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Addendum To Revised Feasibility Study Report

Former Kast Property
Carson, California

Prepared by:

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Geosyntec consultants

ADDENDUM TO REVISED FEASIBILITY STUDY REPORT

Former Kast Property
Carson, California

Prepared for:
Shell Oil Products US
Prepared by:
Geosyntec Consultants, Inc.

CERTIFICATION

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REVISED FEASIBILITY STUDY REPORT
FORMER KAST PROPERTY
CARSON, CALIFORNIA

I am the Project Manager for Equilon Enterprises LLC, doing business as Shell Oil Products US, for this project. I am informed and believe that the matters stated in this Addendum to the Revised Feasibility Study Report for the Former Kast Property located in Carson, California are true, and on that ground I declare, under penalty of perjury in accordance with Water Code section 13267, that the statements contained therein are true and correct.

_____

Doug Weimer
Principal Project Manager
Shell Oil Products US
October 15, 2014

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LIST OF ACRONYMS AND ABBREVIATIONS

bgs	Below ground surface
CAO	Cleanup and Abatement Order
City	City of Carson
CLSM	Controlled Low Strength Material
COCs	Constituents of Concern
cy	Cubic yard
FS	Feasibility Study
ft	Foot or feet
g	Grams
Geosyntec	Geosyntec Consultants, Inc.
HHRA	Human Health Risk Assessment
L	Liter
LA	Los Angeles
lb	Pound
LNAPL	Light Non-Aqueous Phase Liquid
m	Meter
mg/kg	Milligrams per kilogram
MNA	Monitored natural attenuation
msl	Mean sea level
NAPL	Non-aqueous phase liquid
pcf	Pounds per cubic foot
psi	Pounds per square inch
RAOs	Remedial action objectives
RAP	Remedial Action Plan
Regional Board	Los Angeles Regional Water Quality Control Board
ROI	Radius of influence
ROVI	Radius of vacuum influence
RWQCB	Los Angeles Regional Water Quality Control Board
Shell	Shell Oil Products United States
Site	Former Kast Property, Carson, California
SOPUS	Shell Oil Products United States
SSD	Sub-slab depressurization
SVE	Soil vapor extraction
TPH	Total petroleum hydrocarbons
URS	URS Corporation
µg/kg	Micrograms per kilogram

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

µg/L	Micrograms per liter
µg/m^3	Micrograms per cubic meter
%	Percent

1. INTRODUCTION

1.1 Regulatory Basis

Geosyntec Consultants, Inc. (Geosyntec), with support from URS Corporation (URS), prepared this Addendum to the Revised Feasibility Study Report (Addendum) dated October 15, 2014 for the former Kast Property (Site) in Carson, California, on behalf of Equilon Enterprises LLC, doing business as Shell Oil Products US (Shell or SOPUS). This Addendum is being submitted in response to Cleanup and Abatement Order No. R4-2011-0046 issued by the California Regional Water Quality Control Board, Los Angeles Region (RWQCB or Regional Board) on March 11, 2011, as modified by RWQCB correspondence, directing Shell to submit a Remedial Action Plan (RAP) and Human Health Risk Assessment (HHRA) pursuant to California Water Code Section 13304.

On behalf of SOPUS, URS and Geosyntec submitted a RAP and companion Feasibility Study (FS), and HHRA on March 10, 2014 (URS and Geosyntec, 2014a; Geosyntec, 2014b, and 2014a). The RWQCB reviewed and commented on the March 10, 2014 RAP, FS, and HHRA (LARWQCB, 2014c, and 2014d; UCLA Expert Panel, 2014b) and directed Shell to submit a Revised RAP, Revised FS, and Revised HHRA, which were submitted to the Regional Board on June 30, 2014. While Shell believes these documents, as well as the RAP, FS, and HHRA originally submitted on March 10, 2014, proposed a remedial approach that addressed the environmental conditions in the Carousel neighborhood and was protective of human health given residential land use, comments and questions were raised by Regional Board staff during a July 30, 2014 meeting and in subsequent meetings and conference calls.

Shell and its consultants have prepared this Addendum and the companion addenda to the Revised RAP (URS and Geosyntec, 2014c) and Revised HHRA (Geosyntec, 2014e) to address the comments and questions and provide clarification to certain aspects of the selected remedy that were requested by the Regional Board's technical staff. The addenda to the Revised RAP and Revised HHRA are being submitted concurrently as separate documents.

1.2 Addendum Objectives

The objective of this Addendum is to address the Regional Board's comments and questions specifically related to the Revised FS (Geosyntec, 2014d) and provide clarification to certain aspects of the preferred remedy. The following table summarizes the comments and questions raised by the Regional Board that are being addressed in the Addenda to the Revised HHRA, Revised FS, and Revised RAP. The "X's" in each

column indicate in which Addendum each comment or question is addressed. Only the comments with an "X" in the Addendum to the Revised FS columna are addressed in this Addendum.

Regional Board Comment/Question	Addressed in Addendum to Revised -		
	HHRA	FS	RAP
Update arsenic background assessment	X		X
Update Revised HHRA with data that are now available after preparation of the June 30, 2014 Revised HHRA	X		
Update properties identified for remedial action in Revised FS and Revised RAP based on updated HHRA analysis		X	X
Discuss approach to address properties where access to collect data has not yet been granted		X	X
Additional evaluation for targeted deeper excavation		X	X
Update related/derivative metrics in Revised FS and Revised RAP figures and tables		X	X
Add flexibility of work phases to decrease overall implementation duration			X
Provide additional information regarding the use of controlled low-strength materials (CLSM; i.e., slurry fill)		X	X
Provide additional information to support proposed SVE/bioventing design		X	X
Provide a contingency to for additional excavation if mobile LNAPL is encountered at limits of excavation identified in the RAP			X

1.3 Addendum Approach

The Regional Board's comments and questions specifically related to the Revised FS are addressed in Section 2 of this Addendum. Many of the responses to comments are aimed at providing clarification to certain aspects and/or further details of the preferred remedy and/or its implementation and therefore do not change the preferred remedy (Alternative 4D). Some of the responses to comments have resulted in an increase to the number of properties selected for excavation and SVE/bioventing under various remedial alternatives compared to the numbers identified in the Revised FS (Geosyntec, 2014d) and the Revised RAP (URS and Geosyntec, 2014b) (see Section 1.4 below). These have, in turn, resulted in changes to related/derivative metrics (e.g., excavation volumes, costs, contaminant mass removed, remediation durations, truck trips, etc.). The approach taken in this Addendum to the Revised FS is to provide replacement tables and figures that contain the updated property addresses and related/derivative metrics. Where these property addresses and metrics occur in the text of the Revised FS (Geosyntec, 2014d) they are hereby revised by reference to the updated property addresses and metrics in the replacement tables (attached to this Addendum).

It is important to stress that while the number of properties identified for remedial action and related/derivative metrics has changed, the effect of these changes is relatively minor, and they ***do not*** affect the analyses presented in the Revised FS (i.e., the detailed and comparative evaluations of remedial alternatives), which led to the selection of the preferred remedy (Alternative 4D). For the reasons stated in the Revised FS, ***Alternative 4D remains the preferred remedy.***

1.4 Summary of Changes To Number of Affected Properties From the Revised FS to the Addendum

The following table summarizes changes in the numbers of properties selected for various remedial technologies/alternatives that have occurred in response to the comments and questions raised by the Regional Board.

Description	Revised FS Report	Addendum
# properties for exc. from 0-2 ft bgs (Alt. 4A & 5A)	202	207-219*
# properties for exc. from 0-3 ft bgs (Alt. 4B & 5B)	202	207-219*
# properties for exc. from 0-5 ft bgs (Alt. 4C, 4D, 5C, & 5D)	202	207-219*
# properties w/ targeted exc. from 5-10 ft bgs (Alt. 4D & 5D)	82	85-97*
# properties w/ targeted exc. in front yard only	20	23-24*
# properties w/ targeted exc. in back yard only	29	24
# properties w/ targeted exc. in both yards	33	38-49*
# yards excavated	115	123-146*
# properties for exc. from 0-10 ft bgs (Alt. 4E & 5E)	224	229-241*
# properties w/ SVE/bioventing	221	224-236*

* Ranges are due to addition of 12 properties (23 yards) for which no environmental characterization data have been collected as of September 9, 2014. For purposes of the Environmental Impact Report (EIR) being prepared in accordance with the California Environmental Quality Act (CEQA), it has been assumed that these 12 properties will be excavated to 10 feet bgs. Whether excavation is needed at these 12 properties, and the scope of any such work, would be established based on analysis of sampling data obtained when access is obtained.

These changes have resulted in changes to related/derivative metrics which are included in the replacement tables and figures provided in this Addendum. The remainder of this Addendum addresses the comments and questions raised by the Regional Board.

2. DISCUSSION OF ISSUES FOR CLARIFICATION AND FS REVISIONS

Each of the following sections address the Regional Board's comments and questions specifically related to the Revised FS (Geosyntec, 2014d) as listed in the table in Section 1.2 above and/or provide clarification to certain aspects of the preferred remedy.

2.1 Update Properties Identified For Remedial Action Based on Updated HHRA Analysis

Responses to Regional Board comments on the Revised HHRA (i.e., the first two comments in the table in Section 1.2 of this Addendum) resulted in re-evaluation of arsenic and inclusion of new data collected after preparation of the Revised HHRA (Geosyntec, 2014c). For details, please see the Addendum to the Revised HHRA (Geosyntec, 2014e). As a result, the number of properties identified for excavation from 0-5 feet bgs under the preferred Remedial Alternative (4D) increased from 202 to 207. The property addresses selected for excavation from 0-5 feet bgs are identified in replacement **Table 3-3** and shown on replacement **Figure 3-1**. Also included are replacement **Figures 3-2** and **3-4** from the Revised FS updated to include data collected since preparation of the Revised HHRA. These changes to the number of properties identified for excavation are relatively minor, and they ***do not*** affect the analyses presented in the Revised FS (i.e., the detailed and comparative evaluations of remedial alternatives), which led to the selection of the preferred remedy (Alternative 4D). For the reasons stated in the Revised FS, Alternative 4D remains the preferred remedy.

2.2 Approach to Address Properties Where Access to Collect Data Has Not Yet Been Granted

The Regional Board asked Shell to clarify that there is flexibility in the number of properties identified for remdial action under the preferred Remedial Alternative (4D) to address properties with limited or no data available, and to list those properties. The text in this section augments the text in Section 3.3 of the Revised FS (Geosyntec, 2014d). There remain 12 properties with no soil matrix data as of September 9, 2014. Evaluations will be conducted when access is obtained, sampling is conducted, and data are evaluated to assess whether remedial action objectives (RAOs) are met under existing conditions based on unrestricted land use. If the RAOs are not met, these properties will receive the same remedial approach as appropriate, based on property-specific conditions, as other properties identified for remediation. Per Regional Board direction, for purposes of evaluating potential environmental impacts associated with RAP implementation, the Environmental Impact Report (EIR) being prepared in accordance with the California Environmental Quality Act (CEQA) assumes that all 12

properties will be excavated to a depth of 10 feet bgs in front and back yards, where possible, and to 5 feet bgs only in side yards. Therefore, the number of properties identified for excavation from 0-5 feet bgs has increased by another 12 properties (from 207 to 219). Properties identified for excavation from 0-5 feet bgs are summarized in replacement **Table 3-3** and shown on replacement **Figure 3-1**. The actual need for remedial action at these properties will be evaluated when access becomes available, soil sampling is conducted, and data are obtained. These changes to the number of properties identified for excavation are relatively minor, and they ***do not*** affect the analyses presented in the Revised FS (i.e., the detailed and comparative evaluations of remedial alternatives), which led to the selection of the preferred remedy (Alternative 4D). For the reasons stated in the Revised FS, Alternative 4D remains the preferred remedy.

2.3 Additional Evaluation For Targeted Deeper Excavation

The Regional Board has asked Shell to perform additional evaluation of properties for targeted mass removal excavation from 5-10 feet bgs to make clear that no precedent is intended for other sites and that other considerations including cost/benefit analysis of mass removal were assessed when determining the location of targeterd deeper excavation, adding a discussion of individual sample evaluation to address sensitivity of krigged data, adding an explanation of why it's not cost effective to excavate for targeted mass removal at properties where excavation is not required in the 0-5 feet bgs range based on human health risk and leaching-to-groundwater cleanup criteria, and to revise the number of properties proposed for targeted excavation. The text in this section replaces text from Section 5.2.1 of the Revised FS (Geosyntec, 2014d).

An alternative that evaluates local targeted excavation between 5 and 10 feet bgs was included in the Revised FS and in the Revised RAP (Alternative 4D). Targeted excavation areas were identified where, based on distribution of hydrocarbon impacts in the 5 and 10-foot bgs interval, the potential exists for substantial hydrocarbon mass removal via deeper excavation. The assessment of areas for targeted excavation also considers the technical feasibility and cost effectiveness of the mass removal.

Properties for targeted deeper excavation under Alternative 4D were previously identified by reviewing the distribution of TPH in soil in the 5 to 10-foot bgs interval and by considering a cost-benefit analysis of the proposed targeted excavation. The contoured and point by point distribution of the TPH fractions (as depicted on Figures 3-3 through 3-5, 3-9 through 3-11, and 6-3 of the Revised RAP) were reviewed to identify areas of elevated TPH concentrations, including areas with TPH above residual concentrations. At the request of Regional Board staff, and in an effort to address the

uncertainty in contouring, the TPH distribution was additionally evaluated by examining different spatial distribution mapping methods: point-by-point maps, two-dimensional contour maps, and three-dimensional contours.

Factors that affect the cost and feasibility of conducting excavations between 5 and 10 feet bgs were considered in identifying properties for targeted deeper excavation under Alternative 4D:

- Targeted deeper excavation is not proposed for properties that are not identified for excavation in the 0 to 5-foot bgs interval. The added cost and time to excavate the 0 to 5-foot bgs interval for the sole purpose of hydrocarbon mass removal in the 5 to 10-foot bgs interval will have a dramatic effect on the practicability of targeted deeper excavations under these circumstances.

- Targeted deeper excavation is not proposed for yards where a swimming pool is present. If a swimming pool is present in a yard, then excavation for a large portion of the yard has already taken place and given the technical difficulties of excavating around a swimming pool and the potential damage to swimming pools and its appurtenant equipment, targeted deeper excavation in these areas is not considered practicable.

- Targeted deeper excavation is not proposed for yards where a limited mass is expected to be removed. For example yards with one or two samples with elevated TPH concentrations at depth or where the contours of elevated TPH concentrations cover a small portion of the yard are not identified for targeted deeper excavation.

Excavation to 5 feet bgs for properties exceeding human health criteria or soil SSCGs for leaching to groundwater criteria is estimated to result in 520,000 pounds of hydrocarbon mass removal. The proposed targeted deeper excavation (Alternative 4D) is estimated to result in an additional 1,260,000 pounds of hydrocarbon mass removal, for a total of 1,780,000 pounds of hydrocarbon mass removed under this proposed remedy. For comparison, excavation to 10 feet bgs for properties exceeding human health criteria or soil SSCGs for leaching to groundwater criteria (Alternative 4E) is estimated to result in approximately 2,180,000 pounds of hydrocarbon mass removal, of which 1,660,000 is in the 5 to 10-foot bgs interval. Consequently, the targeted deeper excavation (Alternative 4D) is estimated to remove approximately 76% of the TPH mass that could potentially be excavated in the 5 to 10 feet bgs interval at all properties where leaching to groundwater SSCGs were exceeded (Alternative 4E). It should be noted that these mass estimates are for the excavation portion of the recommended

remedy. Significant further mass removal will occur through SVE/bioventing which will be implemented Site-wide upon completion of the excavation program.

A cost-benefit analysis of this proposed targeted deeper excavation (Alterntiave 4D) was conducted by comparing the TPH mass that would be removed under the different excavation scenarios evaluated to the cost for removal (similar to the incremental cost per pound of TPH removed presented in the Revised FS). This cost-benefit analysis is summarized in Addendum **Figure 6-1**.

This figure shows a substantial increase in the estimated incremental cost for TPH mass removal (i.e., the slope of the curve) for additional excavation beyond what is proposed for the targeted deeper excavation. There is likewise a declining benefit of mass removal for additional excavation of TPH-impacted soil in the 5 to 10-foot bgs interval beyond what is proposed for the targeted deeper excavation. Based on this cost-benefit analysis, the proposed remedy of targeted deeper excavations followed by SVE/bioventing (Alternative 4D) is the most efficient pathway for reduction of TPH and related compounds at the Site.

Based on the additional data evaluation for targeted mass removal from 5-10 feet bgs (Alternative 4D), an additional eight front yards were identified for deeper excavation; five of these are at properties where the back yard was previously identified for deeper excavation, and three are at additional properties not previously identified. Therefore, the number of properties and yards identified for targeted deeper excavation from 5-10 ft bgs has increased from 82 to 85 and from 115 to 123, respectively. The additional 12 properties with no soil matrix data increases the number of properties and yards identified for targeted deeper excavation by 12 and 23, respectively (from 85 to 97 and from 123 to 146). The actual need for remedial action at these properties will be evaluated when access becomes available, soil sampling is conducted, and data are obtained. Properties identified for targeted deeper excavation from 5-10 feet bgs are summarized in replacement **Table 3-3** and shown on replacement **Figure 3-3**. Some properties were identified for excavation of both front and back yards, while others were identified for excavation of only the front or back yard.

These changes to the number of properties identified for targeted deeper excavation are relatively minor, and they ***do not*** affect the analyses presented in the Revised FS (i.e., the detailed and comparative evaluations of remedial alternatives), which led to the selection of the preferred remedy (Alternative 4D). For the reasons stated in the Revised FS, Alternative 4D remains the preferred remedy.

2.4 Update Related/Derivative Metrics In Revised FS Figures and Tables

The Regional Board asked Shell to revise related/derivative metrics in tables and figures. In response, the text in this section is provided to augment the text throughout the Revised FS (Geosyntec, 2014d) referencing these metrics.

The increase in number of properties selected for excavation has resulted in changes to related/derivative metrics including excavation volumes, costs, contaminant mass removed, remediation durations, truck trips, etc., for each remedial alternative. The revised metrics are included in replacement tables to this Addendum (**Tables 3-3**, **5-1**, **5-3**, **6-1**, **6-4** through **6-13**, **7-1**, and Appendix **Tables A-1.2** and **A-2**). For a discussion of updated soil excavation volume estimates related to the preferred Remedial Alternative (4D) see the Addendum to the Revised RAP (URS and Geosyntec , 2014c).

These changes to the related/derivative metrics including excavation volumes, costs, contaminant mass removed, remediation durations, truck trips, etc., for each remedial alternative are relatively minor, distributed across remedial alternatives 4A through 5E, and they ***do not*** significantly affect the analyses presented in the Revised FS (i.e., the detailed and comparative evaluations of remedial alternatives), which led to the selection of the preferred remedy (Alternative 4D). For the reasons stated in the Revised FS, Alternative 4D remains the preferred remedy.

2.5 Use of Controlled Low-Strength Materials (Sand/Cement Slurry) Fill Materials

The Regional Board asked Shell to provide clarification on the use of controlled low-strenght materials (CLSM) or slurry fill. In response, the text in this section is provided to augment the text throughout the Revised FS (Geosyntec, 2014d) referencing the use of slurry fill.

Placement of cement-sand slurry (slurry), more properly referred to as controlled low-strength material (CLSM), in the lower part of slot-trench and auger excavations is a safe and necessary component of the excavation portion of the preferred Remedial Alternative. CLSM is a self-compacting, flowable fill material used primarily as backfill in lieu of compacted or granular backfill. CLSM is pumpable using a standard concrete pumper, flows easily, and is self-leveling. Its consistency is like that of a slurry or lean grout (comparable to that of a milk shake), yet several hours after placement the material is hard enough to support traffic loads without settling.

2.5.1 CLSM – General Properties and Uses

CLSM is not concrete or soil cement. It is a fluid mixture made of Portland cement, water, and fine aggregate or fly ash. It contains the same components as concrete, but in different proportions. By using a lower proportion of cement than used for concrete, CLSM has in-place properties following curing similar to compacted fill soils (ACI, 1999). The American Concrete Institute (ACI) defines CLSM as having a compressive strength less than 1,200 pounds per square inch (psi); however, most current CLSM applications require unconfined compressive strengths of less than 300 psi to allow for possible future excavation (ACI, 1999). CLSM with an unconfined compressive strength of less than 150 psi is considered excavatable by hand tools (National Ready Mixed Concrete Association (NRMCA) *Guide Specification for Controlled Low Strength Materials (CLSM)*, undated).

Because excavatable CLSM has physical properties similar to compacted soils, there is no reason to believe that tree and shrub roots would not penetrate the cured fill materials. The density of typical CLSM ranges from 115 to 145 pounds per cubic foot (pcf) (Smith, 1991), which is consistent with the density of Site soils of 125 pcf established by geotechnical materials testing of Site soils to support the Excavation Pilot Tests.

The CLSM fill materials will be designed to achieve permeability generally comparable to that of the surrounding soil so as not to cause short circuiting or reduced radius of vacuum influence during SVE/bioventing operation. CLSM may be designed to be as permeable as a uniform coarse sand with a hydraulic conductivity of 4.0×10^{-1} centimeters per second (cm/sec) or as impermeable as clay with a hydraulic conductivity of 1.0×10^{-7} cm/sec. Permeability of most excavatable CLSM is in the range of 10^{-4} to 10^{-5} cm/sec (ACI, 1999). It is often desirable to have the permeability of backfill material equal to or greater than the surrounding soil, and the NRMCA (undated) recommends designing CLSM mixtures to have a hydraulic conductivity coefficient equal to that of fine sand (4.0×10^{-4} cm/sec).

CLSM is ordinarily slightly alkaline and its resistivity increases as the material hardens and the cement continues to hydrate, so that within a few days, CLSM usually has an electrical resistivity that is sufficient to alleviate most corrosivity concerns (Federal Highway Administration, 1997).

CLSM is used widely in the construction industry as a structural fill or backfill material in place of compacted soil around structures, particularly in confined or limited spaces. Conventional compacted soil backfill in trenches and around small structures involves placement of soil fill material in thin layers and mechanical compaction followed by

compaction density testing. Because CLSM flows and needs no compacting, it is ideal for use in tight or restricted-access areas where placing and compacting soil or granular fill is difficult or impossible. Also, because CLSM is self-compacting, it eliminates the need for mechanical compaction and associated safety hazards for workers.

Further advantages of using CLSM over compacted soil and granular fill include (modified from University of Florida, 2004):

- CLSM has a fast setup time, providing support for construction equipment the following day.
- It sets up with sufficient strength that it stabilizes trenches and prevents future trench settlement.
- The additional costs for CLSM compared to compacted soil backfill are offset by the elimination of soil compaction and testing labor, reducing the required equipment, manpower and inspection requirements.
- CLSM does not form voids and is less prone to settlement than compacted soil.
- CLSM mix designs can be varied to achieve desired density and permeability.
- It can be used to fill deeper excavations that would otherwise require shoring to allow personnel entry to conduct soil compaction and testing, thereby reducing safety hazards to workers.

The use of CLSM/slurry is common in the construction industry and has been approved by the City of Carson (City) for use at other locations below streets and sidewalks in the City. Also, the Los Angeles County Department of Public Works, Geotechnical and Materials Engineering Division allows the use of CLSM as engineered fill or as trench backfill material, and the City of Los Angeles Building Code (LABC) allows the use of CLSM for the backfill of excavations.

For further discussion regarding the use of CLSM in the preferred Remedial Alternative (4D) see the Addendum to the Revised RAP (URS and Geosyntec , 2014c). The clarifications on the use of CLSM in the preceding sections ***do not*** affect the analyses presented in the Revised FS (i.e., the detailed and comparative evaluations of remedial alternatives), which led to the selection of the preferred remedy (Alternative 4D). For the reasons stated in the Revised FS, Alternative 4D remains the preferred remedy.

2.6 Additional Information to Support Proposed SVE/Bioventing Design

The Regional Board asked Shell to provide clarification of the SVE/bioventing design, including providing justification for not using horizontal wells and including a literature

search for radius of influence (ROI) in silty sands and calculated permeabilities to address concerns that ROI is insufficient for degradation under homes. In response, the text in this section is provided to augment the text included in Section 5.3.3 of the Revised FS (Geosyntec, 2014d).

2.6.1 SVE/Bioventing Approach

Cyclical operation of a combined SVE and bioventing system is the selected remedial technology to address petroleum hydrocarbons, VOCs, and methane in soil vapor and to promote degradation of residual hydrocarbon concentrations in soils that do not meet RAOs and are not removed by excavation. Use of SVE/bioventing will address impacted areas beneath existing paved areas, City sidewalks, and concrete foundations of the homes, in addition to addressing reduction of constituent of concern (COC) concentrations in excavated areas below 5 or 10 feet bgs and areas not targeted for deeper excavation for mass removal, with the ultimate goal of achieving RAOs over time. Operation of the SVE/bioventing system will also address impacted soils that may be associated with residual concrete reservoir slabs left in place below the depth of excavation.

The SVE system will be operated in a cyclical manner, with active extraction occurring in different portions of the Site at different times. The SVE/bioventing system(s) will be operated cyclically (pulsed) to extract impacted soil vapor and introduce oxygen to the subsurface to stimulate degradation of the heavier fraction of diesel-range hydrocarbons and motor oil-range hydrocarbons in a bioventing operational mode. During periods of active vapor extraction from a sub-set of wells ("on cycle"), the SVE system will not only remove hydrocarbon vapors, but will also draw oxygen into the subsurface to enhance the biodegradation of residual petroleum hydrocarbons in soil. During periods when no extraction is occurring for the set of wells ("off cycle"), remediation will be achieved through biodegradation alone (i.e., bioventing). The system will be designed to use the same infrastructure (i.e., extraction wells) for both SVE and bioventing, and the cyclical operating conditions will be used to implement both remedial actions. The SVE/bioventing system will be operated in manner to achieve the soil oxygen demand estimated from the bioventing pilot tests (Geosyntec, 2012b).

The SVE pilot test examined vertical extraction wells and the bioventing pilot test examined both vertical and horizontal extraction wells. Although horizontal and vertical extraction wells were both effective in treating soils through bioventing during pilot testing, the physical and operational limitations of using horizontal wells make vertical extraction wells the preferred option for the proposed remedy. Vertical

extraction wells will be used for implementation of the SVE/bioventing system for the Site based on the following rationale:

- The lateral radii of influence for horizontal and vertical wells are similar. The estimated radius of influence for the horizontal wells during the bioventing pilot test ranged from 6 to 20 feet while the radius of influence for the vertical wells during the bioventing pilot test ranged from <5 to 15 feet.

- The vertical wells will provide better remediation for impacted soils deeper than 5 feet bgs. The horizontal wells were installed at a depth of 5 feet bgs during the bioventing pilot test. With this placement, the effect of the horizontal wells on soils within the 5 to 10-foot depth interval is likely limited due to short-circuiting via the granular soil backfill that will be placed following excavation to 5 feet bgs. The vertical SVE/bioventing wells with screened interval from 5 to 10 feet bgs within the soils targeted for remediation will have a greater impact on this zone.

- The vertical wells can be placed closer to the buildings and consequently provide greater reduction of COCs in soils beneath the homes. Based on the proposed excavation approach, it will be logistically impractical to place horizontal SVE wells within a few feet of the building foundation. Because the vertical wells will be installed with hand tools, the vertical wells can be located much closer to the building foundation.

2.6.2 SVE/Bioventing Conceptual Design

SVE/bioventing will be implemented throughout the Site to remediate volatile petroleum hydrocarbons (i.e., gasoline-range petroleum hydrocarbons and the lighter fractions of the diesel range petroleum hydrocarbons), VOCs, and methane, and induce increased airflow to promote microbial degradation of longer-chain hydrocarbons (diesel and motor oil-range petroleum hydrocarbons). The SVE/bioventing infrastructure will consist of a system of extraction wells, belowground conveyance piping, aboveground manifold and treatment compound(s), vapor treatment system(s), and various system controls and instrumentation. SVE will be applied in the shallow zone from approximately 5 to 10 feet bgs, intermediate zone from approximately 15 to 25 feet bgs, and deep zone from approximately 30 to 40 feet bgs and locally deeper depending on depths of soil impact and depth to groundwater. Nested shallow, intermediate, and deep zone wells will be installed in the streets of the Site, which provide ready access for installation. Shallow zone wells will also be installed within the front and back yards of select residences. In general, two wells will be installed on

each residential property identified for SVE/bioventing; however, locations and actual numbers of these shallow-zone wells in the front and back yards will be designed during preparation of PSRPs for individual properties and will be based on locations where RAOs are not met in the 0 to 10-foot bgs depth interval and to achieve SVE/bioventing coverage beneath houses. Well and piping components for SVE/bioventing wells installed on residential properties will be entirely below grade. These shallow wells will be screened from 5 to 10 feet bgs and will be connected to the SVE system via conveyance piping, which will be installed in the streets.

Based on the SVE pilot test radius of vacuum influence (ROVI) results for the intermediate zone, a total of 63 nested well clusters (shallow, intermediate, and deep zone) will be installed in the streets with an average spacing of approximately 125 feet. Based on the estimated ROVI of 50 feet for the shallow zone from the SVE pilot test, an additional 65 shallow zone wells will be installed between the nested wells in the streets of the Site to provide increased vapor extraction coverage within the shallow zone. Additionally, shallow zone wells will be installed in the front and back yards of residences requiring remediation of the shallow zone soil by SVE/bioventing. Due to potential short-circuiting from surface landscaping, the shallow zone ROVI for the residential wells has conservatively been reduced to 25 feet.

The ROVI for the SVE/bioventing system is based on the results of the SVE pilot test rather than the bioventing pilot test, because the blower planned for vapor extraction of the combined system is a robust unit with large capacity and vacuum and a system to treat extracted vapors (see Section 8.2.2 of the Revised RAP). The estimated radius of influence reported for the bioventing pilot test (Geosyntec, 2012b) assumed small fans would be used to minimize the concentrations of extracted vapors. The radii of influence estimated from the bioventing pilot test are not applicable for the proposed SVE/bioventing system. Data from the SVE pilot test indicates the expected ROVI for shallow wells will range from 25 to 78 ft. This is consistent with the pilot test results reported for the Turco facility adjacent to the former Kast property, wherein they established a shallow zone ROVI of approximately 26 to 32 feet (ERM-West, 2008). Additionally, the concurrent application of SVE at greater depths in the areas where shallow SVE is proposed will enhance the potential ROVI due to superposition of vacuum influence of the different wells.

As shown in replacement **Table 3-3**, a total of 224 residences are identified for SVE/bioventing remediation. A total of 229 properties are identified in replacement **Table 3-3** as exceeding either human health risk or leaching to groundwater criteria in the ≤5 foot or >5 to 10 foot depth interval. Five of these properties were identified

based on metals concentrations alone, reducing the number of properties for SVE/bioventing to 224.

Following approval of the RAP, a RDIP providing the well field layout, SVE system(s) location(s) and specifications, and conveyance piping layout will be submitted for RWQCB approval.

2.6.3 SVE/Bioventing Equipment

Based on the estimated quantity of extraction wells (63 nested street wells, 65 shallow zone street wells, and approximately 474 shallow zone residential wells), it is impractical to construct an SVE system to extract simultaneously from all of the proposed wells. As a result, a system or systems rated for a combined 3,000 standard cubic feet per minute (scfm) at up to 12 inches of mercury (in-Hg) vacuum is planned.

Shell is currently evaluating offsite locations for the installation of the remediation equipment. Potential offsite SVE system locations are being evaluated in terms of technological feasibility, accessibility and availability of the locations. These potential SVE locations are shown on Figure 8-8 of the Revised RAP.

The clarifications of the SVE/bioventing design in the preceding sections ***do not*** affect the analyses presented in the Revised FS (i.e., the detailed and comparative evaluations of remedial alternatives), which led to the selection of the preferred remedy (Alternative 4D). For the reasons stated in the Revised FS, Alternative 4D remains the preferred remedy.

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Geosyntec
consultants

REPLACEMENT TABLES

Geosyntec consultants

Table 3-3
Property Addresses For Consideration in Remedial Planning

Address	Shallow Excavation		SVE/Bioventing	Targeted Excavation for >5 to ≤10 ft bgs depth interval			Sub-Slab Soil Vapor Mitigation
	Exceeds HH Criteria or Leaching to GW SSCGs < 5 ft bgs	Exceeds HH Criteria or Leaching to GW SSCGs >5 to <10 ft bgs	Exceeds in either ≤ 5ft or >5 to ≤10 ft bgs depth interval	Front Yard	Back Yard	Both Yards	Identified in HHRA based on > 1 E-6 Risk Level
24401 MARBELLA AVE							
24402 NEPTUNE AVE	X	X	X		X		
24402 PANAMA AVE	X		X				
24402 RAVENNA AVE	X	X	X		X		
24403 NEPTUNE AVE	X	X	X	X	X	X	
24403 RAVENNA AVE		X	X				
24405 MARBELLA AVE							
24406 MARBELLA AVE	X	X	X		X		
24406 NEPTUNE AVE		X	X				X
24406 PANAMA AVE	X		X				
24406 RAVENNA AVE	X	X	X				
24409 NEPTUNE AVE	X	X	X	X	X	X	
24409 RAVENNA AVE		X	X				
24410 PANAMA AVE							
24411 MARBELLA AVE	X		X				
24411 PANAMA AVE	X	X	X		X		
24412 MARBELLA AVE	X	X	X	X	X	X	X
24412 NEPTUNE AVE							
24412 RAVENNA AVE	X	X	X				
24413 NEPTUNE AVE	X	X	X	X	X	X	
24413 RAVENNA AVE		X	X				
24416 MARBELLA AVE	X	X	X	X	X	X	
24416 NEPTUNE AVE	X		X				
24416 PANAMA AVE							
24416 RAVENNA AVE	X	X	X				X
24417 MARBELLA AVE	a	a	a				
24417 PANAMA AVE		X	X				
24419 NEPTUNE AVE	X	X	X	X	X	X	
24419 RAVENNA AVE		X	X				
24420 PANAMA AVE	X		X				
24421 PANAMA AVE	X	X	X	X			
24422 MARBELLA AVE	X	X	X				
24422 NEPTUNE AVE		X	X				
24422 RAVENNA AVE	X	X	X				
24423 MARBELLA AVE	a	a	a				
24423 NEPTUNE AVE	X	X	X	X	X	X	X
24423 RAVENNA AVE	X	X	X				
24426 MARBELLA AVE	X	X	X	X	X	X	
24426 NEPTUNE AVE		X	X				
24426 PANAMA AVE	X		X				
24426 RAVENNA AVE	X		X		X		
24427 MARBELLA AVE							
24427 PANAMA AVE		X	X				
24429 NEPTUNE AVE	X	X	X	X	X	X	X

Table 3-3
Property Addresses For Consideration in Remedial Planning

Address	Shallow Excavation		SVE/Bioventing	Targeted Excavation for >5 to ≤10 ft bgs depth interval			Sub-Slab Soil Vapor Mitigation
	Exceeds HH Criteria or Leaching to GW SSCGs < 5 ft bgs	Exceeds HH Criteria or Leaching to GW SSCGs >5 to <10 ft bgs	Exceeds in either ≤ 5ft or >5 to ≤10 ft bgs depth interval	Front Yard	Back Yard	Both Yards	Identified in HHRA based on > 1 E-6 Risk Level
24429 RAVENNA AVE	X	X	X				
24430 PANAMA AVE							
24431 PANAMA AVE	X	X	X				
24432 MARBELLA AVE	X	X	X		X		
24433 MARBELLA AVE	X		X				X
24436 PANAMA AVE	X		X				
24437 PANAMA AVE							
24502 MARBELLA AVE	X	X	X				
24502 NEPTUNE AVE		X	X				
24502 PANAMA AVE							
24502 RAVENNA AVE	X	X	X		X		
24503 MARBELLA AVE							
24503 NEPTUNE AVE	X	X	X	X	X	X	
24503 PANAMA AVE	X	X	X				
24503 RAVENNA AVE		X	X				
24506 MARBELLA AVE	X	X	X	X			X
24507 MARBELLA AVE							
24508 NEPTUNE AVE	X	X	X		X		
24508 PANAMA AVE							X
24508 RAVENNA AVE	X	X	X	X			
24509 NEPTUNE AVE	X	X	X				
24509 PANAMA AVE	X	X	X	X	X	X	
24509 RAVENNA AVE	X	X	X	X			
24512 MARBELLA AVE	X	X	X	X	X	X	
24512 NEPTUNE AVE	X	X	X		X		
24512 PANAMA AVE							
24512 RAVENNA AVE	X	X	X	X			
24513 MARBELLA AVE							
24513 NEPTUNE AVE		X	X				
24513 PANAMA AVE	X	X	X	X	X	X	
24513 RAVENNA AVE		X	X				X
24516 MARBELLA AVE	X	X	X		X		
24517 MARBELLA AVE	X		X				
24518 NEPTUNE AVE	X	X	X	X			
24518 PANAMA AVE							
24518 RAVENNA AVE	X	X	X	X	X	X	
24519 NEPTUNE AVE	X	X	X				
24519 PANAMA AVE	X	X	X		X		
24519 RAVENNA AVE	X	X	X				
24522 MARBELLA AVE	X	X	X	X			
24522 NEPTUNE AVE	X	X	X				
24522 PANAMA AVE							
24522 RAVENNA AVE	X	X	X				
24523 MARBELLA AVE							

Table 3-3
Property Addresses For Consideration in Remedial Planning

Address	Shallow Excavation		SVE/Bioventing	Targeted Excavation for >5 to ≤10 ft bgs depth interval			Sub-Slab Soil Vapor Mitigation
	Exceeds HH Criteria or Leaching to GW SSCGs < 5 ft bgs	Exceeds HH Criteria or Leaching to GW SSCGs >5 to <10 ft bgs	Exceeds in either ≤ 5ft or >5 to ≤10 ft bgs depth interval	Front Yard	Back Yard	Both Yards	Identified in HHRA based on > 1 E-6 Risk Level
24523 NEPTUNE AVE	X	X	X		X		
24523 PANAMA AVE							
24523 RAVENNA AVE	X	X	X	X			
24526 MARBELLA AVE	X	X	X		X		
24527 MARBELLA AVE							
24528 NEPTUNE AVE	X	X	X				
24528 PANAMA AVE							
24528 RAVENNA AVE							
24529 NEPTUNE AVE	X	X	X		X		
24529 PANAMA AVE							
24529 RAVENNA AVE	X	X	X				
24532 MARBELLA AVE	X	X	X		X		
24532 NEPTUNE AVE							
24532 PANAMA AVE	X	X	X				
24532 RAVENNA AVE							
24533 MARBELLA AVE							
24533 NEPTUNE AVE *	X	X	X				
24533 PANAMA AVE	X		X				
24533 RAVENNA AVE							
24602 MARBELLA AVE		X	X				
24602 NEPTUNE AVE							
24602 PANAMA AVE		X	X				
24602 RAVENNA AVE							
24603 MARBELLA AVE	X		X				X
24603 NEPTUNE AVE	X	X	X				
24603 PANAMA AVE	X		X				
24603 RAVENNA AVE	X	a	X				
24606 MARBELLA AVE	X	X	X		X		
24607 MARBELLA AVE		X	X				
24608 NEPTUNE AVE	X	X	X				
24608 PANAMA AVE	X	X	X				
24608 RAVENNA AVE	X	X	X				
24609 NEPTUNE AVE	X	X	X	X	X	X	
24609 PANAMA AVE	X	X	X				X
24609 RAVENNA AVE	X		X				
24612 MARBELLA AVE	X	X	X	X	X	X	
24612 NEPTUNE AVE	X	X	X	X	X	X	
24612 PANAMA AVE	X	X	X				
24612 RAVENNA AVE	X		X				
24613 MARBELLA AVE	a	a	a				
24613 NEPTUNE AVE	X	X	X	X	X	X	
24613 PANAMA AVE	X	X	X				X
24613 RAVENNA AVE	X	X	X				
24616 MARBELLA AVE	X	X	X	X	X	X	

Table 3-3
Property Addresses For Consideration in Remedial Planning

Address	Shallow Excavation		SVE/Bioventing	Targeted Excavation for >5 to ≤10 ft bgs depth interval			Sub-Slab Soil Vapor Mitigation
	Exceeds HH Criteria or Leaching to GW SSCGs < 5 ft bgs	Exceeds HH Criteria or Leaching to GW SSCGs >5 to <10 ft bgs	Exceeds in either ≤ 5ft or >5 to ≤10 ft bgs depth interval	Front Yard	Back Yard	Both Yards	Identified in HHRA based on > 1 E-6 Risk Level
24617 MARBELLA AVE	X	a	X				
24618 NEPTUNE AVE	X	X	X	X	X	X	
24618 PANAMA AVE	X	X	X				
24618 RAVENNA AVE	X		X				
24619 NEPTUNE AVE	X	X	X	X	X	X	
24619 PANAMA AVE	X	X	X				
24619 RAVENNA AVE		X	X				
24622 MARBELLA AVE	X	X	X	X	X	X	
24622 NEPTUNE AVE	X	X	X	X	X	X	
24622 PANAMA AVE							
24623 MARBELLA AVE	X	X	X				X
24623 NEPTUNE AVE	X	X	X	X	X	X	
24623 RAVENNA AVE							
24627 MARBELLA AVE	X	X	X	X			
24628 MARBELLA AVE	X	X	X	X	X	X	
24628 NEPTUNE AVE		X	X				
24629 NEPTUNE AVE	X	X	X	X	X	X	X
24632 NEPTUNE AVE[b]	X	X	X	X	X	X	X
24633 MARBELLA AVE	X		X				
24700 MARBELLA AVE	X	X	X	X			
24700 RAVENNA AVE							
24702 NEPTUNE AVE	X	X	X	X	X	X	
24702 PANAMA AVE	X	X	X				
24703 MARBELLA AVE	X		X				
24703 NEPTUNE AVE	X	X	X	X			
24703 PANAMA AVE	X	X	X				
24703 RAVENNA AVE	X	X	X	X	X	X	
24706 MARBELLA AVE	X	X	X	X			
24706 RAVENNA AVE	X		X				
24707 MARBELLA AVE							
24708 NEPTUNE AVE							
24708 PANAMA AVE	X	X	X				
24709 NEPTUNE AVE	X	X	X		X		X
24709 PANAMA AVE	X	X	X		X		
24709 RAVENNA AVE	X	X	X		X		
24710 MARBELLA AVE	X	X	X	X	X	X	
24712 NEPTUNE AVE	X	X	X	X	X	X	X
24712 PANAMA AVE	X	X	X				
24712 RAVENNA AVE	X		X				
24713 MARBELLA AVE							
24713 PANAMA AVE	X	X	X				
24713 RAVENNA AVE	X	X	X		X		
24715 NEPTUNE AVE	X	X	X	X	X	X	
24716 MARBELLA AVE	X	X	X				

Table 3-3
Property Addresses For Consideration in Remedial Planning

Address	Shallow Excavation		SVE/Bioventing	Targeted Excavation for >5 to ≤10 ft bgs depth interval			Sub-Slab Soil Vapor Mitigation
	Exceeds HH Criteria or Leaching to GW SSCGs < 5 ft bgs	Exceeds HH Criteria or Leaching to GW SSCGs >5 to <10 ft bgs	Exceeds in either ≤ 5ft or >5 to ≤10 ft bgs depth interval	Front Yard	Back Yard	Both Yards	Identified in HHRA based on > 1 E-6 Risk Level
24716 RAVENNA AVE	X		X				
24717 MARBELLA AVE	X		X				
24718 NEPTUNE AVE	X	X	X	X			
24718 PANAMA AVE	X	X	X				
24719 NEPTUNE AVE	X	X	X	X			
24719 PANAMA AVE	X	X	X				
24719 RAVENNA AVE	X	X	X		X		
24722 MARBELLA AVE	X		X				
24722 NEPTUNE AVE							X
24722 PANAMA AVE	X		X				
24722 RAVENNA AVE	X		X				
24723 MARBELLA AVE	X		X				X
24723 PANAMA AVE							
24723 RAVENNA AVE	X	X	X				
24725 NEPTUNE AVE							
24726 MARBELLA AVE							
24726 RAVENNA AVE	X		X				
24727 MARBELLA AVE	X		X				
24728 NEPTUNE AVE	X	X	X				
24728 PANAMA AVE	X	X	X				
24729 NEPTUNE AVE	X		X				
24729 PANAMA AVE							
24729 RAVENNA AVE							
24732 MARBELLA AVE	X		X				
24732 NEPTUNE AVE	X	X	X		X		
24732 PANAMA AVE							
24732 RAVENNA AVE	X		X				
24733 MARBELLA AVE	X		X				
24733 PANAMA AVE	X		X				
24733 RAVENNA AVE	X	X	X				
24735 NEPTUNE AVE	X		X				
24736 MARBELLA AVE							
24736 RAVENNA AVE	X	X	X	X			
24737 MARBELLA AVE	X	X	X				
24738 NEPTUNE AVE	X	X	X	X	X	X	X
24738 PANAMA AVE	X		X				
24739 NEPTUNE AVE	X		X				
24739 PANAMA AVE	X	X	X				
24739 RAVENNA AVE	X	X	X	X	X	X	
24740 MARBELLA AVE	X		X				
24741 MARBELLA AVE							X
24742 RAVENNA							
24743 RAVENNA AVE	X	X	X	X	X	X	
24744 MARBELLA AVE	X		X				X

Table 3-3
Property Addresses For Consideration in Remedial Planning

Address	Shallow Excavation		SVE/Bioventing	Targeted Excavation for >5 to ≤10 ft bgs depth interval			Sub-Slab Soil Vapor Mitigation
	Exceeds HH Criteria or Leaching to GW SSCGs < 5 ft bgs	Exceeds HH Criteria or Leaching to GW SSCGs >5 to <10 ft bgs	Exceeds in either ≤ 5ft or >5 to ≤10 ft bgs depth interval	Front Yard	Back Yard	Both Yards	Identified in HHRA based on > 1 E-6 Risk Level
24748 RAVENNA AVE	X	X	X				
24749 RAVENNA AVE	X	X	X	X	X	X	X
24752 RAVENNA AVE	X	X	X				
24802 PANAMA AVE	X		X				
24803 NEPTUNE AVE	X		X				
24803 PANAMA AVE	X	X	X				
24808 PANAMA AVE	X		X				
24809 NEPTUNE AVE	X	X	X				
24809 PANAMA AVE	X	X	X	X	X	X	
24812 PANAMA AVE	X		X				
24813 PANAMA AVE	X	X	X				
24815 NEPTUNE AVE	X	X	X				
24818 PANAMA AVE	X		X				
24819 PANAMA AVE	X	X	X		X		
24822 PANAMA AVE	X	X	X				
24823 PANAMA AVE	X	X	X	X			
24825 NEPTUNE AVE							
24828 PANAMA AVE	X	X	X				
24829 PANAMA AVE	X	X	X				
24832 PANAMA AVE	X	X	X				
24833 PANAMA AVE	X	X	X				
24838 PANAMA AVE	X		X				
24904 NEPTUNE AVE		X	X				
24912 NEPTUNE AVE		X	X				
301 244TH ST							
305 244TH ST	X	X	X				
311 244TH ST	X	X	X				
317 244TH ST	X		X				X
321 244TH ST	a	a	a				
327 244TH ST							
331 244TH ST	a	a	a				
337 244TH ST							
341 244TH ST							
344 249TH ST	X		X				
345 249TH ST	X	X	X	X			
347 244TH ST							
348 248TH ST	X	X	X	X			X
348 249TH ST	X	X	X				
351 244TH ST	X		X				
352 249TH ST		X	X				X
353 249TH ST	X	X	X				
354 248TH ST	X	X	X	X	X	X	
357 244TH ST	X		X				
357 249TH ST		X	X				

Table 3-3
Property Addresses For Consideration in Remedial Planning

Address	Shallow Excavation		SVE/Bioventing	Targeted Excavation for >5 to ≤10 ft bgs depth interval			Sub-Slab Soil Vapor Mitigation
	Exceeds HH Criteria or Leaching to GW SSCGs < 5 ft bgs	Exceeds HH Criteria or Leaching to GW SSCGs >5 to <10 ft bgs	Exceeds in either ≤ 5ft or >5 to ≤10 ft bgs depth interval	Front Yard	Back Yard	Both Yards	Identified in HHRA based on > 1 E-6 Risk Level
358 249TH ST	X		X				
360 248TH ST	X	X	X	X			
361 244TH ST							
362 249TH ST							
363 249TH ST	X	X	X	X			
364 248TH ST	X	X	X				
367 244TH ST	X		X				
367 249TH ST	X	X	X				
368 249TH ST	X	X	X				
370 248TH ST							
373 244TH ST							
373 249TH ST	X	X	X	X			
374 248TH ST	X	X	X		X		
374 249TH ST	X	X	X	X			
377 244TH ST							
377 249TH ST	X	X	X	X			
378 249TH ST	X	X	X				X
383 249TH ST	X	X	X				X
402 249TH ST	X		X				
408 249TH ST							
412 249TH ST	X	X	X				

X = Property selected for remediation based on results of Human Health Risk Assessment or additional considerations such as targeted mass removal (Excavation at some properties > 5 to ≤10 feet bgs) or risk management considerations (for subslab depressurization systems).

Soil and/or sub-slab soil vapor sampling was not conducted at addresses that are shaded.

* = Property was not able to be sampled; identified for remedial action based on surrounding property results.

[a] = Property exceeds SSCGs only for metals above background; SVE/bioventing may not be required.

[b]= Property not identified in HHRA based on >1E-6 risk level, but slightly exceeds RAO for methane.

GW = groundwater
HH = Human Health
RA = Risk Assessment
SSCG = Site-Specific Cleanup Goal
SVE = Soil Vapor Extraction

Table 5-1
Depth of Excavation Considerations

Issue	Excavation to 2 Feet	Excavation to 3 Feet	Excavation to 5 Feet	Excavation to 5 Feet and Targeted to 10 Feet	Excavation to 10 Feet
Utilities Encountered	• None	• None	• Gas service laterals • Telecommunication lines • Landscape irrigation systems • California Water Service Company water mains • Sewer laterals	• Gas service laterals • Telecommunication lines • Landscape irrigation systems • California Water Service Company water mains • Sewer laterals	• Gas service laterals • Telecommunication lines • Landscape irrigation systems • California Water Service Company water mains • Sewer laterals
Residential Hardscape	Removal for Alternative 4A. No removal for Alternative 5A.	Removal for Alternative 4B. No removal for Alternative 5B.	Removal for Alternative 4C. No removal for Alternative 5C.	Removal for Alternative 4D. No removal for Alternative 5D.	Removal for Alternative 4E. No removal for Alternative 5E.
Permitting	• Grading permit required for removal > 50 CY. • SCAQMD Rule 1166, VOC Emissions from Decontamination Soil • Excavation and Encroachment Permits • Asbestos Notifications/ Abatement Permits • OSHA Trenching Permit per 29 CFR 1926.650 • Plumbing and Electrical Permits	• Post-excavation, grading permit required for excavation to ≥3 feet. • SCAQMD Rule 1166, VOC Emissions from Decontamination Soil • Excavation and Encroachment Permits • Asbestos Notifications/ Abatement Permits • OSHA Trenching Permit per 29 CFR 1926.650	• Post-excavation, grading permit required for excavation to ≥3 feet. • SCAQMD Rule 1166, VOC Emissions from Decontamination Soil • Excavation and Encroachment Permits • Asbestos Notifications/ Abatement Permits • OSHA Trenching Permit per 29 CFR 1926.650	• Post-excavation, grading permit required for excavation to ≥3 feet. • SCAQMD Rule 1166, VOC Emissions from Decontamination Soil • Excavation and Encroachment Permits • Asbestos Notification/ Abatement Permits • OSHA Trenching Permit per 29 CFR 1926.650	• Post-excavation, grading permit required for excavation to ≥3 feet. • SCAQMD Rule 1166, VOC Emissions from Decontamination Soil • Excavation and Encroachment Permits • Asbestos Notification/ Abatement Permits • OSHA Trenching Permit per 29 CFR 1926.650
Permitting (Continued)	• Masonry Permit • Landscaping Permit	• Plumbing and Electrical Permits • Masonry Permit • Landscaping Permit	• Plumbing and Electrical Permits • Masonry Permit • Landscaping Permit	• Plumbing and Electrical Permits • Masonry Permit • Landscaping Permit	• Plumbing and Electrical Permits • Masonry Permit • Landscaping Permit

Table 5-1
Depth of Excavation Considerations

Issue	Excavation to 2 Feet	Excavation to 3 Feet	Excavation to 5 Feet	Excavation to 5 Feet and Targeted to 10 Feet	Excavation to 10 Feet
Shoring	• None	• None	• Shoring systems; • Slot trenching; • Sidewalls back-sloped below foundation footings of structures	• Shoring systems; • Slot trenching; • Sidewalls back-sloped below foundation footings of structures	• Shoring systems; • Slot trenching; • Sidewalls back-sloped below foundation footings of structures
Properties Proposed For Remediation	111-123* Properties Excavated; SVE/Bioventing on 224-236* Properties	207-219* Properties Excavated; SVE/Bioventing on 224-236* Properties	207-219* Properties Excavated; SVE/Bioventing on 224-236* Properties	207-219* Properties Excavated (85-97* Targeted to 10 feet); SVE/Bioventing on 224-236* Properties	229-241* Properties Excavated; SVE/Bioventing on 224-236* Properties
Volume per property (vertical sidewalls)	Alternative 4A: 6,600 ft^3 (244 CY) Alternative 5A: 2,860 ft^3 (106 CY)	Alternative 4B: 9,900 ft^3 (367 CY) Alternative 5B: 4,290 ft^3 (159 CY)	Alternative 4C: 16,500 ft^3 (611 CY) Alternative 5C: 7,150 ft^3 (265 CY)	Alternative 4D: 19,900 ft^3 (737 CY) Alternative 5D: 8,900 ft^3 (330 CY)	Alternative 4E: 33,000 ft^3 (1,222 CY) Alternative 5E: 14,300 ft^3 (530 CY)

* Ranges are due to addition of 12 properties for which no environmental characterization data have been collected as of September 9, 2014. Whether excavation is needed at these 12 properties, and the scope of any such work, would be established based on analysis of sampling data obtained if and when access is obtained.

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Table 5-3
Screening of Remedial Alternatives

ALT	DESCRIPTION	SCREENING CRITERIA			STATUS
		EFFECTIVENESS	IMPLEMENTABILITY	COST	
1	No Action No remedial actions, no institutional controls, no engineering controls, and no further monitoring of the site.	Not effective at achieving RAOs.	Easy to implement.	No cost in short or long term.	Retained as a baseline to compare to the remaining alternatives.
2	Removal of all site features and the excavation of impacted soils over the entire Site.	Low effectiveness. Effectively meets RAOs in the long term. Soil, soil vapor and nuisance goals met. LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA. Relocation would have significant long-term negative impacts on the community.	Very difficult. Relocate all residents. 285 homes and all roads/utilities removed. ~250,000 truckloads of soil, exported and imported to the Site Possibly not be permitted under CEQA. 4.5 years active remediation	Very High. Highest of all alternatives.	Not retained due to very difficult implementability, very high cost, and long lasting effects on the community.
3	Removal of all site features and the excavation to a depth of 10 feet bgs over the entire Site.	Low effectiveness. Effectively meets RAOs in the long term. Soil goals met in upper 10 feet. Remaining soils meet health goals for infrequent exposure. Soil vapor and nuisance goals met. LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA. Relocation would have significant long-term negative impacts on the community.	Very difficult. Relocate all residents. 285 homes and all roads/utilities removed. ~130,000 truckloads of soil Possibly not be permitted under CEQA. 2.5 years active remediation	Very High. Second highest of all alternatives.	Not retained due to very difficult implementability, very high cost, and long lasting effects on the community.
4A	Excavation of shallow soils to a depth of 2 feet bgs from both landscaped areas and areas covered by hardscape at properties where human health or groundwater goals are exceeded.	High short-term effectiveness, low long-term effectiveness. Effectively meets RAOs in the long term. Soil goals met in upper 2 feet, but not in 2-to-3-foot zone. No existing institutional controls preventing contact with soil from below 2 feet to 3 feet. Soil vapor and nuisance goals met. LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA.	High. 111-123* properties require excavation. 28 homes would have sub-slab mitigation installed. 224-236* properties would have SVE/bioventing infrastructure. ~4,600 truckloads of soil Removal of hardscape is inconvenient for residents. Short-term disturbances of community including air quality, noise, and traffic impacts. 1.5 years active remediation	Moderate.	Not retained due to lack of protectiveness.

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Table 5-3
Screening of Remedial Alternatives

ALT	DESCRIPTION	SCREENING CRITERIA			STATUS
		EFFECTIVENESS	IMPLEMENTABILITY	COST	
4B	Excavation of shallow soils to a depth of 3 feet bgs from both landscaped areas and areas covered by hardscape at properties where human health or groundwater goals are exceeded.	Effectively meets RAOs in the long term. Relatively high effectiveness in the short term. Soil goals met in upper 3 feet. Remaining soils meet health goals for infrequent exposure. Soil vapor and nuisance goals met. LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA.	Relatively high. 207-219* properties require excavation. 28 homes would have sub-slab mitigation installed. 224-236* properties would have SVE/bioventing infrastructure. ~12,000 truckloads of soil Removal of hardscape is inconvenient for residents. Short-term disturbances of community including air quality, noise, and traffic impacts. 3.3 years active remediation	Moderate to High.	Retained as technically and economically feasible.
4C	Excavation of shallow soils to a depth of 5 feet bgs from both landscaped areas and areas covered by hardscape at properties where human health or groundwater goals are exceeded.	Effectively meets RAOs in the long term. Moderate effectiveness in the short term. Soil goals met in upper 5 feet. Remaining soils meet health goals for infrequent exposure. Soil vapor and nuisance goals met. LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA.	Moderate. 207-219* properties require excavation. 28 homes would have sub-slab mitigation installed. 224-236* properties would have SVE/bioventing infrastructure. ~19,700 truckloads of soil Utilities capped, removed and replaced. Removal of hardscape is inconvenient for residents. Short-term disturbances of community including air quality, noise, and traffic impacts. 4.4 years active remediation	High.	Retained as technically and economically feasible.
4D	Excavation of shallow soils to a depth of 5 feet bgs from both landscaped areas and areas covered by hardscape at properties where human health or groundwater goals are exceeded and targeted deeper excavation to 10 feet bgs.	Effectively meets RAOs in the long term. Low effectiveness in the short term. Soil goals met in upper 5 feet; upper 10 feet in areas of additional targeted excavation. Remaining soils meet health goals for infrequent exposure. Soil vapor and nuisance goals met. LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA.	Difficult. 207-219* properties require excavation. 28 homes would have sub-slab mitigation installed. 224-236* properties would have SVE/bioventing infrastructure. ~23,700 truckloads of soil Utilities capped, removed and replaced. Removal of hardscape is inconvenient for residents. Short-term disturbances of community including air quality, noise, and traffic impacts. 5.5 years active remediation	High to very high.	Retained as technically and economically feasible.

Table 5-3
Screening of Remedial Alternatives

ALT	DESCRIPTION	SCREENING CRITERIA			STATUS
		EFFECTIVENESS	IMPLEMENTABILITY	COST	
4E	Excavation of shallow soils to a maximum depth of 10 feet bgs from both landscaped areas and areas covered by hardscape at properties where human health or groundwater goals are exceeded.	Effectively meets RAOs in the long term. Very low effectiveness in the short term. Soil goals met in upper 10 feet. Remaining soils meet health goals for infrequent exposure. Soil vapor and nuisance goals met. LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA.	Very Difficult. 229-241* properties require excavation. 28 homes would have sub-slab mitigation installed. 224-236* properties would have SVE/bioventing infrastructure. ~42,700 truckloads of soil Utilities capped, removed and replaced. May come in contact with reservoir slabs. Removal of hardscape is inconvenient for residents. Short-term disturbances of community including air quality, noise, and traffic impacts. 8.4 years active remediation	Very high.	Retained as directed by RWQCB.
5A	Excavation of shallow soils to a depth of 2 feet bgs from landscaped areas at properties where human health or groundwater goals are exceeded.	Low effectiveness at meeting RAOs in the long term. Relatively high effectiveness in the short term. Soil goals met in upper 2 feet, but not in 2-to-3-foot zone. No existing institutional controls preventing contact with soil from below 2 feet to 3 feet. Soil vapor and nuisance goals met. LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA.	High. 111-123* properties require excavation. 28 homes would have sub-slab mitigation installed. 224-236* properties would have SVE/bioventing infrastructure. ~1,400 truckloads of soil Short-term disturbances of community including air quality, noise, and traffic impacts. 1.2 years active remediation	Moderate.	Not retained due to lack of protectiveness.
5B	Excavation of shallow soils to a depth of 3 feet bgs from landscaped areas at properties where human health or groundwater goals are exceeded.	Moderately effective at meeting RAOs in the long term. Relatively high effectiveness in the short term. Soil goals met in upper 3 feet. Remaining soils meet health goals for infrequent exposure. Soil vapor and nuisance goals met. LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA.	Relatively high. 207-219* properties require excavation. 28 homes would have sub-slab mitigation installed. 224-236* properties would have SVE/bioventing infrastructure. ~4,300 truckloads of soil Short-term disturbances of community including air quality, noise, and traffic impacts. 2.7 years active remediation	Moderate.	Retained as technically and economically feasible.

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Table 5-3
Screening of Remedial Alternatives

ALT	DESCRIPTION	SCREENING CRITERIA			STATUS
		EFFECTIVENESS	IMPLEMENTABILITY	COST	
5C	Excavation of shallow soils to a depth of 5 feet bgs from landscaped areas at properties where human health or groundwater goals are exceeded.	Moderately effective at meeting RAOs in the long term. Moderate effectiveness in the short term. Soil goals met in upper 5 feet. Remaining soils meet health goals for infrequent exposure. Soil vapor and nuisance goals met. LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA.	Moderate 207-219* properties require excavation. 28 homes would have sub-slab mitigation installed. 224-236* properties would have SVE/bioventing infrastructure. ~8,300 truckloads of soil Utilities capped, removed and replaced. Short-term disturbances of community including air quality, noise, and traffic impacts. 3.3 years active remediation	Moderate to high.	Retained as technically and economically feasible.
5D	Excavation of shallow soils to a depth of 5 feet bgs from landscaped areas at properties where human health or groundwater goals are exceeded and targeted deeper excavation to 10 feet bgs.	Moderately effective at meeting RAOs in the long term. Low effectiveness in the short term. Soil goals met in upper 5 feet; upper 10 feet in areas of additional targeted excavation. Remaining soils meet health goals for infrequent exposure. Soil vapor and nuisance goals met. LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA.	Difficult 207-219* properties require excavation. 28 homes would have sub-slab mitigation installed. 224-236* properties would have SVE/bioventing infrastructure. ~10,900 truckloads of soil Utilities capped, removed and replaced. Short-term disturbances of community including air quality, noise, and traffic impacts. 4.4 years active remediation	Moderate to high.	Retained as technically and economically feasible.
5E	Excavation of shallow soils to a maximum depth of 10 feet bgs from landscaped areas at properties where human health or groundwater goals are exceeded.	Moderately effectively meets RAOs in the long term. Very low effectiveness in the short term. Soil goals met in upper 10 feet. Remaining soils meet health goals for infrequent exposure. Soil vapor and nuisance goals met. LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA.	Very Difficult. 229-241* properties require excavation. 28 homes would have sub-slab mitigation installed. 224-236* properties would have SVE/bioventing infrastructure. ~18,200 truckloads of soil Utilities capped, removed and replaced. May come in contact with reservoir slabs. Short-term disturbances of community including air quality, noise, and traffic impacts. 6.0 years active remediation	High to very high.	Retained as directed by RWQCB.

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Table 5-3
Screening of Remedial Alternatives

ALT	DESCRIPTION	SCREENING CRITERIA			STATUS
		EFFECTIVENESS	IMPLEMENTABILITY	COST	
6	Removal of all site features and cap entire site.	Effectively meets RAOs in the long term. Low effectiveness in the short term. Meet human health goal for infrequent exposure to soils Meet nuisance goals by limiting contact with soil and soil vapor Limited removal of COCs from soils. Soil vapor goals for methane and vapor intrusion may not be met in some areas but no receptors. LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA.	Very Difficult Relocate all residents. 285 homes and all roads/utilities removed. ~12,500 truckloads of import fill and construction debris Possibly not be permitted under CEQA. 4.5 years at minimum active remediation	Very high.	Not retained due to very difficult implementability and very high cost.
7	Cap all exposed soils on-site.	Effectively meets RAOs in the long term. High effectiveness in the short term. Meet human health goal for infrequent exposure to soils Meet nuisance goals by limiting contact with soil and soil vapor Limited removal of COCs from soils. Soil vapor goals for methane and vapor intrusion addressed using sub-slab mitigation LNAPL effectively addressed through LNAPL removal. Groundwater goals achieved in long term through MNA.	Moderate 285 properties require capping 28 homes require sub-slab mitigation. 224-236* properties would have SVE/bioventing infrastructure. Short-term disturbances of community including air quality, noise, and traffic impacts. All landscaping above cap in long-term Potentially significant increases in stormwater runoff could occur 1.1 years	Moderate.	Retained as technically and economically feasible.

* Ranges are due to addition of 12 properties for which no environmental characterization data have been collected as of September 9, 2014. Whether excavation is needed at these 12 properties, and the scope of any such work, would be established based on analysis of sampling data obtained if and when access is obtained.

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Table 6-1
Summary of Estimated Excavation Costs, Mass Removed, Durations and Relocation Time: Alternatives 4B-4E

Alternative	Scope	Cost and Duration Based on Excavation of Four Properties at Time										
		Est Cost ($)	Incremental Cost Above Preceding Alternative	Chemical Mass Removed (lbs)[2]	Incremental Chemical Mass (lbs) Removed Above Preceding Alternative	Incremental Cost ($) Per Incremental Pound of Chemical Mass Removed	% Chemical Mass Removed From Top 10 ft	Incremental % Chemical Mass Removed Above Preceding Alternative	% Chemical Mass Removed From Entire Site	Incremental % Chemical Mass Removed Above Preceding Alternative	Duration (yrs)	Est Relocation Time Per Property (days)
4B	Excavate hard and softscape to 3 ft bgs at 207-219* properties (80,000 CY total)	$101,000,000 [1]		210,000			5.0%		1.3%		3.3	35
4C	Excavate hard and softscape to 5 ft bgs at 207-219* properties (134,000 CY total)	$129,000,000	$28,000,000	520,000	310,000	$90	12.1%	7.2%	3.2%	1.9%	4.4	49
4D	Excavate hard and softscape to 5 ft bgs at 207-219* properties (134,000 CY total), plus targeted deeper excavation from 5-10 ft bgs at 85-97* properties (28,000 CY)	$146,000,000	$17,000,000	1,790,000	1,270,000	$13	41.3%	29.2%	10.8%	7.7%	5.5	56
4E	Excavate hard and softscape to 10 ft bgs at 229-241* properties (295,000 CY total)	$220,000,000	$74,000,000	2,180,000	390,000	$190	50.4%	9.0%	13.2%	2.4%	8.4	70

[1] Baseline cost of Alternative 4B is $481 per pound of COC Mass Removed.

[2] Mass removed is cumulative for each alternative.

* Ranges are due to addition of 12 properties for which no environmental characterization data have been collected as of September 9, 2014. Whether excavation is needed at these 12 properties, and the scope of any such work, would be established based on analysis of sampling data obtained if and when access is obtained.

Table 6-4
Preliminary Cost Estimate For Alternative 4B

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ALTERNATIVE 4B
* Excavate exposed soils and soils under residential hardscape[A] to 3 feet where HH350 goals are exceeded.
* No excavation beneath streets.
* Install subslab mitigation at homes where subslab VOC and methane concentrations exceed screening value.
* MNA remedy for GW.
* Remove LNAPL as feasible.* SVE/Bioventing

Item	Description	Quantity	Unit	Rate	Amount	Comments
1.0	**Property Purchase Cost (285 properties)**	0	LS	NA	**$** -	
2.0	**Demolition Costs**				**$ 1,720,026**	Includes 5% handling on outside services
2.1	Asbestos Surveys	0	LS	$ 3,200	$ -	URS Est.
2.2	Asbestos Abatement	0	LS	$ 18,000	$ -	URS Est.
2.3	D & D of Homes	0	LS	$ 35,000	$ -	AIS Est.
2.4	D & D of Hardscape	409,530	SF	$ 4	$ 1,638,120	AIS Est.
3.0	**Excavate, Backfill, & Assoc. Costs**				**$ 40,736,686**	Includes 5% handling on outside services
3.1	Excavate and Load Impacted Soil	80,000	CY	$ 50	$ 4,000,000	219 homes; 1870 sf hardscape, 1430 sf landscape on average, 3' deep
3.2	Remove and Dispose Concrete Bases	0	TONS	$ 80	$ -	AIS Est. (No city sidewalk)
3.3	Shoring (H pile/lagging or sheet pile)	0	SF	$ 40	$ -	
3.4	Vapor Mitigation	219	EA	$ 1,500	$ 328,500	AIS Est.
3.5	T&D Non Haz Soil (Recycle) 100%	136,000	TON	$ 60	$ 8,160,000	Soil Safe, Adelanto AIS Est.
3.6	T&D RCRA Haz Soil (Out of State) 0%	0	TON	$ 215	$ -	Beaty, NV AIS Est.
3.7	Groundwater Remediation	0	LS	$ -	$ -	Assume NMA, no active treatment
3.8	Import Clean Soil	80,000	CY	$ 20	$ 1,600,000	URS Est.
3.9	Backfill and Compact	80,000	CY	$ 9	$ 720,000	AIS Est.
3.10	Fine Grade	16.5	ACRES	$ 30,000	$ 495,868	AIS Est.
3.11	SWPP BMPs	1	LS	$ 150,000	$ 150,000	URS Est.
3.12	Subslab Vapor Mitigation	28	EA	$ 20,000	$ 560,000	URS Est.
3.13	Utilities Restoration	219	EA	$ 1,500	$ 328,500	URS Est.
3.14	Landscape/Hardscape	219	EA	$ 45,000	$ 9,855,000	URS Est. Includes $15K block walls
3.15	SVE/Bioventing	1	LS	$ 11,644,303	$ 11,644,303	URS Est.
3.16	Soil Waste Profiling	1	LS	$ 101,000	$ 101,000	URS Est. ~ 1 sample per 500 cy at $630
3.17	Post-excavation Sampling	1	EA	$ 1,408,164	$ 1,408,164	URS Est. See Tab PEx Samp
4.0	**Other Direct Costs**				**$ 28,933,537**	Includes 5% handling on outside services
4.1	Contingency for Treatment of Rainwater	1	LS	$ 1,000,000	$ 1,000,000	AIS Est.
4.2	PM, Planning, Permitting, Coordination, Reporting	1	LS	$ 5,349,546	$ 5,349,546	12.6% of Construction $ 24,427 per home
4.3	Grading Permits	219	EA	$ 5,000	$ 1,095,000	
4.4	Geotechnical Investigation/Reports	1	LS	$ -	$ -	
4.5	Field Mgmt, Monitoring, Oversight	1	LS	$ 6,368,507	$ 6,368,507	15.0% of Construction $ 38,773 per week
4.6	Relocation	219	EA	$ 24,500	$ 5,365,500	$ 700 per day 35 days
4.7	Security	164	WEEKS	$ 54,400	$ 8,935,200	5 guards - 16 hours per day/24 hours weekend
5.0	**Post Excavation Construction and Long Term O&M**				**$ 29,614,173**	Includes 5% handling on outside services
5.1	Groundwater Monitoring	30	YEAR	$ 80,000	$ 2,400,000	URS Est. Assume semi-annual monitoring plus MNA parameters
5.2	LNAPL Recovery	112	Events	$ 4,571	$ 511,952	URS Est. $4.6K / event: monthly for 4 years, quarterly for next 6 years and semi-annualy for next 20 years
5.3	SVE/Bioventing O&M	30	YEAR	$ 683,075	$ 20,492,247	URS Est.
5.4	SVE/Bioventing Performance Sampling	1	LS	$ 2,288,976	$ 2,288,976	
5.5	SSP Probe Install at SSD Properties	28	EA	$ 2,800	$ 78,400	
5.6	Periodic Sub-Slab SVP Sampling Prior to SVE/BV Opns	330	Events	$ 2,400	$ 792,000	Assumes 1.5 bi-annual events at 219 properties for 5.5 years (330 events total)
5.7	Periodic Sub-Slab SVP Sampling After Start of SVE/BV Opns	573	events	$ 2,400	$ 1,375,200	Assumes 191 homes sampled every 5 years for 15 years (219-28=191; remaining 28 homes sampled for SSD systems)
5.7	Sub-slab Soil Vapor Probe Periodic Sampling for SSD	364	Events	$ 2,400	$ 873,600	Assumes will sample 2 SVPs at 28 homes with SSD systems annually for 5 yrs, bi-ann for 10 yrs, and every 5 yrs for 15 yrs
5.8	Asphalt Capping of Streets (1" grind and overlay)	33,000	SY	$ 15	$ 495,000	URS Est.
	Subtotal Estimate Alternative 4B without Contingency				**$ 101,000,000**	
	Total Estimate Alternative 4B with Contingency Range -20% to +30%			**$ 81,000,000**	**$ 131,000,000**	
				Low	**High**	

Estimated Duration	164 Weeks	3.3 Years
Estimated Truck Loads/Day	11 Loads/Day Export	11 Loads/Day Import
Estimated Total Loads	6,256 Loads Export	5,714 Loads Import

Table 6-5
Preliminary Cost Estimate For Alternative 4C

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ALTERNATIVE 4C
Same as Alt 4B except excavate to 5 feet

Item	Description	Quantity	Unit	Rate	Amount	Comments
1.0	**Property Purchase Cost (285 properties)**	0	LS	NA	**$** -	
2.0	**Demolition Costs**				**$ 1,720,026**	Includes 5% handling on outside services
2.1	Asbestos Surveys	0	LS	$ 3,200	$ -	URS Est.
2.2	Asbestos Abatement	0	LS	$ 18,000	$ -	URS Est.
2.3	D & D of Homes	0	LS	$ 35,000	$ -	AIS Est.
2.4	D & D of Hardscape	409,530	SF	$ 4	$ 1,638,120	AIS Est.
3.0	**Excavate, Backfill, & Assoc. Costs**				**$ 59,188,373**	Includes 5% handling on outside services
3.1	Excavate and Load Impacted Soil	133,800	CY	$ 60	$ 8,028,000	219 homes; 1870 sf hardscape, 1430 sf landscape on average, 5' deep
3.2	Remove and Dispose Concrete Bases	0	TONS	$ 80	$ -	AIS Est.
3.3	Shoring (H pile/lagging or sheet pile)	208,050	SF	$ 30	$ 6,241,500	AIS Est. around each house
3.4	Vapor Mitigation	219	EA	$ 1,500	$ 328,500	AIS Est.
3.5	T&D Non Haz Soil (Recycle) 100%	227,460	TON	$ 60	$ 13,647,600	Soil Safe, Adelanto AIS Est.
3.6	T&D RCRA Haz Soil (Out of State) 0%	0	TON	$ 215	$ -	Beaty, NV AIS Est.
3.7	Groundwater Remediation	0	LS	$ -	$ -	Assume NMA, no active treatment
3.8	Import Clean Soil	133,800	CY	$ 20	$ 2,676,000	URS Est.
3.9	Backfill and Compact	133,800	CY	$ 9	$ 1,204,200	AIS Est.
3.10	Fine Grade	16.6	ACRES	$ 30,000	$ 497,603	AIS Est.
3.11	SWPP BMPs	1	LS	$ 200,000	$ 200,000	URS Est.
3.12	Subslab Vapor Mitigation	28	EA	$ 20,000	$ 560,000	URS Est.
3.13	Utilities Restoration	219	EA	$ 2,000	$ 438,000	URS Est.
3.14	Landscape/Hardscape	219	EA	$ 45,000	$ 9,855,000	URS Est. Includes $15K block walls
3.15	SVE/Bioventing	1	LS	$ 11,644,303	$ 11,644,303	URS Est.
3.16	Soil Waste Profiling	1	LS	$ 169,000	$ 169,000	URS Est. ~ 1 sample per 500 cy at $630
3.17	Post-excavation Sampling	1	EA	$ 1,434,664	$ 1,434,664	URS Est. See Tab PEx Samp
4.0	**Other Direct Costs**				**$ 38,459,715**	Includes 5% handling on outside services
4.1	Contingency for Treatment of Rainwater	1	LS	$ 1,000,000	$ 1,000,000	AIS Est.
4.2	PM, Planning, Permitting, Coordination, Reporting	1	LS	$ 6,699,924	$ 6,699,924	11% of Construction $ 30,593 per home
4.3	Grading Permits	219	EA	$ 5,000	$ 1,095,000	
4.4	Geotechnical Investigation/Reports	1	LS	$ 606,000	$ 606,000	URS Est.
4.5	Field Mgmt, Monitoring, Oversight	1	LS	$ 8,527,176	$ 8,527,176	14% of Construction $ 38,937 per week
4.6	Relocation	219	EA	$ 34,300	$ 7,511,700	$ 700 per day 49 days
4.7	Security	219	WEEKS	$ 54,400	$ 11,913,600	5 guards - 16 hours per day/24 hours weekend
5.0	**Post Excavation Construction and Long Term O&M**				**$ 29,869,453**	Includes 5% handling on outside services
5.1	Groundwater Monitoring	30	YEAR	$ 80,000	$ 2,400,000	URS Est. Assume semi-annual monitoring plus MNA parameters
5.2	LNAPL Recovery	112	Events	$ 4,571	$ 511,952	URS Est. $4.6K / event: monthly for 4 years, quarterly for next 6 years and semi-annualy for next 20 years
5.3	SVE/Bioventing O&M	30	YEAR	$ 683,075	$ 20,492,247	URS Est.
5.4	SVE/Bioventing Performance Sampling	1	LS	$ 2,288,976	$ 2,288,976	
5.5	SSP Probe Install at SSD Properties	28	EA	$ 2,800	$ 78,400	
5.6	Periodic Sub-Slab SVP Sampling Prior to SVE/BV Opns	438	Events	$ 2,400	$ 1,051,200	Assumes 2 bi-annual events at 219 properties for 5.5 years (438 events total)
5.7	Periodic Sub-Slab SVP Sampling After Start of SVE/BV	573	events	$ 2,400	$ 1,375,200	Assumes 191 homes sampled every 5 years for 15 years (219-28=191; remaining 28 homes sampled for SSD systems)
5.7	Sub-slab Soil Vapor Probe Periodic Sampling for SSD	364	Events	$ 2,400	$ 873,600	Assumes will sample 2 SVPs at 28 homes with SSD systems annually for 5 yrs, bi-ann for 10 yrs, and every 5 yrs for 15 yrs
5.8	Asphalt Capping of Streets (1" grind and overlay)	33,000	SY	$ 15	$ 495,000	URS Est.

Subtotal Estimate Alternative 4C without Contingency		**$ 129,000,000**
Total Estimate Alternative 4C with Contingency Range -20% to +30%	**$ 103,000,000**	**$ 168,000,000**
	Low	**High**

Estimated Duration	219	Weeks	4.4	Years
Estimated Truck Loads/Day	12	Loads/Day Export	12	Loads/Day Import
Estimated Total Loads	10,099	Loads Export	9,557	Loads Import

Table 6-6
Preliminary Cost Estimate For Alternative 4D

Geosyntec consultants

ALTERNATIVE 4D
Same as Alt 4B except excavate to 5 feet with 5-10' in Localized Areas Under Hardscape and Landscape

Item	Description		Quantity	Unit	Rate	Amount	Comments
1.0	**Property Purchase Cost ( )**		0	LS	$ 345,000	**$ -**	Average of recent sales compiled by Sheri Repp, City of Carson Assume 4 houses for SVE system footprint/yard
2.0	**Demolition Costs**					**$ 1,720,026**	Includes 5% handling on outside services
2.1	Asbestos Surveys		0	LS	$ 3,200	$ -	URS Est.
2.2	Asbestos Abatement		0	LS	$ 18,000	$ -	URS Est.
2.3	D & D of Homes		0	LS	$ 35,000	$ -	AIS Est.
2.4	D & D of Hardscape		409,530	SF	$ 4	$ 1,638,120	AIS Est. excludes city sidewalk 7584 cy @ 6" thick
3.0	**Excavate, Backfill, & Assoc. Costs**					**$ 67,335,734**	Includes 5% handling on outside services
3.1	Excavate and Load Impacted Soil	0-5 ft	133,800	CY	$ 60	$ 8,028,000	219 homes; 1870 sf hardscape, 1430 sf landscape on average, 5' deep
3.1.1	Excavate and Load Impacted Soil - Backhoe 67%	5-10 ft	18,760	CY	$ 80	$ 1,500,800	146 front and back yards
3.1.2	Excavate and Load Impacted Soil - Auger 33%	5-10 ft	9,240	CY	$ 225	$ 2,079,000	
3.2	Remove and Dispose Concrete Bases		6,761	TONS	$ 80	$ 540,851	AIS Est. (excludes city sidewalk)
3.3	Shoring (H pile/lagging or sheet pile)		0	SF	$ 40	$ -	
3.4	Vapor Mitigation		219	EA	$ 2,500	$ 547,500	AIS Est.
3.5	T&D Non Haz Soil (Recycle) 100% 0-5 ft & 67% 5-10 ft		259,352	TON	$ 60	$ 15,561,120	Soil Safe, Adelanto AIS Est. 1.7 tons/cy
3.6	T&D RCRA Haz Soil (Out of State) 33% of 5-10 ft		15,708	TON	$ 215	$ 3,377,220	Beaty, NV AIS Est.
3.7	Groundwater Remediation		1	LS	$ -	$ -	Assume MNA and no active treatment
3.8	Import Clean Soil		133,800	CY	$ 20	$ 2,676,000	URS Est.
3.8.1	2 Sack Slurry Backfill		28,000	CY	$ 100	$ 2,800,000	URS Est.
3.9	Backfill and Compact		133,800	CY	$ 9	$ 1,204,200	AIS Est.
3.10	Fine Grade		16.6	ACRES	$ 30,000	$ 497,603	AIS Est.
3.11	SWPPP BMPs		1	LS	$ 500,000	$ 500,000	URS Est.
3.12	Subslab Vapor Mitigation		28	EA	$ 20,000	$ 560,000	URS Est.
3.13	Utilities Restoration		219	EA	$ 5,000	$ 1,095,000	URS Est.
3.14	Landscape/Hardscape		219	EA	$ 45,000	$ 9,855,000	URS Est. Includes $15K block walls
3.15	SVE/Bioventing		1	LS	$ 11,644,303	$ 11,644,303	URS Est.
3.16	Soil Waste Profiling		1	LS	$ 204,000	$ 204,000	URS Est. ~ 1 sample per 500 cy at $630
3.17	Post-excavation Sampling		1	EA	$ 2,013,164	$ 2,013,164	URS Est. See Tab PEx Samp
4.0	**Other Direct Costs**					**$ 46,350,145**	Includes 5% handling on outside services
4.1	Contingency for Treatment of Rainwater		1	LS	$ 1,000,000	$ 1,000,000	AIS Est.
4.2	PM, Planning, Design, Coordination, Reporting		1	LS	$ 7,596,134	$ 7,596,134	11% of Construction $ 34,686 per home
4.3	Grading Permits		219	EA	$ 5,000	$ 1,095,000	URS Est.
4.4	Geotechnical Investigation/Reports		1	LS	$ 814,000	$ 814,000	URS Est.
4.5	Field Mgmt, Monitoring, Oversight		1	LS	$ 11,048,922	$ 11,048,922	16% of Construction $ 40,361 per week
4.6	Relocation		219	EA	$ 39,200	$ 8,584,800	$ 700 per day 56 days
4.7	Security		274	WEEKS	$ 54,400	$ 14,892,000	5 guards - 16 hours per day/24 hours weekend
5.0	**Post Excavation Construction and Long Term O&M**					**$ 30,133,475**	Includes 5% handling on outside services
5.1	Groundwater Monitoring		30	YEARS	$ 80,000	$ 2,400,000	URS Est. Assume semi-annual monitoring plus MNA parameters
5.2	LNAPL Recovery		112	events	$ 4,571	$ 511,973	URS Est. $4.6K / event: monthly for 4 years, quarterly for next 6 years and semi-annualy for next 20 years
5.3	SVE/Bioventing O&M		30	YEAR	$ 683,075	$ 20,492,247	URS Est.
5.4	SVE/Bioventing Performance Sampling		1	LS	$ 2,288,976	$ 2,288,976	
5.5	SSP Probe Install at SSD Properties		28	EA	$ 2,800	$ 78,400	
5.6	Periodic Sub-Slab SVP Sampling Prior to SVE/BV Opns		548	Events	$ 2,400	$ 1,315,200	Assumes 2.5 bi-annual events at 219 properties for 5.5 years (548 events total)
5.7	Periodic Sub-Slab SVP Sampling After Start of SVE/BV Opns		573	events	$ 2,400	$ 1,375,200	Assumes 191 homes sampled every 5 years for 15 years (219-28=191; remaining 28 homes sampled for SSD systems)
5.7	Sub-slab Soil Vapor Probe Periodic Sampling for SSD		364	Events	$ 2,400	$ 873,600	Assumes will sample 2 SVPs at 28 homes with SSD systems annually for 5 yrs, bi-ann for 10 yrs, and every 5 yrs for 15 yrs
5.8	Asphalt Capping of Streets (1" grind and overlay)		33,000	SY	$ 15	$ 495,000	URS Est.

Subtotal Estimate Alternative 4D without Contingency			**$ 146,000,000**
Total Estimate Alternative 4D with Contingency Range -20% to +30%	**$ 117,000,000**		**$ 190,000,000**
Total Estimate with Contingency Range -10% to +15%	**$ 131,000,000**		**$ 168,000,000**
	Low		**High**

Estimated Duration	Excavation duration + 1.5 week	274	Weeks	5.5	Years
Estimated Truck Loads/Day	4 houses at a time	12.6	Loads/Day Export	12.63	Loads/Day Import
Estimated Total Loads	3.5 weeks per house to excavate	12,099	Loads Export	11,557	Loads Import

Table 6-7
Preliminary Cost Estimate For Alternative 4E

Geosyntec consultants

ALTERNATIVE 4E
Same as Alt 4B except excavate to 10 feet

Item	Description	Quantity	Unit	Rate	Amount	Comments
1.0	**Property Purchase Cost (285 properties)**	0	LS	NA	**$ -**	
2.0	**Demolition Costs**				**$ 1,892,814**	Includes 5% handling on outside services
2.1	Asbestos Surveys	0	LS	$ 3,200	$ -	URS Est.
2.2	Asbestos Abatement	0	LS	$ 18,000	$ -	URS Est.
2.3	D & D of Homes	0	LS	$ 35,000	$ -	AIS Est.
2.4	D & D of Hardscape	450,670	SF	$ 4	$ 1,802,680	AIS Est.
3.0	**Excavate, Backfill, & Assoc. Costs**				**$ 121,524,072**	Includes 5% handling on outside services
3.1	Excavate and Load Impacted Soil	294,600	CY	$ 80	$ 23,568,000	241 homes; 1870 sf hardscape, 1430 sf landscape on average, 10' deep
3.2	Remove and Dispose Concrete Bases	16,591	TONS	$ 80	$ 1,327,283	AIS Est. 137 properties with conc res bases
3.3	Shoring (H pile/lagging or sheet pile)	457,900	SF	$ 50	$ 22,895,000	AIS Est. around each house
3.4	Vapor Mitigation	241	EA	$ 1,500	$ 361,500	AIS Est.
3.5	T&D Non Haz Soil (Recycle) 98%	490,804	TON	$ 60	$ 29,448,216	Soil Safe, Adelanto AIS Est.
3.6	T&D RCRA Haz Soil (Out of State) 2%	10,016	TON	$ 215	$ 2,153,526	Beaty, NV AIS Est.
3.7	Groundwater Remediation	0	LS	$ -	$ -	Assume NMA, no active treatment
3.8	Import Clean Soil	294,600	CY	$ 20	$ 5,892,000	URS Est.
3.9	Backfill and Compact	294,600	CY	$ 9	$ 2,651,400	AIS Est.
3.10	Fine Grade	18.3	ACRES	$ 30,000	$ 547,810	AIS Est.
3.11	SWPP BMPs	1	LS	$ 250,000	$ 250,000	URS Est.
3.12	Subslab Vapor Mitigation	28	EA	$ 20,000	$ 560,000	URS Est.
3.13	Utilities Restoration	241	EA	$ 5,000	$ 1,205,000	URS Est.
3.14	Landscape/Hardscape	241	EA	$ 45,000	$ 10,845,000	URS Est. Includes $15K block walls
3.15	SVE/Bioventing	1	LS	$ 11,644,303	$ 11,644,303	URS Est.
3.16	Soil Waste Profiling	1	LS	$ 371,000	$ 371,000	URS Est. ~ 1 sample per 500 cy at $630
3.17	Post-excavation Sampling	1	EA	$ 2,571,664	$ 2,571,664	URS Est. See Tab PEx Samp
4.0	**Other Direct Costs**				**$ 65,663,406**	Includes 5% handling on outside services
4.1	Contingency for Treatment of Rainwater	1	LS	$ 1,000,000	$ 1,000,000	AIS Est.
4.2	PM, Planning, Permitting, Coordination, Reporting	1	LS	$ 8,639,182	$ 8,639,182	7% of Construction $ 35,847 per home
4.3	Grading Permits	241	EA	$ 5,000	$ 1,205,000	
4.4	Geotechnical Investigation/Reports	1	LS	$ 896,000	$ 896,000	URS Est.
4.5	Field Mgmt, Monitoring, Oversight	1	LS	$ 17,278,364	$ 17,278,364	14% of Construction $ 40,968 per week
4.6	Relocation	241	EA	$ 49,000	$ 11,809,000	$ 700 per day 70 days
4.7	Security	422	WEEKS	$ 54,400	$ 22,943,200	5 guards - 16 hours per day/24 hours weekend
5.0	**Post Excavation Construction and Long Term O&M**				**$ 31,290,253**	Includes 5% handling on outside services
5.1	Groundwater Monitoring	30	YEAR	$ 80,000	$ 2,400,000	URS Est. Assume semi-annual monitoring plus MNA parameters
5.2	LNAPL Recovery	112	Events	$ 4,571	$ 511,952	URS Est. $4.6K / event: monthly for 4 years, quarterly for next 6 years and semi-annualy for next 20 years
5.3	SVE/Bioventing O&M	30	YEAR	$ 683,075	$ 20,492,247	URS Est.
5.4	SVE/Bioventing Performance Sampling	1	LS	$ 2,288,976	$ 2,288,976	
5.5	SSP Probe Install at SSD Properties	28	EA	$ 2,800	$ 78,400	
5.6	Periodic Sub-Slab SVP Sampling Prior to SVE/BV Opns	964	Events	$ 2,400	$ 2,313,600	Assumes 4 bi-annual events at 241 properties for 5.5 years (964 events total)
5.7	Periodic Sub-Slab SVP Sampling After Start of SVE/BV	639	events	$ 2,400	$ 1,533,600	Assumes 213 homes sampled every 5 years for 15 years (remaining 28 homes sampled for SSD systems)
5.7	Sub-slab Soil Vapor Probe Periodic Sampling for SSD	364	Events	$ 2,400	$ 873,600	Assumes will sample 2 SVPs at 28 homes with SSD systems annually for 5 yrs, bi-ann for 10 yrs, and every 5 yrs for 15 yrs
5.8	Asphalt Capping of Streets (1" grind and overlay)	33,000	SY	$ 15	$ 495,000	URS Est.

Subtotal Estimate Alternative 4E without Contingency		**$ 220,000,000**
Total Estimate Alternative 4E with Contingency Range -20% to +30%	**$ 176,000,000**	**$ 286,000,000**
	Low	**High**

Estimated Duration	422 Weeks	8.4 Years	
Estimated Truck Loads/Day	14 Loads/Day Export	14	Loads/Day Import
Estimated Total Loads	21,639 Loads Export	21,043	Loads Import

Table 6-8
Preliminary Cost Estimate For Alternative 5B

Geosyntec consultants

ALTERNATIVE 5B
* Excavate exposed site soils from 0 to 3 feet where HH350 goals are exceeded at residential properties.
* No excavation beneath residential hardscape[A], streets and sidewalks.
* Install subslab mitigation at homes where subslab VOC and methane concentrations exceed screening value.
* MNA remedy for GW.
* Remove LNAPL as feasible. * SVE/Bioventing

Item	Description	Quantity	Unit	Rate	Amount	Comments
1.0	**Property Purchase Cost (285 properties)**	0	LS	NA	**$** -	
2.0	**Demolition Costs**				**$** -	Includes 5% handling on outside services
2.1	Asbestos Surveys	0	LS	$ 3,200	$ -	URS Est.
2.2	Asbestos Abatement	0	LS	$ 18,000	$ -	URS Est.
2.3	D & D of Homes	0	LS	$ 35,000	$ -	AIS Est.
2.4	D & D of Hardscape	0	SF	$ 4	$ -	AIS Est.
3.0	**Excavate, Backfill, & Assoc. Costs**				**$ 26,243,623**	Includes 5% handling on outside services
3.1	Excavate and Load Impacted Soil	30,000	CY	$ 50	$ 1,500,000	219 homes; 1430 sf landscape on average, 3' deep
3.2	Remove and Dispose Concrete Bases	0	TONS	$ 80	$ -	AIS Est.
3.3	Shoring (H pile/lagging or sheet pile)	0	SF	$ 30	$ -	AIS Est. around each house
3.4	Vapor Mitigation	219	EA	$ 1,500	$ 328,500	AIS Est.
3.5	T&D Non Haz Soil (Recycle) 100%	51,000	TON	$ 60	$ 3,060,000	Soil Safe, Adelanto AIS Est.
3.6	T&D RCRA Haz Soil (Out of State) 0%	0	TON	$ 215	$ -	Beaty, NV URS Est.
3.7	Groundwater Remediation	0	LS	$ -	$ -	Assume NMA, no active treatment
3.8	Import Clean Soil	30,000	CY	$ 20	$ 600,000	URS Est.
3.9	Backfill and Compact	30,000	CY	$ 9	$ 270,000	AIS Est.
3.10	Fine Grade	6	ACRES	$ 30,000	$ 185,950	AIS Est.
3.11	SWPP BMPs	1	LS	$ 150,000	$ 150,000	URS Est.
3.12	Subslab Vapor Mitigation	28	EA	$ 20,000	$ 560,000	URS Est.
3.13	Utilities Restoration	219	EA	$ 1,500	$ 328,500	URS Est.
3.14	Landscape	219	EA	$ 25,000	$ 5,475,000	URS Est. Includes $15K block walls
3.15	SVE/Bioventing	1	LS	$ 11,644,303	$ 11,644,303	URS Est.
3.16	Soil Waste Profiling	1	LS	$ 38,000	$ 38,000	URS Est.
3.17	Post-excavation Sampling	1	EA	$ 1,408,164	$ 1,408,164	URS Est. See Tab PEx Samp
4.0	**Other Direct Costs**				**$ 24,760,083**	Includes 5% handling on outside services
4.1	Contingency for Treatment of Rainwater	1	LS	$ 1,000,000	$ 1,000,000	AIS Est.
4.2	PM, Planning, Permitting, Coordination, Reporting	1	LS	$ 5,248,725	$ 5,248,725	20% of Construction $ 23,967 per home
4.3	Grading Permits	219	EA	$ 5,000	$ 1,095,000	
4.4	Geotechnical Investigation/Reports	1	LS	$ -	$ -	
4.5	Field Mgmt, Monitoring, Oversight	1	LS	$ 4,986,288	$ 4,986,288	19% of Construction $ 36,430 per week
4.6	Relocation	219	EA	$ 19,600	$ 4,292,400	$ 700 per day 28 days
4.7	Security	137	WEEKS	$ 54,400	$ 7,446,000	5 guards - 16 hours per day/24 hours weekend
5.0	**Post Excavation Construction and Long Term O&M**				**$ 29,614,173**	Includes 5% handling on outside services
5.1	Groundwater Monitoring	30	YEAR	$ 80,000	$ 2,400,000	URS Est. Assume semi-annual monitoring plus MNA parameters
5.2	LNAPL Recovery	112	Events	$ 4,571	$ 511,952	URS Est. $4.6K / event: monthly for 4 years, quarterly for next 6 years and semi-annualy for next 20 years
5.3	SVE/Bioventing O&M	30	YEAR	$ 683,075	$ 20,492,247	URS Est.
5.4	SVE/Bioventing Performance Sampling	1	LS	$ 2,288,976	$ 2,288,976	
5.5	SSP Probe Install at SSD Properties	28	EA	$ 2,800	$ 78,400	
5.6	Periodic Sub-Slab SVP Sampling Prior to SVE/BV Opns	330	Events	$ 2,400	$ 792,000	Assumes 1.5 bi-annual events at 219 properties for 5.5 years (330 events total)
5.7	Periodic Sub-Slab SVP Sampling After Start of SVE/BV Opns	573	events	$ 2,400	$ 1,375,200	Assumes 191 homes sampled every 5 years for 15 years (219-28=191; remaining 28 homes sampled for SSD systems)
5.7	Sub-slab Soil Vapor Probe Periodic Sampling for SSD	364	Events	$ 2,400	$ 873,600	Assumes will sample 2 SVPs at 28 homes with SSD systems annually for 5 yrs, bi-ann for 10 yrs, and every 5 yrs for 15 yrs
5.8	Asphalt Capping of Streets (1" grind and overlay)	33,000	SY	$ 15	$ 495,000	URS Est.

Subtotal Estimate Alternative 5B without Contingency		**$ 81,000,000**
Total Estimate Alternative 5B with Contingency Range -20% to +30%	**$ 65,000,000**	**$ 105,000,000**
	Low	**High**

Estimated Duration	137 Weeks	2.7 Years
Estimated Truck Loads/Day	5 Loads/Day Export	5 Loads/Day Import
Estimated Total Loads	2,143 Loads Export	2,143 Loads Import

Table 6-9
Preliminary Cost Estimate For Alternative 5C

Geosyntec consultants

ALTERNATIVE 5C
Same as Alt 5B except excavate exposed soils to 5 feet.

Item	Description	Quantity	Unit	Rate	Amount	Comments
1.0	**Property Purchase Cost (285 properties)**	0	LS	NA	**$** -	
2.0	**Demolition Costs**				**$** -	Includes 5% handling on outside services
2.1	Asbestos Surveys	0	LS	$ 3,200	$ -	URS Est.
2.2	Asbestos Abatement	0	LS	$ 18,000	$ -	URS Est.
2.3	D & D of Homes	0	LS	$ 35,000	$ -	AIS Est.
2.4	D & D of Hardscape	0	SF	$ 4	$ -	AIS Est.
3.0	**Excavate, Backfill, & Assoc. Costs**				**$ 38,989,751**	Includes 5% handling on outside services
3.1	Excavate and Load Impacted Soil	57,994	CY	$ 60	$ 3,479,667	219 homes; 1430 sf landscape on average, 5' deep
3.2	Remove and Dispose Concrete Bases	0	TONS	$ 80	$ -	AIS Est.
3.3	Shoring (H pile/lagging or sheet pile)	208,050	SF	$ 30	$ 6,241,500	AIS Est. around each house
3.4	Vapor Mitigation	219	EA	$ 1,500	$ 328,500	AIS Est.
3.5	T&D Non Haz Soil (Recycle) 100%	98,591	TON	$ 60	$ 5,915,433	Soil Safe, Adelanto AIS Est.
3.6	T&D RCRA Haz Soil (Out of State) 0%	0	TON	$ 215	$ -	Beaty, NV AIS Est.
3.7	Groundwater Remediation	0	LS	$ -	$ -	Assume NMA, no active treatment
3.8	Import Clean Soil	57,994	CY	$ 20	$ 1,159,889	URS Est.
3.9	Backfill and Compact	57,994	CY	$ 9	$ 521,950	AIS Est.
3.10	Fine Grade	7	ACRES	$ 30,000	$ 215,682	AIS Est.
3.11	SWPP BMPs	1	LS	$ 200,000	$ 200,000	URS Est.
3.12	Subslab Vapor Mitigation	28	EA	$ 20,000	$ 560,000	URS Est.
3.13	Utilities Restoration	219	EA	$ 2,000	$ 438,000	URS Est.
3.14	Landscape	219	EA	$ 25,000	$ 5,475,000	URS Est. Includes $15K block walls
3.15	SVE/Bioventing	1	LS	$ 11,644,303	$ 11,644,303	URS Est.
3.16	Soil Waste Profiling	1	LS	$ 73,000	$ 73,000	URS Est.
3.17	Post-excavation Sampling	1	EA	$ 1,434,664	$ 1,434,664	URS Est. See Tab PEx Samp
4.0	**Other Direct Costs**				**$ 31,362,263**	Includes 5% handling on outside services
4.1	Contingency for Treatment of Rainwater	1	LS	$ 1,000,000	$ 1,000,000	AIS Est.
4.2	PM, Planning, Permitting, Coordination, Reporting	1	LS	$ 6,628,258	$ 6,628,258	17% of Construction $ 30,266 per home
4.3	Grading Permits	219	EA	$ 5,000	$ 1,095,000	
4.4	Geotechnical Investigation/Reports	1	LS	$ 606,000	$ 606,000	URS Est.
4.5	Field Mgmt, Monitoring, Oversight	1	LS	$ 6,238,360	$ 6,238,360	16.0% of Construction $ 37,981 per week
4.6	Relocation	219	EA	$ 27,300	$ 5,978,700	$ 700 per day 39 days
4.7	Security	164	WEEKS	$ 54,400	$ 8,935,200	5 guards - 16 hours per day/24 hours weekend
5.0	**Post Excavation Construction and Long Term O&M**				**$ 29,873,373**	Includes 5% handling on outside services
5.1	Groundwater Monitoring	30	YEAR	$ 80,000	$ 2,400,000	URS Est. Assume semi-annual monitoring plus MNA parameters
5.2	LNAPL Recovery	112	Events	$ 4,571	$ 511,952	URS Est. $4.6K / event: monthly for 4 years, quarterly for next 6 years and semi-annualy for next 20 years
5.3	SVE/Bioventing O&M	30	YEAR	$ 683,075	$ 20,492,247	URS Est.
5.4	SVE/Bioventing Performance Sampling	1	LS	$ 2,288,976	$ 2,288,976	
5.5	SSP Probe Install at SSD Properties	28	EA	$ 2,800	$ 78,400	
5.6	Periodic Sub-Slab SVP Sampling Prior to SVE/BV Opns	438	Events	$ 2,400	$ 1,051,200	Assumes 2 bi-annual events at 219 properties for 5.5 years (438 events total)
5.7	Periodic Sub-Slab SVP Sampling After Start of SVE/BV Opns	573	events	$ 2,400	$ 1,375,200	Assumes 191 homes sampled every 5 years for 15 years (219-28=191; remaining 28 homes sampled for SSD systems)
5.7	Sub-slab Soil Vapor Probe Periodic Sampling for SSD	364	Events	$ 2,400	$ 873,600	Assumes will sample 2 SVPs at 28 homes with SSD systems annually for 5 yrs, bi-ann for 10 yrs, and every 5 yrs for 15 yrs
5.8	Asphalt Capping of Streets (1" grind and overlay)	33,000	SY	$ 15	$ 495,000	URS Est.
	Subtotal Estimate Alternative 5C without Contingency				**$ 100,000,000**	
	Total Estimate Alternative 5C with Contingency Range -20% to +30%			**$ 80,000,000**	**$ 130,000,000**	
				Low	**High**	

Estimated Duration	164 Weeks	3.3 Years	
Estimated Truck Loads/Day	8 Loads/Day Export	8	Loads/Day Import
Estimated Total Loads	4,142 Loads Export	4,142	Loads Import

Table 6-10
Preliminary Cost Estimate For Alternative 5D

Geosyntec consultants

ALTERNATIVE 5D
Same as Alt 5B except excavate exposed soils to 5 feet with 5-10' in Localized Areas Under Landscape

Item	Description		Quantity	Unit	Rate	Amount	Comments
1.0	**Property Purchase Cost ( )**		0	LS	$ 345,000	**$ -**	Average of recent sales compiled by Sheri Repp, City of Carson Assume 4 houses for SVE system footprint/yard
2.0	**Demolition Costs**					**$ -**	Includes 5% handling on outside services
2.1	Asbestos Surveys		0	LS	$ 3,200	$ -	URS Est.
2.2	Asbestos Abatement		0	LS	$ 18,000	$ -	URS Est.
2.3	D & D of Homes		0	LS	$ 35,000	$ -	AIS Est.
2.4	D & D of Hardscape		0	SF	$ 4	$ -	AIS Est. excludes city sidewalk
3.0	**Excavate, Backfill, & Assoc. Costs**					**$ 47,050,033**	Includes 5% handling on outside services
3.1	Excavate and Load Impacted Soil	0-5 ft	58,500	CY	$ 60	$ 3,510,000	219 homes; 1430 sf landscape on average, 5' deep
3.1.1	Excavate and Load Impacted Soil - Backhoe 67%	5-10 ft	11,866	CY	$ 80	$ 949,280	82 front and back yards
3.1.2	Excavate and Load Impacted Soil - Auger 33%	5-10 ft	5,934	CY	$ 225	$ 1,335,150	
3.2	Remove and Dispose Concrete Bases		2,927	TONS	$ 80	$ 234,188	AIS Est. (excludes city sidewalk)
3.3	Shoring (H pile/lagging or sheet pile)		0	SF	$ 40	$ -	
3.4	Vapor Mitigation		219	EA	$ 2,500	$ 547,500	AIS Est.
3.5	T&D Non Haz Soil (Recycle) 100% 0-5 ft & 67% 5-10 ft		119,724	TON	$ 60	$ 7,183,452	Soil Safe, Adelanto AIS Est. 1.7 tons/cy
3.6	T&D RCRA Haz Soil (Out of State) 33% of 5-10 ft		9,986	TON	$ 215	$ 2,146,947	Beaty, NV AIS Est.
3.7	Groundwater Remediation		1	LS	$ -	$ -	Assume MNA and no active treatment
3.8	Import Clean Soil		58,500	CY	$ 20	$ 1,170,000	URS Est.
3.8.1	2 Sack Slurry Backfill		17,800	CY	$ 100	$ 1,780,000	URS Est.
3.9	Backfill and Compact		58,500	CY	$ 9	$ 526,500	AIS Est.
3.10	Fine Grade		7.3	ACRES	$ 30,000	$ 217,562	AIS Est.
3.11	SWPPP BMPs		1	LS	$ 500,000	$ 500,000	URS Est.
3.12	Subslab Vapor Mitigation		28	EA	$ 20,000	$ 560,000	URS Est.
3.13	Utilities Restoration		219	EA	$ 5,000	$ 1,095,000	URS Est.
3.14	Landscape/Hardscape		219	EA	$ 45,000	$ 9,855,000	URS Est. Includes $15K block walls
3.15	SVE/Bioventing		1	LS	$ 11,644,303	$ 11,644,303	URS Est.
3.16	Soil Waste Profiling		1	LS	$ 96,000	$ 96,000	URS Est. ~ 1 sample per 500 cy at $630
3.17	Post-excavation Sampling		1	EA	$ 2,013,164	$ 2,013,164	URS Est. See Tab PEx Samp
4.0	**Other Direct Costs**					**$ 39,435,632**	Includes 5% handling on outside services
4.1	Contingency for Treatment of Rainwater		1	LS	$ 1,000,000	$ 1,000,000	AIS Est.
4.2	PM, Planning, Design, Coordination, Reporting		1	LS	$ 7,057,505	$ 7,057,505	15% of Construction $ 32,226 per home
4.3	Grading Permits		219	EA	$ 5,000	$ 1,095,000	URS Est.
4.4	Geotechnical Investigation/Reports		1	LS	$ 814,000	$ 814,000	URS Est.
4.5	Field Mgmt, Monitoring, Oversight		1	LS	$ 9,410,007	$ 9,410,007	20% of Construction $ 42,968 per week
4.6	Relocation		219	EA	$ 32,200	$ 7,051,800	$ 700 per day 46 days
4.7	Security		219	WEEKS	$ 54,400	$ 11,913,600	5 guards - 16 hours per day/24 hours weekend
5.0	**Post Excavation Construction and Long Term O&M**					**$ 30,137,395**	Includes 5% handling on outside services
5.1	Groundwater Monitoring		30	YEARS	$ 80,000	$ 2,400,000	URS Est. Assume semi-annual monitoring plus MNA parameters
5.2	LNAPL Recovery		112	events	$ 4,571	$ 511,973	URS Est. $4.6K / event: monthly for 4 years, quarterly for next 6 years and semi-annualy for next 20 years
5.3	SVE/Bioventing O&M		30	YEAR	$ 683,075	$ 20,492,247	URS Est.
5.4	SVE/Bioventing Performance Sampling		1	LS	$ 2,288,976	$ 2,288,976	
5.5	SSP Probe Install at SSD Properties		28	EA	$ 2,800	$ 78,400	
5.6	Periodic Sub-Slab SVP Sampling Prior to SVE/BV Opns		548	Events	$ 2,400	$ 1,315,200	Assumes 2.5 bi-annual events at 219 properties for 5.5 years (548 events total)
5.7	Periodic Sub-Slab SVP Sampling After Start of SVE/BV Opns		573	events	$ 2,400	$ 1,375,200	Assumes 191 homes sampled every 5 years for 15 years (219-28=191; remaining 28 homes sampled for SSD systems)
5.7	Sub-slab Soil Vapor Probe Periodic Sampling for SSD		364	Events	$ 2,400	$ 873,600	Assumes will sample 2 SVPs at 28 homes with SSD systems annually for 5 yrs, bi-ann for 10 yrs, and every 5 yrs for 15 yrs
5.8	Asphalt Capping of Streets (1" grind and overlay)		33,000	SY	$ 15	$ 495,000	URS Est.
	Subtotal Estimate Alternative 5D without Contingency					**$ 117,000,000**	
	Total Estimate Alternative 5D with Contingency Range -20% to +30%				**$ 94,000,000**	**$ 152,000,000**	
					Low	**High**	

Estimated Duration	Excavation duration + 1.5 week	219 Weeks	4.4 Years
Estimated Truck Loads/Day	4 houses at a time	8.0 Loads/Day Export	7.96 Loads/Day Import
Estimated Total Loads	2.5 weeks per house to excavate	5,450 Loads Export	5,450 Loads Import

Table 6-11
Preliminary Cost Estimate For Alternative 5E

Geosyntec consultants

ALTERNATIVE 5E
Same as Alt 5B except excavate exposed soils to 10 feet.

Item	Description	Quantity	Unit	Rate	Amount	Comments
1.0	**Property Purchase Cost (285 properties)**	0	LS	NA	**$** -	
2.0	**Demolition Costs**				**$** -	Includes 5% handling on outside services
2.1	Asbestos Surveys	0	LS	$ 3,200	$ -	URS Est.
2.2	Asbestos Abatement	0	LS	$ 18,000	$ -	URS Est.
2.3	D & D of Homes	0	LS	$ 35,000	$ -	AIS Est.
2.4	D & D of Hardscape	0	SF	$ 4	$ -	AIS Est.
3.0	**Excavate, Backfill, & Assoc. Costs**				**$ 77,436,183**	Includes 5% handling on outside services
3.1	Excavate and Load Impacted Soil	127,641	CY	$ 80	$ 10,211,259	241 homes; 1550 sf landscape on average, 10' deep
3.2	Remove and Dispose Concrete Bases	9,844	TONS	$ 80	$ 787,558	AIS Est. 137 properties with conc res bases
3.3	Shoring (H pile/lagging or sheet pile)	457,900	SF	$ 50	$ 22,895,000	AIS Est. around each house
3.4	Vapor Mitigation	241	EA	$ 1,500	$ 361,500	AIS Est.
3.5	T&D Non Haz Soil (Recycle) 98%	212,649	TON	$ 60	$ 12,758,968	Soil Safe, Adelanto AIS Est.
3.6	T&D RCRA Haz Soil (Out of State) 2%	4,340	TON	$ 215	$ 933,054	Beaty, NV AIS Est.
3.7	Groundwater Remediation	0	LS	$ -	$ -	Assume NMA, no active treatment
3.8	Import Clean Soil	127,641	CY	$ 20	$ 2,552,815	URS Est.
3.9	Backfill and Compact	127,641	CY	$ 9	$ 1,148,767	AIS Est.
3.10	Fine Grade	8	ACRES	$ 30,000	$ 237,348	AIS Est.
3.11	SWPP BMPs	1	LS	$ 250,000	$ 250,000	URS Est.
3.12	Subslab Vapor Mitigation	28	EA	$ 20,000	$ 560,000	URS Est.
3.13	Utilities Restoration	241	EA	$ 5,000	$ 1,205,000	URS Est.
3.14	Landscape	241	EA	$ 25,000	$ 6,025,000	URS Est. Includes $15K block walls
3.15	SVE/Bioventing	1	LS	$ 11,644,303	$ 11,644,303	URS Est.
3.16	Soil Waste Profiling	1	LS	$ 161,000	$ 161,000	URS Est.
3.17	Post-excavation Sampling	1	EA	$ 2,571,664	$ 2,571,664	URS Est. See Tab PEx Samp
4.0	**Other Direct Costs**				**$ 50,050,834**	Includes 5% handling on outside services
4.1	Contingency for Treatment of Rainwater	1	LS	$ 1,000,000	$ 1,000,000	AIS Est.
4.2	PM, Planning, Permitting, Coordination, Reporting	1	LS	$ 8,517,980	$ 8,517,980	11% of Construction $ 35,344 per home
4.3	Grading Permits	241	EA	$ 5,000	$ 1,205,000	
4.4	Geotechnical Investigation/Reports	1	LS	$ 896,000	$ 896,000	URS Est.
4.5	Field Mgmt, Monitoring, Oversight	1	LS	$ 12,389,789	$ 12,389,789	16% of Construction $ 41,128 per week
4.6	Relocation	241	EA	$ 34,300	$ 8,266,300	$ 700 per day 49 days
4.7	Security	301	WEEKS	$ 54,400	$ 16,388,000	5 guards - 16 hours per day/24 hours weekend
5.0	**Post Excavation Construction and Long Term O&M**				**$ 31,294,173**	Includes 5% handling on outside services
5.1	Groundwater Monitoring	30	YEAR	$ 80,000	$ 2,400,000	URS Est. Assume semi-annual monitoring plus MNA parameters
5.2	LNAPL Recovery	112	Events	$ 4,571	$ 511,952	URS Est. $4.6K / event: monthly for 4 years, quarterly for next 6 years and semi-annualy for next 20 years
5.3	SVE/Bioventing O&M	30	YEAR	$ 683,075	$ 20,492,247	URS Est.
5.4	SVE/Bioventing Performance Sampling	1	LS	$ 2,288,976	$ 2,288,976	
5.5	SSP Probe Install at SSD Properties	28	EA	$ 2,800	$ 78,400	
5.6	Periodic Sub-Slab SVP Sampling Prior to SVE/BV Opns	964	Events	$ 2,400	$ 2,313,600	Assumes 4 bi-annual events at 241 properties for 5.5 years (908 events total)
5.7	Periodic Sub-Slab SVP Sampling After Start of SVE/BV Opns	639	events	$ 2,400	$ 1,533,600	Assumes 213 homes sampled every 5 years for 15 years (remaining 28 homes sampled for SSD systems)
5.7	Sub-slab Soil Vapor Probe Periodic Sampling for SSD	364	Events	$ 2,400	$ 873,600	Assumes will sample 2 SVPs at 28 homes with SSD systems annually for 5 yrs, bi-ann for 10 yrs, and every 5 yrs for 15 yrs
5.8	Asphalt Capping of Streets (1" grind and overlay)	33,000	SY	$ 15	$ 495,000	URS Est.
	Subtotal Estimate Alternative 5E without Contingency				**$ 159,000,000**	
	Total Estimate Alternative 5E with Contingency Range -20% to +30%			**$ 127,000,000**	**$ 207,000,000**	
				Low	**High**	

Estimated Duration	301 Weeks	6.0 Years
Estimated Truck Loads/Day	10 Loads/Day Export	10 Loads/Day Import
Estimated Total Loads	9,117 Loads Export	9,117 Loads Import

Table 6-12
Preliminary Cost Estimate For Alternative 7

Geosyntec consultants

ALTERNATIVE 7
* Cap all areas of exposed soil at the site.
* Install subslab mitigation at homes where subslab VOC and methane concentrations exceed screening values.
* Remove LNAPL as feasible.
* MNA remedy for GW.
* SVE/Bioventing

Item	Description	Quantity	Unit	Rate	Amount	Comments
1.0	**Property Purchase Cost (285 properties)**	0	LS	NA	**$ -**	
2.0	**Demolition Costs**				**$ -**	
2.1	Asbestos Surveys	0	LS	$ 3,200	**$ -**	Includes 5% handling on outside services
2.2	Asbestos Abatement	0	LS	$ 18,000	$ -	URS Est.
2.3	D & D of Homes	0	LS	$ 35,000	$ -	AIS Est.
2.4	D & D of Hardscape	0	SF	$ 4	$ -	AIS Est.
3.0	**Excavate, Backfill, & Assoc. Costs**				**$ 20,326,100**	Includes 5% handling on outside services
3.1	Excavate and Load Impacted Soil	6,011	CY	$ 20	$ 120,226	Clear and grub surface to 6"
3.2	Remove and Dispose Concrete Bases	0	TONS	$ 80	$ -	AIS Est.
3.3	Shoring (H pile/lagging or sheet pile)	0	SF	$ 30	$ -	AIS Est.
3.4	Vapor Mitigation	0	LS	$ 500,000	$ -	AIS Est.
3.5	T&D Non Haz Soil (Recycle) 100%	10,219	TON	$ 60	$ 613,152	Soil Safe, Adelanto AIS Est.
3.6	T&D RCRA Haz Soil (Out of State) 10%	0	TON	$ 215	$ -	Beaty, NV AIS Est.
3.7	Groundwater Remediation	0	LS	$ -	$ -	Assume NMA, no active treatment
3.8	Import Clean Soil	0	CY	$ 20	$ -	URS Est.
3.9	Backfill and Compact	0	CY	$ 9	$ -	AIS Est.
3.10	Fine Grade	0	ACRES	$ 30,000	$ -	AIS Est.
3.11	SWPP BMPs	1	LS	$ 150,000	$ 150,000	URS Est.
3.12	Subslab Vapor Mitigation	28	EA	$ 20,000	$ 560,000	URS Est.
3.13	Landscape with Artificial Turf/Pavers etc.	227	EA	$ 30,000	$ 6,810,000	URS Est.
3.15	SVE/Bioventing	1	LS	$ 11,644,303	$ 11,644,303	URS Est.
3.16	Soil Waste Profiling	1	LS	$ 15,000	$ 15,000	URS Est.
4.0	**Other Direct Costs**				**$ 6,216,308**	Includes 5% handling on outside services
4.1	Contingency for Treatment of Rainwater	1	LS	$ 500,000	$ 500,000	AIS Est.
4.2	PM, Planning, Coordination, Reporting	1	LS	$ 3,658,698	$ 3,658,698	18% of Construction $ 16,118 per home
4.3	Field Mgmt, Monitoring, Oversight, Security	1	LS	$ 2,032,610	$ 2,032,610	10% of Construction $ 35,817 per week
5.0	**Post Excavation Construction and Long Term O&M**				**$ 6,407,702**	Includes 5% handling on outside services
5.1	Groundwater Monitoring	30	YEAR	$ 80,000	$ 2,400,000	URS Est. Assume semi-annual monitoring plus MNA parameters
5.2	LNAPL Recovery	112	Events	$ 4,571	$ 511,952	URS Est. $4.6K / event: monthly for 4 years, quarterly for next 6 years and semi-annualy for next 20 years
5.3	SVE/Bioventing O&M	30	YEAR	$ -	$ -	URS Est.
5.4	SVE/Bioventing Performance Sampling	1	LS			
5.5	SSP Probe Install at SSD Properties	84	EA	$ 2,800	$ 235,200	
5.6	Sub-slab Soil Vapor Probe Periodic Sampling	1,092	Events	$ 2,400	$ 2,620,800	Assumes will sample 2 SVPs at 84 homes with SSD systems annually for 5 yrs, semi-ann for 10 yrs, and every 5 yrs for 15 yrs
5.7	Asphalt Capping of Streets (1" grind and overlay)	33,000	SY	$ 15	$ 495,000	URS Est.

Subtotal Estimate Alternative 7 without Contingency		**$ 33,000,000**
Total Estimate Alternative 7 with Contingency Range -20% to +30%	**$ 26,000,000**	**$ 43,000,000**
	Low	**High**

Estimated Duration	57 Weeks	1.1 Years

Table 6-13
Detailed Evaluation of Remedial Alternatives

Alternative		Detailed Evaluation Criteria[1]										
		Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, and Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost Estimate**	**State Acceptance**	**Consistency with Resolution 92-49**	**Social Considerations**	**Sustainability**
Alt 1 No Action		No action taken. Not protective.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavate Beneath Residential Landscape and Hardscape; SVE / Bioventing; Sub-slab Mitigation; LNAPL Recovery; Groundwater Monitored Natural Attenuation and Treatment; Existing Institutional Controls.	**Alt 4B Excavate To 3 Feet**	Highly protective. Planned excavation would mitigate incidental contact with impacted soils. SSD would mitigate potential for vapor intrusion. Institutional controls, SVE/bioventing, LNAPL removal, groundwater MNA and contingency groundwater treatment as needed would be protective.	High degree of compliance. ARARs are met through remedial action.	Highly effective and permanent in the long term.	High degree of reduction of toxicity, mobility and volume through treatment (SVE/ bioventing, LNAPL removal, contingency groundwater treatment).	Short-term effectiveness is relatively high through careful planning and execution. Potential for community and worker exposure during excavation would be mitigated. SVE/bioventing and SSD would be effective in the short-term.	Implementability is relatively high because utility lines are likely to be below this depth, shoring would not be required, and there would be a relatively small volume of soils. Permission from property owners must be granted to implement remedy.	$101MM; contingency range is $81MM to $131MM	RWQCB believes an excavation to 3 ft bgs may not be sufficient to address nuisance caused; may not protect residents from exposure during the some types of residential activities; and would leave a considerable mass of waste in Site soil that could continue to leach to groundwater.	Shell believes Alt. 4B is fully compliant with Resolution 92-49. RWQCB does not believe this alternative performs as well against this criterion as do alternatives which excavate deeper.	Low-to-moderate social impact. Landscape and hardscape would be temporarily removed. Neighborhoods would be impacted by traffic, noise, dust, and odors. 207-219* properties would be affected by excavation; 224-236* by SVE/bioventing.	Moderate sustainability. Excavation equipment, truck emissions and greenhouse gas emissions would affect air quality. The disposal of some impacted materials would occupy landfill space, affecting a future resource.
	Alt 4C Excavate To 5 Feet	Highly protective. Planned excavation would mitigate incidental contact with impacted soils. SSD would mitigate potential for vapor intrusion. Institutional controls, SVE/bioventing, LNAPL removal, groundwater MNA and contingency groundwater treatment as needed would be protective.	High degree of compliance. ARARs are met through remedial action.	Highly effective and permanent in the long term.	High degree of reduction of toxicity, mobility and volume through treatment technologies listed above.	Short-term effectiveness is moderate. While SVE/bioventing and SSD would be as effective as in Alt 4B, there would be more disruption of Site features and community and worker exposure.	Implementability is moderate because shoring or slot trenching would be required where utilities would be encountered during excavation. Utility lines would have to be removed and replaced, or protected and manually excavated around. Permission from property owners must be granted to implement remedy.	$129MM; contingency range is $103MM to $168MM	Likely would address RWQCB concerns regarding potential nuisance; would protect residents from exposure during some types of residential activities; would remove a larger mass of waste in Site soil than with a 3-foot excavation. Logical to assume that larger mass removal would result in incremental (but not measureable) reduction of SVE/bioventing system operating time, and therefore the time required to achieve groundwater cleanup goals.	Since an even greater mass of impacted soil is removed, RWQCB may conclude that this alternative better meets requirements of 92-49 than Alt. 4B.	Moderate-to-significant social impact due to potential utility disruption, truck traffic, remedy implementation time. Excavation and soil import would take multiple days because of additional soil, shoring, and work with utilities. 207-219* properties would be affected by excavation; 224-236* by SVE/bioventing.	Low-to-moderate sustainability. More excavation would increase the impacts listed for Alt 4B.

Table 6-13
Detailed Evaluation of Remedial Alternatives

Alternative		Detailed Evaluation Criteria[1]										
		Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, and Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost Estimate**	**State Acceptance**	**Consistency with Resolution 92-49**	**Social Considerations**	**Sustainability**
	Alt 4D Excavate To 5 Feet with Targeted Deeper Excavation to 10 Feet	Highly protective. Planned excavation would mitigate incidental contact with impacted soils. SSD would mitigate potential for vapor intrusion. Institutional controls, SVE/bioventing, LNAPL removal, groundwater MNA and contingency groundwater treatment as needed would be protective.	High degree of compliance. ARARs are met through remedial action.	Highly effective and permanent in the long term.	High degree of reduction of toxicity, mobility and volume through treatment technologies listed above.	Short-term effectiveness is low. While SVE/bioventing and SSD would be as effective as in Alt 4B, there would be more disruption of Site features and community and higher worker exposures due to longer excavation periods.	Implementability is difficult because shoring or slot trenching would be required where utilities would be encountered during excavation. Utility lines would have to be removed and replaced, or protected and manually excavated around. Permission from property owners must be granted to implement remedy. May require specialized excavation equipment for excavation to 10 ft bgs.	$146MM; contingency range is $117MM to $190MM	Likely would be sufficient to address RWQCB concerns regarding potential nuisance; would protect residents from exposure during some types of residential activities; would remove an even larger mass of waste than shallower excavation; larger amount of mass removal would result in incremental (but non measureable) reduction of operating time of SVE/bioventing system, and therefore the time required to achieve GW goals.	Since an even greater mass of impacted soil is removed, RWQCB may conclude that this alternative better meets requirements of 92-49 than Alt. 4B.	Significant social impact due to potential utility disruption, truck traffic, longer remedy implementation time. Excavation and soil import would take multiple days because of additional soil, shoring, and work with utilities. 207-219* properties would be affected by excavation; 224-236* by SVE/bioventing.	Low-to-moderate sustainability. More excavation would increase the impacts listed for Alt 4B.
	Alt 4E Excavate To 10 Feet	Highly protective. Planned excavation would mitigate incidental contact with impacted soils for uses other than extensive construction. SSD would mitigate potential for vapor intrusion. Institutional controls, SVE/bioventing, LNAPL removal, groundwater MNA and contingency groundwater treatment as needed would be protective.	High degree of compliance. ARARs are met through remedial action.	Highly effective and permanent in the long term.	High degree of reduction of toxicity, mobility and volume through treatment technologies listed above.	Short-term effectiveness is very low. While SVE/bioventing and SSD would be as effective as in Alt 4B, there would be extensive disruption of Site features, exposures to community, and higher worker exposures due to longer excavation periods and more properties being affected.	Implementability is very difficult. An excavator large enough to reach this depth would not be able to access the backyard via the side yard. Large setbacks would be required, resulting in only being able to excavate 40% of the front yard. Shoring and setbacks required not feasible. May require specialized excavation equipment for excavation to 10 ft bgs.	$220MM; contingency range is $176 MM to $286MM	Would be extremely difficult to implement and would not further reduce nuisance when compared with shallower excavation; would not further protect residents from exposure during some types of residential activities; would remove an even larger mass of waste in Site soil than would be removed under Alts. 4C or 4D, but such removal would be achieved only at an economically infeasible cost; would create additional disruption to the community due to much longer remedial timeframe.	Because the marginal benefit from removing the additional mass is greatly outweighed by the additional cost and disruption to the homeowners and the community, this alternative does not best meet the requirements of Resolution 92-49.	Very significant social impact due to utility disruption, truck traffic, long remedy implementation time. Excavation and soil import would take several days because of additional soil, shoring, and utility work. 229-241* properties would be affected by excavation; 224-236* by SVE/bioventing.	Low sustainability. More excavation would roughly triple the impacts listed for Alt 4B.

Table 6-13
Detailed Evaluation of Remedial Alternatives

Alternative		Detailed Evaluation Criteria[1]										
		Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, and Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost Estimate**	**State Acceptance**	**Consistency with Resolution 92-49**	**Social Considerations**	**Sustainability**
Excavate Beneath Residential Landscape; SVE / Bioventing; Sub-slab Mitigation; LNAPL Recovery; Groundwater Monitored Natural Attenuation and Treatment; Existing Institutional Controls.	**Alt 5B Excavate To 3 Feet**	Moderately protective. It is less than 4B because hardscape could be removed and contact with impacted soils possible. Planned excavation would mitigate incidental contact with impacted soils. SSD would mitigate potential for vapor intrusion. Institutional controls, SVE/bioventing, LNAPL removal, groundwater MNA and contingency groundwater treatment as needed would be protective.	High degree of compliance. ARARs are met through remedial action.	Moderately effective and permanent in the long term. Hardscape could be removed and contact with impacted soils possible.	High degree of reduction of toxicity, mobility and volume through treatment technologies listed above.	Short-term effectiveness is relatively high through careful planning and execution. Potential for community and worker exposure during excavation would be mitigated. SVE and SSD would be effective in the short-term.	Implementability is relatively high because utility lines are likely to be below this depth, and this alternative relies on existing institutional controls. Permission from property owners must be granted to implement remedy.	$81MM; contingency range is $65MM to $105MM	RWQCB has expressed concerns regarding nuisance, potential inadequacy of ICs to protect human health, and lack of protection of groundwater with excavations ≤ 3 feet bgs. These concerns are heightened when soils beneath residential hardscapes are left in place.	Not as compliant with Resolution 92-49, because a lesser level of protectiveness is achieved compared with Alt 4 series.	Relatively low-to-moderate social impact. Landscape would be temporarily removed. Neighborhoods would be impacted by traffic, noise, dust, and odors. Would likely be able to complete excavation and soil replacement within a day for each property. 207-219* properties would be affected by excavation; 224-236* by SVE/bioventing.	Moderate-to-high sustainability. Excavation equipment and truck emissions would affect air quality. The disposal of contaminated soil would occupy landfill space, and could be a future issue.
	Alt 5C Excavate To 5 Feet	Moderately protective, less than 4C. Planned excavation would prevent most contact with impacted soils. SSD would mitigate potential for vapor intrusion. Institutional controls, SVE/bioventing, LNAPL removal, groundwater MNA and contingency groundwater treatment as needed would be protective.	High degree of compliance. ARARs are met through remedial action.	Moderately effective and permanent in the long term. Hardscape could be removed and contact with impacted soils possible.	High degree of reduction of toxicity, mobility and volume through treatment technologies listed above.	Short-term effectiveness is moderate. While SVE/bioventing and SSD would be as effective as in Alt 4B, there would be more disruption of site features and community and worker exposure.	Implementability is moderate because shoring or slot trenching would be required where utilities would be encountered during excavation. Utility lines would have to be removed and replaced, or protected and manually excavated around. Permission from property owners must be granted to implement remedy.	$100MM; contingency range is $80MM to $130MM	RWQCB has expressed concerns regarding nuisance and lack of protection of groundwater with excavations ≤ 5 feet bgs. When soils beneath residential hardscapes are left in place, RWQCB has concerns regarding the potential inadequacy of ICs to protect human health.	Not as compliant with Resolution 92-49, because a lesser level of protectiveness is achieved compared with Alt 4 series.	Moderate-to-significant social impact due to potential utility service disruption, truck traffic, and remedy implementation time. Excavation and soil replacement would take multiple days because of additional soil, shoring, and work with utilities. 207-219* properties would be affected by excavation; 224-236* by SVE/bioventing.	Low-to-moderate sustainability. More excavation would increase the impacts listed for Alt 5B.
	Alt 5D Excavate To 5 Feet with Targeted Deeper Excavation to 10 Feet	Moderately protective, less than 4D. Planned excavation would prevent most contact with impacted soils. SSD would mitigate potential for vapor intrusion. Institutional controls, SVE/bioventing, LNAPL removal, groundwater MNA and contingency groundwater treatment as needed would be protective.	High degree of compliance. ARARs are met through remedial action.	Moderately effective and permanent in the long term. Hardscape could be removed and contact with impacted soils possible.	High degree of reduction of toxicity, mobility and volume through treatment technologies listed above.	Short-term effectiveness is low. While SVE/bioventing and SSD would be as effective as in Alt 4B, there would be more disruption of site features and community and worker exposure due to longer excavation periods.	Implementability is difficult because shoring or slot trenching would be required where utilities would be encountered during excavation. Utility lines would have to be removed and replaced, or protected and manually excavated around. Permission from property owners must be granted to implement remedy. May require specialized excavation equipment for excavation to 10 ft bgs.	$117MM; contingency range is $94MM to $152MM	Though RWQCB has indicated that excavation to 5 feet bgs with targeted excavation to 10 feet bgs would be an acceptable alternative, when soils beneath residential hardscapes are left in place, RWQCB has concerns regarding the potential inadequacy of ICs to protect human health.	Not as compliant with Resolution 92-49, because a lesser level of protectiveness is achieved compared with Alt 4 series.	Significant social impact due to potential utility service disruption, truck traffic, and longer remedy implementation time. Excavation and soil replacement would take multiple days because of additional soil, shoring, and work with utilities. 207-219* properties would be affected by excavation; 224-236* by SVE/bioventing.	Low-to-moderate sustainability. More excavation would increase the impacts listed for Alt 5B.

Table 6-13
Detailed Evaluation of Remedial Alternatives

Alternative		Detailed Evaluation Criteria[1]										
		Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, and Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost Estimate**	**State Acceptance**	**Consistency with Resolution 92-49**	**Social Considerations**	**Sustainability**
	Alt 5E Excavate To 10 Feet	Moderately protective, less than 4E. Planned excavation would prevent contact with impacted soils for uses other than extensive construction. SSD would mitigate potential for vapor intrusion. Institutional controls, SVE/bioventing, LNAPL removal, groundwater MNA and contingency groundwater treatment as needed would be protective.	High degree of compliance. ARARs are met through remedial action.	Moderately effective and permanent in the long term. Hardscape could be removed and contact with impacted soils possible.	High degree of reduction of toxicity, mobility and volume through treatment technologies listed above.	Short-term effectiveness is very low. While SVE/bioventing and SSD would be as effective as in Alt 4B, there would be much more of disruption of site features, exposures to community, and higher worker exposures due to longer excavation periods and more properties being affected.	Implementability is very difficult. An excavator large enough to reach this depth would not be able to access the backyard via the side yard. Large setbacks would be required, resulting in only being able to excavate 40% of the front yard. Shoring and setbacks required not feasible. May require specialized excavation equipment for excavation to 10 ft bgs.	$159MM; contingency range is $127MM to $207MM	Though RWQCB has indicated that excavation to 10 feet bgs would be an acceptable alternative, when soils beneath residential hardscapes are left in place, RWQCB has concerns regarding the potential inadequacy of ICs to protect human health.	Not as compliant with Resolution 92-49, because a lesser level of protectiveness is achieved compared with Alt 4 series.	Very significant level of social impact due to utility service disruption, truck traffic, and long remedy implementation time. Excavation and soil replacement would take several days because of additional soil, shoring, and work with utilities. 229-241* properties would be affected by excavation; 224-236* by SVE/bioventing.	Low sustainability. More excavation would roughly triple the impacts listed for Alt 5B.
Alt 7 Cap Site		Moderate-to-highly protective. Combination of capping the Site, institutional controls, SVE/bioventing, LNAPL removal, groundwater MNA and contingency groundwater treatment as needed would be protective.	High degree of compliance. ARARs are met through remedial action.	Highly effective and permanent in the long term.	Moderate-to-high degree of reduction of toxicity, mobility and volume through treatment technologies listed above.	Short-term effectiveness is relatively high, due to only moderate disruption and exposure to community and worker exposure.	Implementability is moderate because excavation is expected to be minimal, so utility lines would not be encountered. Additional permits and institutional controls would be required to prevent residents from contacting impacted soil.	$33MM; contingency range is $26MM to $43MM	RWQCB has expressed concerns regarding a lack of protection of groundwater with alternatives that do not include excavation.	Not as compliant with Resolution 92-49, because of modified land use. Current land use could not accommodate normal residential landscape.	Significant social impact because of the removal and cover of landscape. May affect long-term property values. Would likely be able to complete installation of cap within a day for each property. 285 properties would be affected; 224-236* by SVE/bioventing.	Moderate-to-high sustainability. Relatively little use of trucks, excavators or landfill space. Capping may affect stormwater quality, and groundwater recharge would be reduced.

[1] Community Acceptance will be evaluated after public comment on the Revised FS and Revised RAP.

* Ranges are due to addition of 12 properties for which no environmental characterization data have been collected as of September 9, 2014. Whether excavation is needed at these 12 properties, and the scope of any such work, would be established based on analysis of sampling data obtained if and when access is obtained.

Table 7-1
Comparative Evaluation of Remedial Alternatives

Alternative		Detailed Evaluation Criteria[1]											
		Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, and Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost**	**State Acceptance**	**Consistency with Resolution 92-49**	**Social Considerations**	**Sustainability**	**OVERALL SCORE**
Alternative 1 No Action		Does not meet threshold requirement.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**N/A**
Alternative 4: Excavate Beneath Residential Landscape and Hardscape; SVE / Bioventing; Sub-slab Mitigation; LNAPL Recovery; Monitored Natural Attenuation and Groundwater Treatment; Existing Institutional Controls.	**Alt 4B Excavate To 3 Feet**	Meets threshold requirement.	Complies with ARARs.	High: 5	High: 5	High: 5	High: 4	$81 million to $131 million – Moderate to High Cost: 2	RWQCB has expressed concerns	High: Fully compliant: 5	Low-to-Moderate Impact: 4	Moderate: 3	RWQCB has expressed concerns
	Alt 4C Excavate To 5 Feet	Meets threshold requirement.	Complies with ARARs.	High: 5	High: 5	Moderate: 3	Moderate: 3	$103 million to $168 million – High Cost: 1	RWQCB has expressed concerns	Moderate-to-High: Less compliant: 4	Moderate-to-Significant Impact: 2	Low-to-Moderate: 2	RWQCB has expressed concerns
	Alt 4D Excavate To 5 Feet	Meets threshold requirement.	Complies with ARARs.	High: 5	High: 5	Low: 2	Difficult: 2	$117 million to $190 million – High to Very High Cost: 1	Acceptable	Moderate-to-High: Less compliant: 4	Significant Impact: 2	Low-to-Moderate: 2	**23**
	Alt 4E Excavate To 10 Feet	Meets threshold requirement.	Complies with ARARs.	High: 5	High: 5	Very low: 1	Very Difficult: 1	$176 million to $286 million – Very High Cost: 1	Acceptable	Moderate-to-High: Less compliant: 4	Very Significant Impact: 1	Low: 1	**19**
Alternative 5: Excavate Beneath Residential Landscape; SVE / Bioventing; Sub-slab Mitigation; LNAPL Recovery; Monitored Natural Attenuation and Groundwater Treatment; Existing Institutional Controls.	**Alt 5B Excavate To 3 Feet**	Meets threshold requirement.	Complies with ARARs.	Moderate: 3	High: 5	High: 5	High: 4	$65 million to $105 million – Moderate Cost: 3	Not Acceptable due to RWQCB concerns	Moderate-to-High: Less compliant: 4	Low-Moderate Impact: 4	Moderate-to-High: 4	Not Acceptable due to RWQCB concerns
	Alt 5C Excavate To 5 Feet	Meets threshold requirement.	Complies with ARARs.	Moderate: 3	High: 5	Moderate: 3	Moderate: 3	$80 million to $130 million – Moderate to High Cost: 2	Not Acceptable due to RWQCB concerns	Moderate-to-High: Less compliant: 4	Moderate-to-Significant Impact: 2	Low-to-Moderate: 2	Not Acceptable due to RWQCB concerns
	Alt 5D Excavate To 5 Feet	Meets threshold requirement.	Complies with ARARs.	Moderate: 3	High: 5	Low: 2	Difficult: 2	$94 million to $152 million – Moderate to High Cost: 2	Not Acceptable due to RWQCB concerns	Moderate-to-High: Less compliant: 4	Significant Impact: 2	Low-to-Moderate: 2	Not Acceptable due to RWQCB concerns

Table 7-1
Comparative Evaluation of Remedial Alternatives

Alternative		Detailed Evaluation Criteria[1]											
		Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, and Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost**	**State Acceptance**	**Consistency with Resolution 92-49**	**Social Considerations**	**Sustainability**	**OVERALL SCORE**
	Alt 5E Excavate To 10 Feet	Meets threshold requirement.	Complies with ARARs.	Moderate: 3	High: 5	Very Low: 1	Very Difficult: 1	$127 million to $207 million – High to Very High Cost: 1	Not Acceptable due to RWQCB concerns	Moderate-to-High: Less compliant: 4	Very Significant Impact: 1	Low: 1	Not Acceptable due to RWQCB concerns
Alternative 7 Cap Site		Meets threshold requirement.	Complies with ARARs.	High: 5	Moderate-to-High: 4	High: 5	Moderate: 3	$26 million to $43 million – Moderate Cost: 3	Not Acceptable due to RWQCB concerns	Moderate-to-High: Less compliant: 4	Significant Impact: 1	Moderate-to-High: 4	Not Acceptable due to RWQCB concerns

[1] Note: Community Acceptance will be evaluated after public comment on the RAP.

Table A-1.2 Estimates of TPH Mass in Vadose Zone to be Excavated
Former Kast Site, Carson, CA

Geosyntec Consultants

	Alternative 4B	Alternative 4C	Alternative 4D	Alternative 4E
Alternative from Feasibility Study, Residential Hardscapes Removed	**Excavation to 3 ft**	**Excavation to 5 ft**	**Targeted Excavation from 5 to 10 ft**	**Excavation to 10 ft**
	excavate 367 cubic yards per lot at 219 lots, approximately 80,000 cy	excavate 611 cubic yards per lot at 219 lots, approximately 134,000 cy	excavate 146 front and back yards at 97 lots from > 5 to 10 ft, approximately 28,000 cy	excavate 1222 cubic yards per lot at 241 lots, approximately 295,000 cy
TPH MASS BY DEPTH INTERVAL - MASS REMOVED BY EXCAVATION				
Chemical Mass lbs	210,000	520,000	1,260,000	2,180,000
EXCAVATED TPH MASS AS A PERCENTAGE OF MASS IN TOP 10 FEET OF TOTAL SITE				
Fraction Excavated	5.0%	12%	29%	50%
EXCAVATED TPH MASS AS A PERCENTAGE OF TOTAL TOTAL SITE				
Fraction Excavated	1.3%	3.2%	7.7%	13%

Notes:

1 - Kriged data set used one half of the laboratory method detection limit for non-detect samples.

2 - Depth to groundwater assumed to be 50 feet below ground surface.

3 - The 219 lots presumed for excavation were estimated by URS to have the following volumes for each depth interval on average: 0-3': 367 cubic yards, and 0-5': 611 cubic yards.

4 - The 241 lots presumed for excavation from 0-10' were estimated by URS to have, on average 1222 cubic yards excavated.

5 - Soil analytical data Kriged using a 10-to-1 horizontal-to-vertical anisotropy.

6 - Excavated TPH masses calculated as the Kriged average TPH concentration in soil over the appropriate number of lots multiplied by the volume to be excavated, as estimated by URS.

7 - Total chemical mass expressed here under Alternative 4D, Targeted Excavation from 5 to 10 ft, excludes mass excavated from 0 to 5 ft.

Table A-2 Estimates of TPH Mass in Vadose Zone
Former Kast Site, Carson, CA

		TPH-D	TPH-G	TPH-M	TOTAL TPH							
	Depth Interval	Chemical Mass lbs	Chemical Mass lbs	Chemical Mass lbs	Chemical Mass lbs	Total Soil Volume cu ft	Total Soil Volume cy	Average lbs/cy	No. of Properties to be Excavated	Average No. cy to be Excavated per Property	Total cy to be Excavated	Total lbs TPH to be Excavated
Total Site	0.5 - 2	71,423	161	170,018	241,603							
	2 - 3	80,489	519	151,612	232,621							
	3 - 5	275,504	5,803	401,353	682,661							
	5 - 10	1,421,191	98,863	1,646,370	3,166,424							
	10 - GW	5,531,939	1,069,587	5,585,507	12,187,033							
	0 - 3	151,913	680	321,630	474,223							
	0 - 5	427,417	6,484	722,984	1,156,884							
	0 - 10	1,848,608	105,347	2,369,353	4,323,308							
	0 - GW	7,380,547	1,174,934	7,954,861	16,510,342							
Excavation Area Only - 207+12[4] Lots	0 - 3	102,201	166	230,084	332,452	3,368,805	124,771	2.7	219	367	80,373	214,154
	0 - 5	296,789	4,026	512,609	813,424	5,608,026	207,705	3.9	219	611	133,809	524,030
Excavation Area Only - 229+12[4] Lots	0 - 10	1,377,186	76,756	1,778,115	3,232,057	11,805,772	437,251	7.4	241	1,222	294,502	2,176,891
Excavation Area Only - 85+12[4] Lots (Elevated Concentrations)	5 - 10	787,104	59,095	844,651	1,690,850	1,006,689	37,285	45.3	97	n/a	27,855	1,263,213

Notes:

1 - TPH mass estimates based on 3D kriged analytical soil data using MVS software.

2 - Average soil volumes to be excavated by depth interval were estimated from aerial photographs and subsurface utility maps.

3 - The average soil volume for Elevated Concentrations was not computed; rather, a total volume of soil to be excavated was estimated through review of individual properties.

4 - Twelve (12) properties for which no environmental characterization data have been collected as of September 9, 2014 are included in the mass calculations.

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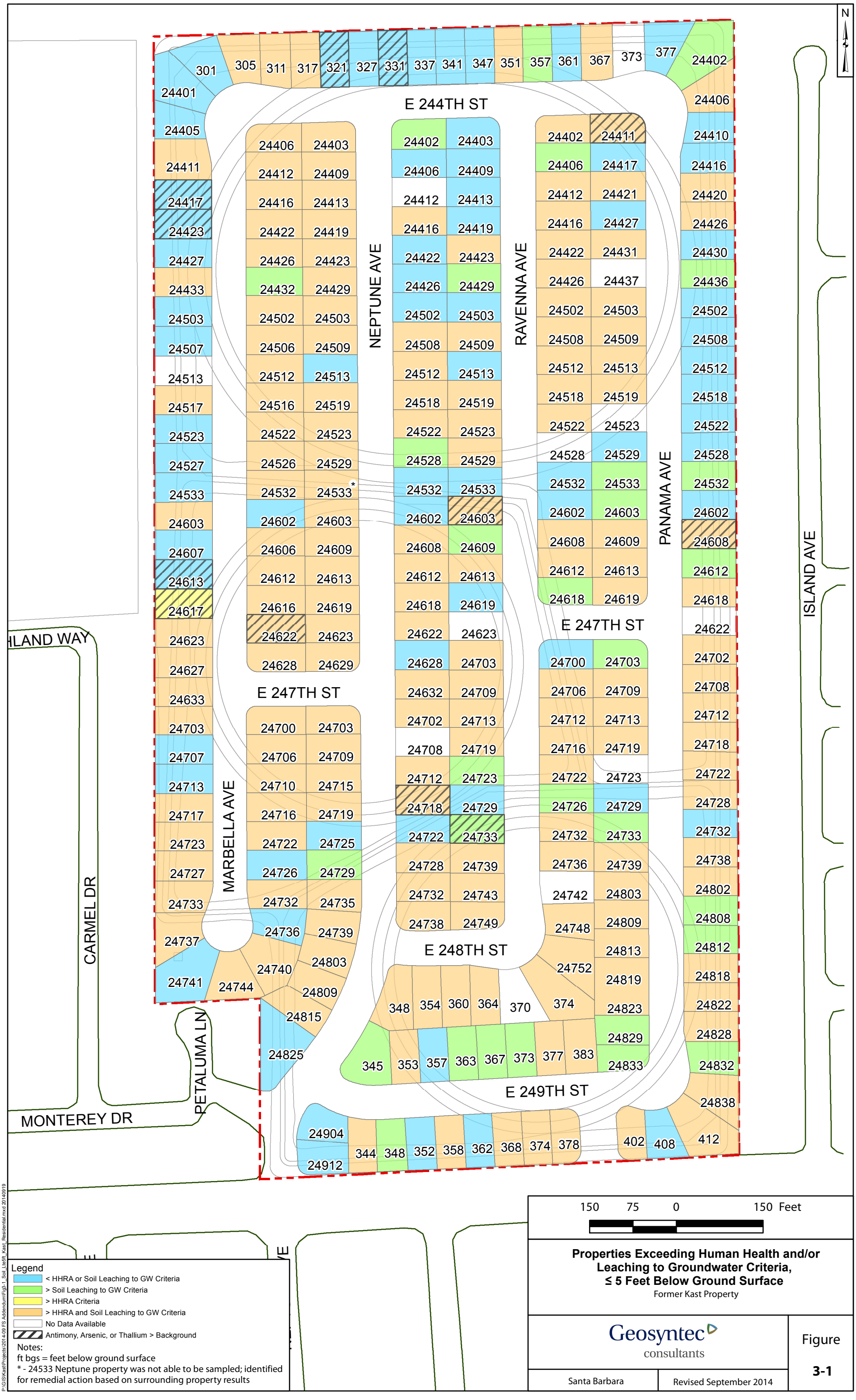
REPLACEMENT FIGURES



Properties Exceeding Human Health and/or Leaching to Groundwater Criteria, ≤ 5 Feet Below Ground Surface

Former Kast Property

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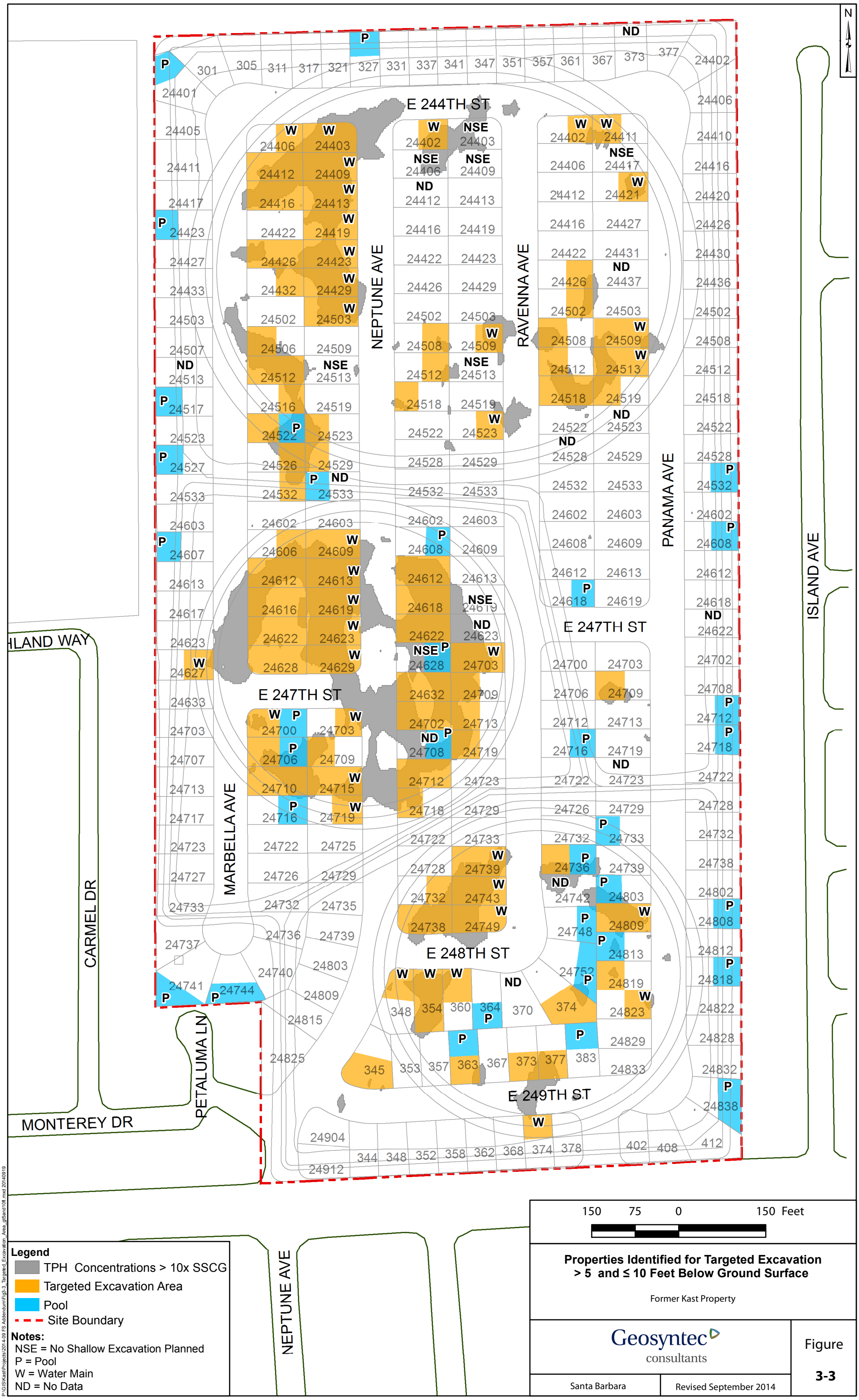
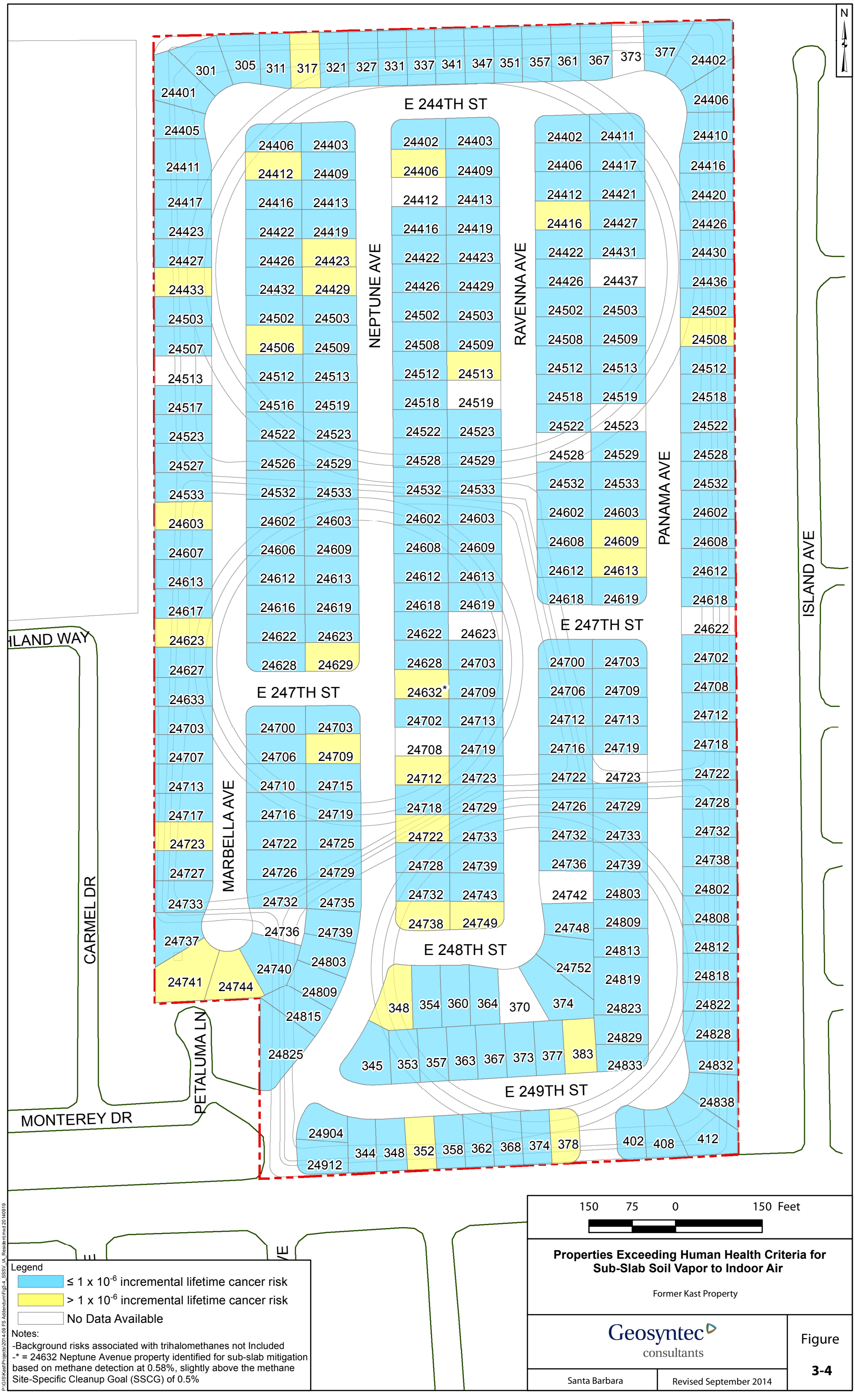
Santa Barbara | Revised September 2014

Figure 3-1

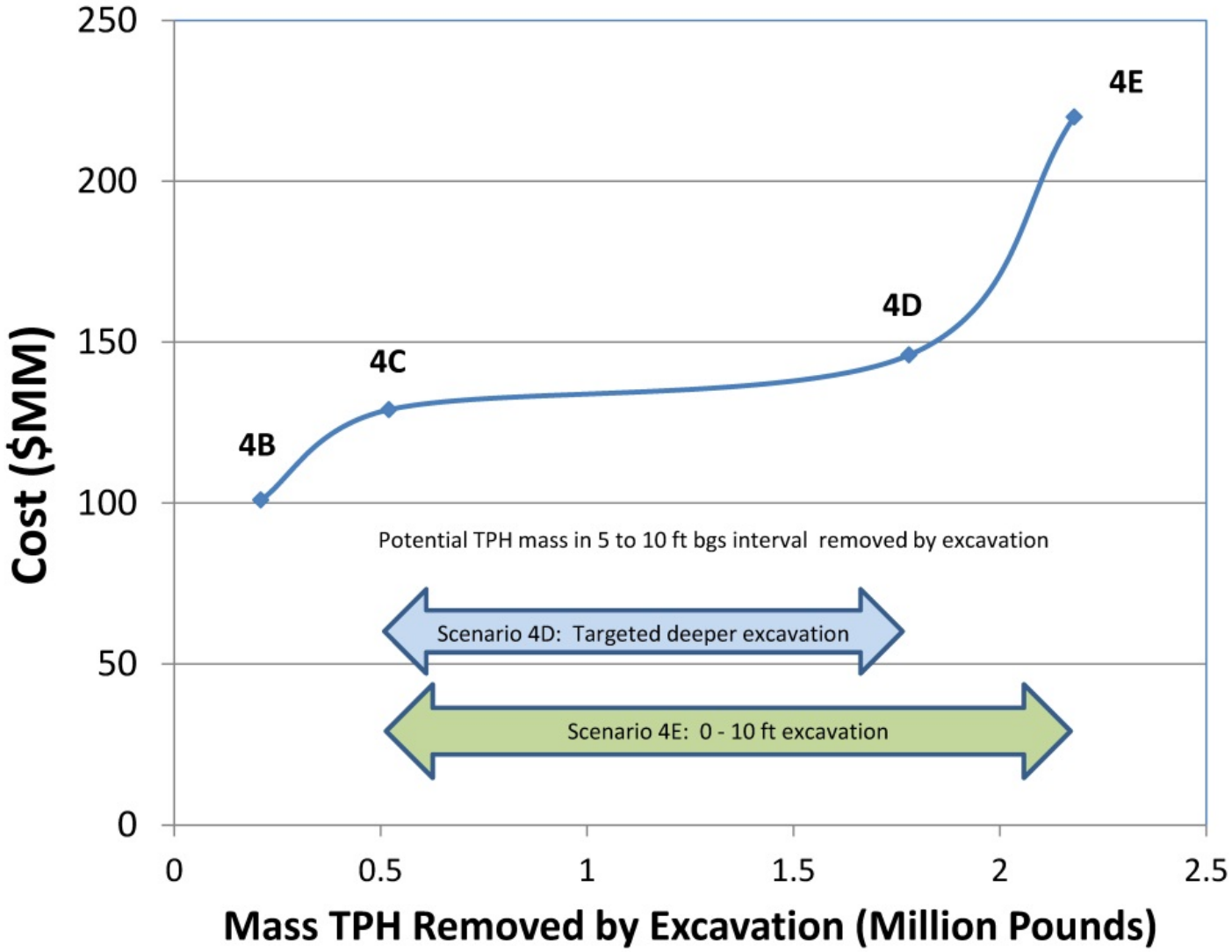

N
E 244TH ST
NEPTUNE AVE
RAVENNA AVE
PANAMA AVE
ISLAND AVE
E 247TH ST
E 247TH ST
E 248TH ST
E 249TH ST
MARBELLA AVE
CARMEL DR
PETALUMA LN
MONTEREY DR
HLAND WAY
301 305 311 317 321 327 331 337 341 347 351 357 361 367 373 377
24401 24405 24411 24417 24423 24427 24433 24503 24507 24513 24517 24523 24527 24533 24603 24607 24613 24617 24623 24627 24633 24703 24707 24713 24717 24723 24727 24733 24737 24741 24744
24406 24403 24412 24409 24416 24413 24422 24419 24426 24423 24432 24429 24502 24503 24506 24509 24512 24513 24516 24519 24522 24523 24526 24529 24532 24533* 24602 24603 24606 24609 24612 24613 24616 24619 24622 24623 24628 24629
24402 24403 24406 24409 24412 24413 24416 24419 24422 24423 24426 24429 24502 24503 24508 24509 24512 24513 24518 24519 24522 24523 24528 24529 24532 24533 24602 24603 24608 24609 24612 24613 24618 24619 24622 24623 24628 24703 24632 24709 24702 24713 24708 24719 24712 24723 24718 24729 24722 24733 24728 24739 24732 24743 24738 24749
24700 24703 24706 24709 24710 24715 24716 24719 24722 24725 24726 24729 24732 24735 24736 24739 24740 24803 24809 24815 24825
348 354 360 364 370 374 24752 24748 24742 24736 24732 24728 24722 24718 24712 24708 24702 24718 24716 24712 24706 24700
24402 24411 24406 24417 24412 24421 24416 24427 24422 24431 24426 24437 24502 24503 24508 24509 24512 24513 24518 24519 24522 24523 24528 24529 24532 24533 24602 24603 24608 24609 24612 24613 24618 24619
24700 24703 24706 24709 24712 24713 24716 24719 24722 24723 24726 24729 24732 24733 24736 24739 24742 24803 24748 24809 24813 24819 24823 24829 24833
345 353 357 363 367 373 377 383
402 408
24410 24416 24420 24426 24430 24436 24502 24508 24512 24518 24522 24528 24532 24602 24608 24612 24618 24622 24702 24708 24712 24718 24722 24728 24732 24738 24802 24808 24812 24818 24822 24828 24832 24838 412
24904 24912 344 348 352 358 362 368 374 378
150 75 0 150 Feet
Legend
< HHRA or Soil Leaching to GW Criteria
> Soil Leaching to GW Criteria
> HHRA Criteria
> HHRA and Soil Leaching to GW Criteria
No Data Available
Antimony, Arsenic, or Thallium > Background
Notes:
ft bgs = feet below ground surface
* - 24533 Neptune property was not able to be sampled; identified for remedial action based on surrounding property results
Properties Exceeding Human Health and/or Leaching to Groundwater Criteria,
> 5 Feet and ≤ 10 Feet Below Ground Surface
Former Kast Property
Geosyntec consultants
Figure 3-2
Santa Barbara
Revised September 2014
P:\GIS\Kast\Projects\2014-09 FS Addendum\Fig3-2_Soil_8to10ft_Kast_Residential.mxd 20140919


N
E 244TH ST
E 247TH ST
E 248TH ST
E 249TH ST
NEPTUNE AVE
RAVENNA AVE
PANAMA AVE
ISLAND AVE
MARBELLA AVE
CARMEL DR
PETALUMA LN
MONTEREY DR
HLAND WAY
Legend
TPH Concentrations > 10x SSCG
Targeted Excavation Area
Pool
Site Boundary
Notes:
NSE = No Shallow Excavation Planned
P = Pool
W = Water Main
ND = No Data
150 75 0 150 Feet
Properties Identified for Targeted Excavation
> 5 and ≤ 10 Feet Below Ground Surface
Former Kast Property
Geosyntec consultants
Santa Barbara
Revised September 2014
Figure
3-3
P:\GIS\Kast\Projects\2014-09 FS Addendum\Fig3-3_Targeted_Excavation_Area_gt5and10ft.mxd 20140919


N
E 244TH ST
NEPTUNE AVE
RAVENNA AVE
PANAMA AVE
ISLAND AVE
E 247TH ST
MARBELLA AVE
E 248TH ST
E 249TH ST
PETALUMA LN
CARMEL DR
MONTEREY DR
HLAND WAY
301 305 311 317 321 327 331 337 341 347 351 357 361 367 373 377
24401 24402 24405 24406 24410 24411 24416 24417 24420 24423 24426 24427 24430 24433 24436 24437 24502 24503 24507 24508 24513 24512 24517 24518 24523 24522 24527 24528 24533 24532 24603 24602 24607 24608 24613 24612 24617 24618 24623 24622 24627 24628 24633 24632* 24703 24702 24707 24708 24713 24712 24717 24718 24723 24722 24727 24728 24733 24732 24737 24738 24741 24744 24749 24748 24752 24803 24802 24807 24808 24812 24813 24818 24819 24822 24823 24828 24829 24832 24833 24838
24406 24403 24412 24409 24416 24413 24422 24419 24426 24423 24432 24429 24502 24503 24506 24509 24512 24513 24516 24519 24522 24523 24526 24529 24532 24533 24602 24603 24606 24609 24612 24613 24616 24619 24622 24623 24628 24629
24402 24403 24406 24409 24412 24413 24416 24419 24422 24423 24426 24429 24502 24503 24508 24509 24512 24513 24518 24519 24522 24523 24528 24529 24532 24533 24602 24603 24608 24609 24612 24613 24618 24619 24622 24623 24628 24703 24632* 24709 24702 24713 24708 24719 24712 24723 24718 24729 24722 24733 24728 24739 24732 24743 24738 24749
24402 24411 24406 24417 24412 24421 24416 24427 24422 24431 24426 24437 24502 24503 24508 24509 24512 24513 24518 24519 24522 24523 24528 24529 24532 24533 24602 24603 24608 24609 24612 24613 24618 24619
24700 24703 24706 24709 24710 24715 24716 24719 24722 24725 24726 24729 24732 24735 24736 24739 24740 24803 24809 24815 24825
24700 24703 24706 24709 24712 24713 24716 24719 24722 24723 24726 24729 24732 24733 24736 24739 24742 24803 24748 24809 24813 24752 24819 24823 24829 24833
348 354 360 364 370 374
345 353 357 363 367 373 377 383
24904 24912 344 348 352 358 362 368 374 378 402 408 412
Legend
≤ 1 x 10-6 incremental lifetime cancer risk
> 1 x 10-6 incremental lifetime cancer risk
No Data Available
Notes:
-Background risks associated with trihalomethanes not Included
-* = 24632 Neptune Avenue property identified for sub-slab mitigation based on methane detection at 0.58%, slightly above the methane Site-Specific Cleanup Goal (SSCG) of 0.5%
150 75 0 150 Feet
Properties Exceeding Human Health Criteria for Sub-Slab Soil Vapor to Indoor Air
Former Kast Property
Geosyntec consultants
Santa Barbara
Revised September 2014
Figure 3-4
P:\GIS\Kast\Projects\2014-09 FS Addendum\Fig3-4_SSSV_IA_Resident.mxd 20140919

Geosyntec
consultants

ADDENDUM FIGURE



Targeted Excavation Cost-Benefit Figure

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Figure 6-1

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