposal must be transported in accordance with applicable state and federal laws. Loading of transport containers should be adjacent to stockpiles or excavations, just outside designated exclusion zones. Any soil falling to the ground surface during loading should be placed back into the container. Loaded containers should be inspected to ensure that they are within acceptable weight limits and should be covered and inspected prior to departure to minimize the loss of materials in transit. The waste profile analyses should accompany the shipping document (i.e., bill of lading or hazardous waste manifest) to the offsite facility.

7.6 BACKFILL AND RESTORATION

Backfilling typically occurs after the cleanup objectives have been met. Confirmation samples are collected from the sides and bottom of the excavation to confirm that the clean up goals have been achieved. An annotated outline for a soil confirmation sampling plan is included in Appendix D3.

Once the cleanup goals have been achieved, backfill operations can begin. Backfill soils should have physical properties consistent with engineering requirements for the planned site use. The Uniform Building Code typically requires a compaction between 90 and 95 percent. The excavated areas should be restored to be consistent with its continued use and graded to ensure proper runoff.

7.6.1 Borrow Source Evaluation

When selecting material for backfilling excavated areas, steps should be taken to minimize the chance of introducing soil to the site that may pose a risk to human health and the environment at some future time. As a general rule, fill should not be obtained from industrial areas, from sites undergoing environmental cleanups, or from commercial sites with potential impacts (e.g., former service stations, dry cleaners).

The *DTSC Information Advisory, Clean Imported Fill* (DTSC, 2001) suggests that two approaches can be used to demonstrate acceptable backfill materials: (1) providing appropriate documentation and conducting analyses as needed; or (2) collecting samples from the borrow area or borrow area stockpile and analyzing the samples for an appropriate list of parameters.

The selected analytes should be based on the source of the fill and knowledge of the prior land use. Table 5 summarizes potential contaminants based on the fill source area.

Table 5. Potential Contaminants Based on Land Use in Fill Source Area

FILL SOURCE AREA	POTENTIAL TARGET COMPOUNDS
Land near an existing freeway	Lead, PAHs
Land near a mining area or rock quarry	Metals, Asbestos, pH
Agricultural land	Pesticides, Herbicides, Metals
Residential or commercial land	VOCs, SVOCs, TPH, PCBs, Metals, Asbestos

From DTSC (2001).

A standard laboratory data package, including the quality assurance/quality control (QA/QC) sample results should accompany all analytical reports. Chemicals detected in the fill material should be evaluated for risk in accordance with the DTSC *Preliminary Endangerment Assessment Guidance Manual* or against the CHHSLs. If contaminant concentrations exceeding acceptance criteria are identified in the soil, the fill should be deemed unacceptable and new fill material should be obtained, sampled, and analyzed.

Fill documentation should include detailed information on the previous land use(s) in the area from which the fill is taken, the findings of any environmental site assessments, and the results of any testing. If such documentation is inadequate, samples of the fill material should be collected and analyzed for an appropriate list of parameters. This alternative may be the best alternative when very large volumes of fill material are anticipated or when larger areas are considered as borrow areas.

If limited fill documentation is available, samples should be collected from the potential borrow area and analyzed for an appropriate list of parameters. If fill material is not characterized at the borrow area, it will need to be stockpiled until analyses have been completed. Approximately one sample should be collected and analyzed per truckload. Table 6 provides recommended sampling frequencies for the fill soil. This sampling frequency may be modified upon consultation with appropriate regulatory agencies if all fill material is derived from a common borrow area.

Table 6. Recommended Fill Material Sampling

EXTENT OF INDIVIDUAL BORROW AREA	NUMBER OF SAMPLES
2 acres or less	Minimum of 4 samples
2 to 4 acres	Minimum of 1 sample for every 0.5 acres
4 to 10 acres	Minimum of 8 samples
Greater than 10 acres	Minimum of 8 locations with 4 subsamples per location
VOLUME OF BORROW AREA STOCKPILE	**NO. OF SAMPLES**
Up to 1,000 cubic yards	1 sample per 250 cubic yards
1,000 to 5,000 cubic yards	4 samples for first 1,000 cubic yards; 1 sample per each additional 500 cubic yards
Greater than 5,000 cubic yards	12 samples for first 5,000 cubic yards; 1 sample per each additional 1,000 cubic yards.

From *DTSC Information Advisory, Clean Imported Fill* (DTSC, 2001).

Composite sampling for fill characterization may or may not be appropriate, depending on the quality and homogeneity of the source/borrow area and the potential contaminants. The *DTSC Information Advisory, Clean Imported Fill* (DTSC, 2001) provides further discussion on the use of composite samples for certain contaminant groups.

7.7 QUALITY CONTROL / QUALITY ASSURANCE

The workplan should address the quality assurance and quality control (QA/QC) procedures that will be followed. If a quality assurance project plan (QAPP) was prepared during the characterization phase, the plan may be amended to address the pertinent changes for the excavation plan.

Excavation is selected as the remedy of choice when removal of the top layers of contaminated soil will prevent the direct contact and exposure to receptors. Soil samples from the outer limits of the excavation are typically collected to ensure that the clean up objectives have been met. The approximate locations, sampling frequency, number of samples, and the associated detection limits for confirmation samples should be identified (see annotated outline for soil confirmation sampling plan in Appendix D3). The documentation of activities should be included, ensuring site activities were conducted in accordance with the approved workplan.

Under unusual circumstances the removal action may not be carried out as planned because conditions not anticipated in the workplan were encountered. Institutional controls (ICs) or other actions may be required if the cleanup goals cannot be achieved.

7.8 HEALTH AND SAFETY MONITORING

The workplan should reference the health and safety plan (HASP) that addresses site-specific excavation and restoration and the health and safety issues that may arise at the site. These health and safety requirements should be followed by all personnel, including contractors and subcontractors conducting work at the site. The HASP used during site characterization activities may be amended to include excavation and restoration activities. The HASP should be prepared in accordance with the requirements of California Code of Regulations, title 8, section 5192 and all applicable federal, state and local laws, ordinances, and regulations and guidelines.

The HASP should at a minimum address the following:

- Identification of activities being carried out, the associated risks and the measures in place to prevent injury;
- Names and titles of personnel in charge;
- Emergency action plan;
- Location of HASP, a copy should be on site at all times;
- Method utilized to train all personnel on site on HASP and excavation safety awareness (e.g. tail gate meetings and frequency);
- Method for identifying hazards, documentation and correction of hazards;
- System in place to ensure that all workers comply with the rules to maintain a safe work environment. (e.g. disciplinary methods for workers who fail to comply)

7.9 COMPLETION REPORT

The workplan should briefly identify the key elements that will be covered in a completion of work report[10] (hereafter referred to as the "report") and the anticipated date of submittal. The report should be signed by a professional engineer or a professional geologist licensed in California with expertise in hazardous substance site cleanup.

An annotated outline for the report is provided in Appendix D5. At a minimum, the report should provide the following:

- Summary of the work performed;
- Any difficulties or unexpected conditions encountered;

[10] The title of this document will vary depending on the cleanup process.

- Deviations from the approved workplan;
- The results of post-excavation sampling (i.e., before backfilling and restoration), and compliance with performance standards;
- Determination as to whether the goals and objectives of the cleanup were met;
- Results of the post-excavation evaluation for lead (if applicable, see Section 5.5);
- Written and tabular summary of disposal activities;
- As-constructed drawings and results of post-restoration activities on habitat if applicable;
- Health and safety activities including any analytical results;
- Compliance with all permit requirements;
- Copies of permits for the project; and
- Copies of manifests and bills of lading.

7.10 CERTIFICATION

When the final cleanup actions are fully implemented, DTSC issues a certification letter that the site has been remediated to levels required in the regulatory decision document. Any requirements for a Land Use Covenant (LUC) or other ICs, and an Operation and Maintenance Agreement/Plan[11] (including establishment of a financial assurance mechanism) must be met prior to site certification. See Section 9.4 for further discussion regarding LUCs.

[11] The title of this document will vary depending on the cleanup process.

8.0 DESIGN AND IMPLEMENTATION OF CONTAINMENT/CAPPING ALTERNATIVE

This chapter describes the approach that could be used to select the type of cover/cap to be installed at a site and to prepare a cap/cover design and implementation plan. It provides general guidelines regarding cover/cap selection and design that are intended to enhance the efficiency of, but not replace, site-specific decisions made on the basis of individual site characteristics, applicable laws and regulations, and the principles of good engineering design.

The intent of this chapter is to provide guidance to the preparer of a design and implementation plan that will help them identify and design a cover/cap system that is fully protective of human health and the environment, achieves site-specific remedial action objectives (RAOs), is compatible with reasonably foreseeable future uses of the site, and which meets specific requirements of the regulatory process under which the site is being addressed. Under the PT&R approach, a basic cap design for the least complex sites must effectively eliminate ingestion, inhalation, and dermal contact as complete routes of exposure and preclude contaminant dispersion through the air and surface water run-off. As site complexity increases, or where site-specific circumstances produce additional objectives, this chapter provides the latitude to pursue a full range of design options.

8.1 DESIGN OBJECTIVES

For some of the sites addressed under the PT&R process where containment/capping has been selected as the preferred remedy in the remedy selection document, the protection of human health and the environment can be assured by meeting the following RAOs:

- Elimination of receptor contact with contaminants in shallow soil which exceed cleanup goals; and
- Isolation of contaminated soil to eliminate wind and surface water dispersion.

As a result, the installation of a soil cover, or a cover constructed of a single layer of asphalt and/or concrete, along with provisions for appropriate long-term stewardship may be adequate. For other sites, additional RAOs may be identified in the remedy selection document. These additional RAOs may result in the need to adopt a more complex design.

Often, site-specific considerations may affect the specific design selected for a site. The considerations may be associated with planned development or future use of the property, or may be connected to the site's physical location, features, or surroundings. Some examples include:

- Anticipated future use of the property (both short and long term);

- Utilization of construction features such as a building foundation or parking lot as a cover/cap;
- Climatic conditions and their impact on construction materials and cap performance;
- Storm water management;
- Potential seismic impacts to the cap;
- Erosion control;
- Support for vegetation; and
- Operation and maintenance needs.

8.2 INFORMATION NEEDED TO SUPPORT COVER/CAP SELECTION AND DESIGN

The following table summarizes the data and information that may be needed to adequately address the selection and design of an appropriate cover/cap.

ALL COVER/CAP TYPES
• Lateral and vertical extent of impacted soils exceeding cleanup goals • An assessment of the mobility of metal contaminants (i.e., the potential for groundwater impacts) based on historical observations, methodical evaluations, and/or modeling • Average depth to groundwater • Survey map of site and surrounding features (e.g., topography, existing structures, utilities, wells, surface water control measures, property boundaries) • Geotechnical data for native and imported soil types (e.g., USCS classification, Atterberg limits, moisture content, bulk density, saturated hydraulic conductivity, shrink-swell potential) • Identification of site conditions that affect the selection of construction equipment
SOIL AND EVAPOTRANSPIRATION COVERS/CAPS
• Climatology/seasonal variations • Identification of native plant species • Estimates of evapotranspiration rates • Location and soil properties of borrow materials (see Table 7) to be used for cap construction

Ideally, these data will be collected during the characterization phase of the project (see Chapter 4) rather than requiring another field mobilization during the design phase.

8.3 DESIGN CONSIDERATIONS

8.3.1 Factors to Consider When Selecting an Appropriate Cap

Existing and planned land use. To the extent possible, cover/cap design should be compatible with both short and long-term land use plans. This may entail integrating cap design into the construction of site improvements such as utilizing building foundations or parking lot improvements as design elements. Or, it could involve designing the cap to allow future construction to occur with minimal disruption of contaminated materials.

Migration potential. Based on a pre-remediation evaluation of the potential for infiltration-driven migration that is acceptable to the lead oversight agency, an assessment should be made as to the need for, and degree of, infiltration control that must be addressed by the cap design. While the need for infiltration control will most often be captured as an RAO, significant design decisions will still need to be made due to the multitude of design options that are capable of achieving the degree of infiltration control that will likely be required.

Climatic conditions. Climatic conditions such as high rainfall or extremely low temperatures may indicate a need for enhanced cap design features. Conversely, low rainfall and high year-round evapotranspiration rates may support a simple soil cover design.

Foundation conditions. When the subgrade soil does not meet strength and compressibility requirements, additives can be combined with the in-place soil to improve its properties. This alternative uses either cement or lime to stabilize clay or sandy soil. The cement stabilization alternative is recommended for unsuitable soils with small percentages of clay and a high percentage of sand. Lime stabilization is recommended for unsuitable soils with a high percentage of clay.

Build-up of gases. If substances may be present in the vapor phase below the cap (e.g. methane), the design may need to allow venting through the cap.

Terrain. Site factors such as very uneven terrain or location within a floodplain may at a minimum complicate cap design and could potentially eliminate capping as a viable remedy.

RCRA cap versus “non-RCRA” cap. Installation of a RCRA standard cap in accordance with Subtitle C or equivalent may be necessary if remediation is being pursued under certain regulatory requirements, or if those requirements are identified as ARARs in the remedy selection document.

8.3.2 Consolidating Impacted Soils

The consolidation of metals-impacted soils may be desirable or necessary prior to cover/cap construction at many sites. Consolidation may be used to clean up the edges of a single contiguous contaminated area to make it more geometrically regular, reduce the size of the area being capped, or to combine soils from one or more contaminated areas into a single area at a site. Anticipated future land use or specific development plans may also result in consolidation being identified as an appropriate step prior to cap construction.

In most cases and depending on site-specific circumstances, consolidation of metals-impacted soils can be accomplished through the application of either the Area of Contamination (AOC) approach or in accordance with Corrective Action Management Unit (CAMU) regulations (Cal. Code Regs., tit. 22, §66264.550, §66264.551, §66264.552, §66264.552.5).

For the purpose of implementing a consolidation and capping remedy under this guidance, the AOC approach is generally preferred unless site-specific conditions or regulatory considerations make the use of the CAMU regulations, and their added flexibility, necessary. Those parties interested in pursuing a consolidation and capping remedy are cautioned to work closely with DTSC staff to ensure that the appropriate option is selected and properly implemented.

The following information on the AOC approach and CAMU regulations is intended only as a brief summary. The reader is cautioned to read the more detailed discussions presented in the AOC references provided below and the CAMU regulations in order to fully review the complexities involved in their use.

Area of Contamination (AOC) Approach

The AOC approach will provide an adequate basis for the consolidation of metals-impacted soils at many of the sites being cleaned up in accordance with this PT&R guidance. It is based on an interpretation of federal regulations which allow for the movement of hazardous wastes within a contiguous area of generally dispersed contamination without being considered land disposal and without triggering land disposal restrictions (LDRs) or minimum technology requirements.

The AOC approach was initially discussed in detail in the preamble to the National Contingency Plan (NCP; 55 *FR* 8758-8760, March 8, 1990). The NCP discusses using the concept of "placement" to determine what requirements might apply within an AOC. The placement of hazardous wastes into a land-based unit is considered land disposal, which would trigger LDRs and other requirements. The NCP provides that, "placement does not occur when waste is consolidated within an AOC, when it is treated in situ, or when it is left in place." The concept of placement can similarly be applied in determining that consolidation within an AOC does not, in and of itself, constitute a release of a hazardous substance.

While no formal designation of an AOC is necessary, appropriate regulatory oversight is recommended to ensure that the AOC approach is properly applied. Additionally, for most consolidation and capping remedies, regulatory oversight and approval will be necessary to:

- take advantage of certain permit exclusions,
- ensure that the remedy is properly designed,
- ensure that the remedy will remain protective over the long term through the use of ICs and implementation of proper operation and maintenance activities, and
- obtain agency certification of the completed response action.

The AOC approach may not be applicable to some sites because of the nature and timing of the original release, or as a result of the specific regulatory authority under which the sites are being cleaned up.

Additional information regarding the AOC approach can be found in the following documents:

- Preamble to the National Contingency Plan (55 *FR* 8758-8760, March 8, 1990);
- *Management of Remediation Wastes Under RCRA* (EPA, 1998); and
- *Area of Contamination Policy* (EPA, 1996).

Corrective Action Management Unit (CAMU) Approach

CAMUs can provide an effective means for implementing consolidation with capping remedies at metals-impacted sites being cleaned up in accordance with this PT&R guidance. They provide similar features to those of the AOC approach with the added flexibility of being able to receive wastes from more than one contaminated area and being constructed in an uncontaminated area at a facility. CAMUs must be formally designated by DTSC. They may be used only for managing remediation wastes associated with corrective action or cleanup at a facility. CAMUs must be located within the contiguous property under the control of the owner or operator where the wastes to be managed in the CAMU originate. One or more CAMUs may be designated at a facility.

The placement or consolidation of remediation wastes into or within a CAMU does not constitute land disposal of hazardous wastes, does not trigger LDRs, and does not create a unit subject to minimum technology requirements.

For further information, the reader should review the CAMU regulations (Cal. Code Regs., tit. 22, §66264.550, §66264.551, §66264.552, §66264.552.5).

8.3.3 Source of Borrow Materials

The source of borrow materials to be used for cap construction is identified during the design phase. In addition to material and transportation costs, the selection process for borrow materials should consider the preferred properties of each layer and the objective that the materials will not introduce new contamination to the site (see Section 7.8).

8.3.4 Storm Water Runoff Control

Surface water collection and diversion may be needed to control run-on and run-off. Storm water drainage and piping is a drainage system which refers to the use of subsurface drainage controls that collect and redirect runoff/run-on from rainfall events from the asphalted surface to a retention pond or other predetermined location. A drainage system may consist of inlet grates and pipes.

8.3.5 Erosion Control

Design of the cap should include measures to control erosion around the cap perimeter and on the main body of the cap. Additional erosion control measures will be needed for soil caps, such as selecting an appropriate slope length and steepness to minimize erosion and such as incorporating an upper vegetation layer.

8.3.6 Side Slope of Cap

Applicable cap side slopes are dependent on regulatory requirements and guidelines that vary from locality to locality. An example of side slopes would be a ratio of 5:1 (20 percent), where five is the horizontal run and one is the vertical rise. Generally, the maximum side slopes that can be implemented are 3:1 (33 percent). Steeper slopes may cause the underlying layers of sand, gravel, or geotextiles to slide or fail along the contact interface. Also, steeper slopes increase maintenance and the potential for erosion and soil loss. The benching of slopes at steeper grades may be needed to control potential erosion and promote stability of the cap.

8.4 TYPES OF CAPS

As indicated in Sections 8.1 and 8.3, the type of cover/cap used at a site depends on a variety of site-specific factors. Caps may be temporary and/or final, their selection and design may be based upon site-specific RAOs, or they may be subject to prescriptive requirements in accordance with the regulatory authority under which they are being addressed. They may consist of a generic standard design, a composite of multiple elements of standard designs, or a unique design that addresses an unusual combination of site-specific objectives. It is anticipated that covers/caps selected for PT&R metal sites will consist of one or more of the following types (listed in order of increasing complexity):

- Soil cover/cap,
- Evapotranspiration (ET) cover,
- Asphalt and/or concrete cover/cap,
- Low permeability composite soil and vegetation cover/cap,
- Geosynthetic/composite cap, and
- Standard RCRA cap (RCRA Subtitle C cap).

The California Department of Transportation (CalTrans) has developed substantial information on the design and properties of both asphalt and concrete utilized in highway construction (e.g., CalTrans, 2006). There is also a great deal of information available on the design requirements for a RCRA Subtitle C cap available through EPA and other sources. In 1991, the EPA issued a revised guidance document concerning closure and final cover for hazardous waste facilities (EPA, 1991b). Information on the design, installation, and monitoring of alternative landfill covers has been published by the Interstate Technology and Regulatory Council (ITRC, 2003a). This document draws information from these and other sources in an effort to provide foundational information on the cover/cap types listed above. It does not however attempt to provide detailed information on the design aspects of the various alternatives discussed, the reader is instead left to review these source materials if more detail is desired.

8.4.1 Soil Cover/Cap

Soil covers/caps can range from a single layer of vegetated soil to multiple layers with varying hydraulic conductivities. Under favorable conditions a single layer of vegetated clean native soil, or soil with properties similar to native soils, may be sufficient to achieve site-specific goals. In other cases climatic conditions, contaminant mobility characteristics, regulatory concerns, or land use issues may dictate a multilayered design.

For a single layer, design consideration should be given to:

- Cap thickness for the purpose of minimizing the potential for accidental/incidental penetration of the clean cap material into the underlying contaminated soil;
- The utilization of a demarcation layer (permeable mat) between the cover material and underlying contamination to indicate when contaminated materials have been or might be encountered;
- The relationship between compaction and both water-holding capacity and support of vegetation;
- Long-term care of the cover; and
- Land use and construction plans.

For single layer designs, a minimum cover thickness of approximately two feet will be adequate for most sites provided intrusion risks are low. As infiltration and surface water management issues become more important, soil with higher water-holding capacity and the use of evapotranspiration-enhancing vegetation may help address those concerns. Where the construction of buildings or other improvements is likely to occur, design properties will need to be adjusted to address those building needs without compromising the health and environmental protectiveness of the cover.

Where single layer designs are found to be unsuitable, a multilayered design made up of different soil types may be appropriate. Multilayer designs can provide infiltration control, drainage management and support for vegetative covers or future construction through the careful selection and design of soil layers. Good design practices dictate that specific soil properties be exploited to achieve the desired results. Table 7 identifies various soil properties that should be considered when selecting soils for various layers in the soil cover.

Table 7. Critical Parameters for Soil Cap Material

PARAMETER	PREFERRED PROPERTIES	RECOMMENDED TESTS
Materials	The primary requirement is that the material is capable of being compacted to produce a suitable low conductivity layer or substrate.	
Fines	The soils should contain at least 20% fines. Soil screened on a dry-weight basis of passing a No. 200 sieve are considered fines.	ASTM D-422, ASTM D-1140 ASTM D-2487, USCS Soil Classification, ASTM D-3282, AASHTO Soil Classification tests
Plasticity Index (PI)	The soils should have a PI of at least 10%. Some soils may be slightly lower PI may still be suitable. Soils with PIs greater than 30 to 40% may be to difficult to work with as they may form hard chunks when dry and to be sticky when wet. Ideally soils with a PI between 10 to 35% are good for this purpose.	ASTM D-4318, Atterberg Limit Test
Percentage of Gravel	A maximum of 10% gravel is generally acceptable. The percentage of gravel is defined as the amount of soils retained on a No. 4 sieve.	ASTM D-422, ASTM D-2487, USCS Soil Classification, ASTM D-3282, AASHTO Soil Classification tests
Stones and rocks	Soil containing stones or rocks larger than 1 to 2 inches should not be used in liner materials.	ASTM D-2487, USCS Soil Classification, ASTM D-3282, AASHTO Soil Classification tests
Water Content	The water content of the soil at the time it is compacted is an important variable controlling the engineering properties of the soil liner.	ASTM D698 Proctor Test, ASTM D1557, Modified Proctor Test, ASTM D-2216, ASTM D-3017 ASTM D-4643
Compactive Strength	The hydraulic conductivity of a soil that is compacted wet of optimum could be lowered one to two orders of magnitude by increasing the energy of compaction.	ASTM D-698; ASTM D-1556, ASTM D-2167, ASTM D-2922, ASTM D-2937, California Test Method (CTM) 301
Size of Clods	Soils with low plasticity do not form very large clods. For soils that form clods, the clods need to be remolded into a homogeneous mass that is free of large inter-clod if low hydraulic conductivity is to be achieved.	

Soil caps may be utilized to provide increased separation between contaminated soils and building foundations, thereby minimizing the potential for construction worker exposure to contaminants during site preparation and utility installation activities. When overlain by building foundations, or other constructed surface features, the combined “cap” system will result in an easy to maintain, health and environmentally protective long-term solution for many contaminated sites.

In summary, site-specific RAOs in conjunction with site-specific considerations such as climatic conditions, future land use and development plans will guide the selection and design of suitable soil caps.

8.4.2 Evapotranspiration (ET) Cover

Because of the water-holding properties of soils and the fact that most precipitation returns to the atmosphere via evapotranspiration, it is possible to devise a cover that meets the requirements for remediation and yet does not contain a barrier layer. Plants and soils play a dominant role in all aspects of the hydrologic cycle. It is necessary to understand both the requirements for plant growth and the properties of the soil used in an ET cover in order to successfully design and construct the cover. ET covers are generally used in arid areas where clay and other barriers may not be ideal because of the high potential for cracking and settlement. Resources for design, construction, and long-term management of ET covers are provided on the ITRC and the Desert Research Institute Websites (www.itrcweb.org and www.dri.edu, respectively). An EPA fact sheet on ET landfill cover systems is also available (EPA, 2003).

8.4.3 Asphalt / Concrete Cap

Asphalt and/or concrete pavement is suitable for providing a cap for many sites. Both asphalt and concrete are especially well suited as a cap for developed areas where there is a need to combine containment with continued or new commercial or industrial use (e.g., parking lot, building foundation). Paving requires higher maintenance than caps with soil or synthetic elements, and is prone to cracking and deterioration. Paving may increase storm water run-off and could increase erosion of surrounding areas. However, these issues are easily addressed through appropriate design, inspection and maintenance activities. Storm water runoff associated with a cap that is integrated into a site development project is no different than would be expected from the development itself and would normally be addressed through development-related storm water management requirements. For stand alone pavement caps, storm water control features can be incorporated into the design.

An asphalt cap may consist of two or more components, including:

- Top cover of asphalt or concrete (may be multiple layers);
- Base rock;

And on a case by case basis,

- An impervious layer, that may be below the base rock and a protective layer or may be sandwiched between asphalt layers.

Top Cover of Asphalt or Concrete. In addition to isolating metal contaminated soil, pavements may be engineered to distribute stresses imposed by loading such as traffic or building(s) to the subgrade. Where loading is a significant design factor, the subgrade condition is a principal factor in selecting the pavement structure. Before a pavement is engineered, the structural quality of the subgrade soil should be evaluated to ensure that it has adequate strength to carry the predicted loads during the design life of the pavement. The pavement should also be engineered to limit the expansion and loss of density of the subgrade soil.

The top cover material for the asphalt cap is normally comprised of hydraulic asphalt concrete, which serves as a hydraulic barrier as well as a physical barrier. Asphalt can be designed with consideration for vehicle use, or it can be modified for the purpose of enhancing its weatherability and permeability characteristics. Refer to the *California Department of Transportation Highway Design Manual* (CalTrans, 2006) for traffic load/design criteria.

Base Rock. The base rock layer is used to support the asphalt layer of the cover. The crushed base rock will be spread over the entire area of the cap. The typical range of base rock material depth is 6 to 12 inches and is dependent upon the type of loading that is anticipated.

Optional Impervious Layer. An impervious layer which reduces the amount of infiltration may be added to the design when site-specific conditions indicate the need. The barrier formed by the impervious layer reduces the potential for contaminant migration toward groundwater. This layer in a pavement cap may consist of a flexible membrane liner (FML), or it may be incorporated as a fabric and liquid asphalt layer between two asphalt lifts.

FMLs provide a low hydraulic conductivity layer that is placed beneath a protective layer of sand or fabric which separates it from the base rock. There are several acceptable materials that are commonly used including:

- 40 mil high density polyethylene (HDPE);
- 60 mil HDPE;
- 80 mil HDPE;
- 30 mil polyvinyl chloride (PVC);
- 40 mil PVC.

8.4.4 Geosynthetic/ Composite Cap

A geosynthetic/composite cap may consist of anywhere from two to five layers. At a minimum it will consist of a geosynthetic clay (GC) layer and an overlying soil layer that is typically vegetated. Often a drainage layer is included immediately above the GC layer. A low-permeability soil may be added to reduce permeability and a rodent control layer may also be incorporated. This complex design, although implementable, is generally more difficult to install and more expensive than soil or asphalt/concrete caps. For sites using the PT&R approach, the number of layers included in the geosynthetic/composite cap will depend on RAOs, the site location, climatic conditions, evapotranspiration rates, soil layer water-holding capacity and drainage considerations.

Soil Layer. The soil layer serves as the final (top) layer of the cap. The soil is used in conjunction with vegetation to reduce erosion and infiltration of rainwater, enhance evapotranspiration and to protect the underlying layer(s) of the cap from water and wind erosion and dehydration. The typical thickness of the topsoil layer will range from 12 to 24 inches. The material used for the top soil layer will be selected on the basis of site-specific considerations. It should have good soil water-holding capacity, and be capable of supporting appropriate vegetation. Appropriate compaction will be necessary to provide structural stability within the overall cap design without adversely impacted the rooting of the vegetated cover.

Drainage Layer. A drainage layer consisting of high permeability materials may be installed immediate above the GC layer to allow drainage of infiltrating water and to prevent downward movement of water into the impacted soil. This layer will generally range from 6 inches to one foot in thickness and will consist of soil having a hydraulic conductivity of approximately 1×10^{-2} cm/sec.

Geosynthetic Clay Layer. The GC layer is composed of a manufactured product consisting two non-woven fabrics sandwiching a layer of bentonite which acts as a barrier to prevent significant infiltration through the cap. The low-permeability GC layer has a hydraulic conductivity on the order of 1×10^{-6} to 1×10^{-7} cm/sec.

8.4.5 RCRA Standard Cap

RCRA Subtitle C (subparts G, K and N) establishes the minimum requirements for cap systems designed and constructed for the containment of hazardous waste. Standard RCRA Subtitle C caps are designed to provide containment and hydraulic protection for a performance period of a minimum of 30 years. The surface barrier comprises five layers with a combined minimum thickness of 5.5 feet and a vegetated erosion-control surface. A RCRA standard cap typically includes the layers with the characteristics listed in Table 8.

8.5 IMPLEMENTATION CONSIDERATIONS

Prior to conducting field work, a series of project management and regulatory tasks should be completed. The general areas that require preparatory activities include:

- site access,
- permits,
- underground utilities,
- environmental and cultural protection,
- health and safety,
- waste management,
- staff and training,
- support and equipment, and
- notifications.

Table 8. Typical Requirements for RCRA Caps

LAYER[1]	REQUIREMENTS FOR SUBTITLE C CAP[2]	REQUIREMENTS FOR SUBTITLE D CAP[2]
Top Vegetation	Thickness varies from >6 inches dependent on site conditions.	Thickness varies from >6 inches dependent on site conditions.
Soil Layer	Minimum of 2 feet in thickness of graded soils at slope of 3 to 5%.	Thickness varies from >6 inches dependent on site conditions. Thickness of top vegetation and soil layers combined should be a minimum of 24 inches.
Drainage Layer[3]	Minimum of 1 foot in thickness and constructed of soil having a minimum hydraulic conductivity of $1x10^{-2}$ cm/sec or equivalent.	N/A
Impervious Layer[3]	Minimum of 2 feet in thickness of compacted natural or amended soils with a hydraulic conductivity of $1x10^{-7}$ cm/sec in contact with geomembrane.	Minimum of 18 inches in thickness of compacted natural or amended soils with a hydraulic conductivity of $1x10^{-5}$ cm/sec.
Leveling Layer	May vary in thickness from 6-18 inches to form a layer for construction of the overlying layers.	May vary in thickness from 6-18 inches to form a layer for construction of the overlying layers.

1 Layers in order from surface to increasing depth.
2 Final covers must be designed and constructed to have a permeability less than or equal to natural subsoils.
3 Varies in geo synthetic/composite cap.

Some municipalities have restrictions on the type of equipment that can be used within a specified distance from water mains, sewer lines, and utility lines. In addition, air districts may require a similar application that identifies the mitigation measures to reduce or eliminate air dispersal of contaminants.

8.5.1 Dust Control and Air Monitoring

Control of fugitive dust and emissions is required by local air districts and, if not identified as a project element in the remedy selection process, may be identified as a mitigation measure under the CEQA process. Therefore, a fugitive dust control and monitoring plan should be developed for the project. Dust control applies to any construction, demolition, excavation, and other earthmoving activities, including, but not limited to, land clearing, grubbing, scraping, travel on site, and travel on access roads to and from the site. Please refer to Section 7.5.1 for further discussion of the fugitive dust control and monitoring plan.

8.5.2 Community Air Standards

Activities occurring near residential communities, schools, and other sensitive receptors (e.g., elderly or high use community areas) should specifically be considered in the dust control planning. Adequate protection of exposure to contaminants contained in the dust should be considered as part of the dust control measures.

If appropriate, community air monitoring should be conducted to ensure that the implementation of the remedy does not pose a potential treat to off-site receptors. Site-specific risk-based action levels should be calculated, in consultation with DTSC, and included in the community air monitoring plan.

8.5.3 Borrow Material Management

The design and implementation plan will need to provide for staging of borrow materials that are transported to the site for use in cap construction. Staging should be implemented so as to prevent the placement of clean material within contaminated areas unless provisions are included for use of an appropriate barrier. Generally, staging within contaminated areas with the use of a barrier will not be accepted except in cases where acceptable clean areas are not available.

8.5.4 Safety Standards

The design and implementation plan should address applicable Cal-OSHA health and safety requirements.

8.6 DESIGN AND IMPLEMENTATION PLAN

The engineered cap design and implementation plans will be presented in a design and implementation plan. The plan may be contained in the remedy selection document or as a stand-alone document. In general, plans for less complex projects will be included in the remedy selection document. The oversight agency should be consulted on specific submittal requirements. An annotated outline for the design and implementation plan is provided in Appendix E1.

8.7 COMPLETION REPORT

A completion report documenting the cap construction should be prepared. It should include as-built drawings as well as material testing results and should be stamped and signed by a professional engineer or professional geologist licensed in California with appropriate experience in hazardous substance site cleanup. An annotated outline for a completion report is provided in Appendix E3.

8.8 LONG-TERM STEWARDSHIP

Long-term stewardship applies to sites and properties where long-term management of contaminated environmental media is necessary to protect human health and the environment over time.

8.8.1 Institutional Controls

Institutional controls (ICs) such as Land Use Covenants (LUCs) will be required due to hazardous substances remaining on-site at concentrations which preclude unrestricted use of the property. Further discussion of ICs and LUCs is provided in Section 9.3.

8.8.2 Financial Assurance

Financial assurance will be required to assure that sufficient monies are available to implement any required corrective action activities and on-going O&M activities, conduct necessary five-year reviews and pay the regulatory oversight costs associated with those activities and IC implementation. Depending on the specific cap design employed, financial assurances may also need to include the costs of cap replacement. These on-going costs should be included in the cost calculation utilized in the remedy selection process. Financial assurance can be accomplished by several different mechanisms.

Life-cycle cost analysis (LCCA) is a useful tool for comparing the value of alternative cap structures and strategies. LCCA is an economic analysis method that compares the initial cost, future cost, and user delayed cost of different cap alternatives. Although not specific to caps, the *Life-Cycle Cost Analysis Primer* (U.S. Department of Transportation, 2002), the *Full Cost Accounting for Municipal Solid Waste Management: A Handbook* (EPA, 1997b), and *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA, 2000) describe the methods and techniques used in LCCA. Software programs such as RACER[12] can be used to create cost estimates for the LCCA methodology.

LCCA is an integral part of the decision making process for selecting the cap type and design. Present worth or value analysis is often used for comparing cost alternatives with varying durations.

8.8.3 Regulatory Oversight Agreement

A regulatory oversight agreement will be required because contaminants have been left in place that may pose a threat to human health and the environment if the cover is not maintained as designed. Examples include post-closure care permits and Operation and Maintenance (O&M) Agreements.

8.8.4 Operation and Maintenance

Any regulatory oversight agreement or enforceable mechanism should reference or include the approved O&M plan that outlines the procedures and requirements for on-going O&M of the cap. The purpose of the O&M plan is to ensure that the cap is maintained in good condition so that it remains protective of public health and the

[12] Mention of any trade names or commercial products does not constitute endorsement or recommendation of the Department of Toxic Substances Control.

environment. An sample document for an O&M plan is provided in Appendix E2. Selected elements of the O&M plan are highlighted below.

Inspections. The O&M Plan should provide for inspections of the cap to ensure that it is functioning as intended. These inspections should be conducted on a routine basis as well as after unplanned events (e.g., earthquake, on-site construction activities) that may have affected cap integrity.

Repairs and Maintenance. The cap should be maintained in a manner that ensures it is functioning as intended. Examples of cap maintenance include vegetation control, and repairs due to cover erosion, asphalt cracking, settlement, and subsidence. For asphalt and concrete caps, periodic sealing of the cap surface will be necessary. Repairs and maintenance of the cap should be performed according to the procedures and the timeframes specified in the O&M Plan.

Reporting, Recordkeeping, and Notifications. The O&M plan should outline the recordkeeping requirements for O&M activities and should provide for submittal of periodic inspection summary reports. The O&M plan should also identify the site activities or conditions that require notification of the regulatory agencies. The plan should also identify the timeframe and mechanism (e.g., verbal, written) for the required notifications.

8.8.5 Contingency Plan

Any regulatory oversight agreement or enforceable mechanism should reference or include a contingency plan that will be implemented in the event that an immediate response action is required to ensure protection of human health and the environment. The contingency plan may be a stand alone document or may be included as an element of the O&M plan.

8.8.6 Five-Year Review

Under CERCLA and State law, five-year reviews are required for a remedial action that results in hazardous substances remaining at the site. Any regulatory oversight agreement or enforceable mechanism, as well as the O&M plan, should include provisions for conducting five-year reviews. The purpose of the five-year review is to ensure that the remedy remains protective of human health and the environment, is functioning as designed, and is maintained appropriately by O&M activities. The review generally addresses the following questions:

- Is the remedy functioning as intended?
- Are the cleanup objectives, goals and criteria used at the time of cleanup alternative selection still valid?
- Have there been significant changes in the distribution or concentration of impacted soils at the site?

- Are modifications needed to make the O&M plan more effective?

The scope of the five-year review may be outlined in the O&M plan or in a separate workplan developed for a specific review. The review of the cap/cover portion of a remedy would typically consist of:

- Notifying the community that the review is being conducted;
- Inspecting the cap to document the condition of the cap; determine if necessary actions are required to maintain or improve cap integrity; and ensure the cap is meeting the intended performance objectives; and
- Preparing a report that details the findings of the review.

As applicable to a given site, other components of the remedy should also be addressed by the review.

Depending on site-specific considerations, the cap inspection and/or technical assessment may be conducted by DTSC staff and/or responsible party representatives. DTSC staff will review the report and make recommendations to: ensure that the remedy remains effective; identify milestones toward achieving or improving effectiveness; and provide a schedule to accomplish necessary tasks.

9.0 SITE CERTIFICATION

When the cleanup process is completed, DTSC will certify that the required cleanup has been completed and that no further cleanup is necessary, unless new information is obtained or site conditions change. DTSC will determine whether the residual concentrations of metals in soil are protective of public health and the environment based on the cleanup levels established in the regulatory decision document. The possible determinations are:

- adequate cleanup has been achieved (e.g., closure of a hazardous waste management unit);
- additional cleanup is necessary; and/or
- institutional controls (ICs*) are required to manage the remaining contamination.

9.1 CERTIFICATION OF ACTION

When a site cleanup is satisfactorily completed, DTSC issues a certification letter that the site has been cleaned up to levels required in the regulatory decision document. The certification letter is issued after any requirements for a Land Use Covenant (LUC*) or other ICs, and an Operation and Maintenance (O&M) Agreement/Plan (including establishment of a financial assurance mechanism) are met. These documents will state that DTSC has continuous oversight and the responsible party is required to maintain any measures necessary for on-going protection of public health and the environment.

9.2 OPERATION AND MAINTENANCE

Sites that have waste left in place when the PT&R alternative of containment/capping is selected will be required to have an O&M Plan (see Section 8.8.4). The mechanism under which O&M is conducted depends on the type of site.

9.3 INSTITUTIONAL CONTROLS FOR CONTAMINATION REMAINING IN PLACE

Where future land and water uses may not be compatible with residual metals contamination or where cleanup involves leaving metals-impacted soils in place, ICs are used to stop or reduce the exposure of human and environmental receptors. ICs are non-engineering mechanisms used to ensure that the intended future land use is consistent with site cleanup and engineering controls (e.g., caps) maintain their integrity and effectiveness. Examples of ICs for sites where contamination remains in place include LUCs, as well as public notice, signs, and fencing.

For sites requiring ICs, California Code of Regulations, title 22, section 67391.1 requires the property owner to enter into a LUC to ensure that DTSC will have authority to implement, monitor, and enforce the protective restrictions. LUCs allow on-going use of the property as long as the cleanup remedy is not compromised by current or future development. LUC Agreements are intended to protect public health and the environment by preventing inappropriate land use, increasing the probability that the public will have information about residual contamination, ensuring that long-term mitigation measures are carried out by protecting the engineering controls and remedy, and ensuring that subsequent owners assume responsibility for preventing exposure to contamination.

California Code of Regulations, title 22, section 67391.1 requires that a LUC imposing appropriate limitations on land use shall be executed and recorded with the local county recorder's office when hazardous materials, hazardous wastes or constituents, or hazardous substances will remain at the property at levels which are not suitable for unrestricted use of the land. It requires DTSC to clearly set forth and define land use limitations or covenants in a cleanup decision document prior to approving or concurring in any facility closure, corrective action, remedial or removal action, or other response actions. Further information regarding LUCs is available on the DTSC Internet site.

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GLOSSARY

ARARs. Section 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) requires that on-site remedial actions attain or waive federal environmental “applicable or relevant and appropriate requirements” (ARARs), or more stringent State environmental ARARs, upon completion of the remedial action. The 1990 National Oil and Hazardous Substances Pollution Contingency Plan (NCP) also requires compliance with ARARs during remedial actions and during removal actions to the extent practicable.

Background. Metals concentrations that represent only pristine or natural conditions often are referred to as “background” concentrations. In some instances, non-specific off-site sources may also have contributed to the “background” concentration. For the purposes of this guidance document, the general term “background” will be used to refer to soil that has not been affected by site-related releases.

Brownfields. Brownfields are properties that are contaminated, or thought to be contaminated, and are underutilized due to perceived remediation costs and liability concerns. When agricultural and green spaces are developed for residential, commercial or industrial uses, infrastructure such as roads and sewers must be developed. That redundant infrastructure wastes scarce tax dollars and adds to the burden on California's environment. Redeveloping frequently urban brownfields properties optimizes the use of existing infrastructure and protects our resources.

CAMU. Corrective Action Management Units, or "CAMUs,"' are special units authorized under the federal and state hazardous waste management laws to facilitate treatment, storage, and disposal of hazardous wastes managed for implementing cleanup, and to remove the disincentives to cleanup that the application of hazardous waste management requirements can sometimes impose.

Capping. Impacted soils are isolated by placement of a barrier to prevent exposure and/or reduce surface water infiltration.

Capillary fringe. Zone of soil immediately above the water table that acts like a sponge taking up water from the underlying water table and retaining this water under suction. The soil pores act like capillary tubes with the smaller the soil pore (space between mineral grains), the greater is the rise of water within the soil pore. At the base of the capillary fringe most if not all of the soil pores are completely filled with water. At the top of the capillary fringe, only the smallest soil pores are filled with water.

CERCLA. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress on December 11, 1980, and amended in 1986, by the Superfund Amendments and

Reauthorization Act (SARA). This law created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. CERCLA established prohibitions and requirements concerning closed and abandoned hazardous waste sites, provided for liability of persons responsible for releases of hazardous waste at these sites; and established a trust fund to provide for cleanup when no responsible party could be identified.

CEQA. The California Environmental Quality Act was signed into law in 1970 (Public Resources Code, §21000 et seq). CEQA requires public agencies to disclose and consider the environmental implications of their decisions, and to eliminate or reduce the significant environmental impacts of their decisions whenever it is feasible to do so.

Chemical fixation. The term *chemical fixation* implies transformation of toxic contaminants to new, nontoxic forms. Chemical fixation typically requires mechanical mixing or blending of reagents with the contaminated mass. These reagents effect destruction, alteration, or chemical bonding of the contaminant(s).

Chemicals of potential concern. Chemicals of potential concern (COPCs) are the metals that exceed screening levels and are carried forward into the risk assessment.

Chemical oxidation state. Refers to the positive or negative charge associated with a metal or metal ion. The chemical oxidation state affects how the metal moves in the soil and may affect the toxicity of the metal. A higher oxidation state means that the metal has a relative higher positive charge (less electrons around the nucleus) than lower oxidation states. Each metal has certain oxidation states typically occur in nature. For example, chromium usually occurs in a trivalent oxidation state (Cr^{+3}, Cr(III)) or in a hexavalent oxidation state (Cr^{+6}, Cr(VI)).

CHHSLs. California Human Health Screening Levels (CHHSLs) were developed as a tool to assist in the evaluation of contaminated sites for potential adverse threats to human health. Developed by the Office of Environmental Health Hazard Assessment (OEHHA), CHHSLs include concentrations of metals in soil that the Cal/EPA considers to be below thresholds of concern for risks to human health. The CHHSLs pertain to the direct exposure of humans to contaminants in soil via incidental soil ingestion, dermal contact, and inhalation of dust in outdoor air. The thresholds of concern used to develop the CHHSLs are an excess of lifetime cancer risk of one-in-a-million (10^{-6}) and a hazard quotient of 1.0 for noncancer health effects.

Cleanup goal. Concentration value against which the success or completeness of a cleanup effort is evaluated.

Colloids. Small particles (less than ten microns in diameter) suspended in liquid phase of soil.

Complex. Unit in which a central metal ion is bonded by a number of associated atoms or molecules in a defined geometric pattern. The associated atoms or molecules are termed ligands.

Conceptual site model (CSM). Tool to help organize and communicate information about the site characteristics. It provides a summary of how and where contaminants are expected to move, and who might be exposed to chemicals and how it explains what a problem is and why a response is needed.

Corrective Measures Study. The corrective measures study is the mechanism for the development, screening, and detailed evaluation of alternative corrective actions.

Detection frequency. The percentage of total samples of in which the metal was detected.

Exposure point concentration. The exposure point concentration (EPC) is a conservative estimate of the average chemical concentration in the soil.

Feasibility Study. The feasibility study is the mechanism for the development, screening, and detailed evaluation of alternative remedial actions.

HSAA. Hazardous Substances Account Act, Health and Safety Code, division 20, chapter 6.8.

HWCL. Hazardous Waste Control Law, Health and Safety Code, division 20, chapter 6.5.

Institutional control. Institutional controls (ICs) are actions, such as legal controls, that help minimize the potential for human exposure to contamination by ensuring appropriate land or resource use.

Interim measures. Interim measures as short-term actions to control on-going risks while site characterization is underway or before a final remedy is selected.

Ligand. An atom, molecule, group, or ion that is bound to a central atom of a molecule, forming a complex.

Land Disposal Restrictions. The Land Disposal Restriction (LDR) program found in federal and state regulations requires waste handlers to treat hazardous waste or meet specified levels for hazardous constituents before disposing of the waste on the land. To ensure proper treatment, the regulations establish a treatment standard for each type of hazardous waste. The regulations list these treatment standards and ensure that hazardous waste cannot be placed on the land until the waste meets specific treatment standards to reduce the mobility or toxicity of the hazardous constituents in the waste.

Land Use Covenant. Written instruments and agreements restricting land uses, easements, servitudes, and land use restrictions. Recorded land use restrictions (or covenants) are provisions set forth in a document which can specify requirements on real property and affect the title, which is the evidence of ownership, to property. Land use covenants are recorded at the county recorder's office so that they will be found during a title search of the property deed.

Metals. Metals are defined as any element that has a characteristic luster, is usually in solid form, is malleable and ductile, and is usually a good conductor of heat and electricity. These elements are referred to by various terms, including alkali metals, alkaline earth metals, transition metals, trace metals, heavy metals, micronutrients, and toxic metals. For the purposes of this document, metalloids (e.g., arsenic, antimony, selenium) are also considered metals because these elements exhibit both metallic and non-metallic properties.

Metal retention capacity. When a contaminant is released to soil, chemical reactions with soil particles will cause the metal to be retained in the vicinity of the release. If the release continues for longer time periods or consists of large amounts of metal, the ability of the soil to react with the metal will be overwhelmed and the metal will migrate further away from the source.

National Contingency Plan. The National Oil and Hazardous Substances Pollution Contingency Plan, more commonly called the National Contingency Plan or NCP, is the federal government's blueprint for responding to both oil spills and hazardous substance releases. The NCP is the result of our country's efforts to develop a national response capability and promote overall coordination among the hierarchy of responders and contingency plans. Since its first version published in 1968, Congress has revised the NCP to include a framework for responding to hazardous substance spills. [40 Code of Federal Regulations sections 300.1 - 300.920]

Non-time-critical removal action. Non-time-critical removal actions, as defined by CERCLA, are removal actions that the lead Agency determines, based on the site evaluation, that a removal action is appropriate, and a planning period of at least six months is available before on-site activities must begin. Further, because non-time-critical removal actions can address priority risks, they provide an important method of moving sites more quickly through the Superfund process. Thus, conducting non-time-critical removal actions advances the goals of the Superfund Accelerated Cleanup Model (SACM) to include substantial, prioritized risk reduction in shorter time frames and to communicate program accomplishments to the public more effectively.

Operable unit. An OU is a geographical area designated for the purpose of analyzing and implementing remedial actions. OUs are defined on the basis of similar features and characteristics (e.g., physical and geographic properties and characteristics developed in previous investigations) and for ease of site management and administration.

Preliminary Endangerment Assessment. Under DTSC (2004), the Preliminary Endangerment Assessment (PEA) includes activities performed to determine whether current or past waste management practices have resulted in the release or threatened release of hazardous substances or materials which pose a threat to public health or the environment.

RCRA. The Resource Conservation and Recovery Act (RCRA), an amendment to the Solid Waste Disposal Act, was enacted in 1976 to address the huge volumes of municipal and industrial solid waste generated nationwide. Under RCRA, EPA has the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous wastes. [Title 40 of the Code of Federal Regulations (CFR), Parts 239 through 282]

Remedial Action Plan. Under the HSAA, the RAP is the remedy selection document for a remedial action for which the capital costs of implementation are projected to cost $1,000,000 or more.

Removal Action Workplan. Under the HSAA, the RAW is the remedy selection document for a nonemergency removal action (or a remedial action if cost is less than $1 million) at a hazardous substance release site. Typically, short-term actions designed to stabilize or cleanup a site posing an immediate threat to human health or the environment.

Risk assessment. A risk assessment is an analysis that uses information about toxic substances at a site to estimate a theoretical level of risk for people who might be exposed to these substances.

Risk screening. Process of the identification of metal COPCs that need to be cleaned up on the site based on potential risk to human health. Screening involves a comparison of site media concentrations with risk-based values (e.g., CHHSLs).

Screening level. Concentration value used to evaluate whether a metal poses a risk to human health and should be identified as a COPC.

Site characterization. Process of determining the type, quantity, and location of contaminant releases at a site. Also includes assessment of site characteristics that affect how and where the contaminant may be moved and the how human health and the environment are or may be affected.

Soils. Loose material on the surface and in the subsurface of the earth consisting of solids (i.e., mineral grains, organic matter), water, and air.

Soil Washing. Water-based process for scrubbing soils to remove contaminants by dissolving/ suspending in wash solution or concentration into smaller volume of soil through particle size separation, gravity separation, and attrition scrubbing.

Solidification/Stabilization. Use of chemical or physical processes to treat wastes. Solidification technologies encapsulate waste to form a solid material. Stabilization technologies reduce the hazard potential by converting waste to less soluble, mobile, or toxic forms.

Soluble/solubility/solubilization. Tendency of a metal to dissolve in the soil solution or groundwater. Process of causing a metal to dissolve.

Time-critical removal action. Where a release or threatened release poses an imminent or substantial risk to health or environment, an emergency or time-critical removal may be employed to prevent a release of contaminants or minimize its risk. For these types of removal actions, evaluation and reporting requirements are kept to a minimum to expedite the response.

Treatability study. Treatability studies are investigations conducted to provide sufficient data to allow treatment alternatives to be fully developed and evaluated during cleanup option evaluation and to support the design of the selected alternative(s). Treatability studies may also be used to reduce cost and performance uncertainties for treatment alternatives to acceptable levels so that a cleanup option can be selected.

Upper confidence limit (UCL). The upper confidence limit (UCL) is a statistical term that can be calculated using soil data collected from a statistically designed sampling program. The method for calculating the UCL will depend on the data distribution. Soil samples collected from a statistically designed program are taken to be representative of the actual environmental conditions onsite (i.e., samples collected are a subset of the actual site conditions, but represent the whole site). The 95 percent confidence interval (or error) is the region about the arithmetic sample mean that is likely to contain the underlying population mean (representing the whole site itself) with a probability of 95 percent.

Volatile/Volatilization. Tendency of a metal to change into a vapor. Process of causing a metal become a vapor.

APPENDIX A

Appendix A1: Conceptual Site Model

Appendix A2: Characterization Phase Workplan

Appendix A3: Annotated Outline for Site Characterization Report

APPENDIX A1
CONCEPTUAL SITE MODEL

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PREFACE

This appendix is for guidance only, and is applicable on a case-by-case basis.

OVERVIEW OF A CONCEPTUAL SITE MODEL (CSM)

The following overview of a conceptual site model (CSM) is summarized from handouts provided in the U.S. Environmental Protection Agency's (EPA) short course entitled, *Best Practices for Efficient Soil Sampling Designs* (EPA, 2008).[1]

Definitions of a CSM

- Any representation of the nature, extent, and fate of contamination that allows assessment of the potential exposures to contamination, so that the decision maker can evaluate strategies to reduce the risks from contamination.
- The working hypothesis about the site's physical reality.
- The decision-maker's mental picture of the site characteristics pertinent to evaluating the risk posed by the site and deciding how to clean up a site.
- The scientific hypothesis that is tested, modified, and refined until confident decision-making is possible.

Uses of a CSM

- Organize project information.
- Point of consensus about sources of uncertainty.
- Identify uncertainty that prevents confident decision-making.
- Identify need for additional data collection either to reduce CSM uncertainties or to test CSM assumptions.
- Basis for all site decisions about risk, remediation, and reuse.
- Basis for cost-effective, confident decisions.
- Basis for identifying decision units (i.e., the area, volume, or set of objects that is treated as a single unit for decision-making).

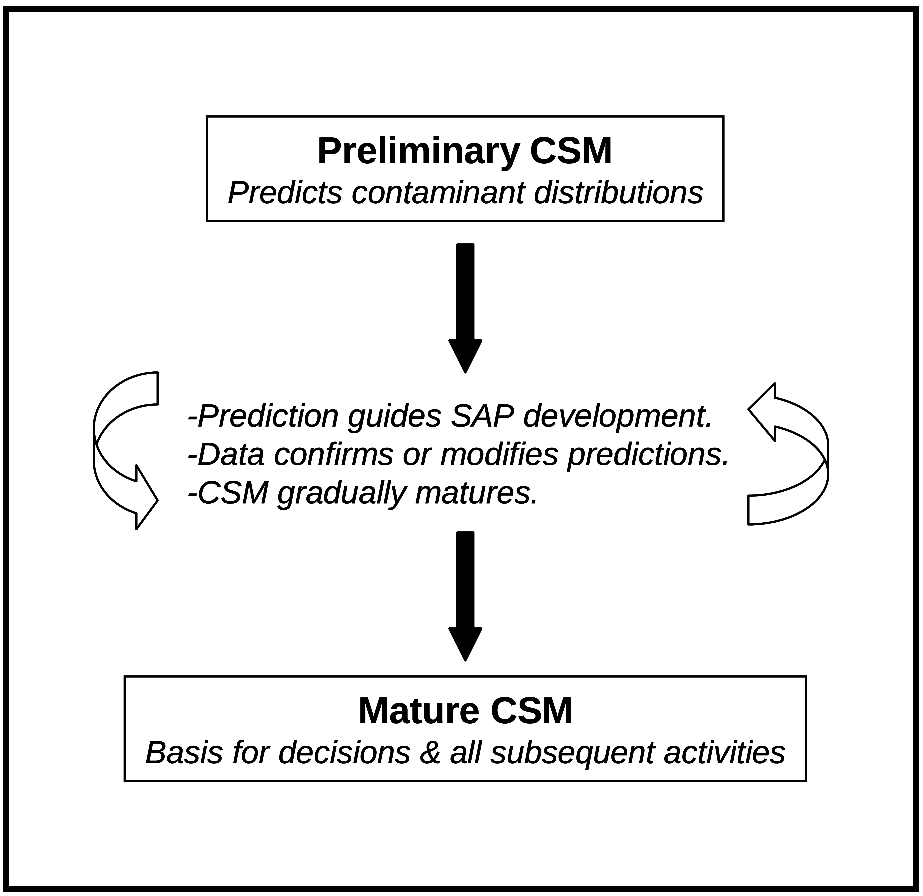
[1] EPA. 2008. Module 6, Truth Serum for Environmental Decision-Making: Efficient and Effective Program Designs. Short course manual for Best Practices for Efficient Soil Sampling Designs. CERCLA Education Center. January.

CSM Representations[2]

CSMs can be presented in a variety of forms. It usually takes more than one format to organize and display different types of site information. Examples of CSM representations include a text description supported by appropriate figures (e.g., site maps, cross-sections, block diagrams), a release-transport-exposure cartoon, and an exposure pathway CSM used to support the risk assessment. Computer model simulations or exposure scenario models may be a component of the CSM, but do not represent the entire CSM.

Evolution of a CSM

As illustrated by the following figure, a CSM evolves as new data become available, the new data is incorporated into the CSM and the CSM matures.



[2] Suggested Reference: U.S. Environmental Protection Agency (EPA). 1996. Attachment A, Conceptual Site Model Summary. Soil Screening Guidance: User's Guide. Second Edition. EPA 540/R-96/018. July. www.epa.gov/superfund/health/conmedia/soil/pdfs/attacha.pdf

CONCEPTUAL SITE MODEL CHECKLIST

CSM REQUIREMENT	STATUS	REQUIRED ACTION
FACILITY		
Identify current and historical structures (e.g., buildings, drain systems, sewer systems, underground utilities)		
Identify process areas, including historical processing areas (e.g., loading/unloading, storage, manufacturing)		
Identify current and historical waste management areas and activities		
Other		
LAND USE AND EXPOSURE		
Identify specific land uses on the facility and adjacent properties		
Identify beneficial resources (e.g., groundwater classification, wetlands, natural resources)		
Identify resource use locations (e.g., water supply wells, surface water intakes)		
Identify subpopulation types and locations (e.g., schools, hospitals, day care centers)		
Identify applicable exposure scenarios (e.g., residential, industrial, recreational, farming)		
Identify applicable exposure pathways (e.g., contaminant sources, releases, migration mechanisms, exposure media, exposure routes, receptors)		
Other		
PHYSICAL FEATURES		
Identify topographical features (e.g., hills, gradients, surface vegetation, or pavement)		
Identify surface water features (e.g., routes of drainage ditches, links to water bodies)		
Identify surface geology (e.g., soil types, soil parameters, outcrops, faulting)		
Identify subsurface geology (e.g., stratigraphy, continuity, connectivity)		
Identify hydrogeology (e.g., water-bearing zones, hydrologic parameters, impermeable strata, direction of groundwater flow)		
Identify existing soil boring and monitoring well logs and locations		
Other		

CONCEPTUAL SITE MODEL CHECKLIST (CONTINUED)

CSM REQUIREMENT	STATUS	REQUIRED ACTION
RELEASE INFORMATION		
Identify potential sources of releases		
Identify potential contaminants of concern associated with each potential release		
Identify confirmed source locations		
Identify confirmed release locations		
Identify existing delineation of release areas		
Identify distribution and magnitude of COPCs and COCs		
Identify migration routes and mechanisms		
Identify fate and transport modeling results		
Other		
RISK MANAGEMENT		
Summarize the risks		
Identify impact of risk management activities on release and exposure characteristics		
Identify performance monitoring locations and media		
Identify contingencies in the event performance monitoring criteria is exceeded		
Other		
CLEANUP		
Identify study options		
Identify study requirements		
Identify cleanup options		
Identify cleanup requirements		
Other		

EXAMPLE FOR CONCEPTUAL SITE MODEL IN NARRATIVE FORMAT

Site Description

The Project Site (site) is an active wood treatment facility located on approximately 12 acres near the town of Redding in Shasta County. The site is currently owned by Company X and was previously owned by Company Y. Site operations have been relatively stable since operations began in 1955 and have generally consisted of a process area, drip pad, and a pole yard used for treated wood storage. The current and historical configuration of the facility is shown on Figure 1. Although the property was used for pasture prior to 1955, there is no record of any pesticide or herbicide applications.

The treatment operations primarily used inorganic treatment solutions, some of which contained arsenic, chromium, copper, and zinc. Wastes generated at the site are consistent with those typically associated with wood treatment facilities and include retort drippings, tank and retort sludges, process water, wastewater, drying area drippings, storage area drippings, empty containers, and spilled raw preservative compounds. Several leaks and direct discharges of wood treatment chemicals from the process area have been reported from the 1960s through 1970s.

The site is fenced and access is controlled. As shown in Figure 2, the site is located at the edge of a mixed industrial/commercial area and is bordered to the south by an undeveloped field. The wood treatment facility is active and is projected to operate for the foreseeable future.

The site is largely unpaved and unvegetated. The site slopes at about a 1 percent grade toward the southeast. Surface water runoff is intercepted by a drainage ditch that borders the southern and eastern margin of the property. No other surface water features are present.

There are no known cultural resources at the site. The nearest school is located about one mile north of the site.

Source Areas

The process area (about 2 acres) includes the engine room, chemical mix building, and related structures. The engine room houses two retorts that are used to pressure inject treatment solutions into the wood. An underground storage tank that stored spent treatment solutions was located below the retorts until it was closed in 1983. Now and in the past, wood treatment chemicals are prepared at the chemical mix building and placed in storage vessels within the retort area.

The drip pad area (about 1 acre) includes the railroad tracks and surrounding land immediately east of the engine room building. Treated wood removed from the retorts is held in the drip pad area until dripping ceases. Concrete drip pads were installed in this area in 1982.

The pole yard (about 9 acres) includes the eastern portion of the site. The area is used for storage of treated and untreated wood.

Site Geology and Hydrogeology

The geology and hydrogeology of the site have been presented in several documents. These include the Remedial Investigation Report (Consultant X, 1989) and the Characterization and Treatability Study Report of Results (Consultant Y, 1993). The site is generally underlain by five stratigraphic units (discussed in order of increasing depth).

Artificial Fill. Artifical fill is present across the site at thickness ranging from 1 to 3 feet. The fill material typically consists of gravelly sand derived from local quarries.

Younger Clastic Assemblage (YCA). The YCA is a poorly-sorted, unstratified pyroclastic debris flow, consisting of silty, gravelly sand. Gravel is angular to subangular, and can be greater than 2.5 inches in diameter. Locally it contains alternating beds of silty sand, sandy silt, and rounded gravel. The transition to the underlying unit occasionally is marked by a sandy-silt to silty-sand layer. The unit has a distinctive pinkish-brown to pinkish-gray color. It ranges up to 20 feet thick at the site.

Younger Alluvial Assemblage (YAA). The YAA is a well-sorted unit of fluvial origin. The unit consists of fine to medium sand to silty sand and gravelly medium coarse sand. Gravels in this unit are generally less than one inch in diameter. Locally on the site the YAA can be poorly sorted and very silty, which may represent transitional environments of a fluvial system. The YAA is brown to gray and can have a reddish or greenish hue. The YAA ranges from 15 to 18 feet thick.

Older Clastic Assemblage (OCA). The OCA is a distinctive unit that is present beneath the YAA. The OCA caps the older pyroclastic flows and the lower aquifer. In air rotary drill cuttings, the OCA is described as brown gravelly clay. In split-spoon samples, the OCA is described as dense greenish-gray silt or sandy silt. The boring logs indicate that the OCA ranges from 20 to 29 feet thick beneath the site. The OCA acts as the confining layer that separates the uppermost aquifer from the lower aquifer.

Older Alluvial Assemblage (OAA). The OAA is a well-sorted unit of fluvial origin. The unit consists of medium to coarse sand to gravelly sand. Gravels in this unit are generally less than one inch in diameter. The OAA is brown to gray. The OAA ranges from 30 to 40 feet thick.

Two water-bearing units have been identified at the site and are separated by the OCA aquitard. The shallower water-bearing unit is referred to as the uppermost aquifer and occurs within the YAA. The second water-bearing unit occurs in the OAA and is used as a local water supply. Depth to groundwater at the site generally ranges from 27 to

30 feet below ground surface (bgs). Hydrographs from monitoring wells indicate that there is a persistent downward vertical gradient across the Site between the two water-bearing units. The head difference can be as much as 10 feet. The regional groundwater flow direction is toward the northwest. Beneath the site, the ground water flow direction in the uppermost water-bearing unit is generally to the north-northwest. The groundwater flow direction in the lower water-bearing unit is generally toward the west reflecting the influence of local water supply wells.

Nature and Extent of Contamination

Investigations at the site have identified arsenic as the COC most commonly detected in soil above the estimated background concentration (8 milligrams per kilogram (mg/Kg)) at concentrations ranging from 40 to 32,000 mg/Kg. Chromium, copper, and zinc exceed the respective background concentrations in localized areas, but are co-located with elevated arsenic concentrations. The data indicate that impacted surface soil (0 to 2 feet bgs) is found throughout the process area and pole yard as well as along the drainage ditch. The majority of surface soil samples contained in excess of 100 mg/Kg of arsenic. Soil impacts below 2 feet bgs were only observed in the vicinity of the chemical mix building and engine room. The maximum depth of impact in these localized areas was 6 feet bgs.

The data suggest a lack of mobility of arsenic at the site because concentrations decrease rapidly with depth and arsenic is found in the subsurface only near the chemical management areas. In addition, arsenic has not been detected above background concentrations in groundwater.

Figure 3 shows the extent of surface soil impacted with metals, an area covering approximately 8.5 acres. The extent of impacted soil at depths greater than 2 feet bgs in shown in Figure 4 and covers about 0.3 acres. The estimated volume of metals-impacted soil is 18,750 cubic yards.

Human Health Risk

The Remedial Investigation identified potential risk to human receptors. The risk assessment identified chemicals of concern (COCs) for human receptors. The chemicals were selected primarily on the basis of the concentration detected, or the known or suspected toxicological properties of the substance. The wood treatment COCs include arsenic, chromium, copper, and zinc, with arsenic being identified as a high threat contaminant. Chromium, copper, and zinc have been identified as secondary COCs because they are considered to be less toxic than arsenic, are not widespread, are relatively immobile, and/or do not consistently exceed health-based standards.

The Remedial Investigation identified the principal exposure pathways by which human receptors could potentially be exposed to site contaminants as:

- Direct contact with contaminated soils; and
- Inhalation of fugitive dust emissions.

The evaluation performed under the risk assessment indicated that, under current land-use conditions, the principal exposure pathways by which human receptors could potentially be exposed to site contaminants are direct contact by site workers with contaminated soils and inhalation of fugitive dust emissions on and off site. It is anticipated that future land use of the site will continue to be industrial. Within the risk assessment, the exposure point concentrations of site chemicals were estimated using measured concentrations and models to estimate fugitive dust emissions.

The risk assessment evaluated two main baseline (no action) scenarios: continued use of the property as industrial (wood treatment) and future-use development of the property as residential. Exposure was assessed for both an average case and a maximum plausible case for each exposure scenario. For the average case, geometric mean concentrations were used, together with what were considered to be the most likely exposure conditions. For the maximum plausible case, the highest measured concentrations were generally used, together with high, although plausible, estimates of the range of potential exposure parameters relating to frequency and duration of exposure and quantity of contaminated media contact.

The highest current-use potential health risk due to arsenic was identified as exposure by site workers to the soil by direct contact (plausible maximum case risk of 8×10^{-2}). The maximum non-carcinogenic risks from direct contact with soil by workers at the site exceeded a hazard index of 1.0. Inhalation of arsenic-contaminated fugitive dust by adults working in the area of Front Street poses a current use maximum potential excess cancer risk of 2×10^{-3} and a noncancer risk from inhalation of less than one.

Higher health risks are associated with future residential use of the site. Children in direct contact with site soil have a maximum excess cancer risk of 1×10^{-2} from arsenic and a non-cancer risk greater than 1. Adults in direct contact with site soil have a maximum excess cancer risk of 5×10^{-2} and a corresponding non-cancer risk greater than 1.

Potential remedies to remove these exposure pathways include: excavation and off-site disposal; excavation, treatment, and off-site disposal; and capping or paving the site.

Ecological Risk

Based on a field summary by a qualified biologist, the potential risk to ecological receptors is considered to be limited because of the low quality habitat at and near the site.

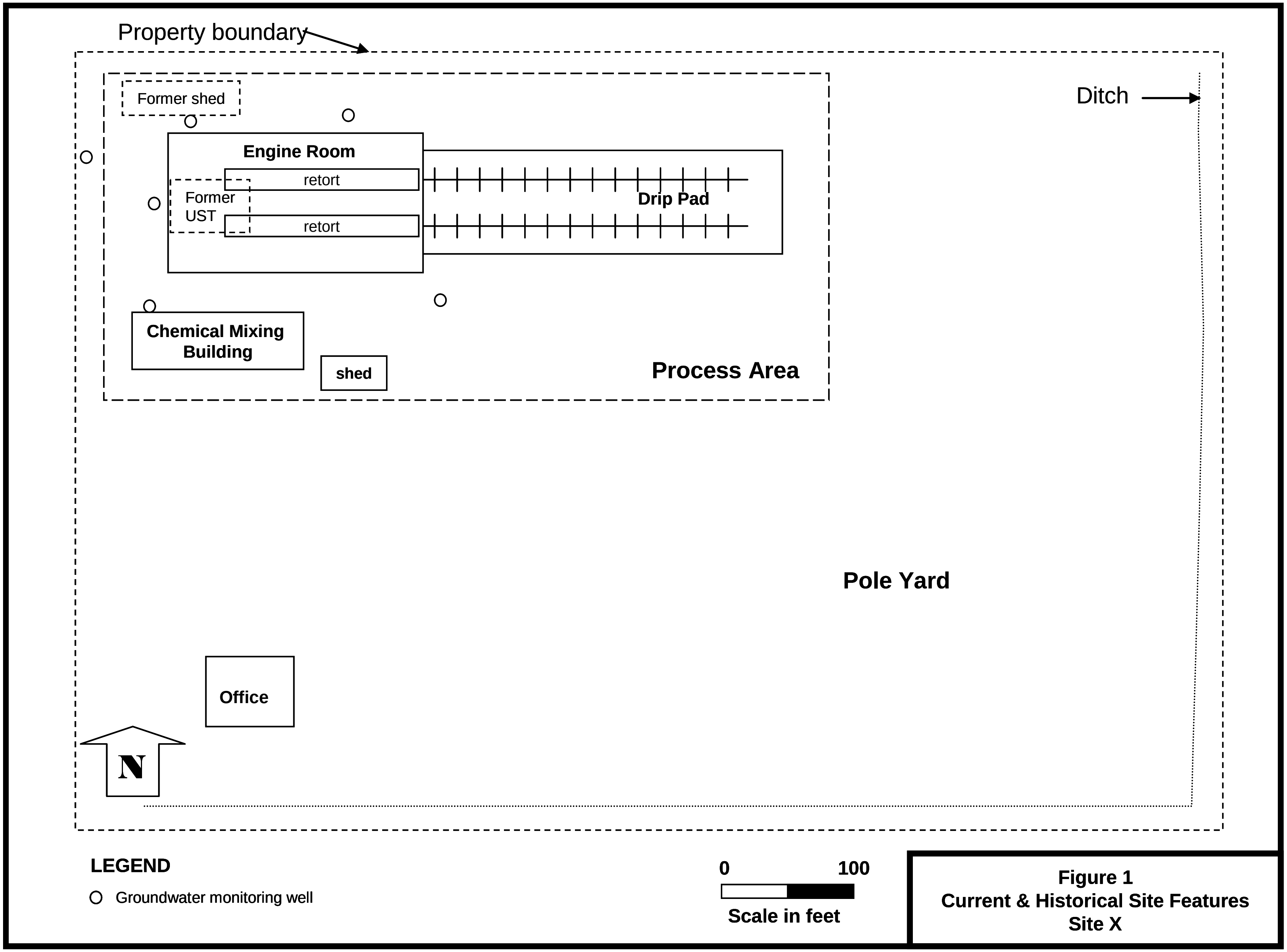


Figure 1
Current & Historical Site Features
Site X

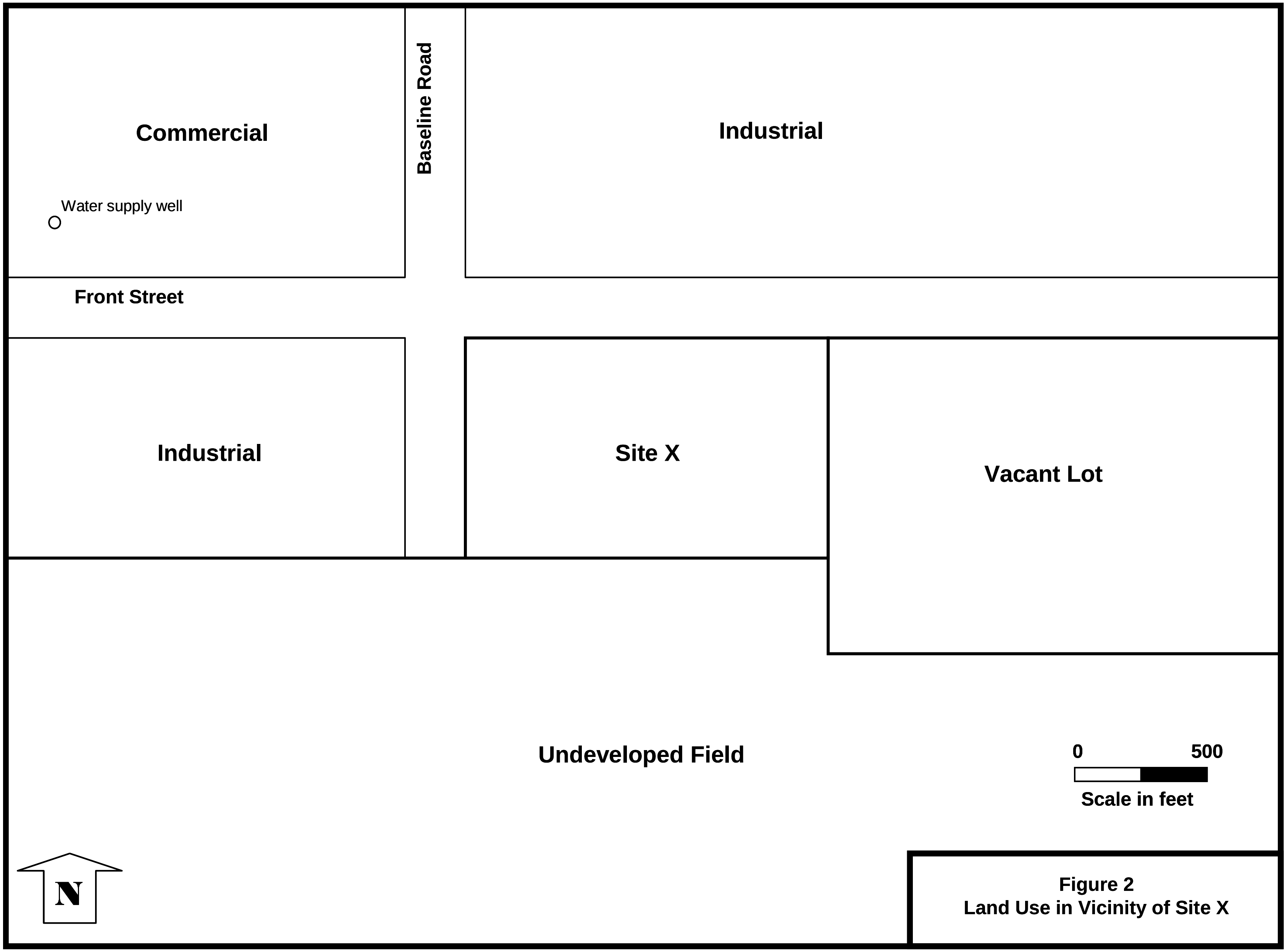


Figure 2
Land Use in Vicinity of Site X

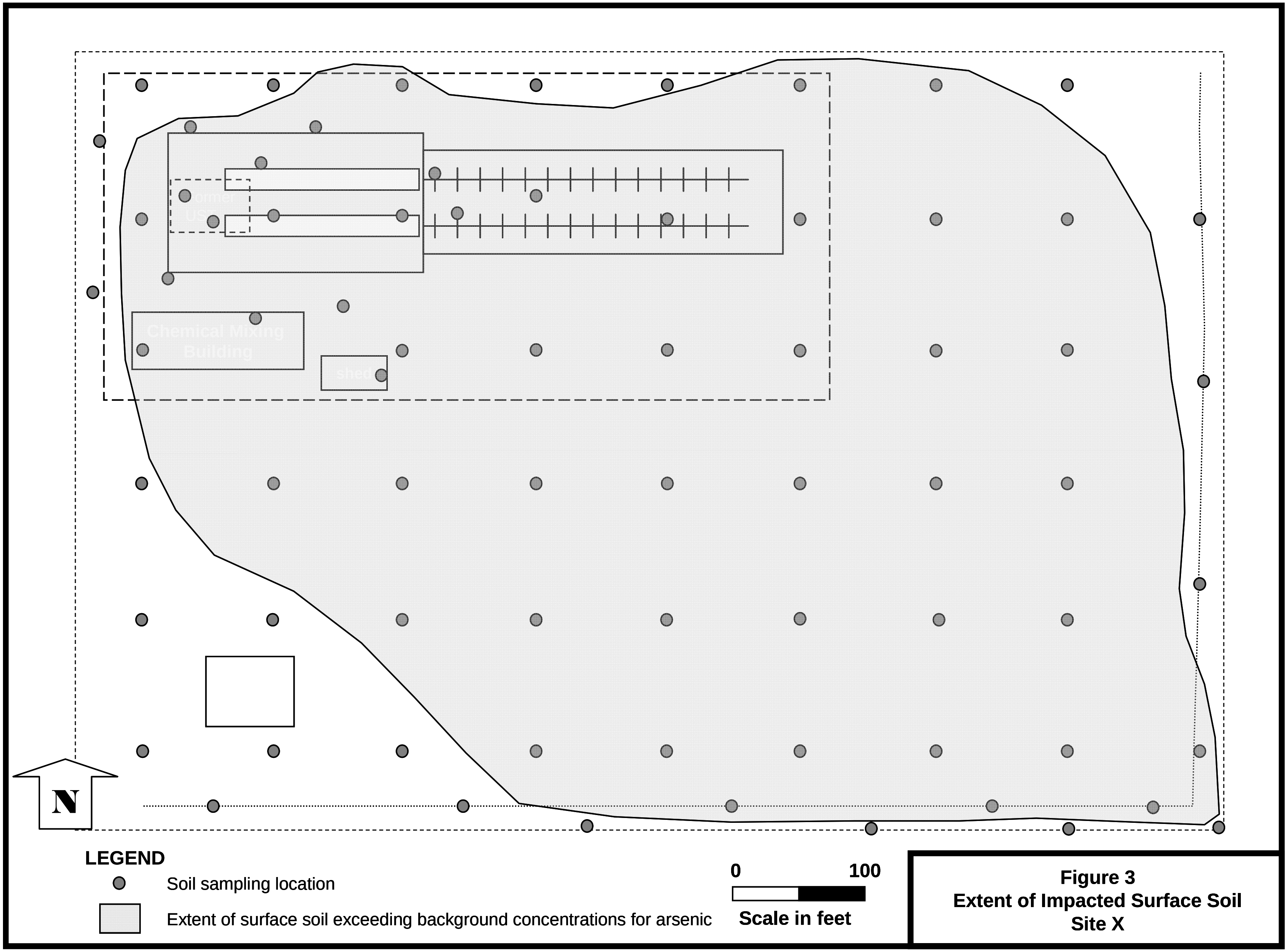
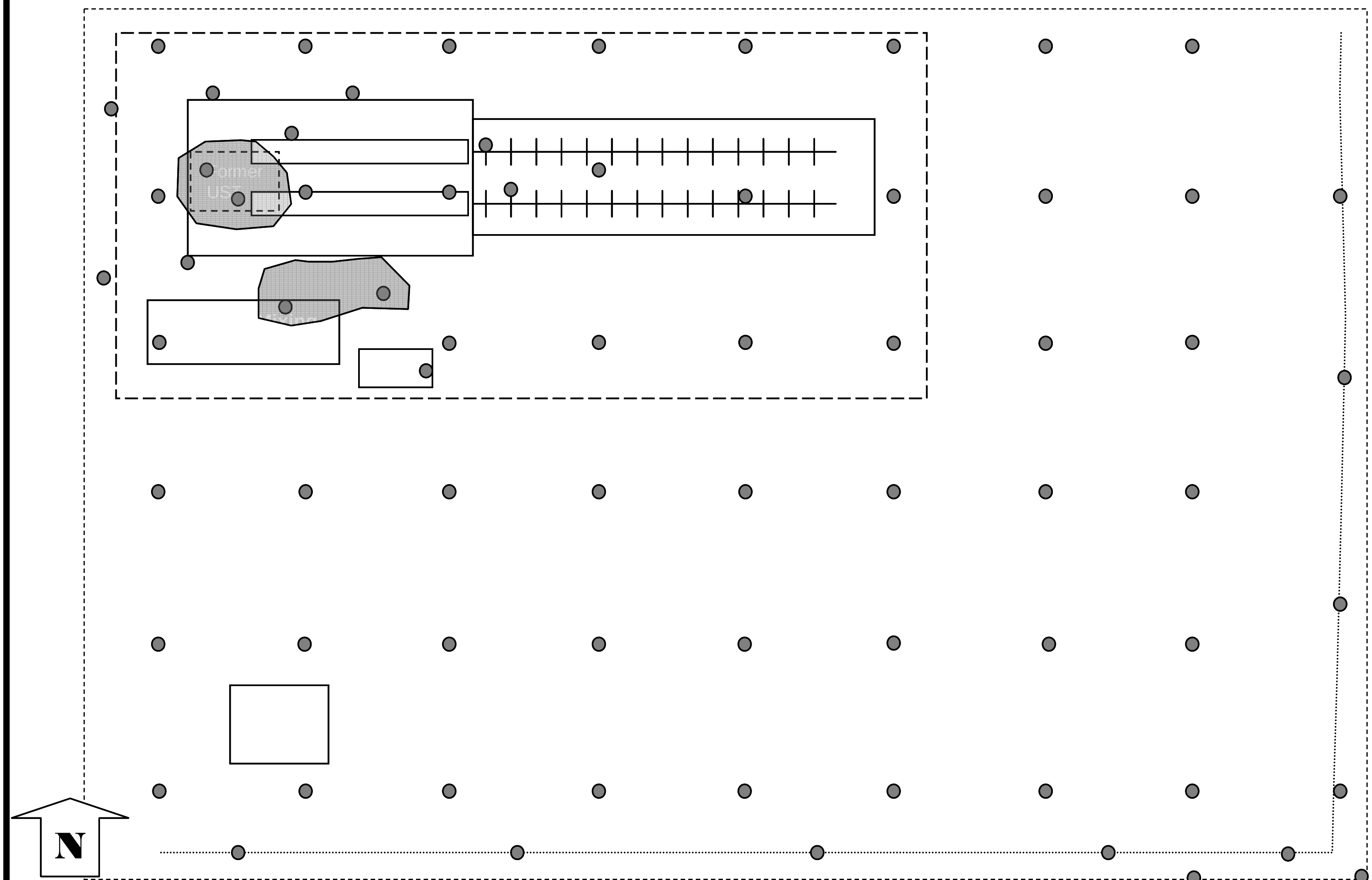


Figure 3
Extent of Impacted Surface Soil
Site X



LEGEND

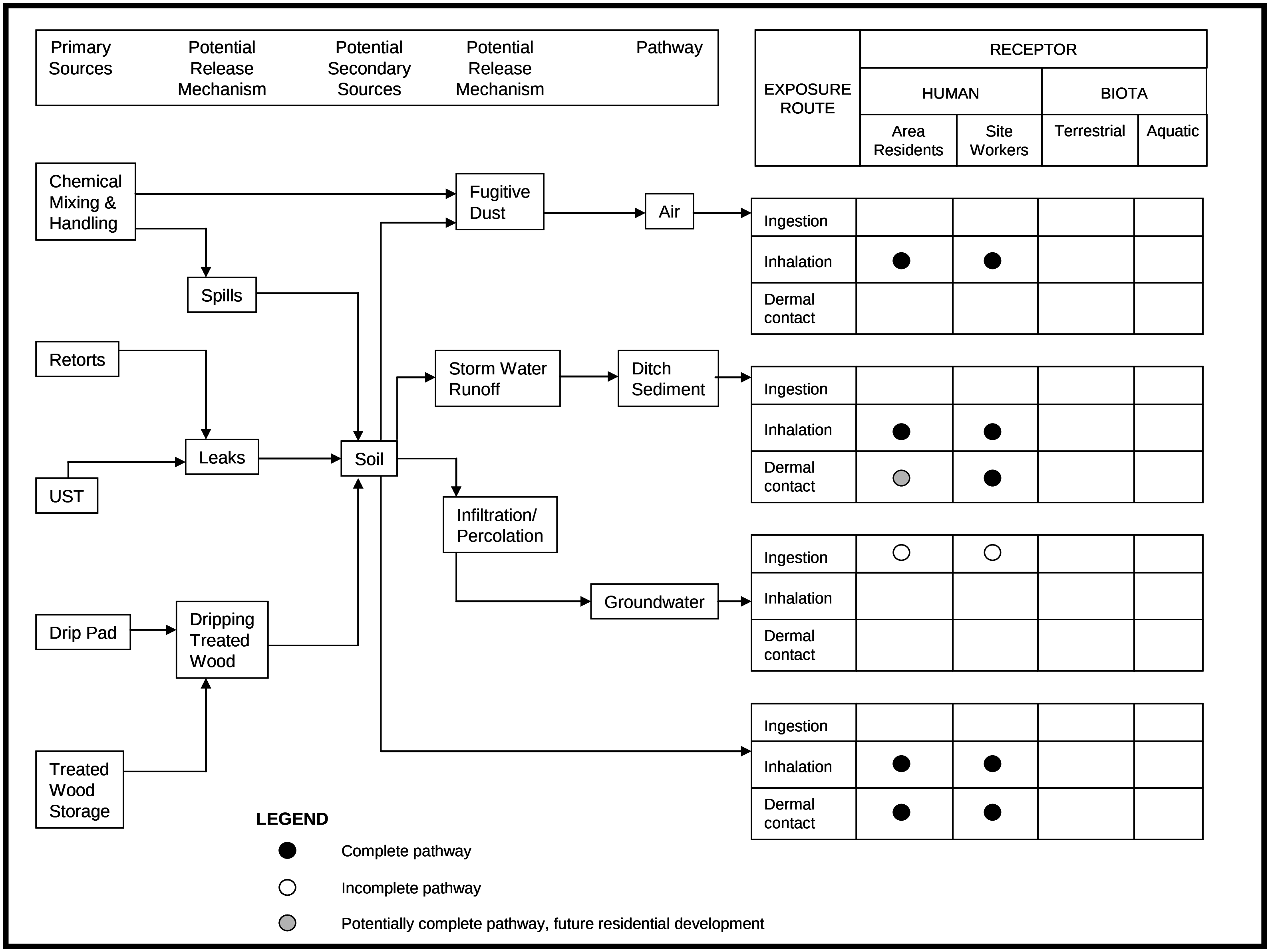
- Soil sampling location
- Extent of soil exceeding background concentrations for arsenic

0 100

Scale in feet

Figure 4
Extent of Impacted Soil >2 feet bgs
Site X

EXAMPLE FOR PATHWAY-EXPOSURE CSM



APPENDIX A2
CHARACTERIZATION PHASE WORKPLAN

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PREFACE

The annotated outlines included in this appendix identify potential content for a Characterization Phase Workplan, a Generic Field Sampling Plan (FSP), and a Generic Quality Assurance Project Plan (QAPP). These outlines are not intended to be prescriptive and should be adjusted as appropriate for the site-specific conditions. Some elements of the outlines may apply to your site, while other elements may not. Additional elements than are addressed by these outlines may also be needed. This appendix is for guidance only, and is applicable on a case-by-case basis.

ANNOTATED OUTLINE FOR CHARACTERIZATION PHASE WORKPLAN

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

**These documents must be prepared to support the field investigation. The documents can either be included as appendices to the workplan or can be referenced by the workplan.*

1.0 INTRODUCTION

Instructions: Provide a general site description. Identify the sites or areas to be investigated. Briefly present the purpose and scope of the investigation. Identify the responsible agency. Outline the project organization.

1.1 SITE LOCATION AND DESCRIPTION
1.2 SITE OR SAMPLING LOCATION DESCRIPTION
1.3 PURPOSE AND SCOPE OF WORK PLAN
1.4 RESPONSIBLE AGENCY
1.5 PROJECT ORGANIZATION

2.0 SITE BACKGROUND

Instructions: The background section should orient the reader to the site. Summarize the site history and operations, as well as any key features relevant to the investigation or conceptual site model. Briefly describe all pertinent details of the topographic and physiographic setting (including the location of rivers, streams, and drainages near the property), the local climate (rainfall, temperature, wind directions, seasonal changes), and local land uses (i.e., residential, industrial, commercial, sensitive land uses). Provide an overview of the site geology and hydrogeology. Identify the depth to groundwater and the water resources in the vicinity of the site. If appropriate, use separate subsections to discuss other relevant topics (e.g., findings of any ecological surveys, whether any cultural resources are present or discuss other environmental media (e.g., surface water).

2.1 SITE HISTORY, OPERATIONS, AND FEATURES
2.2 TOPOGRAPHY, CLIMATE, AND SETTING
2.3 GEOLOGY AND HYDROGEOLOGY
2.3.1 Geology and Soils
2.3.2 Groundwater
2.4 [OTHER APPROPRIATE TOPICS]

3.0 PREVIOUS INVESTIGATION AND REMEDIAL ACTIVITIES

Instructions: Discuss and summarize all previous investigations performed at the site. This section should include:

- *A narrative history of previous investigations;*
- *The results of any background studies performed at the site or determined from published sources;*
- *A list of the contaminants of concern that may have been previously determined;*

- *Any remedial measures (such as interim removals or capping) which may have been performed at the site; and*
- *A summary of the investigation results.*

This section should lay the ground work for the investigation objectives and approach described in Section 4 and the sampling design and rationale discussed in Section 5.

3.1 PREVIOUS INVESTIGATIONS
3.2 BACKGROUND CONCENTRATIONS [IF KNOWN]
3.3 CONTAMINANTS OF CONCERN
3.4 PREVIOUS REMEDIAL MEASURES
3.5 SUMMARY OF INVESTIGATION RESULTS

4.0 PROJECT OBJECTIVES/DATA QUALITY OBJECTIVES AND APPROACH

Instructions: Identify the project objectives and data quality objectives (DQOs), including the process used to develop the DQOs. Outline the approach to the investigation (e.g., the PT&R approach is being used, any site-specific adjustments to the PT&R approach, use of TRIAD, how step-out sampling will be addressed if needed. Synthesize the information presented in Sections 2 and 3 to provide a clear and concise presentation of the conceptual site model (CSM). Use the CSM and DQOs to identify the data gaps to be addressed by the investigation.

4.1 PROJECT OBJECTIVES AND DATA QUALITY OBJECTIVES
4.2 PROJECT APPROACH
4.3 CONCEPTUAL SITE MODEL
4.4 DATA GAPS

5.0 SCOPE OF WORK FOR INVESTIGATION

Instructions: This section outlines the scope of work for the investigation. Include separate subsections for each focal point of the investigation. For example, separate subsections should be provided for the activities focused on determining the nature and extent of contamination and those focused on evaluating background concentrations of metals. In addition, data collection activities to support the evaluation and design of the remedy should be addressed in a separate section. If appropriate, include subsections that address other investigation objectives (e.g., sampling of other media).

Each subsection should identify the sampling objectives, provide the technical basis for the proposed sampling, and identify the sampling locations and depths. Support each subsection with appropriate figures which accurately depict the locations of proposed samples.

5.1 NATURE AND EXTENT OF CONTAMINATION
- 5.1.1 Objectives
- 5.1.2 Sampling Design and Rationale
- 5.1.3 Sample Locations and Depths

5.2 BACKGROUND CONCENTRATIONS OF METALS [IF NECESSARY]
- 5.2.1 Objectives
- 5.2.2 Sampling Design and Rationale
- 5.2.3 Sample Locations and Depths

5.3 REMEDY EVALUATION AND DESIGN
- 5.3.1 Objectives
- 5.3.2 Sampling Design and Rationale
- 5.3.3 Sample Locations and Depths

5.4 [OTHER INVESTIGATION ELEMENTS]

6.0 SAMPLING AND ANALYSIS

Instructions: Outline the general sample collection and preservation procedures and methods, a complete discussion of the analytical methods to be applied to the samples, and a quality assurance/quality control program for the field aspect of the investigation (which includes provisions for duplicate samples, blanks, and equipment blanks). Reference the FSP, QAPP, and site-specific health and safety plan (HASP). Also, reference any additional appendices that support the investigation activities (e.g., waste management plan).

6.1 GENERAL SAMPLE COLLECTION PROCEDURES AND PRESERVATION METHODS

6.2 LABORATORY ANALYTICAL METHODS

6.3 QUALITY ASSURANCE AND QUALITY CONTROL

7.0 DATA MANAGEMENT, EVALUATION, AND REPORTING

Instructions: Describe how the data generated by the investigation will be managed, evaluated, and reported. The data evaluation section should address any statistical methods that will be used to evaluate the data or to compare data to background concentrations, screening levels, or another threshold value. The reporting section should indicate whether/how information will be conveyed to stakeholders during the investigation (e.g., regulatory input on step-out sampling) and should outline the content of the investigation report.

7.1 DATA MANAGEMENT

7.2 DATA EVALUATION
- 7.2.1 General Data Evaluation
- 7.2.2 Statistical Methods

7.3 REPORTING

8.0 PROJECT SCHEDULE

Instructions: If appropriate, a project schedule may be included as a separate section.

9.0 REFERENCES

Instructions: Include all references to documents cited in the workplan.

FIGURES/TABLES
APPENDICES

ANNOTATED OUTLINE FOR GENERIC FIELD SAMPLING PLAN (FSP)

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

1.0 INTRODUCTION

Instructions: Indicate what the FSP presents and how it relates to the associated workplan and QAPP.

This Field Sampling Plan (FSP) presents, in specific terms, the requirements and procedures for conducting field operations and investigations. The FSP presents project specific elements to ensure (1) the data quality objectives (DQOs) specified to this project are met, (2) the field sampling protocols are documented and reviewed in a consistent manner, and (3) the data collected are scientifically valid and suitable for risk management decision making. The FSP together with the project specific Quality Assurance Project Plan (QAPP) shall constitute, by definition, a Sampling and Analysis Plan (SAP).

This FSP is required reading for all staff participating in field work on this project. The FSP shall be in the possession of the field teams during the collection of samples. All personnel are required to be familiar with the components of the FSP and each team member is required to sign the Field Sampling Team Compliance Form (Section 5.4) before each sampling event stating that he/she has read and understands the current version of the SAP.

2.0 PROJECT BACKGROUND

2.1 SCOPE AND PURPOSE

Instructions: Briefly describe the purpose of this FSP.

2.2 PROJECT SITE DESCRIPTION

Instructions: Provide a brief description of the project including the general location, current land use, proposed future land use (if known), problem to be investigated, types of analyses that will be performed, and regulatory oversight.

2.3 SITE HISTORY

Instructions: Describe the history of activity at the project location (site) including activities that led to contamination and previous investigations (if any) to determine the nature and extent of contamination.

3.0 SCOPE AND OBJECTIVES

3.1 OBJECTIVES

Instructions: Discuss the project: DQOs, data quality indicators (DQIs), data review and validation, data management, and assessment oversight—which collectively describe the procedures used to implement the quality assurance program (QA). The FSP should discuss how project-specific decision rules were derived from the DQO process and define data quality categories (e.g., screening data vs. definitive data). Reference the project QAPP.

3.2 SAMPLING RATIONALE

Instructions: Justify the number and location of samples, types of samples, types of analytical analyses, and field activities needed. Justify the location of any proposed background or ambient condition samples (e.g., collected from similar lithology to the site, but free from impacts of site-related activity).

3.3 SAMPLE ANALYSIS SUMMARY

Instructions: For each analytical method, list the (1) number of analyses, (2) total number of environmental samples for all matrices, (3) number of background or ambient condition samples and their location, (4) the number of equipment blanks, (5) the number of field duplicate samples, and (6) the number of screening samples to be confirmed (if screening samples are taken).

3.4 FIELD ACTIVITIES

Instructions: Provide a general overview of the soil sampling event. Present a rationale for choosing each sampling location and depth at the site. If sampling decisions are to be made in the field, provide details concerning the criteria that will be used. List the compounds of concern at each location and provide a rationale for why the specific compound was chosen.

4.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Instructions: List the names, addresses, e-mail address and, telephone numbers for the project organization and key personnel responsibilities on the project. At a minimum list the: Project Manager, Regulatory Oversight Contact, Field Staff, Quality Assurance Manager, and all contractors with their staff. The Quality Assurance Manager is responsible for the implementation of the SAP and QA plan, and specifies if quality control (QC) procedures are being followed.

5.0 FIELD OPERATIONS

5.1 SITE RECONNAISSANCE AND PREPARATION

Instructions: Describe the results of site reconnaissance including preparation for determining the presence of underground utilities at any location designated for intrusive investigation. Vehicle and field staff access should be determined and provide maps of all access roads, trails, or other access features. Central decontamination areas should be designated and locations provided to store investigation derived wastes.

5.2 SAMPLING METAL-IMPACTED MATERIALS

Instructions: Describe the materials to be sampled and the methods to be employed. Given the methods selected chose all applicable subsections as follows.

5.2.1 Borehole Drilling

Instructions: Describe the general drilling activities to be used including methods of drilling, sampling (e.g. split spoon or direct push), frequency of sampling, logging methods, and borehole decommissioning. Indicate that all drilling activities will conform to state and local requirements and will be supervised by a licensed geologist or engineer. Indicate that permits, applications, and other documentation will be acquired prior to field deployment. Describe all decontamination procedures.

5.2.2 Trench/Test Pit Excavations

Instructions: Describe the general excavation activities to be used including methods used , sampling method, frequency of sampling, logging methods, and excavation decommissioning. Describe all decontamination procedures.

5.2.3 Surface Sampling

Instructions: Describe the results of site reconnaissance including preparation for determining the presence of underground utilities at any location designated for intrusive investigation. Vehicle and field staff access should be determined and provide maps of all access roads, trails, or other access features. Central decontamination areas should be designated and locations provided to store investigation derived wastes.

5.3 SURVEYING

Instructions: Describe the methods to survey the location of all investigations on the site and provide the licensed surveyor or other method used.

5.4 EQUIPMENT DECONTAMINATION

Instructions: Specify the decontamination procedures that will be followed for all non-dedicated/non-disposable sampling equipment.

5.5 WASTE HANDLING

Instructions: Specify all investigation-derived waste handling procedures including storage methods, storage containers, storage locations, handling procedures, waste manifest and categorization, and disposal options.

5.6 SAMPLE HANDLING

Instructions: For each type of analysis, specify sample containers to be used, sample volume, and the preservation methods. Specify the sample identification (numbering and labeling), sample packaging and shipping, field quality control procedures (ambient blank samples, equipment blanks, field duplicates and field replicates), sample custody procedures including forms, and methods for determining background samples.

5.7 FIELD MEASUREMENTS

Instructions: When field measurements are obtained, the parameters to be obtained should be listed by the technique used (e.g., mobile laboratory, field assay kit, X-ray fluorescence) and describe equipment handling and calibration, quality control measures (replicate samples sent to analytical laboratories), equipment maintenance, adequate field staff training on the instrument to be used, and decontamination procedures.

6.0 RECORD KEEPING

Instructions: Describe how the project will keep adequate field records and provide copies of the forms to be used including chain-of-custody form, field notes and photograph logs, field variances from the SAP recorded, and the field sampling compliance form (stating that the individual field staff understands and knows the latest version of the SAP attested to by signature before field activities commence.

7.0 FIELD HEALTH AND SAFETY PROCEDURES

Instructions: Reference, or attach a copy of, the field health and safety plan prepared by a qualified industrial hygienist.

ANNOTATED OUTLINE FOR GENERIC QUALITY ASSURANCE PROJECT PLAN (QAPP)

TABLE OF CONTENTS

**Include all standard operating procedures (SOPs) referenced in the QAPP.*

1.0 PROJECT MANAGEMENT

Instructions: Identify the purpose of the Quality Assurance Project Plan (QAPP) (e.g., document the results of technical planning process, providing in one document a clear, concise, and complete plan for environmental data acquisition, respective data quality objectives, and related key project personnel). Outline the content of the QAPP (e.g., defines and describes how the environmental data will be used, the project's goals, the decisions that will be made from the information obtained, how the data will be obtained, the possible problems that may occur during data collection, the quantity and quality of data to be collected, how data will be evaluated for suitability for decision making, and how the data will be reported.) Briefly describe the project, its background, location, history of operation, previous environmental work (if any), and associated reports including Sampling and Analysis Plan (SAP), Work Plan, Field Sampling Plan (FSP), etc.

1.1 DISTRIBUTION LIST

Instructions: List the names of key project personnel that will be provided with copies of the current version of the QAPP including: project manager, laboratory manager, field team leader, data processor or statistician, modeler, quality assurance (QA) officer, data reviewers, and prime contractors and subcontractor personnel.

1.2 PROJECT/TASK ORGANIZATION

Instructions: List the individuals and organizations involved with the project identifying roles and responsibilities, including those that will use the data such as the principal data user and decision maker or regulator; and the information producers such as QA managers and field staff. Provide an organizational chart showing the relationships and lines of communication among project personnel.

1.3 PROBLEM DEFINITION

Instructions: State the specific problem to be solved, decision to be made, or outcome to be achieved. More complex projects will require more extensive information in this section.

1.4 PROJECT/TASK DESCRIPTION

Instructions: Summarize the work to be performed and data to be developed. Provide the project schedule and maps, tables, etc. showing geographic locations.

1.5 QUALITY OBJECTIVES AND CRITERIA

Instructions: Define the project data quality objectives (DQOs) and data quality indicators (DQIs). Example DQIs are shown in Table 1. Describe the criteria for measuring data performance and acceptance. These relate the quality of data needed to the established limits on the chance of making a decision error.

Table 1. Data Quality Indicators (DQIs)

DQI	Definition	Methodologies
Precision	A measure of agreement among repeated measurements, can be expressed as a range or standard deviation.	Use the same instrument to make repeated analyses on the same sample. Use split samples.
Bias	Systematic or persistent distortion of measurements.	Use reference materials or analyze spiked samples.
Accuracy	A measure of the overall agreement of a known value.	Analyze reference materials or reanalyze known concentrations.
Representativeness	Qualitatively expresses the accuracy and precision of a parameter.	Evaluate measurements and sample collection methods to appropriately reflect the environment.
Comparability	A qualitative term expressing the confidence of data comparison.	Compare sample collecting and handling methods, holding times, QA, etc.
Completeness	A measure of the amount of valid data needed for a measurement system.	Compare the number of valid data with those established by the DQOs.
Sensitivity	The ability to discriminate between different levels of the variable of interest.	Determine the minimum concentration that can be measured (method detection limit), by an instrument (instrument detection limit), or by a laboratory (quantitation limit).

1.6 SPECIAL TRAINING/CERTIFICATIONS

Instructions: Identify special training/certifications needed by personnel. Provide documentation of this training.

1.7 DOCUMENTATION AND RECORDS

Instructions: Describe how the most current approved QAPP will be distributed to project staff. List records to be included in the data report package, list any other project documents to be produced, and provide disposition of records including location and retention schedule.

2.0 DATA GENERATION AND ACQUISITION

2.1 SAMPLING PROCESS DESIGN

Instructions: Define representative sampling (e.g., selection of a portion of a larger target population, universe, or body, with the characteristics of that sample being inferred as applicable to the target population). Discuss types of sampling strategies (e.g., probability-based, judgmental) and how the strategies affect the conclusions that can be drawn from the data. Provide the current sampling protocol and the basis for sampling design. Include the number of samples, sampling locations, number of samples at each location, the number of composite samples (if any), and the number of QA samples (field replicates, etc.).

2.2 SAMPLING METHODS

Instructions: Describe what constitutes a sample, the required volume, the description of sample/data collection procedures. List the equipment needed; identify performance requirements, and describe corrective actions to be taken if problems arise.

2.3 SAMPLE HANDLING AND CUSTODY

Instructions: Describe the procedures to ensure the integrity of the samples: preservation methods, holding times, chain of custody, field notes to be made, custody seals, and packing procedures. Provide examples of chain of custody forms, custody seals, etc.

2.4 ANALYTICAL METHODS

Instructions: Describe the analytical methods to be used. Identify performance criteria and describe corrective actions to be taken if problems arise.

2.5 QUALITY CONTROL

Instructions: List the QC activities needed for sampling, analytical, or measurement techniques, along with their frequency. Provide control limits for each QC activity and give corrective action measures when they are exceeded. Identify any applicable statistical methods to be used.

2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Instructions: List the equipment and/or systems needing periodic maintenance, testing, or inspection, and provide the schedule. Describe how these procedures will be performed and how they will be documented. Discuss how critical spare parts will be provided and stocked. Describe how re-inspections will be performed and the effectiveness of corrective actions taken.

2.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Instructions: List all project tools, gages, instruments, sampling, and testing equipment to be used in the project. Describe specific calibration methods and frequency. Provide copies of calibration and certification forms and how records will be maintained.

2.7.1 Calibration Record Form
2.7.2 Technician Certification

2.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Instructions: List project supplies and consumables that may directly or indirectly affect the quality of the data. Identify acceptable criteria and identify the staff responsible.

2.9 NON-DIRECT MEASUREMENTS

Instructions: Identify any existing data that will be obtained from non-measurement sources such as literature files and historic databases. Describe acceptance criteria and how the data will be used.

2.10 DATA MANAGEMENT

Instructions: Discuss the project data management process giving record-keeping procedures, data handling equipment, error identification and correction. Provide examples of forms or checklists to be used. Identify computer hardware/software to be used. Include provisions to evaluate the effectiveness of the data management processes.

3.0 ASSESSMENT AND OVERSIGHT

Instructions: Indicate that assessments and evaluations are conducted to determine whether the QAPP is being implemented as approved and to evaluate the effectiveness of project implementation.

3.1 ASSESSMENTS AND RESPONSE ACTIONS

Instructions: Provide a description of the project assessments planned and the information to be collected. Give the schedule for these assessments and work deliverables. Provide for both self- and independent-assessments.

3.2 REPORTS TO MANAGEMENT

Instructions: Indicate how the assessment report will be distributed, who will prepare the report, etc.

4.0 DATA VALIDATION AND USABILITY

Instructions: Indicate that the content of this section addresses the final project checks to determine if the data conforms to the project objectives and to assess the effect of any deviations.

4.1 DATA REVIEW, VERIFICATION, AND VALIDATION

Instructions: State the criteria for accepting, rejecting, or qualifying project data in an objective and consistent manner.

4.2 VERIFICATION AND VALIDATION METHODS

Instructions: Describe how data will be verified and validated. Provide how issues will be resolved and who has authority for resolution. Describe how data results will be released to users. Describe how verification issues differ from validation issues. Provide examples of any forms or checklists used in this process.

4.3 RECONCILIATION WITH USER REQUIREMENTS

Instructions: Indicate how project results will be reconciled with the data requirements and how data user's needs will be met. Analyze and determine possible anomalies or departures from assumptions made when the project was planned.

5.0 REFERENCES

List the references cited in the QAPP.

APPENDIX A3
ANNOTATED OUTLINE FOR
SITE CHARACTERIZATION REPORT

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Page

PREFACE

The annotated outline included in this appendix identifies potential content for a Site Characterization Report. This outline is not intended to be prescriptive and should be adjusted as appropriate for the site-specific conditions.

This outline is for guidance only, and is applicable on a case-by-case basis. Some elements of the outline may apply to your site, while other elements may not. Additional elements than are addressed by this outline may also be needed.

ANNOTATED OUTLINE FOR SITE CHARACTERIZATION REPORT

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TABLE OF CONTENTS (Continued)

EXECUTIVE SUMMARY

Instructions: Provide a concise summary of the site investigation. This should be a text summary (i.e., no tables or figures). Inform the reader of major physical aspects of the site, measures taken to fulfill the objectives of the investigation, and conclusions and recommendations.

This section should include, but not be limited to, very brief descriptions of the following:

- *Purpose of investigation;*
- *Site location, characteristics, background, and current status;*
- *Known and potential releases to media (soil, air, groundwater);*
- *Significant contamination;*
- *Pathways demonstrating potential threats and hazards from contaminants;*
- *Potentially exposed populations or sensitive receptors, and;*
- *Conclusions and recommendations*

1.0 INTRODUCTION

Instructions: Give an overview of the site and background information behind the purpose of the investigation. As applicable, summarize information previously presented in the characterization workplan.

1.1 SITE INVESTIGATION OBJECTIVES

Instructions: Clearly describe the goals and purpose of the investigation. Discuss the area investigated, the media investigated, and specific goals of the investigation (e.g., nature and extent of contamination, background determination, remedy design).

1.2 SITE DESCRIPTION

Instructions: Provide a physical description of the site. Include all pertinent details of the topographic and physiographic setting, the local climate, and local land uses. Describe other features as appropriate.

1.3 SITE BACKGROUND

Instructions: Summarize the site history, any previous investigations, chemicals of concern, and any community issues. Address other topics (under appropriate subsections) as needed to support an updated conceptual site model (CSM) and subsequent sections of the report.

1.3.1 History of Site

Instructions: Provide a complete history of the site. Include as much detail as possible on the pre-development uses of the property, the types of operations that have been conducted on the property, and modifications that have been done (e.g., infill, foundation construction, zoning).

Provide information regarding all current and past business operations, including:

1) *Business Type: Identity and description of the types of businesses which are currently operating or have operated at the site in the past.*
2) *Years of Operation: Operating dates for each business identified.*
3) *Prior Land Use: Identity of the land use prior to development of the site (including placement of fill upon the property).*
4) *Facility Ownership/Operators: Identity of all persons or corporations which owned and/or operated businesses on the site.*
5) *Summary of the property ownership at the site extending back to the date of first business operations. This should reference title documents and tax assessor parcel maps which should be included as appendices, and should also include current street addresses, mailing addresses, and phone numbers for all persons/corporations identified.*
6) *Surrounding Land Use: History and/or general uses of properties in the area surrounding the site should be researched to the extent to which the information is useful to determine the influence on contaminant releases and dispersal.*

1.3.2 Previous Investigations (if applicable)

Instructions: Summarize the results of any previous investigations or soil removal activities at the site. The investigation documents may be referenced, or included as Appendices.

1.3.3 Compounds of Concern

Instructions: Provide a general discussion of the complete list of the compounds of suspected and detected at the site. Identify which media (soil, surface water, sediment, groundwater, soil gas) are impacted, and at what general range of concentrations. If applicable, briefly indicate how natural background metal conditions were determined, with a more complete description of background determination described in a later report section.

1.3.4 Community Issues

Instructions: Discuss any local community issues relevant to the investigation. Include a summary of residential areas adjacent to and near the site, sensitive land uses, and community groups involved in the investigation. Summarize any community meetings and all efforts taken to send mailings, internet announcements, and make documents available for public review.

2.0 SITE GEOLOGY AND HYDROGEOLOGY

Instructions: Summarize the site geology. Include relevant information from published sources (maps, USGS Bulletins, California Geological Survey (CGS) Maps) and observations made in the field. Discuss the geologic setting, stratigraphy, surface water hydrology, and hydrogeology. The level of detail of these descriptions may vary, based on the nature of the impacts to the site. For instance, shallow soil contamination with little impacts to groundwater does not require a detailed description of site hydrogeology.

2.1 GEOLOGIC SETTING
2.2 STRATIGRAPHY
2.3 HYDROGEOLOGY

3.0 SITE INVESTIGATION SUMMARY

Instructions: Summarize the investigation conducted at the site. Reference the approved workplan under which the investigation was conducted, and list the overall objectives of the investigation. Discuss and reference a map showing the actual locations and depths of the samples collected in the field. Discuss any deviations from the approved workplan sample locations and depths. Discuss sampling strategies and analytical methods. Summarize the general quality assurance and quality control measures taken during the investigation (field blanks, duplicates, splits, etc.). Discuss how the data quality objectives (DQOs) for the investigation were met.

3.1 INVESTIGATION OBJECTIVES
3.2 ANALYTICAL METHODS
3.3 FIELD ACTIVITIES
3.3.1 Location of Samples
3.3.2 Sampling Strategies
3.3.2 Quality Assurance/Quality Control

4.0 BACKGROUND METAL CONCENTRATIONS

Instructions: Describe how background metals concentrations were determined for the site. Summarize the approach for identifying of background concentrations (e.g., published or reported values, reference to other studies, and special local considerations that could affect background values). If soil sampling was conducted, demonstrate that the resultant data set is representative of the site soils and conditions (e.g., discuss the lithology of the background samples relative to the lithology of the site samples, show that the concentration ranges of metals in the background data set are reasonable and have not been impacted by site activities or other unforeseen conditions)). Describe the statistical methods used in the background determination. If applicable, include the calculations in this section or as an appendix to the report.

Present the background data set, any statistical interpretations of the data set, and limitations of the data set and statistical interpretations.

4.1 CRITERIA FOR IDENTIFICATION OF BACKGROUND
4.2 LITHOLOGY/ SOIL TYPE
4.3 SITE-SPECIFIC BACKGROUND RANGE

5.0 SOIL INVESTIGATION RESULTS

Instructions: Summarize the general results of the investigation. Reference maps depicting the sample locations, depths, and analytical results. Describe any limitations to the investigation (e.g., areas inaccessible to sample collection, or analytical limitations to data).

5.1 NATURE AND EXTENT OF ELEVATED METALS

Instructions: Summarize the investigation results which have defined the extent of the metals impacts (and any other contaminants of concern). Support the section with appropriate figures that show the lateral and vertical extent of impacted soil. Discuss any hot spots or areas of special concern.

5.1.1 Horizontal Extent
5.1.2 Vertical Extent

5.2 AREAS OF CONCERN

Instructions: Discuss and depict the results of the metals investigation which have allowed of areas of concern (AOCs) to be defined. The area and volume of impacted soil within these AOCs should be calculated and presented, and each AOC should be individually identified. Potential AOCs should also be identified in the report and depicted in appropriate figures.

5.2.1 Criteria for Identification of Areas of Concern
5.2.2 Criteria for Identification of Potential Areas of Concern

5.3 CONCEPTUAL SITE MODEL

Instructions: Provide an updated conceptual site model (CSM) that incorporates data collected during the investigation.

5.4 DATA FOR REMEDY EVALUATION AND DESIGN

Instructions: Present and discuss the results of data collected to support the remedy evaluation and design.

6.0 HUMAN AND ECOLOGICAL RISK EVALUATIONS

Instructions: Extensive risk assessment for human and ecological receptors may or may not be required of the report. In those cases where such evaluations are required, this section of the report should be reserved for their presentation. Several options are provided in the subsections below.

6.1 COMPARISON TO HEALTH BASED SCREENING LEVELS

Instructions: If the results of the investigation are proposed to be compared to health-based screening levels or other screening criteria, this section of the report should provide such a comparison. Include a discussion of the limitations of such comparisons, and the specific purposes for which comparisons are being made.

6.2 HUMAN HEALTH SCREENING EVALUATION

Instructions: A human health screening evaluation, if required, should be presented in this section of the report. The detailed outline of such an evaluation is be beyond the scope of this document, and DTSC's Human and Ecological Risk Division (HERD) can provide more details and reference to appropriate guidance.

6.3 ECOLOGICAL SCREENING EVALUATION

Instructions: An ecological screening evaluation, if required, should be presented in this section of the report. The detailed outline of such an evaluation is be beyond the scope of this document, and HERD can provide more details and reference to appropriate guidance.

7.0 SUMMARY AND CONCLUSIONS

Instructions: Provide a broad summary and conclusions of the results of the investigation. These conclusions should extensively reference the individual sections of the report, rather than repeat analyses and discussions. The section should include a summary of the investigations findings involving:

1) *compounds of concern detected at the site;*
2) *extent (vertical and horizontal) of contamination;*
3) *risks associated with the metals;*
4) *considerations for remedy evaluation and design; and*
5) *recommendations for future actions, such as interim remedial measures, or the selection and implementation of a final remedy.*

8.0 REFERENCES

List all references cited in the report.

APPENDIX B
STRATEGIES FOR ESTABLISHING AND USING BACKGROUND ESTIMATES OF METALS IN SOIL

TABLE OF CONTENTS

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ABBREVIATIONS AND ACRONYMS

bgs	below ground surface
COPC	chemical of potential concern
DF	detection frequency
DQO	data quality objective
DTSC	Department of Toxic Substances Control
EDA	exploratory data analysis
EPA	U.S. Environmental Protection Agency
f_s	fourth spread
IQR	interquartile range
Max	maximum concentration in data set
Min	minimum concentration in data set
n	sample size
Q1	first quartile
Q3	third quartile
St. Dev.	standard deviation

PREFACE

This appendix provides a suggested strategy for establishing and applying background concentrations of metals in soil, if determined to be necessary to support characterization and cleanup activities at a site. The strategy is presented as a progression of steps beginning with considerations for establishing background concentrations, use of the background concentrations to identify constituents of potential concern (COPCs), and use of the background concentrations to establish appropriate cleanup goals.

Because it is not possible to provide a single approach that would apply to all sites, this appendix does not prescribe or mandate a particular methodology. The project team should develop and apply background concentrations using an approach that is appropriate for the conditions and objectives at a given site.

This appendix is for guidance only, and is applicable on a case-by-case basis.

1.0 INTRODUCTION

The amount of metals present in soils at a site may represent contributions from several sources, including metals present under pristine conditions (natural conditions without any impacts from humans), metals contributed by releases from site activities, and metals attributable of other off-site sources (e.g., lead historically emitted from car exhaust). Metals concentrations that represent only pristine or natural conditions often are referred to as “background” concentrations. Metals concentrations that represent a combination of natural levels and non-specific off-site sources are referred to as “ambient concentrations.” More detailed discussions of the terms “background” and “ambient” can be found in EPA (1989, 1995, 2002a). For the purposes of this appendix, the general term “background” will be used to refer to soil that has not been affected by site-related releases.

An assessment of background concentrations of metals in soil may be needed during the site cleanup process to:

- assist with characterizing the nature and extent of metals contamination that was caused by site activities,
- evaluate whether a metal should be identified as a chemical of potential concern (COPC) for the risk assessment, and
- assist with establishing an appropriate cleanup goal for the metal.

2.0 RATIONALE FOR SITE-SPECIFIC BACKGROUND ESTIMATES

The ultimate objective of developing background estimates is to enable an “apples to apples” comparison that eliminates unnecessary variability in the comparison between metals concentrations in potentially-impacted site soils and unimpacted soils. With this in mind, the ideal approach for establishing site-specific background concentrations is to identify unimpacted areas:

- that are located as close as possible to the potentially impacted areas, and
- with soil characteristics similar to soils that potentially have been impacted by site activities. (See Section 3.0 for further discussion.)

The role of proximity in the background determination is based on the concept that soils located closer to the site will be more representative of site conditions than soils located further away. The range of metals concentrations measured in these nearby soils will more closely reflect the range of metals concentrations in site soils prior to site activities. Soils located further away may have been influenced by different natural processes or other anthropogenic activities than have occurred at the site.

Several common constraints may necessitate deviation from the ideal approach to site-specific background estimates. At some sites, it may not be possible to find a nearby area that has not been affected by site activities. Extensive fill placement (e.g., such as in coastal areas) may require an alternate approach.

Options to consider when it is not possible to use the ideal approach for a site-specific background determination include:

- Using background estimates that have been developed for a nearby site;
- Using regional estimates for background concentrations;
- Pooling site data and using statistical techniques to identify a range of background concentrations;
- For sites (and their surrounding areas) that are thought only to have potential impacts to surface soil (e.g., former agricultural sites), using soil data collected at depth (e.g., 5 feet bgs); and/or
- Using geochemical methods to identify a range of background concentrations.[1]

Each of these options requires careful assessment as to whether the background estimates are appropriate for use at the subject site. A decision to use background estimates from nearby sites or from regional studies should be made after a thorough review of the data set (e.g., data quality, soil types) and statistical protocols used to derive these estimates. Use of regional estimates is arguably the least preferred option because it has the greatest potential to be least representative of site conditions (e.g., range of metals concentrations, unaccounted for variables). Experience has shown that the approach of using pooled site data requires a meticulous review of the data set to

[1] Discussion of geochemical methods for identifying a range of background concentrations is beyond the scope of this appendix. NAVFAC (2002) provides further discussion of the use of geochemical methods in background screening.

identify (1) data with elevated detection limits, (2) disparities in data quality, (3) variability introduced by differences in represented soil types, (4) sample results that do not represent soil (e.g., concrete rubble), and (5) data reflecting obvious site impacts. Hence, the use of pooled data sets is not a simple undertaking and requires careful evaluation.

Whether using the ideal approach or one of the alternative options to establish a site-specific background value, professional judgment must be used to ensure that the background estimates are reasonably conservative to define the nature and extent of contamination, identify metal COPCs, and derive background-based cleanup goals. At the same time, professional judgment is needed to ensure that the background estimates are not set too high or too low. Studies that have compiled typical ranges of metals concentrations in regional soil types can be a useful check that the site-specific background estimates are realistic.

3.0 ESTIMATING BACKGROUND CONCENTRATIONS

Estimating background concentrations is a multi-step process that begins with careful definition of the target population. The next step is developing and screening the background data set. Finally, statistical techniques are used to characterize the background population.

3.1 DEFINING THE TARGET POPULATION

In the most general terms, the target population for the background determination is soil with characteristics similar to those occurring on the cleanup site. Characteristics to consider when matching soils from unimpacted areas to site soils include:

- Soil type
  - Lithology (e.g., sand, silt, clay)
  - Soil series
  - Soil horizons (e.g., zones where metals are accumulating/leaching, zones with differences in clay content)
  - Mineralogy
  - Geochemical conditions
  - Vegetation types,
- Topography and landform (e.g., marshy areas versus upland areas),
- Conceptual site model for fate and transport pathways of site contaminants,
- Location and source of fill materials, and
- Similar historical use (prior to site activities subject to cleanup effort).

Depending on the variability in site conditions, one or more target populations may be identified, each requiring its own background estimates. For example, a site consisting of upland and marshy areas likely will require at least two target background populations, one for upland soil and one marshy soil. In contrast, if the site consists of sandy, undisturbed soils, the background estimates may be based on a single target background population of sandy, undisturbed soils from nearby unimpacted areas.

3.2 DEVELOPING AN APPROPRIATE BACKGROUND DATA SET

The background data set may consist of existing data collected in previous investigations, new data collected to address the data quality objectives (DQOs) for the background determination, and/or a combination of the new and existing data. All data used to support the background estimates must represent the target population.

The background estimates should be based on a data set generated using probability-based sampling designs (e.g., systematic sampling, random sampling). The number of samples in the data set should be sufficient to support the statistical comparisons (EPA, 2002b) and the desired statistical power. In general, larger sample sizes will provide a better estimate of the background population characteristics and will provide greater power for the statistical tests.

Data considered for inclusion in the background data set should be posted on a map to allow for identification of any clustered high or low concentrations. Clustered or spatially-related concentrations may suggest that data are not appropriate (e.g., potential contamination) or that the data are not from the same background population (e.g., different soil types).

3.2.1 Using Existing Background Data

Previous site investigations may have generated background data for the site. The data set development process should include a review of the existing data to ensure that it is appropriate or adequate to support the background estimate. This review should address whether (EPA, 2002a):

- The data represent the appropriate target population(s). (Note: This assessment may require review of the boring logs for each sample to ensure that the sample results represent the target population.)
- There are a sufficient number of samples to support the intended statistical comparisons with the desired level of statistical power.
- The sampling design (e.g., random versus judgmental) and spatial distribution (e.g., no correlated or clustered samples) will support the assumptions of the statistical tests.
- The conceptual site model of contaminant distribution has remained unchanged since the background sampling (i.e., the background samples were not collected from an area that is now considered to be impacted).
- The data are of known and acceptable quality.

3.2.2 Generating New Background Data

Generating new background data should follow the DQO process and should have a sampling design that will support the intended statistical analyses. Suggested resources for the DQO process and sampling design include:

- *Guidance for Data Quality Assessment* (EPA, 2006ab),
- *Guidance for Choosing a Sampling Design for Environmental Data Collection* (EPA, 2002b).
- *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (EPA, 2002a), and
- *Visual Sampling Plan* (PNNL, 2007).

Sampling and analysis activities should be conducted under an approved sampling and analysis plan and quality assurance project plan. An annotated outline that could be used for a workplan to evaluate background concentrations of metals is provided in Appendix A2.

3.2.3 Pooling Background Data Sets

The data set used for the background estimates may include data generated by various investigation phases. In this instance, the data sources should be compared to ensure that:

- the data were collected using similar sampling and analytical methods (EPA, 1992),

- the data are of comparable quality,

- the data have similar detection limits (this is particularly applicable when the pooled data set contains a significant number of censored values (also known as “non-detects”)),

- one data set does not consistently show a higher or lower bias relative to the other data (For example, data generated using one analytical method may be biased higher than data generated using another analytical method.),

- one portion of the reference area is not overrepresented,

- the data sets have similar concentration ranges, measures of central tendency, and variability, and

- the combined data set fulfills the DQOs for the background estimates (e.g., probability-based sampling strategy, samples distributed throughout the selected reference area).

Graphical and statistical methods should be used to ensure that it is appropriate to pool the data sets. Graphical methods such as histograms, boxplots, and probability plots (see Section 3.3.2) can be used to assess similarity between data sets. Statistical tests can be used to test differences between measures of central tendency and variability of the data sets (see Section 5; see Gilbert, 1987; EPA, 2006b; Helsel and Hirsch, 2002).

3.3 EXPLORATORY DATA ANALYSIS

Exploratory data analysis (EDA) is an iterative process that uses several tools to evaluate data characteristics, make appropriate adjustments to the data set (e.g., adjust for censored values), and refine the data set (e.g., remove outliers). Prior to beginning EDA, all data should have been reviewed to ensure that it represents the target population (Section 3.1) and that it is appropriate to include the data in the analysis (Section 3.2).

3.3.1 Descriptive Statistics

Descriptive statistics can be used as the starting point for EDA to provide an initial assessment of the data set characteristics as well as to evaluate the effects of any data set adjustments. These statistics include the number of samples, the detection frequency[2], the maximum and minimum concentrations (range of the data), calculated measures of central tendency (mean, median), and calculated measures of dispersion (standard deviation, variance). The statistics may also include measures of relative standing (e.g., concentration corresponding to a certain percentile of the sample). Definitions for these parameters can be found in general statistical texts, EPA (2006b) and Helsel and Hirsch (2002).

Descriptive statistics are updated during EDA, particularly after adjusting for censored values or removing outlier values.

3.3.2 Graphical Representations

Graphical representations can be used as a starting point for EDA to obtain an initial assessment of the data set characteristics as well as to evaluate the effects of any data set adjustments. Various graphical methods are used to represent the background data set during EDA. Three particularly useful graphical methods are highlighted below and illustrated in Figure B-1. It is beyond the scope of this appendix to provide detailed discussions of possible graphical methods that may be useful during EDA. However, general statistical texts typically discuss the various graph styles. EPA (2006b) and Helsel and Hirsch (2002) also provide useful discussions of graphical methods.

Histogram

As shown on Figure B-1, histograms divide the concentration range into bins and count the number of samples that fall into each bin. Histograms are useful for assessing whether the data are symmetric around the mean or median, or whether the data are

[2] Ratio of the number of detected values and the total number of values in the data set. The detection frequency can be expressed as the percentage of detected values by multiplying the ratio by a factor of 100.

skewed toward higher or lower concentrations. The distance between the mean and median provides an indication of the skewness in the data. Histograms may also be useful in recognizing whether multiple populations are present in the data set.

Box-and-Whisker Plot

Box-and-whisker plots are useful tools for summarizing and visualizing the range, mean, median, and skewness of the background data set (Figure B-1). The plots are constructed by ranking the data set from lowest to highest concentrations and presenting the data in four segments (quartiles), each representing 25 percent of the data set. The first quartile represents the lowest 25 percent of the concentrations and is represented by the lower tail. The fourth quartile represents the highest 25 percent of the concentrations and is shown as the upper tail. The data between the first and third quartiles (Q1 and Q3) is represented as the box that is bisected by the median value (midpoint of the ranked data). Outlier values typically are shown as individual data points located outside of the box-and-whisker diagram (asterisks on Figure B-1).

Probability Plot

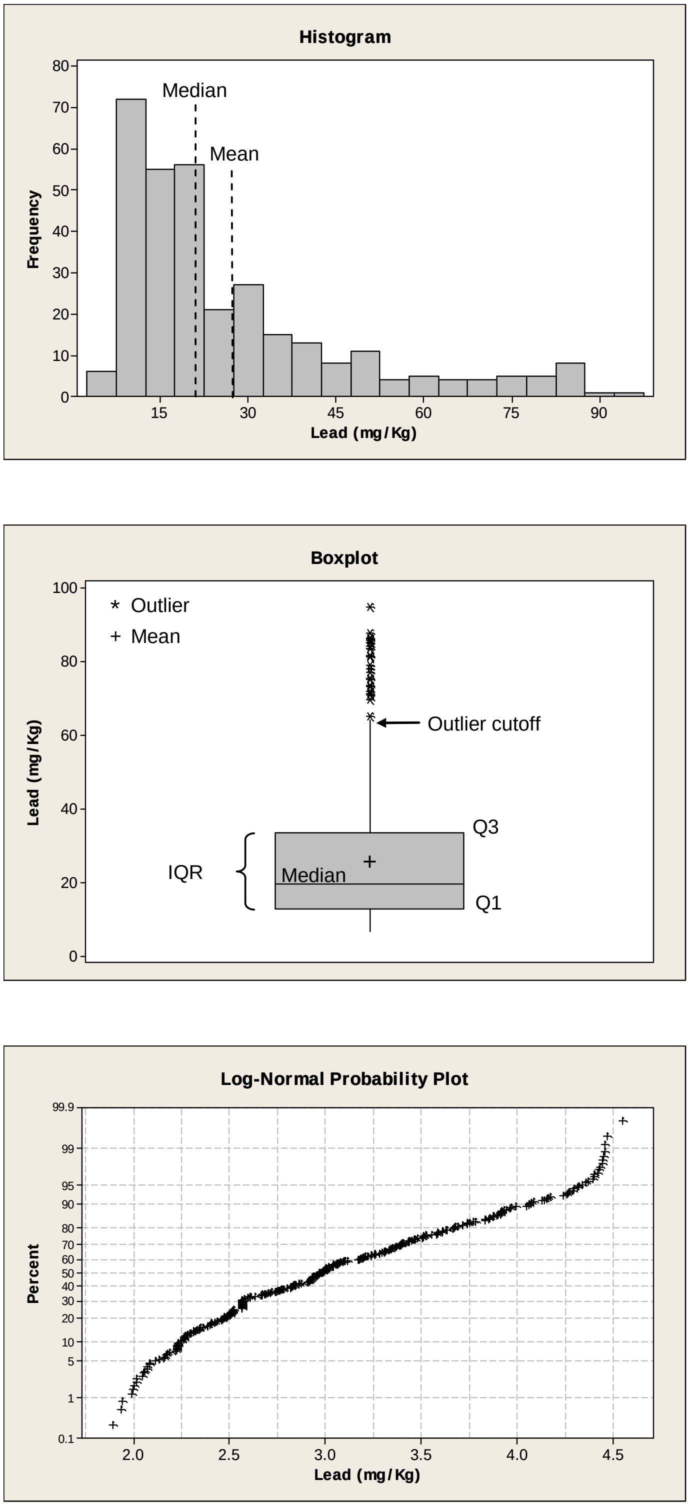
Probability plots are useful for evaluating how well the data set distribution is modeled by an assumed distribution. Common types include a normal probability plot which compares the data to a normal distribution and a log-normal probability plot which compares the data to a log-normal distribution. Departures from linearity provide information about how the data distribution deviates from the assumed distribution. EPA (2006b) and Helsel and Hirsch (2002) provide detailed descriptions of how to construct a probability plot.

3.3.3 Tests of the Data Set Distribution

An understanding of the distribution underlying a data set is needed to ensure selection of appropriate statistical tests[3], such as for flagging outliers or for comparing background and site data sets. Multiple lines of evidence should be used to determine the data set distribution. Evaluation of the data set distribution should use a combination of graphical techniques (i.e., histograms, probability plots) and quantitative methods (see Table 1). Details regarding the distributional tests can be found in EPA (2006b) and Gilbert (1987).

Distributional tests should be repeated after removing outliers and adjusting for censored values. If the revised tests indicate changes in the data set distribution or if the data set distribution is unclear, one option is to use both parametric and non-parametric techniques to conduct the statistical comparisons. The most conservative approach could be selected if there are any differences in the outcome of the statistical tests that would affect the cleanup decisions at the site

[3] Parametric statistical methods should be used if a data set has a normal or log-normal distribution. Non-parametric statistical methods can be used if a data set has neither a normal or log-normal distribution.



Descriptive Statistics	
n	321
DF	100%
Min	6.63
Max	94.7
Mean	27.0
Median	19.6
St. Dev.	20.1
Q1	13.0
Q3	33.4
IQR	20.4
Q3+1.5IQR	64.0

Figure B-1. Example Graphical Representations.

Table 1. Selected Quantitative Tests for Normality.

TEST	SAMPLE SIZE	RECOMMENDED USE
None recommended	≤ 8	Not applicable.
Tests Recommended by EPA (2006b)		
Shapiro Wilk *W* Test	≤ 5000	Highly recommended by EPA (2006b).
Filliben's Statistic	≤ 100	Highly recommended by EPA (2006b), especially in conjunction with a normal probability plot.
Skewness and Kurtosis Tests	> 50	Useful for large sample sizes (EPA, 2006b).
Geary's Test	> 50	Useful when tables for other tests are not available (EPA, 2006b).
Studentized Range Test	≤ 1000	Highly recommended, except for asymmetric data with large tails (EPA, 2006b)
Chi-Square Test	Large	Useful for grouped data and when the comparison distribution is known (EPA, 2006b)
Lilliefors Kolmogorov-Smirnoff Test	> 50	Useful when tables for other tests are not available (EPA, 2006b).
Other Tests		
Coefficient of Variation Test	Any	Only use to quickly discard an assumption of normality
D'Agostino Test	50 < n <1000	Data sets with 100% detection frequency (NAVFAC, 2002).

Note: Table not intended to be inclusive for all possible tests for normality.

3.3.4 Outlier Identification and Removal

Outliers are measurements that are extremely large or small relative to the rest of the data and are thought to misrepresent the population from which they are intended to be collected (EPA, 2006b). These values may be a result of errors associated with the sample collection, laboratory analysis, transcription, or data entry. The values could also be a true reflection of the population being sampled (e.g., heterogeneous geologic conditions, evidence of contamination).

A conservative approach should be taken to identify outliers in the background data set because inclusion of these values may bias the population estimates derived from the data set. For example, mean values are particularly sensitive to outliers. Also, the maximum value in the background data set may be set too high and thus affect the COPC identification process. The background data set should be screened for outliers using multiple approaches (described below and summarized in Table 2), evaluating the reason for any extreme values, and using professional judgment to remove data points that are interpreted as outliers.

Table 2. Selected Outlier Screening Methods.

APPROACH	METHOD	ASSUMES NORMAL DISTRIBUTION?	SAMPLE SIZE	ABLE TO ADDRESS MULTIPLE OUTLIERS?
Graphical Identification of Unusual Data Points				
1	Graphs of Data	No	$n \geq 6$	Yes
Quantitative Tests Recommended by EPA (2006b)				
2	Extreme Value Test	Yes	$n \leq 25$	Only if apply test to least extreme value first (EPA, 2006b).
	Discordance Test	Yes	$3 < n \leq 50$	No
	Rosner's Test	Yes	$n \geq 25$	Yes, up to 10 outliers (EPA, 2006b)
	Walsh's Test	No	$n \geq 50$	Yes
Outlier Cutoff Value				
3	Quartile-Based Outlier Cutoff	No	$n \geq 6$	Yes

Note: Table not intended to be inclusive for all possible outlier screening methods.

The simplest approach consists of evaluating graphs of the data (e.g., box plots, scatter plots) for unusual data points. Another approach is to use an appropriate quantitative statistical method to screen for outliers. Detailed descriptions of outlier screening methods are provided in EPA (2006b) and Gilbert (1987). A third approach for identifying outliers is based on the values used to construct a box-and-whisker plot of the data set (see Section 3.3.2). The approach ranks the data, and determines the largest measurement corresponding to the first quartile (Q1) and third quartile (Q3). The outliers are then identified as values that fall above or below the following:

Lower Outlier Cutoff: Q1 - 1.5 (Q3-Q1)[4]
Upper Outlier Cutoff: Q3 + 1.5 (Q3-Q1)

This approach is an iterative process in which Q1, Q3, and the cutoffs are recalculated each time outliers are removed from the data set. The process continues until no data points fall outside of the outlier cutoffs. Without additional data collection, this approach may be the only option available for data sets with small sample sizes. This approach may also be useful for identifying outliers in data sets with neither normal nor log-normal distribution.

3.3.5 Treatment of Censored Data

Some measurements in the data set may be reported as less than a reporting limit (i.e., the concentration falls between “0” and the reporting limit). These censored values

[4] The difference between Q3 and Q1 is referred to as the interquartile range (IQR) or fourth spread (f_s).

(also known as non-detects) are still part of the background data set, but will need to be addressed before performing some quantitative analyses. The number of censored values in a data set is often discussed in terms of the detection frequency[5], which is simply the ratio of the number of detected values and the total number of values in the data set. Some statistical procedures require a certain detection frequency.

The approach used to deal with censored values should be selected based on the data set characteristics and the intended use of the data. EPA (2006b) and Helsel and Hirsch (2002) provide some general guidelines for addressing censored data. These guidelines are summarized in Table 3. Discussions regarding these methods can be found in EPA (2006b) and NAVFAC (2002).

Table 3. General Guidelines for Addressing Censored Data.

PERCENTAGE OF CENSORED VALUES	STRATEGY	COMMENT
< 15%	Aitchison's Method or Cohen's Method	Cohen's method can be used if n ≥ 20 (EPA, 2006b).
< 15%	Replace censored values with the RL, one-half the RL, or replace with a very small number.[1]	• For some sample sizes, replacement of censored values may affect estimate of parameter variability. • Check to make sure that replacement value does not overly-influence the calculated population parameters.
15 to 50%	Replace censored values with the RL, one-half the RL, or a very small number. [1]	• Consider using non-parametric methods or test of proportions to analyze data. Alternatively, consider using Cohen's or Aitchison's Method. • Check to make sure that replacement value does not overly-influence the calculated population parameters.
15 to 50%	Aitchison's Method or Cohen's Method	See EPA (2006b) for distributional assumptions and for recommended criteria for selecting which method to use.
15 to 50%	Trimmed mean	Discards tails of data for unbiased estimated of the population mean.
15 to 50%	Winsorized mean and standard deviation	Replaces data in tails of data set with next most extreme data value.
>50 to 90%	Tests for proportions.	For data sets having this range of detection frequency, descriptive statistics do not provide much insight into the underlying distribution of measurements.
>90%	None	Consult with a statistician.

Notes: RL is reporting limit.
1 The *ProUCL User Guide* (EPA, 2007) notes that substitution methods may not perform well even for detection frequencies as low as 5 to 10 percent. Further, the *ProUCL User Guide* suggests avoidance of substitution methods for some estimation and hypothesis testing approaches.

3.4 DOCUMENTING BACKGROUND ESTIMATES

At a minimum, documentation of the process used to develop the background estimates should include:

[5] Detection frequency can be expressed as either a ratio or as a percentage (ratio multiplied by 100).

- Description of site history and setting,
- Summary of major soil types at the site,
- Description of background data set (e.g., sample numbers, map of locations, data posted on maps, reports that present the results of data included in the data set),
- Demonstration that background data set is adequate,
- Description of steps used to evaluate the data set and rationale for any data set adjustments,
- Descriptive statistics for background population before and after any adjustments to the data set, and
- Appropriate figures, graphics, and tables.

4.0 IDENTIFYING METALS AS CHEMICALS OF POTENTIAL CONCERN

As discussed in Chapter 5, the background data set is used to screen on-site data to determine which metals should be identified as COPCs. If multiple soil types are present, this comparison should compare background and on-site data from the same soil types. The steps that should be followed for this comparison are:

Step 1 For each metal, compare the highest site concentration with the highest background concentration. If the site concentration is equal to or less than the highest background concentration, the metal may be eliminated as a COPC. If the onsite maximum concentration is greater than the background maximum concentration and the detection frequency is greater than 50 percent, go to Step 2. If the detection frequency is less than 50 percent and the onsite maximum is greater than the background maximum, retain the metal as a COPC.

Step 2 For each metal, 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 metal is not eliminated by this screening, go to Step 3.

Step 3 Statistically compare the site and background concentrations. Select the statistical approach depending on the sample size.

Option 1. If the data set is of sufficient size, statistically evaluate the overlap of the background and on-site distributions to determine if the data sets come from the same population and have the same distribution. If so, 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. Table 4 summarizes some options for making this statistical comparison. The statistical comparison method should be selected based on site-specific considerations, desired statistical power, and the data set characteristics.

Option 2. If the background data set is limited (i.e., small sample size), the site data can be evaluated using probability plots to determine if one or more populations are present. If only one population is present, and if the highest on-site concentration is below the concentration associated with unacceptable risk or hazard, the metal may be eliminated as a COPC. If two or more populations are present, include the metal as a COPC.

Note that this option should be applied cautiously because using probability plots to screen for multiple populations is subjective and requires professional judgment. Cook (1998) states that use of probability plots for this purpose requires careful consideration of the "actual site conditions, sample descriptions, spatial distribution, and the degree to which different soil types, sample types, or qualified data affect the appearance of the plot." If using this option, it is important to keep the following points in mind:

A. Inflection points on probability plots do not always indicate multiple populations or a break in population. Instead, an inflection point may only indicate that the data distribution assumed for construction of the probability plot is incorrect. Inflection points in the probability plot should be carefully evaluated to determine if the point is a true separation of statistical populations (e.g., can the point be explained by site operation history, geological features, and analytical problems) (Cook, 1998).

B. A lack of an inflection point does not necessarily indicate one population. Populations may overlap such that they are indistinguishable on a probability plot. Given that each population will have its own characteristics, supplemental EDA is needed to assist in defining discrete populations (Cook, 1998).

C. If a wide range of concentrations are present on-site, including the higher concentrations in the probability plot may hinder the ability to discern the break between populations characterized by lower concentrations. In this instance, excluding data with known impacts may facilitate recognition of multiple populations.

Additional information on eliminating metals as COPCs is provided in *Selecting Inorganic Constituents are Chemicals of Potential Concern at Risk Assessments at Hazardous Waste Sites and Permitted Facilities – Final Policy* (DTSC, 1997).

Table 4. Common Data Set Comparison Methods.

TEST	TESTS FOR DIFFERENCES IN	REQUIREMENTS	COMMENT
Wilcoxon Rank Sum Test (WRS Test)	Medians of the site and background populations.	• Only one reporting limit for censored values and all detected values greater than reporting limit. • Data sets comprised of independent, random samples. • Underlying populations have same shape and dispersion. • Detection frequency ≥60%.	• Recommended by DTSC (1997). • May produce misleading results if many tied values (EPA, 2006b).
Two-Sample t-Test (Equal Variances)	Means of the site and background populations.	• Both data sets have a normal distribution, or n>30 for both data sets (EPA, 2006b). • Both data sets have equal variances. • Treatment of censored values has no significant impact on computed mean. • Independent populations.	• Outliers may affect test results. • Not well suited to data sets with censored values. Generally use with data sets having detection frequency ≥85%.
Satterthwaite Two-Sample t-Test (Unequal Variances)	Means of site and background populations.	• Both data sets have a normal distribution, or n>30 for both data sets (EPA, 2006b). • Detection frequency of 100%. • Site and background data sets do not have equal variances. • Independent populations.	• Outliers may affect test results.
Gehan Test	Medians of the site and background populations.	• Censoring mechanism for censored values is the same for both populations.	
Slippage Test	Largest values of the site and background populations.	• At least one detected background value is present and is larger than the largest censored value. • Independent, random sampling design.	• May require large sample size for adequate power. • High outliers may bias test results. • Use in combination with t-test or WRS test (EPA, 2006b).
Quantile Test	Largest values of the site and background populations.	• Independent, random or systematic sampling design for both data sets. • Both data sets have similar variances.	
Two-Sample Test of Proportions	Proportions of the site and background populations above a given cutoff level.	• Detection frequency ≥50%. • Random sampling design for both data sets. • Approximate normal distribution.	• Verify that normal approximation may be used (EPA, 2006b).

Note: This table summarizes information presented in EPA (2006b) and NAVFAC (2002). Additional details regarding these data set comparison methods can be found in EPA (2006b), NAVFAC (2002), and Helsel and Hirsch (2002).

5.0 DEVELOPING BACKGROUND-BASED CLEANUP GOALS FOR METALS

As discussed in Chapter 5, it is anticipated that cleanup goals for certain metals (e.g., arsenic) may need to be developed using background values because the risk-based cleanup goal would be below the concentration that occurs in nature. In general, two options are available for developing background-based cleanup goals for metals (DTSC, 2007).

Option 1. Use an upper limit of the background data set (e.g., 95^{th} percentile concentration, maximum concentration) as the cleanup goal.

Option 2. Select a cleanup goal based on a graphical and statistical evaluation of the background and site data sets.

- The graphical evaluation consists of using probability plots of the combined site and background data sets to interpret an inflection point as an approximation of the cleanup goal. When making this approximation, please refer to the caveats for interpreting inflection points on probability plots that are discussed on page B-15.
- The statistical evaluation consists of calculating the upper 95 percent Limit for the 0.99 Quartile ($UL_{0.95}(X_{0.99})$) as described by Gilbert (1987).

The DTSC document entitled, *Arsenic Strategies, Determination of Arsenic Remediation, Development of Arsenic Cleanup Goals for Proposed and Existing Schools Sites* (DTSC, 2007), provides examples of how to derive a cleanup goal using these two options. Please note that these examples may not be applicable to, or feasible for, all sites. The document is included as Attachment A of this appendix.

6.0 REFERENCES

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ATTACHMENT A

Arsenic Strategies, Determination of Arsenic Remediation, Development of Arsenic Cleanup Goals for Proposed and Existing School Sites (DTSC, 2007)

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Arsenic Strategies
Determination of Arsenic Remediation
Development of Arsenic Cleanup Goals
For Proposed and Existing School Sites

March 21, 2007

The Department of Toxic Substances Control (DTSC) oversees the environmental assessments of proposed and existing school sites. During the Preliminary Environmental Assessment (PEA) or Remedial Investigation (RI) for school sites, arsenic may be identified as a chemical of concern based on comparisons to naturally occurring background concentrations. Once arsenic has been identified as a chemical of concern, a standard approach is needed to determine if remedial action is warranted and, if so, how to develop appropriate cleanup goals. The following is the suggested approach from the DTSC Human and Ecological Risk Division (HERD) for arsenic remediation on school sites.

Determination of Necessity for Remedial Action

Once arsenic concentrations have been identified to be above background levels, additional characterization may be required to determine the lateral and vertical extent of contamination. This information should be used in the decision making process for the necessity of a removal action. For the areas with elevated arsenic concentrations, if the data from the step out samples indicate that they are isolated areas (i.e., no real extent of contamination), no remedial action may be an option. For areas with high levels of arsenic concentrations, this approach may not be applicable. The complete data set for arsenic should be considered in the determination, including background, onsite ambient levels, and potential contamination.

Development of Cleanup Goals

The following are two options for developing a cleanup goal for arsenic.

Option 1

The upper limit of the background data set can be selected as the cleanup goal.

Option 2

Cleanup goals may be developed using the site specific data set for the school project. This data set may include both the data from the school site as well as background values from the immediate area. The approach uses both visual evaluation of the data plots (graphical evaluation) and statistical calculations (statistical evaluation).

Graphical Evaluation

Step 1: Create normality plots. The plot should be completed using both log transformed and non-transformed data.

Step 2: For limited data sets, visually determine the inflection point in the distribution. This inflection point can in some cases be used as the approximation for a cleanup goal.

Statistical Evaluation

Step 1: After entering the data into an Excel spreadsheet, calculate summary statistics for the data set (e.g., mean, standard deviation, first quartile and third quartile). If the data set is sufficiently large, evaluate outliers in the data set. Suggested techniques include the ***fourth spread***, or other comparable techniques. Remove outliers from data set and estimate the Upper 95% Limit for the 0.99 Quartile $UL_{0.95}(X_{0.99})$ as described by Gilbert (1987).

Step 2: Recalculate summary statistics, including 95% Upper Confidence Limit (UCL) using modified data set.

Step 3 (optional): Comparisons of arsenic concentrations corresponding to the approximated inflection point with the summary statistics from data set excluding outliers.

Discussion of Uncertainties

- The incremental cancer risk difference between background levels and proposed cleanup goals will be very small or insignificant in most cases.

- Soil cleanup goals do not take into consideration potentially limited bioavailability of arsenic in soil. Most toxicology studies were based on arsenic in water, which is considerably more bioavailable.

Examples of Derivation of Arsenic Cleanup Goals

Example 1: Simple, Graphical Determination of the Arsenic Clean-up Goal for a School Site

The following example utilizes an actual data set from a school site in southern California. This example represents a rather large data set with 651 sample values. Table 1 summarizes the data set statistics.

Table 1
Arsenic Data Set Summary Statistics

DESCRIPTIVE STATISTIC	VALUE
Number of Samples	651
Minimum Concentration	0.27
Maximum Concentration	33
Mean Concentration	6.9
Median Concentration	6.7
Standard Deviation	4.02

Figure 1 presents the normality plot of the raw arsenic data. As can be seen from the plot, the data appears to be normally distributed and linear in the range from 1.0 up to about 12 mg/kg, where a distinct change in slope can be seen. This linear portion of the curve would be representative of ambient arsenic in this typical, urban environment. The inflection point where the slope changes is indicative of a population different from ambient arsenic, i.e., site contamination. For this example, 12 mg/kg would represent the upper-bound of ambient arsenic in soil at this site and would serve as the clean-up goal for arsenic.

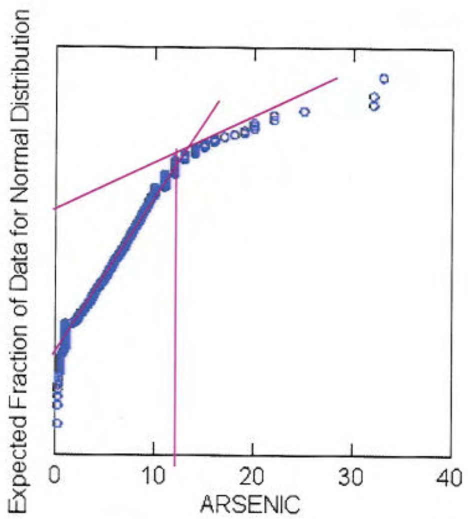

Figure 1
Normality Plot of the Arsenic Data Set

Example 2: Statistical Determination of the Arsenic Clean-up Goal for a School Site

The following example utilizes a combined data set made up of 19 individual school sites in southern California in order to exemplify the statistical determination of an arsenic clean-up goal. Figure 2 presents a plot of the frequency verses arsenic concentration, also known as a histogram. The shape of the histogram clearly demonstrates a classical, lognormal distribution. The descriptive statistics for the "Log-Transformed" combined arsenic data set of 1097 samples are summarized in Table 2.

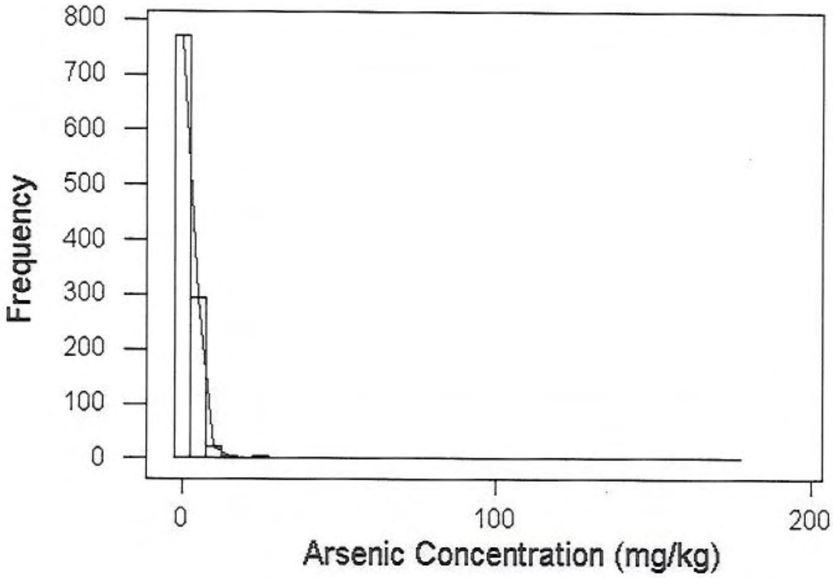

Figure 2
Histogram of the Arsenic Data

Table 2
Descriptive Statistics of the Combined Arsenic Data Set

DESCRIPTIVE STATISTIC	VALUE
Sample Size (n)	1097
Mean (μ)	0.1873 (1.54 mg/kg)
Median	0.1761 (1.50 mg/kg)
Standard Deviation	0.3916
Standard Error of the Mean[1]	0.0118
Minimum Concentration	-1.7620 (0.02 mg/kg)
Maximum Concentration	2.2480 (177 mg/kg)
Lower Quartile (Q_1)	-0.1249
Upper Quartile (Q_3)	0.4502

[1] The *Standard Error of the Mean* = $\frac{Std.Dev.}{\sqrt{n}}$

Because of the large sample size, wide range of arsenic concentrations and obvious extremes of the distribution, the data were analyzed for values that do not conform to the pattern established by the majority of values in the data set, e.g., ***outliers***. To determine the outliers in the arsenic data set, a pictorial summary called the box plot was utilized. A box plot describes the most prominent features of a data set, including 1) center, 2) spread, 3) extent and nature of any departure from symmetry and 4) identification of any outliers or observations that lie unusually far from the main body of data. A box plot is based on measures that are unaffected by the presence of a few outliers, also known as the ***fourth spread***, f_s. The fourth spread, f_s, is defined as the measure of spread in a data set that is resistant to outliers and is calculated according to the following equation.

$$f_s = Q_3 - Q_1 \qquad \textbf{(Equation 1)}$$

$$= (0.4502 - (-0.1249))$$

$$= 0.5751$$

By definition, any observation farther than $1.5f_s$ from the closest fourth is considered an outlier. For the combined arsenic data set, $1.5f_s$ is equal to 0.8627 and any observation below $Q_1 - 1.5f_s$ or above $Q_3 + 1.5f_s$ would be considered an outlier. For the combined arsenic data set, outliers were defined as all observations:

$< Q1 - 1.5f_s$	and	$> Q3 + 1.5f_s$
$< (-0.1249 - 0.8627)$	and	$> (0.4502 + 0.8627)$
< -0.9876 (0.103 mg/kg)	and	> 1.3129 (20.55 mg/kg)

Therefore, the following arsenic concentrations were determined to be outliers: 177, 61.4, 49.2, 31.0, 27.6, 26.5, 24.0, 23.3, 22.7, 0.067 and 0.0173 mg/kg. These results are consistent with the box plot of the combined arsenic data set (Figure 3), which indicates that the nine largest and two lowest values are outliers.

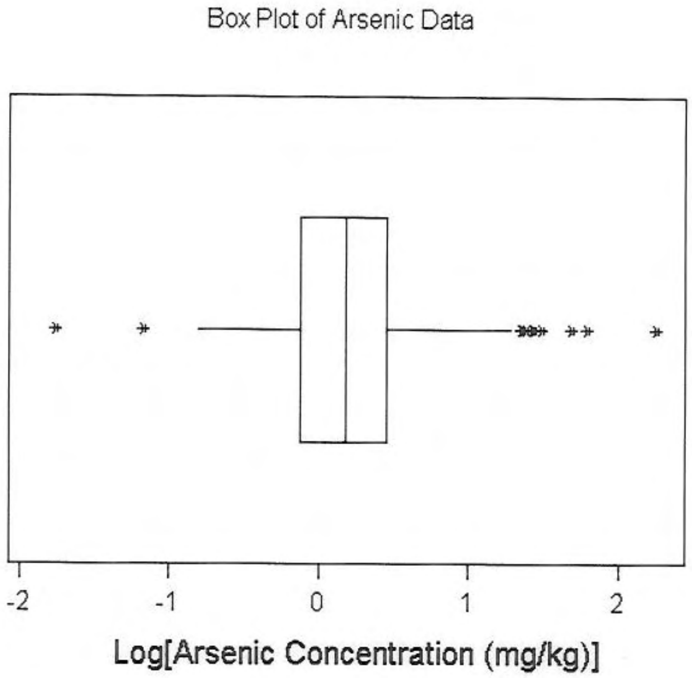

Figure 3

The large number of data points well characterizes the extremes of the distribution, thereby making it possible to use an estimate of an upper percentile of background concentrations as the value to be compared with the onsite C_{max}.

For this analysis, the 95% Upper Confidence Limit on the 99th-Percentile was chosen as the upper limit concentration. An upper 100(1 - α)% confidence limit for the true *p*th quantile, x_p, can be calculated if the underlying distribution is normal. As shown in Figure 4, the normal probability plot of arsenic data, excluding the outliers, clearly shows that the arsenic data is not normally distributed. However, as shown in Figure 5, the log-transformed arsenic data is normally distributed (i.e., the arsenic data fits a lognormal distribution). The descriptive statistics for the log-transformed arsenic data set, excluding the outliers previously established, are summarized in Table 3.

Normal Probability Plot for Arsenic Data

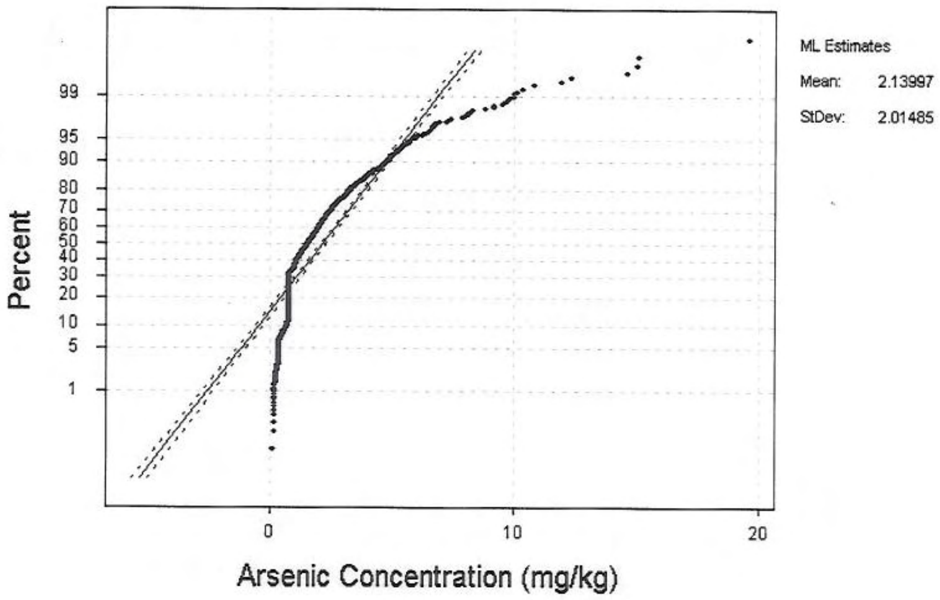

Figure 4

Normal Probability Plot of Arsenic Data

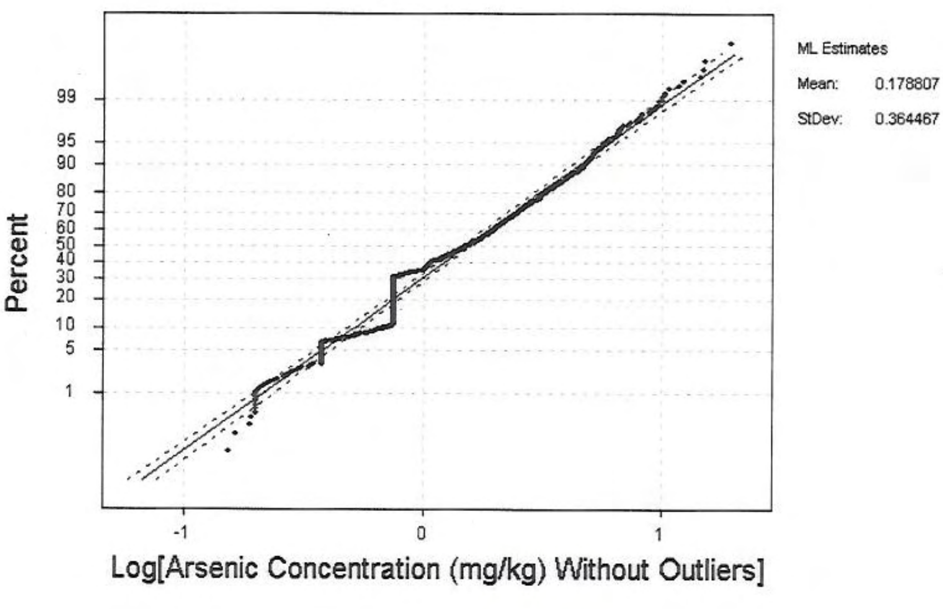

Figure 5

Table 3

Descriptive Statistics of the Combined Arsenic Data Set Without Outliers

DESCRIPTIVE STATISTIC	VALUE
Sample Size (n)	1086
Mean (μ)	0.1788 (1.51 mg/kg)
Median	0.1761 (1.50 mg/kg)
Standard Deviation	0.3646
Standard Error of the Mean[1]	0.0111
Minimum Concentration	-0.8125 (0.15 mg/kg)
Maximum Concentration	1.2930 (19.63 mg/kg)
Lower Quartile (Q_1)	-0.1249
Upper Quartile (Q_3)	0.4472

[1] The *Standard Error of the Mean* = $\frac{Std.Dev.}{\sqrt{n}}$

The upper limit of the data set can be estimated according to the following equation:

$$UL_{1-\alpha}(x_p) = \bar{x} + sK_{1-\alpha,p} \qquad \textbf{(Equation 2)}$$

Where,

$$UL_{1-\alpha}(x_p) = \textit{The Upper Limit of the data set}$$
$$\bar{x} = \textit{Mean of the data set}$$
$$s = \textit{Std. Dev. of the mean}$$
$$K_{1-\alpha,p} = \textit{Statistical tolerance factor for estimating an Upper } 100(1-\alpha) \textit{ Confidence Limit on the pth Quantile}$$

For calculating the 95% confidence limit of the 99th quantile of the arsenic data set, excluding outliers, $\boldsymbol{K_{0.95,\,0.99} = 2.40}$ (from Table A3, Gilbert 1987). Using the mean and standard deviation of the arsenic data set (Table 2), the $\boldsymbol{UL_{0.95}(X_{0.99})}$ can be calculated as follows:

$$UL_{0.95}(X_{0.99}) = 0.1788 + (2.40)(0.3646)$$
$$= 1.054$$

Since the arsenic data is log-transformed, the Upper Limit Concentration is the antilogarithm of this value.

$$UL_{0.95}(X_{0.99}) = 10^{1.054}$$

= 11.32 mg/kg

A distribution-free, non-parametric analysis was also conducted to estimate the theoretical ***$UL_{0.95}(X_{0.99})$*** as described by Gilbert (1987). This method, also known as the distribution-free technique, is used when the underlying distribution is either unknown or non-normal. This method was employed using the following equation:

$$\textit{The Rank of the } UL_{0.95}(X_{0.99}) = p(n+1) + Z_{1-\alpha}[np(1-p)]^{1/2} \quad \textbf{(Equation 3)}$$

Where,

$$p = 99th Quantile = 0.99$$
$$Z_{1-\alpha} = Z \textit{ Value for the } 95\% \textit{ Confidence Interval}$$
$$= Z_{0.95}$$
$$= 1.645$$
$$n = \textit{Number of samples, excluding outliers}$$
$$= 1086$$

For the arsenic data set, the Rank of the Upper 95% Limit for the 0.99 Quantile (***Rank of $UL_{0.95}(X_{0.99})$***) can be calculated as follows:

$$\textit{Rank of } UL_{0.95}(X_{0.99}) = 0.99(1087) + 1.645[1086(0.99)(0.01)]^{1/2}$$
$$= 1081.524$$

Then, the ***$UL_{0.95}(X_{0.99})$*** would be the arsenic concentration that is 52.4% of the way between the 1081st and the 1082nd largest values. Since the 1081st value is 11.9 mg/kg and the 1082nd value is 12.3 mg/kg, the ***$UL_{0.95}(X_{0.99})$*** would be approximately **12 mg/kg**.

Example 3: Determination of the Arsenic Clean-up Goal for a School Site

Examples 1 and 2 represent very large, ideal arsenic data sets used to demonstrate the graphical and statistical approaches to setting clean-up goals. The following example utilizes a much smaller and typical arsenic data set from a school site in Southern California and demonstrates several methods for determination of arsenic cleanup goals.

Method 1. Graphical Evaluation

Step 1. Graphical representations of arsenic data set.

Create Normality plots using both raw and log transformed data as shown in Figures 6 and 7. The arsenic concentration can be plotted as a function of the expected value for a normal distribution or alternatively, the data set can be plotted from least value to highest value as the cumulative percent of samples. Either graphical treatment results in a curve representing the distribution of the data set.

Step 2. Visual inspection of the curves

Visual inspection of the curve may yield a determination of an inflection point which represents a break between the ambient level of arsenic for the site and the portion of the curve that represents a separate, higher population which may be a consequence of a release to the environment. For the example shown below it can be determined that an inflection point in the distribution of samples occurs at an approximate arsenic concentration of 10 mg/kg (Figure 6) or at the Log_{10}[arsenic concentration] value of 1 which corresponds to 10 mg/kg (Figure 7).

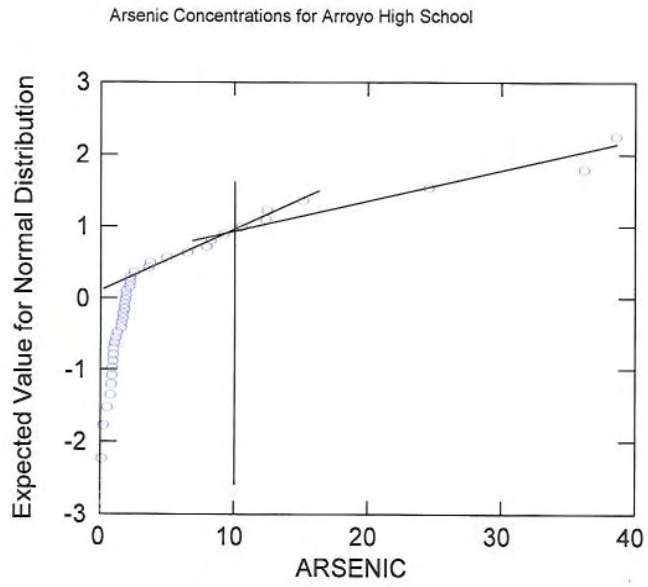

Figure 6
Distribution of arsenic concentrations in mg/kg

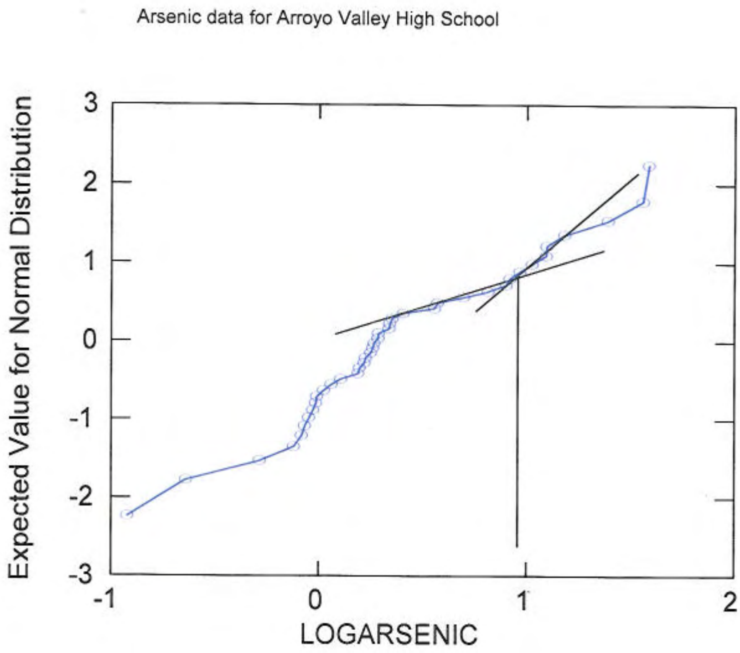

Figure 7
Distribution of arsenic in a log transformed representation

Method 2. Statistical Evaluation: Quartile Analysis ("Fourth Spread")

A statistical approach may be used that identifies upper-bound outliers which can then be removed from the data set to generate a new data set for which an upper confidence limit (UCL) can be defined and utilized as the cleanup goal.

Step 1. Derivation of Descriptive Statistics:

Descriptive statistics as shown in Table 4 were calculated for this site based on the site-specific arsenic data set. These statistics included: number of samples, minimum and maximum site concentration, mean, standard deviation, sample distribution, median and quartiles, 95th and 98th percentile and 95% UCL.

Table 4
Descriptive Statistics

DESCRIPTIVE STATISTIC	VALUE
Number of samples	40
Minimum detected value	0.12
Maximum detected value	38.6
Mean	5.75
First quartile (Q1)	0.98
Median	1.85
Third quartile (Q3)	4.98
95^{th} percentile	25.18
98^{th} percentile	36.73
95%UCL of mean	8.61
Standard deviation	8.93

Values listed in mg/kg

Step 2. Determine upper-bound outliers:

The quartile analysis to determine upper-bound outliers in the data set may be conducted as in the following example: The median and first and third quartiles from the data set shown in Table 4 were determined and a fourth spread (*Fs*) was generated.

First quartile (Q1) = 0.98
Median (second quartile, Q2) = 1.89
Third quartile (Q3) = 4.98

Fs = (Q3 –Q1) = 4.0

Outliers for the upper bound of the site-specific arsenic concentrations are defined as:

All data points greater than Q3 + [1.5 x *Fs*]: 4.98 + 6.0 = 10.98.

Therefore, any value higher than 10.98 mg/kg is considered an outlier (contaminated soil sample) and is eliminated from the data set because it is higher than the ambient level.

Step 3. Statistical re-evaluation of the data set.

The site-specific data set is then re-evaluated with outliers removed to create the adjusted site ambient data set. The statistical evaluation of the adjusted ambient data set yields the following values:

Table 5
Arsenic data set statistics with upper-bound outliers removed

Number of samples	35
Minimum detected value	0.12
Maximum detected value	10.6
Mean	3.74
Std deviation	6.49
98th percentile	9.72

Values listed in mg/kg

An appropriate cleanup goal for this site is the 98th percentile of the adjusted arsenic data set, which is approximately 10 mg/kg. Note that the 98th-percentile was used as an upper-bound for this data set due to the smaller number of samples (N = 40).

References

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APPENDIX C

Appendix C1 **Supporting Documentation for DTSC Technology Screening**

Appendix C2: **Remedial Action Plan Sample**

Appendix C3: **Removal Action Workplan Sample**

Appendix C4: **Scope of Work for Corrective Measures Study**

Appendix C5: **Scope of Work for Interim Measures**

Appendix C6: **Example for Statement of Basis**

Appendix C7: **Example for Bridging Memorandum**

APPENDIX C1
SUPPORTING DOCUMENTATION FOR DTSC TECHNOLOGY SCREENING

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Table C1-1. Cleanup Options Selected and Characteristics of Sites Evaluated by DTSC Study

DTSC Site Type (Number of Sites)	Cleanup Option Selected (Number of sites)							
	No Action	ICs	Capping in Place	Consolidation and capping	CAMU	Excavation and disposal	Reuse/ Recovery	Treatment
Schools Properties (32*)	0	0	0	1	0	32	0	0
Military Facility (55*)	3	5	3	1	9	37	3	3
Voluntary Cleanup (51*)	0	1	8	5	0	40	5	1
State Response/NPL (32*)	0	0	5	7	0	22	0	4
Corrective Action (7)	0	0	0	0	3	4	0	0
Facility Closure (11)	0	0	0	0	0	11	0	0

Total number of sites represented: 188

Cubic Yards of Impacted Soil (Number of Sites)	Cleanup Option Selected (Number of sites)							
	No Action	ICs	Capping in Place	Consolidation and capping	CAMU	Excavation and disposal	Reuse/ Recovery	Treatment
<100 (21*)	0	0	1	0	0	21	0	0
≥100 - 1000 (56*)	0	1	3	3	3	50	2	2
≥1000 - 10,000 (60*)	0	0	7	8	3	43	2	3
>10,000 (29*)	0	1	4	3	6	17	3	1

Total number of sites represented: 166 (Impacted volume data not available for all 188 sites.)

Maximum Depth of Impacted Soil (Number of Sites)	Cleanup Option Selected (Number of sites)							
	No Action	ICs	Capping in Place	Consolidation and capping	CAMU	Excavation and disposal	Reuse/ Recovery	Treatment
<2 feet (41*)	2	1	4	3	3	39	1	1
≥2 - 5 feet (45*)	0	0	6	5	1	35	4	1
≥5 - 10 feet (30*)	0	0	4	0	2	26	1	3
>10 feet (8*)	0	1	1	2	1	4	0	0

Total number of sites represented: 124 (Depth of impact not available for all 188 sites.)

Other Affected Media	Cleanup Option Selected (Number of sites)							
	No Action	ICs	Capping in Place	Consolidation and capping	CAMU	Excavation and disposal	Reuse/ Recovery	Treatment
Soil Only (113*)	2	2	11	7	6	94	2	3
Groundwater (53*)	1	2	3	6	4	39	5	2
Soil Vapor (9*)	0	0	0	1	0	8	2	0
Sediment (8*)	0	0	2	2	0	5	0	1
Surface Water (5*)	0	0	1	1	0	4	0	1
Indoor Air (1)	0	0	0	0	0	1	0	0

Total number of sites represented: 182 (Information on other affected media not available for all 188 sites.)

Notes:
*Some sites selected multiple cleanup options. Hence, this number is not the sum of frequencies indicated in this row.
CAMU - corrective action management unit
ICs - institutional controls
NPL - National Priorities List

Table C1-1 (Continued)

Metals Contaminants Present	Cleanup Option Selected (Number of sites)							
	No Action	ICs	Capping in Place	Consolidation and capping	CAMU	Excavation and disposal	Reuse/ Recovery	Treatment
Antimony	0	0	0	1	2	8	0	2
Arsenic	1	1	9	6	3	64	4	3
Cadmium	0	2	0	4	1	18	0	1
Chromium III	0	0	2	5	2	9	0	1
Chromium VI	0	0	1	0	0	5	0	0
Copper	1	0	2	4	1	13	1	2
Lead	0	3	11	9	6	107	7	7
Mercury	1	0	4	0	0	11	3	0
Molybdenum	1	0	0	0	0	3	0	0
Nickel	0	0	2	3	0	7	0	1
Thallium	0	0	1	0	0	5	0	0
Zinc	1	0	1	2	2	7	0	2

Total number of sites represented: 168 (Information on metals present not available for all 188 sites.)

Other Contaminants Present	Cleanup Option Selected (Number of sites)							
	No Action	ICs	Capping in Place	Consolidation and capping	CAMU	Excavation and disposal	Reuse/ Recovery	Treatment
None reported	0	1	8	2	6	47	1	3
Fuel-related compounds	1	1	6	3	0	43	2	1
Volatile organic compounds	0	0	4	1	1	33	5	1
Polynuclear aromatic hydrocarbons	0	2	5	3	2	26	4	2
Pesticides/herbicides	2	0	3	1	1	28	3	1
Polychlorinated biphenyls	2	1	5	1	1	24	0	2
Dioxins/furans	0	0	1	2	1	6	0	2
Semivolatile organic compounds	0	0	2	1	2	4	0	0
Other inorganics	0	0	2	0	0	5	0	0
Gases (e.g., methane)	0	0	1	1	0	3	0	0

Total number of sites represented: 174 (Information on other contaminants present not available for all 188 sites.)

Historical Site Activity	Cleanup Option Selected (Number of sites)							
	No Action	ICs	Capping in Place	Consolidation and capping	CAMU	Excavation and disposal	Reuse/ Recovery	Treatment
School	0	0	0	0	0	5	0	0
Residential	0	0	0	0	0	14	0	0
Retail Stores/Office	0	0	0	0	0	4	0	0
Agriculture	0	0	1	1	0	15	4	0
Manufacturing/Industry	0	1	5	4	3	23	0	5
Firing range	0	0	0	2	1	6	4	0
Foundry/smelter	0	0	0	2	1	2	0	1
Reclamation/junkyard/scrapyard	0	3	1	4	0	26	0	0
Vehicle maintenance/storage/refueling	0	1	0	0	0	16	0	0
Hazardous waste treatment & storage	1	1	0	0	1	8	0	0
Landfill/refuse burning/disposal pit	2	0	2	0	7	15	2	2
Shipyard/dry docks	0	0	1	1	0	7	0	1
Mining	0	0	0	1	0	5	0	0
Other	0	1	2	2	0	18	0	0

Total number of sites represented: 176 (Information on historical activities not available for all 188 sites.)

Notes:

*Some sites selected multiple cleanup options. Hence, this number is not the sum of frequencies indicated in this row.

CAMU - corrective action management unit

ICs - institutional controls

NPL - National Priorities List

Table C1-1 (Continued)

Projected Future Land Use	Cleanup Option Selected (Number of sites)							
	No Action	ICs	Capping in Place	Consolidation and capping	CAMU	Excavation and disposal	Reuse/ Recovery	Treatment
Residential, potentially residential	0	0	1	6	0	31	5	3
Industrial	1	4	6	4	8	7	0	0
School	0	0	0	1	0	31	0	0
Commercial	0	2	5	2	0	14	3	2
Recreational or natural area	0	0	2	1	0	9	0	0
Other	0	0	2	1	0	7	0	0

Total number of sites represented: 121 (Information on projected future land use not available for all 188 sites.)

Site Size (Number of sites)	Cleanup Option Selected (Number of sites)							
	No Action	ICs	Capping in Place	Consolidation and capping	CAMU	Excavation and disposal	Reuse/ Recovery	Treatment
≤1 acre (47*)	0	1	5	1	1	40	0	1
>1 - 10 acres (59*)	0	1	5	3	5	50	4	2
>10 - 50 acres (38*)	0	2	2	6	1	27	2	2
>50 - 100 acres (8*)	0	0	1	2	2	3	0	1
>100 acres (8*)	0	0	0	1	0	7	1	1

Total number of sites represented: 160 (Site size not available for all 188 sites.)

Notes:
*Some sites selected multiple cleanup options. Hence, this number is not the sum of frequencies indicated in this row.
CAMU - corrective action management unit
ICs - institutional controls
NPL - National Priorities List

Table C1-2 Technologies Applicable at Sites with Metals in Soil

TECHNOLOGY	DESCRIPTION	APPLICABILITY	LIMITATIONS / CONSTRAINTS	REF.
Ex Situ Technologies				
Isolation (Excavation and Disposal)	Impacted soil is excavated and isolated beneath an engineered cap or within an engineered disposal unit (e.g., landfill, CAMU).	• Consolidation beneath a cap is applicable to a wide variety of soils and immobile contaminants. • Placement in an engineered unit is applicable to most soils and a wide variety of contaminants.	• Long-term maintenance. • Land use restrictions. • May not be protective if groundwater is shallow.	
Immobilization by Solidification/Stabilization (S/S)	Use of chemical or physical processes to treat wastes. Solidification technologies encapsulate waste to form a solid material. Stabilization technologies reduce the hazard potential by converting waste to less soluble, mobile, or toxic forms.	• Often used as a pre-treatment for land disposal activities to meet land disposal restrictions. • Assess applicability with treatability study.	• Short-term to medium-term technology. Long-term effectiveness not demonstrated for many contaminant/process combinations. • May result in significant increase in volume. • Certain wastes are incompatible with S/S. Limited effectiveness if soil contains SVOCs, pesticides, and some VOCs. • Generally not effective in soils with high organic content. • Used in conjunction with other technologies.	3, 4
Immobilization by Vitrification	Mobility of metal contaminants is decreased by high-temperature treatment of contaminated area. The high temperature component of the process destroys/ removes organic materials. Radionuclides and heavy metals are retained within the vitrified product.	• Applicable to most soils and for a wide variety of inorganic and organic contaminants. Particularly well suited for treatment of lead, chromium, arsenic, zinc, cadmium, and copper wastes. • Sites with moisture content less than 25%.	• High energy requirements and cost. • Unsuitable for treatment of mercury unless present at very low levels. • Complex process that typically includes excavation, pretreatment, mixing, feeding, melting, and vitrification. Requires off-gas collection and treatment as well as forming/casting the product. • Used in conjunction with other technologies.	3

Table C1-2 (Continued)

TECHNOLOGY	DESCRIPTION	APPLICABILITY	LIMITATIONS / CONSTRAINTS	REF.
Ex Situ Technologies				
Toxicity or Mobility Reduction by Chemical Treatment	Introduction of chemical reagents to change the chemical oxidation state of the metal in order to reduce its mobility or toxicity.	• Assess applicability through treatability study using site-specific materials. • Often used as a pretreatment for other treatment technologies, e.g., reduction of Cr(VI) is a common form of treatment because Cr(III) can be precipitated as a hydroxide by a subsequent treatment process.	• Long-term stability of reaction products is a concern because changes in geochemistry may reverse some reactions. • Used in conjunction with other technologies.	1, 3
Removal by Pyrometallurgical Extraction	Separation of metals from soil in form of metal, metal oxide, ceramic product, or other products that have potential market value. Typical processes to concentrate and purify the metal include smelting, roasting, and retorting.	• Most applicable to large volumes of highly contaminated soils (>5-20% metals concentrations), especially when metal recovery is expected. • May be applicable to low concentrations of easily volatilized metals (e.g., mercury).	• Often performed off-site because few mobile treatment units are available. • Not cost effective for many environmental projects. • Usually preceded by physical separation and concentration to produce uniform feed material, to upgrade metal content, and/or to enhance separation performance.	3, 4

Table C1-2 (Continued)

TECHNOLOGY	DESCRIPTION	APPLICABILITY	LIMITATIONS / CONSTRAINTS	REF.
Ex Situ Technologies				
Removal by Soil Washing	Water-based process for scrubbing soils to remove contaminants by dissolving/ suspending in wash solution or concentration into smaller volume of soil through particle size separation, gravity separation, and attrition scrubbing.	• Assess applicability with bench scale treatability study. • Applicable to SVOCs, fuels, and heavy metals. • Applicable to coarse-grained soils. Soils with low fines content (<20% of particles with diameters <2 mm) are easier to process. • Most easily implemented when a single metal contaminant occurs in a particular insoluble fraction of soil that can be separated by particle size classification. • Economically feasible with >5,000 tons of soil.	• Commercialization of process not yet extensive. • Complex waste mixtures make formulating washing fluid difficult. • High humic content in soil may require pretreatment. • Difficult to remove organics adsorbed to clay-size particles. • Aqueous stream will require treatment at demobilization. • Multiple treatment steps may be required to address washing solvent remaining in treated residuals. • Some soil fractions may still require disposal in an engineered unit.	1, 3, 4
In Situ Technologies				
Isolation by Capping	Impacted soils are isolated by placement of a low permeability barrier to surface water infiltration.	• Applicable to most soils and metals with limited mobility. • Frequently used to address impacted soils in industrial areas.	• Long-term maintenance. • Land-use restrictions. • May not be protective if groundwater is shallow.	3

Table C1-2 (Continued)

TECHNOLOGY	DESCRIPTION	APPLICABILITY	LIMITATIONS / CONSTRAINTS	REF.
In Situ Technologies				
Immobilization by Solidification/Stabilization (S/S)	Use of chemical or physical processes to treat wastes. Solidification technologies encapsulate waste to form a solid material. Stabilization technologies reduce the hazard potential by converting waste to less soluble, mobile, or toxic forms. Vertical auger mixing is most common method for mixing binders with soil.	• Appropriate for soil conditions conducive for mixing binders. • Useful for treating surface or shallow contamination that involves spreading and mixing binders with soil using conventional excavation equipment. • Assess applicability through treatability study conducted using site-specific materials.	• Limited data on performance. • Interference with binding process caused by soil chemical composition, moisture content, and ambient temperature. • Achieving complete, uniform mixing of binder with contaminated soil. • Not useful for metals occurring as anions or metals that have low-solubility hydroxides. • Mixing binders in presence of bedrock, large boulders, cohesive soils, and clays. • Used in conjunction with other technologies.	2, 3
Immobilization by Vitrification	Mobility of metal contaminants is decreased by high-temperature treatment of contaminated area. The high temperature component of the process destroys or removes organic materials. Radionuclides and heavy metals are retained within the vitrified product.	• Applicable to most soils and for a wide variety of inorganic and organic contaminants. Particularly suitable for treatment of soils with lead, chromium, arsenic, zinc, cadmium, and copper. • Soil should be able to carry the current and solidify as it cools.	• Still in demonstration phase. Limited commercial availability. • High cost relative to other cleanup alternatives. Costs increase with increasing moisture content. • Maximum treatment depth is approximately 20 feet. • Too much alkali metal content increases the conductivity to a point where insufficient heating occurs. • Not suitable for treatment of mercury, unless include off-gas recovery. • May not be appropriate for sites with high levels of organics (off-gassing) or inorganics (potential to exceed glass solubility limits).	2, 3

Table C1-2 (Continued)

TECHNOLOGY	DESCRIPTION	APPLICABILITY	LIMITATIONS / CONSTRAINTS	REF.
In Situ Technologies				
Toxicity or Mobility Reduction by Chemical Treatment	Introduction of chemical reagents to change the chemical oxidation state of the metal in order to reduce its mobility or toxicity. Reagents introduced via soil mixing (e.g., backhoe, trenching, augers).	• Sites with shallow metals contamination that can be effectively addressed through soil mixing. • Assess applicability through treatability study conducted using site-specific materials.	• Non-specific nature of chemical reagents may create new problems. Agents that treat one metal may target other reactive metals and make them more toxic or mobile. • Reagent delivery problems due to reactive transport and soil heterogeneity. • Control of in situ geochemical conditions so that reaction proceeds. • Usually requires multiple applications. • Used in conjunction with other technologies.	1, 2, 3
Removal by Soil Flushing	Extraction of contaminants from the soil with water or other suitable aqueous solutions. Soil flushing is accomplished by passing the extraction fluid through in-place soils using an injection or infiltration process. Considered a mature technology because of its use in the oil industry, but there has been very little commercial success for environmental applications.	• Assess applicability through treatability study performed under site-specific conditions. • Can mobilize contaminants from coarse-grained soils with relatively high hydraulic conductivity. • Can be used to treat VOCs, SVOCs, fuels, and pesticides, but it may be less cost-effective than alternative technologies. • Used only where flushed contaminants and flushing fluid can be contained and recaptured.	• Limited information available on application of this technology to metals-impacted sites. • Difficult to treat low permeability or heterogeneous soils. • Surfactants can reduce effective soil porosity. • Reactions of flushing fluids with soil can reduce contaminant mobility. • Ability to control contaminant and flushing fluids. • Aboveground separation and treatment costs for recovered fluids can drive the economics of the process.	1, 2, 3

Table C1-2 (Continued)

TECHNOLOGY	DESCRIPTION	APPLICABILITY	LIMITATIONS / CONSTRAINTS	REF.
In Situ Technologies				
Removal by Electrokinetic Remediation (ER)	Process removes metals and organic contaminants from low permeability soil. Uses electrochemical and electrokinetic processes to desorb, and then remove, metals and polar organics.	• Heavy metals, anions, and polar organics in soil, mud, sludge, and marine dredging. • Can treat concentrations ranging from a few parts per million (ppm) to tens of thousands of ppm. • Most applicable in low permeability soils. Such soils are typically saturated and partially saturated clays and silt-clay mixtures that are not readily drained.	• Demonstrated at several sites with mixed results. Success varies depending on metals present in soil. Effectiveness sharply reduced for wastes with a moisture content of less than 10%. • Presence of buried metallic or insulating material can induce variability in the electrical conductivity of the soil. • Inert electrodes must be used so that no residue will be introduced into the treated soil mass. Metallic electrodes may dissolve as a result of electrolysis and introduce corrosive products into the soil mass. • Extreme pH at the electrodes and reduction-oxidation changes induced by the process electrode reactions may inhibit effectiveness. • Oxidation/reduction reactions can form undesirable products (e.g., chlorine gas). • Unfavorable soil conditions include high cation exchange capacity, high buffering capacity, high naturally-occurring organic content, salinity, and very low moisture content.	1, 2, 3

1 For more information about this technology, refer to http:// clu-in.org/techfocus/
2 EPA. 2006. Engineering Issue Forum Paper: In Situ Treatment Technologies for Contaminated Soil, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, EPA 542/F-06/013. November.
3 Evanko, C.R. and D.A. Dzombak. 1997. Remediation of Metals-Contaminated Soils and Groundwater, Ground-Water Remediation Technologies Analysis Center, Technology Evaluation Report TE-97-01, October.
4 EPA. 1997a. Engineering Bulletin: Technology Alternatives for the Remedial of Soils Contaminated with As, Cd, Cr, Hg, and Pb, U.S. Environmental Protection Agency, Office of Research and Development, EPA/540/S-97/500, August.

Table C1-3 Evaluation of Technologies Applicable to Sites With Metals in Soil Against NCP Analysis Criteria

TECHNOLOGY	NCP CRITERIA						
	OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	COMPLIANCE WITH ARARS	LONG-TERM EFFECTIVENESS	REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT	SHORT-TERM EFFECTIVENESS	IMPLEMENTABILITY	COST
Institutional Controls	• **Manages potential exposure by restricting access and future land use.**	• May not comply with ARARs.	• Uncertain because does not permanently address contamination.	• Not a treatment alternative.	• Does not create risks during implementation.	• Easily implemented.	• Typically the lowest cost alternative.
Excavation and Off-site Disposal	• Protectiveness achieved by metal removal from site.	• Requires compliance with applicable state and federal transportation and disposal requirements.	• High long-term effectiveness for site. • Protectiveness at disposal site dependent on off-site management choices.	• Disposal reduces mobility. • Reduction in toxicity and volume depends on offsite management choices.	• Requires standard precautions necessary for protection of human health and environment during excavation, transport, and disposal.	• Easily implementable given facility with adequate capacity for waste type, located within a reasonable distance of site. • Uses standard construction equipment and labor.	• Usually reasonable for small to medium volumes of contaminated soil. • **May be cost-prohibitive** for large volumes.
Recovery/ Reclamation	• Protectiveness achieved by metal removal.	• Removal eliminates need to comply with land disposal restrictions. • Action-specific ARARs may be activated by treatment process.	• Highly effective if metal content removed to acceptable levels.	• Removal reduces toxicity, mobility, and volume. • Residual metals immobilized in slag or residue.	• Requires standard precautions for protection of human health and environment during excavation and treatment.	• **Treatment usually performed off-site.** • **Usually preceded by physical separation and concentration of metal.** • **Applicable to highly contaminated soils.**	• Not cost effective for many environmental projects.

Notes: Bold indicates major reason(s) rejected during alternatives analysis for sites evaluated by DTSC Study (see Table 2 of main text of PT&R guidance).
In part, table content based on EPA (1997a, 1999, 2006) and Evanko and Dzombak (1997).

Table C1-3 (Continued)

TECHNOLOGY	NCP CRITERIA						
	OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	COMPLIANCE WITH ARARS	LONG-TERM EFFECTIVENESS	REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT	SHORT-TERM EFFECTIVENESS	IMPLEMENTABILITY	COST
Containment by Capping	• Contaminated soil remains in place. • Risk of exposure through dermal contact and/ or incidental ingestion reduced through barriers. • Protectiveness of groundwater depends on depth to water, mobility of metals, and cap design that reduces water migration through soil.	• Waste disposal requires compliance with ARARs.	• Long-term protection ensured through **continued cap maintenance and institutional controls.**	• Not a treatment alternative.	• Requires standard precautions for protection of human health and environment.	• Commercially available. • Demonstrated technology. Necessary materials easily attainable. • Uses standard construction equipment and labor.	• Generally less expensive than most forms of treatment.
Solidification/ Stabilization (S/S)	• Protectiveness achieved by reducing metal mobility.	• Treatment unit may require location- or action-specific ARARs. • Treatment may eliminate need to dispose as hazardous waste.	• **Considered to be a short-term to medium-term technology.** • **Long-term effectiveness not demonstrated for many contaminant/ process combinations.**	• If effective, reduces metal mobility. • **Does not address toxicity.** • **May result in increased volume.**	• Requires standard precautions for protection of human health and environment. • May pose short-term risks if ex-situ treatment performed.	• **Assess applicability with treatability study.** • Commercially available.	• Generally lowest cost treatment alternative.

Notes: Bold indicates major reason(s) rejected during alternatives analysis for sites evaluated by DTSC Study (see Table 2 of main text of PT&R guidance).
In part, table content based on EPA (1997a, 1999, 2006) and Evanko and Dzombak (1997).

Table C1-3 (Continued)

TECHNOLOGY	NCP CRITERIA						
	OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	COMPLIANCE WITH ARARS	LONG-TERM EFFECTIVENESS	REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT	SHORT-TERM EFFECTIVENESS	IMPLEMENTABILITY	COST
Soil Washing	• Aqueous stream and solid residuals must be treated to achieve protection.	• Excavation may activate action-specific ARARs.	• If effective, eliminates risk and provides permanent solution. • **If ineffective, will need to identify another cleanup alternative.**	• Transfers mass from soil to aqueous solutions which must be treated.	• Requires standard precautions for protection of human health and environment during excavation and treatment.	• **Requires treatability study.** • **High removal efficiencies difficult to attain or require complex treatment process.** • **Applicable to narrow range of soil types and contaminant mixtures.** • **Limited commercial availability.**	• Economically feasible for large soil volumes.
Soil Flushing / Leaching	• Flushing fluid must be captured and treated.	• Must ensure that washing solution complies with chemical- or location-specific ARARs.	• Permanent solution if successful.	• Transfers mass from soil to flushing fluid which must be captured and treated.	• Requires standard precautions for protection of human health and environment during injection.	• **Requires treatability study.** • **Applies to narrow range of soils and contaminant mixtures.** • **Limited data on performance for metals-impacted soils.**	• **Costs for treatment of recovered fluids can drive cost.**

Notes: Bold indicates major reason(s) rejected during alternatives analysis for sites evaluated by DTSC Study (see Table 2 of main text of PT&R guidance).
In part, table content based on EPA (1997a, 1999, 2006) and Evanko and Dzombak (1997).

Table C1-3 (Continued)

TECHNOLOGY	NCP CRITERIA						
	OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	COMPLIANCE WITH ARARS	LONG-TERM EFFECTIVENESS	REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT	SHORT-TERM EFFECTIVENESS	IMPLEMENTABILITY	COST
Chemical Treatment	• Protectiveness achieved by reducing metal mobility and/or toxicity. • Must also manage other reactions triggered by reagents.	• Treatment unit may require location- or action-specific ARARs. • Treatment may eliminate need to dispose as hazardous waste.	• Changes in geochemical conditions may affect long-term effectiveness.	• If effective, reduces metal mobility and/or toxicity. May increase mobility or toxicity of naturally-occurring metals.	• Requires standard precautions for protection of human health and environment. • May pose short-term risks if ex-situ treatment	• **Assess applicability through treatability studies.** • Commercially available.	• **Can be higher cost than other cleanup alternatives.** • Generally lower cost treatment alternative.
Vitrification	• Protectiveness achieved by immobilizing metal.	• Excavation may activate action-specific ARARs. • Generation of off-gas may trigger chemical-specific ARARs.	• If successful, produces solid with low leachability. • Limited data on long-term effectiveness.	• Reduces toxicity and mobility by immobilizing metal. • Generally decreases volume. • Some metals may need conversion to less volatile forms prior to treatment.	• Off-gas may require extensive controls, including respiratory protection, fugitive dust control, and air monitoring.	• Requires extensive pilot testing. • In situ methods still in demonstration phase. • Limited commercial availability. • Requires substantial energy source.	• **Typically higher costs than other cleanup alternatives.**
Electrokinetic Remediation	• Protectiveness achieved by metal removal.	• May require location- or action-specific ARARs.	• If successful, removes metal from soil.	• Results in mass removal, reducing metal mobility and toxicity and affected volume.	• Requires standard precautions for protection of human health and environment.	• **To-date demonstrated through bench- and pilot-scale studies with mixed success.**	• Cost likely high because not commercially available.

Notes: Bold indicates major reason(s) rejected during alternatives analysis for sites evaluated by DTSC Study (see Table 2 of main text of PT&R guidance).
In part, table content based on EPA (1997a, 1999, 2006) and Evanko and Dzombak (1997).

APPENDIX C2
REMEDIAL ACTION PLAN SAMPLE

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PREFACE TO THE REMEDIAL ACTION PLAN SAMPLE

This version of the Remedial Action Plan (RAP) Sample is the result of efforts of the Voluntary Cleanup Program (VCP) and Proven Technologies and Remedies (PT&R) teams. In preparing this RAP Sample, the VCP team had a broader perspective than the PT&R team which focused on the cleanup of metals in soil (for the *PT&R Guidance -- Remediation of Metals in Soil*). As of February 2008, the RAP Sample was the same for both the VCP and PT&R team purposes, although some sections of the document are not applicable to sites applying the PT&R approach (indicated by gray shading). The RAP Sample is expected to change in the future as the VCP team continues its efforts to streamline a final version of the document. The VCP team will maintain the master version of the RAP Sample.

When applying the PT&R approach, please contact DTSC staff for the most current version of the master RAP Sample. However, as discussed above, the user must recognize that not all aspects of the master RAP Sample are applicable to sites applying the PT&R approach (i.e., sections flagged with gray shading).

In general, the outline of the RAP should look similar to the outline presented in this Sample. However, the RAP Sample is intended to provide sufficient flexibility to accommodate different types of sites. Although the language in this Sample is primarily focused on the soil matrix, it can easily be modified to address other media.

This document is for guidance only, and is applicable on a case-by-case basis. Some elements of this guidance may apply to your site, and others may not. Additional elements than are addressed by this Sample may also be needed.

Instructions for suggested content (denoted by boxed text) are included under most major headings. Some sections provide example text that could be applied to any site. The example text intended for general application is shown as normal text with brackets and underline to indicate locations for inserting site-specific information. Other sections provide example descriptions for specific remedial alternatives (i.e., excavation/off-site disposal and in situ injection to address a groundwater VOC plume). These example descriptions (indicated by italics) are not intended for broad application; some specificity has intentionally been removed from the example descriptions (e.g., design elements, sampling frequencies, other site-specific factors), as indicated by bracketing and underlining.

BACKGROUND

The RAP is one of two remedy selection documents that may be prepared for a hazardous substance release site pursuant to California Health and Safety Code section 25356.1. It is appropriate for response actions whose capital costs of implementation are projected to cost $1,000,000 or more.

The RAP is a public document that should be written in a clear and concise manner (avoid using technical language if possible). It presents the DTSC/RWQCB preliminary decisions and/or the Project Proponent's or Responsible Party's (RP's)) preliminary recommendations for a site. As such, it should not make definitive findings or statements concerning the alternatives that would later be difficult to revise after public comments or additional data are received. The RAP will also make reference to specific documents where more detailed information is available. Ideally, the RAP text should be between 10 to 20 pages in length, with the majority of the supporting information in tables, figures and appendices. However, the length of the text depends on the number and complexity of issues at the site.

A RAP must clearly and concisely reflect the remedial action decision reached by: identifying the preferred alternative for a remedial action and explaining the reasons for the preference; describing the other remedial alternatives considered; and soliciting public review and comments on all the alternatives described. The public is encouraged to submit comments and participate in the remedy selection process.

The RAP contains a brief summary of the Remedial Investigation/Feasibility Study (RI/FS) findings and presents the key components of the conceptual plan for site remediation. When the *PT&R Guidance – Remediation of Metals in Soil* is used to identify potential cleanup alternatives, a separate feasibility study (FS) document is not required if the FS evaluation is contained in a combined FS/RAP document. The decision to prepare a combined FS/RAP document should be made by the project team.

RAPs must clearly set out specific remedial action objectives, including cleanup levels and timeframes for completion of the remedial actions. They do not typically contain the specific engineering design details of the proposed remedial actions. However, for some sites, it may also be possible to combine the FS/RAP and the design document. This decision must be made by the project team.

RAPs (both Draft and Final) may be prepared by DTSC or its contractors, by the State Water Resources Control Board/Regional Water Quality Control Boards (SWRCB/RWQCBs), or by RPs or project proponents (with DTSC/RWQCB oversight). Only DTSC or RWQCBs may approve RAPs.

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TABLES

Instructions: Include all tables referred to in the narrative of the RAP. The tables should appear in the order that they are mentioned in the RAP. They should be clearly labeled and prepared with an appropriate font size so that they are easily legible and understandable.

FIGURES

Instructions: Include appropriate maps, cross sections, and other figures. They should appear in the order that they are mentioned in the RAP. All maps should include standard map information, including a north arrow, scale, and map legend. Similarly, cross sections should include vertical and horizontal scale bars and legends. All figures should be shown at an appropriate scale such that text, labels, and patterns are clearly legible. Ideally, maps should be superimposed on the site layout map.

APPENDICES

Instructions: The user has the choice to include the detailed attachments for the following as appendices. Adjust the table of contents as needed.

ARARs
Statement of Reasons
Administrative Record List
CEQA Documents
Sampling and Analysis Plan/Quality Assurance Project Plan
Responsiveness Summary

ACRONYMS AND ABBREVIATIONS

Instructions: Define the acronyms and abbreviations used in the RAP.

EXECUTIVE SUMMARY

Instructions: The executive summary presents an overview of the entire RAP. The executive summary should be clear and concise, yet contain enough information to give the reviewer a basic understanding of the site, the nature and extent of contamination, potential receptors, and the proposed remedial action. Generally, no more than 4-5 pages are recommended. However, the length of the executive summary depends on the number and complexity of issues at the site. The executive summary should briefly summarize the following:

- *Purpose of the RAP;*
- *Site name and location;*
- *Site description (the physical features, buildings, brief site history of ownership and site operations);*
- *Description of the scope and role of the remediation or operable unit;*
- *Contaminants and chemicals involved within each environmental medium (soil, groundwater, surface water, and air);*
- *Proposed alternative, and the reasons for proposing that alternative;*
- *If applicable, indicate that the PT&R approach is being applied;*
- *Other remedial alternatives that were considered in the RI/FS Report and the reasons for rejecting them; and*
- *Information on how the public can be involved in the remedy selection process.*

This report presents the draft Remedial Action Plan (RAP) for the [site name], located at [site location]. This RAP report was prepared by [consultant] on behalf of [who the RAP was prepared for, if applicable] in compliance with the Site [agreement/order] Docket No. [Docket Number] and California Health and Safety Code section 25356.1. It presents an evaluation of remedial alternatives in accordance with the United States Environmental Protection Agency's (US EPA's) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation/ Feasibility Study (RI/FS) guidance (EPA, 1988). This RAP describes the selected remedy and includes a conceptual design.

The [site name] operated as [type of operations] from [dates of operations]. The site is [current description of site, e.g. vacant lot, structures] occupies approximately [acreage or square footage of property] of real property within a [type of zoning e.g., residential/commercial/industrial] area in the City of [site location]. The site is bordered by [description of surrounding area] to the south, by [description of surrounding area] to the east, [description of surrounding area] to the north, and [description of surrounding area] to the west. [Describe past uses that may have contributed to the contamination found at the Site.]

During the past [years or time period of previous investigation(s)], several [type(s) of investigation(s) e.g., soil and/or groundwater] investigations have been completed at the site. [Type of media impacted, e.g., soil] at the site are impacted with [contaminant(s) of concern (COCs)] from former [source(s) of contamination]. In shallow soil [definition of shallow soil, e.g., 0-10 feet bgs], concentrations of [COCs] were the highest [COCs] in the vicinity of [location of where contamination was found]. [Describe deeper soil contamination, if found.]

Groundwater at the site occurs [description of water-bearing units] at approximately [depth of water-bearing unit(s)]. Groundwater flow in the water-bearing unit ranges from [direction of groundwater flow]. [If applicable, describe the groundwater plumes.]

The risk assessment results indicated that the site represents elevated risks to human health and the environment due to the presence of [COCs] in [identify media, e.g., soil]. To address these risks, the following remedial action objectives (RAOs) were developed for the [name of site]:

- [List RAOs.]

[COCs] were identified in the risk assessment as the chemicals posing the greatest risk to the human health. Therefore, soil screening levels were developed for these chemicals based upon [indicate basis for screening levels, e.g., standard U.S. Environmental Protection Agency (U.S. EPA) and California Environmental Protection Agency (Cal/EPA) risk assessment guidance]. The cleanup goal for [COC] is based upon its background concentration in soil and is set at [#] mg/kg. The cleanup goal for [COC] is based upon the potential for [pathway, e.g., direct contact with soil] under a [residential, commercial/industrial or other land use scenario] and is set at [type of concentration, e.g., average] concentration of [#] mg/kg. The cleanup goal for [COC] is set at [#] mg/kg for protection of groundwater resources and is based upon the Water Board's Environmental Screening Level.

The groundwater underlying the Site is designated as a [designation, e.g., potential municipal supply]. Therefore, the cleanup goals for groundwater are based upon [basis for cleanup goal, e.g., drinking water standards] and are set at [#] micrograms per liter (µg/L) for [COC], [#] µg/L for [COC] and [#] µg/L for [COC].
.
The following remedial alternatives were developed for the Site:

- [List the remedial alternatives evaluated.]

Based on the CERCLA nine-criteria analysis, Alternative [# and description] was selected as the preferred remedial alternative. The preferred remedial alternative consists of the following components: [List components.]

The following is an example description of a preferred remedial alternative.

Soil excavation involves the removal of the top [#] feet of soil across the entire site to minimize the potential for direct exposure to [COCs] in soils. The excavation will use sloped sidewalls at a slope ratio of [#], which will protect structures in the vicinity of the site. The total in-place volume of impacted soil for excavation is estimated to be about [#] cubic yards ([#] tons). The excavation will include removal of [features]. The *excavation could remove soils locally in some hot spot areas to deeper than [#] feet bgs if warranted (e.g., if heavy staining is observed under former structures or cleanup goals are not achieved in the confirmation samples).*

The excavated soils are proposed to be hauled to a permitted facility for soil treatment and/or disposal. Some of the soils have high [COC] concentrations. Therefore, a significant portion of the excavated soil would likely be classified as [waste type, e.g., Resource Conservation and Recovery Act (RCRA) hazardous waste]. Portions of the site known to have high [COC] concentrations based on prior sampling will be [describe how soil will be managed, e.g., directly excavated and loaded onto trucks for offsite disposal]. For other soils, [describe how these soils will be managed, e.g., attempts will be made during excavation and staging of materials to segregate the most impacted, hazardous soils using X-ray fluorescence instrumentation]. [Describe any stockpiling or segregation activities, e.g., Stockpiling and segregation activities on site will be limited by space constraints and excavation timeframes]. [Describe features to be protected during excavation, e.g., Existing onsite groundwater wells will need to be protected during excavation.] [Describe site backfill, grading, and restoration activities.]

[Material] will be injected into groundwater to decrease [COC] contaminant mass in the groundwater source area and to place vertical barriers to limit migration in the downgradient direction. A total of [#] injection wells are proposed with typical screen intervals of {depth range] feet bgs which includes [#] proposed on-site and [#] proposed off-site injection wells. A field injection pilot test will be conducted to determine the appropriate well spacing and injection flow rates. [Material] will be first injected into the source area perimeter wells to act as a containment barrier for the interior source area injections. Later, [material] will be injected into the downgradient wells to set up long-term barriers to [COC] migration. A minimum of two rounds of injection in groundwater are assumed in the first two years. After the injection rounds are completed, long-term groundwater monitoring for at least two years would be required to ensure that the source area has been adequately remediated and that the downgradient barriers are effectively reducing the remaining contamination that is migrating through groundwater. A Waste Discharge Requirements (WDR) permit is required from the RWQCB for injecting [material] into the subsurface and the application has been submitted. The field injection pilot test will be addressed under a separate Work Plan and performed after the RAP is finalized and the RWQCB has approved the WDR permit application. This RAP presents a conceptual design of the remediation system. The design will be finalized after the field pilot test is completed and will be presented in the Remedial Design and Implementation Plan report.

A land use covenant (LUC) that runs-with-the-land will be executed with the property owner and recorded to ensure that information about a property containing residual contamination is available to local governments, the public, prospective purchasers and tenants. The LUC would limit the use of the property to exclude sensitive uses such as residences, schools, hospitals, day care centers, and other uses such as an underground parking garage that could involve excavation into soil containing residual chemicals in soil without DTSC's prior approval. The LUC would also restrict future use *of groundwater underlying the Site until Site cleanup goals are achieved; and require non-interference with the groundwater monitoring system.*

An Operation and Maintenance Agreement will be executed and financial assurance required for monitoring of the groundwater and the LUC.

A tentative implementation schedule and a list of required permits for implementation of the preferred remedial alternative are presented in the report.

1.0 INTRODUCTION

Instructions: Provide a general overview of the site including location, purpose of the RAP, and contamination identified at the site.

This report provides the draft Remedial Action Plan (RAP) for the [site name], located at [address, city]. The site location is shown on Figure [#]. This RAP report was prepared by [consultant] in accordance with the Site [order or agreement], Docket No. [#], California Health and Safety Code section 25356.1 and DTSC RAP guidance. The purpose of this RAP is to summarize the environmental conditions at the site and use technical data to justify the selection of the remedial action to address the environmental impacts. The RAP defines the contamination, sets up remedial action objectives, and then describes the remedial action response to satisfy these remedial objectives. The soil and groundwater at the site is impacted with [contaminant(s) of concern (COCs)] from [type of site operations]. [Describe impacts to other media if applicable.]

1.1 SITE DESCRIPTION

Instructions: Because the RAP is intended to be a stand-alone document, provide basic information about the site and its owners/operators. Provide the site name and describe the site location. Also, present information about the physical setting of the site. Support the discussion with appropriate figures.

The site is located at [address] in [city], California. The property consists of [#] parcels with [County] Assessor's Parcel Number(s) [APN Number(s)]. See Figure [#] for a site location map. The site occupies approximately [#] acres ([lot dimensions]) of real property. [Describe onsite structures and features, if the site is occupied or vacant, paved or unpaved, and whether there are access controls.] Figure [#] depicts the site plan.

The subject property lies at an elevation of [#] feet above Mean Sea Level (msl). The ground surface in the vicinity is generally [describe the ground surface, e.g., flat]. The slope in the site vicinity is generally directed [direction, describe any controlling features]. [Identify any waterways or bodies near the site], which is the nearest surface water body, is located approximately [distance] to the [direction] of the site. The site is in a [identify type of zoning where site is located]. [Describe surrounding land use, e.g., There are commercial buildings to the east and north, offices to the west, and a four-lane highway to the south. The subject site is zoned [describe zoning]. Figure [#] depicts the regional site plan.

The Site is currently owned by [site owner]. [Discuss cultural resources, sensitive habitat, if present.]

1.2 SITE HISTORY

Instructions: Describe the site's industrial or commercial history. This section may include detailed information regarding the following:

- *A list of the previous owners and ownership dates;*
- *Any alternative or historical facility names;*
- *A discussion of the historical use of the site, previous business operations, and periods of operation;*
- *Possible contaminant sources;*
- *Information regarding historical non-hazardous wastes generated, received, disposed of, or managed at the site;*
- *Types, quantities, management practices, and rates of hazardous wastes historically generated, received, disposed of, or managed at the site;*
- *Historical aerial photographs;*
- *Processing or storage locations; and*
- *A chronology and description of known or suspected environmental incidents, spills, or releases of hazardous substances or pollutants.*

The following is an example description of the site history.

The Site operated as a [type of site operations] from [timeframe that site operated]. Operations included [list specific operations at the site]. The following chemical types were used at the site (approximate quantities used/generated are noted in parentheses): [List of chemical types and quantities used]. The site was leased to [Company X] in [year] and to [Company Y] in [year] for [purpose of leases]. It is unclear whether these two companies exercised their respective leases. The structures at the site were damaged by a fire in [year] and were subsequently razed in [year]. The subsurface structures were covered with fill soil, brought up to grade level and paved with asphalt in [year]. The site is currently a vacant lot.

1.3 SITE CHARACTERIZATION

Instructions: Provide an overview of the activities conducted to characterize the Site. Subsections can be used to describe each investigation, a group of investigations, or a summary of all of the investigation activities. If a separate report was not developed for the last sampling event, a separate section should be used to describe the activities in more detail.

During the past [#] years, several site investigations have been completed at the site. Sampling efforts have primarily been focused on [identify site features investigated e.g., former locations of an earthen containment trench to the north, the drainage sump to the northeast, three concrete-lined containment trenches to the northwest, the plating department to the west, and a closed clarifier to the east side of the site]. Soil samples were collected from [#] locations across the Site at depths ranging from the ground surface to [#] feet bgs. Soil gas samples were collected from [#] locations at [#] feet bgs. Between [year] and [year], [#] groundwater monitoring wells were installed. Groundwater samples were collected from [year] to [year]. Surface water samples were collected in [year] and [year]. Sediment samples were collected in [year].

[Soil, soil gas, groundwater, surface water, sediment] samples were collected and analyzed for [analytical parameters]. The results of these sampling events are described in the following documents: [list documents or reference a table containing these documents]. Figure [#] is a site map depicting soil boring, monitoring well and soil vapor probe locations.

1.4 PREVIOUS REMOVAL ACTIONS TAKEN [add this section, if appropriate]

Instructions: Provide information about previous removal actions taken to address contamination at the Site. These actions can include removal of underground storage tanks, spill responses, implementation of interim groundwater or soil vapor extraction and treatment systems, etc.

1.5 SITE GEOLOGY AND HYDROGEOLOGY

Instructions: Describe the site-specific geology and hydrogeology in a detail sufficient to support the proposed site cleanup. Include information on the regional geology and hydrogeology as necessary to provide context to the site-specific descriptions. Group the information into appropriate subsections and provide supporting figures to illustrate the discussion (e.g., geologic cross-sections, maps).

Describe the soil types, lithology, and geologic formations present. Identify the location and thickness of fill areas. Discuss structural features that might affect contaminant migration (e.g., preferential pathways, features that may impede the movement of contaminants). Address geologic heterogeneity and complex stratigraphy.

Identify the water-bearing units beneath the site, the position and thickness of the units, the depth to groundwater, and the groundwater flow rate and direction in each unit. For sites with numerous water-bearing units, it may be appropriate to include this information in a table. Describe the locations of springs/seeps, perched aquifers, and nearby extraction/production wells.

Describe the location of nearby water bodies, wetlands, floodplains, and other hydrologic features. If appropriate, describe surface water flow, flood frequency, drainage direction, and topography.

The following is an example description of site geology and hydrogeology.

1.5.1 Regional Geology

The Site is located in the central portion of the Coastal Plain of Los Angeles County. The Coastal Plain makes up the northwest end of the Peninsular Ranges Geomorphic Province. The Coastal Plain is bounded by the Santa Monica Mountains to the north, the Puente Hills to the east-northeast, and the Pacific Ocean to the south. The Santa Monica Mountains are approximately six miles north of the site.

The stratigraphic units present at the site include Recent Alluvium, the Lakewood Formation of upper Pleistocene age, and the San Pedro Formation of lower Pleistocene age. The Recent Alluvium consists of stream channel and flood plain units deposited by the Los Angeles River. The Recent Alluvium extends from below fill material or ground surface to a maximum depth of approximately 50 feet bgs. The Lakewood Formation of upper Pleistocene age underlies the Recent Alluvium and includes all upper Pleistocene deposits. Sediments consist of fine-grained alluvial deposits in the upper portion with basal deposits of coarse-grained sands and gravels. The San Pedro Formation of lower Pleistocene age underlies the Lakewood Formation and includes all lower Pleistocene deposits. The San Pedro Formation is composed of stratified sand with some beds of fine gravel, silty sand, and silt.

The site is located within the tectonically active Coastal Plain of Southern California that has several major active faults. The Newport-Inglewood Fault Zone is located approximately 4.5 miles west of the site and trends northwest to southeast towards Huntington Beach. Parallel fault zones west of the Newport-Inglewood Fault Zone include the Palos Verdes Hills Fault Zone and San Pedro Bay Fault Zone. The Hollywood fault is located approximately eight miles northwest of the site and trends southwest to northeast along the base of the Santa Monica Mountains.

Recent Alluvium and the Lakewood Formation are generally flat lying with a general dip towards the south in the Coastal Plain. Folding from tectonic activity has been observed in sediments of the San Pedro Formation within the Paramount Syncline south of the site. The axis of the Paramount Syncline lies approximately 0.5 miles south of the site. Folding in the San Pedro Formation north of the Paramount Syncline may have reversed the southerly dip direction of the overlying Lakewood Formation and Recent Alluvium [Source, Date].

1.5.2 Regional Hydrogeology

The site is located in the northern portion of the Central Groundwater Basin. The California Department of Water Resources has mapped nine aquifers and associated aquitards in the site area. The aquifers, from shallowest to deepest are Semi-perched, Gaspur, Exposition, Gage/Gardena, Hollydale, Jefferson, Lynwood, Silverado, and Sunnyside. Low permeability units (aquitards) that act as barriers to infiltration of groundwater separate the aquifers. Table [#] summarizes the regional hydrogeologic units in the vicinity of the site.

Table [#]. Summary of Regional Hydrogeologic Units Found Beneath the Site (listed in order of increasing depth)

UNIT	LOCATION	LITHOLOGY	THICKNESS AND/OR DEPTH	NOTABLE CHARACTERISTIC
Semi-perched aquifer	*On or near the surface of much of the Coastal Plain of Los Angeles County*	*Coarse sands and gravels of both Recent and late Pleistocene age*	*0 to 60 feet thick*	*May contain significant amounts of unconfined water where more than 20 feet thick*
Bellflower aquiclude	*Directly beneath the Semi-perched aquifer.*	*All fine-grained sediments extending from ground surface, or from base of Semi-perched aquifer, to Gaspur aquifer.*	*~40 feet thick with a base lying at a depth of ~68 feet bgs beneath the site.*	*Restricts vertical movement of groundwater*
Gaspur aquifer	*Present, but may be merged with the Exposition aquifer in the immediate vicinity of the site*	*Basal coarse facies of Recent series. Continental stream deposits. Ranges in size from boulder gravel to silt/clay*	*Base of the Gaspur aquifer is at a depth of ~109 feet bgs beneath the site.*	
Exposition aquifer	*Occurs in the Lakewood Formation below the Bellflower aquiclude and Gaspur aquifer*	*Consists of one to four discontinuous coarse members. Materials range in size from coarse gravels to clay, with fine deposits separating the lenticular sandy and gravelly beds.*	*Occurs from depths of ~100 to 125 feet bgs beneath the site.*	
Gage aquifer	*Most extensive Lakewood Formation aquifer underlying the region around the site*	*Comprised primarily of sand with gravel and interbedded silts and clays.*	*Extrapolated to be ~20 feet thick with the base at a depth of ~200 feet bgs beneath the site.*	
Lynwood aquifer	*Extends throughout the region*	*Continental deposits of red brown and yellow gravels, sands, silts and clays. Marine deposits of sand and gravels and blue to black clays and silts.*	*Extrapolated to be ~50 feet thick beneath the site with the base at ~470 feet bgs.*	
Silverado aquifer		*Continental deposits of yellow to brown fine sand and gravel interbedded with yellow to brown silt. Marine deposits of blue to gray sand, gravel, silt, and clay.*	*~125 feet thick beneath the area of the site. Lies at a depth of ~750 feet bgs*	*Important aquifer for groundwater production wells in the Coastal Plain region*
Sunnyside aquifer		*Marine deposits of blue, coarse-grained sands/ gravels interbedded with fine-grained blue sandy clay and clay*	*~650 feet thick with the base of the aquifer at approximately 1,200 feet bgs*	

Notes: The Gardena, Hollydale, and Jefferson aquifers are not located beneath the site and therefore are not described in this table.
[Source, Date].

1.5.3 Site-Specific Geology

The Site is underlain by fill material to a maximum depth of approximately 6 feet bgs. The fill consisted of dark brown or dark reddish brown very fine- to fine-grained sand with a trace of silt and construction debris.

Interbedded clays, silts, and sands associated with the Recent Alluvium unit extend from below fill material or ground surface to a maximum depth of approximately 50 feet bgs. The Lakewood Formation of upper Pleistocene age underlies the Recent Alluvium and includes all upper Pleistocene deposits. Sediments consist of fine-grained alluvial deposits in the upper portion with basal deposits of coarse-grained sands and gravel.

The San Pedro Formation of lower Pleistocene age underlies the Lakewood Formation and includes all lower Pleistocene deposits. The San Pedro Formation is composed of stratified sand with some beds of fine gravel, silty sand, and silt. Abundant gravel occurs at a depth from 343 feet bgs to a total depth of 425 feet bgs [Source, Date].

1.5.4 Site-Specific Hydrogeology

The Semi-perched aquifer, if present in the Recent Alluvium, is dry beneath the Site. Gravels and sand of the Gaspur aquifer occur at a depth of 47 to 88 feet bgs. The Gaspur aquifer is dry in the Site vicinity. Gravels of the Exposition aquifer occur at a depth of 100 feet bgs to 120 feet bgs. The Exposition aquifer is dry in the Site vicinity.

Fine- to medium-grained sands and clays beginning at a depth of 130 feet bgs underlie the gravels of the Exposition aquifer. Beds of fine- to medium-grained sands within this interbedded sequence of sands and clays are typically 1 to 4 feet thick. The confined sand beds are dry to moist to a depth of approximately 160 feet bgs and saturated and under higher confined pressure below a depth of 175 feet bgs. Groundwater encountered in these sand beds is considered the "uppermost water-bearing" unit [Source, Date].

Groundwater at the site occurs in two water-bearing units: an upper water-bearing unit at approximately 150 to 160 feet bgs and a deeper water-bearing unit at approximately 355 feet bgs. Groundwater in the upper water-bearing unit flows toward the north to northwest under a gradient of 0.02 feet/foot. Groundwater was observed in soils collected from well [#] at an approximate depth of 154 feet bgs. Groundwater was measured in well [#] at a depth of 151.73 feet bgs.

1.6 BACKGROUND CONCENTRATIONS

Metals occur naturally in soils. EPA (1989) and DTSC (1997) guidance indicates that risk evaluations for metals are only necessary when the levels exceed naturally occurring background concentrations. To distinguish between site-related contamination and naturally-occurring or ambient contaminant levels, a study was conducted to identify background levels of metals.

Metals in soils at the site that are elevated above naturally occurring background concentrations were identified using [method, e.g., statistical analyses]. The [method] compared metal concentrations in soil at the site to [reference concentrations, e.g., background soil data set]. Background data for [#] metals, including [metals], were obtained from soils sampled at [location]. Based on the results of the [method], [#] metals exceeded their background levels. These metals include [metals].

2.0 NATURE AND EXTENT OF CONTAMINATION

Instructions: Describe the conceptual site model (CSM), including the fate and transport of contaminants and the full nature and extent of contamination in each of the environmental media (air, surface water and sediments, soils and vadose zone, groundwater) at the site. It is important to describe the horizontal and vertical extent of contaminants in all media, both at the site and migrating from the site. To the extent possible, describe how the contamination relates to specific source areas identified during the investigation. The lateral and vertical extent of groundwater contamination should generally be defined to Basin Plan standards. Soil contamination should generally be defined to the residential soil screening levels.

The conceptual site model (CSM) is a summary and evaluation of the site information that will help make decisions regarding the path moving forward. Using all available information, the CSM distills what is already known about the nature and extent of contamination, the media of concern, and the potential receptors/exposure routes. The CSM is used to identify the information needed to achieve project goals. A project's CSM will evolve and mature as project work progresses. The maturity of the CSM reflects both the level of site understanding and the amount of information and complexity of analysis required to support the decisions that need to be made.

The project team should agree upon the components of a project-specific CSM during the scoping meeting. At a minimum, a project-specific CSM should consist of:

- *Plot Plans and Cross Sections: Include figures with: isoconcentration contours showing the type, concentration and extent of contamination in all affected media; lines/shading showing locations (plan views) and depths (cross-sections) where contaminants exceed site-specific screening levels for human health and, if applicable, screening levels for water quality protection.*
- *Proposed Redevelopment Drawings and/or Engineering Plans: Conceptual and technical drawings showing the exact location and dimensions of the proposed buildings and a detailed explanation of the proposed uses.*

- *Data Summary Tables: Tables presenting the analytical methods, detection limits, maximum and minimum concentrations, and frequency of detection for each contaminant, and which contaminants exceed the site-specific screening levels for human health and water quality protection.*
- *Pathway Identification/Evaluation and Screening Levels: An exposure pathway flow chart should be developed and agreed upon by the project team. The project team should also agree upon the site-specific screening levels, including the use of Preliminary Remediation Goals (PRGs), California Human Health Screening Levels (CHHSLs), and Ecological Screening Levels (ESLs).*

The soil sample collection locations referred to in the following discussion are shown in Figure [#] and the sample results are shown in Table [#]. [Summarize findings of the site investigation.] The groundwater collection locations referred to in the following discussion are shown in Figure [#] and the sample results are shown in Table [#]. [Summarize findings of the site investigation.]

2.1 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) has been developed to address: (1) the distribution of chemicals; (2) potential sources of chemicals; and (3) affected media. Based on the results of previous investigations and an understanding of the site history, activities associated with past operations at the site by [name] between [year] and [year] most likely resulted in the release of chemicals to the subsurface [Reference Information Source: Consultant, Report, Date of Report]. Material and waste handling procedures employed by [operator] may have resulted in [leaks, spills, and/or releases of hazardous substances from potential sources, e.g., the former waste management units or hazardous materials storage areas] [Reference Information Source: Consultant, Report, Date of Report]. As indicated in Section [#], [describe source areas, e.g., the former waste management units were used primarily for waste containment and some treatment] are shown along with other site features on Figure [#]. An updated CSM is presented in the [Reference Information Source: Consultant, Report, Date of Report].

On the basis of our current understanding of the site, the CSM is graphically presented on Figure [#]. [Discuss key elements of the CSM,].

The following is an example description of a CSM.

As described in Section [#], and graphically depicted on Figure [#], the nature of the Site's subsurface lithology (e.g., the presence of the clay and alluvium materials) has influenced the transport of chemicals from the source areas into the subsurface. Releases of hazardous materials and/or waste from aboveground areas (e.g., drainage ditches, drum storage areas) as well as the underground sump areas are suspected to have migrated through the upper [#]-foot fill layer of predominantly silty sand/gravel mixtures, into the [#]-foot laterally continuous low-permeability clay layer, and into the Upper aquifer. As indicated by the soil sample laboratory analytical data from previous *investigations at the site, the main distribution of chemicals in the vadose zone appears to be predominantly within the clay layer at areas of the site coinciding with previous use or storage of chemicals.*

2.2 SOIL CONTAMINATION

[COC(s)] are the COCs for soil. Based on the results of investigations conducted at the site, the extent of soils with [COC(s)] concentrations in excess of the site-specific soil screening levels has been adequately estimated for remedial planning purposes and is graphically presented on Figure [#].

[COC] has been detected at concentrations up to [#] mg/kg. As shown in Figures [#], the contamination extends to a depth of [#] feet bgs, with the highest concentrations detected above [#] feet bgs. [COC] was detected at [site feature] at concentrations up to [#] mg/kg, with the highest concentrations detected at a depth of [#] feet bgs. Figure [#] shows the lateral extent of [contaminant] in shallow soil. A vertical profile to illustrate the general occurrence of chemicals identified within the soil is presented on Figure [#]. A summary of historical chemical data for [contaminant] in soil is included in Table [#].

2.3 GROUNDWATER CONTAMINATION

Groundwater underlying the Site [has/has not] been impacted by COCs detected in soil. Groundwater sampling was initiated in [year] after detection of elevated concentrations of [COC] in soil. [#] groundwater wells monitor the upper water-bearing unit and [#] groundwater wells monitor the deeper water-bearing unit. [Describe findings, e.g., [COCs] have only been detected in the upper water-bearing unit.]

The [contaminant(s) of concern] groundwater plume is presented on Figure [#]. As shown in the figure, the highest concentration [COC] contours [#] mg/L, [#] mg/L) cover [describe area]. The plume [does/does not] extend offsite. [If the plume extends offsite, describe the extent, e.g., The plume is generally narrow in width and elongated downgradient. It is estimated to be [#] feet long and [#] feet wide based on the [#] mg/L contour.] The contours were estimated using data obtained by [Consultant] during the most recent sampling event ([month, year]).

3.0 REMEDIAL ACTION OBJECTIVES

Instructions: RAOs are statements that define qualitative goals and quantitative levels of cleanup that you intend to achieve for each of the contaminants identified at the site. Your selection of RAOs will be based on the intended land use for the site and groundwater use in the area of the site. This section should also summarize the rationale for deciding which contaminants will be remediated and their respective cleanup goal. The RAOs should be specific for the following:

- *Chemicals of concern;*
- *Exposure pathways;*
- *Potential receptors that will be addressed;*
- *Cleanup goals;*
- *Location(s) or point of compliance at which the cleanup goals will be achieved; and*
- *Timeframe for which remedial actions will be completed.*

This section should also identify and discuss the ARARs applicable to the Site. This information can be presented in a table or appendix.

Site characterization has revealed the presence of chemicals of potential concern in [soil, groundwater, surface water, soil gas, air] at the site. Remedial Action Objectives (RAOs) have been developed based upon the current environmental conditions and the current and reasonably anticipated future uses of the site. Based on the RAOs, cleanup goals were developed that establish specific concentrations of chemicals in environmental media that are protective of both human health and the environment.

In addition, a review of pertinent laws, regulations, and other criteria was performed to identify applicable or relevant and appropriate requirements (ARARs) and other criteria to be considered (TBC) for remediating the site. A summary of the potentially applicable ARARs and TBCs is presented in [Table # or Appendix #].

A discussion of regulatory requirements, human health risks, and the remedial goals developed for the site is presented below.

3.1 SUMMARY OF RISK ASSESSMENT

Instructions: Describe the risk screening/assessment conducted to evaluate potential risks and hazards associated with the chemicals of concern at the site. Identify the chemicals of concern for each environmental media. Identify background concentrations and how they were developed if necessary to help identify chemicals of concern. Discuss the most likely receptors and pathways.

The baseline human health risk assessment (HRA) [Source, Date] evaluated the potential for human health impacts from chemicals released due to past activities at the [site name] Site. The results of the baseline HRA provide a basis for decisions regarding further action at the Site. The baseline HRA addressed the potential human health risks associated with current and future exposures to environmental media at the Site.

For risk assessment purposes, chemicals in soil were grouped according to depth below ground surface (bgs): surface soil ([define depth range, e.g., 0 to 1 feet bgs]), subsurface soil ([define depth range, e.g., 1 to 10 feet bgs]), and deeper soils ([define depth, e.g., greater than 10 feet bgs]). Under certain exposure scenarios, it was assumed that human receptors might come into direct contact with chemicals in the surface and subsurface soils up to a depth of [#, e.g., 10 feet bgs]. Chemicals detected in deeper soils were not evaluated for direct human exposure. However, they were evaluated for indirect exposure from the inhalation of VOCs emitted from subsurface sources.

USEPA (1989) and DTSC (1997) guidance indicate that risk evaluations for metals are only necessary when the levels exceed naturally occurring background concentrations. Metals in soils at the site that are elevated above naturally occurring background concentrations were identified using statistical analyses. The statistical analyses compared metal concentrations in soil at the site to metal concentrations in similar local soils. Background data for [#] metals including [list metals], were obtained from soils sampled at [location]. Based on the results of the statistical testing, the following metals were identified as chemicals of potential concern (COPCs) at the site: [List metals identified as COPCs].

There are no water production wells located within three miles of the site that are screened through the first water-bearing unit encountered at a depth of approximately [#] feet bgs. In accordance with the Basin Plan, the first water-bearing unit is classified as [classification (e.g., potential drinking water source (MUN)] [Consultant, Date of Report(s)]. Therefore, all of the detected organic compounds were identified as chemicals of potential concern (COPC) in groundwater. The primary inorganic compound identified as a COPC in groundwater was [COPC].

At the site, the most likely receptors for exposure to soil were assumed to be [receptors, e.g., industrial workers, construction workers]. Also, to assess unrestricted site use, future onsite residents were assumed to be exposed to the COPCs in soil. These receptors could be exposed to COPCs is via [list exposure scenarios and associated exposure pathways].

The overall risk estimate for construction workers exposed to the top 10 feet of soil is approximately [#], which exceeds the US EPA target risk range of 10^{-6} and 10^{-4}. The majority of this risk is due to [COPC(s)]. The overall risk for hypothetical future onsite residents is predominantly due to [COPC(s)] in soil. Overall, the calculated risks indicate that assumed exposure to COCs in soils contribute to risk estimates that exceed the point of departure of 1×10^{-6} for future receptors. Exposures to COPCs in soils also contribute to Hazard Indices [that exceed/do not exceed] the noncarcinogenic threshold of 1.

3.2 REMEDIAL ACTION OBJECTIVES

Instructions: Identify the site-specific RAOs.

The following RAOs have been developed for the [site name] Site:

- Minimize or eliminate potential exposure of humans [receptor, e.g., industrial/commercial workers, hypothetical future residents] to [COC(s)] in surface or shallow soil through [pathway, e.g., inhalation, dermal absorption, and ingestion];

- Reduce the human health-based risks associated with onsite [COCs] contamination in soil to a level that is acceptable for [land use] land use;
- Prevent or control potential exposures to contaminants in deeper soil and groundwater;
- Minimize the potential for COCs in soil to impact groundwater; and
- Prevent or control further [COC(s)] groundwater plume migration horizontally or vertically to deeper aquifers and thus eliminate the potential migration of contaminant to drinking water wells.

3.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Instructions: If not addressed in a separate Feasibility Study Report, identify and discuss the ARARs applicable to the Site. A table may be used to summarize this information.

Investigations of the Site indicate the presence of the COCs in [media] exceeding the site RAOs. The most effective remedial action has been determined to be removal consisting of [remedy]. The applicable or relevant and appropriate requirements (ARARs) for the Site are summarized in Table [#].

3.4 CLEANUP GOALS

Instructions: Identify and discuss the cleanup goal established for each COC in each impacted environmental medium at the Site.

Risk-based cleanup goals were selected for the Site based upon [basis for goals,e.g., the California Human Health Screening Levels (CHHSLs) and background concentrations]. The cleanup goal for [COC] is a [maximum concentration/average concentration/ background concentration] of [#] mg/kg.

3.5 AREAS EXCEEDING CLEANUP GOALS

Instructions: Identify the area where a response action is required to address environmental media containing COCs above site cleanup goals.

Soil remedial measures will generally be required to depths ranging from approximately [#] to [#] feet bgs to meet the soil cleanup-level goals. In select areas, deeper soil remediation may be required to the depth of the top of the first encountered groundwater. As shown on Figure [#], the areal extent of soil with [COC] concentrations exceeding the soil cleanup-level goal is approximately [#] square feet (ft^2) located [describe area]. As such, the total in-place volume of affected soil requiring remediation is estimated to range from approximately [#] cubic yards (cy; approximately equivalent to [#] tons) to [#] cy (approximately equivalent to [#] tons). The actual volume of affected soil will depend on the distribution of target contaminants in soil based on existing chemical data, confirmation sample laboratory analytical results, and limitations of the remedial measure implemented.

Groundwater remedial measures will be required to address [COC(s)] in the upper water-bearing unit. As shown in Figure [#], the groundwater plume is estimated to be [#] feet long and [#] feet wide based on the [#] mg/L contour.

4.0 SUMMARY OF FEASIBILITY STUDY

Instructions: Describe the process of identifying and screening remedial technologies to develop remedial alternatives. Identify the remedial action alternatives. Summarize the individual analysis of each alternative against the nine federal criteria. Present a comparative analysis of the alternatives. Identify the recommended remedial alternative.

If the project team determines that the PT&R process is appropriate to address COCs in soil, the Feasibility Study evaluation may be incorporated into the RAP document. The PT&R process presents three commonly evaluated alternatives to address metals in shallow soil.

Site-specific contaminants and media of concern will dictate the need for evaluation of additional and/or different alternatives. Any alternative being considered for the site should follow the analysis process outlined in this section.

A draft Feasibility Study Report [Date] for the [Site Name] site was submitted to the DTSC. The report discussed applicable remedial technologies for the impacted soils and groundwater at the site followed by an evaluation of remedial alternatives in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation/Feasibility Study (RI/FS) guidance* (EPA, 1988). The remedial alternatives were evaluated separately for the impacted soil zone and the impacted groundwater zone.

4.1 TECHNOLOGY SCREENING

Instructions: Describe the process used to screen technologies or discuss the application of the PT&R Process.

During the screening of technologies, a wide range of technology types from in-situ to ex-situ and containment to active removal were evaluated. The technologies were evaluated for their implementability, effectiveness, and cost. The technology types and process options that were considered to be technically implementable were evaluated using the criteria of effectiveness, implementability and relative cost. Those technologies that had poor implementability, effectiveness, cost, or a combination thereof were not retained for further evaluation. In cases where there were multiple variations of the same technology that were retained, a representative technology was selected for that technology type.

4.2 IDENTIFICATION OF ALTERNATIVES FOR SOIL

Instructions: Identify and describe the remedial alternatives for soil.

After the initial screening of technologies, [#] remedial alternatives were retained for in-depth evaluation to address COCs in soil.

4.2.1 Alternative 1 – No Further Action

As required by the DTSC, the No Further Action alternative has been included to provide a baseline for comparisons among other removal alternatives. The No Further Action alternative would not require implementing any measures at the site, and no costs would be incurred. This action includes no institutional controls, no treatment of soil, and no monitoring.

4.2.2 Alternative 2 – Soil Containment/Capping-in-Place

This alternative would consist of capping the surface of the impacted areas with [describe cap (e.g., a two-foot engineered soil cover, asphalt or asphalt/concrete pavement]. The cap would be used to minimize the potential to come into contact with the contaminated soil. To achieve the RAOs, it has been determined that soil at [locations] requires capping (see Figure [#]). If capping is selected, a total of [#] acres of affected soil will need to be covered.

A land use restriction will be executed between DTSC and the property owner and recorded to ensure that the cap is operated and maintained and that future uses of the property are consistent with the operation and maintenance (O&M) of the cap. An O&M plan will be submitted and approved by DTSC. An O&M Agreement signed with DTSC specifying the O&M requirements and providing financial assurance for future O&M of the cap.

4.2.3 Alternative 3 – Soil Excavation/Off-site Disposal

The excavation/off-site disposal alternative would consist of removing and transporting impacted soil to an appropriate, permitted off-site facility for disposal. Excavation includes using loaders, backhoes, and/or other appropriate equipment. Excavation operations will generate dust emissions. Suppressant, water spray, and other forms of dust control may be required during excavation, and workers may be required to use personal protective equipment to reduce exposure to COCs. Sloping excavation sidewalls may result in increased volume of soil requiring excavation. Confirmation soil sampling and analysis would be conducted to verify that cleanup criteria were met at the excavation bottom and perimeter. Excavation will require soil stockpiling, prior to [treatment, disposal]. To achieve the RAOs, soil at [location(s)] within the site requires removal to depths ranging up to [#] feet (see Figure [#]. The volume of soil removed is projected to be between [range] cubic yards ([range] tons).

[If cleanup to unrestricted land use standards is not achieved by this alternative, a land use covenant must be proposed as part of the alternative and the specific restrictions described. For example, to ensure that the property is not developed for sensitive land uses such as residential, schools, day care centers, hospitals, parks. Also need to consider whether an O&M plan and an O&M agreement are required. If they are necessary, this should be discussed in the description of the alternative.]

4.3 IDENTIFICATION OF ALTERNATIVES FOR GROUNDWATER

Instructions: Identify and describe the remedial alternatives for groundwater.

For the groundwater, the remedial alternatives evaluated were: [list remedial alternatives].

4.4 EVALUATION OF ALTERNATIVES

Instructions: Identify and describe the criteria used to evaluate the remedial alternatives. Reference a table or appendix presenting the evaluation.

The listed remedial alternatives were evaluated using the EPA CERCLA nine-criteria analysis described in the RI/FS guidance.

- Overall Protection of Human Health and the Environment - Describes how the alternative as a whole would achieve and maintain protection of human health and the environment. Evaluates protection of human health in terms of the potential risks that remain after cleanup objectives have been met;

- Compliance with ARARs - Describes how the alternatives comply with Applicable or Relevant and Appropriate Requirements;

- Long-Term Effectiveness - Evaluates the long-term effectiveness of each alternative in maintaining protection of human health and the environment after the remedial goals have been met.

- Reduction of Toxicity, Mobility, and Volume through Treatment - Evaluates the anticipated performance of each alternative with respect to the following factors:
    - The treatment process to be used and the materials to be treated;
    - The amount of hazardous substances that will be treated or destroyed;

  - The degree of expected toxicity, mobility, and volume reduction as compared to conditions prior to the remedial action;
  - The degree to which total destruction is achieved;
  - The type and quantity of residual chemical compounds; and
  - The degree to which the alternative addresses the principal risk.

- Short-Term Effectiveness – Evaluates the effects of each alternative during construction, implementation, and operation are assessed. Factors considered include protection of the community and workers during remedial operations, the time required to implement the alternative and to achieve the remedial goals, and the potential adverse environmental impacts that may result.

- Implementability – Evaluates the technical and institutional feasibility of implementing a particular alternative. Technical feasibility includes the availability of treatment, storage, and disposal services, and the availability of necessary equipment and skilled workers to implement the particular process. Institutional feasibility includes obtaining the necessary permits or regulatory concurrence.

- Cost – Estimates the amount of capital and operation and maintenance (O&M) costs to implement each alternative. The focus should be to make comparative estimates for alternatives with relative accuracy so that cost decisions among alternatives will be sustained. The capital cost estimates developed for this evaluation include equipment, construction, engineering, and permitting and construction management. The O&M cost estimates developed for this evaluation include those costs necessary to operate and maintain the remedy.

- Regulatory Agency Acceptance – Evaluates the anticipated administrative and technical issues that state or other agencies may have concerning the alternative. Actual assessment of regulatory agency acceptance is dependent on comments received during the public comment period.

- Community Acceptance – Evaluates each alternative in terms of currently available public input and the anticipated public reaction to the alternative. However, actual assessment of community acceptance is dependent on comments received during public comment period.

See Table [#] for this evaluation.

4.5 COMPARATIVE ANALYSIS

Instructions: For each evaluation criterion, describe the advantages and disadvantages of each remedial alternative and how the alternatives compare with each other. Conclude the discussion with a clear statement of the best ranked alternative for each media. If preferred, much of this discussion could be presented in tabular format.

4.6 DESCRIPTION OF RECOMMENDED REMEDIAL ALTERNATIVE

Instructions: Describe the recommended remedial alternative for each impacted media. Indicate whether the remedy includes any land use restrictions. If applicable, specify and list the land use restrictions and indicate whether a O&M plan and/or agreement (including financial assurance) is part of the remedy.

4.6.1 Recommended Remedial Alternative for Soil

Alternative [#] is the recommended alternative for soil. To remediate soils, [identify remedy]. Long-term monitoring and land use controls [are/are not] required as part of this remedy.

The recommended alternative assumes excavation of the soils impacted with [COCs] to prevent the potential for direct exposure. As a conservative measure, this alternative assumes the entire site ([#] feet by [#] feet) is excavated down to [#] feet bgs (Figure [#]). The excavation will require sloping of the sidewalls to protect structures located in the vicinity of the site. It is estimated that the total in-place volume of impacted soil for excavation is about [#] cubic yards. This alternative will include removal of any subsurface structures prior to completing the excavation. It is assumed that excavated soils will be hauled to a permitted facility for soil treatment and/or disposal. Given that some of the soils are impacted with high concentrations of [COCs], a significant portion of these soils would likely be classified as [waste type, e.g., RCRA hazardous waste].

Clean fill will be imported to backfill the excavation. The backfill will be compacted appropriately to meet geotechnical requirements amenable for typical future site uses.

[Include a paragraph indicating whether land use restrictions are required. List restrictions, as applicable. If applicable, specify what land use restrictions would be imposed. Indicate whether an O&M Plan and Agreement, including financial assurance are part of the final remedy.]

The following is an example paragraph pertaining to the land use restrictions, the O&M plan, and financial assurance.

A land use covenant is required to place some use restrictions on the Site because [COCs] will remain in soil above unrestricted use standards at the Site.

4.6.2 Recommended Remedial Alternative for Groundwater

Alternative [#] is the recommended alternative for groundwater. To remediate the groundwater, [identify remedy]. Long-term monitoring and land use controls [are/are not] required as part of this remedy.

The groundwater remediation will consist of the [describe remedy] to remediate the groundwater source area. [Describe the groundwater remedy.]

The following is an example description of a groundwater remedy.

Based upon [basis, e.g., pilot study conducted at the Site], [#] [unit, e.g., gallons, pounds] of [material] will be injected into a total of [#] injection wells (Figure [#]) installed throughout the groundwater source area. Injection wells will be installed on [#] foot centers, assuming a radius of influence of about [#] feet. A Waste Discharge Permit (WDR) would be required from the RWQCB for this activity. [#] groundwater monitoring wells will be placed within and downgradient of the treatment area to monitor treatment progress. [#] injection rounds are assumed [injection schedule, e.g., quarterly, once a year]. After the first round of injection, [frequency, e.g., monthly] sampling of groundwater monitoring wells will be conducted for [time period, e.g., the first three months, followed by quarterly sampling for the next two years]. Groundwater monitoring will continue until site RAOs are achieved. However, the sampling frequency may be reassessed after [timeframe, e.g., the first two years of sampling].

[Include a paragraph indicating whether land use restrictions are required. List restrictions, as applicable. If applicable, specify what land use restrictions would be imposed. Indicate whether an O&M Plan and Agreement, including financial assurance are part of the final remedy.]

The following is an example paragraph pertaining to the land use restrictions, the O&M plan, and financial assurance.

A land use covenant is required to place some use restrictions on the Site because contaminants remain in groundwater above unrestricted use standards at the Site. Institutional controls will be required to restrict future groundwater use at the site. Land use restrictions will be required to retain groundwater monitoring wells and injection wells onsite. An Operation and Maintenance Plan and financial assurances would also be required to ensure that appropriate long term monitoring of the groundwater and land use restrictions are conducted.

4.7 JUSTIFICATION OF SELECTED REMEDY

Instructions: For each impacted media, provide the justification for the selected remedy.

4.7.1 Justification for Selected Soil Remedy

The following is an example justification for selecting a soil remedy.

The preferred remedy removes soil containing COCs above Site cleanup goals to eliminate direct exposure and enable redevelopment of the Site. The primary factors which supported the selection of Alternative [#] (soil excavation and off-site disposal) are: (1) this alternative is protective of human health and the environment, is cost *effective, and is technically feasible; (2) the shorter duration of remedial action will reduce the impact to active site operations; and (3) it will help minimize the potential for contaminants to migrate to groundwater.*

Alternative [#] for soil was rated moderate to good for the threshold criteria (overall protection of human and environment and compliance with ARARs). It was rated moderate to good for the balancing criteria such as long term effectiveness, reduction of toxicity, mobility and volume, short term effectiveness, and implementability. Furthermore, it was moderate in cost and hence the most cost effective of the remedial alternatives that meets the threshold criteria requirements.

4.7.2 Justification for Selected Groundwater Remedy

The following is an example justification for selecting a groundwater remedy.

For groundwater, the remedy proposes to inject [material] to decrease [COCs] contaminant mass in the source area to achieve the RAOs.

The primary factors which supported the selection of Alternative [#] (in situ treatment) are that (1) this alternative is protective of human health and the environment, is cost effective, and is technically feasible; and (2) the timeframe to achieve the RAOs is reasonable and will not interfere with active site operations.

Alternative [#] for groundwater was rated moderate to good for the threshold criteria (overall protection of human and environment and compliance with ARARs). It was rated moderate for the balancing criteria such as long term effectiveness, reduction of toxicity, mobility and volume, short term effectiveness, and implementability. Furthermore, it was moderate to good in cost and hence the most cost effective of the remedial alternatives that meets the threshold criteria requirements.

5.0 PRELIMINARY REMEDIAL DESIGN FOR SOIL REMEDY

Instructions: Identify the steps in the remedial action and describe the key elements for each step. The following example language is biased toward the excavation/off-site disposal alternative. Analogous sections and content should be included for other alternatives or other components of alternatives that are proposed. If the design is relatively simple and the project team agrees, it may be possible to include the design within this section, rather than as part of a subsequent separate submittal.

This section presents a preliminary remedial design for the various phases of the soil remedy. [Indicate whether additional details will be presented in the Remedial Design and Implementation Plan to be completed later.]

Implementation of the recommended remedial action consists of a series of separate tasks. The following sections discuss each task and the activities of which they consist:

selecting excavation locations (Section 5.1); permits, notifications and site preparation (Section 5.2); excavation methodology (Section 5.3); control measures (Section 5.4); air monitoring during excavation (Section 5.5); and field variances (Section 5.6).

5.1 PERMITTING

Instructions: Discuss the applicable agencies and notification and/or permits that will need to be made or obtained, respectively, prior to the initiation of any field activities.

It is expected that the following permits may be required for excavation operations:

- A grading permit from the City of [city name].
- Building department permits from the City of [city name] Building and Safety Department.
- Well abandonment permits will be needed from the [county name] County Department of Health Services (DHS).
- An Air District permit [will/will not] be required due to the concentrations of [COCs] in the soil.
- [Name] will obtain a U.S. EPA Identification number as the generator of the waste.
- [List other permits that may be required, such as a stormwater pollution prevention permit (SWPPP), air district permit or notification, Waste Discharge Requirements permit, well replacement permits].

The excavation and soil handling will be conducted by a qualified, HAZWOPER-trained, contractor using conventional earthwork equipment. The contractor will prepare a Site Specific Health and Safety Plan (HASP), which will address identification of hazards, hazard mitigation, safe work practices and emergency response procedures for the project. The site-specific HASP will be prepared to comply with 29 CFR 1910.120 and 8 CCR GIS0 5192.

5.2 UTILITY CLEARANCE

Instructions: Indicate how utilities will be cleared. If available, provide a figure showing locations.

Prior to commencing with excavation activities, Underground Service Alert (USA) will be contacted at least 48 hours in advance to identify the location of utilities that enter the property. All proposed excavation areas will be clearly marked with white paint or surveyors flagging as required by USA. USA will contact all utility owners of record within the Site vicinity and notify them of the intent to excavate. All utility owners of record will be expected to clearly mark the position of their utilities on the ground surface throughout the designated area.

[Describe other applicable utility clearance measures.]

5.3 SITE PREPARATION

Instructions: Discuss site preparation activities, such as clearing and grubbing, pavement removal, demolition activities, access control, installation of storm water best management practices (BMPs), set up of decontamination areas, etc.

The following is an example description of site preparation methods.

Conventional construction equipment, such as a front-end loader equipped with a backhoe, will be used to remove the asphalt cover and any remaining concrete footings, concrete foundations, buried utility piping, and a concrete clarifier that reportedly remains on-site. Stained or corroded asphalt, concrete, and/or piping will be segregated and disposed as hazardous waste. The remaining material will be disposed as construction debris.

5.4 EXCAVATION EXTENT AND METHODS

Instructions: Discuss the excavation locations and depth intervals. Provide tables and figures summarizing the excavation locations and depths and the COC(s) driving the excavation. Describe how the excavation will proceed, including pit dimensions, shoring, timing of excavation floor and sidewall sampling, and decision criteria for stopping or continuing the excavation. Describe how soil will be managed on-site and profiled. Describe backfill activities. Describe timeframe for work activities (e.g., weekdays, hours of operation).

The following is an example description of excavation extent and methods.

The upper [#] feet of soil from across the entire Site will be removed to minimize the potential for direct exposure to [COC(s)] in soils. Due to engineering constraints, the vertical extent of excavation will be limited to [#] feet bgs around the entire site as shown on (Figure [#]). Excavation areas will be sloped or benched at a minimum slope of [#] to provide appropriate slope stability protection in accordance with Cal-OSHA regulations. If needed, a ramp leading into the excavation will be sloped at a minimum of [#] to allow for safe backhoe/excavator access. It is estimated that the total in-place volume of impacted soil for excavation is about [#] cubic yards. The excavation could remove soils locally in some hot spot areas to deeper than [#] feet bgs if warranted, for example, if heavy staining is observed or if confirmation sampling results indicate that site cleanup goals have not been attained.

Soil excavation activities are expected to take approximately [#] weeks to complete. Work would be conducted between [#] a.m. and [#] p.m., Monday through Saturday.

The soil will be removed using standard earthmoving equipment (e.g., backhoe, front end loader). Manual excavation methods will be used in the immediate vicinity of the monitoring wells that will remain in place (Figure [#]). Excavated soil will be segregated based on previous sampling data and other evidence, such as soil discoloration and odors, and field screening with an organic vapor meter or immuno-assay testing into three separate stockpiles: (1) potentially reusable fill stockpile; (2) soil potentially requiring disposal as a RCRA-hazardous waste; and (3) soil potentially requiring disposal as a California-hazardous waste. Stockpiling and segregation activities on Site will be limited by space constraints and excavation timeframes.

If not directly loaded into trucks, the excavated soil will either be stockpiled or placed in covered soil bins until characterization and disposal arrangements are completed. Stockpiled soil will be placed on plastic sheeting and covered with plastic sheeting when not actively being worked on and at the end of each workday. Sandbags, or other weights, will be used to keep the plastic cover in place. Soil stockpile locations will be determined prior to initiation of remedial actions through coordination with the property owners and operating businesses on-site. At this time, it is anticipated that the stockpiled soil will be placed [location]. Soil samples will be collected and submitted for chemical analyses to evaluate on-site reuse and disposal alternatives at a frequency of at least one discrete sample analyzed per [#] cubic yards. Off-site disposal of the affected soil that is unsuitable for reuse on-site will be conducted based on the soil stockpile analytical results under appropriate documentation and in accordance with applicable federal, state, and local regulations. The following table summarizes the projected soil volumes and number of trucks for each soil type.

Soil Classification	*In Place Volume (cubic yards)*	*Ex situ Weight (tons)*	*No. of Trucks*
RCRA Hazardous			
California- hazardous Soil			
Non-hazardous			

A geotechnical field technician will provide observation and testing services during backfill operations. The clean backfill material will be moisturized as needed by hose or water truck prior to placement, or else mixed as the fill material is being placed. Fill will typically be placed in [#]-inch lifts and compacted. In situ density tests will be performed to determine when a minimum relative compaction rate of [#] percent has been achieved relative to the maximum dry density obtained from ASTM [#]. The backfilling process will continue until the desired site grade is reached. A compaction report will be submitted to the City of [city name] Department of Building and Safety in accordance with the grading permit.

The source of the clean backfill material, certification that the fill is clean, and supporting analytical data will be obtained from the excavation subcontractor and submitted to DTSC approximately five working days before beginning excavation activities at the site.

The clean backfill material shall not contain chemicals above [specify levels, e.g., residential CHHSLs, US EPA PRGs]. The source of the fill material cannot be included at this time because the excavation subcontractor and the specific fill material source have not been identified.

5.5 CONTROL MEASURES

Instructions: Describe site control measures, e.g., dust control, fencing, erosion, stormwater, traffic.

The following is an example description of control measures to be applied during soil excavation.

During excavation activities, depending on soil conditions, there is potential to generate airborne dust. Dust control measures will comply with the local Air District feasible control measures to protect on-site and off-site receptors from chemicals in soil and nuisance dust.

Dust suppression will be performed by [method, e.g., lightly spraying or misting the work areas (such as the excavation, soil handling areas and haul roads) with water, BioSolve®, or a similar surfactant if water is not sufficient to reduce the potential for dust generation]. Misting may also be used on soil placed in the transport trucks. Efforts will be made to minimize the soil drop height from the excavator's bucket onto the soil pile or into the transport trucks. The excavator will be positioned so as to load or stockpile soil from the leeward side. After the soil is loaded into the transport trucks, the soil will be covered to prevent soil from spilling out of the truck during transport to the disposal facility. Additionally, soil stockpiles and truck beds containing soil will be covered to minimize the potential for dust generation.

The site currently has permanent fencing installed; however, part of this fencing, especially along the southern boundary, will need to be removed to allow heavy equipment access to the site. These areas will be secured at night using temporary fencing to reduce the potential for unauthorized personnel to enter the excavation area. Low-visibility with low-permeability windscreen will be attached to the temporary and permanent fencing prior to commencement of on-site activities.

If precipitation is anticipated, engineering controls will be implemented to minimize the collection of rainwater in the excavation. While on the property, all vehicles will maintain slow speeds (e.g., less than 5 miles per hour) for safety purposes and for dust control measures. Before exiting the job site, the vehicle's tires will be inspected and brushed, if necessary, to ensure that impacted soil remains on-site. This cleanup/ decontamination area will be established as close to the excavation and/or loading areas as possible to minimize spreading the impacted soil.

5.6 PERIMETER AIR MONITORING DURING EXCAVATION

Instructions: Describe the site air monitoring strategy, e.g., volatile constituents, fugitive dust, perimeter monitoring.

The following is an example description of perimeter air monitoring during excavation.

Air monitoring activities will be conducted in the work zone and in the immediate perimeter by the Site Safety Officer during excavation. This section describes the perimeter air monitoring program that will be implemented at the Site. Work zone air monitoring is addressed in the HASP [consultant, date].

Airborne particulate monitoring will be conducted to verify and document the effectiveness of dust suppression measures in conformance with [air management district requirement]. To mitigate offsite dust migration impacts to neighboring properties, watering of the active excavation areas will be conducted throughout the removal action. Factors considered in providing fugitive dust control measures will include wind direction, wind speed, and available dust control and dust suppression methods.

Air monitoring for particulates will be performed during the excavation activities at the perimeter of the property using an upwind/downwind sampling approach. The limit on dust concentrations at the property boundaries will be determined based on the airborne [PRG type] PRG of [#] micrograms per cubic meter (µg/m^3) and an average shallow soil [COC] concentration of [#] mg/kg.

Periodic real time particulate measurements will be taken in the working zone in accordance with the HASP. These measurements will also be taken near and around the property boundary at breathing height level using a portable hand held dust monitor. The target total particulate action level in the working zone is [#] milligrams per cubic meter (mg/m^3) of respirable particulate and [#] mg/m^3 of total particulates.

VOCs are not expected to be encountered during excavation activities based on low VOC concentrations in the site soil. Air monitoring, however, will be conducted as a safety precaution using a direct reading photo-ionization detector (PID) during excavation and soil handling activities as specified in the HASP.

5.7 FIELD VARIANCES

Instructions: Describe how field variances will be addressed.

Variances from the work plan will be discussed with DTSC prior to any action being taken except for emergencies (when an immediate response is required). The DTSC will be notified if an emergency response is implemented. The field variances will be documented in the Completion Report prepared for the project.

5.8 CONFIRMATION SAMPLING AND ANALYSIS PLAN

Instructions: Discuss the approach to confirmation sampling, analytical methods, QA/QC, general criteria for determining excavations complete, and general criteria for classifying excavated soil and determining appropriate disposal options.

Soil samples from the sides and bottom of the completed soil excavation will be collected to assess the [COCs] concentrations. The exact confirmation sample locations will be verified in the field in consultation with the DTSC. Sample locations and the number of samples collected may be adjusted in the field if necessary. After the impacted area has been excavated to the appropriate depth, bottom samples from the excavation base will be collected on a [#]-foot grid. Samples will be collected primarily using the [method]. Excavation bottom verification soil samples will be collected unless: [list exceptions]. One sidewall soil sample will be collected for every [#] linear feet of sidewall at depth intervals corresponding to areas exhibiting field indications of potential contamination and/or at depths where previous samples indicated contaminants were present. Sidewall samples will be collected using the [method]. Field quality control (QC) samples, which include [list, e.g., calibration check standards, blanks, and field duplicates] will be checked and/or collected for [#] percent of the soil samples.

[Describe any on-site screening to be conducted. If using on-site screening, describe the number of QA/QC samples to be sent to the off-site laboratory. For off-site analyses, describe sample handling, shipping, analytical parameters, analytical methods, and analytical laboratory. Describe the timing of confirmation sampling relative to excavation/backfill activities and waste characterization.]

[Describe constraints on soil excavation (e.g., existing structures, water table).]

5.9 TRANSPORTATION PLAN

Instructions: Include this section if excavated soil is to be transported. Describe the transportation plan for the remedial action. For the excavation/off-site disposal option, describe the anticipated waste classification for the soil, the potential disposal facilities, the transportation type, transportation routes, site traffic control, and associated record keeping.

Elevated levels of [COCs], up to [#] mg/kg of total [COC] and [#] mg/L of soluble [COC], were detected in the Site soil. The Total Threshold Limit Concentration (TTLC) for hazardous waste classification is [#] mg/kg for [COC]. The Soluble Threshold Limit Concentration (STLC) for hazardous waste classification is [#] mg/L for soluble [COC]. The Toxicity Characteristic Leaching Procedure (TCLP) limit for classifying [COC]-impacted soil as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) of 1976 (and as amended) is [#] mg/L. As a result, any mixture of [COC]-impacted soils removed from the Site is expected to be handled as a [RCRA/non-RCRA] hazardous waste.

As a hazardous waste generator, [name] will secure an EPA Identification Number from DTSC for proper management of the hazardous waste. Compliance with the DTSC requirements of hazardous waste generation, temporary onsite storage, transportation and disposal is required. Any container used for onsite storage will be properly labeled with a hazardous waste label. Within 90 days after its generation, the hazardous waste will be transported offsite for disposal. Any shipment of hazardous wastes in California will be transported by a registered hazardous waste hauler under a uniform hazardous waste manifest. Land disposal restrictions will also be followed, as necessary. Any shipment of non-hazardous waste in California will be transported under a non-hazardous waste manifest or bill-of-lading.

Soils classified as [type] waste will probably be transported to [location] or to [location] for disposal. These disposal facilities are licensed [type] landfills and are located at the following addresses:

[Facility Name and EPA ID Number]
[Address]
[City, State, Zip code]
[Phone]
[Contact Person]

[Facility Name and EPA ID Number]
[Address]
[City, State, Zip code]
[Phone]
[Contact Person]

Soils classified as [type] will probably be transported to the following facility:

[Facility Name and EPA ID Number]
[Address]
[City, State, Zip code]
[Phone]
[Contact Person]

[Continue, as needed for each waste anticipated.]

5.9.1 Truck Transportation

Approximately [#] tons of soil will be removed from the Site. Assuming each truck carries [#] tons, up to [#] trucks will be needed to transport the impacted soil. All permitted disposal facilities operate a certified weight station at their facility. As such, each truck will be weighed before offloading its payload. Weight tickets or bills of lading will be provided to the removal action subcontractor after all the soil has been shipped off-site. Below is a summary of the truck route from the site to the disposal facilities listed above:

[Facility Name 1]
This truck route is illustrated in Figure [#]. [Describe truck route.]

[Facility Name 2]
This truck route is illustrated in Figure [#]. [Describe truck route.]

[Indicate whether alternate routes are an option and how an alternate route would be chosen. Discuss truck transportation days and hours.]

Before leaving the site, each truck driver will be instructed to notify the site manager. Each truck driver will be provided with a Uniform Hazardous Waste Manifest, Non-Hazardous Waste Manifest, or bill-of-lading and the cellular phone number for the site manager. It will be the responsibility of the site manager to notify DTSC and [entity] of any unforeseen incidences. Each truck driver will be instructed to use the freeway Call Box System (if available), a cellular telephone, and/or their radio dispatch system to call for roadside assistance and report roadside emergencies.

5.9.2 Site Traffic Control

During soil transport activities, trucks will enter the Site through [location] located on [street name]. A flag person will be located at the site to assist the truck drivers to safely drive onto the site. Transportation will be coordinated in such a manner that at any given time, on-site trucks will be in communication with the site trucking coordinator. In addition, all vehicles will be required to maintain slow speeds (e.g., less than 5 mph) for safety and for dust control purposes.

Prior to exiting the Site, the vehicle will be swept to remove any extra soil from areas not covered or protected. This cleanup/decontamination area will be set up as close to the loading area as possible so as to minimize spreading the impacted soil. Prior to the off-site transport, the site manager will be responsible for inspecting each truck to ensure that the payloads are adequately covered, the trucks are cleaned of excess soil and properly placarded, and that the truck's manifest has been completed and signed by the generator (or its agent) and the transporter. As the trucks leave the site, the flag person will assist the truck drivers so that they can safely merge with traffic on [street name].

5.10 RECORD KEEPING

The remedial action contractor will be responsible for maintaining a field logbook, which will serve to document observations, personnel on site, equipment arrival and departure times, and other important project information. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. Logbooks will be bound, with consecutively numbered pages and each page will indicate the date and time of the entry. All entries will be legible, written in black or blue ink, and signed by the author. Language will be factual and objective. If an error is made, corrections will be made by crossing a line through the error and entering the correct information. Corrections will be dated and initialed.

Because some portion of the excavated soil likely will be profiled as hazardous waste under California or EPA regulations, the Uniform Hazardous Waste Manifest (hazardous waste manifest) form will be used to track the movement of soil from the point of generation to the point of ultimate disposition. The hazardous waste manifests will include the following information:

- Name and address of the generator, transporter, and the destination facility
- United States Department of Transportation description of the waste being transported and any associated hazards
- Waste quantity
- Name and phone number of a contact in case of an emergency
- EPA Hazardous Waste Generator Number
- Other information required either by the EPA and/or the DTSC.

Any soil that is profiled as non-hazardous and sent off site for disposal will be documented using a Non-Hazardous Waste Manifest or Bill-of-Lading form. At a minimum, this form will include the following information:

- Generator name and address
- Transportation company
- Accepting facility name and address
- Waste shipping name and description
- Quantity shipped.

Prior to transporting the excavated soil off site, an authorized representative of [entity] will sign each hazardous and/or non-hazardous waste manifest. The removal action site manager will maintain one copy of all hazardous and/or non-hazardous waste manifests on site.

6.0 PRELIMINARY REMEDIAL DESIGN FOR GROUNDWATER REMEDY

Instructions: Identify the components of the groundwater remedial action and describe the key aspects of each component.

The following is an example description of the preliminary remedial design for a groundwater remedy.

6.1 INJECTION INTO GROUNDWATER

The final remedial action component is [material] injection into groundwater to decrease [COC] contaminant mass in the groundwater source area. Figure [#] depicts [#] proposed injection wells and [#] proposed monitoring wells. The [material] will be injected into the source area perimeter injection wells to act as a containment barrier for the interior source area injections. Then, [material] will be injected into the source area interior to treat the higher [COC] concentrations located there. A typical onsite injection well construction with corresponding site lithology variation is shown in Figure [#]. A minimum of [#] rounds of [#] injection are assumed in the [timeframe]. After each injection round is completed, long-term groundwater monitoring for at least [timeframe] would be required to ensure that the source area has been adequately remediated.

6.1.1 Injection Permits

The following permits will be needed for the groundwater chemical injection program:

- *WDR permit from the RWQCB. This permit will take approximately [#] months to obtain.*
- *Well permits from the [name] County Department of Health Services.*
- *A building permit from the City of [name] Department of Building and Safety for the piping manifold and above-ground piping used to connect the wells to the manifold.*

6.1.2 Injection System Design

To effectively remediate the groundwater area identified above, a total of [#] injection wells will be installed with [#]-inch diameter, [casing material], and screen intervals from approximately [#] to [#] feet bgs. The injection wells will be connected together by above-ground #-inch [casing material], connected to a common manifold with control valves, a pressure gauge, and a flow meter. Chemical and water injection into the wells will be made directly through the manifold or headers.

The injection wells will be spaced about [#] feet apart around the perimeter of the source area assuming a radius of influence of about [#] feet (Figure #). [Material] will be injected into these wells first to act as a containment barrier for subsequent injection into the interior source area wells. [#] wells will be installed into the interior of the source area. [COCs] that migrate laterally away from these wells as a result of the fluid injection will be forced into the containment barriers set up by the perimeter wells.

6.1.3 Injection Procedure

[Material] solution ([#]%) will be delivered to the injection manifold at a constant rate directly from a tanker truck or from an on-Site aboveground storage tank through a flexible hose connected to a [#]-inch drop pipe in the injection well that will extend approximately [#] feet below the water table. Either the discharge pump on the truck will be used to feed the solution into the wells, or the solution will be gravity fed from the storage tank. The flow rate will be measured with an electronic stainless-steel turbine flow meter with a range of at least [#] to [#] gallons per minute (gpm).

The average injection rate is estimated to be about [#] or [#] gpm. The optimum injection rate will be limited by the local hydraulic conductivity, fluid viscosity, well efficiency, flow impedance through the injection system, tanker truck pump capacity, and the height of the fluid column in the well or the injection pressure. Plugging of the well screen and viscosity effects are likely to reduce the specific injection capacity of the injection wells and may require a reduction in the injection rate during injection. Approximately [#] to [#] minutes will be required to inject the estimated [#] gallons of concentrated [#]% solution needed to achieve the appropriate reductive environment in the saturated zone at each injection point. Multiple injections of smaller batches may also be used to reduce potential clogging issues, if necessary.

6.1.4 Injection Volume into Groundwater

Approximately [#] gallons of [material] will be used per injection point based on an injection radius of [#] feet, an average [Contaminant(s) of Concern] concentration of [#] mg/L, an average soil porosity of [#], and a saturated zone thickness of [#] feet. An estimated [#] gallons of [material] solution will be injected into each of the injection points. As the estimated treatment zone around each of injection points contains approximately [#] gallons of groundwater, the injected volume for each point represents less than [#]% of the total groundwater volume, so the dilution impact on groundwater concentrations will be minimal.

6.1.5 Confirmatory Groundwater Sampling Events

After the first injection round, [frequency] monitoring of [#] wells will be conducted for the [timeframe] followed by [frequency] monitoring for [timeframe]. In general, wells that are dedicated for monitoring will be utilized for confirmatory groundwater sampling. This proposed field sampling program will provide sufficient short-term data to assess the effectiveness of the first injection round, plus identify the areas that might need additional [material] applications. Groundwater samples will be analyzed for [COCs].

6.1.6 Performance Criteria

Performance of the groundwater remediation with respect to RAOs will be demonstrated through long-term monitoring as described in Section [#]. A trend analysis will be used *to assess the rate of [COC] concentration changes based on reductions in mass flux due to source area and downgradient remediation, and to demonstrate reductions in concentrations towards regulatory objectives.*

7.0 INSTITUTIONAL CONTROLS

Instructions: One way to minimize the potential for human exposure to contamination and/or protect the integrity of a remedy is through the use of land use restrictions. Land use covenants are legal or administrative measures that limit land or resource use. They are typically used when the chosen remedial action involves leaving the contaminants in place or when implementing long-term cleanup actions. Often, institutional controls are used in combination with engineering controls or long-term groundwater cleanup actions. This section should be used to describe the institutional controls, if applicable, that will be utilized at the site.

Institutional controls (ICs) are required for sites that contain residual contamination to prevent inappropriate uses, which would pose a threat under certain exposure scenarios. ICs in the form of a land use covenant (LUC) guarantee that information about a property containing residual contamination is available to local governments, the public, prospective purchasers and tenants. A LUC is also used to ensure O&M of long-term mitigation and monitoring measures.

A LUC will place use restrictions on the Site because [COCs] will continue to exist [describe location] above levels acceptable for unrestricted use of the property. These controls would allow a wide range of future uses for the Site, but would limit sensitive uses (e.g., residences, schools, day care centers) and other uses that could involve excavation of impacted soil (e.g., such as an underground parking garage) if DTSC has not approved provisions for addressing the potentially-contaminated soils. Generally, the LUC is deemed to be effective with respective to controlling exposures because it runs-with-the-land and the use restrictions are recorded on the property deed. Also, environmental databases are being developed that include all properties with such use restrictions such as DTSC's EnviroStor database. Such registries of properties with residual contamination will provide information to future property buyers or owners and minimize the potential for exposure to residual contamination.

The LUC will also be required to restrict future groundwater use at the Site until cleanup goals for groundwater are achieved. [List possible engineering controls, if applicable] would be needed for any future building constructed at this Site due to the presence of residual [COCs] in groundwater. The LUC would also require non-interference with the groundwater monitoring system.

Periodic monitoring of compliance with the LUC restrictions at the Site will be required.

8.0 MONITORING AND REPORTING

Monitoring consists of periodic measurement of physical and/or chemical parameters to evaluate the progress of the remedial action in achieving the RAOs defined for the site. Performance monitoring can also be used to verify or adjust estimates of remediation timeframes or determine whether advances in remediation technologies or approaches could improve the ability to achieve the RAOs. At sites where engineering controls and ICs are used, performance monitoring may be necessary to demonstrate that on-going contamination of the groundwater is prevented, groundwater contamination is not spreading to uncontaminated areas, and potential receptors are being protected.

In this section you should discuss a monitoring plan that includes a description of the RAOs, locations, frequency, type and quality of samples, techniques, and measurements that will be used to assess the performance of the remedial action. The monitoring plan should include sampling and analysis and quality assurance procedures. In addition, a schedule for submittal of periodic monitoring reports should be included in the plan. The plan should also include an O&M plan for the monitoring system. Finally, the plan should discuss the proposed remediation timeframe during which performance monitoring activities will be conducted.

8.1 MONITORING

The following is an example description of monitoring activities.

Monitoring related to the soil excavation, such as air monitoring, was discussed in Section [#]. Other monitoring activities primarily relate to performance monitoring for groundwater injection. This would involve short term monitoring after [material] injection at a frequency of about [frequency] for [timeframe] followed by [frequency] monitoring for [timeframe]. One additional round of [material] injection is assumed after [timeframe]. Long term groundwater monitoring will also be required until Site [remedial action objectives/site cleanup goals] are achieved. This long term monitoring may start of at a [frequency] frequency and later decrease to [frequency] frequency once the plume has shown stability post-remediation.

Performance monitoring and/or long-term monitoring reports should be submitted to DTSC on a periodic basis after approval of the RAP. These reports should include the following:

- *Analytical results*
- *QA/QC results*
- *Chain of custody records*
- *Groundwater sampling and field data sheets*
- *Data tables containing groundwater elevations and well data*

8.2 REPORTING

The following is an example description of reporting.

After completion of the soil excavation, an implementation report will be submitted to DTSC summarizing the excavation procedures, documenting observations, and presenting the confirmation sampling results. After the groundwater injection is completed, an implementation report will be prepared to document the implementation.

[Frequency] performance monitoring reports will be prepared summarizing the groundwater conditions post-injection. After the second round of injection, long term groundwater monitoring reports will be prepared quarterly. The reporting frequency may be reevaluated and reduced upon DTSC approval if conditions warrant.

8.3 FIVE-YEAR REVIEW

If contamination remains onsite above unrestricted use standards, the final remedy shall be evaluated after a period of five years from the completion of construction and/or startup of the final remedy and every five years thereafter. The review and reevaluation shall be conducted to determine if human health and the environment are being adequately protected by the remedial alternative(s) implemented. A five-year review workplan will be submitted to DTSC for review and approval at least [#]-days prior to the completion of this five-year period. Within [#] days of DTSC's approval of the workplan, A report will be submitted containing the results of the five-year review. The report shall describe the results of all sampling analyses, tests and other data generated or received by Proponent and evaluate the adequacy of the implemented remedy in protecting human health and the environment.

9.0 IMPLEMENTATION SCHEDULE

Instructions: Provide the proposed schedule of remedial activities. The schedule should be in tabular format and contain a brief description of the activity, date of initiation, date of completion, and other relevant information.

If the intent is to move forward with remedial action implementation at a fairly fast pace, there are several things that should be considered. First, DTSC should be notified before the planning stage of the remedial action. Second, the schedule should allow time for a 30-day public comment period and response to comments. As regulatory issues can have an impact on the timing and overall construction schedule, you should identify concurrent tasks and get DTSC involved early in the planning stage of these tasks.

A tentative implementation schedule is shown in [reference to figure or location of schedule]. The schedule shows tasks such as [description of tasks to be accomplished in the RAP].

10.0 HEALTH AND SAFETY PLAN

Instructions: The purpose of the health and safety plan is to assign responsibilities, establish personal protection standards and mandatory safety procedures, and provide for contingencies that may arise while operations are being conducted at the site. It will describe controls and procedures that shall be implemented to minimize injury, accidents, and risks. All work at the site will be performed in accordance with applicable State and Federal occupational and health safety standards as set forth in 29 CFR §1910 and 1926, California Health and Safety Regulations as set forth in Title 8, California Code of Regulations, and guidance established by the DTSC.

All contractors will be responsible for operating in accordance with the most current requirements of State and Federal Standards for Hazardous Waste Operations and Emergency Response (Cal. Code Regs., tit. 8, section 5192; 29 CFR 1910.120). Onsite personnel are responsible for operating in accordance with all applicable regulations of the Occupational Safety and Health Administration (OSHA) outlined in the State General Industry and Construction Safety Orders (Cal. Code Regs., tit. 8) and Federal Construction Industry Standards (29 CFR 1910 and 29 CFR 1926), as well as other applicable federal, state and local laws and regulations. All personnel shall operate in compliance with all California OSHA requirements.

In addition, California OSHA's Construction Safety Orders (especially Cal. Code Regs., tit. 8, sections 1539 and 1541) will be followed as appropriate. Specific requirements are identified below:

- [list all appropriate or applicable requirements.]

A site-specific HASP will be prepared for the Site or the existing health and safety plan (HASP) will be updated in accordance with current health and safety standards as specified by the federal and California OSHAs and submitted to DTSC prior to initiation of field work.

The provisions of the HASP are mandatory for all personnel of the RP/PP and its contractors who are at the Site. The RP's/PP's contractor and its subcontractors doing fieldwork in association with this RAP will either adopt and abide by the HASP, or shall develop their own safety plans which, at a minimum, meet the requirements of the HASP. All onsite personnel shall read the HASP and sign the "Plan Acceptance Form" (Attachment [#] of the HASP) before starting Site activities.

11.0 CEQA INITIAL STUDY

Instructions: Describe the DTSC's CEQA role, e.g., Lead Agency or Responsible Agency. Describe the documents that were prepared or reviewed to ensure CEQA compliance, and the status of the documents, e.g., approved and final, under review concurrent with the RAP, etc.. Attach copies of CEQA documents and/or approval notices, if applicable, as an Appendix to the RAP.

The California Environmental Quality Act (CEQA), modeled after the National Environmental Policy Act (NEPA) of 1969, was enacted in 1970 as a system of checks and balances for land-use development and management decisions in California. It is an administrative procedure to ensure comprehensive environmental review of cumulative impacts prior to project approval. It has no agency enforcement tool, but allows challenge in courts.

A CEQA project is a project that has a potential for resulting in a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment. CEQA applies to all discretionary projects proposed to be carried out or approved by California public agencies, unless an exemption applies

In accordance with CEQA, the DTSC has prepared [or reviewed, if DTSC has Responsible Agency status] an [Insert CEQA document title and Lead Agency name, if prepared by another Agency] to ensure that CEQA requirements have been satisfied.

12.0 PUBLIC PARTICIPATION

Instructions: Identify the public participation requirements for the RAP process. Discuss the status of the process and the remaining steps of the process. Generally, the RAP process includes conducting a baseline community survey, developing a Public Participation Plan, publishing a public notice of the public comment period (minimum 30-days) in a local newspaper of general circulation, distributing of a fact sheet describing the proposed remedy selection and the availability of the draft RAP for public comment, conducting a community meeting during the public comment period and publishing a responsiveness summary responding to the comments received during the public comment period. The public is directed to the DTSC office, EnviroStor, and other repositories to conduct their review. All comments received during the public comment period will be responded to in writing and distributed to everyone who submits a comment.

All of the applicable activities described in the preceding paragraph should be summarized in this section.

The public participation requirements for the RAP process include the following [insert other activities, as appropriate]:

Public Participation Requirement	Compliance
1) Development of a Public Participation Plan	1) DTSC approved the Plan on [Date]
2) Holding a minimum 30-day public comment period.	2) Public comment period to be held from [Date] to [Date]
3) Publishing a public notice of the availability of the draft RAP for public review and comment in a local newspaper of general circulation	3) Public notice to run on [Date] in [newspaper]
4) Posting a notice of the availability of the draft RAP for public review and comment at the Site.	4) Copy of the public notice was posted at the Site on [Date] [Discuss translation, if necessary.]
5) Distributing a fact sheet to the site mailing list describing the proposed remedy and the availability of the draft RAP for public comment;	5) Fact Sheet to be distributed out to the mailing list on [Date]. [Discuss translation, if necessary.]
6) Making the draft RAP and other supporting documents available at DTSC's office and in the local information repository(ies).	6) RAP and CEQA-documents were placed in the [local information repository] on [Date]. RAP and CEQA-documents were placed in DTSC's File Room and on its EnviroStor database on [Date].
7) Conducting a public meeting during the public comment period for the draft RAP	7) Community Meeting is scheduled for [Date]
8) Responding to public comments received on the RAP and CEQA documents.	8) Following the close of the public comment period, DTSC will respond to the public comments received in a Responsiveness Summary. The Responsiveness Summary will be mailed to commenters and made a part of the Final RAP.

Once the public comment period is completed, DTSC will review and respond to the comments received. The RAP will be revised, as necessary, to address the comments received. If significant changes to the RAP are required, the RAP will be revised and be resubmitted for public review and comment. If significant changes are not required to the RAP, the RAP will be modified and DTSC will approve the modified RAP for implementation.

13.0 REFERENCES

Instructions: Provide complete citations for all site-related documents and references cited in the RAP.

APPENDIX C3
REMOVAL ACTION WORKPLAN SAMPLE

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PREFACE TO REMOVAL ACTION WORKPLAN SAMPLE

This version of the Removal Action Workplan (RAW) Sample is the result of efforts of the Voluntary Cleanup Program (VCP) and Proven Technologies and Remedies (PT&R) teams. In preparing this RAW Sample, the VCP team had a broader perspective than the PT&R team which focused on the cleanup of metals in soil (for the *PT&R Guidance -- Remediation of Metals in Soil*). As of February 2008, the RAW Sample was the same for both the VCP and PT&R team purposes. The RAW Sample is expected to change in the future as the VCP team continues its efforts to streamline a final version of the document. The VCP team will maintain the master version of the RAW Sample.

When applying the PT&R approach, please contact DTSC staff for the most current version of the master RAW Sample.

The following Sample provides a typical table of contents for a RAW. In general, the RAW should look similar to the outline presented in this Sample. However, this Sample is not intended to be prescriptive and should be adjusted as appropriate for the site-specific conditions. Although the language in this Sample is primarily focused on the soil matrix, it can easily be modified to address other media.

This document is for guidance only, and is applicable on a case-by-case basis. Some elements of this Sample may apply to your site, and others may not. Additional elements than are addressed by this Sample may also be needed.

Instructions for suggested content (denoted by boxed text) are included under most major headings. Some sections provide example text that could be applied to any site. The example text intended for general application is shown as normal text with brackets and underline to indicate locations for inserting site-specific information.

BACKGROUND

A Removal Action Workplan (RAW) is one of two remedy selection documents that may be prepared for a hazardous substance release site pursuant to California Health and Safety Code (HSC) Section 25356.1, and is appropriate for removal actions that are projected to cost less than $1,000,000. In California HSC 25323.1, RAW is defined as "a workplan prepared or approved by the Department (DTSC) or a California Regional Water Quality Control Board (RWQCB) which is developed to carry out a removal action, in an effective manner, which is protective of the public health and safety and the environment."

The RAW is a public document that should be written in a clear and concise manner (avoid using technical language if possible). It presents DTSC/RWQCB preliminary decisions and/or the DTSC/RWQCB (or RP) preliminary recommendations for a site. A RAW must clearly and concisely reflect the removal action decision reached by: identifying the preferred alternative for a removal action and explaining the reasons for the preference; describing the other removal alternatives considered; and soliciting public review and comments on all the alternatives described. The RAW should not make definitive findings or statements concerning the alternatives that would later be difficult to revise after public comments or additional data are received. The RAW must include a description of onsite contamination; goals to be achieved by the removal action; any alternative removal options considered in an analysis of the alternatives considered evaluated against effectiveness, implementability and cost criteria; the recommended alternative and the reasons for the recommendations; the basis for rejecting other alternatives; a detailed engineering plan for conducting the removal action and an Administrative Record List.

The public is encouraged to submit comments and participate in the remedy selection process. Public participation requirements include preparation of a Community Profile Report, public notice, minimum 30-day public comment period and preparation of a written responsiveness summary. The RAW must comply with applicable requirements of the California Environmental Quality Act (CEQA).

DRAFT FINAL
REMOVAL ACTION WORK PLAN
[PROJECT NAME]
[SITE ADDRESS]

Prepared for:

[PROPONENT NAME]
[PROPONENT ADDRESS]

Prepared by:

[CONSULTANT NAME]
[CONSULTANT ADDRESS]

[Date]

Reviewed by:

[Name]
[Title]
[Geologist/Engineer License Number]

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TABLE OF CONTENTS (Continued)

Instructions: The user has the choice to include the detailed attachments for the following as appendices. Adjust the Table of Contents as needed.

ABBREVIATIONS AND ACRONYMS

AQMD	Air Quality Management District
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
Cal/EPA	California Environmental Protection Agency
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHHSL	California Human Health Screening Level
COC	chemical of concern
COPC	chemical of potential concern
DQO	data quality objective
DTSC	California Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
HASP	Health and Safety Plan
HHRA	Human Health Risk Assessment
HSC	California Health and Safety Code
LUC	land use covenant
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mph	miles per hour
msl	mean sea level
NCP	National Oil and Hazardous Substances Pollution Prevention Contingency Plan
ND	Negative Declaration
NEPA	National Environmental Protection Act
OEHHA	Office of Environmental Health Hazard Assessment
OSHA	Occupational Safety and Health Administration
PEA	Preliminary Endangerment Assessment
PPE	personal protective equipment
PRD	Permit Registration Document
PT&R	Proven Technologies and Remedies
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RA	removal action
RAOs	Removal Action Objectives
RAW	Removal Action Workplan
RCRA	Resource Conservation and Recovery Act
RWQCB	Regional Water Quality Control Board
STLC	soluble threshold limit concentration
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TCLP	toxicity characteristic leaching procedure
USA	Underground Service Alert
$\mu g/m^3$	micrograms per cubic meter

EXECUTIVE SUMMARY

Instructions: The Executive Summary should present an overview of the entire workplan. The Executive Summary should be clear and concise, yet contain enough information to give the reviewer a basic understanding of the site, the nature and extent of contamination, potential receptors, and the proposed removal action. Generally, the Executive Summary should be no more than 4 to 5 pages, but should adequately represent the issues at the site. The Executive Summary should briefly summarize the following:

- *Purpose of the RAW;*
- *Site name and location;*
- *Site description (the physical features, buildings, brief site history of ownership and site operations, and include a description of the scope and role of the remediation or operable unit);*
- *Contaminants and chemicals involved within each environmental medium (soil, groundwater, surface water, and air);*
- *Proposed alternative, and the reasons for proposing that alternative;*
- *Other removal alternatives that were considered; and the reasons for rejecting them;*
- *If applicable, indicate that the PT&R process is being used;*
- *Information on how the public can be involved in the remedy selection process.*

1.0 INTRODUCTION

Instructions: Identify the purpose and objectives of the RAW. Describe the RAW process as it will apply to the site. Provide a brief introduction to the site.

A Removal Action Workplan (RAW) is one of two remedy selection documents that may be prepared for a hazardous substance release site pursuant to California Health and Safety Code (HSC) Section 25356.1, and is appropriate for removal actions that are projected to cost less than $1,000,000. This RAW has been prepared in compliance with the Site [Agreement/Order] Docket No. [Docket #], California Health and Safety Code sections 25323.1 and 25356.1 and the California Environmental Protection Agency (Cal/EPA), Department of Toxic Substances Control (DTSC) 23 September 1998 guidance memorandum entitled *Removal Action Workplans – Senate Bill 1706.*

1.1 REMOVAL ACTION PROCESS

The RAW process, including the regulatory background and the RAW objectives, is described in the following sections.

1.1.1 Regulatory Basis for the RAW

In California HSC 25323.1, a RAW is defined as “a workplan prepared or approved by the Department (DTSC) or a California Regional Water Quality Control Board (RWQCB) which is developed to carry out a removal action, in an effective manner, that is protective of the public health and safety and the environment.” As mentioned previously, a RAW is appropriate when the estimated cost of the removal action is less than $1,000,000. If the estimated capital cost of implementing the chosen action will exceed $1,000,000, a Remedial Action Plan should be prepared.

The estimated cost of the selected removal alternative recommended in this RAW is estimated to be less than $1,000,000.

1.1.2 Objectives of the RAW

The objectives of this RAW are to:

- Present and evaluate existing site conditions;
- Establish appropriate removal action objectives (RAOs) for protection of human health and the environment; and
- Evaluate alternatives and identify a final recommendation for a removal action at the site that is protective of human health and the environment.

1.1.3 Elements of the RAW

To accomplish the objectives stated in the preceding section, and satisfy regulatory requirements, this RAW includes the following elements:

- A description of the nature and extent of the COCs at the Site;
- The goals to be achieved by the removal action;
- An analysis of the alternatives considered and rejected, and the basis for the rejection, including a discussion of effectiveness, implementability, and cost of each alternative;
- A description of the recommended alternative and an implementation plan; and
- An administrative record list (see Appendix [X]).

1.2 SITE DESCRIPTION

Instructions: Basic information about the site and its owners/operators should be provided. The site name should be provided and the site location should be depicted on a site location map. This section should also present information about the physical setting of the site at local as well as regional scales.

The site is located at [address] in [city], California. The property consists of [#] parcels with [County] Assessor's Parcel Number(s) [APN Number(s)]. See Figure [#] for a site location map.

The subject property lies at an elevation of [#] feet above mean sea level (msl) and is generally [Describe the ground surface, e.g., flat]. The slope across the site is generally directed towards the [direction, describe any controlling features]. [Describe onsite structures and features, if the site is occupied or vacant, paved or unpaved, and whether there are access controls] [Describe nearby water bodies.] Figure [#] depicts the site plan.

[Discuss cultural resources, sensitive habitat, if present.]

1.2.1 Land Use

The site occupies approximately [#] acres ([lot dimensions]) of real property. The site is in a [commercial/residential/industrial] area. [Provide general description of nearby landuses and features. Describe site zoning.] Figure [#] depicts the regional site plan.

1.2.2 Historic Uses

[Describe historical uses of property, providing more detailed information on those that may have contributed to the contamination.]

1.2.3 Adjacent Properties

[Describe property uses adjacent to the site and in the general vicinity.]

1.3 SITE OWNER

Instructions: Information on both current and previous owners, if applicable, should be provided in this section.

The site is currently owned by the [entity]. [Entity] has owned the site since [insert date]. Previous owners have included [previous owner name], who owned the site from [insert date] through [insert date].

1.4 PURPOSE

Based on the information developed during the site characterization activities, the DTSC has determined that further action is required for the site due to elevated concentrations of [list contaminants] detected in soil samples collected from the site. Following completion of the public comment period, DTSC will consider and respond to the comments received. The RAW will be revised, as necessary, in response to the comments received. If significant changes are not required, DTSC will then approve the RAW for implementation. When the remedy has been implemented, a removal action completion report will be submitted to DTSC for review and certification.

2.0 SITE CHARACTERIZATION

Instructions: Provide an overview of investigation activities conducted at the site. Describe the site geology and hydrogeology. Clearly describe the nature and extent of contamination and reference supporting figures and tables. Summarize the results of the human health risk assessment.

Characterization of the site was conducted in [timeframe]. A summary of the activities and results are discussed in the sections below.

2.1 SITE CHARACTERIZATION

Instructions: Provide an overview of the activities conducted to characterize the Site. Subsections can be used to describe each investigation, a group of investigations or a summary of all of the investigation activities. If a separate report is not developed for the last sampling event, a separate section should be used to describe the activities in more detail.

2.1.1 Phase I Environmental Site Assessment

[Instructions: Describe the dates for conducting the Phase I Environmental Site Assessment activities conducted and the findings of the assessment. Identify any recognized environmental conditions.]

2.1.2 Preliminary Endangerment Assessment (PEA) [or equivalent documents]

From [month, year] to [month, year], sampling was conducted, including the collection and analysis of soil samples [and list any other investigation activities]. These sampling events are described in the following documents: [list documents or reference a table containing these documents].

Soil samples were collected at [#] locations ([#] samples from [depth range] feet below ground surface (bgs) and [#] samples from [depth range] feet bgs) and selectively analyzed for concentrations of [analytical parameters].

[Describe the sampling results.] [If applicable, describe results from other investigation activities and/or environmental media.]

2.1.3 Other Site Characterization Efforts

[Rationale for other site characterization efforts, e.g., because the human health screening of the PEA indicated that current conditions at the site may pose a threat to the health of a hypothetical resident living at the site], additional site characterization was completed in [timeframe].

Additional soil samples were collected in accordance with the procedures outlined in the [document title and reference]. [Describe results of supplemental sampling.]

2.1.4 Site Geology and Hydrogeology

Instructions: Provide a description of the regional and site-specific geology and hydrogeology. Describe the lithology and geologic formations present. Discuss structural features that might act as preferential pathways and features that may impede the movement of contaminants. Identify the location and thickness of fill areas, the depth to groundwater and groundwater flow direction and rate. If appropriate, geologic cross-sections and maps can be used to illustrate the site geology and hydrogeology. The location of nearby water bodies, wetlands, floodplains, and other hydrologic features should be described. If appropriate describe surface water flow, flood frequency, drainage direction, and topography.

2.1.5 Background Concentrations

Metals occur naturally in soils. EPA (1989) and DTSC (1997) guidance indicates that risk evaluations for metals are only necessary when the levels exceed naturally occurring background concentrations. To distinguish between site-related contamination and naturally-occurring or ambient contaminant levels, a study was conducted to identify background levels of metals.

Metals in soils at the site that are elevated above naturally occurring background concentrations were identified using [method, e.g., statistical analyses]. The [method] compared metal concentrations in soil at the site to [reference concentrations, e.g., background soil data set]. Background data for [#] metals including [metals], were obtained from soils sampled at [location]. Based on the results of the [method], [#] metals exceeded their background levels. These metals include [metals].

2.2 NATURE AND EXTENT OF CONTAMINATION

Instructions: Describe the conceptual site model (CSM), including the fate and transport of contaminants and the lateral and vertical extent of impacted environmental media. As appropriate, geologic cross-sections and plot plan maps should be used to demonstrate that the extent of contamination has been defined.

The CSM is a summary and evaluation of the site information that will help make decisions regarding the path moving forward. Using all available information, the CSM distills what is already known about the nature and extent of contamination, the media of concern, and the potential receptors/exposure routes. The CSM is used to identify the information needed to achieve project goals. A project's CSM will evolve and mature as project work progresses. The maturity of the CSM reflects both the level of site understanding and the amount of information and complexity of analysis required to support the decisions that need to be made.

For each project, the project team should agree upon the components of a project-specific CSM during the scoping meeting. At a minimum, a project-specific CSM should consist of:

- *Plot Plans and Cross Sections: Figures should present isoconcentration contours lines showing the type, concentration and vertical and lateral extent of contamination in soil (vapor, adsorbed, liquid phases) and groundwater, lines/shading showing locations (plan views) and depths (cross-sections) where contaminants exceed site-specific screening levels for human health and water quality protection.*
- *Proposed Redevelopment Drawings and/or Engineering Plans: Conceptual and technical drawings showing the exact location and dimensions of the proposed buildings and a detailed explanation of the proposed uses.*
- *Data Summary Tables: Tables presenting the analytical methods, detection limits, maximum and minimum concentrations, and frequency of detection for each contaminant, and which contaminants exceed the site-specific screening levels for human health and water quality protection.*
- *Pathway Identification/Evaluation and Cleanup Levels: An exposure pathway flow chart should be developed and agreed upon by the project team. The project team should also agree upon the site-specific cleanup levels, including the use of PRGs, CHHSLs and ESLs.*

Ideally, the CSM should be developed and updated independently of the RAW, and used as a tool throughout the work plan development process. The CSM included in the RAW is a point-in-time reflection of the CSM.

The soil sample collection locations referred to in the following discussion are shown in Figure [#] and the sample results are shown in Table [#]. [Summarize findings of the site investigation.]

Figure [#] shows the lateral extent of [contaminants] in shallow soil. [Use additional figures and/or cross sections to show the lateral and vertical extent of contaminants in deeper soil and in other media such as groundwater, surface water and soil gas.]

2.3 HUMAN HEALTH RISK ASSESSMENT

Instructions: Describe the risk screening/assessment conducted to evaluate potential risks and hazards associated with the chemicals of concern at the site. Identify the chemicals of concern for each environmental media. Identify background concentrations and how they were developed if necessary to help identify chemicals of concern. Discuss the most likely receptors and pathways.

The risk assessment [(Reference)] evaluated the potential for human health impacts from chemicals released due to past activities at the Site. Potential human health risks associated with current and future exposures to contaminated environmental media were considered. The results of this assessment along with an assessment of the potential for the contaminated environmental media to impact environmental receptors, if applicable, were used to provide a basis for requiring further action at the site. [Describe how the risk screening or risk assessment was conducted (e.g., comparison to screening levels or reference document containing the evaluation).]

2.3.1 Identification of Chemicals of Concern

Instructions: Describe the selection process for chemicals of concern and identify the chemicals of concern for each environmental media at the Site. The conceptual site model would need to address whether contamination could present a migration risk to groundwater.

Based upon the site characterization conducted, the following contaminants were identified as COPCs: [list contaminants]. For risk assessment purposes, chemicals in soil were grouped according to depth below ground surface: surface soil ([#] to [#] feet bgs), subsurface soil ([#] to [#] feet bgs), and soils below 10 feet bgs. Under certain exposure scenarios, it was assumed that human receptors might come into direct contact with chemicals in the surface and subsurface soils up to a depth of [#] feet bgs. Chemicals detected below 10 feet were not evaluated for direct human exposure under normal conditions assuming that deep structures (for example, underground parking facilities) are not planned for the property.

2.3.2 Exposure Assessment

Instructions: Describe receptors and pathways associated with each impacted environmental media and COPC. State assumptions of risk assessment.

2.3.3 Risk Evaluation

Instructions: Discuss the overall risk estimate and hazard index for each receptor. If lead is a chemical of concern, describe whether the blood-lead level is above acceptable levels. Reference a table presenting the cancer risks and non-cancer hazard indices.

Based on current site environmental conditions, the total excess cancer risk of [#] was [greater than or less than] the de minimis level of 1 in a million excess cancer risks for [receptor]. The hazard quotient was [greater than or less than] 1 for [receptor] and the blood-lead level was [#] which is [above/below] the acceptable blood lead level of 10 µg/dL for [receptor].

Based upon the projected future use of the site for [land use] uses, the total excess cancer risk of [#] was [greater than or less than] the de minimis level of 1 in a million excess cancer risks for [receptor]. The majority of this risk is attributable to [chemicals of concern] by the [exposure pathway(s)]. The highest [chemical of concern] concentration(s) are found at [location]. The hazard quotient was [greater than or less than] 1 for [receptor] and the blood-lead level was [#] which is [above/below] the acceptable blood lead level of 10 µg/dL for [receptor].

Therefore, the following COCs are found above acceptable levels at the Site and must be addressed: [COCs].

3.0 REMOVAL ACTION GOALS AND OBJECTIVES

Instructions: Identify the site-specific RAOs. Describe the removal goals. Identify the area where a removal action is required. Identify applicable or relevant and appropriate requirements (ARARs).

Site characterization has revealed the presence of chemicals of potential concern in [environmental media] at the site. Removal Action Objectives (RAOs) have been developed based upon the current environmental conditions and reasonably anticipated future uses of the site.

Based on the RAOs, removal goals were developed that establish specific concentrations of chemicals in soil that are protective of both human health and the environment. Specific removal goals have been developed for the site from: (1)

information obtained during removal investigations at the site; and (2) risk management decisions based upon the current and proposed future use of the site. Information used to develop these removal goals included laboratory analytical results, hydrogeologic data, soil leaching analysis, and a site-specific risk evaluation, as applicable.

In addition, a review of pertinent laws, regulations, and other criteria was performed to identify applicable or relevant and appropriate requirements (ARARs) and other criteria to be considered (TBC) for remediating the site. A summary of the potentially applicable ARARs and TBCs is presented on Table [#].

Discussions of regulatory requirements, an assessment of human health risks, and the removal goals developed for the site are presented below.

3.1 REMOVAL ACTION OBJECTIVES

Instructions: Identify the site-specific RAOs. Examples of RAOs include:

- *Minimize or eliminate potential exposure of humans ([receptors]) to [COCs] in [environmental media] through [direct contact, ingestion and inhalation].*
- *Reduce the human health-based risks associated with onsite [COCs] contamination in soil to a level that is acceptable for [land use] land use.*
- *Provide for a Site that can be redeveloped for [unrestricted, residential, commercial or industrial] uses within [X] months.]*
- *Minimize the potential for chemicals of concern in soil to impact groundwater.*

Removal action objectives (RAOs) have been established that are protective of human health and the environment and reduce the potential for exposure to the COCs in media encountered at the Site. These RAOs are presented below.

- [Remove/contain] impacted media that:

  (1) exceed the following human health risk criteria, to prevent exposure to the excessive COCs (Select all that are applicable):

  _____ California Human Health Screening Level (CHHSL) of [#] for [COC] in [residential, commercial] soils, established by the Office of Environmental Health Hazard Assessment (OEHHA).

  _____ cancer risk criteria of [#].
  [If multiple COCs are carcinogens, adjustments to the final cleanup goals may be necessary. Contact DTSC.].

  _____ the non-cancer hazard index of [#].
  [If multiple COCs are non-carcinogens, adjustments to the final cleanup goals may be necessary. Contact DTSC.].

_____ the California hazardous waste classification concentration of [#] for [chemical of concern].

_____ [Type in site-specific situations].

(2) exceed the following environmental risk criteria (Select all that are applicable):

_____ the screening level of [#] for [chemical of concern] in [media] contained in the Water Board Basin Plan.

_____ the Soil Screening Level of [#] established by USEPA Region 9 for [parameter] in [media].

_____ the California hazardous waste classification concentration of [#] for [parameter] (e.g., 5 milligrams per liter (mg/L) for soluble lead) in [media].

_____ [Type in site-specific situations].

- [List other applicable RAOs].

The removal goals developed and adopted for contaminated media at the Site will be responsive to these RAOs.

3.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Instructions: Identify and discuss the ARARs applicable to the Site. A table can be used to present this information. Example table includes some, but not all ARARs that may be applicable or relevant and appropriate to your project. This information can also be presented as an Appendix to the RAW.

Applicable or relevant and appropriate requirements or ARARs are federal and state environmental statutes, regulations, and standards. Applicable requirements are federal or state laws or regulations that specifically address a hazardous substance, pollutant, contaminant, removal action, or location. Relevant and appropriate requirements that, while not "applicable," address problems or situations sufficiently similar to those encountered that their use is well suited to the particular site. State requirements are ARARs only if they are more stringent than federal requirements.

In addition to ARARs, this analysis includes an evaluation of To-Be-Considered criteria ("TBCs"). TBCs are advisories, criteria, or guidance that may be considered for a particular action or specific issue, as appropriate. TBCs are not ARARs because they are neither promulgated nor enforceable.

The ARARs or TBCs may be: 1) chemical; 2) location; or 3) activity specific. Chemical-specific ARARs or TBCs are usually health- or risk-based numerical values or methodologies used to determine acceptable concentrations of chemicals that may be found in, or discharged to, the environment. Location-specific ARARs or TBCs restrict actions or contaminant concentrations in certain environmentally sensitive areas.

Examples of areas regulated under various federal laws include locations where endangered species or historically significant resources are present.
Action-specific ARARs or TBCs are usually technology- or activity-based requirements or limitations on actions or conditions involving specific chemicals of concern. See Table [X] for a listing of ARARs and TBCs or see discussion below [or in the Appendix, as applicable].

Table [X]
Summary of ARARs and TBCs

Requirement	Description	ARAR or TBC
Resource Conservation and Recovery Act, as amended by the Hazardous and Solid Waste Amendments (40 CFR 260 to 299, 42 USC 7401-7642)	Federal act that classifies and regulates hazardous waste and facilities that treat, store and dispose of hazardous waste.	Applicable for determining whether environmental media impacted by COCs is a hazardous waste. May be applicable or relevant and appropriate depending upon the response action being considered.
• 40 CFR 264.110 and 264.117	Requirements for closing and monitoring hazardous waste management units.	
• 40 CFR 264.250 and 42 USC 6924	Requirements that prohibits placement of certain hazardous wastes in a land disposal unit.	
• 40 CFR 263	Standards applicable to transporters of hazardous waste.	
Clean Water Act (CWA) (33 USCA 125-1-1376 and 40 CFR 100-149.	Federal act that establishes a system of national effluent discharge standards and ocean discharge requirements.	
• CWA, Section 304	Establishes water quality criteria based on the designated or potential use of the water and designated use of the receiving waters.	
• CWA, Section 404	Prohibits discharge of dredged or fill material into wetlands without a permit. US Army Corps of Engineers regulates activities that may physically alter the waters of the United State.	
Safe Drinking Water Act	Establishes primary and secondary drinking water standards.	
Clean Air Act (42 USC 7401-7642, 40 CFR 50 – 69)	Identifies categories of industrial sources and treatment standards. Establishes primary and secondary ambient air standards. States develop implementation plans for attainment of the standards.	May be applicable or relevant and appropriate depending upon the response action being considered. Impacts to air quality, if any, under local air district jurisdiction may result from the implementation of some of the removal actions.

Table [X] (Continued)

Requirement	Description	ARAR or TBC
Occupational Safety and Health Act (29 CFR 1910.120 et seq.)	Identifies permissible exposure limits (PELs) for inhalation or dermal exposure of workers to chemicals. When PELs are exceeded, OSHA requires the use of personal protective equipment or other methods to block exposure.	
National Historic Preservation Act of 1966 (NHPA) 16 USC 470 and 36 CFR 800	Established to preserve historic properties	
Endangered Species Act of 1973	Established to conserve endangered or threatened species	
Hazardous Waste Control Act (HSC, Chapter 6.5, section 25100 et seq., 22 CCR 66260.1 et seq.)	Establishes criteria for determining waste classification for the purposes of transportation and land disposal of wastes in California. Regulates treatment, storage, transportation and disposal of substances identified as hazardous.	
• Hazardous Waste Generator Requirements (22 CCR 66262.1 et seq.)	Establishes standards applicable to generators of hazardous waste.	
• Land Disposal Restrictions (22 CCR 66268.7 et seq.)	Establishes standards for treatment and land disposal of hazardous waste.	
• Stockpiling Requirements for Contaminated Soil (HSC section 25123.3(a)(2)	Establishes standards for stockpiling of non-RCRA contaminated soil	
California Hazardous Substances Account Act (HSC section 25340-25392)	Establishes fees regarding disposal of hazardous substances and outlines process for cleanup of hazardous substance release sites.	
Porter Cologne Water Quality Act (23 CCR Chapter 3, Subchapter 15, WC section 13000 et seq.)	Establishes the authority of the State Water Resources Control Board and Regional Water Quality Control Boards to protect water quality by identifying beneficial uses of the waters of the State, establishing water quality objectives, and regulating discharges to waters of the state.	
• Regional Water Quality Control Board Basin Plan	Adopts narrative standards and permissible concentrations of organic and inorganic chemicals for surface water, groundwater, point sources and non-point sources. Establishes beneficial uses of surface waters and groundwater.	

Table [X] (Continued)

Requirement	Description	ARAR or TBC
• NPDES Permit	The State Water Resources Control Board (SWRCB), as part of the National Pollutant Discharge Elimination System (NPDES), has adopted a statewide NPDES General Permit for Stormwater Discharges Associated with Construction Activity (General Permit) to address discharges of storm water runoff from construction projects that encompass one acre or more in total acreage of soil disturbances.	This would be applicable for construction activities, including demolition, clearing, grading, excavation, soil stockpiling, material storing, onsite staging, offsite staging, and other land disturbance activities.
Hazardous Waste Haulers Act (22 CCR Chapter 30)	Governs transportation of hazardous materials in California.	
Safe Drinking Water and Toxic Enforcement Act (Proposition 65) (22 CCR section 12000 et seq.)	Requires public warnings of potential exposure to suspected carcinogens and reproductive toxins.	
California Occupational Health and Safety (8 CCR 5192)	Requires workers involved in hazardous substance operations associated with cleanup of sites perform the cleanup operations in accordance with Cal OSHA health and safety requirements.	Applicable requirement for all workers who can come into contact with contaminated media at the Site
California Fish and Game Code (sections 1601-1607 and 5650)	Regulates activities that involve construction within stream channels to assure protection of fish and wildlife. Prohibits discharges to waters of the State that may cause adverse effects to fish, plant or bird life.	
[Add in additional state requirements]		
Local noise ordinance	Limits the amount of noise generated during certain times of day.	

3.3 REMOVAL GOALS

Identify and discuss the cleanup goal established for each chemical of concern in each impacted environmental medium at the Site.

Risk-based cleanup levels were selected for the Site based upon the California Human Health Screening Levels (CHHSLs) and background concentrations. The cleanup goal for [COC] is a [maximum concentration, average concentration] of [#] mg/kg.

4.0 ALTERNATIVE EVALUATION

Instructions: Describe the process of identifying and screening the removal action alternatives. Identify the removal action alternatives. Summarize the individual analysis of each alternative. Present comparative analysis of the alternatives. Identify the recommended removal alternative.

This RAW Sample presents three commonly evaluated alternatives. Site-specific contaminants and media of concern will dictate the need for evaluation of additional and/or different alternatives. Any alternative being considered for the site should follow the analysis process outlined in this section.

The purpose of this Section of the RAW is to identify and screen possible removal action alternatives that may best achieve the RAOs discussed in Section 3.0. The removal action alternatives were screened and evaluated on the basis of their effectiveness, implementability, and cost.

4.1 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

The response actions to address [chemicals of concern] in [environmental media] include [list general technologies, e.g., excavation and offsite disposal, excavation and onsite containment, capping in-place, institutional controls]. These response actions have been assembled into candidate removal alternatives for the site. Screening of several technology types using the above criteria was conducted to select removal actions for further evaluation. Based on this screening, the [insert number of alternatives being considered] removal actions identified and developed are:

- Alternative 1 – no further action
- Alternative 2 – containment/capping-in-place
- Alternative 3 – excavation/off-site disposal

[If applicable, list additional alternatives that were considered and carry through the remainder of Section 4.0.]

4.1.1 Alternative 1 – No Further Action

As required by the DTSC, the No Further Action alternative has been included to provide a baseline for comparisons among other removal alternatives. The No Further Action alternative would not require implementing any measures at the site, and no costs would be incurred. This action includes no institutional controls, no treatment of soil, and no monitoring.

4.1.2 Alternative 2 – Soil Containment/Capping-in-Place

This alternative would consist of capping the surface of the impacted areas with [describe cap (e.g., a two-foot engineered soil cover, asphalt or asphalt/concrete pavement]. The cap would be used to minimize the potential to come into contact with the contaminated soil. To achieve the RAOs, it has been determined that soil at [locations] requires capping (see Figure [X]). If capping is selected, a total of [#] acres of affected soil will need to be covered. A land use restriction will be executed between DTSC and the property owner and recorded to ensure that the cap is operated and maintained and that future uses of the property are consistent with the operation and maintenance of the cap. An operation and maintenance plan will be submitted and approved by DTSC. An operation and maintenance agreement signed with DTSC specifying the operation and maintenance requirements and providing financial assurance for future operation and maintenance of the cap.

4.1.3 Alternative 3 – Soil Excavation/Off-site Disposal

The excavation/off-site disposal alternative would consist of removing and transporting impacted soil to an appropriate, permitted off-site facility for disposal. Excavation includes using loaders, backhoes, and/or other appropriate equipment. Excavation operations will generate dust emissions. Suppressant, water spray, and other forms of dust control may be required during excavation, and workers may be required to use personal protective equipment to reduce exposure to COPCs. Sloping excavation sidewalls may result in increased volume of soil requiring excavation. Confirmation soil sampling and analysis would be conducted to verify that cleanup criteria were met at the excavation bottom and perimeter. Excavation will require soil stockpiling, prior to disposal. To achieve the RAOs, soil at [location(s)] within the site requires removal to depths ranging up to [#] feet (see Figure [#]. The volume of soil removed would be between [range] cubic yards ([range] tons). [If cleanup to unrestricted land use standards is not achieved by this alternative, a land use covenant must be proposed as part of the alternative and the specific restrictions described. For example, to ensure that the property is not developed for sensitive land uses such as residential, schools, day care centers, hospitals, parks.] [Also need to consider whether an operation and maintenance plan and agreement are required. If they are necessary, this should be discussed in the description of the alternative.]

4.2 EVALUATION CRITERIA

Each removal action alternative was independently analyzed without consideration to the other alternatives. Each of the removal action alternatives is screened based on effectiveness, implementability, and cost.

4.2.1 Effectiveness

In the effectiveness evaluation, the following factors are considered:

- *Overall Protection of Human Health and the Environment* - This criterion evaluates whether the removal alternative provides adequate protection to human health and the environment and is able to meet the Site's RAOs.
- *Compliance with ARARs/TBCs* - This criterion evaluates the ability of the removal alternative to comply with ARARs and TBCs.
- *Short-Term Effectiveness* - This criterion evaluates the effects of the removal alternative during the construction and implementation phase until removal objectives are met. It accounts for the protection of workers and the community during removal activities and environmental impacts from implementing the removal action.
- *Long-Term Effectiveness and Permanence* - This criterion addresses issues related to the management of residual risk remaining on site after a removal action has been performed and has met it objectives. The primary focus is on the controls that may be required to manage risk posed by treatment residuals and/or untreated wastes.
- *Reduction of Toxicity, Mobility, or Volume* - This criterion evaluates whether the removal technology employed results in significant reduction in toxicity, mobility, or volume of the hazardous substances.

4.2.2 Implementability

This criterion evaluates the technical and administrative feasibility of implementing the alternative, as well as the availability of the necessary equipment and services. This includes the ability to design and perform a removal alternative, ability to obtain services and equipment, ability to monitor the performance and effectiveness of technologies, and the ability to obtain necessary permits and approvals from agencies, and acceptance by the State and the community.

4.2.3 Cost

This criterion assesses the relative cost of each technology based on estimated fixed capital for construction or initial implementation and ongoing operational and maintenance costs. The actual costs will depend on true labor and material cost, competitive market conditions, final project scope, and the implementation schedule.

4.3 ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Each alternative is discussed in the following sections.

4.3.1 Alternative 1 – No Further Action

The No Further Action alternative would not require implementing any measures at the site, and no costs would be incurred. Consequently, there would be no activities that would disturb site soil, and therefore, no short-term risks to site workers or the community as a result of implementing this alternative.

However, under the No Further Action alternative, the impacts due to the presence of [COPCs] in soil would not be addressed and there would be no reduction in the potential risks. This alternative, therefore, does not meet the effectiveness criterion. As a result, acceptance by the State and the community would be unobtainable.

4.3.2 Alternative 2 – Soil Containment/Capping-in-Place

Effectiveness
The containment/capping-in-place alternative would involve little to no disturbance of the impacted soil. Therefore, there would be very little exposure to the COPC and the short-term risks would be low. The installation of a surface cap would require long-term inspection and maintenance to meet ARARs and provide long-term effectiveness.

Periodic inspections would be required for settlement, cracking, ponding of liquids, erosion, and naturally occurring invasion by deep-rooted vegetation. Additionally, precautions would have to be taken to ensure that the integrity of the cap is not compromised by land use activities.

Containment through surface capping would not lessen toxicity or volume of the COPC, but would limit mobility, specifically the prevention of surface water infiltration and thus, the potential downward migration of contaminants.

Implementability
Containment is a relatively simple technology that is easily implemented and can be quickly installed. As [COPC] would remain on site, obtaining permits and regulatory approval can be difficult. In addition, community acceptance for this alternative may be more difficult since the COPC would remain on site.

Cost
Containment technologies typically involve low to moderate costs. Industry costs are approximately $[#] per acre for [cap type], and approximately $[#] per acre for [cap type].

4.3.3 Alternative 3 – Soil Excavation/Off-site Disposal

Effectiveness
Potential short-term risks to on-site workers, public health, and the environment could result from dust or particulates that may be generated during excavation and soil handling activities. These risks could be mitigated using personal protective equipment for on-site workers and engineering controls, such as dust suppression and additional traffic and equipment operating safety procedures, for protection of the surrounding community and to meet all ARARs. Excavation and disposal would remove the COPCs from the site, and therefore, eliminates the long-term risks and accomplishes the RAOs.

Although the COPC will be removed from the site, excavation and off-site land disposal does not result in the reduction of toxicity or volume of the COPC. By placing the impacted soil in an engineered landfill suitable for receiving the concentrations of [COPCs], the mobility of the COPC will be reduced.

Implementability
Excavation/off-site disposal is a well-proven, readily implementable technology that is a common method for cleaning up contaminated sites. It is a relatively simple process, with proven results. Equipment and labor required to implement this alternative are uncomplicated and readily available. The shallow depths of the identified contamination make excavation readily implementable. It is anticipated that regulatory approval would be granted since it is a proven and permanent technology. Acceptance by the State and the community for this alternative is considered high.

Cost
The estimated cost for excavation, transportation, and disposal of the impacted soils is approximately [#] per ton. This estimate includes permitting, excavation/removal, transportation, and disposal at an approved off-site disposal facility.

4.4 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

A comparative analysis was conducted to identify the advantages and disadvantages of each removal alternative. The comparative analysis of the removal alternatives was conducted to address the criteria listed in Section 4.2.

4.4.1 Effectiveness

Under the no further action alternative, the impacts associated with the site-specific COPC would not be addressed. Consequently, there would be no reduction in the potential risks and the RAOs would not be achieved. The no further action and containment/capping-in-place alternatives do not involve activities that would disturb the impacted soil. Therefore, there would be no short-term risks to on-site workers or the community as a result of implementing these alternatives. The excavation/off-site disposal alternative will require removing, handling, and transporting the impacted soil, resulting in higher short-term exposure risks. However, it is expected that these risks can be sufficiently mitigated through site control measures.

The containment/capping-in-place and excavation/off-site disposal alternatives reduce or eliminate, respectively, potential exposure to COPCs, and therefore, accomplish the RAOs. Once implemented, the containment/capping-in-place alternative would require long-term monitoring to ensure its effectiveness. In addition, future changes in land use could disturb the soil. The excavation/off-site disposal alternative would remove the COPC from the site, and would not require any further management or site controls.

Based upon this evaluation, Alternative [X] is favored is favored under this criterion.

4.4.2 Implementability

No measures would be implemented for the no further action alternative. The containment/capping-in-place and excavation/off-site disposal alternatives are both well-proven, readily implementable technologies. However, only Alternative [X] would be accepted by both the State and the community. Accordingly, Alternative [X] is favored by this criterion.

4.4.3 Cost Effectiveness

A summary of estimated costs to implement the proposed alternatives is presented in Table [#]. Costs are based on containment/capping-in-place of [#] acres of soil or excavation/off-site disposal of [#] cubic yards ([#] tons) of soil.

Table [#] Estimated Costs for Removal Alternatives

SUMMARY OF ESTIMATED COSTS			
Costs	**Removal Action Alternative**		
	Alternative 1 No Further Action	**Alternative 2 Containment**	**Alternative 3 Excavation and Disposal**
Direct Capital Costs			
Equipment Costs			
Material Costs			
Disposal &Transport Costs			
Backfill & Compaction Costs			
Indirect Capital Costs			
Engineering and Design Expenses			
License and Permit Costs			
Annual Post Removal Action Site Control Costs			
Operational Costs			
Maintenance Costs			
Auxiliary Materials			
Total			

4.5 RECOMMENDED REMOVAL ACTION ALTERNATIVE

Based on the comparative analysis described in Section 4.4, Alternative [#] ([description]) is the preferred and recommended removal action alternative for addressing the site. This alternative was selected because [rationale].

5.0 REMOVAL ACTION IMPLEMENTATION

Instructions: Identify the steps in the removal action and describe the key elements for each step. The following example language is biased toward the excavation/off-site disposal alternative. Analogous sections and content should be included for other alternatives.

Implementation of the removal action consists of a series of separate tasks. The following sections discuss each task and the activities of which they consist: selecting excavation locations (Section 5.1); permits, notifications and site preparation (Section 5.2); excavation methodology (Section 5.3); control measures (Section 5.4); air monitoring during excavation (Section 5.5); and field variances (Section 5.6).

5.1 SELECTING EXCAVATION LOCATIONS

Instructions: Discuss the excavation locations and depth intervals. Provide tables and figures summarizing the excavation locations and depths and the chemical of concern driving the excavation.

5.2 PERMITTING AND SITE PREPARATION

Instructions: Discuss site preparation activities, such as clearing and grubbing, pavement removal, demolition activities, etc. Indicate how utilities will be cleared. If available, provide a figure showing locations. Discuss the applicable agencies and notification and/or permits that will need to be made or obtained, respectively, prior to the initiation of any field activities.

5.3 EXCAVATION METHODOLOGY

Instructions: Describe how the excavation will proceed, including pit dimensions, shoring, timing of excavation floor and sidewall sampling, and decision criteria for stopping or continuing the excavation. Describe how soil will be managed on-site and profiled. Reference the Sampling and Analysis Plan. Describe how and where the soil will be transported for disposal. Describe backfill source, backfill activities, grading, and site restoration. Describe timeframe for work activities (e.g., weekdays, hours of operation).

5.4 CONTROL MEASURES

Instructions: Describe site control measures, e.g., dust control, fencing, erosion, stormwater, traffic.

5.5 AIR MONITORING DURING EXCAVATION

Instructions: Describe the site air monitoring strategy, e.g., volatile constituents, fugitive dust, perimeter monitoring.

Air and meteorological monitoring strategies and methodologies will be implemented during the removal action to achieve several goals:

- Identify and measure the air contaminants generated during the soil removal and decontamination activities to assign the appropriate personal protective equipment and safety measures specified for those activities.
- Provide feedback to site personnel regarding potential hazards from exposure to hazardous air contaminants generated through excavation activities.
- Identify and measure air contaminants at points outside of the soil removal and decontamination exclusion zones. Air monitoring will be conducted during work activities to measure potential exposure of sensitive receptors to site COPCs, as a result of removal activities and to monitor the dust control measures implemented.

5.6 FIELD VARIANCES

Variances from the work plan will be discussed with DTSC prior to any action being taken except for emergencies (when an immediate response is required). The DTSC will be notified if an emergency response is implemented. The field variances will be documented in the Removal Action Completion Report prepared for the project.

6.0 SAMPLING AND ANALYSIS PLAN

Instructions: Identify the sampling and analysis plan that will be used during the removal action, as well as the support QA/QC protocols and QAPP. The following sample language is biased toward the excavation/off-site disposal removal alternative. Analogous content should be provided for other alternatives, if collection and analysis of samples is a part of the recommended removal action.

The proposed removal action will require the collection and analysis of samples to confirm the removal of impacted media to determine the proper waste classification of excavated soils for disposal purposes. All sampling will be conducted in general accordance with the applicable field procedures (Appendix [#]), QA/QC protocols, and QAPP presented in this RAW prepared for the site. In the following sections, confirmation sampling and waste disposal classification sampling are discussed.

6.1 CONFIRMATION SAMPLING OF EXCAVATED AREAS

Instructions: Describe how the excavation will proceed, including pit dimensions and target depths, number and location of excavation floor and sidewall sampling, analyses to be conducted on confirmation samples, how data will be evaluated, criteria for further excavation or step-out sampling. Reference the Confirmation Sampling and Analysis Plan.

6.2 WASTE DISPOSAL CLASSIFICATION SAMPLING

Instructions: Describe how soils will be managed on-site and profiled. Discuss the specific analytical methods to be used for profiling and the number of profile samples to be collected. Discuss anticipated waste classification for the excavated soil.

7.0 TRANSPORTATION PLAN

Instructions: Include this section if excavated soil is to be transported. Describe the transportation plan for the removal action. For the excavation/off-site disposal option, describe the anticipated waste classification for the soil, the potential disposal facilities, the transportation type, transportation routes, site traffic control, and associated record keeping.

7.1 CHARACTERISTIC AND DESTINATION OF SOIL TO BE TRANSPORTED

Elevated levels of [metal], up to [#] mg/kg of total [metal] and [#] mg/L of soluble [metal], were detected in the site soil. The Total Threshold Limit Concentration (TTLC) for hazardous waste classification is [#] mg/kg for [metal]. The Soluble Threshold Limit Concentration (STLC) for hazardous waste classification is [#] mg/L for soluble [metal]. The Toxicity Characteristic Leaching Procedure (TCLP) limit for classifying [metal]-impacted soil as a hazardous waste under the Resource Conservation and Recovery Act of 1976 (and as amended) is [#] mg/L. As a result, any mixture of [metal]-impacted soils removed from the site is expected to be handled as a [RCRA/non-RCRA] hazardous waste.

As a hazardous waste generator, [name] will secure an EPA Identification Number from DTSC for proper management of the hazardous waste. Compliance with the DTSC requirements of hazardous waste generation, temporary onsite storage, transportation and disposal is required. Any container used for onsite storage will be properly labeled with a hazardous waste label. Within 90 days after its generation, the hazardous waste will be transported offsite for disposal. Any shipment of hazardous wastes in California will be transported by a registered hazardous waste hauler under a uniform hazardous waste manifest. Land ban requirements will also be followed, as necessary. Any shipment of non-hazardous waste in California will be transported under a non-hazardous waste manifest or bill-of-lading.

Soils classified as [type] waste will probably be transported to [location] or to [location] for disposal. These disposal facilities are licensed [type] landfills and are located at the following addresses:

[Facility Name and EPA ID Number]
[Address]
[City, State, Zip code]
[Phone]
[Contact Person]

[Facility Name and EPA ID Number]
[Address]
[City, State, Zip code]
[Phone]
[Contact Person]

Soils classified as [type] will probably be transported to the following facility:

[Facility Name and EPA ID Number]
[Address]
[City, State, Zip code]
[Phone]
[Contact Person]

[Continue, as needed for each waste anticipated.]

7.2 TRUCK TRANSPORTATION

Approximately [#] tons of soil will be removed from the site. Assuming each truck carries [#] tons, up to [#] trucks will be needed to transport the impacted soil. All permitted disposal facilities operate a certified weight station at their facility. As such, each truck will be weighed before offloading its payload. Weight tickets or bills of lading will be provided to the removal action subcontractor after all the soil has been shipped off-site. Below is a summary of the truck route from the site to the disposal facilities listed above:

[Facility Name 1]
This truck route is illustrated in Figure [#]. [Describe truck route.]

[Facility Name 2]
This truck route is illustrated in Figure [#]. [Describe truck route.]

[Indicate whether alternate routes are an option and how an alternate route would be chosen. Discuss truck transportation days and hours.]

Before leaving the site, each truck driver will be instructed to notify the site manager. Each truck driver will be provided with a Uniform Hazardous Waste Manifest, Non-Hazardous Waste Manifest, or bill-of-lading and and the cellular phone number for the site manager. It will be the responsibility of the site manager to notify DTSC and [entity] of any unforeseen incidences. Each truck driver will be instructed to use the freeway Call Box System (if available), a cellular telephone, and/or their radio dispatch system to call for roadside assistance and report roadside emergencies.

7.3 SITE TRAFFIC CONTROL

During soil transport activities, trucks will enter the site through [location] located on [street name]. A flag person will be located at the site to assist the truck drivers to safely drive onto the site. Transportation will be coordinated in such a manner that at any given time, on-site trucks will be in communication with the site trucking coordinator. In addition, all vehicles will be required to maintain slow speeds (i.e., less than 5 mph) for safety and for dust control purposes.

Prior to exiting the site, the vehicle will be swept to remove any extra soil from areas not covered or protected. This cleanup/decontamination area will be set up as close to the loading area as possible so as to minimize spreading the impacted soil. Prior to the off-site transport, the site manager will be responsible for inspecting each truck to ensure that the payloads are adequately covered, the trucks are cleaned of excess soil and properly placarded, and that the truck's manifest has been completed and signed by the generator (or its agent) and the transporter. As the trucks leave the site, the flag person will assist the truck drivers so that they can safely merge with traffic on [street name].

7.4 RECORD KEEPING

The removal action contractor will be responsible for maintaining a field logbook, which will serve to document observations, personnel on site, equipment arrival and departure times, and other important project information. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. Logbooks will be bound, with consecutively numbered pages and each page will indicate the date and time of the entry. All entries will be legible, written in black or blue ink, and signed by the author. Language will be factual and objective. If an error is made, corrections will be made by crossing a line through the error and entering the correct information. Corrections will be dated and initialed.

Because some portion of the excavated soil likely will be profiled as hazardous waste under California or EPA regulations, the Uniform Hazardous Waste Manifest (hazardous waste manifest) form will be used to track the movement of soil from the point of generation to the point of ultimate disposition. The hazardous waste manifests will include the following information:

- Name and address of the generator, transporter, and the destination facility

- United States Department of Transportation description of the waste being transported and any associated hazards
- Waste quantity
- Name and phone number of a contact in case of an emergency
- EPA Hazardous Waste Generator Number
- Other information required either by the EPA and/or the DTSC.

Any soil that is profiled as non-hazardous and sent off site for disposal will be documented using a Non-Hazardous Waste Manifest or Bill-of-Lading form. At a minimum, this form will include the following information:

- Generator name and address
- Transportation company
- Accepting facility name and address
- Waste shipping name and description
- Quantity shipped.

Prior to transporting the excavated soil off site, an authorized representative of [entity] will sign each hazardous and/or non-hazardous waste manifest. The removal action site manager will maintain one copy of all hazardous and/or non-hazardous waste manifests on site.

8.0 HEALTH AND SAFETY PLAN

Instructions: Identify the standards that will be used to develop the plan and key elements to be included in the plan.

All contractors will be responsible for operating in accordance with the most current requirements of State and Federal Standards for Hazardous Waste Operations and Emergency Response (Cal. Code Regs., tit. 8, section 5192; 29 CFR 1910.120). Onsite personnel are responsible for operating in accordance with all applicable regulations of the Occupational Safety and Health Administration (OSHA) outlined in the State General Industry and Construction Safety Orders (Cal. Code Regs., tit. 8) and Federal Construction Industry Standards (29 CFR 1910 and 29 CFR 1926), as well as other applicable federal, state and local laws and regulations. All personnel shall operate in compliance with all California OSHA requirements.

In addition, California OSHA's Construction Safety Orders (especially Cal. Code Regs., tit. 8, sections 1539 and 1541) will be followed as appropriate. Specific requirements are identified below:

- [list all appropriate or applicable requirements.]

A site-specific HASP will be prepared for the Site in accordance with current health and safety standards as specified by the federal and California OSHAs and submitted to DTSC prior to initiation of field work.

The provisions of the HASP are mandatory for all personnel of the PP and its contractors who are at the Site. The PP's contractor and its subcontractors doing fieldwork in association with this RAW will either adopt and abide by the HASP or shall develop their own safety plans which, at a minimum, meet the requirements of the HASP. All onsite personnel shall read the HASP and sign the "Plan Acceptance Form" (Attachment A of the HASP) before starting Site activities.

9.0 PUBLIC PARTICIPATION

Instructions: Identify the public participation requirements for the RAW process. Discuss the status of the process and the remaining steps of the process. Generally, the RAW process includes conducting a baseline community survey, development of a community profile, public notice of the public comment period, and a fact sheet describing the proposed remedy selection and the availability of the draft RAW for public comment. During the draft RAW public comment period, which is generally 30-days (but can be modified based on project specific needs), the public is directed to the DTSC office, EnviroStor, and other repositories to conduct their review. The project team may make the decision to hold a Public Meeting during the 30 day public comment period. All comments received during the public comment period will be responded to in writing and distributed to everyone who submits a comment.

All of the applicable activities described in the preceding paragraph should be summarized in this section, and the associated documents such as the survey, profile and fact sheet can be included as an appendix.

In addition, to the activities that have been completed, this section should also provide information on how public comments will be addressed, for example in a Responsiveness Summary issued upon approval of the draft RAW.

The public participation requirements for the RAW process include: (1) the development of a community profile, (2) publishing a notice of the availability of the Removal Action Workplan for public review and comment, (3) making the RAW and other supporting documents available at DTSC's office and in the local information repository, and (4) responding to public comments received on the Removal Action Workplan and CEQA documents. In accordance with the Community Profile prepared for this site, the following additional activities will be conducted:
(1) a fact sheet will also be sent out to the site mailing list describing the site and the proposed removal action; 2) the length of the public review and comment period will be 30-days; 3) a public meeting or workshop will be held if there is sufficient community interest; and 4) site documents will be available in electronic format on DTSC's publicly-accessible EnviroStor database.

Once the public comment period is completed, DTSC will review and respond to the comments received. The RAW will be revised, as necessary, to address the comments received. If significant changes to the RAW are required, the RAW will be revised and be resubmitted for public review and comment. If significant changes are not required to the RAW, the RAW will be modified and DTSC will approved the modified RAW for implementation.

10.0 CEQA DOCUMENTATION

Instructions: Describe the DTSC's CEQA role, i.e., Lead Agency or Responsible Agency. Describe the documents that were prepared or reviewed to ensure CEQA compliance, and the status of the documents, i.e., approved and final, under review concurrent with the RAW, etc.. Attach copies of CEQA documents and/or approval notices, if applicable, as an Appendix to the RAW.

The California Environmental Quality Act (CEQA), modeled after the National Environmental Policy Act (NEPA) of 1969, was enacted in 1970 as a system of checks and balances for land-use development and management decisions in California. It is an administrative procedure to ensure comprehensive environmental review of cumulative impacts prior to project approval. It has no agency enforcement tool, but allows challenge in courts.

A CEQA project is a project that has a potential for resulting in a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment. CEQA applies to all discretionary projects proposed to be carried out or approved by California public agencies, unless an exemption applies

In accordance with CEQA, the DTSC has prepared [or reviewed, if DTSC has Responsible Agency status an [Insert CEQA Document title and Lead Agency name, if prepared by another Agency] to ensure that CEQA requirements have been satisfied.

11.0 REFERENCES

Instructions: Provide complete citations for all site-related documents and references cited in the RAW.

APPENDIX C4
SCOPE OF WORK FOR
CORRECTIVE MEASURES STUDY

SCOPE OF WORK FOR A CORRECTIVE MEASURES PROPOSAL

PURPOSE

The purpose of the Corrective Measures Proposal (CMP) is to identify and evaluate remedial alternatives to address the contaminants of concern (COCs) at and from the facility.

SCOPE

A CMP shall describe in detail at the corrective measures proposed to protect human health and the environment from the COCs and must include:

1. Description of Current Conditions

Respondent shall include a brief discussion of any new information that has been developed since the Facility Investigation Report was finalized. This discussion should concentrate on those issues which could significantly affect the evaluation and selection of the corrective measure alternative(s).

2. Proposed Media Cleanup Standards

Respondent shall describe and justify the proposed media cleanup standards and points of compliance.

3. Identification and Evaluation of Corrective Measure Technologies

List and briefly describe potentially applicable technologies for each affected media that may be used to achieve the media cleanup standards. Respondent should include a table that summarizes the available technologies and the advantages and disadvantages of each to eachieve the proposed media cleanup standards.

4. Evaluation of Corrective Measure Alternatives

Use the remedy selection decision factors described below to evaluate then select the corrective measure alternatives. The alternatives must meet the corrective action standards before the remedy selection decision factors are used for further evaluation.

The corrective action standards are as follows:

- Be protective of human health and the environment;
- Attain media cleanup standards;

- Control the source(s) of releases in order to reduce or eliminate, to the extent practicable, further releases of hazardous wastes (including hazardous constituents) that may pose a threat to human health and the environment; and

- Comply with any applicable federal, state, and local standards for management of wastes.

The remedy selection decision factors are:

- Short- and Long-Term Effectiveness;
- Reduction of Toxicity, Mobility and/or Volume;
- Long-Term Reliability;
- Implementability; and
- Cost.

The standard for protection of human health and the environment is a general mandate of the RCRA statute. The standard requires that remedies include any measures that are needed to be protective. These measures may or may not be directly related to media cleanup, source control, or management of wastes. An example would be a requirement to provide alternative drinking water supplies in order to prevent exposures to a contaminated drinking water supply.

a. Describe in detail each corrective measure alternatives ability to meet the proposed media cleanup or performance standards.

b. Describe each corrective measure alternatives ability to control the sources of releases.

   A critical objective of any remedy must be to stop further environmental degradation by controlling or eliminating further releases that may pose a threat to human health and the environment. Unless source control measures are taken, efforts to cleanup releases may be ineffective or, at best, will essentially involve a perpetual cleanup. Therefore, an effective source control program is essential to ensure the long-term effectiveness and protectiveness of the corrective action effort.

   The source control standard is not intended to mandate a specific remedy or class of remedies. Instead, the Respondent is encouraged to examine a wide range of options. This standard should not be interpreted to preclude the equal consideration of using other protective remedies to control the source, such as partial waste removal, capping, slurry walls, in-situ treatment/stabilization and consolidation.

c. Discuss how any specific waste management activities will be conducted in compliance with all applicable state or federal regulations (e.g., CAMU closure requirements, land disposal restrictions).

d. Each corrective measure alternative must be evaluated with regard to its effectiveness in protecting human health and the environment and meeting the proposed media cleanup standards. Both short- and long-term components of effectiveness must be evaluated; short-term referring to the construction and implementation period, and long-term referring to the period after the remedial action is complete. Estimate approximately how much time it will take to implement each corrective measure alternative, the length of time before initial beneficial results are obtained, and the length of time required to achieve the proposed media cleanup standards.

The evaluation of short-term effectiveness must include possible threats to the safety of nearby communities, workers, and environmentally sensitive areas (e.g., oceans, wetlands) during construction of the corrective measure alternative. Factors to consider are fire, explosion, exposure to hazardous substances and potential threats associated with treatment, excavation, transportation and re-disposal or containment of waste material. Laboratory and/or field studies are extremely useful in estimating the effectiveness of corrective measures and should be used whenever possible.

The evaluation of long-term effectiveness must include possible threats to the safety of nearby communities, workers, and environmentally sensitive areas (e.g., oceans, wetlands) during operation of the corrective measure alternative.

e. Each corrective measure alternative must be evaluated for its ability to reduce the toxicity, mobility, and/or volume of the contaminated media. Reduction in toxicity, mobility, and/or volume refers to changes in one or more characteristics of the contaminated media by the use of corrective measures that decrease the inherent threats associated with the media.

Estimate how much the corrective measure alternative will reduce the waste toxicity, volume and/or mobility (compare initial site conditions to post-corrective measure conditions). In general, the Department strongly prefers corrective measures that have a high degree of permanence and reduce the contaminant toxicity, mobility and volume through treatment.

f. Each corrective measure alternative must be evaluated with regards to its long-term reliability. This evaluation includes consideration of operation and maintenance requirements.

Demonstrated and expected reliability is a way of assessing the risk and effect of failure. Discuss whether the technology or combination of technologies have been used effectively together under analogous site conditions, whether failure of any one technology in the alternative has an impact on receptors or contaminant migration, and whether the alternative would have the flexibility to deal with uncontrollable changes at the site (e.g., heavy rain storms, earthquakes, etc).

Operation and maintenance requirements include the frequency and complexity of necessary operation and maintenance. Technologies requiring frequent or complex operation and maintenance activities should be regarded as less reliable than technologies requiring little or straightforward operation and maintenance. The availability of labor and materials to meet these requirements must also be considered.

Most corrective measure technologies, with the exception of destruction, deteriorate with time. Often, deterioration can be slowed through proper system operation and maintenance, but the technology eventually may require replacement. Each corrective measure alternative shall be evaluated in terms of the projected useful life of the overall alternative and of its component technologies. Useful life is defined as the length of time the necessary or required level of effectiveness can be maintained.

g. The implementability criterion addresses the technical and administrative feasibility of implementing a corrective measure alternative and the availability of various services and materials needed during implementation. Each corrective measure alternative must be evaluated using the following criteria:

Construction and Operation: Corrective measure alternatives must be feasible to implement given the existing set of waste and site-specific conditions. This evaluation was initially done for specific technologies during the screening process and is addressed again in this detailed analysis of the alternative as a whole. It is not intended that the screening process be repeated here, but instead to highlight key differences and/or changes from the screening analysis that may result from combining technologies.

Administrative Feasibility: Discuss the administrative activities needed to implement the corrective measure alternative (e.g., permits, public acceptance, rights of way, off-site approvals, etc.).

Availability of Services and Materials: Discuss the availability of adequate off-site treatment, storage capacity, disposal services, needed technical services and materials, and the availability of prospective technologies for each corrective measure alternative.

h. Develop a preliminary cost estimate for each corrective measure alternative (and for each phase or segment of the alternative). The cost estimate shall include both capital and operation and maintenance costs. Include a description of how the costs were estimated and what assumptions were used.

- The preliminary capital cost estimate must consider all key costs including, at a minimum, costs for engineering, mobilization, demobilization, site preparation, construction, materials, labor, equipment purchase and rental, sampling, analysis, waste disposal, permitting and health and safety measures.

- The preliminary operation and maintenance cost estimate must consider all key costs including, at a minimum, costs for labor, training, sampling, analysis, maintenance materials, utilities, waste disposal, waste treatment, permitting and health and safety measures.

- Calculate the net present value of preliminary capital and operation and maintenance costs for each corrective measure alternative.

The Department may require Respondent to conduct additional studies to support the CMP. The Respondent will furnish all personnel, materials and services necessary to conduct the additional tasks.

5. Respondent's Recommended Corrective Measure Alternative

The Respondent may recommend a preferred corrective measure alternative for consideration by the Department. Such a recommendation should include a description and supporting rationale for the preferred alternative that is consistent with the corrective action standards and remedy selection decision factors discussed above.

Based on the CMP and other information, including public comments, the Department will establish final cleanup standards and points of compliance and will select a final remedy for the facility.

APPENDIX C5
SCOPE OF WORK FOR
INTERIM MEASURES

SCOPE OF WORK FOR INTERIM MEASURES IMPLEMENTATION

PURPOSE

Interim measures are actions to control and/or eliminate releases of hazardous waste and/or hazardous constituents from a facility prior to the implementation of a final corrective measure. Interim measures must be used whenever possible to achieve the goal of stabilization which is to control or abate threats to human health and/or the environment, and to prevent or minimize the spread of contaminants while long-term corrective action alternatives are being evaluated.

SCOPE

The documents required for Interim Measures (IM) are, unless the Department of Toxic Substances Control (Department) specifies otherwise, an IM Workplan, an Operation and Maintenance Plan and IM Plans and Specifications. The scope of work (SOW) for each document is specified below. The SOWs are intended to be flexible documents capable of addressing both simple and complex site situations. If the Owner/Operator or Respondent can justify, to the satisfaction of the Department, that a plan or portions thereof are not needed in the given site specific situation, then the Department may waive that requirement.

The scope and substance of interim measures should be focused to fit the site specific situation and be balanced against the need to take quick action.

The Department may require the Owner/Operator or Respondent to conduct additional studies beyond what is discussed in the SOWs in order to support the IM program. The Owner/Operator or Respondent will furnish all personnel, materials and services necessary to conduct the additional tasks.

A. Interim Measures Workplan

The Owner/Operator or Respondent shall prepare an IM Workplan that evaluates interim measure options and clearly describes the proposed interim measure, the key components or elements that are needed, describes the designer's vision of the interim measure in the form of conceptual drawings and schematics, and includes procedures and schedules for implementing the interim measure(s). The IM Workplan must be approved by the Department prior to implementation. The IM Workplan must, at a minimum, include the following elements:

1. Introduction/Purpose

   Describe the purpose of the document and provide a summary of the project.

2. Conceptual Model of Contaminant Migration

It is important to know where the contaminants are and to understand how they are moving before an adequate interim measure can be developed. To address this critical question, the Owner/Operator or Respondent must present a conceptual model of the site and contaminant migration. The conceptual model consists of a working hypothesis of how the contaminants may move from the release source to the receptor population. The conceptual model is developed by looking at the applicable physical parameters (e.g., water solubility, density, Henry's Law Constant, etc.) for each contaminant and assessing how the contaminant may migrate given the existing site conditions (geologic features, depth to ground water, etc.). Describe the phase (water, soil, gas, non-aqueous) and location where contaminants are likely to be found. This analysis may have already been done as part of earlier work (e.g., Current Conditions Report). If this is the case, then provide a summary of the conceptual model with a reference to the earlier document.

3. Evaluation of Interim Measure Alternatives

List, describe and evaluate interim measure alternatives that have the potential to stabilize the facility. Propose interim measures for implementation and provide rationale for the selection. Document the reasons for excluding any interim measure alternatives.

4. Description of Interim Measures

Qualitatively describe what the proposed interim measure is supposed to do and how it will function at the facility.

5. Data Sufficiency

Review existing data needed to support the design effort and establish whether there are sufficient accurate data available for this purpose. The Owner/Operator or Respondent must summarize the assessment findings and specify any additional data needed to complete the interim measure design. The Department may require or the Owner/Operator or Respondent may propose that sampling and analysis plans and/or treatability study workplans be developed to obtain the additional data. Submittal times for any new sampling and analysis plans and/or treatability study workplans must be included in the project schedule.

6. Project Management

Describe the levels of authority and responsibility (include organization chart), lines of communication and a description of the qualifications of key personnel who will direct the interim measure design and implementation effort (including contractor personnel).

7. Project Schedule

   The project schedule must specify all significant steps in the process, when any key documents (e.g., plans and specifications, operation and maintenance plan) are to be submitted to the Department and when the interim measure is to be implemented.

8. Design Basis

   Discuss the process and methods used to design all major components of the interim measure. Discuss the significant assumptions made and possible sources of error. Provide justification for the assumptions.

9. Conceptual Process/Schematic Diagrams.

10. Site plan showing preliminary plant layout and/or treatment area.

11. Tables listing number and type of major components with approximate dimensions.

12. Tables giving preliminary mass balances.

13. Site safety and security provisions (e.g., fences, fire control, etc.).

14. Waste Management Practices

    Describe the wastes generated by the construction of the interim measure and how they will be managed. Also discuss drainage and indicate how rainwater runoff will be managed.

15. Required Permits

    List and describe the permits needed to construct the interim measure. Indicate on the project schedule when the permit applications will be submitted to the applicable agencies and an estimate of the permit issuance date.

16. Sampling and Monitoring

    Sampling and monitoring activities may be needed for design and during construction of the interim measure. If sampling activities are necessary, the IM Workplan must include a complete sampling and analysis section which specifies at a minimum the following information:

    a. Description and purpose of monitoring tasks;
    b. Data quality objectives;
    c. Analytical test methods and detection limits;

d. Name of analytical laboratory;
e. Laboratory quality control (include laboratory QA/QC procedures in appendices)
f. Sample collection procedures and equipment;
g. Field quality control procedures:
    - duplicates (10% of all field samples)
    - blanks (field, equipment, etc.)
    - equipment calibration and maintenance
    - equipment decontamination
    - sample containers
    - sample preservation
    - sample holding times (must be specified)
    - sample packaging and shipment
    - sample documentation (field notebooks, sample labeling, etc.);
    - chain of custody;
h. Criteria for data acceptance and rejection; and
i. Schedule of monitoring frequency.

The Owner/Operator or Respondent shall follow all Department and USEPA guidance for sampling and analysis. The Department may request that the sampling and analysis section be a separate document.

17. Appendices including:

Design Data - Tabulations of significant data used in the design effort;

Equations - List and describe the source of major equations used in the design process;

Sample Calculations - Present and explain one example calculation for significant calculations; and

Laboratory or Field Test Results.

B. Interim Measures Operation and Maintenance Plan

The Owner/Operator or Respondent shall prepare an Interim Measures Operation and Maintenance (O&M) Plan that includes a strategy and procedures for performing operations, maintenance, and monitoring of the interim measure(s). An Interim Measures Operation and Maintenance Plan shall be submitted to the Department simultaneously with the Plans and Specifications. The O&M plan shall, at a minimum, include the following elements:

1. Purpose/Approach

Describe the purpose of the document and provide a summary of the project.

2. Project Management

Describe the levels of authority and responsibility (include organization chart), lines of communication and a description of the qualifications of key personnel who will operate and maintain the interim measure(s) (including contractor personnel).

3. System Description

Describe the interim measure and identify significant equipment.

4. Personnel Training

Describe the training process for O&M personnel. The Owner/Operator or Respondent shall prepare, and include in the technical specifications governing treatment systems, contractor requirements for providing: appropriate service visits by experienced personnel to supervise the installation, adjustment, start up and operation of the treatment systems, and training covering appropriate operational procedures once the start-up has been successfully accomplished.

5. Start-Up Procedures

Describe system start-up procedures including any operational testing.

6. Operation and Maintenance Procedures

Describe normal operation and maintenance procedures including:

a. Description of tasks for operation;
b. Description of tasks for maintenance;
c. Description of prescribed treatment or operation condition, and
d. Schedule showing frequency of each O&M task.

7. Replacement schedule for equipment and installed components.

8. Waste Management Practices

   Describe the wastes generated by operation of the interim measure and how they will be managed. Also discuss drainage and indicate how rainwater runoff will be managed.

9. Sampling and Monitoring

   Sampling and monitoring activities may be needed for effective operation and maintenance of the interim measure. If sampling activities are necessary, the O&M plan must include a complete sampling and analysis section which specifies at a minimum the following information:

   a. Description and purpose of monitoring tasks;
   b. Data quality objectives;
   c. Analytical test methods and detection limits;
   d. Name of analytical laboratory;
   e. Laboratory quality control (include laboratory QA/QC procedures in appendices)
   f. Sample collection procedures and equipment;
   g. Field quality control procedures:
      - duplicates (10% of all field samples)
      - blanks (field, equipment, etc.)
      - equipment calibration and maintenance
      - equipment decontamination
      - sample containers
      - sample preservation
      - sample holding times (must be specified)
      - sample packaging and shipment
      - sample documentation (field notebooks, sample labeling, etc.);
      - chain of custody;
   h. Criteria for data acceptance and rejection; and
   i. Schedule of monitoring frequency.

   The Owner/Operator or Respondent shall follow all Department and USEPA guidance for sampling and analysis. The Department may request that the sampling and analysis section be a separate document.

10. O&M Contingency Procedures:

    a. Procedures to address system breakdowns and operational problems including a list of redundant and emergency back-up equipment and procedures;

    b. Should the interim measure suffer complete failure, specify alternate procedures to prevent release or threatened releases of hazardous substances, pollutants or contaminants which may endanger public health and/or the environment or exceed cleanup standards; and

c. The O&M Plan must specify that, in the event of a major breakdown and/or complete failure of the interim measure (includes emergency situations), the Owner/Operator or Respondent will orally notify the Department within 24 hours of the event and will notify the Department in writing within 72 hours of the event. The written notification must, at a minimum, specify what happened, what response action is being taken and/or is planned, and any potential impacts on human health and the environment.

11. Data Management and Documentation Requirements

Describe how analytical data and results will be evaluated, documented and managed, including development of an analytical database. State the criteria that will be used by the project team to review and determine the quality of data.

The O&M Plan shall specify that the Owner/Operator or Respondent collect and maintain the following information:

a. Progress Report Information

- o Work Accomplishments (e.g., performance levels achieved, hours of treatment operation, treated and/or excavated volumes, concentration of contaminants in treated and/or excavated volumes, nature and volume of wastes generated, etc.).

- o Record of significant activities (e.g., sampling events, inspections, problems encountered, action taken to rectify problems, etc.).

b. Monitoring and laboratory data;

c. Records of operating costs; and

d. Personnel, maintenance and inspection records.

The Department may require that the Owner/Operator or Respondent submit additional reports that evaluate the effectiveness of the interim measure in meeting the stabilization goal.

C. Interim Measures Plans and Specifications

[Note - The decision to require the submittal of plans and specifications should be based on the site specific situation. The requirement for plans and specifications should be balanced against the need to quickly implement interim measures at a facility.]

The Owner/Operator or Respondent shall prepare Plans and Specifications for the interim measure that are based on the conceptual design but include additional detail. The Plans and Specifications shall be submitted to the Department simultaneously with the Operation and Maintenance Plan. The design package must include drawings and specifications needed to construct the interim measure. Depending on the nature of the interim measure, many different types of drawings and specifications may be needed. Some of the elements that may be required are:

- General Site Plans
- Process Flow Diagrams
- Mechanical Drawings
- Electrical Drawings
- Structural Drawings
- Piping and Instrumentation Diagrams
- Excavation and Earthwork Drawings
- Equipment Lists
- Site Preparation and Field Work Standards
- Preliminary Specifications for Equipment and Material

General correlation between drawings and technical specifications is a basic requirement of any set of working construction plans and specifications. Before submitting the project specifications to the Department, the Owner/Operator or Respondent shall:

a. Proofread the specifications for accuracy and consistency with the conceptual design; and

b. Coordinate and cross-check the specifications and drawings.

APPENDIX C6
EXAMPLE FOR STATEMENT OF BASIS

Department of Toxic Substances Control

Statement of Basis

Proposed Remedy

Wilson Street Corporation
1321 Wilson Street
Los Angeles, California
Los Angeles County

Prepared by

Tiered Permitting Corrective Action Branch
Hazardous Waste Management Program
Department of Toxic Substances Control

Raymond J. Campbell, Hazardous Substances Scientist

April 26, 2007

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List of Figures

List of Acronyms

AOC-	Area of Concern
AST -	Aboveground Storage Tanks
bgs -	Below ground surface
CalEPA -	California Environmental Protection Agency
CHHSL -	California Human Health Screening Level
COC -	Contaminant of Concern
FCMAWP -	Final Corrective Measures Action Work Plan
DTSC -	Department of Toxic Substances Control
mg -	Milligram
PEA -	Preliminary Endangerment Assessment
RCRA -	Resource Conservation and Recovery Act
ug -	Microgram
US -	United States
USEPA -	United States Environmental Protection Agency
WSC -	Wilson Street Corporation
WY -	West Yard

Statement of Basis
Proposed Remedy
Wilson Street Corporation
April 26, 2007

1. Introduction

The California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) has prepared this Statement of Basis to discuss the remedy for the Wilson Street Corporation (WSC). The facility is on a 22,000 square foot property, which is located at 1321 Wilson Street, Los Angeles, California (See Figure 1). The facility is currently not operating, but had been operating from 1961 to 2003 to refine and recover precious metal. The subject facility was operated as a chemical warehouse by National Chemical Company from 1949 to 1961 and was a vacant property from 1938 through 1949. WSC plans to construct a concrete cap on the West Yard (WY) to allow for automobile and light truck parking. (See Figure 2).

The proposed remedy is to remove the top 12 inches of contaminated soil from the WY as well as up to 3 feet of soil in targeted excavation areas to within California Human Health Screening Levels (CHHSL's). This would further minimize potential health risk. The proposed remedy will allow for restricted use of the WY. The proposed remedy does not include the Northeast Yard which was remediated in 1995 or the laboratory and process building which were decontaminated in August, 2005.

DTSC is issuing this Statement of Basis as part of its public participation responsibilities under the California Health and Safety Code, Chapter 6.5, Hazardous Waste Control. This Statement of Basis summarizes information that can be found in greater detail in the Final Corrective Measures Action Work Plan (FCMAWP) Report, dated December 18, 2006. DTSC encourages the public to review the document in order to gain a more comprehensive understanding of the facility and corrective action activities that have been conducted there.

In addition to this Statement of Basis, DTSC has prepared a Fact Sheet that summarizes the proposed remedy and provides a notice of the public comment period. DTSC has proposed a remedy for the WY as the best possible way to reduce metal exposure to industrial use, Cal-EPA health risk screening levels. The public is encouraged to review and comment on the proposed remedy. The public can review the remedy selection process by reviewing the documents during the 30-day public comment period which begins April 26, 2007 and ends on May 28, 2007. DTSC would implement the final remedy only after the public comment period has ended and any information submitted during this time has been reviewed and considered. The WSC consultant would be required to implement the remedy under DTSC oversight. The WSC consultant will submit a report when remedy implementation is completed.

2. Proposed Remedy

The WSC consultant is proposing the following remedy for contaminated soil at the WSC WY:

• Excavation of contaminated soil, temporary stockpiling for waste characterization testing, and disposal at an approved off-site facility.

•*Confirmation sampling to ensure that any contaminated soil remaining* is at or below Industrial CHHSL's. If, after excavating approximately 836 tons of contaminated soil and solid debris waste, chemicals remain at concentrations greater than cleanup goals, then supplemental remedial actions will be implemented after approval by DTSC. In addition to excavation, other remedial actions will be considered.

•Capping residual contamination, on WSC property, with deed restrictions.
A more detailed discussion of the proposed remedy is included in **Section 6.2** of this Statement of Basis.

3. Facility Background

3.1 Facility Location and Description

WSC owns a 22,000 square foot facility located at 1321 Wilson Street in Los Angeles, Los Angeles County, California. The facility is located in an industrial area of older building design and construction. The facility is located on the western side of Wilson Street, immediately north of the intersection of East 10th Street, and adjacent to the Santa Monica Freeway (Interstate 10).

The principle process operations were associated with precious metal recovery activities from 1961 to 2003 by the former Martin Metals, Incorporated. During the period from 1949 through 1961, National Chemical Company operated the facility as a warehouse for various types of chemicals. The type of chemicals stored at the site during this period is unknown.

The facility was a Tiered Permitting Onsite Hazardous Waste Treatment facility and had authorization to operate under the Conditional Authorization Tier on August 12, 1993. WSC is in the process of converting the former precious metal recycling facility to a storage facility and a parking area for workers in the vicinity of 1321 Wilson Street. All of the WY will be remediated and capped for restricted land use. The work will be conducted under DTSC Oversight.

3.2. Environmental Conditions and Land Use

3.2.1. Environmental Conditions

The site is located in the Central Basin Area of the Coastal Plain of Los Angeles County. The Coastal Plain of Los Angeles County is located in the northwest portion of the Peninsular Range geomorphic province. This province extends southward into Baja California and consists of a north-northwesterly trending mountain range and associated valleys. The Coastal Plain of Los Angeles County is bounded by the Santa Monica Mountains on the north, the Elysian, Repetto, Merced, and Puente Hills to the northeast, the Los Angeles-Orange County line on the southeast, and the Pacific Ocean on the south and west.

The Central Basin extends over most of the Coastal Plain of Los Angeles County east and northeast of the Newport-Inglewood uplift zone. It is bound on the north by the Hollywood Basin and a series of low rolling hills extending from the Elysian Hills on the northwest to the Puente Hills on the southeast. The Central Basin is bounded on the west and south by Newport-Inglewood uplift and on the southeast by the Los Angeles County Line. The Central Basin is divided internally into three physiographic regions: the Central Basin Pressure Area, and the Los Angeles and Montebello Forebay Areas.

Regional formations beneath the Site include the Lakewood Formation from surface grade to approximately 150 feet below ground surface (bgs) and the San Pedro Formation to approximately 625 feet bgs. Materials composing the Lakewood and San Pedro Formations consist primarily of sand and gravel with small amounts of clay and interbedded layers of silt and clay. The site is located on the south-dipping limb of the Paramount Syncline and members of the underlying formations subsequently dip slightly to the west-southwest.

In order of decreasing depth, the Site is underlain by water bearing deposits composed of the Lakewood and San Pedro Formations. The Lakewood formation of the late Pleistocene age, includes the Gaspur, Exposition, Gage, and Gardena Aquifers. The base of the of the Lakewood Formation (240 feet bgs) is marked by the Gardena Aquifer at a depth of approximately 150 feet bgs. The underlying San Pedro Formation contains water bearing sediment groups of the Hollydale, Jefferson, Silverado, and Sunnyside Aquifers. Depth to groundwater below the site is approximately 60 feet.

4. Facility Investigations

The WY was cleared of all materials, metal scrap, process equipment and containers by the property owner. The WY at this time is a vacant property with an asphalt cover and several concrete bermed areas. In June 2001, ENCON conducted a Limited Environmental Subsurface Site Assessment of the WY that revealed elevated levels of lead, cadmium, and mercury metals. In order to update this environmental data, an investigation was performed in June, 2006 by ENCON to establish the current baseline conditions of the WY. The lateral and vertical extent of the contamination was defined in the site assessment investigation and the results are presented in ENCON's "Subject Property West Yard Baseline Site Assessment Investigation", dated June 20, 2006.

With regards to the present DTSC site assessment requirements leading to the remediation of the WY, the subsurface findings and soil data provided a preliminary base line of soil information on the conditions of the WY. To define the present soil conditions, however, an additional investigation, the Baseline Subsurface Soil Investigation was required by the CalEPA DTSC in order to update this data with recent data that is indicative of present environmental conditions. The objective of the investigation was to determine the vertical and lateral extent of metal impacts over the entire WY. The WY was segmented into various grids based on the type of process formerly conducted in those locations and soil samples were collected at various depths. The purpose of the investigation was to initially evaluate subsurface soil conditions to a depth of 1.5 feet bgs over the entire WY as well as identified areas of elevated contaminant concentrations (also referred to as hot spots'). The soil analytical data was compared to Cal-EPA CHHSL's preliminary screening health risk concentrations to locate "hot spots" and to define additional sampling required to determine the vertical extent of the contamination in the "hot spot" areas.

The 8,100 square foot west rear yard was segmented into three "hot spot" areas for further subsurface shallow soil testing, AOC-1, AOC-2, and AOC-B. These areas of concern (AOC) include the former Martin Metals wet process area located on the north side of the yard (AOC-2), former waste solution treatment area located adjacent to the rear building wall (AOC-1), and the balance of the WY (AOC-B). The sampling incorporated a 10 foot sampling grid in AOC-1 and AOC-2 and a 20 foot sampling grid in AOC-B.

A total of 48 borings were drilled in the WY that included 12 borings in AOC-1, 16 borings in AOC-2 and 20 borings in AOC-B. Additional borings were advanced in the AOC-2 area to test for ammonia, mercury and pH. Soil samples were initially collected at 1.5 feet, and 3.0 feet bgs. The soil samples were collected in acetate plastic tubes, capped on both ends, labeled and recorded on a chain-of-custody document. The samples were transported to a State-Certified hazardous chemical material laboratory, C&E Laboratories, Santa Fe Springs, California for analysis.

The soil samples were analyzed for Title 22 CAM Metals, mercury, PCB, pH, and cyanide with selected borings for ammonia and TRPH. All the 1.5 foot samples were analyzed for these constituents and the 3.0 foot samples were placed on hold to be analyzed for elevated constituents in borings that showed elevated levels found in the 1.5 foot samples. Further selected delineation of the vertical extent was performed at 5.0 feet and 10 feet bgs. A summary of soil test findings and conclusions are presented below for various depths.

The metals cadmium, lead, and mercury were detected above their respective Cal-EPA screening levels, CHHSL's. Laboratory analysis indicated that lead exceeded its CHHSL of 130 mg/kg in

AOC-1 at four locations (concentrations ranging from 189 mg/kg to 512 mg/kg) and at three locations in Area-B (concentrations ranging from 1,027 mg/kg to 2,525 mg/kg). Mercury exceeded its CHHSL of 1.8 in AOC-1 at 6 locations (concentrations ranging from 2.98 mg/kg to 13.13 mg/kg), in AOC-2 at five locations (concentrations ranging from 1.82 mg/kg to 7.61 mg/kg), and in Area-B at one location (concentration of 2.04 mg/kg). Cadmium exceeded its CHHSL of 1.7 mg/kg in Area-B at three locations (concentrations ranging from 9.1 mg/kg to 33.4 mg/kg). Arsenic was not detected above the reporting limit in any of the soil samples collected.

The soil samples from 3 feet bgs in these hot spot areas were also analyzed, resulting in three areas (AOC-A, AOC-B, and AOC-C) where either cadmium (AOC-C), lead (AOC-A and B), or mercury (AOC-A and AOC-B) exceeded their respective CHHSL's.

In June, 2006, ENCON drilled an additional six boreholes in these areas in order to determine the vertical extent of contamination. Laboratory analysis of the soil samples collected at these locations from depths of 5', 10', and 15' bgs indicated that none of the CHHSL's for Title 22 metals or mercury are exceeded in soil at the site beyond the depth of 3 feet bgs. The metals contamination is insoluable and not mobile.

5. Summary of Facility Risk And Clean Up Standards

Cleanup standards for this site are established to protect human health and the environment. The cleanup standards are based on site-specific media of concern, identified Contaminant of Concern (COC's), exposure routes and receptors, and identification of acceptable concentrations or range of concentrations for each exposure route. The media of concern for this site is limited to soil. The primary COC's for this site are metals (cadmium, lead, mercury).

Discussion of migration and exposure pathways of metals and pH follow. Release mechanisms, exposure pathways and exposure routes are also discussed in this section. The WY was used for scrap material storage and sludge recovery from the chemical digestion process performed inside the 2-story building employing solution settling and filtration equipment in addition to AST's (Aboveground Storage Tanks). The settling and filtration AST's were operated inside a bermed area on the north portion of the WY. The scrap metal was processed by acid digestion using acids in retort above ground vessels. The digested material is precipitated and filtered to collect various precious metals in sludge composition.

The digestion metal containing solutions are typically transferred and stored in drums and/or AST's used as settling tanks. Acids and bases were typically stored in drums or used in tanks. The primary release mechanism for metal containing solutions or acids and bases are, therefore, spills and/or leaks. The ground surface in the WY area is paved with asphalt or concrete although the surfaces are in poor condition showing many cracks and separations. Releases in this area are likely to flow either to the drainage surfaces situated in the center of the WY and then flow westward towards

Elwood Avenue, or collect in various surface pockets or in the bermed containment areas resulting in an accumulation of chemical residual material be evaporated.

Strong acids and bases can also dissolve the concrete, and eventually penetrate into the soil. These poor surface conditions were observed in the WY as well as along the 2-story building where the concrete pads were in very poor condition due to acid etching exposing the subsurface natural soil. The process and used parts storage areas asphalt surfaces were also in poor condition, and therefore, a release in this area likely penetrated into the soil. Once in the soil, acids can mobilize metals typically found in soil, to migrate downward.

Exposure pathways include ingestion and absorption. In addition, inhalation exposure is possible since the settling tanks and solution drum storage were open containers which were handled manually. Cyanide compounds are typically complexed as salts which are transferred manually from the shed storage area to the process area.

Based on the WY remedial investigation, the proposed corrective action was developed to reduce metal exposure for industrial use CalEPA health risk screening levels by removing 12-inches of top soil from the WY area as well as up to 3-feet of soil in targeted excavations of selected areas (#1 through #5) to within CHHSL's concentrations and further minimize potential health risk. The remedial investigation soil data in conjunction with CalEPA DTSC acceptable CHHSL's were used to develop the Final Corrective Measures Action Work Plan (FCMAWP) as well as defined the targeted "hot spot" AOC areas. This section presents the scope and procedures to remediate the WY portion of the subject site to within CHHSL's acceptable concentrations.

6. Scope of Corrective Action

6.1 Selected Remedy:

The proposed remedy consists of removing contaminated soil in two (2) stages. The first stage of the remedial excavation will be with the marking of the perimeter of the five targeted excavation AOC areas in proper relationship to the marked "Baseline Site Assessment" exploratory boring locations. These exploratory boring locations are currently marked in place at this time and were drilled and properly marked during the Baseline Remedial Investigation with wood stakes. After targeted area perimeters are marked, the areas will be saw cut and the cap removed with a backhoe to expose the subsurface soil. The cap debris will be stockpiled adjacent to the excavation in order to minimize handling. The soil will then be initially excavated and removed to a depth of 3-feet below grade in targeted areas #01, #03, and #05 and 2-feet in targeted areas #02, and #04. Further remedial excavation may be required in various AOC's based on sidewall and basal soil confirmatory sample data and those targeted areas or portions thereof that exhibit elevated CHHSL's will be further excavated to achieve acceptable CHHSL soil concentrations or non-detect. The excavation will not be extended to chase elevated pH that does not exhibit elevated levels of metals or beneath the building structures on the east portion of the site or on to adjacent properties.

The excavation areas and backhoe soil handling buckets will be sprayed frequently with water to prevent worker air dust exposure or impacting off-site adjacent properties. The excavated soil will be stockpiled pending further profiling and disposal or transferred directly into dump trucks for off-site disposal. Soil from the excavation will be staged adjacent to the excavation area leaving sufficient space for truck access, loading and unloading, and decontamination. The contaminated soil will be removed using a backhoe with a 1.5 cubic yard bucket. The soil will be loaded into the end dumps with a 3 cubic yard bucket loader. Dust control measures will be used during loading. All of the asphalt and concrete debris plus all of the excavated soil will be hauled to a Treatment Disposal Center facility, La Paz County Landfill, Parker, Arizona.

After completing the remedial excavation of the five targeted areas described above, confirmatory basal and sidewall soil samples will be collected by ENCON under the direction of a Professional Geologist in the first natural and undisturbed top zone soil, estimated to be within 4-6 inches below bottom surfaces and approximately 6-inches into the sidewall. The basal soil samples will be collected from the bottom of the excavation using a representative uniform grid sampling plan. The sidewall soil samples will be collected at one sample per sidewall at approximately 2/3rds depth bgs. The soil samples will be removed using a hand auger and collected in stainless steel sampling tubes that are capped at both ends with Teflon sheet and plastic end caps.

The soil samples will be properly labeled, stored in an ice cooler and subsequently transferred to a State-Certified chemical laboratory for analysis. All of the soil samples will be analyzed for the following constituents:

*Title 22 Metals by EPA method 6010

*Mercury by EPA method 7471

*Hexavalent Chrome by EPA method 7199

*Cyanide by EPA method 9010c

*Ammonia by EPA method 350.2

*pH by EPA method 9045.

(It is understood by DTSC and the property owner, confirmatory soil samples are to be used to calculate health risk levels and to delineate the vertical or lateral extent of impacts, present, above the CHHSL's in the subsurface soil requiring additional remedial excavation to achieve acceptable CHHSL's).

All of the hazardous waste soil cuttings from the auger sampler will be stockpiled and retained at the sampling point inside the excavation for subsequent removal, if determined to be above acceptable screening levels. The sampling material hazardous waste will be manifested as non-RCRA hazardous solid waste and transported and disposed at an off-site TSD facility.

The five excavations will be backfilled with clean imported CMB (Crushed Miscellaneous Base) aggregate to 12-inches bgs under supervision of a professional geologist. No excavated soil will be used for backfill and all stockpiled soil removed and disposed off-site will be manifested to ensure proper disposal facility destination. CMB backfill material will be placed on the base of the excavation and backfill material will be placed in 18" lifts and compacted to a minimum of 90%.

The second stage of the remedial excavation will begin after the five targeted excavation areas have been successfully remediated and backfilled to 12 inches bgs. The second stage portion of the asphalt and concrete cap of the balance of the WY will be removed with a backhoe to expose the subsurface soil. The cap debris will be stockpiled in the yard to minimize overhandling. The second stage soil will then be excavated and removed to a depth of 12 inches bgs. The excavation areas and backhoe soil handling buckets will be sprayed frequently with water too prevent worker air dust exposure or impacting off-site adjacent properties. The excavated soil will be stockpiled pending further profiling and disposal or transferred directly into dump trucks for off-site disposal. Soil from the excavation will be staged adjacent to the excavation area leaving sufficient area for work access, loading, unloading and decontamination. The contaminated soil will be removed using a backhoe equipped with a 1.5 cubic yard bucket.

The soil will be unloaded into the end dumps with a 3 cubic yard bucket loader. Dust control measures will be used during loading. All of the asphalt and concrete debris, plus all of the contaminated soil will be removed and manifested to a treatment disposal center, La Paz County Landfill, Parker, Arizona.

After completion of the remedial excavation of the balance of the WY as described above, confirmatory basal soil samples will be collected by ENCON under the direction of a Professional Geologist in the first natural undisturbed top zone soil, estimated to be within 4 to 6 inches below bottom and side wall surfaces. The soil samples will be collected from the excavated surfaces using a representative sampling plan. The soil samples will be removed using a hand auger and collected in stainless steel sampling tubes that are capped at both ends with Teflon sheet and plastic end caps.

The soil samples will be properly labeled, stored in an ice cooler and subsequently transferred to a State-Certified chemical laboratory for analysis. All of the soil samples will be analyzed for the following constituents:

*Title 22 Metals by EPA method 6010

*Mercury by EPA method 7471

*Hexavalent Chrome by EPA method 7199

*Cyanide by EPA method 9010c

*Ammonia by EPA method 350.2

*pH by EPA method 9045.

(It is understood by DTSC and the property owner, confirmatory soil samples are to be used to calculate health risk levels and to delineate the vertical or lateral extent of impacts, present, above the CHHSL's in the subsurface soil requiring additional remedial excavation to achieve acceptable CHHSL's).

After completion of the second stage remedial excavation, the entire WY will be 12 inches bgs. The entire WY will be backfilled with clean imported CMB aggregate to 6 inches bgs under the supervision of a professional geologist. A total of 8 trucks per day for 7 days are needed to bring the CMB aggregate onsite. The final stage of the corrective action plan is to form and pour a 6 inch thick rebar reinforced concrete cap with storm water containment (4 inch curbs) to cover 100% of the WY. CMB backfill material will be placed in the base of the excavation and backfill material will be compacted to a minimum of 90%.

6.2 Remedial Actions:

Capping with Deed-Restrictions

Upon completing the remedial excavation, backfilling of the site excavated areas, and performing the basal and sidewall confirmatory soil sampling, a Preliminary Endangerment Assessment (PEA) health risk assessment will be conducted to determine the collective health risk exposure combining all of the elevated metal constituents as associated with the subject WY property without a concrete cap and with a concrete cap. The site removal action requires a concrete cap and an industrial use deed restriction as conditions of the FCMAWP.

The planned cap will include:

*Backfilling all excavated areas with clean import backfill material to 10-inches of grade surface

*Install 4-inches of crushed miscellaneous base, CMB material

*Forming and installing 6-inch thick rebar reinforced concrete cap to the top of the grade surface.

7. Public Participation

DTSC is now formally soliciting public comments on this document during a 30-day comment period. If DTSC approves the FCMAWP, Wilson Street Corporation will be authorized to implement the remedies recommended in the document and summarized in this Statement of Basis.

The public comment period begins April 26, 2007, and ends May 28, 2007.

DTSC will consider all public comments received before issuing the final remedy selection decision. The final remedies selected could be different from those that have been proposed, depending on the information that is received through the public participation process.

The FCMAWP and other project documents are available for review at:

Vernon Public Library
4504 S. Santa Fe Avenue
Los Angeles, CA 90058

(323) 583-8811

The full administrative record will be available for public review at:

Department of Toxic Substances Control
5796 Corporate Avenue
Cypress, CA 90630

(714) 484-5300 Call for appointment

In addition, this Statement of Basis and the project fact sheet will be available on the

Statement of Basis
Proposed Remedy
Wilson Street Corporation
April 26, 2007

DTSC website at: http://www.dtsc.ca.gov

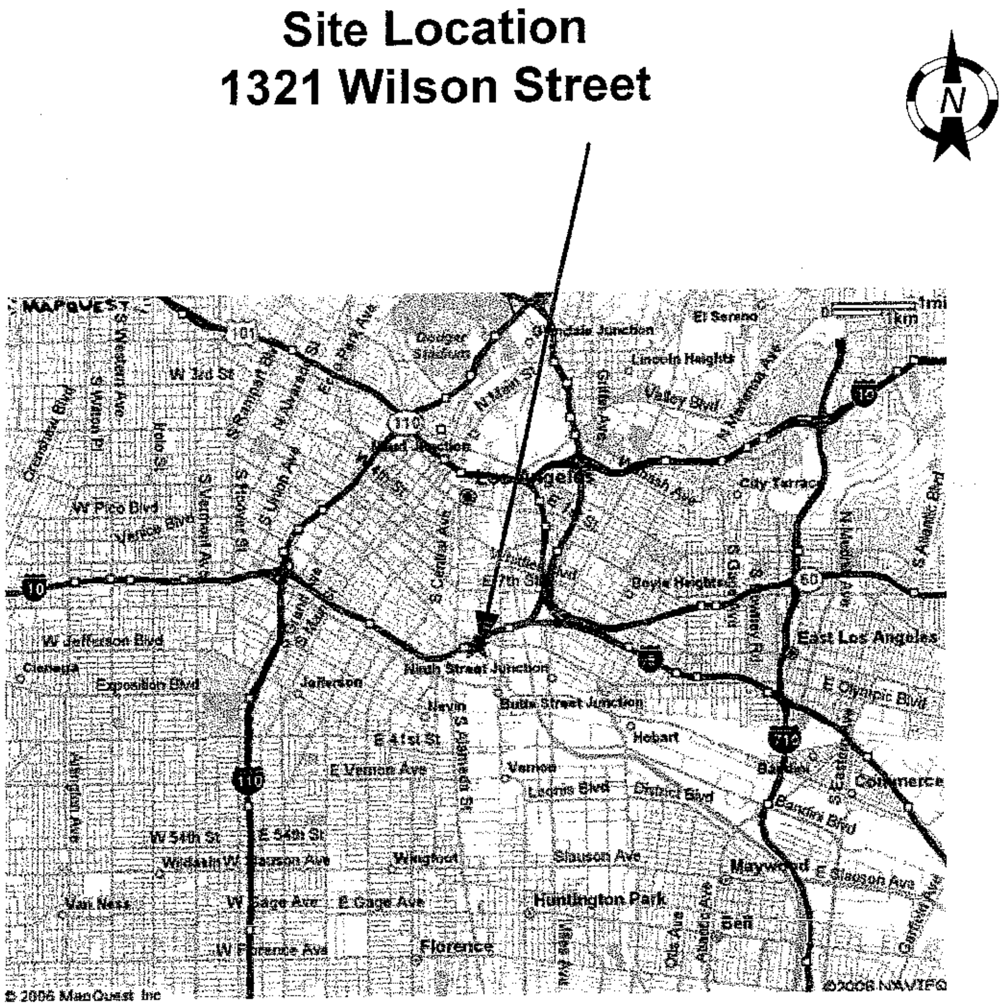
All written comments on the proposed remedy selection should be postmarked or e-mailed by midnight on May 28, 2007, to the following address:

Mr. Raymond J. Campbell
Hazardous Substances Scientist
Tiered Permitting Corrective Action Branch
Department of Toxic Substances Control
5796 Corporate Avenue
Cypress, CA 90630
rcampbel@dtsc.ca.gov

To obtain additional information or if you have questions regarding Wilson Street Corporation, please contact Mr. Raymond J. Campbell at (714) 484-5384 or rcampbel@dtsc.ca.gov.

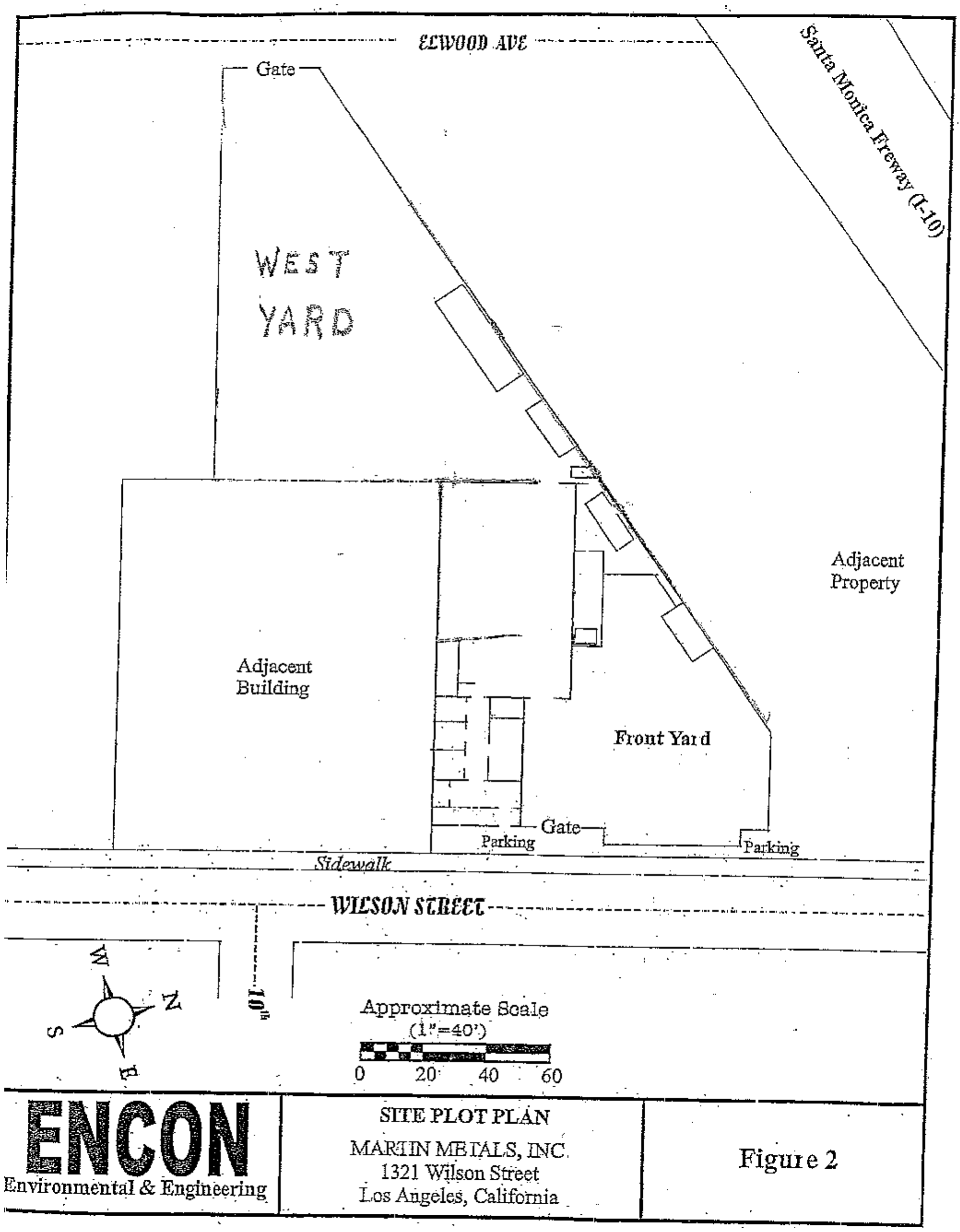
10. Key References

1) ENCON *Technologies, Incorporated*. Final Corrective Measures Action Work plan at 1321 Wilson Street, Los Angeles, California. December 18, 2006.



ENCON TECHNOLOGIES, INC 12145 MORA DR. # 7 SANTA FE SPRINGS, CA	**SITE LOCATION MAP** **1321 Wilson Street** **Los Angeles, CA**	**FIGURE 1**

Statement of Basis
Proposed Remedy
Wilson Street Corporation
April 26, 2007



APPENDIX C7
EXAMPLE FOR BRIDGING MEMORANDUM

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PREFACE TO EXAMPLE BRIDGING MEMORANDUM

This appendix presents an example bridging memorandum describing the changes in the cleanup process that occurred as a result of applying the PT&R approach for a hypothetical site. The bridging memorandum is placed into the administrative record to document how use of the PT&R approach affected site cleanup. Typically, the DTSC project manager will prepare the bridging memorandum.

In general, the bridging memorandum should look similar to this example. The content of the bridging memorandum should reflect site-specific circumstances.

Provided for illustration purposes only, the content and type of activities described in this example are not applicable to every site. For instance, not every site will be cleaned up to an unrestricted land use scenario and the cleanup goals included herein are not applicable to every site. Likewise, the document types will depend in the cleanup process being applied and the document content may vary depending on project-specific decisions.

Department of Toxic Substances Control

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MEMORANDUM

TO: DTSC Project File for Site XYZ

FROM: John Smith
DTSC Project Manager

DATE: July 15, 2010

SUBJECT: Application of Proven Technologies and Remedies (PT&R) Approach to Cleanup of Metals-Impacted Soils Associated with Unit B, Site XYZ, North Highlands, Sacramento County, California (EPA ID # CAD 000 000 000)

The purpose of this memorandum is to document the application of the Proven Technologies and Remedies (PT&R) approach to cleanup of metals-impacted soils at Site XYZ in North Highlands, California. The PT&R approach is described in the guidance document entitled *Remediation of Metals in Soil*. (DTSC, 2008). Attachment A to this memorandum summarizes how application of the PT&R approach affected the Unit B cleanup.

Project Background: The PT&R approach was applied for cleanup of metals contamination associated with the battery and metal recycling area (referred to as Unit B) of Site XYZ. Unit B covers approximately 5 acres in the northeast corner of the Site. The *Preliminary Endangerment Assessment* (PEA; Consultant X, 2008) identified elevated concentrations of cadmium and lead in Unit B soil with maximum concentrations of 205 and 9,800 mg/Kg, respectively. The metals contamination is associated with surface releases.

Assessment of Site Suitability for PT&R Approach: DTSC staff met with Company ABC representatives on February 13, 2009 to discuss the PEA findings and to make a decision regarding suitability for application of the PT&R approach. With one exception, the site clearly met the suitability requirements identified in Section 3.2 of *Remediation of Metals in Soils*. The exception pertained to the depth to groundwater which ranges from 10 to 12 feet bgs beneath the site. During the February 2009 meeting, Consultant X to Company ABC presented the soil data which indicated that the cadmium and lead concentrations in site soil attenuated rapidly with depth and approached the estimated background concentrations at a depth of 3 feet bgs. Based on the PEA findings and discussion of site characteristics, DTSC and Company ABC representatives agreed to apply the PT&R approach. A fact sheet (DTSC, 2009) was sent out informing the community and other stakeholders of the decision to apply the PT&R approach. Responses were provided to two stakeholders who commented on the fact sheet.

Completion of Site Characterization: Based on the findings of the PEA, additional investigation activities were conducted under the *Remedial Investigation Workplan for Unit B* (Consultant X, 2009a) to fully define the nature and extent of the soil contamination associated with Unit B and to verify the conceptual site model. The scope of this investigation also included collection of samples to support the site background estimates and geotechnical data needed to support the remedial design. The results of the investigation were documented in the *Remedial Investigation Report for Unit B* (RI Report; Consultant X, 2009b). The investigation confirmed the attenuation of metals contamination in the upper 3 feet of soil.

Risk Screening and Cleanup Goals: Metals concentrations in Unit B soils were compared to the site background concentrations included in the RI Report. This process identified cadmium and lead as the only constituents of potential concern (COPCs). The exposure point concentration for cadmium exceeds a cancer risk of $1x10^{-6}$. The cleanup goal for cadmium was selected based on an unrestricted land use scenario and a target cancer risk of $1x10^{-6}$. The current California Human Health Screening Level (CHHSL) value of 1.7 mg/Kg was selected as the remedial goal for cadmium. The remedial goal for lead (150 mg/Kg) was selected using the DTSC LeadSpread model. The concentrations of lead on the Site presented a potential significant health risk to children and adults.

Screening and Evaluation of Cleanup Technologies: The *Remediation of Metals in Soil* performed the initial screening and evaluation step for sites with metals-impacted soils (as documented in Section 6.1 and Appendix C1 of the guidance document). Therefore, the screening and evaluation step was not repeated for the cleanup of Unit B at Site XYZ. A focused evaluation was performed for the no action alternative (as required by the NCP) and the two PT&R alternatives: excavation/disposal and containment/capping. This evaluation is documented in the *Remedial Action Plan for Unit B* (RAP; Consultant X, 2009c). The RAP was developed using the sample document provided as Appendix C2 of *Remediation of Metals in Soil*.

Remedy Selection: As approved in the RAP, excavation/disposal was selected as the remedy for Unit B. A CEQA Negative Declaration was prepared in conjunction with the RAP.

Remedy Design and Implementation: The remedial design and supporting documents were included as appendices to the RAP. Cleanup activities are described in the *Remedial Action Completion Report for Unit B* (RACR; Consultant X, 2010). As recommended by Section 5.5 of *Remediation of Metals in Soil*, a post-cleanup evaluation for lead was included in the RACR.

Site Certification: Confirmation sampling verified achievement of cleanup goals for unrestricted use. On July 10, 2010, DTSC issued a letter certifying that Unit B cleanup is satisfactorily completed.

Public Participation: The cleanup process for Unit B followed the public participation process identified in the DTSC *Public Participation Manual* (DTSC, 2003). As discussed above, an additional fact sheet was distributed informing community members and stakeholders that the PT&R approach would be used.

REFERENCES

Consultant X. 2008. Preliminary Endangerment Assessment, Site XYZ, 123 Orange Avenue, North Highlands, California. December 13.

Consultant X. 2009a. Remedial Investigation Workplan for Unit B, Site XYZ, 123 Orange Avenue, North Highlands, California. March 31.

Consultant X. 2009b. Remedial Investigation Report for Unit B, Site XYZ, 123 Orange Avenue, North Highlands, California. June 30.

Consultant X. 2009c. Remedial Action Plan for Unit B, Site XYZ, 123 Orange Avenue, North Highlands, California. September 15.

Consultant X. 2010. Remedial Action Completion Report for Unit B, Site XYZ, 123 Orange Avenue, North Highlands, California. April 4.

DTSC. LeadSpread Model. www.dtsc.ca.gov/AssessingRisk/leadspread.cfm.

DTSC. 2003. Updated Public Participation and Procedures Manual. April.

DTSC. 2008. Proven Technologies and Remedies Guidance, Remediation of Metals in Soil. August.

DTSC. 2009. Fact Sheet, Cleanup of Unit B, Site XYZ, 123 Orange Avenue, North Highlands, California. March.

DTSC. 2010. Letter to Company ABC certifying cleanup of Unit B. July 10.

ATTACHMENT A
SUMMARY OF UNIT B CLEANUP USING PT&R APPROACH
SITE XYZ, NORTH HIGHLANDS, SACRAMENTO COUNTY
EPA ID #000 000 000

Cleanup Process: California Hazardous Substances Account Act, Remedial Action Plan (RAP)

ACTIVITY	FOLLOWED TYPICAL CLEANUP PROCESS?	ADJUSTMENT FOR PT&R APPROACH?	COMMENT OR EXPLANATION OF PT&R-RELATED DIFFERENCE
PUBLIC PARTICIPATION	Yes	Yes	• Fact sheet informing community and stakeholders of decision to apply PT&R approach. • Responded to stakeholder comments regarding decision to use PT&R approach.
REMEDIAL INVESTIGATION			
Investigation	Yes	Yes	• Data to support site background estimate and design collected during characterization phase.
Identification of COPCs	Yes	No	• Documented in RI Report.
Exposure Point Concentrations	Yes	No	• Documented in RI Report.
Health Risk Screening	Yes	Yes	• Used CHHSL for cadmium and DTSC LeadSpread model for lead. • Performed post-cleanup evaluation for lead.
Cleanup Goals	Yes	Yes	• Used CHHSL for cadmium and DTSC LeadSpread model for lead. • Documented in RAP.
FEASIBILITY STUDY (FS)			
Initial Screening & Evaluation	No	Yes	• Completed during development of *Remediation of Metals in Soil*.
Detailed Analysis of Alternatives	Yes	Yes	• Evaluated no action, excavation/disposal, and containment/capping. • Documented in RAP. • Used RAP sample from *Remediation of Metals in Soil*.
Remedy Selection	Yes	No	• Documented and approved in RAP.
CEQA	Yes	No	• Negative Declaration prepared in conjunction with FS/RAP.
REMEDIAL DESIGN	Yes	Yes	• Design and implementation plans included as appendices to FS/RAP. • Used sample documents from *Remediation of Metals in Soil*.
REMEDIAL ACTION	Yes	Yes	• RACR includes post-cleanup evaluation for lead. • RACR follows annotated outline from *Remediation of Metals in Soil*.

ATTACHMENT A (Continued)

ACTIVITY	FOLLOWED TYPICAL CLEANUP PROCESS?	ADJUSTMENT FOR PT&R APPROACH?	COMMENT OR EXPLANATION OF PT&R-RELATED DIFFERENCE
SITE CERTIFICATION	Yes	No	• DTSC certification letter issued on July 10, 2010.
LAND USE COVENANT	n/a	n/a	
OPERATION & MAINTENANCE AGREEMENT	n/a	n/a	
ADMINISTRATIVE RECORD	Yes	Yes	• Prepared this bridging memorandum. • Included *Remediation of Metals in Soil* as electronic appendix to RAP. • Includes responses to comments regarding decision to use PT&R approach.

APPENDIX D

APPENDIX D1
EXCAVATION, DISPOSAL, AND RESTORATION PLAN SAMPLE

TABLE OF CONTENTS

Page

PREFACE

This appendix presents a Sample for an Excavation, Disposal, and Restoration Plan. In general, the site-specific Excavation, Disposal, and Restoration Plan should look similar to the outline presented in this Sample.

This document is for guidance only, and is applicable on a case-by-case basis. Some elements of this Sample may apply to your site, and others may not. Additional elements than are addressed by this Sample may also be needed.

Instructions for suggested content (denoted by boxed text) are included under most major headings. Some sections provide example text that could be applied to any site. The example text is shown as normal text with brackets and underline to indicate locations for inserting site-specific information.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

EXECUTIVE SUMMARY

Instructions: Introduce the site, its location, and history. Address key points regarding the nature of contamination, excavation, disposal and restoration to provide decision makers with a quick overview of the plan. Briefly discuss the time of year, length of project, cost and acres per day undergoing vegetative removal, excavation, and backfilling.

This Excavation, Disposal and Restoration Plan has been prepared by [name of preparer] for [name of site] on behalf of [owner of the site] to address remediation of contaminated soils at the site. The workplan describes the logistical procedures and field work that will be carried out at [name of site] to excavate and dispose of approximately [#] cubic yards of soil contaminated with metals and restore the site for [anticipated landuse].

The [name of site] is located in [city, county, state or distance to major city]. Between [year] and [year] the site was use for [discuss activities that may have contributed to contamination]. A series of site assessments / site characterizations were conducted to determine the extent to which soils had been impacted by site activities.

The data gathered during [list the pertinent investigations] were used to evaluate the risks and hazards associated with metals found in the soils. Using the information gathered during the characterization and investigations, several possible remedial technologies were identified and evaluated. Other alternatives included no action and containment/capping. After a screening process, excavation and off-site disposal was selected as the remedy of choice.

The excavation activities are anticipated to begin around [month and year] and last approximately [# days/weeks/months]. The excavation activities are projected to cost [$]. The excavation activities will begin by clearing approximately [#] acres of vegetation per day. Once excavation activities begin, approximately [#] cubic yards of soil will be removed per day over a period of [#] days. The excavated soil will be [describe how the soil will be managed, transported, and disposed]. After confirmation sampling demonstrates that cleanup goals have been achieved, the excavated areas will be backfilled with [describe material] using [describe methods] to [describe final grade].

1.0 INTRODUCTION

Instructions: Summarize previous investigations and interim actions. Include pertinent information that addresses site background, hydrogeologic conditions, and the nature and extent of contaminants.

This Excavation, Disposal and Restoration Plan (Plan) has been prepared to support a soil removal action for areas of concern at [name of site]. This Plan describes the soil excavation, soil management and disposal and site restoration that will be performed.

1.1 SITE LOCATION AND BACKGROUND

The site consists of a [#] acre parcel of land located in [city or distance to major city]. The site is bounded by [feature] to the [direction], [feature] to the [direction], [describe other features as appropriate]. [Reference the figure(s) showing the site location and surrounding features.] Improvements to the site include [describe any buildings, paved parking areas and landscaping and reference figure showing site plan and utilities]. Surrounding land use is generally [residential, commercial, industrial]. The site is currently zoned as [landuse].

Historically the site was owned and operated by [name owners, operators and activities that are believed to have contributed to contamination]. Site investigations have identified [metals that require remediation] concentrations that exceed background levels and require remediation.

1.2 PREVIOUS INVESTIGATIONS

In [month, year] a [investigation reference] was conducted to identify potential areas of concern. [Investigation] activities included [#] soil boring locations, [#] monitoring wells, [#] surface soil samples, and [describe other investigation activities].

[Describe other investigation phases, as appropriate.]

The investigations have revealed the following areas of concern:

- Area 1 also known as [name of area] located [describe location]
- Area 2 also known as [name of area] located [describe location]
- [Describe other areas of concern]

Additional information on these areas of concern is provided in the [report titles and dates].

1.2.1 Nature and Extent of Contaminants

Soils contaminated with [list metals] are located in [area of concern] at a depth of [#] to [#] feet bgs. [Discuss all of the areas of concern, including the associated depths]. Table [#] summarizes the metals concentrations detected in each area of concern. Figure [#] shows the distribution of metals in soil at the site.

Concentrations of [metals] in soil located in [area of concern] exceed the cleanup goals summarized in Table [#].

1.2.2 Interim Actions

[Describe any interim actions that have been taken to address the impacted soils.]

1.2.3 Climatology

The site is located within the [#] year floodplain in a [climate type, e.g., semi arid] region.

1.2.4 Geology and Hydrogeology

Geotechnical borings have revealed fill materials underlain by [lithlogies encountered, depth to bedrock]. [Describe geologic features relevant to excavation activities. Reference the boring logs and cross-sections in an appendix.]

Depth to groundwater ranges from [#] to [#] feet and generally flows toward the [direction] at a flow rate of about [#] feet per year.

1.2.5 Groundwater Quality

[Discuss any analytical data indicating groundwater impacts. Describe plume extent, if relevant.]

2.0 OBJECTIVES AND SCOPE

Instructions: Present the objectives, scope and goal of the plan. Identify the contaminants of concern, the cleanup goals, and until what point the excavation activities will be carried out (i.e., until either the limits of the contaminants of concern have been removed or until the analytical data demonstrates that the concentrations are below cleanup goals). Indicate whether the excavation will return the site to unrestricted land use.

The purpose of this plan is to present the design and implementation of excavation activities described in the approved [title of remedy decision document]. Soil containing metal constituents of concern greater than established cleanup goals (Table [#]) will be excavated to achieve [residential, industrial] standards and hauled off-site to an appropriate disposal facility. The excavation activities will address the areas depicted Figure [#]. The objective of the cleanup action is to achieve the cleanup goal for the site, which is a total theoretical excess cancer risk of less than 1 in [#] and a total theoretical noncancer hazard index equal to or less than 1.

3.0 PROJECT ORGANIZATION, SCHEDULE AND COST

Instructions: Identify the personnel in charge, their qualifications, the project schedule, and under what conditions changes would be made. Address the anticipated costs for implementation of the plan. Include a table of costs.

A qualified and experienced project team will execute the cleanup activities identified in this Plan. The following relationships will apply for this project:

Owner:	[name];
Engineer/Contractor:	[name], contracted with [name];
Earthwork Contractor:	[name], contracted with [name];
Regulatory Agencies:	[names], [indicate lead agency].

The following project team has been identified for the project:

Owner Project Manager:	[name of individual]
Engineer/Contractor:	[names of individuals, roles, credentials]
Earthwork Contractor:	[company name]

3.1 RESPONSIBILITIES OF ENGINEER/CONTRACTOR

The Engineer/Contractor will provide overall project management and technical services on the project, including the following:

- [List the specific responsibilities.]

3.2 RESPONSIBILITIES OF EARTHWORK CONTRACTOR

The Earthwork Contractor will perform all earthwork activities, including

- [List the specific responsibilities.]

3.3 SCHEDULE

The proposed schedule for the cleanup action is presented in Figure [#].

3.4 COST

Table [#] summarizes the projected costs for the excavation, disposal, and restoration activities.

4.0 BASIS FOR TECHNICAL APPROACH

Instructions: Describe the basis for determining the excavation and off-site disposal as the alternative of choice. Summarize the findings of the cleanup alternative evaluation. Reference figures showing the location, approximate extent, and excavation depths of areas proposed for excavation.

The [title of remedy decision document] selected a cleanup alternative consisting of: (1) soil excavation until performance requirements (as determined by confirmation sampling) are satisfied; (2) stockpiling and profiling excavated soil; and (3) off-haul and off-site disposal. This Plan utilized the following data to develop the projected excavation extents and depths.

- Laboratory data for soil samples obtained during [investigation reference] [report citation].
- Investigation results reported in [report title] [report citation].
- [List all data sources used to develop the plan and provide references.]

These data were utilized in the design of soil excavation plans for [areas of concern]. Figure [#] presents the excavation layout, Figure [#] presents the Excavation Plan, and Table [#] summarizes the projected excavation depths. The Excavation Plan shown on Figure [#] was developed to meet the cleanup goals for the areas of concern identified in Section 1.2. The planned excavation extends up to [#] feet below ground surface. Approximately [#] cubic yards will be removed from [area of concern 1], approximately [#] cubic yards of soil will be removed from [area of concern 2], [insert more volumes and areas of concern as appropriate].

Figure [#] and Table [#] identify the initial excavation limits using the cleanup goals summarized in Table [#]. These limits were developed based on a comprehensive review of existing site data. After removal of soil from the initial excavation limits, the status of the excavation will be evaluated using confirmation samples. If the confirmation sampling results are higher than the cleanup goal(s), further excavation will occur until subsequent confirmation samples indicate that the cleanup goals have been achieved. The Soil Confirmation Sampling Plan (Appendix [#]) outlines the sampling protocol and procedures that will be used to process sample analytical results such that a decision and/or statistical assessment of the analytical results can be made to continue or terminate the excavation.

5.0 PRE-EXCAVATION ACTIVITIES

Instructions: Describe the project management and regulatory tasks that must be completed prior to field work.

5.1 PERMITS AND NOTIFICATIONS

All cleanup activities will be conducted in accordance with applicable local, state, and federal regulations. The following permits and notifications are necessary for implementation of this work:

- Notification to [entity names] for excavation activities.
- Notification to [entity names] utility clearance within excavation areas.
- Permits for excavation, shoring, and grading at [list areas of concern] will be obtained from [list agencies].
- An encroachment permit will be obtained from [list agencies] for work activities in [areas of concern].
- A [city name] water meter will be obtained by [entity] to supply water from the [city name] hydrant on [location] for dust control and other project needs.

- [Describe any other notifications or permits needed for the cleanup activities.]

5.2 UTILITIES

The locations of facilities on and adjacent to [areas of concern] are shown on Figure [#]. [Describe any key utilities in the vicinity of the site (e.g., gas lines, sewer laterals, water mains) and how these utilities will be addressed prior to and during construction activities.]

Prior to any excavation, [entity names] will be contacted in order to mark and verify the locations of public and private utilities that could be affected by the work. In the event that an active utility is damaged, the following procedures will occur:

- [List procedures, including names and contact information for persons to be notified, and timeframes for making each notification.]

5.3 SITE PREPARATION AND CONTROL MEASURES

[Describe the activities that will be performed to prepare the site for excavation (e.g., establish work areas, set up decontamination stations, set up survey control of areas to be excavated, set up air monitoring stations). Reference the figure showing the Work Area Plan].

Personnel exiting the work areas will decontaminate and remove personal protective equipment (PPE) at the personnel decontamination stations established adjacent to the work areas. Personnel will follow the decontamination procedures described in the approved Health and Safety Plan (Appendix [#]). Boot wash water will be transferred to on-site water storage tanks for testing and disposal. Used PPE will be discarded and placed in containers for disposal.

5.4 SITE SECURITY AND CONTROL

[Describe the activities that will be used to secure site security and control (e.g., set up temporary fencing, set up visual barriers, establish access and egress points).]

5.5 PUBLIC PARTICIPATION

[Describe the public participation activities to be conducted during the cleanup action and reference the Public Participation Plan.]

6.0 EXCAVATION ACTIVITIES

Instructions: Address the type of equipment being used, the progression of excavation activities, shoring/setbacks to prevent cave-ins. Provide a detailed description of the approach for clearing and debris removal, including the estimated volumes to be removed. Include a detailed description of the soil excavation, supported by the estimated excavation depths and soil volumes to be removed. Describe how and where soils will be temporarily stockpiled and staged. Describe the transportation and handling of contaminated soils.

Implementation of this plan generally consists of the following steps:

- Clear the site and remove debris;
- Excavate soil up to the initial excavation limits (Figure [#], Table [#]);
- Perform confirmation sampling in accordance with the Soil Confirmation Sampling Plan (Appendix [#]), determine whether cleanup goals have been satisfied, and if needed, conduct additional excavation followed by another round of confirmation sampling;
- Stage excavated soil, characterize each stockpile in accordance with the Stockpile Sampling Plan (Appendix [#]), and identify an appropriate off-site disposal facility;
- Load stockpiled soil into trucks for off-haul in accordance with the Transportation Plan (Appendix [#]);
- Transport for off-site disposal; and
- Backfilling, grading, and restoring the site.

6.1 EXCAVATION LIMITS

6.1.1 Site Clearing and Debris Removal

Prior to beginning soil excavation, the [areas of concern] will be cleared of obstructing features and vegetation. [Describe the site clearing and removal activities. Reference the Site Clearing and Removal Plan.]

6.1.2 Equipment

Implementation of this plan will require [list all earth moving equipment]. Operation of equipment will require trained construction workers.

6.1.3 Shoring and Setbacks

The excavation will be shored where the depth of excavation could endanger nearby structures or site personnel during construction. The excavation will be shored where [describe locations of shoring]. Shoring or other measures will be implemented as necessary within the excavation to ensure that the excavation meets OSHA safety standards for construction personnel. [Describe shoring and setback requirements.]

6.1.4 Excavation Procedures and Progression

Each area of concern will be excavated to the proposed excavation depth and extent identified in Table [#] and Figure [#]. Excavated areas will be widened or deepened if soil confirmation sampling data indicate that the excavation objective has not been achieved. Excavation will continue until [indicate criteria for terminating excavation].

Soil will be excavated with [equipment type] and moved to [location] with [equipment type] to established [management areas, loading zones]. The [management areas, loading zones] will shift as the work and excavation progresses as shown on Figure [#]. [Provide further details on the progression of the excavation procedures.] Temporary soil management areas may be located [location] for [period of time] as needed to perform the work. Soils will be managed for dust control as necessary based on air monitoring measurements and physical conditions. If wetting is insufficient for dust control, soil may be covered or removed.

Loaded trucks will move to the truck decontamination station where soil will be removed from fenders and tires and the bed will be covered. Each loaded truck will leave the site with a completed manifest or bill of lading for transport of soil or other material to the disposal location. Soil loading and off-haul routes are designated in the Transportation Plan (Appendix [#]).

Excavation and removal will be performed by a California-licensed hazardous substances removal contractor. Personnel on site will observe OSHA safety standards and follow the approved Health and Safety Plan (Appendix [#]), which addresses the safety of personnel entering excavations for the purposes of surveying and operating equipment.

6.1.5 Surveying Activities

The site will be surveyed multiple times during the removal action. All surveying activities will be performed under the direction of a California-licensed surveyor. [Describe the coordinate system to be used for the project.] Survey data will be recorded and documented in the Completion Report.

Surveying will include:

- Pre-excavation survey performed to document the site grade prior to excavation;

- Excavation limits (both pre- and post-excavation).
- Confirmation sample locations; and
- Post-excavation survey to document the final site grade.

6.2 DUST CONTROL

Dust control measures will be implemented during excavation and soil-moving activities as required by the Health and Safety Plan. Dust control measures will also be used to manage soil located in temporary storage areas or stockpile areas. [Describe dust control measures.]

6.3 AIR MONITORING

Air monitoring will be performed in accordance with the Air Monitoring Plan included in Appendix [#]. [Describe any perimeter air monitoring to be conducted.]

6.4. EROSION AND RUNOFF CONTROL

Erosion control measures will be implemented to control incidental run-off from the excavation areas. Erosion control measures will be in accordance with [insert standards to be used], and will include [describe erosion control measures to be implemented. Describe runoff control measures to be implemented.]

Excavation will be scheduled outside of the rainy season to the extent possible, and surface water run-off and erosion control measures should minimize the water entering the excavation. Based on the amounts of water expected in the excavation, [#] gallons of water storage capacity will be available to store water pumped from the excavation. Water stored in this tank will be sampled and analyzed prior to disposal at an appropriately permitted disposal facility.

6.5 CONFIRMATION SAMPLING

Soil confirmation samples will be collected to demonstrate that soil exceeding cleanup goals has been removed. Upon reaching the initial excavation limits (Figure [#], Table [#]), confirmation samples will be collected analyzed in accordance with the Soil Confirmation Sampling Plan (Appendix [#]). The results of the confirmation sampling will direct termination or continuation of the excavation. If additional excavation is conducted, it will be followed by additional round(s) of confirmation sampling. The Confirmation Sampling Plan provides guidance as to how confirmation sampling results will be interpreted to support a decision whether the excavation has met the performance standard or whether additional excavation is needed.

7.0 WASTE MANAGEMENT

Instructions: Address the waste management practices that will be followed for excavated soil and materials removed during clearing and debris removal.

Waste management will include management of materials generated from clearing and debris removal, and excavation of soil.

7.1 CLEARING AND DEBRIS REMOVAL.

[Describe how wastes generated during clearing and debris removal will be managed and disposed.]

7.2 SOIL MANAGEMENT, STOCKPILING AND PROFILING

Waste materials generated during soil excavation include soil, water used to decontaminant personnel and equipment, and [list other potential waste materials, e.g., surface water runoff].

[Indicate whether soil will be loaded directly from the excavation, in temporary soil management areas, or in temporary stockpiles. Indicate how temporary soil management areas and stockpiles will be managed (e.g., location, duration of staging materials, plastic liner, plastic cover, dust control).] Excavated soil will be stockpiled on-site in piles measuring approximately [#] cubic yards. The stockpiles will be located [location] and placed on top of a [liner type] to reduce contamination of underlying soil. The stockpiles will be covered with [cover type] to control dust and reduce infiltration of any rainwater. Stockpiles will be sequenced as presented in Figure [#]. After the stockpile is constructed, the sampling and analysis as presented in the Stockpile Sampling Plan (Appendix [#]) will be followed. The sampling and analysis of the stockpile samples is necessary to profile soil for off-site transportation and disposal. The Stockpile Sampling Plan provides guidance as to how to sampling results will be interpreted to make a profile decision for stockpiled soil. Procedures for documenting this decision are outlined in the Stockpile Sampling Plan.

A tracking and record keeping system will be implemented to manage each stockpile generated from the excavation. The guidelines for tracking and recordkeeping are included in the Stockpile Sampling Plan. The information that will be recorded and tracked includes:

- Identification number that links the stockpile with the excavation source;
- Location of the stockpile within the site;
- Date(s) stockpile was generated and approximate volume;
- Sampling information, including number of samples collected, sample identifiers, date of sampling, and requested analyses; and
- Analytical data that characterizes the stockpile.

The recordkeeping system will track the stockpiled soil from the time of excavation until it is placed in a truck for off-haul.

Once the soil had been profiled, the soil will be acceptable for off-site disposal. Excavated soil will be loaded into [trucks, bins, rail cars] for off-haul and disposal. It is anticipated that the soil will be disposed off-site as [types of waste expected, e.g., RCRA-regulated, California hazardous waste.]

7.3 LOAD CHECKING

Prior to leaving the site, the origin (i.e., which stockpile, which portion of the excavation) will be documented as described in Section 7.2. A manifest or bill of lading will be prepared. The truck will be inspected to ensure that the load is properly covered and that the truck has been property decontaminated.

7.4 TRANSPORTATION

Each loaded truck will leave the site with a completed manifest or bill of lading for transport of soil or other material to the disposal location. Soil loading and off-haul routes are designated in the Transportation Plan (Appendix [#]).

8.0 BACKFILL AND RESTORATION

Instructions: Describe the procedures for backfilling and restoring the site. Address how an appropriate borrow source will be identified and evaluated. Describe the backfill activities. Also address grading and drainage.

8.1 BORROW SOURCE EVALUATION

[Fill source] will be used to backfill the excavation. Sources of fill will be inspected and samples analyzed for the presence of chemicals before the fill is brought to the site. Sample collection and QA/QC procedures will be in accordance with [document title]. Potential fill material stockpiles will be sampled at the fill source at a frequency of one [type of sample, e.g., composite] sample per [#] cubic yards. [Describe the analyses to be conducted on the fill. Specify the values that will be used for comparison of chemical concentrations detected in the fill, e.g., site background concentrations.]

8.2 SITE RESTORATION ACTIVITIES

Backfilling operations will begin after confirmation sampling determines that cleanup goals have been achieved. Fill will be placed into the excavation in [#]-inch lifts and compacted to [indicate compaction standard to be achieved]. The surface of the fill will be graded in accordance with the Grading and Drainage Plan shown on Figure [#]. The ground surface will be graded to match existing grades at the edge of the excavation. [Indicate whether the ground surface will be modified after grading, e.g., hydroseeding.]

Following backfilling and grading, surface drainage from [location] will generally be towards [direction], as shown on Figure [#].

[Describe any other activities needed to restore the site.]

9.0 QUALITY CONTROL/ QUALITY ASSURANCE

Instructions: Address the QA/QC procedures that will be followed. Reference the QAPP.

9.1 FIELD OVERSIGHT AND REPORTING

Field oversight of the excavation, disposal, and restoration cleanup and associated activities is the responsibility of [entity name, e.g., Owner, Engineer/Contractor]. The [entity name, e.g., Owner, Engineer/Contractor] is responsible for ensuring appropriate documentation of field activities, preparing periodic reports of cleanup progress, notifying other project team members as issues arise, and preparing the Completion Report.

9.2 FIELD DOCUMENTATION

Field documentation of the cleanup activities will consist of:

- Daily field reports,
- Documentation associated with soil confirmation sampling (as outlined in the Soil Confirmation Sampling Plan);
- Documentation of profiling of soil stockpiles (as outlined in the Stockpile Sampling Plan and discussed in Section 7.2); and
- Copies of manifests or bill of lading for each off-haul.

9.3 CONFIRMATION SAMPLING

The Soil Confirmation Sampling Plan (Appendix [#]) outlines the data quality objectives and sampling design (i.e., sample locations, number of samples) for soil confirmation sampling. This plan addresses all aspects of sample collection and analysis, and includes a Quality Assurance Project Plan (QAPP) for the soil confirmation sampling effort. The plan also describes the recordkeeping requirements for confirmation sampling.

10.0 HEALTH AND SAFETY MONITORING

Cleanup activities include soil excavation and shoring, soil loading and off-hauling, backfilling and grading, and [list other activities]. The Health and Safety Plan (Appendix [#]) establishes site-specific health and safety procedures to be followed during the cleanup.

[Entity] will perform worker and perimeter/environmental air monitoring during the work activities most likely to generate higher concentrations of airborne dust and air emissions. The Air Monitoring Plan included in Appendix [#] presents the requirements and methods to collect air monitoring data during remediation activities. If specific action levels are exceeded, corrective action including worker upgrade to a higher PPE and/or stopping work and implementing control measures such as dust suppression will be undertaken.

11.0 COMPLETION REPORT

Instructions: Identify the key elements that will be covered in the Completion Report and the anticipated timeframe for submittal.

A Completion Report will be prepared at the conclusion of the excavation and restoration activities. The report will be submitted in accordance with the schedule shown in Figure [#]. The report will document the following: work performed; any difficulties encountered; confirmation sampling results and comparison to the performance standards; written and tabular summary of disposal activities (including volumes removed and excavation depths); and results of restoration activities. [If applicable, the completion report should also include a post cleanup evaluation.[1]]

12.0 REFERENCES

Instructions: List all references cited in the plan.

[1] For further information regarding the post-cleanup evaluation, see Section 5.5 of the PT&R Guidance for Remediation of Metals in Soil.

APPENDIX D2
TRANSPORTATION PLAN

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Page

PREFACE

This appendix includes an annotated outline that identifies potential content for a Transportation Plan. This outline is not intended to be prescriptive and should be adjusted as appropriate for the site-specific conditions.

The outline included in this appendix is for guidance only, and is applicable on a case-by-case basis. Some elements of the outline may apply to your site, while other elements may not. Additional elements than are addressed by this outline may also be needed.

INTRODUCTION

This appendix provides guidelines for the development and implementation of transportation plans for the cleanup of sites with metal-impacted soils. It is based primarily on the DTSC *Transportation Plan, Preparation Guidance for Site Remediation* (DTSC, 1994), and includes considerations for transporting metals-impacted soils.

DETERMINE IF A TRANSPORTATION PLAN IS NECESSARY

Not all soil removal actions require a formal transportation plan, and those seeking to conduct a soil removal should confer with DTSC to determine if a plan is necessary. The primary consideration in making such a determination is whether there are significant transportation-related issues. Considerations which must be evaluated in making this decision include:

- Characteristics and volume of material to be removed;
- Distance of transport;
- Contamination control;
- Community concerns;
- Sensitive environments;
- Worker safety and protection; and
- If a transportation plan is legally required (such as at abandoned sites).

DTSC will work with responsible parties to evaluate these criteria and determine whether a transportation plan is required. The evaluation will vary from site to site, and the final determination must be based on the most sensitive factors for each individual site. For instance, transportation plans may be required for small volumes of soil if there are other strong concerns (such as community concerns or worker safety). Conversely, transportation plans may not be required for large soil excavations and removals if the soil is non-hazardous, the relative hazard is low, community concerns have been addressed, and the potential for transportation-related exposures are low.

If a determination is made that a transportation plan is unnecessary, the DTSC project manager will document this decision in the administrative record.

In the event DTSC concludes that a transportation plan will be necessary, the annotated outline included in this appendix could be used to guide its development.

RECOMMENDED RESOURCES

DTSC GUIDANCE

DTSC. 1991. Hazardous Materials Transportation Guides. www.dtsc.ca.gov/HazardousWaste/Transporters/upload/SMB_Tranportation-Plan-Guidances.pdf

DTSC. 1994. Transportation Plan, Preparation Guidance for Site Remediation. Interim Final. May. www.dtsc.ca.gov/HazardousWaste/Transporters/upload/SMB_Transportation-Plan.pdf

FEDERAL GUIDANCE

U.S. Department of Transportation (USDOT) - Hazardous Materials Transportation Guide. www.ehso.com/dotpages.htm

USDOT. National Transportation Library. Hazardous Materials Transportation Guides. ntl.bts.gov/DOCS/hmtg.html.

ANNOTATED OUTLINE FOR TRANSPORTATION PLAN

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1.0 PURPOSE AND OBJECTIVE

Instructions: Clearly and concisely state the purpose and objective of the transportation plan. This can include a short summary of the headings listed below (waste characteristics, destination, mode of transportation, route(s), traffic control and loading, record keeping, health and safety, and transportation contingency plan(s).

2.0 CHARACTERISTICS OF WASTE/MATERIAL TO BE TRANSPORTED

Instructions: Provide specific information regarding the impacted soil which is being transported offsite. This should include information on the soil source, appearance, approximate quantity (generally in cubic yards), and the nature of the contaminants present. Describe the regulatory waste classification of the soil (e.g., California Hazardous Waste, Designated Waste, RCRA Waste) and basis for the determination. Describe any local, state, or federal statues, regulations, or ordinances which apply to the transport of the material. Describe the hazards associated with the soil. If special procedures are required for handling, transportiing, or mixing of the soils based on their characteristics, these procedures should also be described. If appropriate, reference other investigation documents which describe soil characteristics and hazards.

3.0 DESTINATION OF WASTE/MATERIAL

Instructions: All metals-impacted soil must be disposed at a certified facility. The facility or facilities where the impacted soil is being transported should be identified, including the name, address, phone number, and contact persons for each facility. The methods of soil disposition (landfill, recycling, treatment, stabilization) should also be briefly described.

4.0 TRANSPORTATION MODE

Instructions: Identify the means by which the material will be transported (e.g., truck, rail), and what types of vessels, containers, and special features (dust covers) will be used to contain the material during transport. Describe each type of vehicle to be used. Indicate the volume of soil anticipated to be transported in each vehicle type. If available, identify the name of the transportation company. If the material is a hazardous waste, indicate that the transporter must possess a valid certification. Include provisions to ensure that all vehicles used for transport are properly registered, operated, and placarded in compliance with local, state, and federal regulations

5.0 ROUTE DESCRIPTION

Instructions: Describe the primary and alternate routes to be used during transport. Describe why these are the preferred routes in terms of avoiding restricted roads, peak traffic hours, hazardous road conditions, seasonal hazards, etc. Include maps which depict the entire route, and which clearly identify routine stops (e.g., weigh stations), emergency response resources, and repair facilities. Verify that access to designated routes is not restricted by the California Highway Patrol (CHP) or local agencies.

Include an estimate of the one-way time from the site to the facility. State the maximum and average number of round trips required per day, and how many vehicles will be required per day. Provide a schedule for the operation which identifies the period, days, and approximate times of the day trucks will be in operation.

Develop a notification list of emergency service organizations (e.g., fire departments, ambulance services, emergency response organizations), law enforcement agencies, and transportation authorities (e.g., Cal Trans, Public Utilities Commission) that have jurisdiction along the proposed route. Consider notifying these organizations prior to commencement of transportation activities.

6.0 TRAFFIC CONTROL AND LOADING PROCEDURES

Instructions: Discuss the procedures to be used by transportation personnel for entering and leaving the site. Describe any truck staging areas to be utilized near the site. Identify any local traffic problems or hazards. Consider such elements as rush hour traffic, school children, public transportation, etc. Identify the need for lane closures, traffic control signs, flagmen, and other traffic measures. Identify any city and/or county requirements related to traffic controls near the site.

Describe in detail (using maps and diagrams as necessary) on-site traffic and loading procedures (e.g., loading, covering, weighing, decontamination, dust control). Describe how and where each step of the loading process will be conducted. Discuss the methods that will be utilized to minimize releases of material during loading and prior to covering/sealing the container. When transporting contaminated soil, containers that do not have a permanent, fixed cover (e.g., dump truck, rail car) should be sealed with quick hardening foam, tarpaulin, or other appropriate material. Describe the methods that will be employed to seal/cover cargo containers prior to departure from the site to prevent the release of hazardous waste/substances during transport.

Certain site characteristics will have a bearing on the degree of environmental monitoring necessary to monitor for releases of materials. These factors include location, accessibility, environmental features, land use, demography, traffic patterns, public perception, hours and frequency that transportation will take place, entrance and egress control, and local routing. Describe any environmental monitoring to be conducted during loading.

All vehicles leaving the site will require inspection to ensure proper loading, covering/sealing, decontamination, placarding, and manifesting. Describe how such inspections will be conducted and documented.

7.0 RECORD KEEPING

Instructions: For each vehicle moving contamination material offsite, it will be necessary to record the date, time, weight/volume of material, type of material, trucking company, driver, and vehicle used for each trip. Discuss how such records will be created and maintained. Describe how personnel will be trained and instructed in record keeping procedures.

Identify all transportation documents, specifically those required by law to be carried with the load. State precisely where such documents will be carried. As appropriate, such documents may include: bill of lading identifying the shipment, analytical results representing the load, hazardous waste manifest, maps and complete instructions describing the route to be traveled, and special instructions including emergency procedures and contacts for the transporter.

8.0 HEALTH AND SAFETY

Instructions: Describe health and safety procedures during loading as they apply to transportation personnel. All workers should be properly trained in hazardous waste operations in accordance with 29 CFR 1910.120 and CCR Title 8 Section 5192. State the type of health and safety training that will be provided to site personnel and vehicle operators. Describe what personnel will and will not be permitted to do, based on training, during loading. Discuss how the health and safety plan will be communicated to drivers (e.g., tailgate meetings) and how the plan will be enforced.

Describe notification procedures and contingency plans for accidents and breakdowns enroute. Notification procedures should identify key personnel who will be responsible for implementing the contingency plan. Indicate that each driver should carry a copy and demonstrate an understanding of the plan. Large scale removals often involve several independent trucking companies, which will require identification of a transportation coordinator who is accessible 24 hours a day during hauling operations and has the ability to communicate with and direct activities of each driver on and off the site. The plan should also contain an organizational structure showing the chain of command for all trucking companies involved.

Include a comprehensive personnel contingency plan which outlines the steps to be taken in the event of an injury and/or exposure to contaminants. Indicate that the plan should be available to all personnel working at the site. The site safety officer should review the plan with any contractors, subcontractors, and their employees prior to commencing work on the site. Identify key personnel and their alternates who will be responsible for on-site safety and response operations.

9.0 CONTINGENCY PLAN

Instructions: Include a contingency plan for accidental off-site releases which is distributed to the emergency service organizations, law enforcement agencies, and transportation authorities with jurisdiction along the proposed route. At a minimum, include contaminant descriptions, hazard analysis, and methods for the containment and cleanup of an accidental release. Provide sufficient information to allow emergency service organizations to determine if evacuation is necessary. Indicate that all drivers should carry a copy of the transportation plan and be trained to implement provisions of the contingency plan for which they are equipped and capable.

APPENDIX D3
SOIL CONFIRMATION SAMPLING PLAN

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PREFACE

This appendix includes an annotated outline that identifies potential content for a Soil Confirmation Sampling Plan. This outline is not intended to be prescriptive and should be adjusted as appropriate for the site-specific conditions.

This outline is for guidance only, and is applicable on a case-by-case basis. Some elements of the outline may apply to your site, while other elements may not. Additional elements than are addressed by this outline may also be needed.

INTRODUCTION

Soil confirmation sampling at metals-impacted sites is performed for two main purposes.

(1) Following a removal action, soil at the base and sides of the excavation is sampled to demonstrate that the removal has met the cleanup objectives and that contaminants are not left in place at concentrations exceeding the approved cleanup goals.

(2) Excavated soils are characterized to support the decision regarding appropriate disposal or reuse and to determine whether any treatment is necessary.

This appendix provides an annotated outline that may assist with the development of a site-specific Soil Confirmation Sampling Plan. In addition, the following references may be useful in developing the plan.

EPA. 2002. Guidance on Choosing a Sampling Design for Environmental Data Collection, for Use in Developing a Quality Assurance Project Plan, EPA QA/G-5S. EPA/240/R-02/005. December. www.epa.gov/quality/qa_docs.html

EPA. 2006. Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G-4. EPA/240/B-06/001. February. www.epa.gov/quality/qa_docs.html

EPA. 2006. Data Quality Assessment: A Reviewer's Guide, EPA QA/G-9R. EPA/240/B-06/002. February. www.epa.gov/quality/qa_docs.html

EPA. 2006. Data Quality Assessment: Statistical Methods for Practitioners, EPA QA/G-9S. EPA/240/B-06/003. February. www.epa.gov/quality/qa_docs.html

ITRC. 2003. Technical and Regulatory Guidance for the Triad Approach: A New Paradigm for Environmental Project Management. December. www.itrcweb.org/Documents/SCM-1.pdf

Depending on site-specific circumstances and/or the site cleanup process, the Soil Confirmation Sampling Plan can be included as an appendix to a document (e.g., Excavation, Disposal, and Restoration Plan), incorporated into a document (e.g., Removal Action Workplan), or prepared as a standalone document. The content of the plan should be adjusted accordingly.

ANNOTATED OUTLINE FOR
SOIL CONFIRMATION SAMPLING PLAN

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TABLE OF CONTENTS (Continued)

[1] Annotated outlines for the FSP and QAPP are provided in Appendix A2.

1.0 INTRODUCTION

Instructions: A confirmation sampling plan for soils will generally be a smaller and more focused document than characterization workplan or excavation plan documents. If the confirmation plan is a stand-alone document, this section should be more comprehensive.

Describe the site location, description, and history. Identify the purpose, scope and objective of the confirmation sampling. Identify the responsible agency, project organization, and responsibilities.

1.1 SITE LOCATION, DESCRIPTION, AND HISTORY
1.2 PURPOSE, SCOPE, AND OBJECTIVES OF CONFIRMATION SAMPLING
 1.2.1 Demonstrate Removal of Soil Exceeding Cleanup Goals
 1.2.2 Waste Characterization
1.3 RESPONSIBLE AGENCY
1.4 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.0 SUMMARY OF EXISTING SITE DATA

Instructions: Briefly summarize the existing site data. Identify the estimated nature and extent of contamination. Include figures that support the discussion.

3.0 SUMMARY SOIL REMOVAL ACTIONS

Instructions: Describe the soil removal actions to be taken prior to confirmation sampling. Identify the cleanup goals and regulatory criteria. Support the discussion with appropriate figures (e.g., a figure showing the estimated vertical and lateral extent of the excavation). Describe the approach to excavation activities and confirmation sampling (e.g., sequencing of excavation, confirmation sampling, laboratory turnaround time, data evaluation and decision to backfill excavation).

3.1 SUMMARY OF SOIL REMOVAL OBJECTIVES
 3.1.1 Extent of Excavation
 3.1.2 Waste Characterization
 3.1.3 [Other Appropriate Subsections]
3.2 CLEANUP GOALS AND REGULATORY CRITERIA
3.3 ROLE AND TIMING OF CONFIRMATION SAMPLING IN THE DECISION PROCESS

4.0 CONFIRMATION SAMPLE COLLECTION FROM EXCAVATED AREAS

Instructions: Describe the sampling design that will be used to confirm that soil excavation efforts have removed soil exceeding cleanup goals. Provide the objectives and rationale for sample locations and frequencies for both the excavation floor and sidewalls. If applicable, describe the method for establishing a sampling grid. Identify the sampling requirements (e.g., discrete or composite samples). Provide general sample collection and preservation procedures, and analytical methods. Reference the applicable FSP.

4.1 SAMPLING OBJECTIVES
4.2 SAMPLING DESIGN AND RATIONALE
4.3 SAMPLE LOCATIONS AND DEPTHS
 4.3.1.1 Excavation Floor
 4.3.1.2 Sidewalls
4.4 SAMPLING REQUIREMENTS
4.5 SAMPLING AND ANALYSIS
 4.5.1 General Sample Collection Procedures
 4.5.2 Laboratory Analytical Methods
 4.5.3 Quality Assurance/Quality Control

5.0 CONFIRMATION SAMPLE COLLECTION FOR WASTE CHARACTERIZATION

Instructions: Describe the sample collection methods for characterizing excavated soil prior to disposal or reuse and to identify the need for treatment prior to disposal. Indicate the sample collection frequency and rationale. Identify the sample requirements (e.g., discrete or composite samples). Provide general sample collection and preservation procedures, and analytical methods. Reference the applicable FSP.

5.1 SAMPLING OBJECTIVES
5.2 SAMPLING DESIGN AND RATIONALE
5.3 SAMPLE LOCATIONS
5.4 SAMPLING REQUIREMENTS
5.5 SAMPLING AND ANALYSIS
 5.5.1 General Sample Collection Procedures
 5.5.2 Laboratory Analytical Methods
 5.5.3 Quality Assurance/Quality Control

6.0 DATA QUALITY OBJECTIVES

Instructions: Describe the data quality objectives (DQOs), including analytical issues (e.g., method detection limits), quality assurance and quality control (QA/QC) limitations on data, reproducibility, accuracy and precision, and other issues related to objectives of the confirmation sampling. Reference the applicable QAPP.

7.0 DATA EVALUATION

Instructions: Describe how the data will be evaluated (1) to support the decision to continue or stop the excavation and (2) to determine appropriate disposal or reuse of excavated soil and identify any treatment requirements. Include detailed descriptions of how the cleanup goals will be applied, the statistical evaluations that will be performed, and any other methods to be used. If appropriate, include decision matrices and/or flow charts to assist with the decision process.

7.1 DETERMINATION OF ADEQUACY OF EXCAVATION

7.2 DETERMINE DISPOSAL, REUSE, AND TREATMENT REQUIREMENTS FOR EXCAVATED SOIL

8.0 REPORT

Instructions: Describe the format and schedule for reporting the confirmation sampling and data analysis results. Include all the elements of a standard investigation report, including conclusions and recommendations based on the data and data analysis.

9.0 HEALTH AND SAFETY PLAN

Instructions: A health and safety plan for confirmation sampling activities should be included as a separate section or appendix.

10.0 REFERENCES

Instructions: List all references cited in the plan.

APPENDIX D4
EXAMPLE FOR POST-CLEANUP EVALUATION FOR LEAD

OVERVIEW

As discussed further in Section 5.5 of the PT&R guidance, following a completion of the remediation, a post-cleanup evaluation may be needed for sites where lead is a constituent of potential concern (COPC). The purpose of this evaluation is to assess the residual lead concentrations throughout the entire site, not just the area addressed by the cleanup activities.

The evaluation uses data collected during any confirmation sampling activities and during previous site investigations. For sites using containment/capping, the data set used for the evaluation is data from any soil not covered by the cap. For sites using excavation/ disposal, the data set used for the evaluation is the confirmation sampling data and soil data from other areas of the site that were not subject to the cleanup action.

A statistical summary of these data sets should be included in the completion report for cleanup action. The summary should include the minimum and maximum concentrations, the mean concentration, the 95 percent Upper Confidence Limit (UCL) on the mean, and the cleanup goal. The following table is an example of a statistical summary and is based on the data set summarized on the next page.

Example Post-Cleanup Evaluation for Lead

Site XYZ, Anytown, California

Statistical Summary of Lead Concentrations Remaining at the Site After Excavation
(Based on Data Sets B and C listed on next page)

No. of Samples	Mean	Median	Maximum	Minimum	Standard Deviation	95% UCL	Cleanup Goal
240	64.5	46.7	290.0	16.80	51.61	70.0	252

All concentration values in mg/Kg

Lead Concentration (mg/Kg)							
DATA SET A Data from Excavated Areas Prior to Cleanup			DATA SET B Confirmation Data from Excavated Areas				DATA SET C Data from Areas of Site Not Addressed by Cleanup Action
180	372	1420	18.7	36.0	58.9	100	16.8
180	372	1500	18.8	36.1	59.4	100	16.9
180	380	1500	18.9	37.0	59.5	100	17.5
180	395	1600	19.0	37.0	62.0	100	17.5
182	402	1600	19.2	37.0	62.5	101	17.7
184	410	1600	19.5	37.5	62.8	106	18.3
190	430	1600	19.8	37.7	63.8	106	18.4
190	458	1600	20.2	38.0	64.0	110	18.4
190	471	1700	20.4	39.0	65.0	110	18.5
190	480	1700	21.3	39.0	67.1	110	19.6
199	480	1700	21.5	39.4	69.6	110	19.8
200	480	1700	21.6	39.4	69.6	110	19.9
200	498	1880	21.8	39.5	70.0	112	20.0
203	550	1900	22.0	40.0	70.7	115	20.1
210	550	1900	22.2	41.0	71.0	117	20.1
210	565	1920	24.4	41.0	71.2	117	20.2
213	581	1940	24.5	42.0	71.7	120	20.2
213	645	2000	24.6	42.0	71.9	120	20.4
220	654	2000	25.6	42.0	72.9	120	20.8
220	660	2100	26.0	42.7	73.0	125	20.9
226	685	2210	26.0	43.4	73.5	128	21.0
228	708	2300	26.0	43.9	75.0	130	21.2
230	710	2620	26.7	46.1	75.2	130	22.3
230	771	2700	27.3	46.2	76.9	136	22.5
230	781	3000	27.5	47.1	78.0	137	23.8
240	796	3410	28.0	47.3	78.2	140	23.9
244	811	3500	28.2	47.4	79.0	141	24.0
250	870	3520	28.3	48.1	80.3	145	24.1
250	889	3870	29.0	48.3	81.0	150	24.3
265	894	4100	29.6	49.2	81.4	150	24.7
270	910	4100	29.7	49.5	81.5	150	25.0
280	990	4500	29.7	50.0	81.6	155	25.6
290	1000	4500	29.7	50.0	83.3	161	26.7
290	1000	4680	30.0	50.0	83.5	162	27.0
290	1000	5900	30.0	50.0	84.0	167	27.3
298	1040	6000	30.1	50.5	85.0	170	27.5
310	1050	6100	31.0	50.5	85.0	170	28.0
310	1080	6400	31.1	51.0	85.7	170	28.4
314	1100	6700	31.1	51.5	86.0	171	28.6
327	1100	7300	31.9	52.6	86.2	171	28.8
330	1100	7420	32.0	52.9	87.5	179	28.8
330	1200	7600	32.0	53.8	88.1	180	29.0
334	1200	7880	33.2	54.1	93.3	180	31.2
340	1360	8110	34.0	54.2	94.7	250	32.5
340	1360	8330	35.0	57.4	96.6	265	33.0
360	1390	12500	35.8	58.0	98.0	270	33.4
370	1400	14500	35.9	58.0	98.0	280	33.5
370	1400	19700	36.0	58.2	99.0	290	34.0

APPENDIX D5
ANNOTATED OUTLINE FOR
EXCAVATION COMPLETION REPORT

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PREFACE

This appendix includes an annotated outline that identifies potential content for an Excavation Completion Report. This outline is not intended to be prescriptive and should be adjusted as appropriate for the site-specific conditions.

This outline is for guidance only, and is applicable on a case-by-case basis. Some elements of the outline may apply to your site, while other elements may not. Additional elements than are addressed by this outline may also be needed.

ANNOTATED OUTLINE FOR EXCAVATION COMPETION REPORT

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1.0 INTRODUCTION

Instructions: State the purpose of the report. Introduce the site, its location, and history. Summarize previous investigations. Include pertinent information that addresses site background, hydrogeologic conditions, and the nature and extent of contaminants. Identify and outline the key elements of the plan. Identify the Health and Safety Plan and outline the health and safety measures and monitoring undertaken during the cleanup action.

1.1 SITE DESCRIPTION AND HISTORY
1.2 PREVIOUS ENVIRONMENTAL INVESTIGATIONS
1.3 EXCAVATION, DISPOSAL, AND RESTORATION PLAN
1.4 HEALTH AND SAFETY PLAN

2.0 PUBLIC PARTICIPATION

Instructions: Describe the public participation activities associated with the cleanup action.

3.0 SITE PREPARATION ACTIVITIES

Instructions: Describe the major activities used to prepare the site for excavation (e.g., mapping of excavation areas, utilities surveys, permits obtained, backfill source selection). Describe the source of backfill material and the chemical analyses conducted on the material.

3.1 MAPPING OF EXCAVATION AREAS
3.2 UTILITY SURVEY
3.3 PERMITS
3.4 BACKFILL SOURCE SELECTION

4.0 EXCAVATION ACTIVITIES

Instructions: Describe the major activities conducted during excavation.

4.1 SITE CLEARING AND DEBRIS REMOVAL
4.2 EXCAVATION ACTIVITIES
4.3 STOCKPILE MANAGEMENT
4.4 CONFIRMATION SOIL SAMPLING
4.4.1 Confirmation Sampling
4.4.2 Quality Control Samples
4.5 SITE RESTORATION AND BACKFILLING ACTIVITIES
4.6 SURVEYING ACTIVITIES

5.0 DATA INTERPRETATION

Instructions: Present and discuss the soil confirmation sample data. Discuss how the data were interpreted to indicate that no further excavation was necessary.

5.1 LABORATORY ANALYSIS
5.2 EVALUATION OF LABORATORY RESULTS
5.3 QUALITY ASSURANCE AND QUALITY CONTROL EVALUATION
5.4 INTERPRETATION OF CONFIRMATION SAMPLE FINDINGS

6.0 WASTE CHARACTERIZATION AND DISPOSAL

Instructions: Present and discuss the data used to profile the stockpiles. Discuss how the data were interpreted to select the disposal option. Discuss the disposal of excavated soil, any debris, and other waste materials.

6.1 SOIL STOCKPILES
6.1.1 Laboratory Analysis
6.1.2 Evaluation of Laboratory Results
6.1.3 Interpretation of Stockpile Sample Findings
6.2 DISPOSAL

7.0 FIELD VARIANCES

Instructions: Discuss any field variances that occurred during excavation activities.

8.0 AIR MONITORING

Instructions: Present and discuss the air monitoring results collected during the excavation activities.

9.0 POST-CLEANUP EVALUATION[1]

Instructions: If applicable, include a post-cleanup evaluation.

10.0 SUMMARY AND CONCLUSIONS

Instructions: Summarize the excavation activities and indicate whether the cleanup objectives were fully met.

11.0 REFERENCES

Instructions: List any references cited in the report.

[1] For information regarding the post-cleanup evaluation, see Section 5.5 of the Guidance Document and Appendix D4.

APPENDIX E

Appendix E1: **Annotated Outline for Containment/Capping Design and Implementation Plan**

Appendix E2: **Operation and Maintenance Plan Sample**

Appendix E3: **Annotated Outline for Containment/Capping Completion Report**

APPENDIX E1
ANNOTATED OUTLINE FOR CONTAINMENT/CAPPING DESIGN AND IMPLEMENTATION PLAN

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PREFACE

This appendix includes an annotated outline that identifies potential content for a Design and Implementation Plan for a containment/capping remedy. This outline is for guidance only, and is applicable on a case-by-case basis.

Engineering considerations will drive the precise content and organization of such plans. For instance, a simple asphalt cap over an impacted area may not require as extensive an analysis and design as a more elaborate system with components such as a foundation layer and surface water drainage control system. The following outline includes as many potential items as possible, and the site-specific plan may choose those applicable to the system being proposed.

ANNOTATED OUTLINE FOR CONTAINMENT/CAPPING DESIGN AND IMPLEMENTATION PLAN

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TABLE OF CONTENTS (Continued)

1.0 INTRODUCTION

Instructions: Provide basic information on the site location and history, a brief summary of the project history, regulatory considerations, and a summary of site-wide contamination and remediation activities.

1.1 Overview
1.2 Facility/Site Description
1.3 Regulatory Considerations
1.4 Site-Wide Contamination and Remediation Activities
1.5 Report Organization

2.0 DESCRIPTION OF AREA TO BE CAPPED

Instructions: Provide a detailed description of the past and current conditions at the area to be capped. If the area was formerly an active unit or waste area, provide a description of the treatment or disposal activities. If it is a release area, describe the activities leading to the release. To provide a picture of the contaminant distribution, summarize the results of previous investigation documents, supported by appropriate references.

2.1 History of Area
2.2 Physical Characteristics of Area (Topography, Geology, etc.)
2.3 Description of Contamination and Distribution

3.0 CAP DESIGN ANALYSIS

Instructions: Present the engineering analysis performed to arrive at the detailed specifications of the cap. A list of the potential subject areas of the analyses are provided below. A large portion of the section will include geotechnical analysis of the conditions at the site, in preparation for the cap placement.

3.1 Field Investigation and Laboratory Testing
3.2 Seismic Analysis
3.3 Settlement Analysis
3.4 Stability Analysis
3.5 Infiltration Analysis
3.6 Surface Water Design

4.0 COVER DESIGN

Instructions: Provide both a large-scale overview and detailed descriptions of cap system elements. This section may include a quality assurance and quality control section, and may outline the content and format of the post-construction as-built and completion reports. As the section central to the cap design, this section should reference a large number of attached figures, tables, and appendices. In a subsection, outline how the as-built and completion report will be organized (see also Appendix E4, Capping Completion Report Annotated Outline).

4.1 Overview and Principal Design Components
- 4.2 Site Preparation and Grading
  - 4.2.1 Description of Work
  - 4.2.2 Design Criteria
- 4.3 Cover System Design
  - 4.3.1 Cover Description
  - 4.3.2 Construction Techniques
  - 4.3.3 Cover System Design Criteria
  - 4.3.4 Foundation Layer Bearing Capacity
  - 4.3.5 Settlement Criteria
  - 4.3.6 Seismic Design
- 4.4 Surface Water Control System
  - 4.4.1 Design Layout
  - 4.4.2 Engineering Design Criteria
  - 4.4.3 Runoff Management
- 4.5 Gas Venting System
- 4.6 Other Capping Activities
- 4.7 Construction Quality Assurance and Quality Control Plan
- 4.8 As-Built Report
- 4.9 Certification of Completion

5.0 ENVIRONMENTAL MONITORING AND CONTROL MEASURES DURING CONSTRUCTION

Instructions: Describe any construction issues with air emissions and surface water/storm water runoff. Reference any permits and monitoring programs prescribed by state and local agencies.

- 5.1 Air Emissions
- 5.2 Surface Water Runoff

6.0 CONSTRUCTION SCHEDULE

Instructions: Provide a schedule and chronology for construction, preferably with a supplemental timeline or Gantt chart, showing milestones and timeframes for all activities.

7.0 POST-CONSTRUCTION ACTIVITIES

Instructions: Describe activities following construction which require mention in the design document. This can include demobilization issues, landscaping, security features, etc.

8.0 POST-CONSTRUCTION CARE AND RESTRICTIONS

Instructions: Briefly describe long-term operations and maintenance (O&M) issues, and any land-use restrictions which may be applicable to the cap, based on engineering issues. Summarize and reference other plans or governing documents (such as an O&M Plan and deed restriction document) for the cap. Discuss limitations for any future intrusive activities.

8.1 Operations and Maintenance (O&M) Plan
8.2 Land Use Restrictions

9.0 POST-CONSTRUCTION SURVEYING AND ENGINEERS REPORT

Instructions: A separate section may be merited to summarize post-construction surveying and engineering evaluations and reviews, particularly if the final configuration is complex or critical. Alternately, this section may be included as an appendix.

10.0 COST ESTIMATES

Instructions: Evaluate and summarize the cost estimates for the cap design and construction.

11.0 HEALTH AND SAFETY PLAN

Instructions: Include a health and safety plan for all construction and post-construction activities as a separate section or appendix.

12.0 REFERENCES

Instructions: List all references cited in the plan.

FIGURES

TABLES

APPENDICES

Instructions: A list of potential appendix topics is presented below. Include those appendices which are applicable to the type of cap used. Other appendices may also be applicable.

ENGINEERING DRAWINGS

ENGINEERING CALCULATIONS

CONSTRUCTION PHOTOGRAPHS

LABORATORY TEST RESULTS

MATERIAL CERTIFICATIONS

GEOLOGIC CROSS SECTIONS

AERIAL PHOTOGRAPHS

SETTLEMENT AND SEISMIC ANALYSIS

CONFORMANCE TESTINGS RESULTS

FORMAT EXAMPLES OF INSPECTION AND REPORT DOCUMENTS

FIELD MOISTURE/DENSITY TEST RESULTS

NUCLEAR DENSITY TEST

MANUFACTURER'S DATA ON MATERIALS TO BE USED

FOUNDATION LAYER TESTING

QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM

APPENDIX E2
OPERATION AND MAINTENANCE PLAN SAMPLE

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PREFACE

This Operation and Maintenance (O&M) Plan Sample is a modified version of a sample document developed by the DTSC Schools Program (dated October 2005) to address naturally-occurring asbestos response actions at school sites. The content has been modified and expanded to be appropriate for sites with metals-impacted soils. In general, the content of the O&M Plan should look similar to the content suggested in this Sample.

This Sample is for guidance only, and is applicable on a case-by-case basis. Some elements of this Sample may apply to your site, and others may not. Additional elements than are addressed by this Sample may also be needed.

Instructions for suggested content (denoted by boxed text) are included under most major headings. Some sections provide example text that could be applied to any site. The example text intended for general application is shown as normal text with brackets and underline to indicate locations for inserting site-specific information. Other sections provide example descriptions for specific cap types. These example descriptions are indicated by italics.

OPERATION AND MAINTENANCE PLAN SAMPLE

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TABLE OF CONTENTS (Continued)

FIGURES

Instructions: Include appropriate maps, cross sections, and other figures. The figures should appear in the order that they are mentioned in the plan. All maps should include standard map information, including a north arrow, scale, and map legend. Similarly, cross sections should include vertical and horizontal scale bars and legends. All figures should be shown at an appropriate scale such that text, labels, and patterns are clearly legible. Ideally, maps should be superimposed on the site layout map.

As appropriate, plan view maps should be based on a legal survey.

TABLES

Instructions: Include all tables referred to in the narrative of the plan. The tables should appear in the order that they are mentioned in the plan. They should be clearly labeled and prepared with an appropriate font size so that they are easily legible and understandable.

APPENDICES

Instructions: Include appropriate information as appendices to the plan.

1.0 OPERATION AND MAINTENANCE OVERVIEW

1.1 INTRODUCTION

Instructions: Provide a general statement of document purpose, name of site, effective date of document, DTSC authority to oversee site, and general prohibition of intrusive activities unless conducted in accordance with provisions of O&M Plan.

This Operation and Maintenance (O&M) Plan has been prepared by [name] on behalf of [name] for the cap remedy installed at [site name]. The site is located at [street address, city, county] as shown on Figure [#]. Investigations at the site have identified levels of [metals] in soil resulting from [activities that caused metals impact]. This O&M Plan outlines the inspection and maintenance program for maintaining the integrity of the [cap type] cap installed at the site in accordance with [title of cleanup decision document].

This O&M Plan presents the policies and procedures for long-term operation, maintenance, and monitoring of the cap remedy and management of metals-impacted soils at the site. Response actions and long-term O&M activities will continue to be conducted under DTSC oversight, as required by Health and Safety Code (H&SC), Division 20, Chapter 6.8, commencing with §25300 et seq. The property owner and DTSC have entered into an [title of DTSC oversight agreement] which requires the owner to implement an O&M Plan under DTSC oversight.

Activities that intrude into the metals-impacted soils are prohibited unless conducted in accordance with a DTSC-approved Soils Management Plan and site-specific Health and Safety Plan (see Section 6.0).

1.2 O&M PLAN GOAL AND OBJECTIVES

Instructions: State goal and provide general objectives of the O&M Plan, including protecting public health, maintaining engineering controls, and ensuring remedy effectiveness.

The primary goal of the O&M Plan is to prevent uncontrolled exposures to metals-impacted soils and to protect the health of persons at the site. In order to accomplish this goal, the O&M Plan will address the following objectives:

- Establish an inspection and monitoring program to identify damaged cap systems and evaluate remedy effectiveness;
- Provide for timely repair and replacement needed to restore damaged cap systems;
- Minimize disturbances of metals-impacted soils;
- Provide for record-keeping of inspections and repairs, and reporting to DTSC.

1.3 HAZARD SUMMARY

Instructions: Identify the metals of concern at the site. Provide a general summary of hazardous health effects.

[Identify metals of concern and provide brief description of hazardous health effects.]

1.4 O&M PERSONNEL ROLES AND RESPONSIBILITIES

Instructions: Identify the names, contact information (e.g., address, telephone and fax numbers, e-mail address), roles and responsibilities of O&M personnel associated with implementation of O&M activities. Specify responsibility to notify DTSC within a specified number of days of changes in designated personnel.

The site owner will employ or designate the following O&M personnel associated with implementation of the O&M Plan at the site: Project Coordinator and O&M Professional. The site owner will notify DTSC within [#] days of any changes in the names, addresses, or telephone numbers of key O&M personnel.

1.4.1 Project Coordinator

[Project Coordinator Name]
[Title, Affiliation]
[Contact Information]

The responsibilities of the Project Coordinator are to:

- Implement the O&M Plan;
- Be familiar with site conditions and cap systems installed at the site;
- Evaluate work orders to determine if work will intrude into metals-impacted soils or capped areas;
- Oversee implementation of a DTSC-approved plan for intrusive work;
- Receive and submit all notices, comments, documents, reports, approvals, decisions and other communications to and from DTSC on behalf of the site owner;
- Submit O&M Plan and all subsequent reports, including Annual Inspection Summary Reports, Five-Year Review Reports, and Intrusive Work Completion Reports;
- Sign off on Annual Inspection Summary Reports, Five-Year Review Reports, and Intrusive Work Completion Reports; and
- Ensure that issues pertaining to O&M are brought to the attention of the site owner as appropriate, including requests for ongoing appropriations of funds and notification in the event that any exposures occur at the site.

1.4.2 O&M Professional

[O&M Professional Consultant's Name]
[Title, License Number]
[Company Name]
[Contact Information]

Pursuant to Business and Professions Code, Chapters 7 and 12.5, the O&M Professional is a California-registered civil engineer or engineering geologist having experience with the cap systems installed at the site. The O&M Professional has additional expertise and experience with slope stability (if applicable).

The responsibilities of the O&M Professional are to:

- Conduct routine and emergency inspections and five-year reviews;
- Provide recommendations for needed cap repairs;
- Prepare and sign Annual Inspection Summary Reports and Five-Year Review Reports; and
- Prepare and sign Completion Reports for intrusive activities and cap repairs.

1.5 O&M COST ESTIMATE

Instructions: Prepare an initial estimate of annual O&M costs in current dollars for implementation of the approved O&M Plan, to include but not be limited to, consultant costs, DTSC oversight costs, and O&M staff costs. Additionally, prepare an estimate of projected costs for routine or potential repairs and maintenance.

O&M care begins upon completion of remedy installation and, for the purpose of cost estimating, may continue for at least 30 years after that date. The routine annual O&M costs are estimated in current dollars in Table [#].

TABLE [#]
Annual O&M Cost Estimate

Item	Hours	Hourly Rate	Annual Cost
Scheduled Inspections			
Annual Inspection			
Report Preparation			
DTSC Oversight			
Projected Costs (periodic repairs and maintenance, unplanned inspections)			
Total Annual O&M Cost Estimate			

2.0 SITE DESCRIPTION

Instructions: Describe the location, ownership, and physical setting for the site. Provide the legal description for the site. Give relationship to public boundaries such as state, county, and city. Identify current property owner. Describe the general site geology and topography. Describe prior site usage.

[Provide site-specific description using information from existing reports.]

2.1 PREVIOUS SITE INVESTIGATIONS AND CLEANUP

Instructions: Give a brief chronology and summarize the regulatory history of the site, including investigations, cleanup actions, regulatory actions, orders, etc. Identify the metals-impacted areas, sampling results and concentrations of all contaminants of concern. Summarize cleanup measures taken. Cite applicable laws and regulations.

[Provide site-specific chronology and regulatory history.]

2.2 POST-CLEANUP SITE CONDITIONS

Instructions: Provide available information and a brief description of post-cleanup site conditions. Include a survey map (based on a legal survey) showing areas where cleanup has occurred and the location of cap systems.

[Provide site-specific summary of post-cleanup site conditions.]

3.0 SUMMARY OF CAP SYSTEMS

Instructions: Describe all cap systems, including the type of surfaces and materials, areal extent and thickness of covers used, and activities compatible with the cap design. Include maps depicting all buildings, utility line trenches, finished grade elevations, and thickness of clean fill soils throughout the site. Summarize actual onsite engineering specifications from the cap design document for each identified cap system. Provide appropriately-scaled figure of site. Provide cross-section figures and as-built drawings illustrating cap design and construction. Provide a site survey showing final elevations following grading and compaction.

The cleanup option selected in the [title of cleanup decision document] included implementation of engineering controls in the form of "caps" placed over the metal-impacted soils to create barriers to prevent or greatly reduce exposures. Engineering cap systems in use at the site are summarized in Table [#] and described below. The engineering design of the cap is specified in [document title]. A complete set of as-built drawings and specifications, including cross-section maps illustrating cap design and construction is included as Attachment [#]. See also Figures [#], [#], and [#] for Site Plan Map, Site Survey with Elevations, and Cross-Sections.

TABLE 2
Summary of Cap Systems

Area (Description)	Material	Extent (acres)	Thickness (inches)
Area A (e.g., parking lot)			
Area B (e.g., walkway)			

Note: Areas A and B are shown on Figure [#], Map of Areas with Cap Systems

[Provide a site-specific description of the cap systems, including cap, surface water drainage structures, settlement markers, vegetative cover, etc. Describe the appropriate activities for the capped areas (e.g., parking, light vehicles, light storage).]

4.0 O&M ACTIVITIES

4.1 ROUTINE INSPECTIONS

Instructions: State frequency with which routine inspections of caps will be scheduled and conducted to ensure that the caps remain intact and that no erosion or other material degradation has occurred which might result in exposures to metals-impacted soils. Identify all cap features to be inspected (e.g., cap, vegetation, surface water drainage structures, survey monuments). Describe all inspection and maintenance tasks, and specify the inspection and maintenance schedules required for proper care and efficient operation to maintain the effectiveness of each cap system. Refer to the inspection form. Indicate that DTSC will be notified at a specific number of days in advance of each inspection. Indicate the minimum inspection frequency for each component of the installed cap remedy. Indicate that inspections will be conducted by qualified O&M personnel, under the direction and supervision of the O&M Professional. Include requirement to notify DTSC of any failure of the cap that is not repaired within a specific number of days of discovery.

The cap systems will be inspected on a [frequency] basis for [duration] and [frequency] thereafter. Inspections will be conducted in [months] of each year by a licensed O&M Professional with specific technical expertise in the design or evaluation of [cap type]. The Project Coordinator will notify DTSC at least [#] days in advance of each inspection.

The cap inspection will consist of a walking survey of the entire cap system (e.g., capped area, surface water drainage features, fenced perimeter). The O&M Professional will document observations on the inspection from (Attachment [#] and in photographs. Each inspection will include a general evaluation as to whether the cap currently performs its intended function of [state remedial action objectives for the cap]. If the inspector believes the cap is not performing effectively as intended, appropriate corrective actions (see Section 4.3) will be implemented.

4.1.1 Cap

Example 1: For soil caps.

The O&M Professional will inspect the cap for the presence of any signs of damage, failure or disturbance, including:

- *Slope failure or slope stability,*
- *Cracks or rills larger than two inches wide or that penetrate through cap,*
- *Rodent holes,*
- *Seepage or ponding,*
- *Erosional damage or sloughing of edge materials, and*
- *Excessive or uneven settlement.*

Example 2: For asphalt caps.

The inspection will consist of a walking survey of the entire capped area and documenting observations of cap condition. If present, the following features will be noted on the inspection form and in photographs:

- *Cracking (longitudinal, alligator),*
- *Pull-apart from curb and gutters,*
- *Erosional damage,*
- *Excessive or uneven settlement,*
- *Sloughing of edge materials,*
- *Seepage,*
- *Evidence of ponded water, and*
- *Other signs of damage, failure, or disturbance.*

The inspection form will note the locations and dimensions of the damage (e.g., area, crack width, crack length). The observed damage will be photographed.

4.1.2 Surface Water Drainage System

The O&M Professional will evaluate surface water drainage structures and areas that channel surface water runoff at the site (e.g., ditches, slope edges). Each inspection will ensure that the structures remain free of damage and obstructions, are providing adequate runoff, and do not have excessive erosion.

4.1.3 Vegetation [if applicable]

The O&M Professional will survey the cap vegetation to evaluate whether there is stressed or missing vegetation and whether deep-root plants are present that could penetrate the cap. The inspection will also determine if dry grass is present that poses a fire hazard.

4.1.4 Survey Marker [if applicable]

During each inspection the O&M Professional will inspect each survey monument installed during the cover installation to determine if any damage has made its use questionable for survey.

Settlement marker locations will be surveyed at least every six months for the first year and annually thereafter. Once a settlement of [#] foot or less has been measured for [#] consecutive years, surveys can be scaled back to once every [#] years. The baseline northings, eastings, and elevations of the settlement markers are summarized in Table [#]. All surveying will be completed under the direction of a California-certified land surveyor.

Table [#]
Baseline Survey Marker Data

Description	Location	Northing (ft)	Easting (ft)	Elevation (ft msl)
Marker x				
Marker y				
Marker z				

4.1.5 Perimeter Fence [if applicable]

The O&M Professional will evaluate the perimeter fence to identify any damage or need to replace posted signs.

4.1.6 Reporting and Follow-up

The inspection findings will be documented in the inspection form (Attachment [#]) and summarized in the [Frequency, e.g., Annual] Inspection Summary Report. The summary report will be submitted to DTSC within [#] days of completing the final inspection for the reporting period.

If the O&M Professional believes the cap is not performing effectively as intended, appropriate corrective actions (see Section 4.3) will be implemented. The Project Coordinator is responsible for follow-up review to ensure that identified repairs are completed on schedule, and will sign-off on the completion blocks of the inspection reports. The Project Coordinator will notify DTSC of any damage that is not repaired within [#] days of discovery.

4.2 RESPONSE FOR UNPLANNED EVENTS

Instructions: State nature of unplanned events that will trigger inspections, and describe procedures to be followed, including completing an Inspection form. Indicate that DTSC will be notified of any failure of the cap.

Immediate and appropriate action will be taken to prevent, abate, or minimize an emergency related to any action or occurrence such as a fire, earthquake, explosion, or human exposure to hazardous substances caused by a release or threatened release of hazardous substances at the site. The Project Coordinator will notify DTSC within [#] hours of any such occurrence. The need for action will be identified by inspecting the cap after an unplanned event that has the potential to impact the cap integrity or based on a report of damage observed by persons at the site. Inspection observations will be documented on the Emergency Response Inspection Form (Attachment [#]).

The Project Coordinator will take appropriate action in consultation with DTSC and the O&M Professional, and in accordance with the applicable provisions of the [title of DTSC oversight agreement]. A report describing the events that occurred and response measures will be submitted to DTSC within [#] days of the event.

4.2.1 Earthquake

The closest fault to the site is [fault name] and is [#] miles away. The estimated Maximum Credible Earthquake on the [fault name] fault corresponds to a value of [#] on the Richter scale. In the event of an earthquake event of [#] or greater, the O&M Professional will visually inspect the cap system for signs of damage as soon as it is safe and practical to conduct the inspection.

4.2.2 Floods or Major Storms

In the event of a flood or major storm the O&M Professional will inspect the cap system to ensure its integrity within [#] hours of the event. The inspector will document his/her observations on the form included in Attachment [#]. For the purpose of this O&M Plan, a major storm is defined as a storm with a [#]-year return period (>[#]) of presentation or more over a 24-hour period.

4.2.3 Fire

In the event of a surface fire on or near the cap, the O&M Professional will inspect the cap system and document his/her observations on the form included in Attachment [#] as soon as it is safe and practical to conduct the inspection.

4.3 CAP MAINTENANCE AND REPAIR

Instructions: State that the intended cap function will be maintained. Describe the routine and anticipated maintenance activities. Describe anticipated repairs. Give examples of anticipated maintenance activities and repairs. Indicate that cap repairs will be in accordance with the approved cap design document. Indicate the timeframe for making repairs. Indicate that DTSC will be notified prior to conducting major repairs. Define what constitutes a major repair and a significant feature that requires repair.

Example 1. Asphalt caps.

The cap will be maintained in a manner that ensures its intended function: prevent exposure to impacted soils and minimize water infiltration through impacted soils. Examples of maintenance include sealing of cracks, patching of potholes, and regrading to ensure appropriate surface water drainage.

Repairs will be made in accordance with the cap design specifications established in the [title of cap design document]. Under no circumstances will the cap remain in disrepair more than [#] days after discovery of damage. Any major repair that requires significant disturbance of the cap will be performed only after review and approval by DTSC (see Section 6.0). A significant disturbance is defined as a repair that involves excavation to [#] feet or more below grade.

Example 2. Soil caps.

4.3.1 Cap

Typical maintenance will include backfilling of burrows with clean soil, removal of burrowing animals, filling or regrading of depressions, and revegetation or mulching of eroded areas.

For areas where the cap damage or disturbance appears to be continuous or excessive, the Project Coordinator will notify DTSC within [#] days of completing the inspection with recommended measures to correct the problem. Examples of such problems include slope stability issues, excessive erosion, and significant cracks or rills that have the potential to affect the cap function.

4.3.2 Surface Water Drainage System

Typical maintenance will include removal of debris, silt, or other obstructions from the surface water drainage system. If the O&M Professional identifies excessive erosion, inadequate runoff capacity, or other significant damage, the Project Coordinator will notify DTSC within [#] days of completing the inspection with recommended measures to correct the problem.

4.3.3 Vegetation

Maintenance will include removal of deep-root species that penetrate the cap, and seeding, watering, and mulching over barren or poorly vegetated area. Reseeding should take place in accordance with the specifications included in the [cap design document] and should be timed for the season that will optimize establishment of vegetation.

Periodic mowing will take place as needed after the rainy season and in the summer and late fall to ensure that the vegetation does not grow taller than [#] inches.

If the O&M Professional identifies areas that are persistently poorly vegetated, such that the cap integrity is affected, the Project Coordinator will notify DTSC within [#] days of completing the inspection with recommended measures to correct the problem.

4.3.4 Survey Markers

If a survey marker is missing or badly damaged, it will be replaced as soon as possible after discovery of the problem. The Project Coordinator will notify DTSC within [#] days of the problem.

4.3.5 Perimeter Fence

If the O&M Professional identifies fence damage, the Project Coordinator will notify DTSC within [#] days and will repair the fence within [#] days.

4.4 PERIODIC SEALING AND RESURFACING OF CAP [if applicable]

Instructions: Describe the provisions for sealing and resurfacing the cap. Indicate the design specifications and anticipated timeframes for sealing and resurfacing the cap.

The cap is expected to require re-sealing every [#] years and repaving every [#] years. These frequencies may be modified as recommended by the O&M Professional. The overlay thickness of a cap will be consistent with the thickness specified in the [cap design document].

5.0 FIVE-YEAR REVIEW

Instructions: Discuss five-year reviews of remedy effectiveness when hazardous substances remain in place. Identify the purpose of the five-year reviews. Indicate that the O&M Professional should conduct a review, cap inspection, and prepare a report of the cap status at least once every five years after DTSC issuance of site certification. Include a requirement to notify DTSC within a specified number of days in advance of the inspection. Indicate that O&M Professional and Project Coordinator should sign each Five-Year Review report. Indicate that the Five-Year Review Report will be *submitted to DTSC within a specified number of days after completion of inspection. Include a requirement for the Project Coordinator to perform additional investigation, monitoring, and/or mitigation in consultation with DTSC based upon the findings of each Five-Year Review Report.*

Five-Year Reviews will be conducted to evaluate on-going remedy effectiveness. The purpose of the review is to determine whether the remedy: (a) remains protective of human health and the environment; (b) is functioning as designed; and (c) is maintained appropriately by O&M activities. Each Five-Year Review will be conducted by an O&M Professional. The Project Coordinator will notify DTSC at least [#] days in advance of each Five-Year Review inspection. The first Five-Year Review inspection will be completed by [date] and all subsequent inspections will be completed by the [month and day] of every fifth year.

The O&M Professional will inspect the cap systems in the same manner as in the routine inspections (see Section 4.1). The Five-Year inspection will identify and review completion of any required repairs, changes in site conditions or usage, or any other significant information relating to the caps that may have taken place over the previous five years.

The O&M Professional will prepare and sign a report that summarizes his/her findings, conclusions, and recommendations (see Section 7.4). The Project Coordinator will also sign the report. The Five-Year Review Report will be submitted to DTSC within [#] days after completion of the inspection.

The Project Coordinator is responsible for responding to recommendations made in the Five-Year Review Report and any additional requirements identified by DTSC. The DTSC requirements may include additional investigation, monitoring, and/or mitigation. The Project Coordinator is responsible for follow-up review to ensure that identified repairs are completed on schedule, and will sign-off on the completion blocks of the report.

6.0 INTRUSIVE WORK ACTIVITIES

Instructions: Indicate that the intrusive work should be conducted in accordance with a DTSC-approved Soil Management Plan and a site-specific Health and Safety Plan. Identify person responsible for reviewing work order requests to determine if impacted soils will be disturbed, and notifying DTSC prior to performance of intrusive work at the site. Include a requirement to prepare a Completion Report summarizing all intrusive work; incorporate Completion Reports into Annual Inspection Summary Report for submittal to DTSC.

Activities that disturb the soil under the cap will be conducted with a DTSC-approved Soil Management Plan and site-specific Health and Safety Plan. Examples of these activities include excavation, grading, removal, trenching, filling, earth movement, and mining. In the event of such work, the Project Coordinator will:

1. Notify DTSC of the type, cause, location and date of any disturbances to the cap that could affect the ability of the cap to contain the underlying metals-impacted soil.

2. At least [#] days prior to any proposed modifications/disruptions of the cap, provide DTSC with written notification via certified mail. The written notice will include a detailed description of the work to be done, and will include a map showing the exact location of the proposed work and the reasons for the modifications/disruption. The written notice will include a draft Soil Management Plan and site-specific Health and Safety Plan for DTSC comment and approval. These documents should be prepared by qualified O&M Professionals with expertise in the work to be performed.

3. Provide notification to DTSC within [#] days after completion of modifications/repairs to the cap in an Intrusive Work Completion Report that summarizes all intrusive work and that certifies that the cap was restored to specified design requirements. Section 7.3 describes the appropriate report content.

7.0 REPORTING AND RECORDKEEPING

7.1 DTSC NOTIFICATION REQUIREMENTS

Instructions: Provide a listing of all required notifications. Indicate the format (e.g., written) and content of the notifications.

The site owner will notify DTSC in writing within [#] days of any changes in the names, addresses, or telephone numbers of the Project Coordinator or O&M Professional.

The Project Coordinator will notify DTSC in writing as follows:

- At least [#] days prior to a routine inspection or inspection for a Five-Year Review;
- Within [#] hours of an unplanned event that impacts or threatens to impact the integrity of the cap;
- Within [#] hours of identifying an impact or threat of impact to the integrity of the cap;
- At least [#] days prior to intrusive work activities that will affect the integrity of the cap or encounter impacted soils;
- At least [#] months prior to destroying any documents prepared to address O&M Plan requirements.

If appropriate, notifications should include a proposed schedule for completing required repairs and maintenance.

7.2 ANNUAL INSPECTION SUMMARY REPORTS

Instructions: Indicate that Annual Inspection Summary Reports should summarize reports from routine inspections during the preceding 12 months, and may also include recommendations regarding changes to maintenance procedures, etc. based on evaluation of effectiveness of cap systems. Within a specified number of days after each annual O&M inspection, indicate that the Annual Inspection Summary Reports will be submitted for DTSC review and approval. Indicate that each annual report should be signed by the O&M Professional and Project Coordinator.

Annual Inspection Summary Reports will summarize the findings of routine inspections, and will document completions, delays, or failures to repair any items identified as needing repairs. The Annual Inspection Summary Report will be signed by the O&M Professional and the Project Coordinator. The Project Coordinator will submit the report for DTSC review and approval no later than [#] calendar days after the annual inspection as been conducted.

Annual Inspection Summary Reports will follow the format outlined in Attachment D and will include the following content:

- Results of the visual inspections and any supporting data;
- Description of
  - actions taken during the reporting period, including any repairs to the cap that were identified and carried out,
  - any significant changes in site conditions and usage, and
  - any additional onsite construction or other information that may relate to the cap or impact cap function;
- Description of actions planned or expected to be undertaken in the next year that will impact the caps;
- Conclusions regarding the on-going effectiveness of the cap;
- Description of any maintenance or repairs identified as needed during the inspection;
- Description of any requirements under the [title of agreement for DTSC oversight] that were not completed;
- Identify any problems or anticipated problems in complying with the [title of agreement for DTSC oversight];
- Recommendations for O&M Plan modifications;
- Copies of signed inspection forms completed during the reporting period;
- Copies of all field logs completed during the reporting period;

- Photographs depicting site conditions with brief identifying captions or descriptions. Photographs will document inspection findings and demonstrate stability and/or failure of cap;
- Copies of any data generated under the [title of agreement for DTSC oversight] and any significant findings from the data;
- Copies of work orders and Completion Reports for any intrusive work conducted during the reporting period; and
- Documentation of additional investigation, monitoring, and/or mitigation activities required by DTSC.

The reports will be maintained in the site files as described in Section 7.5.

7.3 REPORTING OF INTRUSIVE WORK

Instructions: Indicate that intrusive work activities will be documented in an Intrusive Work Completion Report prepared by the O&M Professional. The report should summarize the dates of work performed, work location, work activities performed including restoration of cap systems where necessary, work practices taken to prevent potential exposures, any variances from the approved Soil Management Plan, and summary of finished site conditions. Indicate that the Completion Report will be submitted to DTSC within a specified number of days after completion of the intrusive work.

Work activities that contact impacted soils will be documented in a Completion Report prepared and signed by the O&M Professional. The report will follow the format provided in Attachment [#] and will include the following information:

- Dates work performed;
- Work location, with maps and figures;
- Work activities performed, including restoration of cap systems;
- Work practices taken to prevent potential exposures;
- Variance or modifications (if any) of the approved Soil Management Plan; and
- Summary of finished site conditions.

Additional report content may be specified by DTSC or identified in the Soil Management Plan. The Completion Report will be submitted within [#] days of completion of the intrusive work.

7.4 FIVE-YEAR REVIEW REPORTS

Instructions: Identify due dates for the Five-Year Review Reports. Indicate that the Five-Year Review Report will be a stand-alone document including a summary of site history and current conditions. Note that DTSC will review and approve each Five-Year Review report. Include a requirement to complete technical assessment of on-going remedy effectiveness. Indicate that Five-Year Review Reports should be submitted within a specified number of days after completion of each fifth year inspection.

The first Five-Year Review Report for the site will be completed five years from the date that DTSC issued site certification. All subsequent Five-Year Review Reports will be completed by [month and date] of every fifth year. The Project Coordinator will submit the Five-Year Review Report to DTSC for review and approval within [#] days after completion of each scheduled Five-Year inspection. Five-Year review reports will be maintained in the site files as described in Section 7.5.

The Five-Year Review Report will follow the format outlined in Attachment [#] and will summarize remedy effectiveness within the reporting period. The Report will identify any incidents or problems with the cap systems, and will evaluate system performance, effectiveness, and protectiveness. The Five-Year Review Report will include a technical assessment and evaluation of the on-going protectiveness of the remedy. This evaluation will address the following questions:

- Is the remedy functioning as intended by the remedy selection decision documents?
- Are the removal action objectives, goals, and criteria used at the time of remedy selection still valid?
- Have there been any significant changes in the distribution or concentration of the impacted soils at the site?
- Are any modifications needed to make the O&M Plan more effective?

The Five-Year Review Report will state conclusions and make recommendations for any changes needed to maintain remedy protectiveness.

The Five-Year Review Report will be prepared by the O&M Professional. Both the O&M Professional and Project Coordinator will sign the report. The report will be submitted to DTSC within [#] days of completing the site inspection.

7.5 RECORDKEEPING AND RETENTION

Instructions: Identify the record-keeping and retention requirements. Indicate that Site Coordinator is responsible for maintenance of all O&M records. Identify location of copies of O&M records and location of DTSC Administrative Record. Describe availability of records for public review and DTSC inspection.

All documentation records prepared under the O&M Plan will be maintained by the Project Coordinator at [location]. The records will be available for inspection upon request by the public and DTSC representatives. The records will include, but are not limited to:

- Inspection checklists and photographs;
- Annual Inspection Summary Reports;
- Five-Year Review Reports;
- Completion Reports for Intrusive Work;
- Records of public inquiries about the impacted soils at the site; and
- Investigation and cleanup-related documents.

Because of the potential volume of paper that could be generated or stored, the Project Coordinator may elect to maintain paper copies of the previous 12 months reports and the latest Five-Year Review Report, if applicable, and keep the rest of the documents as electronic files (in PDF format).

All records will be preserved by the Project Coordinator for a minimum of seven years after the completion of each activity. The Project Coordinator will notify DTSC in writing at least six months prior to destroying any documents prepared pursuant to the O&M Plan. If requested by DTSC, the Project Coordinator will make requested documents available to DTSC for review or copy.

The DTSC administrative record for the site is available for public inspection during office hours at the following DTSC location.

Department of Toxic Substances Control
[Street Address]
[City, State, Zip Code]
Attention: [Name of DTSC project manager]

8.0 SITE ACCESS

Upon request, site access for DTSC representatives and O&M personnel will be arranged and provided by the Project Coordinator at all reasonable times.

9.0 VARIANCE FROM, OR MODIFICATION OF, O&M PLAN

The Project Coordinator may seek variance and/or modification of the O&M Plan at any time during the life cycle of the cap remedy. "Variance" refers to possible release from specific individual O&M Plan requirements for a limited time period, while "modification" refers to permanent revision of specific individual O&M Plan requirements.

The Project Coordinator may apply to DTSC for a written variance from the provisions of the O&M Plan. DTSC will evaluate each request, and will grant a variance request only after determining that such as request would be protective of human health and the environment.

When long-term performance of the selected cap remedies has been confirmed, the Project Coordinator may apply to DTSC to modify the requirements of the O&M Plan based on site-specific monitoring results and conditions. Additionally, DTSC reserves the right to independently initiate appropriate O&M Plan modifications. As a result, DTSC may require the following O&M Plan modifications:

- Changes in the frequency of O&M activities;
- Modification, replacement, or addition of components to the O&M Plan if O&M activities fail to achieve the O&M objectives of protecting human health and the environment; and
- Evaluation, design, construction, and/or operation of additional remedial measures to achieve the O&M objectives.

10.0 REFERENCES

Instructions: List citations or document references for most current regulatory and site-specific requirements.

[DTSC oversight agreement (e.g., O&M Agreement).]

[Cleanup option decision document]

[Cap design document]

[Other appropriate references]

EXAMPLE CAP INSPECTION FORMS

INSPECTION FORM

[SITE NAME]
[SITE ADDRESS]

O&M INSPECTION
[INSPECTION TYPE]

Inspector Information		Project No.
Date/Time:		
Inspector Name:		Weather:
Company:		
Address:		
Phone:		
Fax:		
E-mail:		

Description of Inspection Methods

Observations

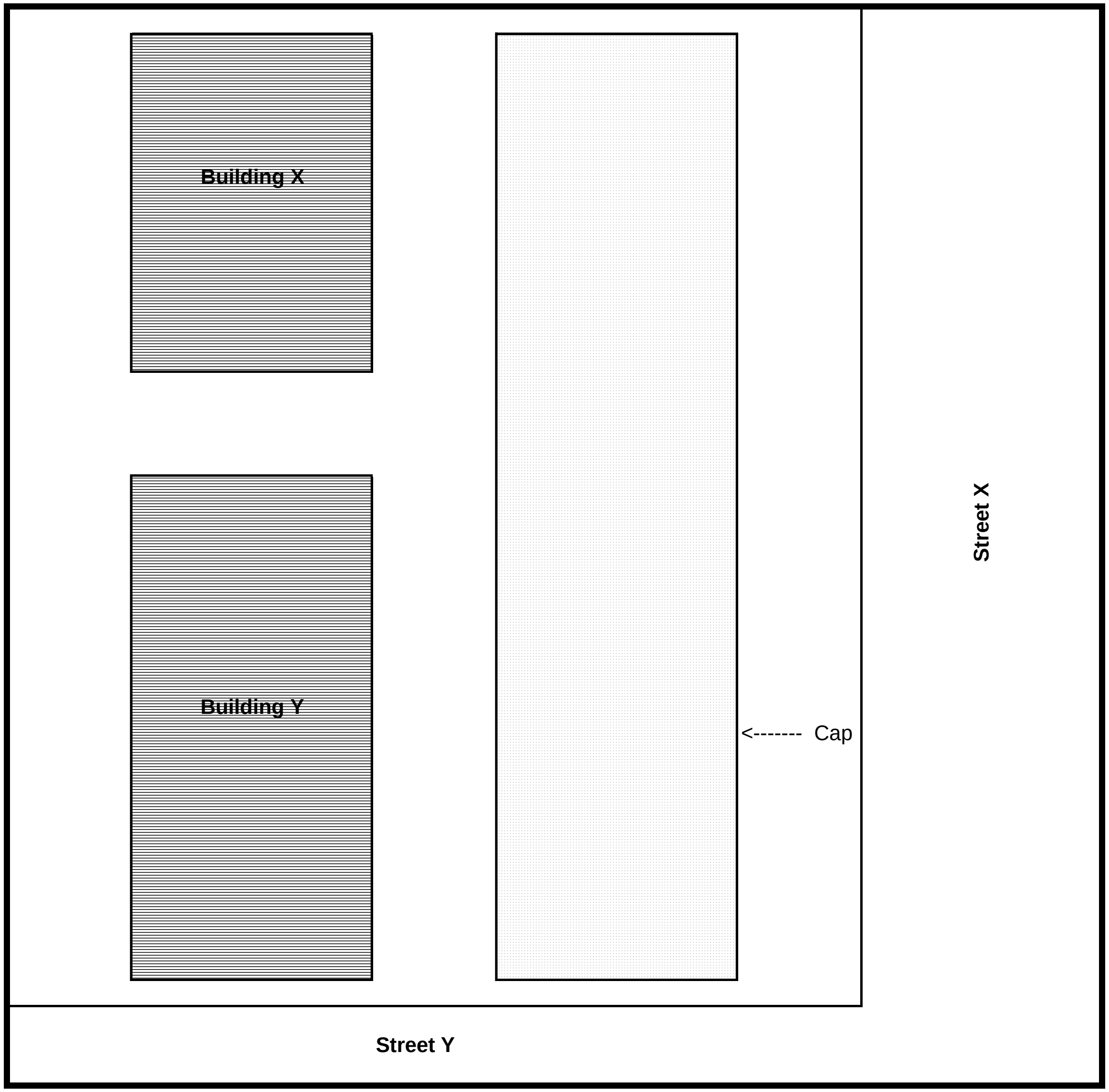
Area Inspected	Evidence of Cracks?	Crack Description (location, type, dimensions)	Evidence of Ponding?	Ponding Description (location, areal extent)	Evidence of Erosion?	Erosion Description (location, characteristics)	Other Observations
	Y N		Y N		Y N		
	Y N		Y N		Y N		
	Y N		Y N		Y N		

Recommendations

Inspector Signature:

Page 1 of 2

SITE PLAN MAP FOR [SITE NAME, ADDRESS]



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CAP SYSTEM INSPECTION FORM

[SITE NAME]
[SITE ADDRESS]

O&M INSPECTION
[INSPECTION TYPE]

Inspector Information	Date/Time:
Inspector Name:	Project No.:
Company:	Weather:
Address:	
Phone:	
E-mail:	

Are there cracks or rills in the soil cap more than 2-inches wide? Do the cracks extend through the cap? ☐ Yes ☐ No
Comments:

Are there noticable depressions, ponding of surface water, or evidence of ponding on cap? ☐ Yes ☐ No
Comments:

Are there any signs of sliding or sloughing of the soil layer which might indicate slope failure? ☐ Yes ☐ No
Comments:

Are there open holes or animal burrows in the cap? ☐ Yes ☐ No
Comments:

Is there excessive debris, silt, or other deleterious material obstructing flow through the surface water control system? ☐ Yes ☐ No
Comments:

Is there evidence of erosion or damage associated with surface water control system? ☐ Yes ☐ No
Comments:

Are there areas of stressed or missing vegetation on the cap? ☐ Yes ☐ No
Comments:

Page 1 of 2

CAP SYSTEM INSPECTION FORM

[SITE NAME] **Date:**

Have invasive or deep-rooting species taken root on the cap cover? ☐ Yes ☐ No
Comments:

Are there areas with continual poor growth despite reseeding efforts? ☐ Yes ☐ No
Comments:

Does the vegetation require mowing? ☐ Yes ☐ No
Comments:

Is the perimeter fencing intact and in good condition? ☐ Yes ☐ No
Comment:

Do the survey markers intact and legible? Have they shown any movement? ☐ Yes ☐ No
Comments:

Other evidence of cap system damage or failure? ☐ Yes ☐ No
Comments:

Additional Notes:

Inspector Signature:

Page 2 of 2

EMERGENCY RESPONSE CAP SYSTEM INSPECTION FORM

[SITE NAME]
[SITE ADDRESS]

O&M INSPECTION
[INSPECTION TYPE]

Inspector Information	Date/Time:
Inspector Name:	Project No.:
Company:	Weather:
Address:	
Phone:	
E-mail:	

Are there large cracks in the soil cover? ☐ Yes ☐ No
Comments:

Are there noticable depressions or ponding of surface water on the cover? ☐ Yes ☐ No
Comments:

Is there excessive debris, silt, or other deleterious material obstructing flow through the surface water control system? ☐ Yes ☐ No
Comments:

Are there any signs of sliding or sloughing of the soil layer which might indicate slope failure? ☐ Yes ☐ No
Comments:

Do the survey markers indicate any significant horizontal or vertical movement? ☐ Yes ☐ No
Comments:

Other evidence of cap damage or failure? ☐ Yes ☐ No

Additional Notes:

Inspector Signature:

TABLE OFCONTENTS FOR ANNUAL INSPECTION SUMMARY REPORT

TABLE OF CONTENTS FOR
COMPLETION REPORT FOR INTRUSIVE WORK

TABLE OF CONTENTS FOR FIVE-YEAR REVIEW REPORT

APPENDIX E3
ANNOTATED OUTLINE FOR
CONTAINMENT/CAPPING COMPLETION REPORT

TABLE OF CONTENTS

PREFACE

The following annotated outline provides a potential table of contents for a Containment/Capping Completion Report. This outline is not intended to be prescriptive and should be adjusted as appropriate for the site-specific conditions.

This outline is for guidance only, and is applicable on a case-by-case basis. Some elements of this outline may apply to your site, while other elements may not. Additional elements than are addressed by this outline may also be needed.

ANNOTATED OUTLINE FOR CONTAINMENT/CAPPING COMPLETION REPORT

TABLE OF CONTENTS

1.0 CERTIFICATIONS

1.1 Engineer's Certification

Instructions: The engineer's certification, with the signature and seal of qualified and registered State of California Engineer is generally placed at the beginning of the document.

1.2 Third Party Engineering Certification

Instructions: In some cases, an independent third party review of the report and the capping activities is required by DTSC. This is generally also placed at the beginning of the document.

2.0 INTRODUCTION AND PROJECT SUMMARY

Instructions: Provide basic information regarding the site location and history, and a brief summary of the project history. A bullet summary of activities conducted during capping is a useful addition to the introduction section.

3.0 PRE-CAPPING PREPARATION

Instructions: Summarize any engineering activities that preceded the placement of the cap over contaminated soils.

3.1 Preparatory Grading, Grubbing, and Debris Removal

Instructions: Describe the activities related to the initial preparation of the impacted area for construction of the cap. This generally includes removal of debris, vegetation, and grading of rough and uneven surfaces. It may also include the construction of access roads or ramps for construction purposes.

3.2 Subsoil Removal

Instructions: If the removal of subsoil was performed prior to capping, describe the activities in this section. Include the reason for soil removal (e.g., for grading and consolidation purposes, for the removal of soil with metal concentrations above allowable concentrations). If impacted soil is removed, describe the concentrations of contaminants, the regulatory classification of the removed material, and how it was disposed (e.g., landfill).

4.0 WASTE IMPORTATION AND CONSOLIDATION

Instructions: If impacted waste from other parts of the site was consolidated in the cap area as part of the remedy, describe these activities in this section. Include a reference to the regulatory process by which waste consolidation was approved, reference to the maximum allowable concentrations of contaminants in such soil, and the protective standards to which the soil is being held (e.g., health risk standards). Also, summarize compaction and debris screening performed (Note: The full compaction details may be summarized in Section 6.0 (Foundation Layer).

5.0 DESCRIPTION OF FINAL COVER SYSTEM DESIGN

Instructions: Briefly summarize the components and design of the cap/cover system. Refer to the approved cap design document.

6.0 FOUNDATION LAYER

Instructions: Describe how either the capped waste or imported fill will serve as a foundation layer beneath the cap. Describe preparation, compaction, screening, and grading to be performed on this foundation layer. Describe the quality assurance and quality control procedures used to verify the foundation layer has been constructed according to the approved specifications.

7.0 CAP LAYERS

Instructions: Based on the approved design, there may be a range of capping components used in construction of the cap. Describe each of the as-built components used in the cap construction as a separate subheading, as illustrated below.

7.1 Layer 1 (e.g., Clay Layer)
7.2 Layer 2 (e.g., Geosynthetic Layer)
7.3 Layer 3 (e.g., Vegetative Soil Layer)
7.4 Layer 4 (e.g., Asphalt Layer)

8.0 GAS VENTING SYSTEM

Instructions: If applicable, describe the as-built gas venting system installed as part of the remedy.

9.0 DRAINAGE STRUCTURES

Instructions: Describe the as-built surface drainage systems installed to prevent erosion and control storm water runoff.

10.0 QUALITY ASSURANCE AND QUALITY CONTROL

Instructions: Quality assurance and quality control (QA/QC) is an integral part of each stage and component of cap construction, and consequently forms a major part of the Completion Report. Some aspect of QA/QC measures should be described within each section of the report, where necessary. In addition, a separate section or appendix may be appropriate to describe an overall QA/QC program for the cap installation.

11.0 CONTROL MEASURES AND ENVIRONMENTAL MONITORING DURING CONSTRUCTION

11.1 Control Measures During Construction

Instructions: Summarize any measures taken during cap construction to prevent and control impacts from surface water runoff or airborne dust. Describe any problems and measures taken to correct such problems.

11.2 Environmental Monitoring

Instructions: If environmental monitoring of air or water was performed during construction, summarize the monitoring activities and results. Such monitoring may be described in separate section. This may also include weather data (e.g., wind, temperatures) collected at the site for monitoring purposes.

12.0 SUMMARY AND CONCLUSIONS

Instructions: A summary and conclusion section of the report can include:
- *A bulleted recap of the activities conducted during cap installation;*
- *A statement that work was performed in accordance with approved plans and specifications;*
- *Any nonconformance results from the construction should be described, along with a discussion of their significance;*
- *A statement that QA/QC procedures were followed, as supported by testing and inspections; and*
- *Other appropriate information.*

13.0 REFERENCES

Instructions: List citations or document references for most current regulatory and site-specific requirements.

<u>[DTSC-approved cap design document.]</u>

<u>[Cleanup option decision document]</u>

<u>[Other appropriate references]</u>

<u>[Technical References related to cap design]</u>

FIGURES

TABLES

APPENDICES

Instructions: Appendices applicable to the type of cap used should be included in the Completion Report. The list of potential appendix topics presented below may or may not be applicable to a given site. Other appendices may also be appropriate for a given site.

AS-BUILT DRAWINGS

CONSTRUCTION PHOTOGRAPHS

LABORATORY TEST RESULTS

MATERIAL CERTIFICATIONS

CONFORMANCE TESTINGS RESULTS

INSTALLATION SUMMARIES

INSPECTION REPORTS

DAILY AND WEELKY PROGRESS REPORTS

FIELD MOISTURE/DENSITY TEST RESULTS

NUCLEAR DENSITY TEST

MANUFACTURER'S QUALITY CONTROL DOCUMENTATION

FOUNDATION LAYER TESTING

DEFECT AND REPAIR SUMMARIES

GEOSYNTHETIC MEMBRANE SEAM TESTING AND LOGS

QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM

LICENSED SURVEYOR'S CERTIFICATION

APPENDIX F

APPENDIX F1
FACT SHEET SAMPLE

TABLE OF CONTENTS

PREFACE

The Fact Sheet Sample included in this appendix was prepared by the DTSC Voluntary Cleanup Program (VCP) team in February 2008. The format of the Sample has been modified slightly to be consistent with the remainder of this PT&R guidance document. In general, the fact sheet should look similar to this Sample.

This sample document is for guidance only, and is applicable on a case-by-case basis. Some elements of this Sample may apply to your site, and others may not. Additional elements than are addressed by this Sample may also be needed.

Instructions for suggested content are denoted by boxed text. Some sections provide example text that could be applied to any site. Text that is intended for general application is shown as normal formatting with brackets and underline to indicate locations for inserting site-specific information. Other sections provide example descriptions for specific remedial alternatives (i.e., excavation/off-site disposal). These example descriptions (indicated by italics) are not intended for broad application; some specificity has intentionally been removed from the example descriptions, as indicated by bracketing and underlining.

Fact Sheet, [Month] [Year]

Cleanup Plan for [name of metal] Available For Review [or other heading as appropriate – keep to 1 line]

A draft plan to remove soil contaminated with [metal] at the [name of site] is open for public review and comment. The draft plan, called a [document title and acronym], was submitted by [name]. The site is located at [address or location description] in [city], California.

[Consider a map here – or a figure depicting the location of the site/facility]

This Fact Sheet provides a brief summary of:

- Why Cleanup Is Necessary [or Why are Protective Actions Necessary]
- History and Operations at the Site
- Environmental Investigations
- Proposed Cleanup Options
- Safety & Dust Control During Cleanup
- Proposed Transportation Route for Trucks
- California Environmental Quality Act
- Next Steps
- Where to Find the Documents
- Who to Contact for Information

Why Cleanup Is Necessary [or Why are Protective Actions Necessary]

[If appropriate: There is **no** immediate health risk because the public is not exposed to the contaminated soil.] However, because exposure to elevated levels of [metal] contamination can cause adverse health effects, DTSC recommends that the [name] prepare a cleanup plan to remove and dispose the contaminated soil to protect [industrial/commercial workers, the future occupants of the property]. DTSC will oversee the removal action and ensure that it is performed in a manner that does not harm people or the environment.

PUBLIC COMMENT PERIOD
[date] to [date]

[IF APPLICABLE: PUBLIC MEETING/HEARING/OPEN HOUSE, DATE & TIME]

Your participation is encouraged. The draft [document title] and other related project documents for this site are available for review and public comment at the locations listed on page [#]. We will make a final decision after all public comment has been reviewed and considered. Please submit written comments in the enclosed postage paid envelope postmarked **by [date]**; or by email before the deadline date no later than 5 p.m. to:

[Your Name, Public Participation Specialist, yourPPS@dtsc.ca.gov.]

Si desea información en español, comuníquese con [name] al [insert number] [o número gratis 1-866-495-5651 if PPS staff is contact]

History and Operations at site

Instruction: Brief description of what occurred on the site historically. Additionally, what is the source of the contamination? The location description should be defined by a map and a written description can be a caption to that map if necessary.

[Metal] occurs naturally in California soils. In addition, [metal] is used in [potential anthropogenic sources and duration of uses e.g., lead was used in various manufacturing processes and was used in paint until 1978, when federal laws changed to restrict its use]. The elevated levels found at this site may have resulted from the use of [potential source, e.g., lead-based paint on the buildings].

Environmental Investigations

Instruction: Brief description of the investigations conducted at the site, the timeframes for these investigations, the contaminants encountered, affected environmental media, and depth of impact.

During the investigations conducted from [date] through [date], elevated concentrations of [metal] were found in shallow soil throughout the site.

-or-

Several site investigations were conducted during [insert year] to identify current conditions at the site, involving the collection of soil samples from [#] locations or borings. The results of these investigations detected [metal] at higher than acceptable levels.

Proposed Cleanup Options

Instruction: Identify the cleanup options to be considered and the recommended cleanup option. Describe the recommended cleanup option.

The following three Cleanup Options will be considered for this site:

Alternative 1 – No Further Action
Alternative 2 – Containment through Surface Capping
Alternative 3 – Removal and Off-Site Disposal

Based on careful analysis of the options, [alternative description, e.g., excavation and removal] is recommended because it [provide rationale, e.g., protects human health and the environment, is permanent and has a reasonable cost]. Details of the removal action alternatives are listed in Section [#] of the [document title].

If Alternative [#] is selected, [Describe the cleanup process. See following examples for excavation and removal alternative.]

Example 1 for excavation/disposal: The contaminated soil will be dug out using a backhoe, bulldozer, shovels or other types of earth moving equipment, as necessary. The soil will be either temporarily stockpiled or loaded directly onto trucks and taken off-site to be disposed at a licensed facility. The soil will not be stockpiled on the site for long durations. After the contaminated soil is removed, samples will be taken to confirm that the contamination is gone.

-or-

Example 2 for excavation/disposal: Soil would be dug up, temporarily stockpiled at the site for [duration], then removed to an off-site location for disposal at a licensed facility. Removing the [#] cubic yards of contaminated soil will reduce the amount of metals in the soil to safe levels. "Safe" is a relative term, based upon DTSC's analysis of the risks posed by its decision. For further discussion on how the Department uses this word, please go to:

www.dtsc.ca.gov/ScienceTechnology/index.html#Human%20Risk%20Assessment.

-or-

Example 3 for excavation/disposal: About [#] yards of contaminated soil will remain beneath the former community hospital's concrete floor while the school district renovates the building. This decision was made because removing the soil from this location would damage the existing structure. This soil will remain in place at the completion of the project and will not pose a risk because it is (under three feet of clean soil/under a layer of concrete, and is not accessible to students, staff or faculty.

Safety & Dust Control During Cleanup

Instruction: Describe the safety and dust control measures to be taken during the cleanup action.

The following actions will be implemented during this process to ensure public safety and minimize dust:

- [List appropriate actions, e.g., installing temporary fencing with windscreens for security and dust control; driving all vehicles at slow speeds while on the property; spraying of work areas with clean water to control dust; securing trucks with covers before they leave the site; brushing truck tires entering and exiting the site to remove soils and debris; monitoring the air at the site to ensure the amount of dust stays at safe levels]

Proposed Transportation Route for [Mechanism, e.g., Trucks]

Instruction: Describe proposed means of transporting the soil and the transportation route(s).

About [#] cubic yards (or about [#] tons) of [metal]-contaminated soil will be removed and taken off-site for disposal. It will take about [#] truckloads to remove the contaminated soil from the site. Trucks leave the site going [describe the truck route]. The soil will be taken to a state licensed and approved disposal and/or treatment facility. This work is limited to the hours between [insert timeframe] [insert frequency, e.g., daily]. The cleanup process is expected to take about [#] weeks.

California Environmental Quality Act

Instruction: Identify the CEQA document prepared for the project. Indicate the findings of the CEQA evaluation.

In compliance with the California Environmental Quality Act (CEQA), DTSC has prepared a [document title, e.g., draft Notice of Exemption (NOE)] for this project. The [document title] states that the proposed cleanup will [insert site-specific determination, e.g., cleanup will not have a significant negative effect on human health and the environment because of short duration, relatively small amount of contaminated soil to be removed, and the controlled way in which the contaminated soils will be dug out, loaded onto trucks and taken away to an approved/permitted facility for lawful disposal.]

Next Steps

Instruction: Describe the steps to be taken after close of the public comment period.

At the close of the Public Comment Period, DTSC will review and consider any public comments and make any necessary revisions to the [document title] prior to final approval. Also, a Response to Comments document will be mailed to everyone who makes a comment and provides their name and address. The soil removal is expected to take place in [month and year], and should take about [duration]. After the cleanup process is completed, [name] will conduct soil testing to confirm cleanup goals have been reached and submit a [report title] to the DTSC for review and approval.

Where to Find the Documents

Instruction: Indicate how the documents can be accessed.

The [document title] and other related documents for [site name] are available for review at the following locations:

[location]
[address]
[Phone: insert number]

[location]
[address]
[Phone: insert number]

Department of Toxic Substances Control
Regional Records Office
[address]
[city], CA [zip]
Contact: [name & phone number]
Hours: 8 a.m. – 5 p.m. Monday – Friday

Site documents are also available at www.envirostor.dtsc.ca.gov [insert specific directions on how to access the site information] for your review. A computer is available in the DTSC file room for your use.

Who to Contact for Information

Instruction: Provide the contact information for DTSC staff working on the project.

If you have any questions about the project or cleanup activities, please contact:

[name]
DTSC Project Manager
[phone]
[e-mail address]

[name]
DTSC Public Participation
[Toll free phone number]
[e-mail]

Media Inquiries:
[name]
DTSC Public Information Officer
[phone number]
[e-mail address]

Notice to Hearing-Impaired Individuals

Instruction: Provide the contact information for hearing-impaired individuals.

You can obtain additional information about the site by using the California State Relay Service at 1 (888) 877-5378 (TDD). Ask them to contact [name & phone #] regarding the [name of project] project.

COMMENT FORM AND MAILING COUPON

[SITE NAME & LOCATION]

You may use this sheet to:

- **send us your comments**
- **be added to or taken off the mailing list**

If you use this form to send us your comments, please include your name and address.
All written comments must be postmarked no later than **[date]**. Please send this form to:

[name], Public Participation Specialist
Department of Toxic Substances Control
[address]
[city], CA [zip]

You may also email this same information to: [e-mail address]

___ Please take me off the mailing list
___ Please add me to the mailing list

Name: ____

Address: ____

Affiliation (if any): _________________________________

Phone number (optional) _____________________________

Comments: (If you need more space, please feel free to use another sheet of paper)

____

____

____

____

____

____

____

____

Our mailing lists are only used for keeping you informed of our activities. However, they are considered public records and, if requested, may be subject to release.

[Mailing Envelope:]

[Return address:]

[name], Public Participation Specialist
Department of Toxic Substances Control
[address]
[city], CA [zip]

Important:
Your comments sought on the cleanup plan for
[name of site]

Importante:
Se buscan sus comentarios en el plan de limpieza para
[name of site]

[Business Reply Mail Envelope:]

[name]
Department of Toxic Substances Control
Re: [site name]
[address]
[city], CA [zip]

APPENDIX F2
PUBLIC PARTICIPATION SAMPLE DOCUMENTS

TABLE OF CONTENTS

PREFACE

The sample documents included in this appendix were prepared by the DTSC Voluntary Cleanup Program (VCP) team in February 2008. The formats of the sample documents have been modified slightly to be consistent with the remainder of this PT&R guidance document. In general, the public participation documents should look similar to the samples included in this appendix.

These sample documents are for guidance only, and are applicable on a case-by-case basis. Some elements of these samples may apply to your site, and others may not. Additional elements than are addressed by these samples may also be needed.

The sample documents provide example text that is generally applicable to most sites. Locations for inserting site-specific information are indicated by brackets and underlining.

Department of Toxic Substances Control

Linda S. Adams
Secretary for
Environmental Protection

Arnold Schwarzenegger
Governor

WORK NOTICE

[name of site]
[address or location]
[city], California

Soil Removal Planned - Starting [date]

The Department of Toxic Substances Control (DTSC) will oversee the removal of [amount] of soil containing [metals] from this property. Approximately [number] truckloads will be used to remove the soil.

The following actions will be implemented during this process to ensure public safety and minimize dust:

- [List the actions that will be taken, e.g., temporary fencing with windscreens will be installed for security; all vehicles will maintain slow speeds while on the property; lightly spraying work areas with clean water to prevent dust; secure trucks with covers as they leave the site; brush truck tires to remove soil and debris when entering and exiting the site; air monitoring at the site to ensure the amount of dust stays at safe levels]

Work hours are [time] to [time].

Confirmation samples will be collected when the removal is completed to ensure that the cleanup goals are met.

Additional information can be found at: www.envirostor.dtsc.ca.gov. [Include specific information on how to access your specific site's information]

If you have any questions regarding this fieldwork please contact:

[name] **Project Manager** Department of Toxic Substances Control [phone number] [e-mail address]	**[name]** **Public Participation Specialist** Department of Toxic Substances Control [phone number], press "#", then press "#" [e-mail address]

Media inquiries: [name], DTSC Public Information Officer – [phone number]

California Environmental Protection Agency
Department of Toxic Substances Control
Region [#], [Address]

COMMUNITY PROFILE

[SITE NAME]

[City], California

[Month, Year]

Approved by:

____
[Name]
Public Participation Specialist
Department of Toxic Substances Control
[Address]
[City], CA [Zip code]

California Environmental Protection Agency
Department of Toxic Substances Control
Region [#], [Address]

COMMUNITY PROFILE

[SITE NAME]

[City], California

[Month, Year]

Prepared by:

[name]
Public Participation Specialist
Department of Toxic Substances Control
[address]
[city], California [zip code]

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 PURPOSE OF THE COMMUNITY PROFILE

This Community Profile describes the community and identifies community concerns regarding the investigation of environmental conditions of [site name], in [City], California.

1.2 DTSC OVERSIGHT RESPONSIBILITIES

As the state regulatory department, the Department of Toxic Substances Control (DTSC) is responsible for overseeing environmental reviews and cleanup actions throughout the state.

DTSC ensures that community members are informed about environmental investigations and cleanup actions and that the public has an opportunity to be involved in DTSC's decision-making process.

1.3 SOURCES OF INFORMATION FOR THE COMMUNITY PROFILE

The Community Profile is based on information from a variety of sources including:

- file reviews
- discussions with community representatives
- demographic data
- site visit
- community survey
- written information from the community

1.4 ORGANIZATION OF THE COMMUNITY PROFILE

The Community Profile contains two sections including an Introduction and the Community Background. In addition, the appendices provide supplemental information.

2.0 COMMUNITY BACKGROUND

2.1 SITE LOCATION AND DESCRIPTION

[Site name] is located at [address], [City], California. [Brief explanation of what has been found at the site.]

2.1.1 Surrounding Land Uses

[Describe surrounding land use. Include sensitive receptors existing within 1 mile of the site. Example text provided in italics.] *Land use in the surrounding area is a mixture of commercial, industrial and residential. Adjoining properties to the west consist primarily of single and multi-family residential dwellings. The remaining adjacent properties are commercial and industrial.*

2.1.2 Current Land Use

[Briefly describe the current use of the property. Describe what remains on the property.]

2.1.3 Surrounding Area Remedial Action or Cleanup Sites

[Identify and describe other cleanup sites or remedial action sites in the area.]

2.2 SITE HISTORY

[Describe the names and types of businesses that historically occupied the site. Include dates if you have them.]

2.3 COMMUNITY RESEARCH AND ASSESSMENT

[Define affected community, establish mailing lists, locate contiguous property owners, identify community concerns and evaluate level of interest.]

A Community Survey was mailed on [date] to approximately [number on site mailing list, key contacts list, DTSC mandatory mailing list] area residents, local elected officials, and community leaders to identify concerns regarding the contamination found at the [name of site] site (See Appendix [#]). Nearly [#] community members responded expressing both environmental and health concerns related to the contamination. A summary of the survey results is provided in Appendix [#] of this document.

Some community members were also contacted by telephone (or in-person) to gather additional information. Through these interviews, the following information was provided:

- [list information provided]

2.4 COMMUNITY DEMOGRAPHIC PROFILE

Table 2.1
Area Demographic Characteristics, Zip code [#]

	Number	Percent
Total Population - 2000 Census		
RACE		
White Alone		
Black or African American		
American Indian and Alaska Native		
Asian		
Native Hawaiian and Other Pacific Islander		
Some Other Race		
Two or More Races		
Hispanic or Latino (of any race)		
ECONOMIC CHARACTERISTICS		
Median Household Income		
Per Capita Income		
Median Family Household Income		
EDUCATION – Population 25 years & Older		
Less than 9th grade		
Some High School, no diploma		
High School Graduate (or GED)		
Some College, no degree		
Associate Degree		
Bachelor's Degree		
Graduate or Professional Degree		
Language – Population 5 years & Older		
Speak Only English		
Speak a Language Other than English		
Speak Spanish		
Speak English Well or Very Well		
Do not Speak English		
Other Indo-European Languages [Expand if necessary]		
Speak English Well or Very Well		
Do Not Speak English		
Asian and Pacific Island Languages [Expand if necessary]		
Speak English Well or Very Well		
Do Not Speak English		
All Other Languages [Specifically identify if necessary]		
Speak English Well or Very Well		
Do Not Speak English		

[Include additional breakdown of language groups if there is a significant number in that area.]

2.5 KEY CONTACTS LIST (INCLUDES ELECTED OFFICIALS)

2.6 INFORMATION REPOSITORIES

Documents related to the environmental investigation and proposed site cleanup action can be reviewed in Public Information Repositories that will be established at the following locations:

Department of Toxic Substances Control Regional Records Office [Address] [City], California [zip code] Contact: [name of file room tech] Phone: [phone #] Hours: Monday – Friday: 8:00 a.m. – 5:00 p.m.	Local library and/or other repository locations

Information can also be found at: www.envirostor.dtsc.ca.gov. [Insert specific directions on how to find the information regarding your site.]

2.7 DTSC CONTACT FOR PUBLIC PARTICIPATION REQUIREMENTS

[Name of PPS]
Public Participation Specialist
Department of Toxic Substances Control
[Address]
[City], California [zip code]
Phone: [phone number], press "[#]", then press "[#]"
Fax: [fax number]
[E-mail address]

2.8 RECOMMENDED PUBLIC PARTICIPATION

DTSC will ensure that the community has the opportunity to be involved in DTSC's decision-making process. All public participation activities will be conducted in accordance with the Health and Safety Code sections 25358.7 and 25356.1(e) (or appropriate section), the DTSC Public Participation Policy and Procedures Manual, and with DTSC's review and approval.

DTSC has determined that the level of community interest at this Site is moderate to high due to the information provided in this document, the majority of community interview respondents that said they have concerns regarding the environmental contamination. DTSC recommends the following public participation activities in the draft [document title] decision-making process:

- A public notice will be published in the [name of local newspaper of general distribution]. [Public notice should also be translated if appropriate and run in the local newspaper of general distribution for that language group.]

- A copy of the draft [document title], CEQA document and this document will be placed in the repositories listed in Section 2.6 prior to the first day of the public comment period.

- A Fact Sheet will be prepared to provide historical information, describe the current Site conditions and provide information on the removal action. [The Fact Sheet should be provided in English and other appropriate languages, if applicable]. It will be distributed to nearby residents, the key contacts list, and the DTSC mandatory mailing list.

- DTSC will contact local community organizations and/or elected officials identified in the Community Survey responses to set-up a briefing date. A public meeting or open house may be scheduled if DTSC cannot meet the needs of community members via the briefings.

Additional community outreach activities may be required.

Appendix A
Figures

Appendix A

Appendix B
Public Notification

COMMUNITY SURVEY RESULTS

[Site name]
[City], CA

		Yes	No	No Response		Total
Q.1	Prior to receiving this survey, were you aware of the environmental investigation being conducted at this site?					
Q.2	Do you have any concerns about the contamination at this site?					
	If so, would you like more information?					
		Fact Sheet	**Community Meeting**	**No Response**	**Both**	
Q.3	Information should be provided by:					
		Yes	**No**	**No Response**		
Q.4	Does your community have regularly scheduled meetings? (i.e. neighborhood watch, community council, etc)					
	If so, when are they scheduled?					
	Who can we contact to find out about these meetings? (name and phone number)?	Responses provided on survey				
Q.5	Who else might be interested in the proposed work at this site? (name and address)	(#) Responses				
Q.6	Any other concerns or comments about this environmental investigation?	See responses listed below chart.				

Mailing Coupon	
Requests to be added to the Mailing List:	
Requests to be deleted from the Mailing List:	
Requests for address corrections on the Mailing List:	
Address completed, no request marked:	
Request marked, no name/address provided:	
Correction requested, no information provided:	

Question #5: Additional concerns and comments received from survey respondents:

Environmental Issues:
➢

Health Concerns:
➢

Other:
➢

Appendix C
Project Schedule

Public Participation Schedule

	Phase [X]	Phase [Y]		
		Draft Workplan	Comment Period	Removal Action
Site Mailing List	■		■	
Notification Letter	■			
Community Interviews		■		
Community Profile		■		
Fact Sheet			■	
Public Notice			■	
Information Repository	■		■	

Appendix D
DTSC Mandatory Mailing List

Community Profile [Site Name]

Appendix D

Appendix E
Community Interview Contacts and Questions

Community Interview Contacts

NOTICE OF PUBLIC COMMENT PERIOD

[Document Title]

[NAME OF SITE]

[Address or location]
[City], California

PUBLIC COMMENT PERIOD: [date - date]

WHAT'S BEING PROPOSED?

The California State Department of Toxic Substances Control (DTSC) invites public comment on the draft [document title] for the [site name] in [city], California.

The draft [document title] proposes (brief description of proposed work)

During previous environmental investigations, soils contaminated with [list COCs] were detected in soil samples at levels that may pose a health risk.

There is no immediate health risk because [state why, i.e. area fenced, contamination below ground surface, etc.]; however, DTSC recommended a plan be developed to remove the contaminated soil to protect future occupants of the property.

DTSC has prepared a [CEQA document title, e.g., draft Notice of Exemption (NOE)] for this soil removal pursuant to the California Environmental Quality Act (CEQA). This project is considered [CEQA findings, e.g., exempt since it will not have a significant negative impact on the human health and the environment because of the relatively short duration and the controlled manner in which the contaminated soils will be excavated, loaded onto trucks and taken off-site for disposal/treatment.]

HOW DO I PARTICIPATE?

This notice provides the community an opportunity to learn more about the project and provide comments to DTSC about the proposed cleanup during the public comment period. Your participation is encouraged. Comments concerning the draft [document title] may be submitted in writing to [name], Public Participation Specialist, DTSC, [address], [city], CA [zip code], e-mail address: [insert e-mail address], and must be postmarked or e-mailed by **[date]**.

WHERE DO I GET MORE INFORMATION?

A copy of the draft [document title], and other project documents are available at the [name] Library, [address], and the DTSC file room at the address listed above. For more information about the DTSC, please visit our website at **www.envirostor.dtsc.ca.gov**.

CONTACT:

[Name], DTSC Public Participation Specialist [toll free number], press [#], then press [#]

[Name], DTSC Project Manager [phone number]

[Name], DTSC Public Information Officer (Media Contact) [phone number]

[Name of Site or Facility Contact] [phone number]

Department of Toxic Substances Control

Linda S. Adams
Secretary for
Environmental Protection

Maureen F. Gorsen, Director
5796 Corporate Avenue
Cypress, California 90630

Arnold Schwarzenegger
Governor

[Date] "This document is a sample for a Community Letter, and is applicable on a case-by-case basis."

Community Survey for [name of site]

Dear Community Member:

The Department of Toxic Substances Control (DTSC) encourages you to complete and return this community survey to tell us about your concerns about an environmental investigation at [name of site], a [type of facility] facility located at [address] in [city]. Your responses to this survey will help us plan future outreach activities, and keep you informed.

Environmental investigations done at this Site have found [contaminants type, e.g., metals] in the soil. [Name of contaminant(s), e.g., lead] is typically associated [describe common commercial/industrial application or site-specific application].

DTSC has requested that a work plan be developed to fully identify the extent of the contamination. The results will determine the best way to cleanup the contamination to levels protective of human health and the environment.

The contaminants do not pose an immediate threat to the community because the site is fenced, and the contamination is beneath the ground and currently not accessible. However, the contamination must be removed to prevent possible exposure in the future.

DTSC, a department within the California Environmental Protection Agency, is responsible for overseeing the investigation and ensuring that mitigation and cleanup activities are conducted in accordance with state and federal laws and regulations.

Thank you for taking the time to fill out and return this community survey. **Please return the survey by (date).** If you have any questions about the environmental investigation or the attached survey, please call me at [toll free phone number], press "[#]", then press "[#]" (toll free), or e-mail me at [insert e-mail address].

Sincerely,

[Name]
Public Participation Specialist

Enclosed – Community Survey

[NAME OF SITE]
[DOCUMENT TITLE]
COMMUNITY SURVEY

Please return to [name], Public Participation Specialist, DTSC
[PPS office address], [city], CA [zip code] or [e-mail address]
*by **[date]***

"This document is a sample for a Community Survey, and is applicable on a case-by-case basis."

Prior to receiving this survey, were you aware of the environmental investigation being conducted at this site? __ Yes __ No

Do you have any concerns about the contamination at this site? __ Yes __ No

If so, would you like more information? __ Yes __ No

Information should be provided by:
__ Mailing a Fact Sheet
__ Community Meeting/Open House
__ Both - Fact Sheet & Meeting

Does your community have regularly scheduled meetings? (i.e. neighborhood watch, community council, etc.) __ Yes __ No

If so, when are they scheduled?____
Who can we contact to find out about these meetings (name and phone number)?

____

Who else might be interested in the proposed work at this site? (Name & address)

____

Any other concerns or comments about the environmental investigation at this site?

____

____

____

____

What languages other than English are spoken in your community?

____

If you did not receive this survey in the mail and would like to be placed on the mailing list for this site, please complete the mailing coupon on the reverse side of this form.

We occasionally contact community members by telephone to clarify information and conduct personal interviews. If you are interested in being contacted, please provide your name and telephone number: ____

MAILING COUPON

Please complete this mailing coupon if you would like to:

___ Add my name to the mailing list
___ Delete my name from the mailing list
___ Correct my address

Name:____

Affiliation (if any): ___________________________________

Mailing Address: ____________________________________

City: _________________ State: ______ Zip Code: ___________

Please note DTSC mailing lists are public records and may be released if requested.