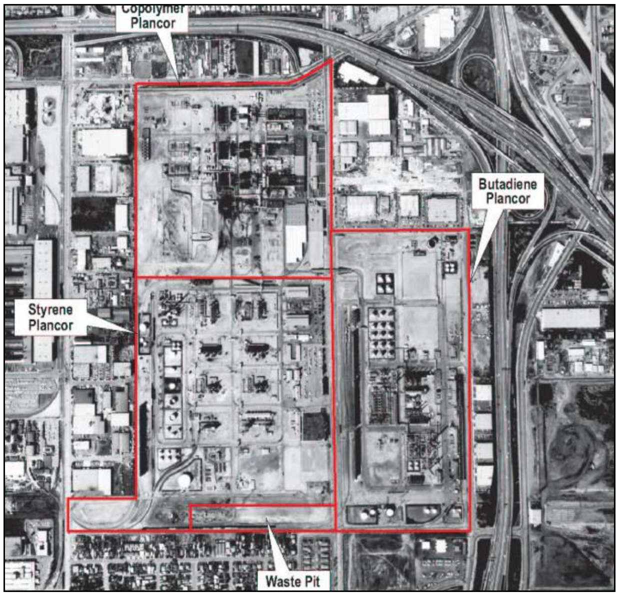
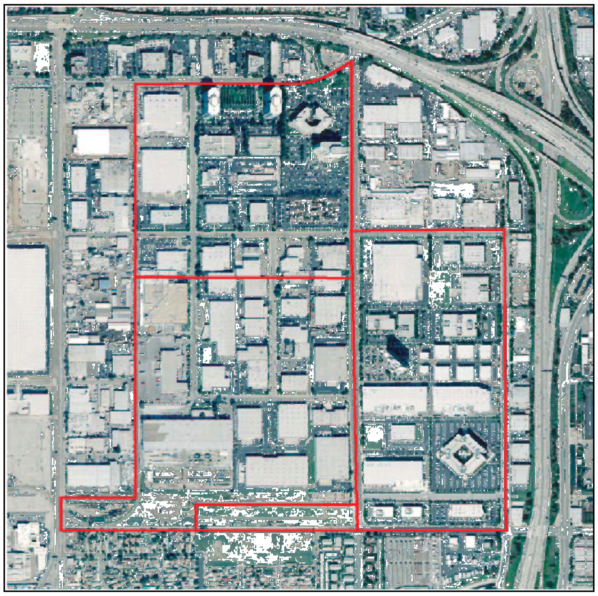
FINAL
SOIL AND NAPL FEASIBILITY STUDY
DEL AMO SUPERFUND SITE
LOS ANGELES, CALIFORNIA





Prepared for:

SHELL OIL COMPANY
AND
THE DOW CHEMICAL COMPANY

Prepared by:

URS
915 Wilshire Boulevard, Ste 700
Los Angeles, California 90017
Tel (213) 996-2200

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AOC	Administrative Order on Consent
APN	Assessor Parcel Number
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	below ground surface
BEC	Building Engineering Control
BRA	Baseline Risk Assessment
BV	Bioventing
Cal EPA	California Environmental Protection Agency
CCF	Cabot, Cabot & Forbes
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980, also known as Superfund: Amended in 1986 by the Superfund Amendments and Reauthorization Act (SARA)
COC	Contaminant Of Concern
COPC	Chemical Of Potential Concern
CPT	Cone Penetrometer
CR	Commercial Risk (cancer)
CSM	Conceptual Site Model
CY	Cubic Yards
ºC	degrees Celsius
ºF	degrees Fahrenheit
DL	Detection Limit
D&M	Dames & Moore
DNAPL	Dense Non-Aqueous Phase Liquid
DOE	Department of Energy
DTSC	Department of Toxic Substances Control
EAPC	Exposure Area of Potential Concern
EPC	Exposure Point Concentrations
ERH	Electric Resistance Heating
ERIC	Environmental Review Institutional Control
ERT	Environmental Review Team
FINDS	Facility Index System/Facility Identification Initiative Program
FS	Feasibility Study
GHG	greenhouse gases
gpm	gallons per minute
GRA	General Response Action
GWTS	Groundwater treatment system
Hg	Mercury
HI	Hazard Index
HI_{com}	Hazard Index, commercial scenario
HI_{res}	Hazard Index, residential scenario
HSU	Hydrostratigraphic Unit

HVAC	Heating Ventilation and Air Conditioning
IBT	In-situ Biodegradation Technology
IC	Institutional Control
ISCO	In-situ Chemical Oxidation
ISGS	In-situ Groundwater Standards
ISSH	In-situ Soil Heating
ISTD	In-situ Thermal Desorption
kV	Kilovolt
kW	Kilowatt
kWhr	Kilowatt hour
LADBS	Los Angeles Department of Building and Safety
LADWP	Los Angeles Department of Water and Power
LAPDZA	Los Angeles Planning Department – Office of Zoning Administration
LBF	Lower Bellflower Aquitard
LEL	Lower Explosive Limit
LF	Linear Feet
LNAPL	Light Non-Aqueous Phase Liquid
LTE	Long Term Effectiveness
MBFB	Middle Bellflower B sand
MBFC	Middle Bellflower C sand
MBFM	Middle Bellflower Mud
MCL	Maximum Contaminant Level
MPE	Multi-Phase Extraction
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
µg/L	micrograms per liter
NAPL	Non-Aqueous Phase Liquid
NCP	National Contingency Plan
ND	Non-Detect
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
OS	Outdoor Soil
OSHA	Occupational Health and Safety Administration
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbon
PEL	Permissible Exposure Level
ppd	pounds per day
ppmv	parts per million by volume
PRB	Permeable Reactive Barriers
PRG	Preliminary Remediation Goal
psi	pounds per square inch
psig	pounds per square inch gauge
PVC	polyvinyl chloride

RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RDC	Risk-Driving Chemical
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
RPs	Responsible Parties
ROD	Record Of Decision
ROI	Radius Of Influence
ROST	Rapid Optical Screen Tool
RR	Residential Risk (cancer)
RTMV	Reduction in Toxicity, Mobility and Volume
RWQCB	Regional Water Quality Control Board
SA	Source Area
SCAQMD	South Coast Air Quality Management District
scfm	standard cubic feet per minute
SF	Square Feet
SSV	Sub-slab Venting (or SSD, sub-slab depressurization)
STE	Short Term Effectiveness
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compound
TBC	To-Be-Considered
TDS	Total Dissolved Solids
TI	Technical Impracticability
TPH	Total Petroleum Hydrocarbons
UAO	Unilateral Administrative Order
UB	Under Building
UBF	Upper Bellflower Aquitard
UCL	Upper Confidence Limit
URS	URS Corporation
USA	Underground Service Alert System
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
UTL	Upper Tolerance Limit
UU/UE	Unrestricted Use/Unrestricted Exposure
VCS	Vapor Collection System
VETS	Vapor Extraction and Treatment System
VPGAC	Vapor Phase Granular Activated Carbon
VOCs	Volatile Organic Compounds
WDRs	Waste Discharge Requirements
ZIMAS	Zoning Information and Map Access System

ACRONYMS FOR CHEMICAL NAMES

1,2,4-TMB	1,2,4-trimethylbenzene
B(a)A	benzo(a)anthracene
B(a)P	benzo(a)pyrene
B(b)F	benzo(b)fluoranthene
B(k)F	benzo(k)fluoranthene
BTEX	benzene, toluene, ethylbenzene, xylene
DDT	dichloro-diphenyl-trichloroethane
H_2O_2	hydrogen peroxide
I(1,2,3-cd)P	indeno(1,2,3-cd)pyrene
I-PB	isopropylbenzene
I-PT	para isopropyltoluene
MEK	methyl ethyl ketone
NDPA	N-nitrosodiphenylamine
PCB	polychlorinated biphenyls
PCE	tetrachloroethene
$S_2O_8^{--}$	persulfate
TCE	trichloroethene

1.0 INTRODUCTION

This report presents the Final Feasibility Study (FS) for the Soil and Non-Aqueous Phase Liquid (NAPL) Operable Unit (OU) at the Del Amo Superfund Site in Los Angeles, California (Figure 1-1). This report was prepared by URS Corporation (URS) and is presented on behalf of Shell Oil Company and The Dow Chemical Company (the Respondents) pursuant to the Administrative Order on Consent (AOC; USEPA Docket Number 92-13) between the Respondents, the U.S. Environmental Protection Agency Region IX (USEPA), and the California Department of Toxic Substances Control (DTSC). The FS was conducted in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National Contingency Plan (NCP, 40 CFR Part 300 et seq.), and the AOC.

1.1 PURPOSE OF THE FEASIBILITY STUDY

The purpose of the FS was to evaluate a range of remedial alternatives that would address soil and NAPL contamination in accordance with the CERCLA Remedial Investigation/Feasibility Study (RI/FS) guidance (USEPA 1988). The FS relied on information in the Soil and NAPL RI Report (URS 2007b) and the Baseline Risk Assessment (BRA; GeoSyntec & URS 2006) that were recently completed. Together, these three documents will provide USEPA with key information necessary to issue the Record of Decision (ROD) for the Soil and NAPL OU.

This CERCLA FS process involved the following:

- Identifying remedial action objectives (RAOs) and general response actions (GRAs);
- Screening available remedial technologies for soil and NAPL contamination;
- Assembling appropriate remedial alternatives for the FS evaluation;
- Conducting the detailed 9-criteria evaluation of the remedial alternatives; and,
- Performing a comparative analysis of the remedial alternatives.

1.2 FORMER PLANT SITE DESCRIPTION

Formal boundaries of Superfund sites are usually defined by the extent of the contaminants associated with a subject facility rather than current or former property boundaries, and thus are not typically fixed or easily defined. The RI, BRA and FS for the Soil and NAPL OU are focused on contaminants associated with a synthetic rubber manufacturing plant formerly located on approximately 280 acres at the southwest corner of the intersection of the 405 and 110 Freeways (Figure 1-1). This area lies within the Harbor Gateway portion of the City of Los Angeles, adjacent to the cities of Torrance to the west, and Carson to the east. While recognizing the potential variability of contaminant distribution, this report focuses on conditions within the area formerly occupied by the synthetic rubber plant, hereafter referred to as the “former plant site” or “former rubber plant”. The former plant site was divided into styrene, butadiene, and copolymer plancors. The Waste Pit Area at the southern end of the former plant site was investigated as a separate operable unit for which USEPA has previously issued a ROD (USEPA 1997a) and is therefore excluded from this FS.

The former plant site is comprised of 67 parcels[1] (two of which are associated with the Waste Pits OU) and additional surface streets, including Vermont Avenue, Francisco Street, Magellan Drive, Pacific Gateway Drive and Knox Street. A total of 59 parcels have been developed with occupied business buildings and/or associated parking lots (Figure 1-2). Remaining undeveloped parcels are primarily at the southern end of the former plant site, and are generally unsuitable for development due to their very narrow width, use as railroad spurs or as a public utility corridor, or former waste pit use. Buildings, paved parking areas, streets and landscaped areas currently cover more than 90% of the former plant site. Aerial photographs of the former plant site from 1971 (shortly before demolition of the rubber plant) and 2007 are presented on Figure 1-3 and illustrate the significant changes in land use that have occurred during that time frame. A summary of historical and current property use for each parcel at the former plant site is provided in Appendix A.

There are 68 buildings currently on the former plant site. Building footprints range up to approximately 215,000 square feet (SF), although several buildings are multistory structures, and thus may exceed 215,000 SF of floor space. The buildings are typically concrete tilt-up or high-rise structures and are primarily used for warehouse/freight forwarding operations, manufacturing, and office space (Figure 1-2). All current structures are limited to business use and there are no known full-time residents.

Zoning for the majority of the parcels (64 of 67) is designated as heavy or light manufacturing/industrial, as shown on Figure 1-4. Appendix A presents a brief description of the parcels in the former plant site including information on assessor parcel number (APN), zoning, land use and property owner. One parcel, where a hotel is currently located (7351-033-039), is listed with a dual industrial-commercial zoning designation (Appendix A). Two parcels that collectively make up the Los Angeles Department of Water and Power (LADWP) utility corridor are zoned as “public facilities.” The area surrounding the former plant site is zoned for manufacturing or industry use to the east, north, and west. Land use in the vicinity consists of light industrial and residential areas to the north of the former plant site; industrial and commercial areas to the east; residential, industrial and commercial to the south; and industrial and commercial to the west. Houses in an approximately three-block portion of the residential area located immediately south of the Waste Pit Area were purchased by Shell Oil Company and the U.S. Government in 1998. The houses were subsequently razed, and this area is currently vacant.

1.3 FORMER PLANT SITE HISTORY

1.3.1 Rubber Plant

The synthetic rubber plant was built as part of the nation’s defense program to support the World War II effort. Historical plant site facility locations relative to current buildings and streets are indicated on Figure 1-5. The styrene and butadiene produced at the styrene and butadiene plancors were combined at the copolymer plancor to form the synthetic rubber product. During the period of U.S. Government ownership between 1942 and 1955, the three plancors were operated by various companies under

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[1] The total number and configuration of parcels within the former plant site may change depending on subdivision or merging of lots. The parcels referred to in this FS report represent the configuration at the time of the Soil and NAPL RI Report. Any remedial alternatives selected in the ROD (which may include restrictive covenants with landowners) are assumed to apply to any successor parcels.

Agreements of Lease and Operation. Shell Chemical Company purchased the rubber plant site and facilities (all three plancors) in 1955. Shell continued to operate the three plancors and produce rubber until 1969, when operations were gradually reduced. The rubber plant facility was permanently shut down by 1972 and sold "as is" to Cabot, Cabot & Forbes (CC&F). CC&F dismantled the facility and subsequently subdivided the property for development as a business park. CC&F partnered with Cadillac Fairview/California, Inc. and gradually sold the former plant site parcels to multiple owners. A comprehensive discussion of historical rubber plant facilities and operations is presented in the Soil and NAPL RI Report (URS 2007b).

1.3.2 Regulatory Oversight

Primary regulatory oversight responsibility for environmental remediation was transferred to USEPA from DTSC when the Respondents signed an AOC with USEPA (USEPA 1992) on May 7, 1992. USEPA divided the former plant site into the Soil and NAPL OU, the Waste Pit Area OU, and the Groundwater OU (OU3) for investigation and remedial evaluation purposes. The Waste Pit Focused Feasibility Study was completed in 1996 (Dames & Moore [D&M] 1996) and the USEPA issued a ROD for the Waste Pit Area OU in 1997 (USEPA 1997a). An engineered cap was completed in the Waste Pit Area in 2000 and a soil vapor extraction/in-situ biodegradation technology (SVE/IBT) system was placed into operation in 2006, as directed by the Waste Pit ROD. The Del Amo site as a whole was listed on the USEPA's National Priority List of Superfund sites in September 2002.

In 1998, the Groundwater RI Report (D&M 1998a) was completed, and USEPA subcontractors issued the dual site groundwater FS and risk assessment documents pertaining to both the Montrose and Del Amo Superfund sites' groundwater (CH2M Hill 1998). USEPA issued the dual site groundwater ROD in 1999 (USEPA 1999). More details on the history of agency oversight, including additional information about agency oversight prior to 1992, were provided in the Soil & NAPL RI Report (URS 2007b). Initial remedial design work for the Groundwater OU is currently in progress. The Soil and NAPL RI, the BRA and this FS report will provide the USEPA with key information necessary to issue the ROD for the Soil and NAPL OU at the Del Amo Superfund site.

1.4 FEASIBILITY STUDY APPROACH

The FS for the Soil and NAPL OU was conducted in two parts: a shallow soils evaluation and a NAPL evaluation. The Soil and NAPL OU includes the surface soil (0-1 feet below ground surface [bgs]) and shallow soil (0 to 15 feet bgs) across the entire 280-acre former plant site (except the Waste Pit Area). It also includes deep soil (>15 feet bgs) at specific locations where NAPL is potentially present or known to be present either in the vadose zone or below the water table. Shallow soil was defined as the top 15 feet of soil, based on the maximum depth at which human contact with soil would be likely to occur during a possible future construction project.

The objective of the shallow soils FS evaluation was to evaluate methods for mitigation of human health risk from direct contact, ingestion, and inhalation exposure pathways. These pathways, collectively referred to as the surface exposure pathways, include ingestion of and dermal contact with shallow soils and inhalation of indoor and outdoor air. The NAPL FS evaluation focused on groundwater protection and the goal of enhancing the effectiveness of the groundwater remedy. Since the evaluation for the surface pathways dealt with receptors at the surface (primarily shallow soils) and the evaluation for the NAPL areas dealt with impacts to groundwater (primarily deep soil and groundwater media), the two evaluations were conducted separately and are presented in different sections of this report.

The goal of the FS was to develop and compare remedial alternatives to assist USEPA in preparing the ROD. The surface pathway evaluation relied on the results of the BRA, wherein human health risks were calculated for exposure areas defined by current parcel boundaries and street segments within the former plant site. Exposure areas with similar risk levels were grouped, and representative exposure areas within these groups were selected for detailed FS evaluation. The results of the detailed evaluations were used as the basis for shortened evaluations for the remaining exposure areas within each group. The overall FS process is summarized in a flow chart on Figure 1-6.

To complete the FS analysis of active remedial approaches, there was a need to define the areas to which the active remediation measures might be applied. The extent of impacted outdoor soil was nominally based on exceedance of risk-based threshold levels corresponding to commercial workers risks of 1E-06 and 5E-05 that are presented later in this document. These threshold levels were defined in terms of contaminant concentrations and used as guides to identify areas of impacted soil for the evaluation of remedial alternatives.

1.4.1 Uncertainties and Assumptions in FS Evaluation

This section presents the data limitations in this FS, the assumptions needed to complete the evaluations, and the uncertainties resulting from these assumptions. These assumptions are further identified and discussed in appropriate sections throughout the report, and summarized in Section 10.3.

As discussed in the previous section, the areal extent of contamination needed to be defined in parts of the former plant site where active remedial alternatives were evaluated. While the RI data were adequate to indicate the presence of contamination in shallow soil, existing data may have been insufficient to fully delineate the extent of this contamination in some exposure areas. Therefore, assumptions regarding the areal extent of contamination in outdoor shallow soil were made based on the available shallow soil data and the locations of former plant site facilities. The assumed extent of contamination under existing buildings was based solely on the location of former plant site facilities, since no sampling was conducted beneath existing buildings.

For the NAPL evaluation that addressed deep soil and groundwater, the assumed extent of NAPL contamination was based on a combination of available soil and groundwater data and the location of former plant site facilities. For some areas where NAPL was potentially present under an existing building, the NAPL extent was assumed based on the footprint of a former rubber plant facility because data for the area under the building were not available. The NAPL at such areas was additionally assumed to be present in heterogeneous, predominantly low-permeability soils, similar to other site areas where NAPL conditions were evaluated. Additional investigation may be necessary during the remedial design phase to confirm RI findings and to better define the horizontal and vertical extent of any contamination present. Also, physical properties data, in addition to that collected during the RI may be needed to support remedial design.

It is also noted that hydraulic extraction is the only technology that has been pilot-scale tested for the Soil and NAPL OU. In discussions with USEPA during preparation of the FS, it was agreed that the FS evaluations of technologies should proceed based on whatever published and unpublished information could be gathered about the application and performance of the technologies at other sites. If USEPA ultimately incorporates any of these technologies into the selected remedy for the Soil and NAPL OU, then further pilot testing should be performed during the remedial design process to refine FS assumptions and complete an effective design. Uncertainties in the FS evaluations are significantly lower for the well-developed technologies than for the more innovative technologies.

Assumptions about the extent of contamination and the effectiveness of remedial technologies tend to amplify cost uncertainties because cost (one of the nine CERCLA evaluation criteria) is related to areas, volumes and technology effectiveness. One type of uncertainty that is not accounted for in this FS is how implementation will be affected at properties owned by private parties that are not Responsible Parties. Subsequent discussions with property owners in the remedy selection phase will help address this uncertainty. This can impact cost estimates because property owner/tenant requirements can affect cost estimates for remediation.

1.5 FS REPORT ORGANIZATION

A brief description of the various sections of the FS report is provided below:

Section 1.0	Describes scope and purpose of the FS report and provides background information.
Section 2.0	Presents a summary of the Soil and NAPL RI and BRA findings.
Section 3.0	Describes the FS evaluation approach for the exposure areas and NAPL areas, including the recalculation of risk estimates for exposure areas influenced by elevated detection limits. Describes grouping of exposure areas based on risk levels, and selection of representative exposure areas.
Section 4.0	Describes the RAOs, GRAs, potential applicable or relevant and appropriate requirements (ARARs) and cleanup levels that have been developed for the former plant site.
Section 5.0	Describes the screening of institutional controls (ICs) and technologies for soil and NAPL remediation and provides a description of retained technologies, including conceptual design information relevant to the remedial alternatives discussed in the following sections.
Section 6.0	Assembles and describes the remedial alternatives for soil/surface pathway.
Section 7.0	Assembles and describes the remedial alternatives for NAPL areas.

Section 8.0	Presents the CERCLA 9-criteria evaluation of the soil/surface pathway remedial alternatives.
Section 9.0	Presents the CERCLA 9-criteria evaluation of the NAPL areas.
Section 10.0	Presents a summary of the FS evaluations for the Soil and NAPL OU including identification of uncertainties and limitations resulting from assumptions made in the FS.
Section 11.0	Lists the references used in preparing this report.

Tables, figures and appendices are included to support the FS text. "FS Addenda" material, such as the evaluation of a modified NAPL remedial alternative, alternate cost presentation format for surface pathway remedial alternatives, etc. are presented in Appendix H.

2.0 FORMER PLANT SITE INVESTIGATION AND CHARACTERIZATION

This section presents a summary of environmental conditions at the former plant site, including hydrogeology and the nature and extent of contamination, as presented in the Groundwater RI and Soil and NAPL RI reports. This section also includes a summary of the BRA wherein estimates of risk for commercial workers, hypothetical future residents and trench workers at the former plant site are presented.

2.1 HYDROGEOLOGY

The former plant site overlies the West Coast Groundwater Basin, a sub-basin of the Los Angeles Coastal Groundwater Basin. The near-surface deposits in the vicinity of the former plant site are part of the Lakewood Formation, which extends to a depth of approximately 200 feet bgs and predominantly consists of interbedded fine sand and mud (silt and finer sediment). The former plant site lies on the southwest limb of the Gardena syncline, which results in a dip of the local stratigraphic units of about 1° to the northeast.

The Lakewood Formation is divided into the Bellflower Aquitard and underlying Gage aquifer. For the purposes of the RI and FS, the Bellflower Aquitard is further subdivided into subunits, including, from top to bottom, the Upper Bellflower Aquitard (UBF), the Middle Bellflower B sand (MBFB), the Middle Bellflower Mud (MBFM), the Middle Bellflower C sand (MBFC) and the Lower Bellflower Aquitard (LBF). The relationship between these hydrostratigraphic units (HSUs) and their relative thicknesses are illustrated on Figure 2-1. This Soil and NAPL FS is concerned primarily with conditions within the subunits of the Bellflower Aquitard. Further description of each of these subunits is provided below.

2.1.1 Upper Bellflower Aquitard

The UBF is the uppermost HSU underlying the former plant site and ranges from 41 to 97 feet thick. Soil boring logs and cone penetrometer (CPT) data completed during the RI show that the upper 20 to 30 feet of the UBF is a massive, fine sandy silt to silty sand. Beneath this is stratified mud and sand extending to the base of the UBF. Sand layers within the UBF typically range from one to 10 feet thick and tend to be discontinuous, while the finer grained muds are up to 30 feet thick and more continuous. A distinctive and laterally extensive fossiliferous layer is present in the UBF at depths ranging from 40 to 50 feet bgs.

2.1.2 Middle Bellflower B Sand

The MBFB is generally olive-colored fine sand, with localized muddy layers and laminations. The sand can be massive, or include localized sedimentary structures including planar or cross-stratification, bioturbation, mud drapes, and mud rip-up clasts. These small-scale features can have a significant impact on the migration of dissolved plume contaminants and NAPL, as further discussed in the Groundwater RI Report (D&M 1998a). Where the MBFM is present, the MBFB has an average thickness of approximately 15 feet.

2.1.3 Middle Bellflower Mud

The MBFM consists of a sequence of laminated silts and very fine sands that reach a maximum thickness of 25 feet in the southwestern portion of the former plant site. The MBFM quickly pinches out to the east and is missing in the central and eastern portions of the former plant site. The average thickness of the mud is approximately seven feet. There is typically a gradational contact between the MBFB and MBFM, characterized by an increasing percentage of fine-grained sediments. Due to the inherently low permeability of fine-grained sediments relative to coarser grained sands, the mud is inferred to retard the vertical flow of groundwater and contaminants.

2.1.4 Middle Bellflower C Sand

The MBFC is a thick body of fine to medium sand with local muddy layers and lenses. The contact between the MBFB and MBFC is sharp to gradational, marking the transition from mud and muddy sand to predominantly clean, fine sand. The MBFC averages approximately 43 feet thick, but can vary from nine feet to 60 feet at the former plant site. A distinctive coarsening of the sand and layers of shell fragments in a sand matrix characterize the base of the unit. Sedimentary structures observed in the MBFC include large- and small-scale cross-stratifications, burrows, bioturbation, mud rip-ups, and mud drapes; however, much of the MBFC is massive.

Where the MBFM is absent, the merged MBFB/C is a virtually uninterrupted sand unit with inferred greater hydraulic interconnection relative to areas where the mud is present.

2.1.5 Groundwater Levels and Trends

Due in part to the slight structural dip of the subsurface HSUs toward the northeast, the groundwater table crosses the stratigraphic boundary between the UBF and MBFB along a demarcation line near the western boundary of the former plant site. The water table resides within the UBF to the east of the demarcation line, and within the MBFB to the west of the line, as shown on Figures 2-1 and 2-2. Groundwater conditions are therefore described with respect to the “water table zone” (UBF/MBFB).

The water table elevation across the former plant site varies from approximately 6 to 16 feet below mean sea level based on 2004 groundwater monitoring data. Taking into account ground surface topography across the plant site, this corresponds to a depth to groundwater between 32 and 57 feet bgs. Groundwater elevation data and interpretive contours for the water table zone for 2000 and 2004 are presented on Figure 2-2. The data show that the groundwater flow direction in the water table zone is toward the south-southwest over much of the former plant site, but a radial flow pattern associated with groundwater mounding is inferred in the vicinity of the Waste Pit Area and near the southeast corner of the former plant site. The average horizontal flow velocity is estimated to be 18.3 feet/year for the water table and 36.5 feet/year for the MBFB, as calculated in the Soil and NAPL RI Report (URS 2007b).

Data presented in the Soil and NAPL RI Report indicate that groundwater elevations in the vicinity of the former plant site have been steadily rising for approximately the last 30 years. The average rate of increase is approximately one foot per year. The data show that groundwater levels were more than 20 feet lower than 2004 levels for much of the former rubber plant operational period.

Additional evidence of long-term rising groundwater levels at the former plant site is provided by light non-aqueous phase liquid (LNAPL) conditions in the vicinity of well XMW-20. The LNAPL is submerged within an approximately 30-foot smear zone beneath the water table. This mode of occurrence is consistent with expected conditions after an LNAPL has migrated through the vadose zone, intercepted the water table, and been influenced by a rising groundwater table. The 30-foot smear zone interval indicates that groundwater has risen at least 30 feet since the LNAPL first intercepted groundwater.

2.2 NATURE AND EXTENT OF CONTAMINATION

A chronological overview of the various investigations that constitute the Soil and NAPL RI, and their relation to other investigations at the former plant site is presented on Figure 2-3. Some of these investigations were focused on specific areas such as the investigations for the MW-20 area, southwest styrene plancor storage area, southern copolymer plancor, and utility tanks area. Other elements, such as the surface soil investigation, shallow soil gas investigation, the 1993 addendum investigation, the 2003 addendum investigation and the pipeline and trench transmission system investigation, focused on specific types of contamination rather than a specific area. NAPL was comprehensively investigated at the MW-20 area and NAPL screening investigations were conducted on three additional source areas (SA6, SA11 and SA12). An indoor air monitoring investigation was conducted at 13 buildings that overlie or are immediately adjacent to known or suspected soil volatile organic compound (VOC) contamination. Groundwater monitoring investigations were completed either quarterly or annually from 1994 through 2000, and additional groundwater monitoring events were completed in 2004 and 2006.

The RI data are summarized below and sampling locations are shown on Figures 2-4 through 2-17. The data are summarized based on sample media, as follows:

- Surface soil (0-1 foot bgs)
- Shallow soil (0-15 feet bgs; includes all surface soil samples)
- Deep soil (>15 feet bgs)
- Shallow soil gas (0-15 feet bgs)
- Deep soil gas (>15 feet bgs to groundwater level)
- Indoor air
- Groundwater (water table).

2.2.1 Surface Soil

Surface soil samples were collected to evaluate the potential for exposure where relatively large areas of soil were exposed (without buildings, asphalt, concrete, or landscaping) and contact with soil would be most likely to occur. Most of these areas have since been redeveloped and are now covered by buildings, pavement, or landscaping, significantly reducing the exposure potential. The areas of exposed soil where RI sampling occurred were (1) in the northwest corner of the former copolymer plancor; (2) along the southern boundary of the former plant site; and (3) in the southern portion of the former butadiene plancor.

Surface soil data include results for VOCs, semi-volatile organic compounds (SVOCs), metals, and pesticides/polychlorinated biphenyls (PCBs) and are briefly discussed below.

VOCs

Surface soil VOC data are limited to two sampling locations, as indicated on Figure 2-4. VOC testing of surface soil samples was generally not completed as part of the RI/FS since volatilization would normally remove VOCs in surface soil over the more than 30 years that have passed since the rubber plant was demolished. VOC detections were limited to low concentrations (0.15 milligrams per kilogram [mg/kg] maximum) of ethylbenzene, acetone, methyl ethyl ketone (MEK), and n-butylbenzene. VOCs were not detected at concentrations in excess of USEPA Region IX Preliminary Remediation Goals (PRGs) for a residential setting.

SVOCs/PAHs

Surface soil sampling locations where SVOCs were analyzed are indicated on Figure 2-5. The most commonly detected SVOCs were pyrene, phenanthrene, and fluoranthene. Detections of SVOCs or polycyclic aromatic hydrocarbons (PAHs) in excess of screening criteria (industrial PRGs) were limited to a single sampling location in the former copolymer plancor, as shown on Figure 2-5.

Pesticides/PCBs

Pesticides/PCBs detections were limited to dichloro-diphenyl-trichloroethane (DDT) and its isomers (DDD and DDE), dieldrin, and Aroclor 1260. Pesticides/PCBs detected at concentrations in excess of RI screening criteria (residential PRGs) were limited to DDT at three composite sampling locations near the southwest corner of the former plant site, as indicated on Figure 2-6.

Metals

Metals are naturally occurring, and their detection alone does not necessarily indicate a contaminant release. A total of 19 metals were detected in surface soil samples from the former plant site. Metals detected in excess of RI screening criteria (residential PRGs or background[2]) were limited to arsenic at three composite sampling locations, two located in the southwestern portion of the former plant site and one in the former butadiene plancor (Figure 2-7).

2.2.2 Shallow Soil

Shallow soil incorporates the zone from the ground surface to 15 feet bgs. The previously discussed surface soil samples are therefore a subset of the shallow soil samples. Shallow soil data were used along with shallow soil gas data to evaluate conditions in the vadose zone.

VOCs

Commonly detected VOCs in shallow soils include ethylbenzene, tetrachloroethene (PCE), benzene, and trichloroethene (TCE). Sampling locations where one or more VOCs were detected at concentrations in excess of RI screening criteria (residential PRGs) are indicated on Figure 2-8. VOCs detected at concentrations in excess of screening criteria include benzene (11 locations), ethylbenzene (11 locations),

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[2] For the metals arsenic (As) and iron (Fe), naturally occurring background levels in soil at the former plant site exceed residential PRGs. The background levels of As and Fe in soil at the former plant site were calculated using available data, and these levels were used as RI screening levels instead of the residential PRGs for As and Fe.

TCE (7 locations), styrene (1 location), and 1,2,4-trimethylbenzene ([1,2,4-TMB] 1 location). Elevated VOC concentrations were most prevalent in the tank farm and process areas of the former styrene plancor, at the pits and trenches feature in the southwest corner of the copolymer plancor, laboratories and pipeline area, and adjacent to a former benzene pipeline in the southern butadiene plancor.

SVOCs/PAHs

The most commonly detected SVOCs/PAHs were phenanthrene, pyrene, and fluoranthene. One or more SVOCs/PAHs were detected at concentrations in excess of RI screening criteria (industrial PRGs) at 13 sampling locations, as indicated on Figure 2-9. The following compounds were detected in excess of the screening criteria:

Compound	Number of samples with PRG Exceedances
Benzo(a)pyrene (B[a]P)	11
Benzo(a)anthracene (B[a]A)	3
Benzo(b)fluoranthene (B[b]F)	2
Benzo(k)fluoranthene (B[k]F)	3
Dibenzo(ah)anthracene	3
Indeno(1,2,3-c,d)pyrene (I[1,2,3-cd]P)	1
N-Nitrosodiphenylamine (NDPA)	1

Four of the 13 sampling locations with PRG exceedances are located in the vicinity of the former copolymer plancor laboratory, while the remaining exceedances are single occurrences located sporadically throughout the former plant site.

Pesticides/PCBs

Detections of pesticides/PCBs in shallow soil were limited to DDT and its isomers (DDD and DDE), dieldrin, and the PCB Aroclor 1260. Compounds for which there were screening criteria (residential PRG) exceedances were limited to DDT derivatives (four composite sampling locations) and Aroclor 1260. Figure 2-10 indicates the sampling locations where screening criteria exceedances occurred. A cluster of three composite samples with DDT exceedances is located near the southwestern corner of the former plant site.

Metals

Shallow soil sampling locations where one or more metals were detected in excess of screening criteria are indicated on Figure 2-11. Metals detected at concentrations in excess of screening criteria included arsenic (nine samples), copper (three samples), thallium (three samples) and lead (one sample). Clusters of locations with metal exceedances occurred in the vicinity of the former copolymer plancor laboratory and near wastewater treatment facilities in the northern butadiene plancor.

2.2.3 Deep Soil

Deep soil data were collected in a limited number of locations, typically where there was evidence of overlying shallow soil contamination. Surface exposure pathways for deep soil contaminants are limited to upward migration of volatilized contaminants to the surface[3]. For this reason, deep soil data summarized here are limited to VOCs.

The most frequently detected VOCs in deep soil were benzene, toluene, ethylbenzene and styrene. VOCs detected at concentrations in excess of RI screening criteria (residential PRGs) were limited to benzene (34 samples) and ethylbenzene (two samples). The majority of sampling locations with elevated benzene occur near a former underground benzene pipeline in the southeast corner of the former butadiene plancor and near the western boundary of the former plant site, near an area of known benzene NAPL, as indicated on Figure 2-12.

2.2.4 Shallow Soil Gas

Shallow soil gas data were collected along with shallow soil data to evaluate vadose zone conditions. Shallow soil gas data are limited to VOCs, and available for approximately 850 sampling locations at the former plant site.

The most frequently detected VOCs were PCE and benzene, toluene, ethylbenzene, and xylene (BTEX) compounds. Figure 2-13 presents a map indicating the distribution of sampling locations with various ranges of total VOC concentrations. Sampling locations with more elevated total VOC concentrations tend to be clustered in the tank farm and process areas of the former styrene plancor, in the southwest corner of the former copolymer plancor, in the vicinity of a former laboratory in the butadiene plancor, and near a former benzene pipeline at the southern end of the butadiene plancor.

2.2.5 Deep Soil Gas

Deep soil gas data are limited to VOCs in 12 locations in the former styrene plancor (Figure 2-14) in the vicinity of known NAPL. Sampling depths for all locations were between 47 and 59 feet bgs, immediately above the water table at the time of sample collection.

While 10 different VOCs were detected in deep soil gas, benzene concentrations were far higher than other VOCs at all locations, with concentrations ranging from 1,760 to 30,800 parts per million by volume (ppmv). It is inferred that the elevated deep soil gas concentrations are associated with volatilization of benzene, either dissolved in groundwater or in NAPL, as further explained in the Soil and NAPL RI Report (URS 2007b).

2.2.6 Indoor Air

Indoor (workplace) air monitoring was conducted to evaluate the potential for worker exposure to VOCs. Sampling was performed at 13 site buildings (Figure 2-15) that overlie or are immediately adjacent to (within 25 feet) areas where vadose zone VOC contamination was either known or suspected to be present. In addition to indoor air samples, ambient (outside) monitoring data were collected during the study to establish ambient background levels for each building.

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[3] The potential for exposure through contact with or ingestion of groundwater is not considered in this report, but is discussed within the Groundwater RI (D&M 1998), Groundwater Risk Assessment (McLaren Hart 1998) and the Joint Groundwater Feasibility Study (CH2M Hill 1998).

Detected indoor air VOC concentrations were all less than Occupational Safety and Health Administration (OSHA) permissible exposure levels (PELs) and PEL/20 (i.e., 5% of the PEL) evaluation criteria, indicating that no immediate health risk existed at the time of the sampling. Seven compounds (benzene, chloroform, ethylbenzene, methylene chloride, PCE, TCE, and xylenes) were detected at concentrations above the ambient air PRGs at one or more buildings. Comparison of the indoor air and outdoor air data indicate that compounds detected indoors at concentrations exceeding PRGs were typically also found outdoors, suggesting that the outdoor air quality was likely to be significantly impacting indoor air concentrations.

It is uncertain whether the exceedances of PRGs in indoor air were influenced by the presence of subsurface contamination sources. The elevated VOC concentrations may have been associated with ambient (background) air, activities conducted within the sampled buildings, the upward migration of subsurface contamination, or some combination of these. The relative contribution from these possible sources is unknown.

2.2.7 Groundwater

For the purposes of the FS, relevant groundwater data are limited to VOC concentrations in the water table, for which risks associated with upward migration of vapor were evaluated in the BRA. Potential health risks associated with direct exposures to groundwater have been previously evaluated in the Groundwater Risk Assessment (McLaren Hart 1998).

The July 2000 groundwater monitoring event data were considered for this FS to maintain consistency with the RI and BRA reports for the Soil and NAPL OU. These data indicate that benzene was detected at concentrations in excess of its screening level (drinking water maximum contaminant levels [MCLs]) at a far greater frequency than other VOCs. Other VOCs detected in excess of their MCLs included TCE and chlorobenzene. Individual VOC plumes are typically subsidiary to the benzene plume, and the distribution of benzene is therefore used as an indicator of the extent of dissolved VOC contaminants in the water table, as presented on Figure 2-16.

USEPA has previously issued a ROD for the Groundwater OU (USEPA 1999). The groundwater ROD included a waiver for compliance with groundwater ARARs (drinking water standards) over a portion of the former plant site based on technical impracticability (TI). The TI waiver zone is based on the presence of multiple NAPL areas in close proximity to each other at the former plant site. The NAPL areas represent a continuing source of groundwater contamination where, due to the contamination's mode of occurrence and the relatively low permeability and heterogeneous nature of the subsurface, current technologies cannot remove enough contamination to meet groundwater ARARs. The areal extent of the TI waiver zone varies by hydrostratigraphic unit, but for the water table zone, it is congruent with the existing dissolved benzene plume (the area where the benzene concentration exceeds 1 microgram per liter (μg/L) as shown on Figure 2-16). The TI waiver applies to all groundwater contaminants within the benzene plume. Additional information regarding NAPL areas at the former plant site is provided in the following section.

2.2.8 NAPL

Areas of NAPL at the former plant site are discussed in the Soil and NAPL RI Report (URS 2007b) with respect to whether they are LNAPL or dense NAPL (DNAPL), and are additionally grouped according to the following three categories:

(A) **Areas where NAPL is potentially present, but has never been observed or measured**. NAPL was judged to be "potentially present" where individual dissolved VOC concentrations were ≥ 5% of their respective solubility limits for LNAPL components and ≥ 1% of their solubility limits for DNAPL components. NAPL was also judged to be potentially present where deep soil gas (immediately above the water table) VOC concentrations were similar to concentrations detected in an area of known NAPL.

(B) **Areas where NAPL is present, but at residual (non-mobile) saturations**, as evident from soil core jar testing, laboratory measurements of hydrocarbon saturations, and the lack of any direct observation of NAPL accumulation at groundwater monitoring locations. Saturations of less than 16% are inferred to be indicative of residual levels, based on data presented in the MW-20 Pilot Program Summary Report (URS 2003c). All areas meeting these criteria lie entirely within a larger, potential NAPL area, as described in "A" above.

(C) **Areas where NAPL accumulations occur, as indicated by direct observation of fluid samples from a monitoring well or temporary well point**. This occurrence is distinguished from categories A and B above since remediation by direct NAPL removal techniques (NAPL pumping or bailing) can be evaluated as part of the FS process.

NAPL areas corresponding to the above categories are indicated on Figure 2-17. The primary contaminants present in the LNAPL areas are benzene and ethylbenzene. The LNAPL in the laboratory and pipeline area near the eastern boundary of the former plant site is inferred to be a complex of BTEX, styrene, and numerous other VOCs, SVOCs, and unidentified compounds in the C10-C23 range.

The NAPL areas presented on Figure 2-17 are applicable to the water table zone. NAPL is also known to be present in the vadose zone, but at residual saturations, at the VOC tank farm, laboratory and pipeline, and benzene feedstock pipeline areas. NAPL cannot migrate under natural conditions when at or below residual saturation levels.

A comprehensive evaluation of NAPL conditions was completed for the MW-20 LNAPL area along with a pilot hydraulic extraction program (URS 2003c). The MW-20 LNAPL is composed almost entirely (>95%) of benzene, based on laboratory data from monitoring wells and soil borings. Findings from these investigations confirm that the LNAPL is present in only a limited portion of the "5% of solubility" area shown for the MW-20 area on Figure 2-17. Observational and hydrocarbon saturation data for the MW-20 area indicate the LNAPL is discontinuously present within an approximately 30-foot smear zone extending downward from the water table, from approximately 60 to 90 feet bgs. Laboratory NAPL saturation values range from less than 0.1 to 30%.

Approximately 1.2 million gallons of groundwater were pumped from a portion of the MW-20 LNAPL area over a period of seven consecutive months in 1996 and 1997 as part of the pilot hydraulic extraction program. Separate-phase NAPL recovery during this period was limited to approximately 36 gallons, while an additional 1,420 gallons of benzene were recovered in the dissolved phase. While NAPL distribution within the smear zone is known to be heterogeneous, comparison of pre- and post-hydraulic extraction soil core showed no significant reduction in the subsurface NAPL distribution or hydrocarbon saturation values. It was further concluded that based on experimentally derived equations published by independent researchers (Geller and Hunt 1993), even if 99% of the LNAPL present was removed, the remaining LNAPL would be present for over 100 years. The MW-20 Pilot Program Summary Report (URS 2003c) documents that hydraulic extraction was not judged to be an effective NAPL remediation method based on the lack of significant reductions in NAPL distribution and the inferred longevity of the NAPL.

The results of field investigations to assess the occurrence and distribution of NAPL at three additional areas within the former plant site are reported in Summary of NAPL Screening Investigations, Source Areas 6, 11 and 12 (D&M 1998b). As at the MW-20 LNAPL area, NAPL at these areas was observed to be present intermittently along stratigraphic boundaries at residual saturation levels. Stratigraphic conditions observed at the three investigated areas were also similar to conditions at the MW-20 LNAPL area. Currently, additional field investigations are in progress at these three areas and the MW-20 area to further evaluate the nature and extent of NAPL at these areas. The objectives of these investigations are to: 1) delineate the lateral and vertical extent of NAPL at each area, and 2) further evaluate the composition of the NAPL at each area. The results of these latest investigations are anticipated to be documented in a future report.

No DNAPL accumulation areas are known to exist at the former plant site. The areas of potential DNAPL present along the western boundary of the former plant site on Figure 2-17 are both adjacent to known source areas west of the former plant site. The northerly potential DNAPL area is associated with PCE, with the maximum dissolved concentrations occurring to the west of the former plant site. The potential DNAPL area near the southwest corner of the former plant site is associated with chlorobenzene, which was used extensively for DDT production at the nearby Montrose property. USEPA's investigation of chlorinated solvents at the former plant site and vicinity is ongoing.

2.2.9 Groundwater Contamination Source Areas

Groundwater contamination source areas (hereinafter referred to as "source areas") are areas where past releases of contaminants are inferred to have migrated downward through the vadose zone and impacted groundwater to the extent that MCLs are consistently exceeded. Source areas have been identified based on the following lines of evidence:

- Areas of groundwater contamination in close proximity to historical plant site facilities where large volumes of chemicals were stored, processed, or disposed;
- Evidence of vadose zone contamination, such as elevated contaminant concentrations in shallow soil gas or soil, and/or the observed presence of LNAPL;

- Water table analytical data indicating elevated concentrations of compounds relative to surrounding monitoring locations; and,
- A correspondence or link between the chemicals present in the vadose zone, those known or likely to have been present at the historical facility, and the specific components of the groundwater contamination or NAPL.

Twelve source areas (SA1 through SA12) have been identified at the former plant site through a synthesis of the above guidelines with the former plant site historical information and the soil, soil gas, NAPL and groundwater (water table) data. These source area locations are presented on Figure 2-18 and are identical to those previously presented in the Groundwater RI Report (D&M 1998a). An overview of conditions at each source area is included on the figure.

With the exception of SA1 and SA2, the identified source areas are all associated with elevated concentrations of dissolved benzene and ethylbenzene. SA1 is associated with cyclohexane and SA2 is associated with TCE/PCE. A variety of other compounds is also present at some source areas, as indicated in the table on Figure 2-18.

2.3 RISK ASSESSMENT

2.3.1 Conceptual Site Model

The Conceptual Site Model (CSM) identifies potential chemical sources, release mechanisms, impacted media, transport mechanisms, exposure routes, and potential receptors. The CSM for the Del Amo site is presented on Figure 2-19. The primary sources of chemicals of potential concern (COPCs) are inferred to be historical chemical product releases from former aboveground storage tanks and other facilities at the former plant site. Additional sources unrelated to the former plant site have contributed to groundwater contamination present. Impacted media, which also serve as secondary sources, include soils and groundwater. For the purposes of the CSM, NAPL is considered to be part of these media and is not considered separately. Transport mechanisms, which can also be considered secondary release mechanisms, include fugitive dust emissions, volatilization from soil, and volatilization from groundwater. While other chemical transport mechanisms exist, those identified here are limited to those with the potential to lead directly to human exposures.

"Exposure route" refers to the method by which a chemical may enter the body. Applicable exposure routes include inhalation of soil particulates, inhalation of soil vapor, inhalation of groundwater vapor, ingestion of soil, and dermal contact with soil. Receptors are those organisms that are potentially exposed to the chemicals, and include human receptors, which are the primary focus of the BRA, and other biota, which are evaluated as part of ecological risk assessment. Human receptors for the former plant site are further divided into three types based on differences in the nature of their potential exposures: (1) commercial workers, which includes most of the current indoor work force for the existing businesses; (2) trench workers, who would be more likely to be exposed to subsurface soil; and (3) hypothetical future residents, who would potentially be present at the former plant site on a nearly continuous basis. There are currently no known full-time residents at the former plant site, and current zoning is restricted to commercial/industrial land use.

An exposure pathway is the route and mechanisms by which a chemical reaches a receptor. A "complete" exposure pathway exists where there is a continuous link between the chemical source, release mechanism, transport medium, migration route, exposure medium, and potential receptor(s), indicating there is a potential for exposure. The CSM integrates all of the complete exposure pathways and shows how they are interrelated. Pathways incorporating future residents are identified as "potentially complete" in the CSM since such receptors are hypothetical.

Complete and potentially complete exposure pathways are summarized in more detail in the table below with respect to their receptors, exposure media, and exposure routes (sources, release mechanisms, and transport mechanisms omitted). This table illustrates how the various sample media data presented in the Soil and NAPL RI Report (URS 2007b) apply to the exposure pathways that are evaluated in the BRA.

Receptor	Exposure Media	Exposure Route
Commercial worker	Surface soil	Incidental ingestion Dermal contact Fugitive dust inhalation
	Shallow soil/soil gas	Incidental ingestion Dermal contact Fugitive dust and vapor inhalation Vapor inhalation in indoor air
	Deep soil/soil gas	Vapor inhalation in indoor air
	Groundwater (water table only)	Vapor inhalation in indoor air
	Indoor air	Vapor inhalation in indoor air
Hypothetical future resident	Shallow soil/soil gas	Incidental ingestion Dermal contact Fugitive dust and vapor inhalation Vapor inhalation in indoor air
	Deep soil/soil gas	Vapor inhalation in indoor air
	Groundwater (water table only)	Vapor inhalation in indoor air
Trench worker	Shallow soil/soil gas	Incidental ingestion Dermal contact Fugitive dust inhalation

Further evaluation of the exposure pathways described above is presented in the BRA.

2.3.2 Exposure Areas of Potential Concern

Potential chemical exposures and associated health risks were quantitatively evaluated in the BRA using mathematical modeling of chemical migration and chemical concentrations at locations of potential human exposure. The former plant site was divided into exposure areas based on current parcel boundaries and street segments, and health risks were evaluated for each area. Areas meeting one or more of the following criteria were selected as "exposure areas of potential concern" (EAPCs):

(1) The parcel overlaps one or more of the 12 groundwater contamination source areas defined in the Groundwater RI Report (D&M 1998a). Groundwater contamination source areas typically encompass areas of elevated VOCs in soil and/or soil gas samples associated with an underlying groundwater contaminant plume.

(2) One or more VOCs, SVOCs, pesticides, or PCBs were detected in samples from the parcel at levels exceeding their respective Region IX or CAL-Modified PRGs[4] for residential soil. This includes soil gas samples converted into equivalent soil matrix values.

(3) One or more metals were detected at the parcel above background and above their respective PRGs.

(4) The parcel is surrounded by other parcels that were selected as EAPCs.

A total of 37 EAPCs were identified, and risk calculations were completed for each of these EAPCs. Exposure areas not selected as an EAPC did not meet any of the above criteria, and it is inferred that no significant health risks are associated with such parcels. EAPC locations are presented on Figure 2-18.

2.3.3 Risk Calculations

The FS relies on risk calculations from the BRA that are based on a reasonable maximum exposure (RME) scenario. The RME represents an upper bound (high-end) estimate of exposure and risk, and was selected because of its inherent conservativeness. Health risks are traditionally evaluated with respect to potential carcinogenic risk and noncancer hazards that are compared to accepted standards. The maximum acceptable cancer risk level ranges between 1E-06 and 1E-04 and is selected on a case-by-case basis by USEPA. These values correspond to lifetime incremental cancer risks between one in one million (1E-06) and one hundred in one million (1E-04). Non-cancer health hazards due to chemical exposures are evaluated by comparisons of the calculated hazard index (HI) to the benchmark HI of 1. An HI of 1 or less indicates that no adverse non-cancer health effects are expected. For the purposes of the BRA and FS, risk is divided into four levels. From lowest to highest, these are:

- Risk ≤ 1E-06 and HI ≤ 1
- 1E-06 < Risk ≤ 5E-05 and HI ≤ 1
- 5E-05 < Risk ≤ 1E-04 and HI ≤ 1
- Risk >1E-04 and/or HI>1

Tables 2-1 and 2-2 summarize the findings of the BRA for the RME scenario with respect to the above risk levels. Table 2-1 is organized according to receptor type and pathway to provide a perspective of risk for the entire former plant site. Table 2-2 is organized according to EAPC and is color coded by risk level to promote rapid identification of the specific EAPCs where risk is elevated. As indicated in the tables,

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[4] CAL-Modified PRGS are PRGs developed by the State of California using Cal-EPA toxicity values and, in some cases, are more stringent than USEPA PRGs.

the highest risk level (Risk > 1E-04 and/or HI > 1) for the commercial worker scenario, which applies to the entire former plant site under current land usage, was limited to a single EAPC (EAPC 16) for the indoor air pathway. This elevated risk level was based on elevated detection limits (DLs) for some chemicals at the EAPC rather than true detections, and for this reason, the true risk associated with indoor air at EAPC 16 is likely to be significantly lower. EAPCs with commercial risk (CR) between 5E-05 and 1E-04 were limited to EAPCs 2 and 16 for the outdoor soil pathway, and EAPC 23 for the indoor air pathway. These elevated risks were again associated with elevated DLs in the case of EAPCs 16 and 23. Recalculation of risks for EAPCs where elevated detection limits contributed significantly to the risk is discussed in Section 3. Tables 2-1 and 2-2, discussed earlier in this section, do not reflect the results of these recalculated risk estimates.

3.0 FS EVALUATION APPROACH

This section describes the approach for the Soils FS evaluation for the exposure areas at the former plant site, and the NAPL FS evaluation for the source areas. These evaluations use the results of the RI and BRA. The Soils FS evaluation used the surface pathway risk estimates developed for the commercial worker to determine the extent of remedial evaluation because all the parcels are zoned for commercial/industrial use. Exposure areas with similar risk characteristics were grouped, and representative exposure areas within these groups were selected for detailed FS evaluation. The results of the detailed evaluations were then used as the basis for summary evaluations prepared for the remaining exposure areas within each group.

For the NAPL FS evaluation, full evaluation of remedial options was completed for example areas where NAPL was potentially present or known to be present based on findings presented in the RI report. The full evaluations were then used as the basis for summary evaluations for the remaining NAPL and potential NAPL areas.

Soil and soil vapor sampling during the RI was conducted at locations of former rubber plant facilities. The sampling was conducted in accessible areas outside the existing building footprints. Former rubber plant facility locations that are under existing building footprints were not sampled. This introduced an uncertainty into this FS evaluation. In order to account for the uncertainties associated with these unsampled areas, this FS makes assumptions based on the former locations of rubber plant facilities and available data gathered adjacent to the current building footprints. These assumptions are discussed further in Sections 1.4.1 and 10.3.

An additional uncertainty was the influence of elevated DLs for some chemicals/analytes that resulted in overestimated risks for some EAPCs in the BRA. The influence of elevated DLs was corrected in the FS by recalculating the risk estimates for affected EAPCs without the elevated DLs. These EAPCs were then placed into groups based on the revised risk estimates. As discussed below in Section 3.1.1, only six of the 37 EAPCs were impacted by elevated DLs. Furthermore, only a limited number of chemicals (typically one or two) present at any EAPC were impacted by the elevated DLs issue, and sufficient data remained at each EAPC after discarding the data with elevated DLs to reliably calculate the risk.

3.1 APPROACH FOR SURFACE PATHWAY EVALUATION

This section describes the impact of elevated DLs on risk calculations, and the procedure for recalculation of the risk estimates for use in the FS. The section concludes with explanations of how exposure areas were grouped, and the representative exposure area approach used for the soils FS evaluation.

3.1.1 Impact of Elevated DLs

The risk levels presented in the BRA (Table 23 of the BRA) for EAPCs 5, 7, 16, 23, 24 and 35 were driven by elevated laboratory detection limits for some of the risk-driving chemicals (RDCs). In these cases, the DLs for some compounds were reported by the laboratory at levels significantly greater (often by orders of magnitude) than the maximum reported concentrations for those analytes in other samples collected at the same EAPC. To calculate exposure-point concentrations (EPCs) in the BRA, non-detected analytes were assumed to have concentrations equal to one-half the reported detection limit (½*DL) concentrations.

For the EAPCs listed above, there were numerous instances of an analyte being reported as not detected in one or more samples where ½*DL was a value greater than the maximum reported concentration for the same analyte in other samples collected at the EAPC. The method of using ½*DL to calculate EPCs in the BRA resulted in EPCs and calculated risks that were often substantially higher than would have resulted from using the analyte's maximum detected concentration at the EAPC. This is especially true when the chemical that is impacted by the elevated DL also happens to be a primary risk contributor. For the surface pathway evaluation in the soils FS, risk estimates were recalculated for those EAPCs by replacing the detection limit-influenced EPC value with a revised EPC value that is believed to be more representative of actual conditions at the EAPC. The revised risk estimates for these EAPCs are then used to place the EAPCs into the appropriate risk-based groups for the FS analysis.

3.1.2 Recalculation of Risk Estimates

The recalculation of the risk estimates was performed in accordance with the Risk Assessment Guidance for Superfund (RAGS Part D, Chap 5, USEPA 2001) for EAPCs 5, 7, 16, 23, 24 and 35 as discussed in a meeting with the USEPA on November 3, 2006. The revised EPC value was calculated using the data set that resulted from deletion of the non-detect samples for which ½*DL>max. For completeness, the revised EPC and risk values were calculated for each chemical within an EAPC that was impacted by elevated DLs and not just the RDCs.

A summary of the revised risk results compared with the BRA risk values for the outdoor shallow soil and indoor air/Tiers 1+2-shallow[5] media are presented in Table 3-1. The details showing the data points that were deleted and the revised EPCs for each EAPC are shown in Appendix B. Some of the key findings of the recalculated risk estimates for those EAPCs (5, 7, 16, 23, 24 and 35) are discussed below:

EAPC 5: The BRA reported the dominant risk to be due to the indoor air pathway where the CR for the indoor air pathway (Tiers 1+2) was reported as 2E-06 with PCE as the primary RDC. However, the data for PCE and other chemicals (e.g., acetone, TCE) were impacted by elevated DLs. By recalculating the risks for this exposure area using the RAGS method, the resulting CR was less than 1E-06. Benzene was the primary risk driving chemical (RDC) with an individual risk contribution of 9E-07.

EAPC 7: The BRA reported the CR for the outdoor soil pathway as 9E-06 with arsenic and B(a)P as RDCs. However, benzo(a)pyrene and other PAHs were impacted by elevated DLs. The recalculated risk decreases to 7E-06 with only arsenic remaining as an RDC. The BRA reported the CR as 2E-06 for the indoor air pathway (Tiers 1+2) with PCE as the RDC. The

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[5] "Tier 1+2 – shallow" refers to the parcel-specific indoor air risk estimated in the BRA for all contaminants in shallow soil/soil gas. This involved using Tier 1 modeling (Johnson-Ettinger Model) for the non-BTEX compounds and Tier 2 (Dominant Layer Model) for BTEX.

PCE data were impacted by elevated DLs, and the recalculated CR was less than 1E-06. After recalculation, arsenic remained the primary RDC via the outdoor soil pathway. The commercial worker HI (HI_{com}) for the indoor air pathway after recalculation is 0.96 and reported as 1.0.

EAPC 16: The BRA reported the CR as 4E-04 for the indoor air pathway (Tiers 1+2) with chloroform, PCE, TCE and benzene as RDCs. There were a total of 13 chemicals impacted by elevated DLs at this exposure area. The recalculated CR without the influence of elevated DLs for the indoor air pathway was 9E-06 with PCE and TCE as RDCs. The HI_{com} for indoor air decreased from 3 to 0.3 after recalculation without elevated DLs. The BRA reported the CR as 1E-04 for the outdoor soil pathway, which after recalculation resulted in a risk of 3E-06, with 4,4'-DDT and NDPA remaining as RDCs.

EAPC 23: The BRA reported the CR as 1E-04 for the indoor air pathway (Tiers 1+2). There were a total of 10 chemicals impacted by elevated DLs at this exposure area. The recalculated CR for the indoor air pathway is 2E-05 with benzene as the primary RDC and PCE as a significantly smaller secondary RDC. The BRA reported the CR for outdoor soil as 2E-05 which after recalculation was 1E-05 with benzene as the RDC.

EAPC 24: The BRA reported the CR as 5E-05 for the indoor air pathway with PCE as the primary RDC. There were a total of 7 chemicals impacted by elevated DLs at this exposure area. After recalculation, the CR decreased significantly to less than 1E-06 with benzene as the primary RDC. The BRA reported the CR as 4E-05 for the outdoor soil pathway which after recalculation also decreased to less than 1E-06.

EAPC 35: The BRA reported the CR as 8E-06 for the indoor air pathway with PCE and benzene as RDCs. There were 4 chemicals impacted by elevated DLs. After recalculation the CR decreased to 2E-06 with benzene as the RDC. The outdoor soil risk was not impacted by elevated DLs and hence the CR for outdoor soil was unchanged at 3E-05 with B(a)P as the RDC.

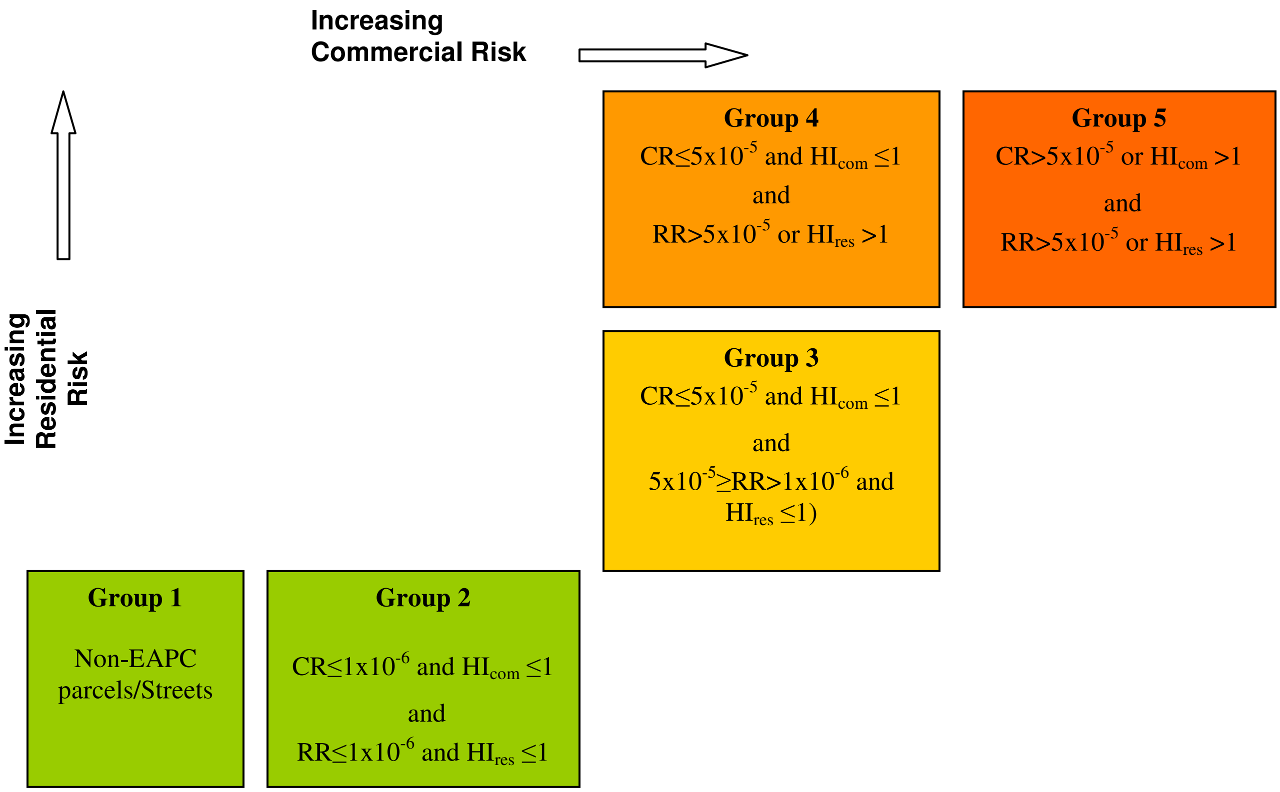
3.1.3 Risk-based Grouping of Exposure Areas

Exposure areas were placed into one of five groups for the FS evaluation based on specific ranges of CR, residential risk (RR), and associated HIs for the respective exposure areas. Of the 65 parcels and 6 street segments that make up the exposure areas for the Soil and NAPL OU, 37 exposure areas (including 3 street segments) were designated as EAPCs and evaluated in the BRA. These EAPCs were placed in Groups 2 through 5. The higher of the outdoor soil or indoor pathway risk estimates were used to determine group assignment for any EAPC. The five risk-based groups are defined below in text and as a graphic:

Group 5 (CR > 5E-05 or $HI_{com} > 1$) and (RR > 5E-05 or residential HI [HI_{res}] > 1)

Group 4 (CR ≤ 5E-05 and $HI_{com} \leq 1$) and (RR > 5E-05 or $HI_{res} > 1$)

Group 3	($CR \leq 5E\text{-}05$ and $HI_{com} \leq 1$) and ($5E\text{-}05 \geq RR > 1E\text{-}06$ and $HI_{res} \leq 1$)
Group 2	($CR \leq 1E\text{-}06$ and $HI_{com} \leq 1$) and ($RR \leq 1E\text{-}06$ and $HI_{res} \leq 1$) and non-EAPC exposure areas with targeted facilities that were not sampled or areas that were in close proximity to NAPL
Group 1	All other non-EAPC exposure areas and some surface streets



Groups 3 and 4 have the same CR range and differ only in the RR estimate. Group 3 includes some EAPCs with a CR less than 1E-06, the same as for Group 2, but which are distinguished by their RR of greater than 1E-06.

Each group can have one or several RDCs including VOCs or non-VOCs based on either outdoor soil or indoor air pathway. RDCs in this FS are defined as any chemical that by itself can result in placement of an EAPC in Groups 3, 4 or 5. The chemicals contributing to the most risk at an EAPC are often referred to as primary RDCs and other RDCs contributing a lower risk are referred to as secondary RDCs.

The site properties (or exposure areas) were initially placed in these groups based on the risk values presented in the BRA (GeoSyntec & URS 2006). The recalculation of the risks for exposure areas impacted by elevated DLs resulted in reassignment of some exposure areas to a different group if the recalculated risk was substantially different, as discussed below:

EAPC 5: Based on the recalculated risks, this exposure area had a CR of 9E-07 (<1E-06) for the indoor air pathway and a corresponding RR of 4E-05 (<5E-05; Revised Table 21, Appendix B). However, the HI_{res} was still greater than 1 (HI_{res} = 9; Table 3-4); hence, EAPC 5 remains in Group 4.

EAPC 7: Based on the recalculated risks, this exposure area had a CR of 7E-06 for the dominant risk outdoor soil pathway and because the corresponding RR was greater than 5E-05, this exposure area remains in Group 4.

EAPC 16: Based on the recalculated risks, this exposure area had a CR of 9E-06 for the dominant risk indoor air pathway, and the corresponding RR was greater than 5E-05. Hence, this exposure area was moved down from Group 5 to Group 4.

EAPC 23: Based on the recalculated risks, this exposure area had a CR of 2E-05 for the indoor air pathway, and the corresponding RR was greater than 5E-05. Hence, EAPC 23 was moved down from Group 5 to Group 4.

EAPC 24: Based on the recalculated risks, this exposure area had a CR less than 1E-06 for both indoor air and outdoor soil pathways. The corresponding RR was 1E-06 for the outdoor soil pathway and less than 1E-06 for the indoor air pathway. EAPC 24 was therefore moved down from Group 4 to Group 3. This exposure area was placed in Group 3 as a conservative measure rather than Group 2 because this property is also a potential NAPL groundwater contamination source area with the potential risk for vapor migration from deep soils.

EAPC 35: Based on the recalculated risks, this exposure area had a CR of 3E-05 for the outdoor soil risk pathway with a corresponding RR greater than 5E-05, and hence this EAPC remains in Group 4.

Table 3-2 shows the assignment of exposure areas to groups by listing parcel numbers (or street segment names) and EAPC numbers within each group. Based on the discussion above, Table 3-2 assigns EAPCs 16, 23 and 24 to lower risk groups. Figure 3-1 shows a site map with each EAPC colored by risk group. Colors vary from green (lowest risk) to dark orange (highest risk).

Table 3-2 further divides the risk-based groups into subgroups A and B. Subgroup A includes EAPCs with non-VOCs in outdoor soil as primary RDCs, including PAHs, (primarily B(a)P) and metals (primarily arsenic). Subgroup A exposure areas can include VOCs as secondary RDCs. Subgroup B includes EAPCs with VOCs as primary RDCs (primarily benzene, but also PCE and TCE) via the indoor air pathway. Subgroup B exposure areas can include non-VOCs as secondary RDCs.

Only one EAPC (EAPC 2) remains in Group 5. This EAPC is impacted primarily by B(a)P and other PAHs and consequently is placed in Subgroup A. There is also a secondary contaminant, arsenic, at this EAPC. Only a single soil sample collected at this EAPC exceeded a 5E-05 risk-based threshold level for commercial workers (Table 3-3). There are no exposure areas in Group 5 Subgroup B.

Seven EAPCs fall into Group 4A. Calculated CRs for all of these EAPCs are less than 5E-05 and HI_{com} are less than 1 (Table 3-4). Three (EAPCs 7, 29, 34) have arsenic as the primary RDC in outdoor soil of which EAPCs 7 and 34 also have benzene as a secondary RDC. Two EAPCs (10, 14) have copper as the primary RDC. Two (EAPCs 28, 35) have B(a)P as the primary RDC and VOCs (PCE, benzene) as secondary contaminants via the indoor air pathway. EAPC 34 also showed elevated indoor air risk based on the groundwater-to-indoor air pathway.[6] EAPC 29 is an undeveloped property in the southwestern portion of the site. EAPC 34 is the LADWP right-of-way with pipelines and electrical lines. EAPC 35 is a surface street (Magellan Drive).

Group 4B includes six EAPCs. Calculated CRs for all of these EAPCs are less than 5E-05 and HI_{com} are less than 1. Five of these EAPCs have benzene as the RDC in indoor air, and EAPC 16 has TCE and PCE as the RDCs. EAPC 5 has a CR less than 1E-06 but is placed in Group 4B because the HI_{res} is greater than 1. Some Group 4B EAPCs have secondary non-VOC RDCs such as arsenic, DDT and NDPA in outdoor soil. Six EAPCs in Group 4 (EAPCs 5, 6, 15, 16, 23, and 28) were also identified as containing or potentially containing NAPL. EAPC 11 is in close proximity to NAPL present at EAPC 5. It is noted that of all the soil and soil gas samples collected at the Group 4 EAPCs, only a single soil sample (from EAPC 23) exceeded a 5E-05 risk-based threshold level for commercial workers.

Group 3A includes seven exposure areas. Calculated CRs for all of these EAPCs are less than 5E-05 and HI_{com} are less than 1. RDCs in outdoor soil include arsenic at three of these exposure areas and B(a)P at four of the exposure areas. EAPC 4 was also identified as a groundwater contamination source area, but Section 7 of this FS Report presents several years of groundwater monitoring results indicating that no NAPL is present in this area.

Group 3B also includes eight exposure areas. Calculated CRs for all of these EAPCs are less than 5E-05 and HI_{com} are less than 1. RDCs in indoor air include benzene at five of the exposure areas and PCE or TCE at three of the exposure areas. EAPCs 9, 22 and 24 were identified as groundwater contamination source areas that potentially contain NAPL. EAPCs 20 and 33 showed indoor air risk via the groundwater-to-indoor air pathway elevated above the 1E-06 threshold.

There are 14 exposure areas in Group 2 with both CR and RR below 1E-06. This group is not divided into subgroups based on contaminant type because all risks are below 1E-06. Six non-EAPC exposure areas are included in Group 2: three have NAPL known or suspected at close proximity and another three have targeted facilities that were inaccessible for sampling during the RI. The remaining eight exposure areas are EAPCs: EAPC 21 is a potential NAPL source area, EAPC 18 is considered a source area with soil contamination only, and four others (including EAPC 37, Pacific Gateway Drive South) have NAPL in close proximity. NAPL is not an issue at the other two EAPCs, 1 and 31.

Group 1 is the lowest risk group with both CR and RR less than 1E-06 and no NAPL. It has a total of 26 exposure areas including 23 parcels and three road segments (Francisco Street, Knox Street, and Vermont Avenue).

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[6] The groundwater-to-indoor air pathway was evaluated in the BRA only when there were insufficient shallow soil data available for that EAPC to evaluate the indoor air pathway. As discussed in the BRA (GeoSyntec & URS 2006), there is considerably greater uncertainty with indoor risk results derived from groundwater data.

3.1.4 Representative Exposure Area Approach for the Soils FS Surface Pathway Evaluation

The surface pathway evaluation is based on the results of the BRA (GeoSyntec & URS 2006) for the 37 EAPCs including revised risk estimates for some EAPCs. As discussed above, exposure areas with similar risk characteristics were grouped, and representative exposure areas within these groups were selected for detailed FS evaluation. The results of the detailed evaluations were then used as the basis for summary evaluations presented for the remaining exposure areas within each group. The remedial alternatives in this evaluation will address volatile and nonvolatile contaminants in surface and shallow soil (<15 feet bgs) to address both the outdoor soil and indoor air exposure pathways.

Representative EAPCs selected included the key contaminant types and exposure pathways characteristic of a group or subgroup, to enable the subsequent extrapolation of the detailed FS evaluations to other EAPCs in the group. In addition, EAPCs that had more data or were considered more completely characterized were chosen for detailed evaluation.

Table 3-3 lists the representative exposure areas selected for the detailed FS evaluation. Generally, one representative exposure area was selected from each subgroup; however, in the case of Group 4B three EAPCs were evaluated in detail as discussed below.

EAPC 2 was selected as representative of Group 5A as it is the only EAPC in the group. It is also an example of an EAPC with B(a)P as the RDC in the higher risk range. EAPC 2 is located at the southwest corner of 190th Street and Vermont Avenue, in the northeastern corner of the former copolymer plancor.

No exposure areas are included in Group 5B because the revised risk calculation moved these EAPCs to a lower risk group.

EAPC 7 was selected as representative of Group 4A, as an example of an EAPC with arsenic as the RDC in the mid-risk range. It is noted that three EAPCs in this group (EAPCs 29, 34, 35) are not typical of the former plant site because they are undeveloped. EAPC 7 is located at the southwest corner of Knox Street and Hamilton Avenue, in the northeastern corner of the former butadiene plancor.

For Group 4B, three EAPCs were evaluated in detail because they either had different RDCs, different site conditions, or different types of buildings on the property. EAPC 16 was selected as representative of the EAPCs in this group where chlorinated solvents (TCE, PCE) are RDCs. EAPC 23 was chosen as representative of EAPCs where benzene is the RDC with a warehouse type facility on site. EAPC 5 was selected as representative of a property with benzene as the RDC and an office building on site. These three EAPCs are well characterized, with more data available than others in the group. EAPCs 16 and 23 are on Pacific Gateway Drive, in the northwestern portion of the former styrene plancor. EAPC 5 is located on the west side of Hamilton Avenue, just north of Del Amo Boulevard, in the southeastern portion of the former butadiene plancor.

EAPC 32 was selected as representative of Group 3A. It has B(a)P as the RDC in the mid-risk range. This EAPC is located on Magellan Drive in the northern portion of the former styrene plancor.

For Group 3B, EAPC 9 was selected as representative, with benzene as the RDC via the indoor air pathway. This EAPC is located on Del Amo Boulevard in the southern portion of the former butadiene plancor.

EAPC 21 located at the northwest corner of Magellan and Francisco streets, in the styrene plancor, was selected as representative of the 14 exposure areas in Group 2.

Parcel No. 7351-031-017 located at the northeast corner of Knox Street and Pacific Gateway, in the copolymer plancor, was selected as representative of the 26 exposure areas in Group 1.

Table 3-4 provides a summary of the risk estimates (including revised risk estimates discussed above) for all exposure areas in each risk-based group. The table presents CR, RR, HI_{com} and HI_{res} values and identifies the primary and secondary RDCs and their associated exposure pathways. The revised risk estimates in the table are highlighted in yellow and the representative EAPCs are listed in blue text. Group 1 exposure areas were not included in this table because they were not EAPCs and risk estimates were not developed for them in the BRA. Only 8 of the Group 2 exposure areas were considered EAPCs; the other non-EAPC exposure areas do not have risk data.

3.2 APPROACH FOR NAPL FS EVALUATION

As mentioned earlier, the FS evaluation for the NAPL source areas was conducted in parallel with the surface pathway evaluation. Both FS evaluations included technology screening, remedial alternative formulation, and detailed evaluation of remedial alternatives. Soils FS surface pathway evaluations were performed for all exposure areas where NAPL source areas are present. The final section of this document will discuss integration of the surface pathway and NAPL FS evaluations.

Table 3-5 lists the eleven[7] groundwater contamination source areas that were discussed in Section 2, the EAPCs in which they occur, the primary contaminants in each source area, and comments. The locations of these source areas in the former plant site are shown on Figure 2-18. With the exception of SA1 and SA2, the source areas are addressed similarly in this report since LNAPL is present or suspected of being present at all of them and because they have similar contaminants of concern (COCs; aromatic hydrocarbons, primarily benzene). Additionally, wherever LNAPL is known to be present at the site, its mode of occurrence is similar. LNAPL is generally present at or near residual saturation levels in the deep vadose zone or shallow saturated zone within fine-grained silt and sand deposits of the UBF and/or MBFB units (see Section 2). SA1 and SA2 are distinct from the other source areas with respect to their COCs and NAPL conditions and are discussed separately in Section 3.2.4 below.

As discussed in Section 2.2.8 of this FS Report, areas of the former plant site where NAPL is either known or suspected to be present have been identified using multiple lines of evidence and are grouped into one of the following three categories:

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[7] The twelfth NAPL source area is located at the Waste Pit Area and is not considered in this FS for the Soil and NAPL OU.

(1) Areas where NAPL accumulations are known to occur based on direct observation of fluid samples from a monitoring well or temporary well point. These areas are discussed below in Section 3.2.1, NAPL Accumulation Areas.

(2) Areas where NAPL is present, but at residual (non-mobile) saturation levels, based on the results of laboratory testing and the lack of any direct observation of NAPL accumulation at groundwater monitoring locations. These areas are discussed below in Section 3.2.2, Residual NAPL Areas.

(3) Areas where NAPL is potentially present based on elevated dissolved VOC concentrations in groundwater samples, but has never been observed or measured. These areas are discussed below in Section 3.2.3, Potential NAPL Areas.

Source areas where NAPL is not known or suspected to be present are discussed in Section 3.2.4. Implementation of any active remedy at any of the NAPL source areas will require additional focused investigations to delineate the actual NAPL-impacted areas.

Based on the various lines of evidence discussed in Section 2.2.9, in four of the source areas (SA12, SA3, SA11 and SA6), NAPL is located predominantly outside the building footprints. However, based on knowledge of former sources, the NAPL is assumed to be predominantly located beneath the buildings in four other source areas (SA4, SA7, SA8 and SA5). It is also noted that the remedial alternatives are identical for source areas located outside building footprints, as discussed in Section 7. The FS 9-criteria evaluation is presented in Section 9 as a detailed discussion of each criterion as it pertains to SA12, including the comparative analysis, followed by a brief discussion of the evaluation for the similar source areas. The discussion for the similar source areas will state where the evaluation is the same as for SA12 and identify where the evaluation differs. SA4 is similarly used as a representative area with NAPL under a building, and the discussion for other source areas under buildings state where the evaluation is the same and identifies where it differs. In general, the differences in the evaluation between the source areas are expected to be small since the contaminants and lithology are so similar. The evaluation and ratings are provided separately in tables for each source area.

The following subsections provide additional discussion of the NAPL source areas and other source areas, and the assumptions that were made for the FS evaluation. A more detailed description of the source areas, including figures, is provided in Section 7, where the NAPL remedial alternatives are described.

3.2.1 NAPL Accumulation Areas

SA12 is a NAPL accumulation source area in the vicinity of the former butadiene plancor laboratory and is located in EAPC 5. Limited LNAPL accumulation was noted based on one-time observation of a thin (<1/4-inch) layer of NAPL at temporary well points CWL0051 and CWL0054. High concentrations of BTEX and styrene were detected in groundwater and therefore inferred to be components of the LNAPL. The LNAPL may also include other chemicals detected in soil such as cyclohexane, naphthalene, 1,2,4-TMB, butylbenzene, ketones, phthalates, phenanthrene, pyrene and numerous unidentified compounds in the C10-C23 hydrocarbon range. The horizontal extent of LNAPL was not formally characterized but assumptions were made based on available data. The NAPL source area is adjacent to an office building and some fraction of the NAPL source area may extend under the building. The vertical extent of the NAPL contamination is assumed to be about 80 feet bgs based on the NAPL screening investigation data (D&M 1998b).

SA3 (also known as the MW-20 area) is associated with the benzene storage tanks in the former styrene plancor. It is located in EAPC 23, and a portion of the source area extends into EAPC 16. SA3 is impacted by LNAPL that is composed largely of benzene and is submerged below the water table in a 40-foot smear zone reaching about 90 feet bgs. The lateral and vertical extent and composition of the NAPL contamination at this source area is well characterized. The lateral extent of SA3 lies entirely outside the footprint of the building on the property. However, there is another source area (SA6) located on this EAPC (discussed below) that may extend under the building. A pilot hydraulic extraction program (URS 2003c) was completed that added to the study of this area.

3.2.2 Residual NAPL Areas

SA6, associated with the VOC tank farm in the former styrene plancor, is located in EAPC 23. This source area is presented in the Soil and NAPL RI Report (URS 2007b) as containing residual NAPL, and is located in the same EAPC that contains SA3. No NAPL accumulation was found in wells here, and the hydrocarbon saturations in this area are at residual saturation levels. The extent of contamination in this source area is not well defined. Assumptions on extent of contamination for the FS evaluation were made based on NAPL investigation and groundwater data, and locations of former rubber plant facilities. Based on the NAPL investigation data, a large fraction of the VOC contamination mass seems to be in the vadose zone but there was intermittent contamination in the saturated zone down to approximately 80 feet bgs.

SA11, associated with a former underground benzene pipeline, is located in EAPC 9 and EAPC 6, and a small portion of the source area extends into the LADWP right-of-way (EAPC 15). This source area is impacted by residual NAPL composed primarily of benzene. The extent of NAPL contamination in this source area is not well defined. Assumptions on extent of contamination for the FS evaluation were made based on NAPL investigation and groundwater data, and locations of former rubber plant facilities. Based on the NAPL investigation data, some of the contamination mass is in the vadose zone and there is intermittent NAPL in the saturated zone down to 75 feet bgs.

3.2.3 Potential NAPL Areas

SA9 is located at the southern end of the former VOC tank farm in the styrene plancor, in EAPC 24, and is listed as a potential NAPL source area based on dissolved-phase groundwater concentrations in downgradient monitoring wells. No well-defined vadose zone source area was found during RI investigations. Due to numerous uncertainties for this source area, assumptions were made for the FS evaluation. The horizontal extent of the source area is assumed based on the locations of former facilities and some of the source area is assumed to be under the building. The vertical extent is assumed to extend from 15 feet bgs to 80 feet bgs.

SA4, 7 and 8 are in the former styrene plancor in EAPCs 28, 22, and 21 respectively. SA4 is associated with the styrene finishing/benzene purification area, while SA7 and SA8 are associated with ethylbenzene production units #1 and #2 respectively. These source areas are also considered potential NAPL areas based on groundwater dissolved-phase concentrations. It is noted that these source areas may extend beneath the existing buildings. These buildings cover a large portion of each property, and the soils below the building were not sampled. For these EAPCs, the extent of contamination is assumed to be entirely under the buildings based on the locations of former rubber plant facilities.

3.2.4 Other Source Areas

SA2 refers to the Pits and Trenches area in the northwestern portion of the former styrene plancor in parcel 7351-034-050, which is part of EAPC 16. SA2 is a potential NAPL area related to elevated concentrations of dissolved-phase TCE and PCE. These chlorinated compounds are DNAPL components and have no known history of use at the former plant site. There is a known offsite source area for these DNAPL components adjacent to the Pits and Trenches area of the former plant site. There is limited observation of chlorinated solvents in the vadose zone soil and soil gas in the Pits and Trenches area but this is not indicative of a significant DNAPL source area.

SA5 is located in EAPC 18 in the northern portion of the former styrene plancor and is associated with a styrene finishing unit. SA5 is characterized as unlikely to contain NAPL, but was evaluated as a soil contamination area per USEPA's request.

SA1 is located in EAPC 4 in the former copolymer plancor and is associated with a cyclohexane storage area. SA1 is characterized in the Soil and NAPL RI Report (URS 2007b) as unlikely to contain NAPL, and recent monitoring data indicate more convincingly that this area does not contain NAPL or groundwater with elevated concentrations of COCs. See Section 7 for discussion supporting the decision that no FS evaluation is needed for this source area.

4.0 REMEDIAL ACTION OBJECTIVES AND RESPONSE ACTIONS

This section presents the remedial action objectives and general response actions for the Soil and NAPL OU (Table 4-1). This section also identifies potential ARARs for the site and summarizes site-wide COCs that are to be addressed by the FS evaluation.

4.1 REMEDIAL ACTION OBJECTIVES

As discussed in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), RAOs describe in general terms what a remedial action should accomplish in order to be protective of human health and the environment. RAOs are narrative statements that specify the contaminants and environmental media of concern, the potential exposure pathways to be addressed by remedial actions, and the receptors to be protected. RAOs consist of environmental medium-specific or operable unit-specific goals for protecting human health and the environment. CERCLA requires that remedial actions:

- "Attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and control of further release at a minimum which assures protection of human health and the environment" (Section 121(d)(1));

- Comply with or attain the level of "any standard, requirement, criteria, or limitation under any Federal environmental law…or any promulgated standard, requirement, criteria, or limitation under a State environmental or facility siting law that is more stringent than any Federal standard, requirement, criteria, or limitation" that is found to be applicable or relevant and appropriate (Section 121(d)(2)(A)).

In developing RAOs in compliance with CERCLA, risks to human health and environment, and ARARs were evaluated. The RAOs were developed based on review of the Soil and NAPL RI Report (URS 2007b) and the BRA (GeoSyntec & URS 2006).

4.1.1 Surface Pathway/Soil Media

Table 4-1 presents the RAOs for the soils/surface pathway based on environmental media (surface soil, shallow soil, indoor air, deep soil and groundwater) and contaminant type (VOCs, non-VOCs). These RAOs are summarized below:

- Prevent direct contact with or ingestion of outdoor soil containing non-VOC contaminants (PAHs, metals, PCBs) above action levels applicable to current land uses;

- Prevent direct contact with or ingestion of outdoor soil containing VOCs or inhalation of VOCs from outdoor soil contaminated with VOCs above action levels for current land uses;

- Prevent inhalation of VOCs in indoor air at levels above threshold levels derived from PELs and/or risk-based screening levels;

- Prevent or control direct contact with or ingestion of non-VOC or VOC contaminants in outdoor soil in the event of construction activity or change in land use.

4.1.2 NAPL/Deep Soil and Groundwater Media

Table 4-1 also presents the primary RAOs for the NAPL/groundwater contamination source areas in deep soil or groundwater media which include:

- Protect groundwater resources outside of the Benzene TI-waiver zone;
- Prevent utilization of impacted local groundwater resources within and adjacent to the Benzene TI-waiver zone as defined in the Groundwater ROD.

4.2 GENERAL RESPONSE ACTIONS

GRAs are actions that can potentially satisfy the RAOs discussed above. GRAs range from no action to passive technologies focused on containment to active removal or destruction technologies. The GRAs developed for this FS include institutional controls, engineering controls, in-situ treatment, ex-situ treatment, or a combination of the above. Like RAOs, GRAs are environmental medium-specific. GRAs were developed based on review of the Soil and NAPL RI Report (URS 2007b) and the BRA (GeoSyntec & URS 2006). Like the RAOs, the GRAs were developed in conjunction with USEPA in Technical Memorandum #1 (URS 2003a). Ultimately, the retained technologies and process options for each GRA were combined to form remedial alternatives evaluated in this FS. The technology types are discussed in detail in the following section on screening of technologies (Section 5) and the remedial alternatives are presented for the surface pathway and NAPL in Sections 6 and 7 respectively.

4.2.1 Surface Pathway/Soil Media

Table 4-1 presents the GRAs developed to address RAOs for the surface pathway by environmental medium, contaminant type, exposure route and receptor. The GRAs for the soil/surface pathway are listed below by technology type:

- No Action
- ICs
  - Implement ICs to notify stakeholders of available information resources, monitoring programs and any control measures relating to surface or shallow soil contamination that apply to portions or all of the site.
  - Implement ICs (fencing, warning/information signs or notices, other) to restrict access to areas of contaminated surface or shallow soil.
  - Implement ICs to control construction activities, and restrict/prohibit residential development in areas of known or suspected contaminated surface or shallow soil including VOC contamination that may result in exceedances of residential indoor air threshold levels.
  - Implement ICs (notifications) and workplace air monitoring to verify threshold levels are not being exceeded.
- Engineering Controls/Containment
  - Isolate contaminated soil with a physical barrier (landscaping, artificial cover or cap).

  - Prevent VOCs from entering a building with a physical (vapor) barrier in soil, or by floor sealing.
  - Modify building ventilation systems to control VOCs in indoor air.
- In-situ Treatment
  - Remove contaminants from shallow or deep soil including beneath or around buildings.
- Ex-situ Treatment (Excavation)
  - Remove contaminants or contaminated surface or shallow soil; replace with clean soil.
- Monitoring
  - Monitor for remedy effectiveness/compliance.
  - Monitor workplace air quality as needed to verify threshold levels are not exceeded.

4.2.2 NAPL/Deep Soil and Groundwater Media

Table 4-1 presents the GRAs developed to address RAOs for the NAPL/deep soil and groundwater pathways by environmental medium, contaminant type, exposure route and receptor. The GRAs for the NAPL/deep soil and groundwater pathways are listed below by technology type:

- No Action
- ICs
  - Implement ICs to enhance current restrictions on groundwater development and to notify stakeholders.
- Containment
  - Where practicable, and where measurable benefits would result, implement source control measures to immobilize or contain NAPL to limit its migration to or contact with groundwater resources.
- In-situ treatment
  - Where practicable, and where measurable benefits would result, implement source control measures to remediate NAPL in-situ to limit its migration to or contact with groundwater resources.
- Ex-situ treatment (Extraction)
  - Where practicable, and where measurable benefits would result, implement source control measures to remediate NAPL by ex-situ treatment to limit its migration to or contact with groundwater resources.
- Monitoring
  - Maintain groundwater monitoring program to verify the long-term effectiveness of monitored natural attenuation and limited hydraulic extraction as the selected remedy for the benzene plume as defined in the Groundwater ROD.

4.3 ARARS

The following section presents an overview of the ARARs evaluation process and identifies ARARs affecting the RAOs and the potential remedies to be implemented for the Soil and NAPL OU. The complete ARARs evaluation is presented in Appendix C.

The CERCLA legislation as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), promulgated the policy regarding ARARs (42 USC §§ 9610-9675, CERCLA §§ 101-405). This policy requires that CERCLA remedial actions must meet any federal, state and local standards that are determined to be fully "applicable" or "relevant and appropriate" requirements. The terms "applicable" and "relevant and appropriate" are defined in 40CFR300.400(g)(2).

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address the situation at a CERCLA site. The requirement is applicable if the jurisdictional prerequisites of the standard show a direct correspondence when objectively compared to the conditions at the site. If the requirement is not legally applicable, then the requirement is evaluated to determine whether it is relevant and appropriate.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law, that while not applicable, address problems or situations sufficiently similar to the circumstances of the proposed response action and are well suited to the conditions of the site.

A requirement must be substantive in order to constitute an ARAR for activities conducted onsite. Procedural or administrative requirements such as permits and reporting requirements are not ARARs.

The NCP provides that where ARARs do not exist, agency advisories, criteria, or guidances are "to-be-considered" (TBCs) useful "in helping to determine what is protective at a site or how to carry out certain actions or requirements" (55 Federal Register 8745). The NCP preamble states, however, that provisions in the TBC category "should not be required as cleanup standards because they are, by definition, generally neither promulgated nor enforceable, so they do not have the same status under CERCLA as do ARARs."

ARARs and TBC requirements are generally divided into three categories: chemical-specific, location-specific, and action-specific. Chemical-specific requirements set health or risk-based concentration limits or discharge limitations for specific chemicals. Location-specific requirements are restrictions placed on activities due to their particular location, for example, floodplains, earthquake faults, wetlands, etc. Action-specific requirements are performance, design or similar criteria related to particular remedial actions.

4.3.1 Identification of ARARs

The identification of potential ARARs and TBCs for the Soil and NAPL OU was accomplished by reviewing federal, state and local laws, regulations and policies. A preliminary determination of ARARs and TBCs was made based upon the terms of these statutes, regulations and policies; consideration of USEPA guidance (USEPA 1988); and best professional judgment. Identification of ARARs was a site-specific determination involving a two-part analysis: first, a determination of whether a given requirement is applicable; and, if it is not directly applicable, whether it is relevant and appropriate. The remedial alternatives and process options were then evaluated in terms of their ability to comply with identified ARARs.

Appendix C presents the potential ARARs identified for the Soil and NAPL OU by individual tables for federal or state/local requirements. These requirements are further divided into chemical-specific, action-specific, and location-specific ARARs. For action-specific ARARs, a general set of remedial technology options are listed at the top of the table and the table lists the technology option number if it is an applicable ARAR. Separate tables are presented for the surface pathway technology options and the NAPL technology options. If alternate technologies other than what have been included as components of remedial alternatives are considered for this site, then these ARARs would need to be reviewed for changes.

4.4 CONTAMINANTS OF CONCERN

The COCs at the site include RDCs derived from the BRA and the primary NAPL constituents at the source areas. The site-wide COCs for shallow soil, deep soil and groundwater are shown in Table 4-2. For the shallow soil, the COCs include both VOCs (BTEX, styrene, and chlorinated solvents) and non-VOCs (PAHs, other SVOCs and metals). For deep soil and groundwater, COCs are limited to VOCs (BTEX, styrene and C6-C10 TPH) and SVOCs (C11-C23 TPH). Chlorinated solvents are not included as COCs for deep soil and groundwater based on RI soil, groundwater and NAPL data for the NAPL source areas evaluated.[8] COCs vary by EAPC and source area as discussed in Section 3. EAPC-specific COCs are presented in the surface pathway evaluation in Sections 6 and 8.

4.4.1 Risk-based Threshold Levels

Risk-based threshold levels are concentration levels that are used to estimate the extent of impacted soil to be evaluated for active remedial alternatives in the surface pathway evaluation. Risk-based threshold levels were developed for each COC and relevant exposure pathway by calculating the COC concentration in soil or soil vapor that would correspond to a specific risk value for a commercial worker scenario. Table 4-3 presents risk-based threshold levels for the COCs at the site for target commercial worker risk levels of 5E-05 and 1E-06.

For non-VOCs, only the outdoor soil pathway is relevant. For VOCs, both outdoor soil and indoor air pathways are potential exposure pathways; however, only the more conservative (lower value) indoor air pathway-derived cleanup levels are listed in Table 4-3. Risk-based threshold levels are presented for two media: soil matrix (in mg/kg) and soil gas (in ppmv). For benzene via the indoor air pathway, the risk-based threshold level is presented based on the Tier 1+2 model.[9]

For urban environments in California, soil contaminants such as carcinogenic PAHs and some metals, including arsenic, are commonly found at background concentrations that exceed residential or industrial

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[8] As discussed in Section 3.2, chlorinated VOCs are present as primary contaminants in the saturated zone only in SA 2. However, as explained in Section 7.11, based on information indicating the presence of an adjacent offsite NAPL source that is unrelated to operations at the former rubber plant site, a detailed evaluation of remedial alternatives was not performed for SA 2.

[9] The Tier 1 model refers to the Johnson-Ettinger Model for vapor intrusion that is used for the non-BTEX compounds. Tier 2 refers to the Dominant Layer Model for vapor intrusion that incorporates vapor phase biodegradation and is used for BTEX compounds. More details on the vapor intrusion modeling is included in the BRA (GeoSyntec & URS 2006).

soil PRG screening criteria or other risk-based soil screening criteria. A statistical background analysis of selected non-VOC contaminants in shallow soil at the former plant site was performed as part of the BRA (GeoSyntec & URS 2006). A conservative background concentration of 10 mg/kg was derived for arsenic in shallow soil at the former plant site (GeoSyntec & URS 2006). In the ROD for the Del Amo Waste Pits OU, USEPA noted that arsenic was detected at a concentration of 25 mg/kg in soil at the Waste Pits OU, and concluded that concentration "…is consistent with background levels of arsenic in California soils, which typically have such elevated concentrations" (USEPA 1997a). A background comparison for carcinogenic PAHs was conducted based on the benzo(a)pyrene equivalent (B(a)P-eq) calculated for all shallow soil samples collected at the former plant site that contained reported concentrations of one or more carcinogenic PAHs (see Section 3.4.1.2 and Appendix D of the BRA.) Concentrations of B(a)P-eq in the background data set ranged up to 4.05 mg/kg with a 95% Upper Confidence Limit (95%UCL) of 0.24 mg/kg. An upper tolerance limit (UTL) of 0.9 mg/kg for B(a)P-eq was developed for the former plant site to assist in remedial decision making for individual sample comparisons. Soil samples with concentrations of B(a)P-eq below the UTL of 0.9 mg/kg are considered to be within background. Additional discussion describing how these background values were used in the FS to delineate areas of impacted soil is provided in Section 6 of the FS Report.

5.0 SCREENING OF TECHNOLOGIES

The screening of technologies involved developing a list of applicable technologies to address contamination at the former plant site. Screening was conducted separately for ICs, soil/surface pathway remedial technologies and NAPL remedial technologies. All applicable technologies were screened by contaminant scenario and medium with respect to three criteria: implementability, effectiveness and cost. *Implementability* is the ability to implement the technology including reliability, vendor availability, administrative acceptance, etc. *Effectiveness* is the ability to achieve RAOs, which could include removal or destruction of contaminants, or mitigation of exposure, or contaminant containment. *Cost* includes Capital and Operations and Maintenance (O&M) costs for the duration of remediation. The screening evaluation uses a 5-point rating scale ranging from poor, poor to moderate, moderate, moderate to good, and good for each criterion.

5.1 DESCRIPTION AND SCREENING OF INSTITUTIONAL CONTROLS

ICs are legal and administrative controls applied to properties to minimize the potential for human exposure to contamination and protect the integrity of the remedy. ICs work by controlling land or resource use and by providing information that helps modify or guide human behavior at properties where the presence of contaminants prevents uncontrolled or unrestricted land uses.

5.1.1 Types of Institutional Controls

Table 5-1 presents the general IC categories and a list of applicable ICs that may be relevant to this site that were derived from USEPA's ICs guidance documents (USEPA 2000a, USEPA 2002). The general categories of ICs are presented below along with a description of each category and a list of applicable ICs within the category:

Governmental Controls

These include controls that use the regulatory authority of a governmental entity to impose restrictions on land use under its jurisdiction. These controls could include the following:

- Zoning Restrictions (to strengthen restrictions on future residential uses)
- Permit Review (Additional requirements or precautions during construction implemented through the construction permits process of the City of Los Angeles)
  - Building Permits
  - Grading/Excavation Permits
- Well Restrictions or Groundwater Use Restrictions

Proprietary Controls:

These include controls based on property law which involve legal instruments placed in the chain of title of the site or property. These are ordinarily binding on the subsequent purchasers of the property (run with the land), and could include easements and covenants. The primary applicable control utilized at contaminated properties is Restrictive Covenants/Deed Restrictions.

Restrictive covenants can include specific requirements for a property owner relating to use of the property. Examples of use restrictions include: a requirement for soil sampling prior to excavation during any construction activities on the property; a requirement to protect any engineering control installed on the property as part of site remedy; and, a requirement to notify USEPA prior to conducting activities such as soil excavation or drilling into groundwater.

Enforcement Tools

Enforcement authority of a government agency is used to either: (1) prohibit a party from using land in certain ways or from carrying out certain activities at a specific property; or, (2) require the Responsible Parties (RPs) to put in place some other form of control. One limitation of enforcement tools is that they are usually only binding on the original signatories of the agreement and do not run with the land. Typical enforcement controls include consent decrees and administrative orders issued by a lead government agency.

Informational Tools

Informational tools are used to provide public information about risks from contamination and sometimes rely on property record systems. These are neither governmental nor proprietary controls. They do not directly control potential exposures but are intended as a means of notification, and a way to modify or guide human behavior. These tools would be readily available to parties during property transactions (e.g., title search, due diligence). Typical informational tools include:

- Web-based information
- Federal/State Site registries (e.g., USEPA's Facility Index System/Facility Identification Initiative Program (FINDS) database, California DTSC's Envirostor database)
- Advisories
- Notices (deed notice, new land owner notice, new land use notice, etc.)
- Announcements (radio, television, web)
- Newsletters, Fact Sheets
- Public or group meetings
- One Call System (Enhancement to Underground Service Alert system)

Long-term Stewardship Tools

Long-term stewardship tools are appropriate for long-term use at a multiple-parcel site in combination with ICs that support the long-term IC objective or prevent exposure to residual contaminants above acceptable risk levels. Typical long-term stewardship tools include:

- Private sector land activity monitoring/alert services
- Private sector IC monitoring, reporting, and compliance support
- Monitoring (i.e., groundwater, vapor, indoor air, or controls)

5.1.2 Screening of Institutional Controls

Table 5-1 presents a list of ICs, each followed by a description and an evaluation based on three screening criteria: effectiveness, implementability and cost. The three screening criteria for the ICs evaluation are defined as follows:

- Effectiveness is the ability to: (i) guard against potential exposure to COCs; and, (ii) provide long-term reliability, enforceability and ability to deactivate control;

- Implementability is a measure of the technical and administrative feasibility of implementing an IC. Evaluation of implementability includes determining whether or not the authority exists for control of the activity under applicable state and/or local laws or regulations, as well as determining the likelihood for cooperation of applicable landowners;

- Cost is rated compared to other IC mechanisms; not compared to engineered approaches. IC costs are generally lower than engineered approaches in terms of up-front expenditures but also may remain in effect for a longer term into the future, resulting in potentially higher long-term costs.

The screening evaluation for ICs does not eliminate many ICs. Most ICs are retained and, used in parallel, are available to form the primary components of the IC layers for the former plant site. Detailed rationale for IC evaluation and screening is provided in Table 5-1 and is summarized in the following paragraphs.

Enforcement Tools were not retained in the screening because other controls were favored that accomplish the same objectives and provide long-term protection. In addition, most enforcement agreements are only binding on the signatories and the property restrictions are not transferred through a property transaction. However, if one of these “other” controls fail or can not be implemented due to property owner issues, USEPA can issue Unilateral Administrative Orders (UAOs) or AOCs to compel the land owner to limit certain site activities. At this time, it is not anticipated that this type of action would be required.

Permit review was retained based on discussions with the City of Los Angeles Department of Planning and Department of Building Safety (LADBS) about their ability to implement such a process. This IC is being pilot tested at the former plant site to further evaluate effectiveness and implementability.

Zoning restrictions to strengthen restrictions against residential use were retained. However, their long-term effectiveness may be reduced if, in the future, property owners or developers petition the City to adopt less restrictive zoning.

Restrictive covenants were retained because the covenants can run with the land; however, an agreement would need to be negotiated with each property owner.

Informational tools such as web-based tools were retained because they can be used to disseminate information relating to the site in a cost-effective manner.

Private sector land activity monitoring services were retained as a supplemental IC to notify RPs of soil-invasive construction activities at site properties.

5.2 DESCRIPTION AND SCREENING OF REMEDIAL TECHNOLOGIES FOR SOIL/SURFACE PATHWAY

The following is a summary of remedial technologies for the soil/surface pathway FS based on the detailed screening of technologies presented in Table 5-2 (Technical Memorandum #2, URS 2003b). As discussed earlier, the Soils FS evaluation addressed a wide range of VOC and non-VOC contaminants for multiple exposure areas. Since the screening of soil/surface pathway technologies was intended to be applicable to a wide range of contaminants, it was broken down by contaminant scenario: non-VOCs in shallow soil and VOCs in shallow soil. VOCs in deep soil were considered an applicable contaminant scenario for engineering control technologies in the surface pathway evaluation. Each scenario was evaluated according to the screening criteria discussed earlier (implementability, cost and effectiveness).

5.2.1 Engineering Controls

Engineering controls are technologies implemented to control potential exposure to residual contaminants and include technologies such as capping, vapor barriers, sub-slab venting, etc.

To address non-VOCs in shallow soil, simple capping such as asphalt or concrete caps was retained as a protection from direct contact exposures.

For VOCs in shallow or deep soil, simple capping such as asphalt or concrete caps was retained for human health protection from direct contact exposures and to limit rainwater infiltration to protect the environment from contaminants leaching to groundwater. Also retained were active sub-slab venting, passive sub-slab venting/vapor barriers and HVAC modification/building pressurization to protect human health from VOC vapor intrusion into indoor air of onsite buildings. See Table 5-2 for a more detailed description.

5.2.2 In-situ Treatment

For non-VOCs in shallow soil, monitored natural attenuation was not retained because these contaminants do not significantly biodegrade. In-situ thermal desorption (ISTD), which involves soil heating to enable volatilization of low-volatility hydrocarbons such as PAHs was retained. However, the applicability of ISTD is limited because the technology is not cost effective for a wide range of contaminant concentrations.

For VOCs in shallow or deep soil, monitored natural attenuation was retained, because vapor-phase intrinsic biodegradation of petroleum hydrocarbons such as benzene is well proven. Of active remedial technologies, SVE, bioventing and ISTD were retained. These technologies are closely related because, like SVE, bioventing includes vapor extraction but also includes vapor/oxygen injection into the subsurface. ISTD is a thermally enhanced SVE technology; however, it is less cost-effective for VOCs than SVE or bioventing. Electric resistance heating (ERH) and steam injection (also variations of thermally enhanced SVE) were not retained because of poor effectiveness in the vadose zone, and poor cost-effectiveness. See Table 5-2 for a more detailed description.

5.2.3 Ex-situ Treatment

For non-VOCs in shallow soil, excavation was retained, followed by onsite thermal desorption (for PAHs, PCBs only; not metals) or offsite treatment/disposal/recycling at a facility permitted to handle these soils. Offsite treatment could include thermal desorption (PAHs, TPH), stabilization (e.g., cement stabilization for metals), landfarming (bioremediation for TPH soils) and disposal in a landfill or soil recycling. In general, both onsite thermal desorption and stabilization (metals) were rated low for implementability (based on limited site access due to the developed nature of the former plant site), and not cost effective compared to offsite treatment/disposal/recycling.

For VOCs in shallow soil, excavation was retained followed by onsite thermal desorption, SVE in soil piles, or offsite treatment/disposal/recycling. However, onsite treatment was rated low for implementability due to the lack of adequate space to stockpile and treat soils. Offsite treatment includes thermal desorption and bioremediation (landfarming or biocells for petroleum hydrocarbons). Based on experience, offsite treatment/disposal/recycling was judged the most cost effective.

5.2.4 Vapor Treatment

Thermal oxidizers, catalytic oxidizers and vapor phase granular activated carbon (VPGAC) adsorption were retained as examples of vapor treatment technologies. However, this is not intended to preclude future consideration of other vapor treatment technologies, as would be evaluated during the remedial design phase if this alternative is selected by the ROD. These technologies have been successfully applied at other sites with different influent vapor concentration ranges: thermal oxidizers at the highest, catalytic oxidizers in the midrange and carbon adsorption at the lowest concentrations. Operation of SVE at any one site can result in use of all three vapor technologies starting with thermal oxidizers initially when concentrations are highest (e.g., >1,000 ppmv), followed by a catalytic oxidizer and finally carbon adsorption at the lowest concentrations (e.g., <500 ppmv). Carbon adsorption can also be used at high influent concentrations but onsite carbon regeneration using steam or offsite regeneration will be required. Onsite carbon regeneration with steam will create a VOC-containing wastewater stream that will need treatment or disposal. Polymeric resin adsorption has been used for high-influent waste stream concentrations but is not considered to be cost effective. Specific experience with resin adsorption and other vapor treatment technologies at the Waste Pits OU is discussed below.

For exposure areas with chlorinated VOCs, a chlorinated catalytic oxidizer can be used that is equipped with an alumina catalyst instead of the precious metal catalyst found in typical hydrocarbon catalytic oxidizers. However, the thermal treatment of chlorinated VOCs generates hydrochloric acid vapor that would need a scrubber that uses a neutralizing solution (e.g., a caustic soda solution). Wastewater would be generated by this process which would need to be treated/discharged in accordance with regulatory limits (e.g., National Pollutant Discharge Elimination System (NPDES) requirements for storm drain discharge or discharge limits associated with the sanitary sewer system). Though the refrigeration/condensation technology is not widely used in remediation applications, it was retained because it has potential applications if influent concentrations are very high or if use of oxidizers face public opposition. For chlorinated VOC vapor concentrations that are low (<100 ppmv), vapor phase carbon is typically the most cost effective form of vapor treatment.

5.2.4.1 Vapor Treatment Experience at the Waste Pits OU

In response to the proposed the use of a thermal oxidizer for vapor treatment at the Waste Pits OU, the Del Amo community expressed significant concerns relating to the use of a Thermal Oxidation treatment and subsequently the USEPA requested that additional treatment technologies be evaluated for implementation. In response to this request, seven alternative vapor treatment technologies were evaluated during the five-year period between implementation of the Phase I Remedy and construction and operation of the existing SVE/IBT system. Treatment technologies included the following:

- Catalytic Oxidation (CH2M Hill 1999a)
- Internal Combustion Engine (CH2M Hill 1999a)
- Plasma Arc Treatment (CH2M Hill 1999a)
- Activated Carbon Adsorption (CH2M Hill 1999b)
- Electrochemical Oxidation (CH2M Hill 1999b)
- Biofiltration Treatment with Adsorption Polishing (CH2M Hill 2000a)
- Resin Adsorption/Desorption/Condensing (C2 REM 2004)

A Field Pilot Test Program was conducted to test the feasibility of a resin adsorption/desorption/ condensing technology to treat collected vapors from the SVE system. The Pilot Test concluded that the process had technical uncertainties, product marketability issues, increased hazardous waste handling, and high operating costs, and also raised community concerns.

In the SVE Baseline Monitoring Results and Low Flow SVE Evaluation Report (C2REM 2000) and the Follow-up Full-Scale SVE Monitoring Event Report of Findings (C2REM 2004), it was concluded that the observed relationships between oxygen, carbon dioxide, and benzene during both monitoring events supported the occurrence of natural in-situ aerobic biodegradation, and the SVE treatment technology should be modified to focus on possibly enhancing this natural process. Based on the results of this testing, the SVE/IBT system was selected for implementation at the Waste Pits.

The SVE/IBT Final Design Report (C2 REM 2006) summarized the selected remedy of the SVE/IBT system. The SVE/IBT system final design was developed based on previous assessments of biodegradation in the SVE/Bioventing Pilot Test Summary Report (D&M 1998), the Draft In-situ Biodegradation Analysis at Del Amo Pits (CH2M Hill 2000b), and the biodegradation pilot tests from the Pre-final Design Report Addendum (C2 REM 2005). This system combines the extraction and re-injection of vapors as well as the injection of generated oxygen, with a portion of the vapor stream diverted to a VPGAC adsorption vessel to meet the ROD objectives at the Waste Pits.

In general, the experience relating to vapor treatment from the Waste Pits OU was considered during the screening of technologies. The approach with the screening of vapor treatment technologies was to retain a broad range of technologies to address the range of EAPCs, contaminants and vapor concentrations that could be encountered within the Soil and NAPL OU.

5.3 DESCRIPTION AND SCREENING OF REMEDIAL TECHNOLOGIES FOR NAPL SOURCE AREAS

The following is a summary of remedial technologies for NAPL source areas based on the screening of technologies presented in Technical Memorandum #2 (URS 2003b). The screening of NAPL source area technologies considered two media (deep soil and groundwater), and the three screening criteria (implementability, cost and effectiveness). Table 5-3 presents a description of the technology, the screening evaluation, and screening comments.

5.3.1 Containment/Engineering Controls

Slurry walls and hydraulic barriers were not retained because they do not remove NAPL and because the NAPL source areas are already reasonably contained with no significant historical plume migration. Also, slurry walls are rated poor for implementability due to depth of NAPL and the developed nature of the site. Complex multi-layer caps were not retained due to poor cost-effectiveness and reduced implementability due to significant impacts to existing onsite facilities.

5.3.2 In-situ Treatment

For NAPL source areas, natural attenuation (intrinsic biodegradation) was retained as a passive long-term cost-effective option. Permeable reactive barriers (PRBs) were not retained due to poor implementability related to the developed nature of the site and depth of NAPL.

SVE and bioventing were retained for NAPL source areas in deep soil (>15 feet bgs). Air sparging and biosparging were not retained for NAPL in groundwater due to anticipated low effectiveness under the heterogeneous, low-permeability subsurface conditions. However, biosparging or enhanced bioremediation may have some applicability if a long-term biodegradation of the benzene dissolved plume downgradient of a source area is desired.

Three in-situ soil heating (ISSH) technologies were evaluated including ISTD, ERH and steam injection. ISTD, a thermally-enhanced SVE, was retained because it is effective for VOC and SVOC contaminants and is implementable in a wide range of site lithologies. However, this technology is better suited for SVOC remediation because it can achieve higher temperatures in the subsurface with closely spaced wells (e.g., 6-15 feet). For VOCs, this technology is often not as cost effective as competing technologies. ERH and steam injection were retained for NAPL source area remediation in groundwater because they are effective for VOCs remediation. Of the three ISSH technologies, ERH is judged to be better suited for this site because steam injection has poorer implementability in the heterogeneous and generally low-permeability soils at the former plant site and the fact that ISTD is better suited for SVOCs. However, all three ISSH technologies are retained in the FS and are available for consideration in the remedial design phase.

In-situ Chemical Oxidation (ISCO) was retained but it could have effectiveness and implementability challenges due to the uncertainties of the technology performance in these low-permeability soils and due to the innovative nature of the technology. Hydrogen peroxide is utilized as Fenton's reagent or in the Peroxone process but its disadvantages include low persistence in the subsurface, as well as instability and gas production in the subsurface that result in lower implementability. Permanganate is generally the most widely used oxidant for ISCO, with its longer persistence in the subsurface. However, its ability to degrade benzene and its reaction rate is rated low (ITRC 2005, Carus 2006). Permanganate is more often used for chlorinated solvent remediation and rarely for BTEX degradation.

In-situ surfactant/cosolvent flushing was not retained because this technology had low effectiveness and implementability ratings given the low-permeability, heterogeneous soils. Enhanced anaerobic bioremediation was retained only for chlorinated solvent plume remediation if needed. In-situ mechanical enhancements (pneumatic or hydraulic fracturing) were also retained as a supplement to enhance other technologies. However, these technologies have significant uncertainties and will only be considered on a case-by-case basis when appropriate.

5.3.3 Ex-situ Treatment

Hydraulic extraction and dual phase/multi-phase extraction were retained, although their ability to remove NAPL from the low-permeability, heterogeneous soils was only rated poor to moderate. These technologies have limited abilities to remove NAPL; however, they do have a moderate ability to remove VOC contaminant mass due to the higher solubility of benzene (a dominant NAPL contaminant at the site).

5.3.4 Vapor Treatment

Vapor treatment technologies were discussed earlier under soil/surface pathway technologies, and evaluations for deep soil and groundwater are comparable.

5.4 DESCRIPTION OF RETAINED TECHNOLOGIES

This section describes in greater detail the ICs and remedial technologies retained for further evaluation in the FS. Tables 5-1 through 5-3 provide the rationale for retaining or screening out technologies. Each description in this section includes a brief conceptual design that is common to all exposure areas or NAPL source areas. These common elements of the conceptual design of these technologies are included here in order to keep the description of the remedial alternatives in Sections 6 and 7 as concise as possible.

5.4.1 Institutional Controls

This section provides a more detailed description of the ICs that were retained in the screening evaluation presented in Table 5-1.

Permit Review for Grading/Excavation Permits or Building Permits

An FS pilot project, known as the "Environmental Review Institutional Control" (ERIC) was implemented in February 2008 on parcels that have been identified by USEPA as properties requiring supplemental environmental review when certain types of construction projects are planned. Properties may be selected for two reasons; the property could contain contamination at levels exceeding an unrestricted use level, or there could be data gaps remaining at the property. This IC would continue in perpetuity if selected as a component by the USEPA in its ROD. For this IC, Respondents, USEPA, and DTSC have worked together with the City of Los Angeles to place "flags" in the Los Angeles Department of City Planning's Zoning Information and Map Access System (ZIMAS) database for selected Del Amo parcels. These flags provide information and instructions to City employees and permit applicants who propose development that require grading/excavation or building permits.

Grading/Excavation or Building permits are issued by the LADBS for excavation, grading or building construction activities. These permits require submission of plans and approval of the City before construction activities take place. The LADBS permit reviewer refers to the ZIMAS database whenever someone applies for a building or excavation permit. The flags will alert the Applicant and the LADBS permit reviewer that (1) the property lies within the Del Amo Superfund site; (2) a separate environmental review by the USEPA's Environmental Review Team for the Del Amo Site (Del Amo ERT) is needed; and (3) the Applicant should contact the Del Amo ERT to initiate the review. The pilot project will be conducted and funded by the Respondents, with the agencies providing oversight, as specified in the approved RI/FS Work Plan Addendum for the pilot project (Appendix F of this FS Report).

The Del Amo ERT will review the proposed project and if the project includes soil-invasive activities, such as grading, excavation, trenching, soil boring, or ground-level demolition work that extend more than 18 inches below ground surface, the ERT will assess whether impacted soils and/or soil vapors are likely to be encountered. Variable amounts of fill soil were placed on the site during redevelopment. The native soil formation (and past contamination) would be encountered at depths below this fill material. A depth of 18 inches was chosen to screen out very shallow excavations that do not have significant potential for encountering former plant site contaminants. The Del Amo ERT includes participation from USEPA, DTSC, and the RPs. The Del Amo ERT will review construction plans and consult with the owner and the contractors involved with the project to develop an understanding of the planned project. The ERT will review existing environmental and historical information for the property to evaluate whether contaminant concentrations of potential concern are known or suspected at the planned areas of soil disturbance. In some cases, additional sampling and testing of soil in the areas to be excavated may be appropriate prior to commencement of construction activities. Based on the results of the Del Amo ERT's review, the USEPA will determine if any remedial response actions are warranted before, during, and/or following completion of the construction project to protect public health, safety, and the environment.

Zoning Restrictions

Zoning restricts land use, specifying allowed and prohibited uses in specific areas. The former plant site is currently zoned to prohibit residential use; however, this IC would strengthen this restriction by amending the General Plan to include a footnote for each identified parcel. The footnote would indicate that the parcel was located on the Del Amo Superfund site and that it was not acceptable for unrestricted use/unrestricted exposure (UU/UE). A City Council representative would need to introduce a motion in the City Council to modify the local land use element of the General Plan (also called the Harbor Gateway Community Plan) to add the footnotes, and both the City Council and the Planning Commission would be required to approve the motion. If approved, the LA Planning Department – Office of Zoning Administration (LAPDZA) would add the footnote to each identified parcel.

Restrictive Covenants

Restrictive covenants are legal agreements between a property owner and the state that place restrictions on the use of the property for environmental reasons. The intent of this IC is to control specified activities which may create risk or complete exposure pathways, and consequently to prevent or impose controls on specified activities by any property occupants and invitees. The restrictions run with the land and are binding on subsequent owners. Examples of potential restrictive covenants include requiring agency review and/or sampling prior to any excavation, grading or drilling project; and requiring operation/maintenance of engineering controls. Restrictive covenants would include USEPA as a third party with rights to enforce.

Informational Tools:

Informational tools are non-enforceable tools that inform or alert the public about the environmental condition of the property.

Notifications: Notifications refer to informational documents filed in public land records that alert anyone searching the records to important information about the property. Examples of such notices include deed notice, new land owner notice, and new land use notice. As discussed earlier, a flag has been added to the City of Los Angeles' ZIMAS database for identified parcels to provide various notifications and could be considered an informational tool.

Federal/State Site Registries: There are various federal and state site registries such as USEPA's FINDS database, USEPA's ICs sites database and California DTSC's Envirostor database. The FINDS database contains both facility information and links to other sources that contain more detailed information on the site. The USEPA's ICs database contains ICs information for former contaminated sites. The DTSC's Envirostor database has a list of contaminated sites for the state of California, including ICs that pertain to these sites. This site registry tool would consist of ensuring the Del Amo site's pertinent information is properly listed in these and other such databases; thus a prospective purchaser would have the opportunity to learn of potential contamination at the property or in the vicinity.

Web-based Information Tool: The web-based information tool would be created and linked to a website dedicated to the Del Amo Superfund Site, to provide parcel-specific data and information based on the RI/FS, BRA, and subsequent remedial design/remedial action information. The website would be updated as new site information is obtained or activities are performed. Any prospective or current owner who proposes construction or redevelopment could check the web site for site contamination information. The website would provide contact information to the USEPA, RPs, and consultants for additional information.

One Call System: A "One Call System" is an informational tool where a single contact location provides information relating to potential contamination prior to digging. It refers to a database that integrates excavation requests with ICs databases by enhancing the currently used Underground Service Alert system (USA). USA is a service provided by Dig Alert in Southern California to help locate subsurface utilities and is funded by its members that include the utility companies

Long-term Stewardship Tools:

Private Sector Land Activity Monitoring and Alert Services: This tool would use a private sector land activity monitoring service as part of IC implementation and long-term monitoring. The service monitors land use activities such as property transfers and permitting, and issues electronic alerts to the RPs for activities that could conflict with IC objectives for designated parcels. This service provides a "backup" to the zoning/permit review IC tools previously described, ensuring that the City of Los Angeles department notifications are functioning appropriately. If the zoning and permitting ICs are providing sufficient and appropriate notifications to all interested parties, then consideration could be given to discontinuing this IC mechanism at some point in the life of the project.

Private Sector IC Monitoring and Compliance Reporting: Refer Section 5.4.5.1 for discussion of ICs monitoring.

5.4.1.1 ICs Layering Plan

Rather than selecting a single best IC tool, the above-described ICs can be layered so that they are used conjunctively. With this approach, if one IC fails, other ICs will be in place to prevent an exposure to the contamination. A preliminary layering of the preferred ICs is proposed that places specific ICs on parcels depending on their risk group, as defined in Section 3.1.3. The IC layers include:

(1) Informational ICs such as federal and state site registry listing, web-based information, and land activity monitoring;
(2) Permit review ICs (building permits, grading/excavation permits for construction activities that involve excavation, site grading or other soil disturbance) implemented through the City of Los Angeles;
(3) Zoning restrictions on residential use strengthened by implementing General Plan amendments through the City of Los Angeles;
(4A) Restrictive covenants that (i) require sampling during future site redevelopment, and (ii) require restrictions on residential use;
(4B) Restrictive covenants that protect engineering controls (if any) that address impacted soil or indoor air; and,
(5) Restrictive covenants that require agency review and approval prior to any drilling into groundwater.

Figure 5-1 shows the properties (using APNs or EAPC numbers) in Groups 1 through 5 and the associated IC layers that would apply to them. As described in Section 3.1.3, Group 1 consists of properties that were not identified as EAPCs and did not require evaluation in the risk assessment. Group 2 consists of properties with both CR and RR below 1E-06. Group 3 consists of properties with both CR and RR below 5E-05, while Group 4 consists of properties with CR less than 5E-05 and RR greater than 5E-05. Group 5 consists of properties with both CR and RR greater than 5E-05.

IC layer 1 (Information only) and IC layer 2 (Permit Review) would cover all 71 properties at the site. Groups 1 and 2 (a total of 40 properties) would use only IC layers 1 and 2. IC layer 3 (Zoning Restriction) and IC layer 4A (Restrictive Covenants) would also cover the 31 properties in Groups 3, 4 and 5. IC layer 4(B) for engineering controls would be utilized only if the remedy includes an engineering control, which will be decided in the ROD. For the Group 3 properties, the restrictive covenant would not prohibit residential use; instead, the deed language would require sampling and either engineering controls or excavation and removal prior to the property being considered for future residential development. Figure 5-2 presents a color-coded map indicating the IC layers for each parcel.

ICs restricting the use of groundwater where it is impacted by rubber plant contaminants were included as part of the Groundwater ROD (USEPA 1999). Additionally, at the request of USEPA and DTSC, restrictive covenants imposing groundwater use restrictions are retained for evaluation in this FS for EAPCs meeting **both** of the following conditions: 1) EAPCs where restrictive covenants are already being considered in the FS based on risk estimates; **and,** 2) EAPCs overlying documented groundwater contamination. The groundwater restrictive covenant (IC layer 5) would be applied to 20 properties. As an example, such a restrictive covenant could require the property owner to agree that any drilling activity into groundwater on the property shall not be permitted without prior notice to DTSC and/or USEPA, followed by review and written approval by the appropriate lead agency.

5.4.2 Engineering Controls

The following are brief descriptions of engineering controls that were retained for the FS evaluation.

Capping

Capping is an engineering control or containment technology and, for this FS, refers primarily to simple caps such as asphalt capping of an impacted area of outdoor soil to limit potential direct contact exposures of site occupants or construction workers to contaminants. Capping is included primarily in the surface pathway alternatives to address non-VOCs and VOCs in surface and shallow outdoor soil. Capping for VOCs is not intended to prevent rainwater infiltration or leachate migration to groundwater[10]. However, some reduction in rainwater infiltration or leachate migration is expected as a result of this capping. A large portion of the outdoor soil areas at the Del Amo site are already paved with asphalt. The implementation of this technology will involve evaluating the existing pavement design for quality and adequacy. If such capping is a component of the selected remedy for an exposure area, and if the surface of the asphalt appears worn, the resulting recommendation could include options such as seal coating to improve integrity of the existing asphalt surface. Other capping approaches can include, on a case-by-case basis during remedial design, any additional components required to create an adequate cap, such as concrete or use of geotextile membranes or identification layers. Capping an impacted area within an exposure area will typically require an IC to protect and maintain the cap for the future.

Heating, Ventilation and Air Conditioning Modification (HVAC mod) or Sub-slab Venting (SSV)

HVAC mod or SSV are engineering controls to protect building occupants from exposure to VOCs from the subsurface soil via the indoor air pathway. HVAC mod technology option assumes an initial evaluation of the building's existing HVAC system for positive pressure to mitigate vapor intrusion. This option would involve modifying the building's HVAC system to ensure positive pressure and mitigate potential for vapor intrusion. This option may be difficult to implement in warehouse buildings especially if the building has large open bays that allow uncontrolled communication between indoor and outdoor air. In office buildings, this option would be primarily applicable to the first floor of the building that has the potential for vapor intrusion. The HVAC mod technology is also referred to in the literature as Building Pressurization.

SSV (also called sub-slab depressurization, SSD) can be implemented with vacuum extraction in an active mode or without vacuum extraction in a passive mode. The passive mode relies only on naturally-occurring pressure gradients to transport vapors and is normally used with newly constructed buildings. Active venting is typically implemented with periodic extraction of sub-slab vapors using a vacuum blower or fan connected to horizontal piping or suction pits below the foundation. At existing buildings that are retrofitted for vapor mitigation, HVAC mod or active SSV are often the most feasible approaches. Active SSV is implemented by retrofitting the buildings with horizontal wells or perforated piping laid in

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[10] In parcels that contain or potentially contain NAPL, the source area is assumed to be present in the deep vadose zone and the upper saturated zone from 15 feet to 80 or 90 feet bgs. The VOCs in surface and shallow soils are not and are not expected to be a significant potential contributor to NAPL contamination in the saturated zone.

trenches just below the foundation at appropriate spacing. SSV can also be implemented by the use of shallow vertical wells in suction pits at an appropriate spacing inside the building. A typical implementation of active SSV would require excavation/trenching inside the building, installation of piping within the trenches, and concrete replacement. Detailed building plans would be required to ensure that the foundation would not be compromised (i.e., cutting through post-tension cables). Active SSV may also be performed using horizontal wells drilled under the building without trenching inside the building. However, SSV is rarely implemented in this manner because excavation/trenching inside the building is generally more cost effective, less complex, and ensures that the system is installed immediately beneath the building foundation in the permeable base material. For the FS evaluation, the SSV technology option assumes the use of horizontal perforated piping laid in trenches rather than horizontal wells which are significantly higher in cost. Horizontal wells can be used for SSV if the horizontal wells are installed as part of a SVE technology option where it would be more cost effective.

If an engineering control such as those discussed above were to be selected as part of the remedy for an exposure area, site-specific investigations including sub-slab soil gas sampling and testing would be performed during remedial design to first demonstrate that such controls are actually necessary to control the potential intrusion of any vapors into a building. The remedial investigation did not include any environmental sampling beneath the buildings, but evaluation of technologies to remediate the vapor intrusion pathway is warranted based on modeling and of contaminant concentrations detected in samples collected adjacent to some site buildings. Therefore, sampling beneath the building during remedial design may be needed for such parcels. If it is determined that potentially harmful vapors are accumulating beneath a building floor slab, then additional information, including information about the design of the building and HVAC system, would be collected and evaluated to provide a basis for making decisions about the best control or combination of controls to implement in each case. For the FS evaluation, the use of active SSV is assumed for the vapor intrusion engineering control; however, in some cases it may be determined that a relatively simple modification to the existing building’s HVAC system would be most appropriate and effective.

For the FS evaluation, an active SSV system is assumed to operate continuously but could also be set to operate periodically (e.g., once daily for an hour) and controlled by a timer. A spacing of 20 feet is assumed for the SSV system with the perforated piping placed below the foundation in areas of impacted soil. The number of wells would vary for each exposure area depending on the extent of impacted soil under the building. A fan capable of generating a vacuum of up to 12 inches of water or regenerative blower rated for low vacuum (0 to 40 inches water) and low flow rates would be connected to these horizontal wells and used for venting, with carbon adsorption treatment of extracted vapors if needed. SSV would be expected to operate into the indeterminate future since it is primarily a containment alternative that does not actively attack the contaminant source. As with any engineering control, an IC (restrictive covenant) would be required to protect and maintain the SSV system in the future.

5.4.3 Soil/Surface Pathway Technologies

This section provides a description of each of the retained surface pathway technologies including introduction of certain elements of the conceptual design applicable to the remedial alternatives discussed in Section 6. Some elements of the conceptual design are common to each of the exposure areas evaluated in the FS (e.g., well spacing for SVE is assumed to be the same across the former plant site). These common elements in conceptual design are described here to avoid repetition of these design items for each of the remedial alternatives and exposure areas in Section 6.

Soil Vapor Extraction/Bioventing

SVE is an active remedial approach that attempts to remediate the soil by removing contaminant mass by vacuum extraction and aboveground treatment. It can be applied to outdoor shallow or deep soil and to soil under a building with vertical and/or horizontal wells; it primarily addresses VOC contaminants. Bioventing (BV) is a technology closely related to SVE and is implemented in a combination vapor extraction and air (or oxygen)/nutrient injection mode; it uses aerobic biodegradation to enhance the fraction of contaminant destruction. BV is a technology that is effective for petroleum hydrocarbons (including BTEX) contamination. Chlorinated solvent contamination such as PCE and TCE is not amenable to aerobic biodegradation in shallow vadose zone soil. BV typically takes longer to accomplish VOC contaminant destruction than SVE, but has the advantage of reducing aboveground treatment of VOCs. For this FS, we assume the use of SVE for the remedial alternative evaluations. If implementation of SVE/BV-type active technology is selected for an exposure area, then area-specific evaluations will be conducted during the remedial design phase to determine the appropriate mode of operation (SVE versus BV, that is, proportion of vapor extraction versus injection).

For SVE in outdoor soil, the vertical wells would be used and screened between 5 and 15 feet bgs with a spacing of about 30 feet assumed for the evaluation. For soil under the buildings, horizontal wells are proposed at shallow depths ranging between 5 and 10 feet bgs drilled below the foundation of the existing buildings. Difficulties can be anticipated in some locations due to access limitations for drilling or due to the presence of building subsurface features. Also, challenges with horizontal drilling can be anticipated because the blind-hole drilling (single completion) approach will need to be used at most locations because of space limitations. Typically, the surface-to-surface completion approach[11] is preferred because the blind-hole drilling method has a significantly higher potential for failure during well installation. At exposure areas where horizontal drilling is not viable, a string of vertical wells adjacent to the foundation is assumed. If SVE under a building is selected as part of a remedy for an area, additional sampling of soils under the building will be needed to confirm the presence of contamination and define the extent of impacted soils.

The wells would be connected by a positive displacement vacuum blower (capable of 8- to 12-inch mercury [Hg] vacuum) to an aboveground vapor treatment system. The vapor treatment system is assumed to include a thermal or catalytic oxidizer[12] initially followed by a carbon adsorption system after the concentrations have decreased below certain thresholds for cost effectiveness. More details on vapor treatment are presented later in this section. The total flow rate for each of these systems would depend on

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[11] Surface-to-surface completion refers to a directionally-drilled borehole where the drill bit starts the hole at an angle achieves the desired depth and length of the horizontal well at which point the drill bit is steered back to the ground surface creating two surface openings prior to hole reaming and well installation. With the blind-hole approach, the drill bit stops when the desired depth and length of the well is reached, with the hole reaming and well installation completed subsequently. http://www.cpeo.org/techtree/ttdescript/horzwel.htm

[12] A catalytic oxidizer would include a scrubber if there are significant vapor concentrations of chlorinated solvents. After SVE influent concentrations decrease, typically carbon adsorption systems would be used for vapor treatment.

the total number of wells needed to address the assumed area of impact. These active remedial systems would typically be expected to operate for 1 to 3 years. More specifically, for the larger and more VOC-impacted EAPCs[13], a 3-year timeframe for SVE was assumed in the conceptual design and cost estimate. For the less impacted EAPCs, a 2-year timeframe was assumed. After SVE has met performance objectives, if residual VOCs in deeper soils represent a potential future concern with respect to vapor intrusion, the SVE horizontal well system under buildings could be converted to an SSV system. Also, if future off-gassing from deeper soils recontaminates the vadose zone, the horizontal well system could be operated as an intermittent SVE system.

In-situ Thermal Desorption (also Thermal Conduction Heading)

ISTD, also known as thermal conduction heating, is an enhanced SVE system that heats the soil up to 1,000°Fahrenheit (°F) using resistive heating elements in thermal wells, The contaminants are either destroyed in-situ or volatilized and removed through vapor extraction. Soil is heated by thermal conduction, making this process very energy intensive. Unlike electric resistance heating, no current flows through soil. ISTD involves closely spaced wells (typically 8-20 feet apart) with the heating elements penetrating the entire thickness of the contaminated zone. Volatilized contaminants are treated in aboveground treatment units such as thermal oxidizers. This is considered a developing, innovative technology offered by one vendor (TerraTherm™). It has been selected and implemented successfully for SVOCs (high PCB and pesticide source areas) and chlorinated solvents. Only one site with petroleum hydrocarbons/LNAPL contamination has been remediated with this technology in the last 10 years, probably because there are a wider range of viable remediation options that are available for petroleum hydrocarbons, and at lower cost. Advantages of this technology are that it is an aggressive remediation approach that can remove a higher fraction of contaminant mass than conventional technologies and can complete remediation in a shorter timeframe.

The conceptual design for ISTD at the former plant site involves vertical heater wells placed at 15-foot spacing across the extent of the impacted source area. Each heater well is a 3-inch steel casing with the heating element placed down the middle of the well and would span the treatment depth range from 5-15 feet bgs. The power transformer would be connected to the nearest 13kiloVolt (kV) power line and would be sized to deliver in the range of 1,000 to 2,000 kiloWatt (kW) of power depending on the size of the remediation area. SVE wells would be spaced 30 feet apart across the source area to capture the heated vapors for treatment in an aboveground treatment system as discussed above. Temperature monitoring points would be spaced about 50 feet apart across the impacted area with thermocouples placed at multiple depths at each point. A total of one year is assumed for this remediation before reaching a point of diminishing returns.

Excavation

Excavation would involve removal of shallow soil (depths ranging from 1 feet bgs to a maximum of approximately 15 feet bgs) across the assumed horizontal extent of impacted outdoor soil. Deeper excavation options are not considered because VOCs present in deep soil are well addressed by proven technologies such as SVE or BV. This assumes the use of standard excavation equipment (excavator,

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[13] EAPCs 16, 23, 5, 6, 11 and 9 assume a 3-year SVE timeframe, while EAPCs 7, 28, 35, 8, 15 and 17 assume a 2-year timeframe.

backhoe etc.). The excavated soils are assumed to be transported offsite for treatment/disposal/recycling at a permitted facility. The sides of the excavation would be sloped in accordance with geotechnical requirements (typically 1:1 or 1.5:1 based on soil properties). The sloped sidewalls would provide clean overburden soils that will be used for backfill. Clean import fill would be brought into the site and compacted as required. Where the excavation abuts a building, the evaluation assumes the use of shoring such as sheet piles or soldier piles with lagging when the excavation is deeper than 5 feet bgs. For shallow excavations (≤5 feet bgs) that abut a building, alternate means of excavation is assumed, such as slot-trenching, that avoids the cost of shoring. More detailed evaluation of excavation options would be considered in the design phase if any active excavation alternatives were to be implemented. The analysis assumes that no excavations will occur beneath the footprint of buildings. Any smaller structures, subsurface pipelines, or wells in the vicinity of the excavation will be protected or replaced in kind during the excavation. Dust, VOC and odor emission control measures will be utilized to limit the nuisance to the site workers or community. Excavated soils will be tested with field instrumentation to ensure that VOC-impacted soils are handled appropriately and in compliance with Rule 1166 of the South Coast Air Quality Management District (SCAQMD). Ambient air monitoring will be conducted during the excavation to confirm there are no air emissions.

Offsite Treatment/Disposal

For this FS evaluation, the excavated soils are assumed to be transported offsite for treatment/disposal/recycling at a permitted facility. Offsite treatment can include thermal desorption for TPH/PAH/VOCs in soil up to the permitted levels for the facility. Petroleum hydrocarbon-impacted soils can also be treated offsite by landfarming (bioremediation). Treatment can include cement stabilization for metals contamination. Treated soils can be reused for certain applications once appropriate cleanup levels are achieved. Landfill disposal is another option for any of these contaminants. Some treated soils may still be disposed of in landfills as daily cover if after treatment any remaining residual contamination is present at allowable concentrations.

Implementation of onsite treatment is considered to be generally impractical because most parcels at the site are developed with buildings and do not have significant amounts of available space for onsite stockpiling and treatment.

Vapor Treatment

Several of the remediation technologies (e.g., SVE and thermal remediation technologies such as ISTD) discussed here generate vapors that need treatment prior to discharge. Typically, a blower extracts contaminant vapors from the subsurface that are then treated in an aboveground vapor treatment system. For BTEX and TPH vapors, the most common contaminants at this site, the vapor treatment system is assumed to include a thermal/catalytic oxidizer[14] or internal combustion engine initially until the concentrations decrease below certain thresholds. The oxidizers use fuel such as natural gas or propane to burn the contaminants. Thermal oxidizers use larger amounts of fuel and burn the contaminants at high temperatures (typically 1,400ºF). Catalytic oxidizers use less fuel and destroy the contaminants at lower temperatures (typically 700ºF) by contacting the vapors on a catalyst surface. If initial concentrations are

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[14] A catalytic oxidizer would include a scrubber if there are significant vapor concentrations of chlorinated solvents. After SVE influent concentrations decrease, typically carbon adsorption systems would be used for vapor treatment.

very high, internal combustion engines are sometimes used for vapor treatment followed by oxidizers at a later stage. After influent concentrations decrease, the vapor treatment approach is typically changed to vapor-phase granular carbon adsorption until cleanup is completed. There are some instances where oxidizers cannot be used; then, carbon adsorption is used even with high influent concentrations and the carbon is regenerated frequently onsite using steam or equivalent method. For chlorinated solvent vapors (TCE, PCE), the vapor treatment options are: a chlorinated catalytic oxidizer with a scrubber, vapor-phase carbon adsorption or refrigeration/condensation. In general, all vapor treatment options are retained so as to allow adequate choice for selection during remedial design. All vapor treatment systems will need to be operated to meet the substantive requirements of SCAQMD, though no SCAQMD permits would be required.

5.4.4 NAPL Technologies

The primary NAPL technologies that were retained during screening are described below including certain elements of the conceptual design that will be utilized in the remedial alternatives presented in Section 7. Some elements of the conceptual design are common to each of the NAPL source areas because of similarities in lithology. For example, the well spacing for SVE or hydraulic extraction is the same for the each of the source areas. These common elements are described here in Section 5 to avoid repeating them for each source area in Section 7.

Natural Attenuation (Intrinsic Biodegradation)

Intrinsic biodegradation is the naturally occurring process of biodegradation of petroleum hydrocarbons (especially lighter volatile hydrocarbons such as BTEX) by soil microbes. Intrinsic biodegradation occurs in the saturated zone at the fringes of the dissolved-phase plume and also in the vadose zone. Long-term monitoring includes annual groundwater monitoring of a set of wells located at or in the immediate vicinity of the source area to confirm that intrinsic biodegradation processes are continuing to be effective in preventing undesirable migration of hydrocarbons. Often there is an adequate number of existing wells in the vicinity of the source area; these wells would be considered for incorporation into an annual groundwater monitoring program for specific source areas.

SVE/BV

SVE/BV was retained as a technology option to address deep soil (15 feet bgs to water table) contamination in the NAPL source areas. A general description of the SVE/BV technology was presented earlier in the Soil/Surface Pathway technologies section. This technology does not directly address NAPL in the saturated zone but, because a significant amount of contaminant mass remains in the vadose zone soils, it merited evaluation as a supplemental technology component for the NAPL source areas. Also, some of the potential NAPL areas may contain NAPL at residual saturations where SVE could be effective in removing a significant percentage of the vadose zone contaminant mass. Just as with the surface pathway evaluation, SVE is assumed as the preferred option in the NAPL evaluation rather than BV. However, if such an active remedy is selected, a detailed evaluation including pilot testing will be conducted during the remedial design phase to select the favored approach, which could include BV, and determine remedial design parameters. SVE was also retained to be included as a supplement for the more aggressive NAPL technologies such as in-situ chemical oxidation or hydraulic extraction. Also, aggressive thermal technologies that are discussed separately such as electric resistance heating, steam injection or in-situ thermal desorption, are essentially thermally-enhanced SVE technologies that use different approaches to subsurface heating.

The conceptual design for SVE/BV at the NAPL source areas is determined by the permeability of the deep soils. Soils in the 15 to 30 feet bgs horizon at the former plant site are considered very low-permeability silts and the soils in the 30 feet bgs to water table horizon are considered moderate in permeability with a greater fraction of fine sand. The conceptual design for SVE/BV assumes wells that are spaced 70 feet apart and screened between 30 feet bgs and the water table. This type of SVE/BV design primarily addresses the more permeable soils in the deeper zone and is also better suited for the BV mode of operation that involves re-injection of a portion of the extracted vapors into the subsurface with added oxygen (which would be similar to the remedial approach implemented at the Waste Pits OU).

Another approach to SVE design evaluated in this FS involves dual-screened SVE wells (two casings screened between 15-30 feet bgs and 30 feet bgs to water table in one borehole) with a closer well spacing of 30 feet. This design would result in higher mass removal in both the low and moderate permeability zones. This approach is used to complement the more aggressive remedial technologies in NAPL alternatives evaluation. Sentry SVE wells are included in the conceptual design for aggressive technologies such as ISCO or ISSH as used adjacent to buildings to prevent vapor intrusion into the buildings. Sentry wells are screened in the 15 to 30 foot bgs zone.

For source areas that are completely under a building, two designs are considered. One design uses horizontal SVE wells drilled under the building from locations outside the building, thus minimizing the impacts to the operation of the facility. The other design uses conventional vertical SVE wells placed inside the building, which would impact the facility operations to a greater extent. Challenges with installation of horizontal wells under buildings are discussed under SVE/BV in the surface pathway technologies (Section 5.4.3). Interior vertical wells would also pose significant implementation challenges because these site buildings are in active use and due to ceiling height limitations that would impact drilling equipment.

If SVE/BV beneath an existing building is selected in the ROD, then additional sampling will need to be conducted to confirm the presence of contamination under the building and define the areal extent of contamination. The extracted vapors would be treated in a vapor extraction and treatment system that would include a high vacuum positive displacement blower rated for appropriate air flow in standard cubic feet per minute (scfm)[15] and use of an appropriate vapor treatment system (i.e., a thermal oxidizer, internal combustion engine or carbon adsorption for vapor treatment). In addition, a comprehensive range of remedial designs will need to be fully evaluated including pilot testing to determine the optimal choice of well screens, well spacing, vapor treatment technology, etc. The typical anticipated timeframe for SVE operation for NAPL source areas is assumed to be 4 years.[16]

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[15] The total flow rate and SVE system sizing was based on assumed well flows from the various lithotypes observed in the vadose zone at this site using unit flow rates ranging between 0.1-0.5 scfm/foot of screen interval for the shallow low-permeability zone and 1-2 scfm/foot for the deeper permeable sandy zone.

[16] At the Del Amo Waste Pit Area there is a history of the local community opposing extraction and treatment of VOC vapors with onsite thermal treatment technology.

The treatment system would typically be located in an open and accessible area on the property (e.g., in a parking area) and would include a treatment compound. A chain-link fence would be needed to enclose the treatment equipment to prevent unauthorized access and ensure public safety. The wells are located in the assumed source area location, which could be in a parking area or driveway or loading dock depending on the property. Access to the wells would be needed periodically for sampling and maintenance activities. The temporary removal of any parking areas would limit available onsite parking for tenants and may require providing transportation to and from the site to an offsite parking facility.

In-situ Soil Heating Technologies

Three types of in-situ soil heating technologies were retained and are discussed below:

Electric Resistance Heating: ERH involves heating of the source area using electrodes placed in the subsurface with an applied voltage (typically 200 to 2,000 volts) that causes current to flow through the soils and groundwater in the contaminated zone (Department of Energy [DOE] 1995). The electric current causes subsurface heating and volatilization of hydrocarbon vapors, which are then recovered by a SVE system and treated in an aboveground treatment system. The heating occurs in the saturated zone and in the deep vadose zone where there is sufficient moisture content to conduct electricity. ERH typically heats the saturated zone to the boiling point of water, which produces steam. Rising steam through the vadose zone will also heat a portion of the vadose zone and promote some vadose zone remediation. ERH can be implemented with either six-phase or three-phase electrical heating. Six-phase heating was developed and patented by the DOE, while three-phase heating was originally developed and patented by Arco. The two approaches to ISSH are largely similar because they use electrodes placed at the same locations with no differences in electrode spacing. Six-phase heating is considered better for small circular (or cylindrical) heated areas with more uniform heating while three-phase heating is better suited for large irregular-shaped areas. Three-phase heating was assumed for this FS evaluation because the source areas at this site are large and irregular in shape. The patent on three-phase heating has expired and the technology is now in the public domain. This technology would require laboratory-scale treatability testing and field-scale pilot testing prior to optimizing remedial design parameters. For this evaluation, typical design parameter values are assumed based on experience gathered from implementation of this technology at other sites.

A typical conceptual design for the ERH alternative involves placement of electrode wells in the subsurface at a spacing of approximately 20 feet on-center throughout the extent of the addressed source area. These electrode wells would also serve as vapor extraction wells. The electrically conductive interval(s) will be selected depending on the parameters of the individual source area. Each conductive interval is about 20-30 feet long and any of these source areas can have one, two or three conductive intervals depending on the depth of the source addressed by remediation. The actively heated zone is from 25 feet bgs down to the bottom of the NAPL area around 80 feet bgs but the rising steam will also heat the shallower soils between 15 and 25 feet bgs. Temperature Monitoring Points completed at multiple depths would be required within the heated source area to monitor subsurface temperatures at an assumed spacing of 50 feet on-center. The boreholes for the electrode wells will also include dual completed SVE wells (two casings screened between 15-30 feet bgs and 30 feet bgs to water table). The SVE system is designed for this alternative with the dual purpose of removing volatile contaminants in the vadose zone and preventing uncontrolled vapor migration into the building. Typically, a string of sentry vapor extraction wells is included along the footprint of the building to prevent vapor migration and vapor intrusion into the building. Limited hydraulic extraction may be needed at some source areas to prevent migration of impacted groundwater away from the source area. Depending on the lateral extent for each source area, the heating may be conducted in sequential phases so that transformer sizing requirements will not be excessive.

The extracted vapors will be treated in an aboveground treatment system that would include condensation, phase separation, and vapor-phase treatment using a thermal oxidizer or internal combustion engine. The treatment system will include a vacuum blower (or multiple blowers) sized appropriately for the number of extraction wells, with typical flows anticipated in the range of 500-2,000 standard cubic feet per minute (scfm). Condensed steam and any water from a supplemental hydraulic extraction system (if required) will be treated in a water treatment system designed to handle 5-20 gallons per minute (gpm) using advanced oxidation and liquid phase carbon adsorption technology. The treated water is assumed to be discharged to the storm drain under a NPDES permit. If water flow rates are lower, the generated wastewater could be handled by offsite disposal rather than onsite treatment. Due to the volatile nature of the contaminants (benzene, toluene, ethyl benzene, etc.), hydrocarbon vapor concentrations above the lower explosive limit (LEL) may be encountered. The ERH system may need to be operated at low heating rates to control vapor extraction concentrations and prevent unsafe conditions. The active remedial components of this alternative (ERH+SVE) are expected to operate for 2 years before reaching the point of diminishing returns.

With a few exceptions, the NAPL source areas evaluated in the FS are assumed to be located outside building footprints (e.g., in a parking area or a driveway). For this ERH alternative, the remediation area (including the treatment compound) is assumed to be enclosed within a chain-link fence both for public safety due to the presence of high voltages and electric currents, and to allow the system operators easy, uninterrupted access to the wellheads for monitoring purposes. This area would not be accessible to the employees at the office building onsite. The temporary removal of a parking area may limit available onsite parking for tenants.

Some potential NAPL source areas (SAs 4, 7 and 8) are assumed to contain NAPL under buildings. For these source areas, ERH could potentially be implemented using vertical wells inside the building if the specific area inside the building is accessible for well installation and can be cordoned off to control access for safety during remedial operations.

In-situ Thermal Desorption: ISTD was described earlier under surface pathway technologies. Soil and groundwater is heated by thermal conduction using thermal wells that are heated to approximately 1,000^{o}F (USEPA 1994). The contaminants are volatilized or destroyed in-situ. ISTD involves closely spaced wells (typically 8-20 feet apart) with the heating elements in the wells covering the entire depth of the contaminated zone to be heated. Volatilized contaminants and the generated steam are condensed and treated in aboveground treatment units including thermal oxidizers and liquid phase carbon adsorption systems. This is considered a developing, innovative technology offered by one vendor (TerraTherm™) that has been implemented in full scale at a limited number of sites. This thermal technology is in direct competition with ERH, which has been implemented at a greater number of sites. Of the sites where ISTD has been implemented, most are chlorinated solvent sites. Only one site with petroleum hydrocarbons/LNAPL contamination has been remediated using ISTD in the last 10 years, because for petroleum hydrocarbons there is a wider range of lower-cost options. In general, the primary advantage of ISTD is its aggressive remediation approach; it can remove a higher fraction of contaminant mass than conventional technologies, and complete remediation in a shorter timeframe (often 2 years or less). Another strength of this technology is its effectiveness with respect to SVOCs in soil and groundwater.

The conceptual design for ISTD as evaluated in the FS involves vertical heater wells placed at 15-foot spacing across the extent of the impacted source area. Each heater well is a 3-inch steel casing with the heating element placed down the middle of the well. Each heater well would span the treatment depth range from 15 feet down to the bottom of the impacted source area (80 or 90 feet bgs depending on the source area). The power transformer would be connected to the nearest 13kV power line and would be sized to deliver in the range of 1,000 to 5,000 kW of power, depending on the size of the source area. This design is based on the goal of achieving heating to steam distillation temperatures of 100ºCelsius (ºC) across the source area. SVE wells would be spaced 30 feet apart across the source area to capture the heated vapors and steam that are treated in an aboveground treatment system as discussed earlier. Temperature monitoring points would be spaced about 50 feet apart across the source area with thermocouples placed at multiple depths at each point. The active remedial components of this alternative would operate for 2 years before reaching a point of diminishing returns.

Steam Injection Heating: Steam injection is an aggressive technology that involves heating the subsurface by injection of steam through subsurface wells with the simultaneous removal of vapor and liquid through extraction wells (USEPA 1997b). The volatilized hydrocarbon contaminants are extracted by a conventional SVE system. Limited hydraulic extraction is typically necessary to prevent contaminant migration away from source area. This technology can address hydrocarbon contamination in the vadose zone and saturated zone. This technology has also been called “dynamic underground stripping” in one of the most comprehensive implementations of this technology (LLNL 1992; 1995). The extracted vapors, steam and groundwater are treated in an aboveground treatment system that typically includes liquid-vapor separators, condensers, thermal oxidizers, and activated carbon vessels. The aboveground treatment system is similar to other thermal treatment technologies except steam injection typically involves more groundwater extraction and hence a larger water treatment system. The low permeability and heterogeneous character of soils at the former plant site would interfere with the uniform transmission of the steam through the subsurface that is needed for effective heating throughout the source zone. Consequently, the source areas at this site are generally not well suited for application of this technology compared to other aggressive thermal technologies considered. However, there is some potential for the technology to be used in certain areas, thus this technology was retained at the request of USEPA as an option for soil heating. For the remedial alternatives discussed in Section 7, ERH was assumed to be the in-situ soil heating technology for the alternative. However, this does not rule out the potential use of the technology as a tool in the ultimate system design if heat treatment is selected in the ROD.

The conceptual design for this technology would include steam injection wells at about 30-foot spacing on the outer portion of the source area. The injection wells are screened at two depths: across the water table and 30 feet below the water table. The extraction wells are dual phase (combined groundwater and vapor) extraction wells at about 40-foot spacing mostly in the interior of the source area. The objective is to push the source area contaminants towards the center where they would be captured by extraction. An additional ring of sentry vapor extraction wells is included on the perimeter at about 30-foot spacing. Some of these sentry wells will be dual cased to serve as groundwater monitoring wells to ensure no significant contaminant migration away from the source area. Steam is injected at pressures of about 30-40 pounds per square inch gauge (psig). As discussed earlier, an aboveground treatment system would treat the vapor and extracted groundwater prior to discharge. The active remedial components of this alternative would operate for 2 years before reaching a point of diminishing returns.

In-situ Chemical Oxidation: ISCO involves the direct injection of oxidant chemicals through subsurface injection points to oxidize the hydrocarbon contaminants (including NAPL) in the source area to benign chemicals such as carbon dioxide and water. Chemical oxidants used for this type of application can range from Fenton's reagent (hydrogen peroxide+ferrous iron), permanganate, and persulfate to peroxide+ozone (Peroxone) oxidants (ESCTP 1999). ISCO can also be implemented in a recirculation mode with groundwater extraction, addition of oxidant and reinjection to induce in-situ oxidation. Overall, ISCO is an innovative technology that is still evolving. ISCO was retained for evaluation at this site as an aggressive technology option that has the potential advantage of destroying contamination in-situ without aboveground treatment. However, ISCO is typically effective only in the saturated zone where there is adequate water to dissolve and distribute the oxidant. Hence ISCO remedial alternatives would need to be supplemented with a vadose zone technology such as SVE. The implementation of this technology would need laboratory-scale treatability testing to select the appropriate oxidant and field-scale pilot testing to determine the effectiveness and design criteria such as natural oxidant demand of soils at this site.

- Permanganate is a crystalline solid. Typically it is injected into the subsurface as a 1% to 4% by weight solution at pressures of 20-100 psi. Permanganate is generally the best developed of these ISCO technologies because of its effectiveness with chlorinated solvent dissolved plumes and DNAPL source areas. Permanganate is effective because of its strong reactivity with chlorinated solvents, and because of its persistence (extended reactive period) in the subsurface, which increases contact time. Permanganate has a low reactivity with benzene, so it has not been widely used for BTEX or petroleum contamination (ITRC 2005; Carus 2006). Another problem attributed to permanganate-based oxidation, especially in low-permeability formations, is the potential for pore blockage and permeability reduction due to manganese dioxide precipitation that can reduce distribution of oxidant and thus reduce effectiveness.

- Fenton's process refers to oxidation of organics using iron-catalyzed hydrogen peroxide through the creation of the hydroxyl free radical. Fenton's-type oxidation can be implemented in one of two ways: using chelated iron with stabilized hydrogen peroxide (e.g., ISOTEC™ proprietary technology) at neutral pH or the more conventional acidified process which involves oxidation with hydrogen peroxide and iron activators (ferrous salt) in reduced pH (acidic) conditions. The acidified process for Fenton's is most effective at pH between 3 and 6. It is a more aggressive remedial approach and considered better suited for NAPL than the neutral process. In general, Fenton's oxidation is complex, with numerous free radical reactions. The associated rapid reaction of hydrogen peroxide (H_2O_2)

results in limited oxidant persistence or contact time with contaminants (USEPA 2006). Fenton's reagent has a better reactivity with benzene than permanganate and has been used extensively for dissolved-phase BTEX or petroleum remediation (ITRC 2005; Carus 2006). Another problem with Fenton's is the rapid gas (oxygen) generation and the exothermic heat generation from degradation of H_2O_2 in the subsurface which makes implementation difficult. Typically, H_2O_2 is sold as 35% or 50% solutions but dilute solutions in the range of 4% to 20% H_2O_2 are used for remediation. In addition, other reagents such as the iron activator require the addition of acids (such as sulfuric acid or hydrochloric acid) to reduce the pH for most effective oxidation.

- Peroxone oxidation technologies involve the injection of a combination of H_2O_2 and ozone for source area remediation. Ozone is typically used at a 1% to 10% concentration in an air or oxygen stream for remediation purposes. Pulse-ox™ is a commercially available process, jointly developed by Groundwater & Environmental Services and Applied Process Technology that injects H_2O_2 and ozone alternately in pulses in nested injection points. Peroxone oxidation, though not widely used for large NAPL remediation projects, is considered effective for petroleum hydrocarbons in the dissolved phase.

- Persulfate ($S_2O_8^{--}$) is a new oxidant in the site remediation field from the peroxygen family of chemicals. Persulfates are used as oxidants in chemical manufacturing, surface preparation and etching in electronics manufacturing, as a "shock treatment" chemical for swimming pools or recreational water bodies to oxidize contaminants, etc. Persulfate is a strong and stable oxidant but would need to be activated by thermal (heating) or chemical (adding H_2O_2) means to be an effective oxidant in site remediation. It has not been widely used in the remediation field and is not assumed for cost estimating purposes for any source areas. However, if the ISCO technology is chosen, then the selection of the oxidant will be made during remedial design based on treatability studies and/or field pilot testing.

Overall, given that no treatability testing or field testing of oxidants has been conducted at the former plant site, and based on experience with this technology elsewhere, all of the ISCO approaches are judged to have limitations for application in the fine-grained and heterogeneous soils at the former plant site. The FS assumes the use of Fenton's reagent primarily for the NAPL accumulation areas (SA12, SA3) and peroxone was assumed for the residual and potential NAPL areas. As stated earlier, although certain oxidants are assumed for cost estimating purposes, final selection of oxidant would be made during remedial design. The FS does not preclude any oxidant from potentially being selected for ultimate use in the remedial design and remedial action.

The conceptual design for ISCO with Fenton's injection assumes typical design parameters based on experience at other sites. Injection can be implemented by either direct-push temporary injection points or permanent injection wells. This design assumes the use of pressurized injection through permanent injection wells, which would allow for implementation of multiple injection events. The injection wells are assumed to be at an approximate spacing of 15 feet on center. Each injection well location would have four separate screened injection points screened at multiple depths to cover the entire depth (typically 40 feet) of proposed oxidant injection. Each injection point would be installed using a direct push rig and there would be four boreholes for each injection well location. For the Fenton's injection, the H_2O_2

oxidant would be injected from storage tanks through a truck-mounted injection rig that can inject under pressure (typically 20-100 pounds per square inch [psi]) through hoses connected to the injection wells. The oxidant chemicals can be set to inject at a given pressure into eight injection points at a time. Other reagents such as iron activator or acids (pH reduction) are mixed inline at the wellhead during injection. For the peroxone injection, a permanent, fixed, below-grade piping system is assumed that can inject the H_2O_2 and ozone from the treatment compound to the injection wells. The oxidants would be injected continuously under pressure into programmed sets of injection wells sequentially to complete injection in all wells.

ISCO would be supplemented by SVE wells in the interior of the plume at a spacing of 30 feet on center to remove VOCs in the vadose zone. These interior SVE wells would be screened into the water table to serve as interim groundwater monitoring wells, and would monitor progress of ISCO remediation. SVE wells would also be included at the periphery of the plume and along the building footprint to control migration of vapors released from the exothermic oxidation process. Details on the vapor treatment system for SVE were discussed earlier under SVE technology description. The ISCO technology would be expected to operate for 2 years with semi-annual injections and the SVE system would operate for 4 years before reaching the point of diminishing returns.

Some potential NAPL source areas (SAs 4, 7 and 8) are assumed to contain NAPL under buildings. For these source areas, ISCO can potentially be implemented using vertical wells inside the building if the specific area inside the building is accessible for well installation and can be cordoned off to control access for safety during remedial operations.

The primary safety concerns with ISCO are related to leaks of VOC vapors or the oxidant at the injection wellheads which can occur with exothermic reactions when Fenton's reagent or to a lesser extent peroxone are used. If persulfate is used as the oxidant, such problems will be reduced. Another concern is the potential for clogging of the formation by byproducts of the oxidation reaction. It has been assumed that a significant portion of the source area and treatment compound will be enclosed within a chain-link fence for public safety and would not be accessible to the employees at the site. The restricted access to the remediation area may limit available onsite parking for tenants and may require providing transportation to and from the site to an offsite parking facility.

In-situ Groundwater Bioremediation

In-situ groundwater bioremediation refers to enhancing the metabolic capacity of naturally occurring soil microbes in the saturated zone to use the contaminants as substrates that are reduced to inert compounds such as carbon dioxide and water. The enhancement of the microbial degradation can be implemented by enhancing aerobic or anaerobic microbial degradation. This technology is retained in this FS for use with aerobic bioremediation of petroleum hydrocarbons or enhanced anaerobic bioremediation of dissolved chlorinated solvent contamination (if needed). For chlorinated solvents, the various bioremediation options for groundwater include injection of electron donors (e.g., emulsified edible oil), methane (cometabolic enhancement) or microbes (e.g., KB-1) and nutrients (ESCTP 2006).

Edible oils are relatively low-cost, innocuous, food-grade substrates. These oils are preferably injected as emulsions for ease of implementation and better subsurface distribution. This technology would require that strongly reducing conditions be generated by addition of emulsified oil and that a microbial community capable of the reductive dechlorination is present. As with other in-situ technologies, this approach will face implementation difficulties due to the low permeability and heterogeneous character of soils at the former plant site which would make it difficult to distribute the oil. The injection of emulsified oil can be implemented by direct-push probes or through injection wells. Typically, one round of injection can provide sufficient carbon to drive reductive dechlorination for as long as two years. This technology can be implemented to address source areas or as a permeable reactive barrier to address downgradient plumes. Based on recent groundwater investigations, the chlorinated solvent plume on the western edge of the former plant site may be undergoing enhanced in-situ anaerobic biodegradation due to the presence of other hydrocarbon contaminants such as BTEX that are serving as electron donors. This issue is discussed later in the NAPL alternatives in Section 7.

Hydraulic Extraction

Hydraulic extraction involves the extraction of groundwater to increase the hydraulic gradient toward the extraction wells and remove any mobile NAPL contaminant as free product or in the dissolved phase. Hydraulic extraction (also called pump and treat) is well known to have limitations in addressing source area contamination because some or all of the NAPL/hydrocarbon contamination is adsorbed or tightly bound in the soil pore space and is removed only through dissolution into groundwater.

Conceptual designs of the hydraulic extraction alternative for individual source areas are described in Section 7. Based on the results of the MW-20 pilot program (Section 2.2.8), an approximate spacing of 30 feet is assumed for the extraction wells. As discussed before, if such an active remedial technology is selected for a source area, then a comprehensive range of remedial designs will need to be evaluated including pilot testing to determine the optimal choice of well screens, well spacing, etc. The aboveground groundwater treatment system is designed based on an assumed flow rate of 1 gpm per well derived from the MW-20 pilot program experience. The treatment process train is assumed to utilize multiple processes including pre-treatment process such as liquid-liquid separator (also oil-water separator) and particulate filters. The two primary treatment processes assumed are advanced oxidation (hydrogen peroxide+ozone oxidation of dissolved phase hydrocarbons) and air stripping (parallel plate air stripper). Liquid-phase carbon adsorption is included in the treatment process train as a polishing or backup technology in the event either of the primary technologies fail. The treated groundwater can be handled in one of three ways: discharge to storm drain, discharge to sewer or reinjection into subsurface. The discharge to storm drain alternative assumes that the extracted groundwater is treated to MCLs to meet the substantive requirements of NPDES as implemented by the Regional Water Quality Control Board (RWQCB). If this alternative is selected in the ROD, then the various treatment and discharge options will be evaluated during remedial design. Any LNAPL recovered from the liquid-liquid separator would be disposed to an offsite facility that is permitted to receive such waste (likely Resource Conservation and Recovery Act [RCRA] hazardous waste).

Since the hydraulic extraction alternative includes SVE, the vapor stream from the air stripper is directed to the SVE blower, which would be sized to handle both the SVE and vapor flow from the air stripper. The vapor treatment technologies discussed earlier under SVE are applicable here as well. The hydraulic extraction alternative is assumed to operate for a 10-year timeframe, with the objective of reducing contaminant mass to enhance the certainty of the site-wide groundwater remedy. It has been assumed that the treatment compound will be enclosed within a chain-link fence for public safety and would not be accessible to the employees at the site. The restricted access to the remediation area may limit available onsite parking for tenants and may require providing transportation to and from the site to an offsite parking facility.

Multi-Phase Extraction

Multi-phase extraction (MPE; also called dual-phase extraction) is the extraction of vapor and groundwater through extraction wells using high vacuum extraction and supplemented by hydraulic extraction with the goal of removing VOCs and NAPL in deep soils and shallow groundwater. Since the water table at these source areas is relatively deep (between 40 and 50 feet bgs), the extraction flow rate of liquids by vacuum alone is expected to be low. Since extraction of NAPL in the saturated zone is a remedial objective, supplemental groundwater extraction with in-well hydraulic pumps would be needed. This would make this technology a hybrid of SVE and hydraulic extraction. Extraction well spacing would be about the same as assumed for SVE (30 feet on center). This technology would be expected to operate for about 4 years. This technology was retained as a potential option for NAPL source areas but it was not evaluated as a remedial alternative because other related options, such as SVE and hydraulic extraction, were already considered.

Vapor Treatment

The vapor treatment technologies associated with the NAPL remediation are similar to those presented in the surface pathway evaluation (Section 5.4.3) and in Table 5-3. All of the vapor treatment technologies presented in Table 5-3 are retained because each technology may have specific advantages for different site conditions depending on vapor composition, concentration or other factors. This approach will retain as many options as possible for selection during remedial design. All vapor treatment systems would need to be operated to meet the substantive requirements of the SCAQMD, though no SCAQMD permits would be required.

5.4.5 Monitoring

Monitoring is included as a technology component in the remedial alternatives evaluated in the FS. Monitoring includes activities such as monitoring of ICs, monitoring of an active remedial option during treatment, monitoring of a containment system such as a sub-slab venting system, and long-term monitoring after treatment.

5.4.5.1 ICs Monitoring

ICs monitoring refers to periodic monitoring of the individual IC layers that are incorporated as part of the remedy. Monitoring of any IC tools selected in the ROD is an important component of remedy implementation. Effective monitoring of institutional controls requires that a process be established to periodically review and critically evaluate the ICs to: 1) verify that the controls remain in place, and, 2) assess whether the controls are functioning effectively to achieve their stated objectives. The results of the evaluation process can then be documented in a report to USEPA and other oversight agencies. It has been suggested that annual ICs monitoring and reporting may be appropriate during the first five years following remedy implementation (USEPA 2002). The reporting frequency can be adjusted during the CERCLA Five-Year Review process. ICs monitoring activities can either function as IC mechanisms themselves, or serve as stewardship tools to confirm that specific ICs are operating effectively over time (Table 5-1). The types of monitoring to be employed will depend on the specific ICs that are ultimately selected as part of the final remedy.

A variety of ICs monitoring and reporting services are becoming available within the private sector, and can be tailored to address the specific objectives and requirements of the applicable control mechanisms in the remedy. Such private sector monitoring services may include monitoring within a geographical target area for specific types of planned activities that could lead to inadvertent contact with contamination that is left in place, or be a signal of a planned change from a current use to a more sensitive type of land use. Examples of the kinds of activities or records that such "landwatch" services monitor and report may include: notices of plans to perform excavation or grading activities, records of applications for building or excavation permits, real estate marketing or transfer of ownership records, and applications filed for changes in zoning designation.

Monitoring done to verify that ICs are in place and functioning effectively may be accomplished by physical inspections or by comparing the results achieved by layered ICs that have one or more common objective. In cases where more than one IC is in place to accomplish the same objective, the results achieved by each of the controls can be compared to provide a basis for evaluating the effectiveness of each control in accomplishing the desired objective. For example, a primary objective of a landwatch mechanism may be to identify planned soil excavation activities before they occur within the area of the former rubber plant site or on selected properties. The permit review for excavation/grading permits discussed above in Section 5.4.1 also has this goal as one of its overall objectives. The incidents of planned excavation and grading work that are identified by both mechanisms over a period of one year (or other time period) can be compared to assess the relative effectiveness of each control in achieving this and any other common objectives. In turn, the results of this comparison can be used to make adjustments in one or both control mechanisms to make them function more effectively.

Periodic (such as annual) reconnaissance inspections of properties where ICs are applied can also be an effective element of an ICs monitoring program. Such inspections can be an effective way of determining whether applicable ICs such as deed restrictions, zoning restrictions, and notification requirements are or are not operating as intended at individual properties. Observations made during inspections of relevant activities such as site grading, new construction, and changes in land use would be photographed, described on an inspection form, and compared to conditions observed during previous inspections. In situations where there is uncertainty about whether something observed during an inspection either represents a violation of an applicable IC, or is something that should have been previously detected by an applicable IC, additional follow-up with the property owner and/or the local agency that plays some role in administering the IC may be appropriate. Any observed conditions that are either determined to violate an applicable IC, or should have been detected by an applicable IC, would be documented in the reconnaissance inspection monitoring report and reported to USEPA. The results of the periodic inspections can also be used to identify deficiencies in the overall ICs program, and to make appropriate adjustments in how individual ICs are administered and enforced.

IC monitoring reports can be archived for review upon request, and be summarized in the 5-year review report. Any issues identified during the IC monitoring reviews should be summarized in the monitoring report submitted to USEPA shortly after completing the review.

5.4.5.2 Environmental Media Monitoring

Monitoring of various environmental media such as soil vapor, soil or groundwater can also be conducted, as described below.

Groundwater Monitoring

Groundwater monitoring results will indicate unanticipated/adverse changes in NAPL or dissolved-phase contaminant distributions in the long term after any remedial actions. A point-of-compliance groundwater monitoring program is being developed in accordance with requirements for the Groundwater ROD and subsequent Groundwater Remedial Design Orders. Limited groundwater monitoring may be conducted during any active remedial system operation, to confirm remedy effectiveness in the vicinity of a source area.

Soil Vapor/Sub-slab Vapor/Indoor Air Monitoring

If evidence of an indoor air exposure is attributed to soil vapor originating from former rubber plant operations and an engineering control is required, soil vapor and/or sub-slab vapor monitoring may be utilized. This monitoring would be performed to ensure that site conditions are not changing adversely and to create a new and/or unacceptable risk. This monitoring could also be used to delineate the extent of the subsurface contamination below the building. Limited soil vapor or indoor air monitoring may additionally be conducted during any active remedial system operation, to ensure there is no vapor migration during remediation.

Soil Monitoring

Monitoring of soil could include soil sampling and laboratory testing prior to any remedial activities to delineate the extent of contamination more precisely. Soil monitoring may also be conducted through the permit review IC process discussed earlier. Any construction activities in the future that involve excavation deeper than 1.5 feet will require the Del Amo ERT environmental review process that may involve soil sampling and testing. Such soil monitoring would occur periodically in the future depending on the construction projects proposed by the property owners. If any active remediation is required by the ROD, additional soil sampling will need to be conducted in some areas to delineate the vertical and horizontal extent of soil contamination. Soil sampling will also be conducted at the conclusion of any active remediation to confirm that the remediation was effective.

Engineering Controls Monitoring

If an engineering control such as a cap or sub-slab venting is implemented to control direct contact or inhalation exposures, long-term monitoring may be required to ensure that the engineering control continues to operate effectively and is not compromised. As discussed earlier in Section 5.4, restrictive covenants will be included for properties that require engineering controls and these covenants will require that property owners protect the engineering control.

6.0 DESCRIPTION OF SOIL OR SURFACE PATHWAY REMEDIAL ALTERNATIVES

The FS evaluation for the Soil and NAPL OU involved separate evaluations for the soil/surface pathway and the NAPL source area remedial alternatives. Surface pathway refers to the exposure pathways for encountering potential soil contamination by direct contact with surface or shallow outdoor soil and by vapor inhalation from outdoor soil or in indoor air inside buildings. Vapor intrusion from soil into buildings occurs primarily by vapor migration from shallow soil but can also occur from deep soil and groundwater, though to a lesser extent.

The surface pathway evaluation addressed remedial evaluation for a wide range of COCs at various exposure areas across the former plant site. Exposure areas were grouped based on the commercial and hypothetical RR estimates (Table 3-2). The remedial alternatives focus on the commercial worker risk because within the former plant site, properties are zoned for commercial/industrial use. As discussed in Section 3, the five groups of exposure areas decrease in risk from Group 5 to Group 1. Groups 3, 4 and 5 were further divided into subgroups depending on contaminant type. Subgroup A includes areas that have non-VOC contaminants as primary risk-driving contaminants and Subgroup B includes areas with VOCs as primary risk-driving contaminants. Some Subgroup A areas have VOCs as secondary contaminants and similarly some Subgroup B areas have non-VOCs as secondary contaminants. Section 3 also described the representative exposure area approach, in which some exposure areas in a group/subgroup were selected as representative of the group or subgroup (Table 3-3). This section describes the assembly of remedial alternatives for the representative areas in each of the parcel groups.

6.1 ASSEMBLY OF REMEDIAL ALTERNATIVES

6.1.1 General Form of the Remedial Alternatives

Active remedial alternatives were evaluated for exposure areas from Groups 3, 4 and 5 (those with risks greater than 1E-06). The technologies retained from Section 5 were combined to form remedial alternatives for each representative exposure area. The remedial alternatives considered for evaluation are presented here separately for Subgroup A parcels (those with non-VOC contaminants in outdoor soil as the primary COCs) and Subgroup B parcels (those with VOC contaminants in outdoor soil or indoor air as primary COCs). Within each subgroup, additional variations of the alternatives are presented for exposure areas that have a combination of contaminants (e.g., VOCs and non-VOCs).

Remedial Alternatives for Subgroup A Exposure Areas

For exposure areas from Groups 3, 4 or 5 with non-VOC contaminants in outdoor soil, the remedial alternatives considered combine retained technologies with monitoring, and include the No Action alternative as required by CERCLA. The alternatives include various combinations of ICs, Capping and Excavation. For Subgroup A areas with only one non-VOC contaminant the general form of the alternatives was as follows:

(1) No Action
(2) ICs + Monitoring
(3) Capping + ICs + Monitoring
(4) Excavation + ICs + Monitoring

If there are multiple non-VOC COCs at a Subgroup A area, additional combinations of remedial alternatives with capping and excavation were considered as discussed in Section 8.

If there is a secondary VOC COC in outdoor soil at a Subgroup A exposure area, additional combinations of remedial alternatives were considered to include the VOC-impacted areas as follows:

(1) No Action
(2) ICs + Monitoring
(3) Capping (non-VOC, VOC) + ICs + Monitoring
(4) Excavation (non-VOC) + Capping (VOC) + ICs + Monitoring
(5) Excavation (non-VOC, VOC) + HVAC mod/SSV (VOC) + ICs + Monitoring

Here the notation "Capping (non-VOC, VOC)" refers to capping of both non-VOC and VOC-impacted areas; "Excavation (non-VOC)" refers to excavation of non-VOC-impacted area. ICs are included for each of these properties consistent with the ICs Layering Plan discussed in Section 5.4.1.1. The ICs selected would depend on the specific group to which the parcel belongs and the type of remedial alternative they are paired with. For example, a remedial alternative that includes capping would include IC layer 4 (among other layers as appropriate) with a restrictive covenant to protect the cap. Monitoring includes monitoring of the installation and operation of the engineered remedy components as well as monitoring of the ICs. ICs monitoring is discussed in Section 5.4.5 and would include, among other actions, occasional site monitoring to check property use and compliance with land use covenants.

ISTD is not included as a technology option for non-VOC contaminants because it is not applicable to some of the contaminants such as metals. While it might have limited applicability, such as for SVOCs (e.g., PAHs) in soil, experience shows ISTD is not cost effective compared to other approaches such as excavation for shallow soil.

With the excavation option, onsite treatment is not included in the remedial alternative evaluation because in general there is very limited space at these properties for onsite treatment. Onsite treatment would be rated poor for implementability also because these properties are operating businesses that would be impacted significantly by dust and odors from handling and treatment of contaminated soil. Typically, with offsite disposal, some soil would be treated offsite, then recycled after it meets appropriate specifications for reuse. If it does not meet criteria for reuse, some soil may be sent to a landfill for burial.

Remedial Alternatives for Subgroup B Areas

For exposure areas from Groups 3, 4 or 5 with VOC contaminants, the remedial alternatives considered included various combinations of Capping, HVAC mod/SSV, SVE/BV and Excavation as shown below. Capping and Excavation components apply only to outdoor soil (OS) while HVAC mod/SSV applies only to soil under a building (UB). SVE/BV can apply to either OS or UB. For alternatives that contain the

SVE (UB) component, after completion of SVE and meeting performance standards, the horizontal wells under the building could be converted to SSV wells if needed. More details of these technology components are presented in Section 5.4. The following is the general form of the remedial alternatives for Subgroup B exposure areas.

(1) No Action
(2) ICs + Monitoring
(3) Capping (OS) + HVAC mod/SSV (UB) + ICs + Monitoring
(4) Capping (OS) + SVE/BV (UB) + ICs + Monitoring
(5) SVE/BV (OS) + HVAC mod/SSV (UB) + ICs + Monitoring
(6) SVE/BV (OS) + SVE/BV (UB) + ICs + Monitoring
(7) Excavation (OS) + HVAC mod/SSV (UB) + ICs + Monitoring
(8) Excavation (OS) + SVE/BV (UB) + ICs + Monitoring

The active remedial alternatives follow the general pattern of “technology for outdoor soil + technology for soil under building”. If non-VOC contaminants are also COCs for a Subgroup B exposure area, then additional components for the capping and excavation options would be added to address the non-VOC contaminants. The alternatives such as Capping would address the areas of the property impacted by non-VOC and VOC contaminants. The SVE and Excavation alternatives designed for the VOC contaminants would include a Capping or Excavation option for the non-VOC contaminants. The list of potential alternatives is presented below showing the technology option (Capping or Excavation) along with the contaminant type (VOC or non-VOC) and media location (OS or UB). SVE/BV and HVAC mod/SSV always apply to VOCs, so for simplicity the contaminant type is not included.

(1) No Action
(2) ICs + Monitoring
(3) Capping [VOC, non-VOC] (OS) + HVAC mod/SSV (UB) + ICs + Monitoring
(4) Capping [VOC, non-VOC] (OS) + SVE/BV (UB) + ICs + Monitoring
(5) SVE/BV (OS) + Capping [non-VOC] (OS) + HVAC mod/SSV (UB) + ICs + Monitoring
(6) SVE/BV (OS) + Capping [non-VOC] (OS) + SVE/BV (UB) + ICs + Monitoring
(7) SVE/BV (OS) + Excavation [non-VOC] (OS) + SVE/BV (UB) + ICs + Monitoring
(8) Excavation [VOC, non-VOC] (OS) + HVAC mod/SSV (UB) + ICs + Monitoring
(9) Excavation [VOC, non-VOC] (OS) + SVE/BV (UB) + ICs + Monitoring

The names of the Capping and Excavation alternatives are simplified when used later in this section by dropping the “OS” designation because Capping and Excavation are always implemented in outdoor soil. For example, Alternative 4 is written as “Capping (VOC, non-VOC) + SVE/BV (UB) + ICs + Monitoring” and Alternative 8 is written as “Excavation (VOC, non-VOC) + HVAC mod/SSV (UB) + ICs + Monitoring”.

6.1.2 Approach and Assumptions for Scoping Remedial Alternatives

The following subsections present the details of the remedial alternatives for each representative exposure area in the surface pathway evaluation. The description for each representative area includes a discussion of background information, the nature and extent of contamination, screening of remedial alternatives and finally a description of remedial alternatives. The nature and extent of contamination includes a summary of investigation results, a summary of risk estimates and RDCs, and the extent of contamination.

For the evaluation of active remedial alternatives for representative EAPCs in Groups 3, 4 and 5, an estimate of the extent of impacted soil at each EAPC is required. For each exposure area, the COCs and pathways to be evaluated were determined based on the risk estimates and the RDCs. For FS evaluation purposes, the extent of impacted outdoor soil for each COC was estimated based on exceedances of risk-based threshold levels (Table 4-3) at the target risk level of 1E-06 for commercial workers. For non-VOC COCs, the extent of impacted outdoor soil is based on the exceedance of the risk-based threshold levels for outdoor soil, given that outdoor soil ingestion is the only complete pathway. For VOC COCs, there is potential risk from both an indoor air pathway and an outdoor soil pathway. The extent of VOC contamination in outdoor soil was based on exceedances of the risk-based threshold levels for VOCs for the indoor air pathway because it is more conservative (lower value) than the risk-based goal for the outdoor soil pathway. The extent of VOC contamination of soil under the building was estimated based only on locations of former plant site facilities and soil gas data from samples collected close to the building footprint. The extent of impacted soil was estimated using conservative, higher-end estimates that were approximated as rectangular areas rather than as interpretive concentration contours.

For each representative exposure area with multiple COCs, the primary COCs and pathway with the dominant risk contribution, as well as secondary COCs and pathways with lower risk contributions were identified. Remedial alternatives were developed to address all COCs, but active technologies were included in more alternatives for the primary COCs than for the secondary COCs. For each representative EAPC, remedial alternatives were developed by modifying the general form of the remedial alternatives presented in Section 6.1.1 to address EAPC-specific COC/pathway information. In cases where there were a large number of potential remedial alternatives, the alternatives were screened to focus the evaluation on five or six remedial alternatives that are most viable. In addition to viability, the remedial alternative selection process was structured so that a wide range of technology options was represented, including containment/engineering controls and in-situ or ex-situ remedial technologies. Table 6-1 lists the remedial alternatives selected for evaluation at each representative EAPC, and summarizes the primary and secondary COCs and their associated CRs.

In estimating risk from VOCs via the indoor air pathway, it should be noted that soil and soil gas data from outdoor soil were used with the Tiers 1+2 modeling. Sub-slab sampling was not conducted at any buildings during the RI. Indoor air monitoring was conducted on some buildings at the former plant site but due to the difficulty in distinguishing VOCs from sources such as ambient air or other indoor sources from subsurface vapor intrusion, indoor air monitoring data were not used in the FS evaluation process. In general, the calculated cancer risks posed by VOCs via the indoor air pathway were higher than the risks associated with the outdoor soil pathway.

These assumptions and the inferred areas of impacted soil are described for each representative exposure area later in this section, and shown on appropriate figures. The FS evaluation ratings are not expected to be significantly sensitive to these assumptions. This approach is anticipated to be adequate to support the contingent remedial decision-making process following completion of the FS. If active remedial measures are proposed for any exposure areas, additional investigation will be necessary during remedial design to confirm RI findings and to define the actual areas and depths of contamination requiring remediation. This additional data will also be used to confirm that the remedy is appropriate for specific exposure areas and if so, to provide the information needed to support remedial design. In addition, for active remedial measures, assumptions have been made regarding spacing of remediation wells since pilot testing data are not available for most technologies. The assumptions for well spacing or other design parameters are based on knowledge of soil characteristics and experience with the technologies at other sites. In summary, if any active remedial technologies or engineering control measures such as HVAC modification are selected during the remedy selection process, then additional investigations to include sampling, laboratory testing and in some cases pilot testing at the targeted areas will need to performed during remedial design.

The remedial alternatives are generally designed to minimize any impact on facility or building operations. The remedial options for the surface pathway evaluation do not include wells inside the buildings. Some remedial options consider horizontal wells/piping installed under buildings, but the implementability of such horizontal wells/piping is specific to each building and may face potential implementation challenges as discussed in Section 5.4. However, because of the locations of the impacted areas, the remediation wells/piping and the treatment compound will often be at locations on an EAPC that cause some impact to a facility or office building. The treatment compound, usually located in a parking area, would be enclosed in a chain-link fence for public safety. For some of the more aggressive remedial alternatives (e.g., excavation), the impacted area may need to be fenced off as well. The fenced-in area would be inaccessible to site employees or business vehicles.

6.2 GROUP 5A REPRESENTATIVE AREA – EAPC 2

Group 5A includes the exposure areas that have a CR and RR greater than 5E-05 and/or HIs above 1 as discussed in Section 3. EAPC 2 was selected as a representative area for this group. Details on grouping of the areas and selection of representative areas were presented in Sections 3.1.3 and 3.1.4.

6.2.1 Background Information

EAPC 2 (parcel 7351-031-020) is located at the southwest corner of 190th Street and Vermont Avenue (Figure 1-2). The property consists of approximately 9.2 acres currently developed with a multi-story office building located in the central portion of the parcel. Paved vehicle parking is provided to the north, east, south, and west, and small landscaped areas are present around the building and along the property boundaries. With respect to the former rubber plant, this parcel is located in the northeastern corner of the former copolymer plancor, where butadiene and styrene were polymerized to produce synthetic rubber. Additional background information on this parcel is provided in the parcel-by-parcel summaries in Appendix A.

6.2.2 Nature and Extent of Shallow Soil Contamination

Summary of Investigation Results

The remedial investigation included 22 soil borings, two soil gas sampling locations and 6 indoor air sampling locations at EAPC 2. The soil and soil gas sampling locations sampled for various analytes are shown on Figures 2-4 through 2-14. All three surface soil (0 to 1 foot bgs) samples showed detectable concentrations of B(a)P with a maximum reported value of 0.76 mg/kg. Eleven of 14 shallow soil (0 to 15 feet bgs) samples analyzed for PAHs showed detections for B(a)P with a maximum concentration of 13 mg/kg at a depth of 1.5 feet bgs in boring SBL0337. Four of these samples exceeded the industrial PRGs for B(a)P. PRG exceedances for other PAHs, including B(a)A, B(b)F, B(k)F, and I(1,2,3-cd)P were also detected at SBL0337. Arsenic and lead were detected at concentrations exceeding RI screening criteria in two and one shallow soil samples, respectively. VOCs were not detected in any of the 10 shallow soil samples analyzed. Figures showing sampling locations and screening criteria exceedances were presented in the Soil and NAPL RI Report (URS 2007b).

Summary of Risk and Risk-driving Chemicals

The following table summarizes risk values for the commercial worker at EAPC 2 for the outdoor soil and indoor air pathways.

EAPC 2 COMMERCIAL WORKER RISK SUMMARY

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer risk	Hazard Index		
5A	Outdoor soil	1E-04	<1	**B(a)P** I(1,2,3-cd)P B(b)F B(k)F B(a)A Arsenic	**1.0E-04** 1.5E-05 7.8E-06 3.8E-06 1.9E-06 6.8E-06
	Indoor air	<1E-06	<1	--	--

B(a)P in outdoor soil is the primary RDC. The B(a)P risk of 1E-04 was based on the maximum detected concentration, which was present in one sample from soil boring SBL0337. This was the only sample collected at this EAPC with contaminants that exceeded a 5E-05 risk-based threshold level for commercial workers. The four other PAH risk drivers were also detected at SBL0337. The risk contribution due to arsenic is primarily due to elevated concentrations of 10.8 mg/kg and 14 mg/kg for two sampling locations (SBL0344, SBL0425). These concentrations are only slightly higher than the upper limit RI background concentration for arsenic of 10 mg/kg, but are below 25 mg/kg, the concentration previously considered by USEPA to be consistent with background levels of arsenic in California soils for the Waste Pits OU.

Extent of Impacted Soil for FS Evaluation

The extent of contamination was estimated for the FS evaluation based on the locations where the COCs identified above were detected in samples at concentrations exceeding the risk-based threshold levels corresponding to a risk of 1E-06 for a commercial worker. The assumed area of impacted soil is shown on Figure 6.2-1, located in Appendix D, as a rectangular area of approximately 70 feet by 70 feet that includes the location of the maximum B(a)P concentration and other samples that exceeded the risk-based threshold levels for B(a)P. Arsenic concentrations detected in excess of background are assumed to be limited to two areas, one 25 feet by 50 feet and the other 50 feet by 50 feet. As previously discussed, additional sampling would need to be performed to confirm the presence and extent of elevated arsenic concentrations in these areas if active remediation such as soil removal is selected as the preferred remedy.

Based on the available soil data and the low mobility of PAHs and arsenic, the area of impacted soil is expected to be limited to the shallow subsurface. The maximum depth of impacted soil was assumed to be 5 feet bgs with an in-place impacted soil volume of approximately 1,600 cubic yards (CY).

6.2.3 Identification of Remedial Alternatives

The RDCs for this parcel are PAHs and arsenic, which are non-VOCs. The remedial alternatives considered for evaluation are derived from the set of four alternatives for non-VOCs discussed in Section 6.1. Since there are two types of contaminants, one additional variation is proposed in the remedial alternatives as follows.

(1) No Action
(2) ICs + Monitoring
(3) Capping (PAHs, Arsenic) + ICs + Monitoring
(4) Excavation (PAHs) + Capping (Arsenic) + ICs + Monitoring
(5) Excavation (PAHs, Arsenic) + ICs + Monitoring

As discussed above, ISTD is not included as an alternative for in-situ remediation of PAH-impacted shallow soil because it is not cost effective compared to excavation, offsite treatment, and soil recycling. Also, as discussed above, the excavation alternatives assume offsite soil treatment and disposal as opposed to onsite treatment. Numerous difficulties can be expected with onsite treatment leading to poor implementability. Since there are only five alternatives for this EAPC, none have been screened out to reduce the length of the list.

6.2.4 Description of Remedial Alternatives

The following is a description of the remedial alternatives for EAPC 2. The technology descriptions provided in Section 5.4 supplement the brief alternative descriptions provided here.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – ICs + MONITORING

EAPC 2 is included in Group 5 and IC layers 1-4A are proposed, as described in Section 5.4. ICs will include restrictive covenants requiring sampling during any future redevelopment and strengthened restrictions on residential use of the property. ICs will also include environmental review requirements and informational controls. Monitoring includes ICs monitoring as discussed in Section 5.4.5.

ALTERNATIVE 3 – CAPPING (PAHs, ARSENIC) + ICs + MONITORING

This alternative includes enhancing the existing asphalt cap currently covering the impacted areas, approximately 8,650 SF as shown on Figure 6.2-2, located in Appendix D. As described in Section 5.4, the existing state of the surface covering the impacted area will be evaluated during remedial design if this alternative is selected for implementation. This alternative will include any additional components required to create an adequate cap. ICs are the same as for Alternative 2 except that they would include a requirement in the restrictive covenant to monitor and maintain the cap (IC layers 1-4B). Monitoring includes ICs monitoring and periodic inspection and maintenance of the asphalt cap.

ALTERNATIVE 4 – EXCAVATION (PAHs) + CAPPING (ARSENIC) + ICs + MONITORING

This alternative includes excavation of the PAH-impacted shallow soil (Figure 6.2-3, located in Appendix D) to a depth of 5 feet bgs which results in an in-place soil volume of approximately 907 CY. It also includes asphalt capping of the two areas that are impacted by arsenic, approximately 3,750 SF. Since this alternative involves capping and leaving in place residual arsenic-impacted soil, ICs include IC layers 1-4B and ICs monitoring.

ALTERNATIVE 5 – EXCAVATION (PAHs, ARSENIC) + ICs + MONITORING

This alternative includes excavation of both PAH- and arsenic-impacted shallow soil (Figure 6.2-4, located in Appendix D). The extent of soil excavation is assumed to include the three impacted areas extending to a depth of 5 feet bgs, which results in an in-place soil volume of approximately 1,600 CY. Since this alternative would remove the contamination, fewer ICs (only IC layers 1 and 2) are proposed.

6.3 GROUP 4A REPRESENTATIVE AREA - EAPC 7

Group 4A includes the exposure areas that have a CR less than or equal to 5E-05 and an HI_{com} less than or equal to 1 but where the RR is greater than 5E-05 or HI_{res} is greater than 1. Group 4A only includes exposure areas where the primary RDC is a non-VOC in outdoor soil.

6.3.1 Background Information

EAPC 7 (parcel 7351-033-024) is located at the southwest corner of Knox Street and Hamilton Avenue, in the northeastern corner of the former butadiene plancor (Figure 1-2), where butadiene was manufactured as a component of synthetic rubber. The area was sampled as part of both the soil gas investigation and 2003 Addendum Investigation.

This 4.9-acre EAPC is currently developed with two multi-story office buildings. The buildings are located in the central portion of the EAPC. The remainder of the parcel includes paved vehicle parking areas to the north, east, south, and west and small landscaped areas along the parcel boundaries. Additional background information on this parcel is provided in the parcel-by-parcel summaries in Appendix A.

6.3.2 Nature and Extent of Shallow Soil Contamination

Summary of Investigation Results

The remedial investigation for this parcel included 21 soil borings and 22 soil gas shallow sampling locations. The soil and soil gas sampling locations sampled for various analytes are shown on Figures 2-4 through 2-14. Exceedances of RI screening criteria occurred for the following analytes and locations at the parcel:

- Arsenic, within the top five feet of soil within the footprint of a former incinerator (19.2 mg/kg at SBL0380) and a former filtration tank (14.2 mg/kg at SBL0388). Detected arsenic concentrations were below background[17] levels of arsenic in California soils;
- Benzene and ethylbenzene between 10 and 15 feet bgs at borings SBL0383 and SBL0384 (maximum benzene = 2.7 mg/kg; maximum ethylbenzene = 55 mg/kg); and,
- B(a)P at 2 feet bgs in the vicinity of an oil skimmer basin (0.22 mg/kg).

Figures showing sampling locations and screening criteria exceedances were presented in the Soil and NAPL RI Report (URS 2007b).

Summary of Risk and Risk-driving Chemicals

The recalculated risk estimates for the commercial worker and the outdoor soil and indoor air pathways for EAPC 7 are summarized in the table below:

EAPC 7 COMMERCIAL WORKER AND HYPOTHETICAL RESIDENT RISK SUMMARY

Group	Medium/Pathway	Commercial Worker Recalculated Risk[a]		Risk-driving Chemicals	Chemical-specific Risk
		Cancer risk	Hazard Index		
4A	Outdoor soil	7E-06	<1	Arsenic	5.9E-06
	Indoor air	<1E-06	1	Benzene I-PB, I-PT, 1,2,4-TMB	<1E-06 --
		Hypothetical Resident Recalculated Risk			
	Outdoor soil	7E-05	1	Arsenic	5E-05
	Indoor air	2E-05	30[b]	Benzene I-PB, I-PT, 1,2,4-TMB	1.9E-05 --

[a] Risk estimates in the BRA were influenced by elevated DLs. Risks for this EAPC were recalculated by the RAGS method as described in USEPA's Risk Assessment Guidance, Part D, Chapter 5, 2001 (RAGS 2001)

[b] i-PB, i-PT and 1,2,4-TMB are primary contributors that make indoor air HI_{res} >1 but do not contribute to cancer risk.

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[17] Detected arsenic concentrations were below 25 mg/kg, a concentration that was previously considered by USEPA to be consistent with background levels of arsenic in California soils for the Waste Pits OU.

The primary RDC is arsenic in outdoor soil, with benzene, i-PB, i-PT and 1,2,4-TMB in indoor air as secondary RDCs. Although the CR from benzene is less than 1E-06, it is included as a secondary RDC because the RR from benzene is greater than 1E-06. The benzene concentrations detected on this parcel are essentially the equivalent of a Group 3 risk. The highest benzene concentrations were detected in samples from borings SBL0383 and SBL0384, located in the vicinity of the former oil skimmer basin. I-PB, I-PT and 1,2,4-TMB are considered secondary RDCs because they are the main contributors that make HI_{res} >1. However, they do not contribute to cancer risk. The highest concentrations of I-PB, I-PT and 1,2,4-TMB are found in boring SBL0383 collocated with benzene.

Extent of Impacted Soil

Based on a target CR of 1E-06, the primary COC for this EAPC is arsenic in outdoor soil and the secondary COCs are VOCs including benzene, I-PB, I-PT and 1,2,4-TMB in indoor air. The extent of arsenic-impacted soil was defined by the locations that exceeded the cleanup level for arsenic (background levels). The impacted extent was assumed to be contained within two 50 feet by 50 feet areas, as shown on Figure 6.3-1, located in Appendix D. Based on its generally low mobility, arsenic-impacted soil was assumed to be limited to a depth of 5 feet bgs, resulting in an in-place impacted soil volume of approximately 925 CY. The VOC-impacted soil around the former oil skimmer basin is assumed to be approximately 100 feet long by 30 feet wide and 15 feet deep for a volume of 1,670 CY. Therefore, the total impacted soil volume is approximately 2,600 CY. If active remedial alternatives are selected for implementation, additional sampling would need to be conducted to define the actual area of impacted soil prior to proceeding with remedial design and implementation.

6.3.3 Identification of Remedial Alternatives

Since this EAPC has one primary non-VOC (arsenic) and multiple VOCs as secondary COCs in outdoor soil, the following remedial alternatives were considered:

(1) No Action
(2) ICs + Monitoring
(3) Capping (Arsenic, VOCs) + ICs + Monitoring
(4) Excavation (Arsenic) + SVE/BV (VOCs) (OS) + ICs + Monitoring
(5) Excavation (Arsenic, VOCs) + ICs + Monitoring

Other combinations of alternatives such as Capping (Arsenic) + SVE/BV (VOCs) or Capping (VOCs) + Excavation (Arsenic) were screened out because their effectiveness was lower compared to Alternatives 4 and 5 above.

6.3.4 Description of Remedial Alternatives

The following is a description of the remedial alternatives for EAPC 7. The technology descriptions provided in Section 5.4 supplement the brief alternative descriptions provided here.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – ICs + MONITORING

EAPC 7 is in Group 4 and the proposed ICs include IC layers 1-4A described in Section 5.4. Monitoring includes ICs monitoring.

ALTERNATIVE 3 – CAPPING (ARSENIC, VOCs) + ICs + MONITORING

This alternative includes asphalt capping of arsenic- and VOC-impacted soils covering 8,000 SF as shown on Figure 6.3-2, located in Appendix D. As described in Section 5.4, the identified area of impact is currently covered with an asphalt cap and the condition of the existing asphalt cap will be evaluated during remedial design if this alternative is selected for implementation. This alternative will include any additional components required to enhance the existing asphalt cap. In addition to the ICs listed for Alternative 2 (1-4A), this alternative would include IC layer 4B, a restrictive covenant to monitor and maintain the cap. Monitoring includes ICs monitoring and periodic inspection and maintenance of the asphalt cap.

ALTERNATIVE 4 – EXCAVATION (ARSENIC) + SVE/BV (VOCs) + ICs + MONITORING

This alternative includes excavation of the impacted shallow soil, assumed to be in the two 50 feet by 50 feet square areas, down to a depth of 5 feet bgs (Figure 6.3-3, located in Appendix D). The estimated in-place soil volume is approximately 925 CY. If active remedial alternatives are selected for implementation, additional sampling would need to be conducted to define the actual area of impacted soil prior to proceeding with remedial design and implementation.

This alternative will include SVE/BV for VOC-impacted soils with 6 SVE wells at a spacing of 30 feet that are screened between 5 and 15 feet bgs. The extracted vapors would be treated in a Vapor Extraction and Treatment System (VETS) that would include a high-vacuum positive-displacement blower with a rated maximum flow of 100 scfm. The ultimate extracted vapor treatment system will be evaluated and selected during remedial design; however, for cost evaluation purposes, the treatment system would include a catalytic oxidizer at the start, and transition to a vapor-phase carbon adsorption system after influent concentrations decrease. Section 5.4 discusses vapor treatment technologies in more detail and the approach to shallow excavations (≤5 feet bgs) adjacent to the building. Since this alternative involves removal of the contamination, IC layers 1 and 2 are proposed, as described in Section 5.4.

ALTERNATIVE 5 – EXCAVATION (ARSENIC, VOCs) + ICs + MONITORING

This alternative includes excavation of the arsenic- and VOC-impacted shallow soil, assumed to be in the two 50 feet by 50 feet square areas, down to a depth of 5 feet bgs and one 100 feet by 30 feet area down to 15 feet bgs (Figure 6.3-4, located in Appendix D). The estimated in-place soil volume is approximately 2,600 CY. If active remedial alternatives are selected for implementation, additional sampling would need to be conducted to define the actual area of impacted soil prior to proceeding with remedial design and implementation. Section 5.4 discusses more details of shallow soil excavations including sloping of sidewalls and the use of the slot-trenching approach when a shallow excavation (≤5 feet bgs) abuts a building. Since this alternative involves removal of the contamination, IC layers 1 and 2 are proposed, as described in Section 5.4.

6.4 GROUP 4B REPRESENTATIVE AREA - EAPC 16

Group 4B includes exposure areas that have a CR less than or equal to 5E-05 and a HI_{com} less than or equal to 1 but where the RR is greater than 5E-05 or the HI_{res} is greater than 1. Group 4B only includes exposure areas where the primary RDC is a VOC in shallow soil.

6.4.1 Background Information

EAPC 16 includes three parcels (7351-034-015, -050, -056) and covers approximately 11 acres. It is located on the southwest corner of Pacific Gateway and Knox Streets (Figure 1-2) which was formerly the northwestern portion of the styrene plancor. The property is currently developed with a printing facility and office. The entrance to the property is on Knox Street with paved parking in the north and a truck loading and unloading area in the south.

Plancor facilities are not known to have been present at parcel 7351-034-015, in the northwestern portion of EAPC 16. However, historical aerial photographs taken during the operational period of the former rubber plant show a series of what appear to be excavations in the parcel area that are referred to as the “Pits and Trenches” area in the Soil and NAPL RI Report (URS 2007b). There is no record of these excavations in available documentation or maps pertaining to the former plant site, and nothing is known regarding their use or purpose. The parcel area is also located within an area of staining that is apparent on some historical aerial photographs. There is no documentation to indicate the nature of the staining material, but carbon black (soot) storage facilities were located within a portion of the stained area that is not part of this parcel and may be related to their origin.

Plancor facilities known to have been present in parcel 7351-034-050 (northeastern portion of property) are limited to a flare stack and associated aboveground pipeline, and underground pipelines associated with the former plant site wastewater system. There is no specific documentation regarding use of the aboveground pipeline, but the presence of the flare stack suggests volatile compounds may have been transported in the gas phase. The area is also within the stained area described above.

Parcel 7351-034-056 is the largest of the three parcels that make up EAPC 16. Located in the southern portion of the property, this area was historically associated with the former plant site steam plant and water treatment plant. The southwestern corner of parcel 7351-034-056 was part of a tank farm that continued further to the south, beyond the parcel boundary.

Additional background information on these parcels is provided in the parcel-by-parcel summaries in Appendix A.

6.4.2 Nature and Extent of Shallow Soil Contamination

Summary of Investigation Results

RI data are available for 68 soil gas sampling locations and 24 soil borings at EAPC 16. The soil and soil gas sampling locations sampled for various analytes are shown on Figures 2-4 through 2-14. In shallow soil gas, there were detections of benzene in 17 samples, ethylbenzene in 32 samples, styrene in 20 samples, PCE in 25 samples and TCE in 16 samples out of a total of 71 soil gas samples. The maximum soil gas concentrations observed for specific chemicals were: TCE at 540 ppmv and PCE at 210 ppmv detected in SGL0357 (URS 2007b; Figure 42) in the northwestern portion of the EAPC; benzene at 120 ppmv, ethylbenzene at 18,000 ppmv, and styrene at 1,900 ppmv, all detected in SGL0005 in the southwestern portion of EAPC (URS 2007b; Figure 43). In soil matrix samples, PCE was detected in 22 samples and TCE in 24 samples out of 34 samples analyzed for VOCs, with maximum PCE and TCE concentrations of 0.66 and 0.29 mg/kg respectively, detected in SBL0302 (URS 2007b). Three of the samples yielded concentrations that exceeded the industrial PRG for TCE and one of the samples exceeded the industrial PRG for PCE. The maximum soil matrix concentration for ethylbenzene was 12,000 mg/kg at SBL0069, and for styrene, 15,000 mg/kg at SBL0036 (URS 2007b; Figure 33). There were 6 detections of 4,4´-DDT and 1 detection of NDPA out of a total of 15 soil samples analyzed for VOCs, PAHs, PCBs or pesticides, with maximum observed concentrations of 7.4 mg/kg (SBL0301) for 4,4´-DDT (URS 2007b; Figure 35) and 280 mg/kg (SBL0036) for NDPA (URS 2007b; Figure 34). Figures showing sampling locations with exceedances of the RI screening criteria were presented in the Soil and NAPL RI Report (URS 2007b).

Summary of Risk and Risk-driving Chemicals

The following table presents a summary of the recalculated risk values for RDCs for the commercial worker and the outdoor soil and indoor air pathways at EAPC 16:

EAPC 16 COMMERCIAL WORKER RISK SUMMARY

Group	Medium/Pathway	Commercial Worker (Recalculated Risk[a])		Risk-driving Chemicals	Chemical-specific Risk
		Cancer risk	Hazard Index		
4B	Outdoor soil	3E-06	<1	4,4´-DDT NDPA	1.1E-06 1.5E-06
	Indoor air	9E-06	<1	PCE TCE	5.5E-06 3.4E-06

[a] Risk estimates in the BRA were influenced by elevated DLs. Risks for this EAPC were recalculated by the RAGS method as described in USEPA's Risk Assessment Guidance, Part D, Chapter 5, 2001 (RAGS 2001)

Based on the BRA, the indoor air (Tier 1+2) CR was 4E-04 (Table 3-3). After accounting for the influence of elevated DLs, the revised indoor air CR was 9E-06 with PCE and TCE as the RDCs. Similarly, the outdoor soil CR was 1E-04, but after recalculation was 3E-06 with chemical-specific risks for DDT and NDPA at 1.1E-06 and 1.5E-06 respectively. Based on this, PCE and TCE via the indoor air pathway were designated the primary RDCs while DDT and NDPA were considered as secondary RDCs. As discussed in Section 3, this parcel was placed in a lower risk group (Group 4B) after recalculation of the risks. No samples exceeded the 5E-05 CR threshold level.

Extent of Impacted Soil

The primary COCs for the surface pathway evaluation at this parcel are PCE and TCE. Based on a target CR of 1E-06, the risk-based threshold level exceedances for PCE and TCE occur in the northwestern portion of the property, encompassing soil gas sampling locations SGL0357, SGL0353, SGL0356, SGL0359, SGL0360, SGL0361 and soil borings SBL0036, SBL0302 and SBL0301. This area also includes the area of elevated NDPA and DDT concentrations in soil. Figure 6.4-1, located in Appendix D, shows the assumed irregular areas of impacted soil under the northwest portion of the building and outside of the building footprint. Since no sampling was conducted for soils under the building, assumptions regarding the extent of the VOC contamination were based on former facilities located in the vicinity. The depth of the impacted soil was assumed to be 0-15 feet bgs. Based on these assumptions, the total in-place volume of impacted outdoor soil is approximately 13,100 CY. If active remedial alternatives are selected for implementation, additional sampling will need to be conducted to define the actual area of impacted soil prior to proceeding with remedial design and implementation.

Since the recalculated benzene CR for the indoor air and outdoor soil pathways at this EAPC was less than the 1E-06 threshold, individual sampling locations exceeding the benzene risk-based threshold level in the southwestern portion of the property were not included as part of the impacted area for the FS evaluation.

6.4.3 Identification of Remedial Alternatives

Since EAPC 16 has a combination of VOC and non-VOC contaminants, the list of remedial alternatives for this EAPC was developed based on the nine remedial alternatives presented in Section 6.1. Alternative 3 is retained as a pure containment alternative. Of the six alternatives from Alternatives 4 through 9, three alternatives are selected. Alternative 4 is similar to Alternative 9 but would be rated lower because Capping is inherently lower in effectiveness compared to Excavation. Alternative 8 with the HVAC mod/SSV component was screened out because it is similar to Alternative 9 and would be rated lower in effectiveness. This is because SVE is rated better at contaminant mass removal than SSV, which is primarily a containment measure to control potential indoor air exposure. In addition, Alternatives 6 and 9 incorporate the option of HVAC mod/SSV under the building after SVE has achieved performance goals, if vapor intrusion from deeper soils remains a concern. Alternative 7 was screened out because there is one retained alternative (Alternative 9) that addresses excavation of the non-VOCs (DDT and NDPA) and another retained alternative (Alternative 6) that addresses capping. With the CR contribution of DDT and NDPA being relatively small at 1.1E-06 and 1.5E-06 respectively, additional excavation alternatives such as Alternative 7 were not deemed necessary.

For this EAPC, Alternative 3 will assume SSV for soil under the building in the FS evaluation because SSV is more commonly used for warehouse-type buildings where building pressurization by HVAC modification (building pressurization) is often less effective and implementable. Also, since the primary COCs in shallow soils are chlorinated solvents (PCE and TCE), BV is not retained as these chemicals are not readily (aerobically) biodegradable in the shallow vadose zone. The alternatives with SVE under the building use horizontal wells that can potentially be used for sub-slab venting if needed after SVE remediation is completed. Hence, the revised list of remedial alternatives for EAPC 16 is renumbered as follows:

(1) No Action
(2) ICs + Monitoring
(3) Capping (VOCs, non-VOCs) + HVAC mod/SSV (UB) + ICs + Monitoring

(4) SVE (OS) + Capping (non-VOCs) + HVAC mod/SSV (UB) + ICs + Monitoring
(5) SVE (OS) + Capping (non-VOCs) + SVE (UB) + ICs + Monitoring
(6) Excavation (VOCs, non-VOCs) + SVE (UB) + ICs + Monitoring

6.4.4 Description of Remedial Alternatives

The following is a brief description of the proposed remedial alternatives. If active remedial alternatives are selected for implementation, additional sampling would need to be conducted to define the actual area of impacted soil prior to proceeding with remedial design and implementation.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – ICs + MONITORING

EAPC 16 is in Group 4 and IC layers 1-4A and 5 are proposed as described in Section 5.4. Monitoring includes ICs monitoring, primarily for private land activity, as described in Sections 5.4.5 and Table 5-1.

ALTERNATIVE 3 – CAPPING (VOCs, NON-VOCs) + HVAC MOD/SSV (UB) + ICs + MONITORING

This option includes only containment strategies, with capping to provide protection from direct contact and HVAC mod/SSV to protect from indoor air vapor intrusion. Figure 6.4-2, located in Appendix D, shows the assumed extent of impacted outdoor soil that would need capping, approximately 23,600 SF. However, this area is already capped as an asphalt-paved parking area. As stated in Section 5.4, the integrity of the existing asphalt cap will be assessed during remedial design if this alternative is selected for implementation. This alternative will include any upgrades required (e.g., seal coating) to make this cap adequate. For the vapor intrusion engineering control, this alternative assumes active SSV for the FS evaluation. However, if such an engineering control is selected as part of the remedy, specific comparison of HVAC mod for building pressurization vs. active SSV will be made during remedial design. The active SSV assumes retrofitting the building with perforated piping laid in 6 shallow trenches totaling approximately 600 linear feet (LF) placed below the foundation over the impacted area at approximately 20-foot spacing, as shown on Figure 6.4-2, located in Appendix D. If HVAC mod/SSV is selected as part of a remedy to be implemented here then additional sampling, testing and engineering evaluation of the existing building would need to be performed as discussed in Section 5.4.2. A vapor collection system (VCS) consisting of a fan or regenerative blower rated for low vacuum and flow rates, and carbon adsorption treatment of extracted vapors, is assumed to be connected to the perforated piping for venting. More discussion on SSV implementation is presented in Section 5.4. Other options such as horizontal wells will be considered during remedial design if this alternative is selected. ICs are the same as for Alternative 2 except that they would include a land use covenant with the property owner to monitor and maintain the cap and the SSV system, if included (IC layers 1-5). Monitoring includes ICs monitoring and periodic monitoring and maintenance of the cap and the SSV system.

ALTERNATIVE 4 – SVE (OS) + CAPPING (NON-VOCs) + HVAC MOD/SSV (UB) + ICs + MONITORING

This alternative includes SVE for VOC-impacted outdoor soil, capping of non-VOC-impacted outdoor soil, and HVAC mod/SSV for VOC-impacted shallow soil under the building, as shown on Figure 6.4-3, located in Appendix D. The non-VOC area targeted for capping is approximately 6,400 SF and is completely contained within the VOC area as shown on Figure 6.4-3, located in Appendix D. As with Alternative 3, capping would include any upgrades of the existing asphalt layer, if needed. The SVE includes a layout of 23 shallow vertical wells at 30-foot spacing across the extent of the impacted area, as shown on Figure 6.4-3, located in Appendix D. SVE wells would be screened between 5 and 15 feet bgs. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 250 scfm. The ultimate extracted vapor treatment system will be evaluated and selected during remedial design; however, for cost evaluation purposes the treatment system included a chlorinated catalytic oxidizer as discussed in Section 5.4. The active SSV assumes perforated piping laid in 6 shallow trenches totaling 1,200 LF at approximately 20-foot spacing, as shown on Figure 6.4-3 located in Appendix D. If HVAC mod/SSV is selected as part of a remedy to be implemented here then additional sampling, testing and engineering evaluation of the existing building would need to be performed as discussed in Section 5.4.2. A VCS consisting of a fan or regenerative blower rated for low vacuum and flow rates, and carbon adsorption treatment of extracted vapors, is assumed to be connected to the perforated piping for venting. More discussion on SSV implementation is presented in Section 5.4. ICs and monitoring are the same as for Alternative 3 (IC layers 1-5). Monitoring includes ICs monitoring and periodic monitoring and maintenance of the cap and the SSV system.

ALTERNATIVE 5 – SVE (OS) + CAPPING (NON-VOCs) + SVE (UB) + ICs + MONITORING

This alternative assumes SVE for VOC-impacted outdoor soils, capping for non-VOC-impacted outdoor soil, and SVE for VOC-impacted shallow soils under the building as shown on Figure 6.4-4, located in Appendix D. The outdoor soil SVE layout is the same as described for Alternative 4 and includes a total of 23 vertical SVE wells at 30-foot spacing, single-screened between 5 and 15 feet bgs. For soil under the buildings, 5 horizontal SVE wells are proposed at shallow depths ranging between 5 and 10 feet bgs drilled below the foundation of the existing buildings. The SVE wells are spaced approximately 30 feet apart and would need to be drilled by the blind drilling (single completion)[18] method due to space limitations. All SVE wells (OS + UB) would be connected to an aboveground VETS that includes a high-vacuum positive-displacement blower sized for a total maximum flow of 750 scfm. The ultimate extracted vapor treatment system will be evaluated and selected during remedial design; however, for cost evaluation purposes, the treatment system included a chlorinated catalytic oxidizer as discussed in Section 5.4. After the SVE system achieves performance goals, if vapor intrusion from deeper soils is still a concern then HVAC mod/SSV can be considered as an option. An SSV system would utilize the horizontal SVE wells under the building. If SVE (UB) is selected as part of the remedy for this area, additional soil sampling under the building would need to be conducted as described in Section 5.4.3. ICs and monitoring are the same as for Alternative 3 (IC layers 1-5). Monitoring includes ICs monitoring and periodic monitoring and maintenance of the asphalt cap and SSV system (if needed).

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[18] A description of blind drilling (single completion) of horizontal wells is presented in Section 5.4.

ALTERNATIVE 6 – EXCAVATION (VOCs, NON-VOCs) + SVE (UB) + ICs + MONITORING

This alternative includes excavation for VOC and non-VOC-impacted outdoor soil, and SVE for contaminant mass removal from VOC-impacted soil under the building as shown on Figure 6.4-5, located in Appendix D. The total volume soil proposed for excavation in this alternative is 13,100 CY. Shoring is assumed to be required as shown on Figure 6.4-5, located in Appendix D. This alternative assumes that the excavated soil is treated and disposed/recycled offsite. This alternative assumes use of 5 horizontal SVE wells at shallow depths ranging between 5 and 10 feet bgs drilled below the foundation of the existing buildings just as for Alternative 5. The wells would be connected to an aboveground VETS that includes a high-vacuum positive-displacement blower sized for a total maximum flow of 500 scfm. The ultimate extracted vapor treatment system will be evaluated and selected during remedial design; however, for cost evaluation purposes, the treatment system included a thermal/catalytic oxidizer as discussed in Section 5.4. As with Alternative 5, the HVAC mod/SSV option is available after SVE achieves performance goals, if vapor intrusion from deeper soils is still a concern. If SVE (UB) is selected as part of the remedy for this area, additional soil sampling under the building would need to be conducted as described in Section 5.4.3. Though this alternative involves remediation of contamination, IC layers 1-4A and 5 are proposed because there is expected to be residual contamination left under the building following treatment. Monitoring includes ICs monitoring and may also involve periodic monitoring and maintenance of an SSV system, as needed.

6.5 GROUP 4B REPRESENTATIVE AREA - EAPC 23

Group 4B includes exposure areas that have a CR less than or equal to 5E-05 and HI_{com} less than or equal to 1 but RR greater than 5E-05 or HI_{res} greater than 1. Group 4B only includes exposure areas where the primary RDC is a VOC in shallow soil.

6.5.1 Background Information

EAPC 23 (parcel 7351-034-057) is located on the west side of Pacific Gateway between Knox and Francisco Street (Figure 1-2). The 7.1-acre parcel has been developed as a product distribution warehouse for The Coca Cola Company. The development includes a single-story building that is approximately 66,000 SF and comprises a warehouse, office space and a vehicle maintenance facility. The development includes heavy vehicle parking and staging to the north, west and south; and light vehicle parking to the east. Heavy vehicles enter the property from Pacific Gateway, past a guard shack.

Parcel 7351-034-057 is located along the western boundary of the former styrene plancor where styrene was manufactured as a component of synthetic rubber. During plant operations the parcel area was primarily used as a tank farm for the storage of VOC feedstock solutions.

Additional background information on this parcel is provided in the parcel-by-parcel summaries in Appendix A.

6.5.2 Nature and Extent of Shallow Soil Contamination

Summary of Investigation Results

The remedial investigation for EAPC 23 included 109 shallow soil gas locations, 10 deep soil gas locations, 6 shallow soil samples, and 12 deep soil matrix samples. The soil and soil gas sampling locations sampled for various analytes are shown on Figures 2-4 through 2-14. In shallow soil gas, there were a total of 40 detections for benzene out of 124 samples. Figure 6.5-1, located in Appendix D, shows 20 soil gas sampling locations with the highest VOC concentrations detected at EAPC 23. A total of 11 soil gas samples from these locations exceeded the 30 ppmv screening concentration for benzene in shallow soil gas. The maximum benzene concentration in soil gas was 2,100 ppmv at SGL0036. PCE was detected along the west side of the building at seven sampling locations (SGL0040, SGL0043, SGL0045, SGL0047, SGL0077, SGL0083 and SGL0084) at concentrations in the range of 9 to 25 ppmv, below the screening level. The maximum detected shallow soil matrix concentration for benzene was 300 mg/kg at SGL0050 at 5 feet bgs. The highest concentration of ethylbenzene detected was 12,000 mg/kg, at SBL0068 at 7 feet bgs in the northwest area of the parcel. Benzene concentrations in deep soil gas were in the range of 2,060 to 30,800 ppmv. The benzene concentrations detected in deep soil matrix samples were in the range of 0.65 to 6.9 mg/kg, in 8 of 21 samples. Figures showing these exceedances were presented in the Soil and NAPL RI Report (URS 2007b).

Summary of Risk and Risk-driving Chemicals

The recalculated risk values associated with the identified RDCs for the commercial worker and the outdoor soil and indoor air pathways at EAPC 23 are summarized in the table below.

EAPC 23 COMMERCIAL WORKER RISK SUMMARY

Group	Medium/Pathway	Commercial Worker Recalculated Risk[a]		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
4B	Outdoor soil	1E-05	<1	Benzene	1.3E-05
	Indoor air	2E-05	<1	Benzene PCE	1.5E-05 1.2E-06

[a] Risk estimates in the BRA were influenced by elevated DLs. Risks for this EAPC were recalculated by the RAGS method as described in USEPA's Risk Assessment Guidance, Part D, Chapter 5, 2001 (RAGS 2001)

Based on the results reported in the BRA, the indoor air (Tiers 1+2) CR was 1E-04 (Table 3-1). After accounting for the contaminants with elevated DLs, the indoor air CR was revised to 2E-05 with benzene as the primary risk driver. Benzene was detected at a concentration that exceeded the 5E-05 risk-based threshold level for commercial workers in only one soil sample collected at this EAPC. EAPC 23 was moved down to Group 4B as discussed in Section 3. PCE also contributed to indoor air risk but at a significantly lower level of 1.2E-06. Based on the BRA the outdoor soil risk estimate was 2E-05, which after accounting for elevated DLs, was revised to 1E-05 with benzene again as the primary risk driver.

Extent of Impacted Soil

The primary COC at EAPC 23 is benzene. Based on a target CR of 1E-06, the risk-based threshold level exceedances for benzene occur in the northwestern portion of the parcel in the MW-20 area and on the east side of the warehouse building. Rectangular areas encompassing these benzene exceedances are shown on Figure 6.5-1, located in Appendix D, and represent the assumed horizontal extent of contamination. Areas where shallow soil gas PCE concentrations exceed risk-based threshold levels are similarly shown on the figure. The total impacted area of outdoor soil is approximately 39,300 SF and the in-place volume of impacted shallow outdoor soil is approximately 21,900 CY assuming impacts down to 15 feet bgs. Since no sampling was completed under the existing building, it is conservatively assumed that the area of impacted soil with a potential for vapor intrusion covers the entire building footprint. The area of impacted soil under the building is approximately 62,250 SF with a shallow soil volume of 34,600 CY.

6.5.3 Identification of Remedial Alternatives

Since the COCs for this site are both VOCs, the list of remedial alternatives will be derived by modifying the eight alternatives presented in Section 6.1 for such EAPCs. A brief screening evaluation was conducted to select the five or six most viable alternatives out of the eight alternatives for VOC-impacted soils. Alternative 3 was retained as a containment alternative. Between Alternatives 4 and 5 in Section 6.1, Alternative 5 would be rated better with respect to implementability and effectiveness than Alternative 4. Among Alternatives 6, 7 and 8, Alternatives 6 and 8 were retained while Alternative 7 was screened out because Alternatives 6 and 8 are more aggressive remedial alternatives addressing VOC contamination in outdoor soil and under the building.

For this EAPC, the FS evaluation of Alternative 3 will assume SSV for soil under the building, because SSV is more commonly used for warehouse-type buildings where building pressurization by HVAC modification (building pressurization) is often less effective and less implementable. The implementability of SVE/BV under the building may pose some challenges because the exact areas of impacted soil are unknown, and due to potential problems with horizontal well installation. The alternatives with SVE/BV under the building use horizontal wells that can potentially be used for sub-slab venting if needed after SVE/BV remediation is completed. Hence the revised list of remedial alternatives for the detailed FS evaluation is renumbered as follows:

1. No Action
2. ICs + Monitoring
3. Capping (VOCs) + HVAC mod/SSV (UB) + ICs + Monitoring
4. SVE/BV (OS) + HVAC mod/SSV (UB) + ICs + Monitoring
5. SVE/BV (OS) + SVE/BV (UB) + ICs + Monitoring
6. Excavation (VOCs) + SVE/BV (UB) + ICs + Monitoring

6.5.4 Description of Remedial Alternatives

The following is a description of the proposed remedial alternatives to address the two VOC COCs (benzene and PCE) discussed earlier. If active remedial alternatives are selected for implementation, additional sampling would be conducted to define the actual area of impacted soil prior to proceeding with remedial design and implementation.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – ICs + MONITORING

IC layers 1-4A and 5 are proposed for this EAPC, as described in Section 5.4. Monitoring includes ICs monitoring as described in Section 5.4.5 and Table 5-1.

ALTERNATIVE 3 – CAPPING (VOCs) + HVAC MOD/SSV (UB) + ICs + MONITORING

This option includes only containment strategies, with capping to provide protection from direct contact and HVAC mod/SSV to protect from indoor air vapor intrusion. Figure 6.5-2, located in Appendix D, shows the extent of impacted outdoor soil that would need capping, approximately 39,300 SF. However, this area is already capped as an asphalt pavement. As stated in Section 5.4, the integrity of this asphalt cap will be assessed during remedial design if this alternative is selected for implementation. This alternative will include any upgrades required (e.g., seal coating) to make this cap adequate. For this EAPC, this alternative assumes SSV instead of HVAC mod for the FS evaluation. The active SSV assumes installing perforated piping in 20 shallow trenches totaling approximately 3,600 LF below the foundation at approximately 20-foot spacing, as shown on Figure 6.5-2, located in Appendix D. If HVAC mod/SSV is selected as part of a remedy to be implemented here then additional sampling, testing and engineering evaluation of the existing building would need to be performed as discussed in Section 5.4.2. A VCS consisting of a fan or regenerative blower rated for low vacuum and flow rates, and carbon adsorption treatment of extracted vapors, is assumed to be connected to the perforated piping for venting. More details on the conceptual design and operation of the SSV system are presented in Section 5.4. ICs are the same as for Alternative 2 except that they would include restrictive covenants for monitoring and maintenance of the cap and the SSV system (IC layers 1-5). Monitoring would include ICs monitoring and periodic monitoring and maintenance of the cap and the SSV system.

ALTERNATIVE 4 – SVE/BV (OS) + HVAC MOD/SSV (UB) + ICs + MONITORING

This alternative applies SVE/BV to the benzene and chlorinated VOC-impacted outdoor soils and HVAC mod/SSV for benzene impacted shallow soil under the building, as shown on Figure 6.5-3, located in Appendix D. A total of 41 shallow vertical wells at 30-foot spacing across the extent of the five impacted soil areas, screened between 5 and 15 feet bgs, are assumed for the SVE conceptual design as shown on Figure 6.5-3, located in Appendix D. The SVE wells would be connected to two aboveground VETS, one for benzene (34 wells) and the other for chlorinated VOCs (7 wells) to keep the two vapor streams separate. The two VETS would include high-vacuum positive-displacement blowers sized for 300 scfm for benzene and 100 scfm for chlorinated VOCs. The ultimate extracted vapor treatment system will be evaluated and selected during remedial design; however, for cost evaluation purposes, the treatment system included thermal/catalytic oxidizers for the benzene stream and carbon adsorption for the chlorinated VOC stream. The active SSV assumes retrofitting the building with perforated piping laid in

20 trenches totaling approximately 3,600 LF at approximately 20-foot spacing, as shown on Figure 6.5-3, located in Appendix D. If HVAC mod/SSV is selected as part of a remedy to be implemented here then additional sampling, testing and engineering evaluation of the existing building would need to be performed as discussed in Section 5.4.2. A VCS consisting of a fan or regenerative blower rated for low vacuum and flow rates, and carbon adsorption treatment of extracted vapors, is assumed to be connected to the perforated piping for venting. More information on the VETS and SSV is provided in Section 5.4. ICs and monitoring are the same as for Alternative 3 (IC layers 1-5). Monitoring includes ICs monitoring and periodic monitoring and maintenance of the SSV systems.

ALTERNATIVE 5 – SVE/BV (OS) + SVE/BV (UB) + ICs + MONITORING

This alternative applies SVE/BV to the VOC-impacted outdoor soil and to VOC-impacted shallow soil under the building as shown on Figure 6.5-4, located in Appendix D. The outdoor soil SVE layout is the same as described for Alternative 4 and includes a total of 41 vertical SVE wells at 30-foot spacing, single-screened interval between 5 and 15 feet bgs. For soil under the building, 14 horizontal SVE wells are proposed at shallow depths ranging between 5 and 10 feet bgs drilled below the foundation of the existing building. The SVE wells are to be spaced approximately 30 feet apart and may need to be drilled by the blind drilling (single completion) method due to space limitations. All benzene SVE wells (OS+UB) would be connected to an aboveground VETS that includes a high-vacuum positive-displacement blower (or multiple blowers) sized for a total maximum flow of 2,000 scfm. The ultimate extracted vapor treatment system will be evaluated and selected during remedial design; however, for cost evaluation purposes, the treatment system included a thermal/catalytic oxidizer. A separate 100 scfm VETS is assumed for the chlorinated VOC wells assumed to be treated with carbon adsorption. More information on the VETS is provided in Section 5.4. After the SVE/BV system has been shut down, the SSV option is available for soils under the building using the SVE horizontal wells. If SVE (UB) is selected as part of the remedy for this area, additional soil sampling under the building would need to be conducted as described in Section 5.4.3. Though this alternative involves remediation of contamination, IC layers 1-4A and 5 are proposed because there is expected to be residual contamination left under the building following treatment. Monitoring includes ICs monitoring and may also involve periodic monitoring and maintenance of an SSV system (if needed).

ALTERNATIVE 6 – EXCAVATION (VOCs) + SVE/BV (UB) + ICs + MONITORING

This alternative includes excavation for VOC-impacted outdoor soil and SVE/BV for mass removal of VOC-impacted soil under the building as shown on Figure 6.5-5, located in Appendix D. The extent of excavation includes the five impacted outdoor soil areas, approximately 39,300 SF to a depth of approximately 15 feet bgs, for a total soil volume of 21,900 CY. Shoring is assumed to be required as shown on Figure 6.5-5, located in Appendix D. This alternative assumes that the excavated soil is sent offsite for treatment and disposal/recycling. This alternative assumes use of 14 horizontal SVE wells at shallow depths ranging between 5 and 10 feet bgs drilled below the foundation of the existing buildings just as for Alternative 5. The wells would be connected to an aboveground VETS that includes a high-vacuum positive-displacement blower sized for a total maximum flow of 1,500 scfm. The ultimate extracted vapor treatment system will be evaluated and selected during remedial design; however, for cost evaluation purposes, the treatment system included a thermal/catalytic oxidizer. More information on the

VETS is provided in Section 5.4. As with Alternative 5, the HVAC mod/SSV option is available after SVE shutdown. If SVE (UB) is selected as part of the remedy for this area, additional soil sampling under the building would need to be conducted as described in Section 5.4.3. Though this alternative involves remediation of contamination, IC layers 1-4A and 5 are proposed because there is expected to be residual contamination left under the building following treatment. Monitoring includes ICs monitoring and may also involve periodic monitoring and maintenance of an SSV system (if included).

6.6 GROUP 4B REPRESENTATIVE AREA - EAPC 5

Group 4B includes exposure areas that have a CR less than or equal to 5E-05 and HI_{com} less than or equal to 1 and where RR is greater than 5E-05 or HI_{res} is greater than 1. Group 4B only includes exposure areas where the primary RDC is a VOC in shallow soil.

6.6.1 Background Information

EAPC 5 (parcel 7351-033-017) is located in the southeastern portion of the former butadiene plancor on the west side of Hamilton Avenue and north of Del Amo Boulevard (Figure 1-2). Butadiene was manufactured as a component of synthetic rubber. The area was used for purification and distillation of various butylene gases, and included multiple buildings, storage tanks containing C5, crude isoprene, slop oil, acetone and acid. The 10.4-acre area of EAPC 5 has been developed with a multi-story office building and a surrounding paved vehicle parking area. Additional background information on this parcel is provided in the parcel-by-parcel summaries in Appendix A.

6.6.2 Nature and Extent of Shallow Soil Contamination

Summary of Investigation Results

Remedial investigation data for EAPC 5 are available for 112 soil gas locations, 32 soil borings with 32 shallow soil samples and 1 deep soil sample. The soil and soil gas sampling locations sampled for various analytes are shown on Figures 2-4 through 2-14. In shallow soil gas, there were a total of 61 detections for benzene out of 112 samples. Figure 6.6-1, located in Appendix D, shows the 28 soil gas sampling locations where the RI screening concentration for benzene of 30 ppmv was exceeded. The maximum benzene concentration was 380 ppmv at SGL0442. The maximum benzene concentration in shallow soil was 5.9 mg/kg at SBL0123, with all other (31) samples being below the residential PRG (0.6 mg/kg). SBL0123 also showed the maximum concentrations of 1,2,4-TMB and cyclohexane at 4.4 mg/kg and 110 mg/kg respectively. Figures showing sampling locations and screening criteria exceedances were presented in the Soil and NAPL RI Report (URS 2007b).

Summary of Risk and Risk-driving Chemicals

Since the risk estimates presented in the BRA for EAPC 5 were influenced by elevated DLs, they were recalculated as discussed in Section 3.1. The recalculated risk values for the commercial worker and outdoor soil and indoor air pathways are summarized below.

EAPC 5 COMMERCIAL WORKER AND HYPOTHETICAL RESIDENT RISK SUMMARY

Group	Medium/Pathway	Commercial Worker Recalculated Risk[a]		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
4B	Outdoor soil	<1E-06	<1	--	--
	Indoor air	<1E-06	<1	Benzene[b]	(9E-07)
		Hypothetical Resident Recalculated Risk[a]			
	Indoor air	4E-05	9	Benzene 1,2,4-TMB, Cyclohexane[c]	4E-05 --

[a] Risk estimates in the BRA were influenced by elevated DLs. Risks for this EAPC were recalculated by the RAGS method as described in USEPA's Risk Assessment Guidance, Part D, Chapter 5, 2001 (RAGS 2001)

[b] Because NAPL accumulation is present at EAPC 5 and benzene is the largest contributor to risk, benzene is identified as a contaminant of concern.

[c] 1,2,4-TMB and cyclohexane are the largest contributors to noncancer hazard index for the hypothetical resident and hence are listed as contaminants of concern. They do not contribute to cancer risk.

The BRA indoor air (Tier 1+2) CR was 2E-06. After accounting for elevated DLs, the indoor air CR was revised to less than 1E-06 and the RR was less than 5E-05, with benzene as the primary risk contributor. However, the HI_{res} was greater than 1 (HI=9, Table 3-4). Based on this, EAPC 5 remained in Group 4, as discussed in Section 3. Because the largest contributor to indoor air risk is benzene, and SA12 with NAPL accumulation is present at this EAPC, benzene is identified as a COC for remedial evaluation. Similarly, because the largest contributors to the HI_{res} are 1,2,4-TMB and cyclohexane, these chemicals are included as COCs. The CR for the outdoor soil pathway was significantly less than 1E-06 and there were no VOC contaminant concentrations that exceeded the 5E-05 risk-based threshold level.

Extent of Impacted Soil

Based on a target CR of 1E-06, the risk-based threshold level exceedances for benzene occur in the northern portions of the parcel on the east and west sides of the existing building. The horizontal extent of outdoor soil contamination was approximated by two areas encompassing these benzene exceedances, as shown on Figure 6.6-1, located in Appendix D. These two areas also include the maximum concentrations observed for the other COCs, 1,2,4-TMB and cyclohexane. Hence, these areas are assumed to cover the exceedances of all the COCs. The total impacted area of outdoor soil is approximately 44,100 SF and the in-place volume of impacted shallow outdoor soil is approximately 24,500 CY, assuming impacts down to 15 feet bgs. The area of impacted soil under the building with a potential for vapor intrusion has conservatively been assumed to underlie the entire northern half of the existing building based on the former presence of butadiene manufacturing facilities and the known presence of NAPL and high dissolved VOC concentrations in the vicinity. This assumed area of impacted soil under the building is approximately 42,800 SF with an associated shallow soil volume of 23,800 CY.

6.6.3 Identification of Remedial Alternatives

A screening evaluation was conducted to select the five or six most viable alternatives out of the eight alternatives presented in Section 6.1 for VOC-impacted soils. The results and the basis for the evaluation are the same as presented for EAPC 23 in Section 6.5. Alternative 3 was retained as a containment alternative. Between Alternatives 4 and 5 in Section 6.1, Alternative 5 would be rated better with respect to implementability and effectiveness than Alternative 4. Among Alternatives 6, 7 and 8, Alternatives 6 and 8 were retained while Alternative 7 was screened out because Alternatives 6 and 8 are more aggressive remedial alternatives addressing VOC contamination in outdoor soil and under the building.

For this EAPC, Alternatives 3 and 4 assume HVAC mod to address vapor intrusion from soil under the building in the FS evaluation because SSV would be more difficult to implement in the office building present here. The implementability of SVE/BV under the building may pose some challenges because the exact areas of impacted soil are unknown, and due to potential problems with horizontal well installation. The alternatives with SVE/BV under the building assume horizontal wells that can potentially be used for sub-slab venting if needed after SVE/BV remediation has met performance goals.

Hence the revised list of remedial alternatives for the detailed FS evaluation is renumbered as follows:

(1) No Action
(2) ICs + Monitoring
(3) Capping (VOCs) + HVAC mod/SSV (UB) + ICs + Monitoring
(4) SVE/BV (OS) + HVAC mod/SSV (UB) + ICs + Monitoring
(5) SVE/BV (OS) + SVE/BV (UB) + ICs + Monitoring
(6) Excavation (VOCs) + SVE/BV (UB) + ICs + Monitoring

6.6.4 Description of Remedial Alternatives

The following is a description of the proposed remedial alternatives. If active remedial alternatives are selected for implementation, additional sampling would need to be conducted to define the actual area of impacted soil prior to proceeding with remedial design and implementation.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 –ICs + MONITORING

IC layers 1-4A and 5 are proposed, as described in Section 5.4. Monitoring includes ICs monitoring as described in Section 5.4.5.

ALTERNATIVE 3 –CAPPING (VOCs) + HVAC MOD/SSV (UB) + ICs + MONITORING

This alternative includes asphalt capping of VOC-impacted outdoor soil and HVAC mod/SSV to protect from vapor intrusion from impacted soil under the building. Figure 6.6-2, located in Appendix D, shows the assumed extent of impacted outdoor soil that would need capping, approximately 44,100 SF.

However, this area is already capped as an asphalt-paved parking area. As described in Section 5.4, the integrity of the existing asphalt cap will be evaluated during the remedial design if this alternative is selected for implementation. This alternative will include any additional components required to create an adequate cap. HVAC mod is assumed over SSV for this parcel as described above. More details on HVAC mod/SSV are presented in Section 5.4. If HVAC mod/SSV is selected as part of a remedy to be implemented here then additional sampling, testing and engineering evaluation of the existing building would need to be performed to select the appropriate engineering control. ICs are the same as for Alternative 2 except that they would include a restrictive covenant to monitor and maintain the cap and SSV system (IC layers 1-5). Monitoring includes ICs monitoring and periodic inspection and maintenance of the asphalt cap and SSV system.

ALTERNATIVE 4 –SVE/BV (OS) + HVAC MOD/SSV (UB) + ICs + MONITORING

This alternative includes SVE/BV for VOC-impacted outdoor soil and HVAC mod/SSV for protection from VOC-impacted soils under the building as shown on Figure 6.6-3, located in Appendix D. A total of 62 shallow vertical wells at 30-foot spacing across the extent of the two impacted outdoor soil areas, single-screened interval between 5 and 15 feet bgs, are assumed for the SVE conceptual design as shown on Figure 6.7-3, located in Appendix D. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower (or multiple blowers) sized for a total maximum flow of 500 scfm. The ultimate extracted vapor treatment system will be evaluated and selected during remedial design; however, for cost evaluation purposes, the treatment system included a thermal/catalytic oxidizer. For the vapor intrusion engineering control, this alternative assumes HVAC mod over SSV as described in Alternative 3. If HVAC mod/SSV is selected as part of a remedy to be implemented here then additional sampling, testing and engineering evaluation of the existing building would need to be performed to select the best engineering control. ICs are the same as for Alternative 2 except that they would include additional restrictive covenants for monitoring and maintenance of the HVAC system (IC layers 1-5). Monitoring includes ICs monitoring and periodic monitoring and maintenance of the HVAC system.

ALTERNATIVE 5 –SVE/BV (OS) + SVE/BV (UB) + ICs + MONITORING

This alternative assumes SVE/BV for VOC-impacted outdoor soil and shallow soil under the building as shown on Figure 6.6-4, located in Appendix D. The outdoor soil SVE layout is the same as described for Alternative 4 and includes a total of 62 vertical SVE wells at 30-foot spacing, single-screened between 5 and 15 feet bgs. For soil under the buildings, 16 horizontal SVE wells are proposed at shallow depths ranging between 5 and 10 feet bgs drilled below the foundation of the existing buildings. The horizontal wells are also spaced at 30 feet and would be likely to need to be drilled by the blind-drilling (single completion) method due to space limitations or subsurface interferences. All SVE wells (OS + UB) would be connected to one of two aboveground VETS. Each VETS includes a high-vacuum positive-displacement blower (or multiple blowers) sized for a total maximum flow of 1,500 scfm. The ultimate extracted vapor treatment system will be evaluated and selected during remedial design; however, for cost evaluation purposes the treatment system included a thermal/catalytic oxidizer. After the SVE/BV system achieves its performance goals, if vapor intrusion from deeper soils is still a concern, the SSV option can be considered for soils under the building using the horizontal SVE wells, as described in Section 5.4. If

SVE (UB) is selected as part of the remedy for this area, additional soil sampling under the building would need to be conducted as described in Section 5.4.3. Though this alternative involves remediation of contamination, IC layers 1-4A and 5 are proposed because there is expected to be residual contamination left under the building following treatment. Monitoring includes ICs monitoring and may also involve periodic monitoring and maintenance of the SSV system (if included).

ALTERNATIVE 6 –EXCAVATION (VOCs) + SVE/BV (UB) + ICs + MONITORING

This alternative includes excavation for VOC-impacted outdoor soil, and SVE/BV for VOC-impacted soil under the building as shown on Figure 6.6-5, located in Appendix D. The extent of the excavation area is assumed to include the approximately 44,100 SF of impacted outdoor soil to a depth of approximately 15 feet bgs. The total volume of soil proposed for excavation in this alternative is 24,500 CY. Shoring is assumed to be required as shown on Figure 6.6-5, located in Appendix D. This alternative assumes that the excavated soil is sent offsite for treatment and disposal/recycling. This alternative assumes use of 16 horizontal SVE wells at depths ranging between 5 and 10 feet bgs drilled below the foundation of the existing buildings as in Alternative 5. The wells would be connected to an aboveground VETS that includes a high-vacuum positive-displacement blower (or multiple blowers) sized for a total maximum flow of 1,000 scfm. The ultimate extracted vapor treatment system will be evaluated and selected during remedial design; however, for cost evaluation purposes, the treatment system consisted of a thermal/catalytic oxidizer. More information on the VETS is provided in Section 5.4. As with Alternative 5, the SSV option is available after SVE/BV shutdown. If SVE (UB) is selected as part of the remedy for this area, additional soil sampling under the building would need to be conducted as described in Section 5.4.3. Though this alternative involves remediation of contamination, IC layers 1-4A and 5 are proposed because there is expected to be residual contamination left under the building following treatment. Monitoring includes ICs monitoring and may also involve periodic monitoring and maintenance of the SSV system (if included).

6.7 GROUP 3A REPRESENTATIVE AREA - EAPC 32

Group 3A includes exposure areas that have a CR less than or equal to 5E-05 and a HI_{com} less than or equal to 1 and where RR is between 1E-06 and 5E-05 and HI_{res} is less than or equal to 1. Group 3A only includes exposure areas where the primary RDC is a non-VOC in outdoor soil.

6.7.1 Background Information

EAPC 32 (parcel 7351-034-076) is located in the northern portion of the former styrene plancor on Magellan Drive (Figure 1-2). Styrene was manufactured as a component of synthetic rubber. The majority of the current parcel area was open space and roads during plancor operation. A small portion of the styrene finishing process area was formerly present within the current parcel boundary. The parcel has an area of 80,000 SF and is developed with a 35,000 SF building. Former plant site facilities on the parcel and their spatial relationship to the warehouse building are illustrated on Figure 6.7-1, located in Appendix D. Paved parking areas are present mostly to the north of the parcel building. Additional background information on this parcel is provided in the parcel-by-parcel summaries in Appendix A.

6.7.2 Nature and Extent of Shallow Soil Contamination

Summary of Investigation Results

Remedial investigation data for this parcel are available for 4 soil gas sampling locations and 6 shallow soil matrix sampling locations. The soil and soil gas sampling locations sampled for various analytes are shown on Figures 2-4 through 2-14. Of the 5 soil matrix samples analyzed for PAHs, only one sample (SBL0328) exceeded the industrial PRG for B(a)P at a concentration of 0.74 mg/kg. None of the shallow soil gas samples exceeded RI screening criteria. VOCs were not detected in any of the soil matrix samples collected. Figures showing sampling locations and screening criteria exceedances were presented in the Soil and NAPL RI Report (URS 2007b).

Summary of Risk and Risk-driving Chemicals

Risk values from the BRA for the commercial worker and the outdoor soil and indoor air pathways at EAPC 32 are summarized in the table below:

EAPC 32 COMMERCIAL WORKER RISK SUMMARY

Group	Medium/Pathway	Commercial Worker		Risk-driving Contaminants	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3A	Outdoor soil	7E-06	<1	B(a)P	7E-06
	Indoor air	<1E-06	<1	--	--

Extent of Impacted Soil

Based on a target CR of 1E-06, B(a)P is the RDC for EAPC 32. The extent of B(a)P-impacted outdoor soil is assumed to be within an area approximately 35 feet by 50 feet, as shown on Figure 6.7-1 located in Appendix D. This area includes the location of the maximum B(a)P concentration (0.74 mg/kg). Based on the observed limited vertical distribution of PAHs in soil at the former plant site, and their generally low mobility, the maximum depth of B(a)P-impacted soil is assumed to be 5 feet bgs. The in-place impacted soil volume is approximately 325 CY. There were no contaminant concentrations that exceeded the 5E-05 commercial worker risk-based threshold level.

6.7.3 Identification of Remedial Alternatives

The remedial alternatives are the same as those described in Section 6.1 for EAPCs with only one non-VOC COC:

(1) No Action
(2) ICs + Monitoring
(3) Capping (B(a)P) + ICs + Monitoring
(4) Excavation (B(a)P) + ICs + Monitoring

6.7.4 Description of Remedial Alternatives

The following is a description of the remedial alternatives for EAPC 32. The technology descriptions provided in Section 5.4 supplement the brief alternative descriptions provided here.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – ICs + MONITORING

This parcel is in Group 3A and IC layers 1-4A and 5 are proposed, as described in Section 5.4. Monitoring includes ICs monitoring.

ALTERNATIVE 3 – CAPPING (B(A)P) + ICs + MONITORING

This alternative includes asphalt capping of impacted soils covering an area 35 feet by 50 feet, approximately 1,750 SF as shown on Figure 6.7-2, located in Appendix D. As described in Section 5.4, the existing state of the surface covering the impacted area will be evaluated during remedial design if this alternative is selected for implementation. This alternative will include any additional components required to create an adequate cap. ICs are the same as Alternative 2 except that they would include a restrictive covenant to monitor and maintain the cap (IC layers 1-5). Monitoring includes periodic inspection and maintenance of the cap and ICs monitoring.

ALTERNATIVE 4 –EXCAVATION (B(A)P) + ICs + MONITORING

This alternative includes excavation of shallow soil in the 35 feet by 50 feet area down to a depth of 5 feet bgs that is assumed to be B(a)P-impacted (Figure 6.7-3, located in Appendix D). The excavation area is close to the building so a combination of shoring and sidewall sloping is assumed as shown on Figure 6.7-3, located in Appendix D. The estimated in-place soil volume is approximately 325 CY. If active remedial alternatives are selected for implementation, additional sampling will need to be conducted to define the actual area of impacted soil prior to proceeding with remedial design and implementation. The excavated soil will be sent offsite for treatment and recycling or disposal. Since this alternative involves removal of the contamination, IC layers 1, 2 and 5 are proposed, as described in Section 5.4.

6.8 GROUP 3B REPRESENTATIVE AREA - EAPC 9

Group 3B includes exposure areas that have a CR less than or equal to 5E-05 and HI_{com} less than or equal to 1 and where RR is less than or equal to 5E-05 and greater than 1E-06 and the HI_{res} is less than or equal to 1. In addition, Group 3B only includes those areas where the primary RDC is VOC in shallow soil. Details on grouping of the areas and selection of representative areas were presented in Sections 3.1.3 and 3.1.4.

6.8.1 Background Information

EAPC 9 (parcel 7351-033-027) is located in the southeastern portion of the former butadiene plancor on the west side of Hamilton Avenue and north of Del Amo Boulevard (Figure 1-2). Butadiene was manufactured as a component of synthetic rubber. The parcel area was primarily used for product storage. An underground benzene pipeline was located on or near the northern boundary of the parcel. Leakage from the benzene pipeline during the operation period of the plancor is believed to have resulted in benzene contaminated soil and groundwater in the vicinity of the parcel. The 1.5-acre area of EAPC 9 has been developed with a single-story commercial/office building with paved vehicle parking and landscaped areas surrounding the building. Additional background information on this parcel is provided in the parcel-by-parcel summaries in Appendix A.

6.8.2 Nature and Extent of Shallow Soil Contamination

Summary of Investigation Results

Remedial investigation data for EAPC 9 is available for 17 soil gas locations, 17 soil borings with 11 shallow soil samples and 14 deep soil samples. The soil and soil gas sampling locations sampled for various analytes are shown on Figures 2-4 through 2-14. In shallow soil gas, there were a total of 7 detections for benzene out of 17 samples. In shallow and deep soil, there were a total of 14 detections for benzene out of 25 samples. Figure 6.8-1, located in Appendix D, shows the 12 soil samples where the RI screening concentration for benzene of 0.60 mg/kg was exceeded. The maximum benzene concentration was 20 mg/kg at 16.5 feet bgs at SBL0124 but in shallow soil the maximum was 4.0 mg/kg at 5.5 feet bgs at GP11. Figures showing sampling locations and screening criteria exceedances were presented in the Soil and NAPL RI Report (URS 2007b).

Summary of Risk and Risk-driving Chemicals

The following table summarizes risk values for the commercial worker at EAPC 9 for the outdoor soil and indoor air pathways.

EAPC 9 COMMERCIAL WORKER RISK SUMMARY

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3B	Outdoor soil	1E-06	<1	Benzene	1.2E-06
	Indoor air	1E-06	<1	Benzene	1.4E-06

Benzene is the primary RDC for both the indoor air and outdoor soil pathways. The RR for indoor air (3E-05) is greater than 1E-06 and the HI_{res} is less than 1. Elevated benzene concentrations detected in shallow and deep soil are assumed to be due to the proximity of this parcel to groundwater contamination SA11.

Extent of Impacted Soil

The primary COC is benzene in both outdoor soil and indoor air for this parcel. The areal extent of impacted soil is defined by the locations that exceeded the risk-based threshold level of 0.90 mg/kg for benzene. There are four soil samples with benzene exceedances in shallow soil. The impacted extent is assumed to be contained within one 40 feet by 200 feet area located north of the building and one 50 feet by 50 feet area located east of the building (totaling 10,500 SF), as shown on Figure 6.8-1 located in Appendix D. In addition, an area of about 100 feet by 150 feet of soil (15,000 SF) under the building is assumed to be impacted based on former facilities. The benzene-impacted shallow soil is assumed to be present down to 15 feet bgs with an in-place impacted outdoor soil volume of 5,830 CY and impacted soil under building of 8,330 CY for a total of about 14,160 CY.

6.8.3 Identification of Remedial Alternatives

A screening evaluation was conducted to select the five or six most viable alternatives out of the eight alternatives presented in Section 6.1 for VOC-impacted soils. The results and the basis for the evaluation are the same as presented for EAPC 23 in Section 6.5. Alternative 3 was retained as a containment alternative. Between Alternatives 4 and 5 in Section 6.1, Alternative 5 would be rated better with respect to implementability and effectiveness than Alternative 4. Among Alternatives 6, 7 and 8, Alternatives 6 and 8 were retained while Alternative 7 was screened out because Alternatives 6 and 8 are more aggressive remedial alternatives addressing VOC contamination in outdoor soil and under the building.

For this EAPC, Alternatives 3 and 4 will assume SSV to address vapor intrusion from soil under the building in the FS evaluation. The implementability of SVE/BV under the building may pose some challenges because the exact areas of impacted soil are unknown, and due to potential problems with horizontal well installation. The alternatives with SVE/BV under the building assume horizontal wells that can potentially be used for sub-slab venting if needed after SVE/BV remediation has met performance goals.

Hence the revised list of remedial alternatives for the detailed FS evaluation is renumbered as follows:

(1) No Action
(2) ICs + Monitoring
(3) Capping (Benzene) + HVAC mod/SSV (UB) + ICs + Monitoring
(4) SVE/BV (OS) + HVAC mod/SSV (UB) + ICs + Monitoring
(5) SVE/BV (OS) + SVE/BV (UB) + ICs + Monitoring
(6) Excavation (Benzene) + SVE/BV (UB) + ICs + Monitoring

6.8.4 Description of Remedial Alternatives

The following is a description of the proposed remedial alternatives. If active remedial alternatives are selected for implementation, additional sampling would need to be conducted to define the actual area of impacted soil prior to proceeding with remedial design and implementation.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 –ICs + MONITORING

IC layers 1-4A and 5 are proposed for this parcel, as described in Section 5.4. Monitoring includes ICs monitoring as described in Section 5.4.5.

ALTERNATIVE 3 –CAPPING (BENZENE) + HVAC MOD/SSV (UB) + ICs + MONITORING

This alternative includes asphalt capping of VOC-impacted outdoor soil and HVAC mod/SSV to protect from vapor intrusion from impacted soil under the building. Figure 6.8-2, located in Appendix D, shows the assumed extent of impacted outdoor soil that would need capping, approximately 10,500 SF. However, this area is already capped as an asphalt-paved parking area. As described in Section 5.4, the integrity of the existing asphalt cap will be evaluated during the remedial design if this alternative is selected for implementation. This alternative will include any additional components required to create an adequate cap. For the vapor intrusion engineering control, SSV is assumed over HVAC mod for this parcel. The active SSV system consists of perforated piping in eight shallow trenches connected to a VCS, as shown on Figure 6.8-2, located in Appendix D. If HVAC mod/SSV is selected as part of a remedy to be implemented here then additional sampling, testing and engineering evaluation of the existing building would need to be performed as discussed in Section 5.4.2. ICs are the same as for Alternative 2 except that they would include a restrictive covenant to monitor and maintain the cap (IC layers 1-5). Monitoring includes ICs monitoring and periodic inspection and maintenance of the asphalt cap and HVAC system.

ALTERNATIVE 4 –SVE/BV (OS) + HVAC MOD/SSV (UB) + ICs + MONITORING

This alternative includes SVE/BV for benzene-impacted outdoor soil and HVAC mod/SSV for protection from benzene-impacted soils under the building as shown on Figure 6.8-3, located in Appendix D. A total of 18 shallow vertical wells at 30-foot spacing across the extent of the two impacted outdoor soil areas, single-screened interval between 5 and 15 feet bgs, are assumed for the SVE conceptual design as shown on Figure 6.8-3, located in Appendix D. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower (or multiple blowers) sized for a total maximum flow of 200 scfm. The ultimate extracted vapor treatment system will be evaluated and selected during remedial design; however, for cost evaluation purposes, the treatment system included a thermal/catalytic oxidizer. For the vapor intrusion engineering control, this alternative assumes SSV over HVAC mod as described in Alternative 3. If HVAC mod/SSV is selected as part of a remedy to be implemented here then additional sampling, testing and engineering evaluation of the existing building would need to be performed as discussed in Section 5.4.2. ICs are the same as for Alternative 2 except that they would include additional restrictive covenants for monitoring and maintenance of the SSV system (IC layers 1-5). Monitoring includes ICs monitoring and periodic monitoring and maintenance of the SSV system.

ALTERNATIVE 5 –SVE/BV (OS) + SVE/BV (UB) + ICs + MONITORING

This alternative assumes SVE/BV for VOC-impacted outdoor soil and shallow soil under the building as shown on Figure 6.8-4, located in Appendix D. The outdoor soil SVE layout is the same as described for Alternative 4 and includes a total of 18 vertical SVE wells at 30-foot spacing, single-screened between 5 and 15 feet bgs. For soil under the buildings, 5 horizontal SVE wells are proposed at shallow depths ranging between 5 and 10 feet bgs drilled below the foundation of the existing buildings. The horizontal wells are also spaced at 30 feet and would be likely to need to be installed by the blind-drilling (single completion) method due to space limitations or subsurface interferences. All SVE wells (OS + UB) would be connected to one aboveground VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 500 scfm. The ultimate extracted vapor treatment system will be evaluated and selected during remedial design; however, for cost evaluation purposes the treatment system included a thermal/catalytic oxidizer. After the SVE/BV system achieves its performance goals, if vapor intrusion from deeper soils is still a concern, the SSV option can be considered for soils under the building using the horizontal SVE wells, as described in Section 5.4. If SVE (UB) is selected as part of the remedy for this area, additional soil sampling under the building would need to be conducted as described in Section 5.4.3. Though this alternative involves remediation of contamination, IC layers 1-4A and 5 are proposed because there is expected to be residual contamination left under the building following treatment. Monitoring includes ICs monitoring and may also involve periodic monitoring and maintenance of the SSV system (if included).

ALTERNATIVE 6 –EXCAVATION (BENZENE) + SVE/BV (UB) + ICs + MONITORING

This alternative includes excavation for VOC-impacted outdoor soil, and SVE/BV for VOC-impacted soil under the building as shown on Figure 6.8-5, located in Appendix D. The extent of the excavation area is assumed to include the approximately 10,500 SF of impacted outdoor soil to a depth of approximately 15 feet bgs. The total volume of soil proposed for excavation in this alternative is 5,830 CY. Shoring is assumed to be required as shown on Figure 6.8-5, located in Appendix D. This alternative assumes that the excavated soil is sent offsite for treatment and disposal/recycling. This alternative assumes use of 5 horizontal SVE wells at depths ranging between 5 and 10 feet bgs drilled below the foundation of the existing buildings as in Alternative 5. The wells would be connected to an aboveground VETS that includes a high-vacuum positive-displacement blower (or multiple blowers) sized for a total maximum flow of 400 scfm. The ultimate extracted vapor treatment system will be evaluated and selected during remedial design; however, for cost evaluation purposes, the treatment system consisted of a thermal/catalytic oxidizer. More information on the VETS is provided in Section 5.4. As with Alternative 5, the SSV option is available after SVE/BV shutdown. If SVE (UB) is selected as part of the remedy for this area, additional soil sampling under the building would need to be conducted as described in Section 5.4.3. Though this alternative involves remediation of contamination, IC layers 1-4A and 5 are proposed because there is expected to be residual contamination left under the building following treatment. Monitoring includes ICs monitoring and may also involve periodic monitoring and maintenance of the SSV system (if included).

6.9 GROUP 2 REPRESENTATIVE AREA (7351-034-047 - EAPC 21)

Group 2 includes exposure areas where both the CR and RR are less than or equal to 1E-06 and both HI_{com} and HI_{res} are less than or equal to 1. In addition, Group 2 includes non-EAPC exposure areas with targeted facilities that were not sampled during the RI or areas that were in close proximity to NAPL.

6.9.1 Background Information

Parcel (7351-034-047) is located at the northwest corner of Magellan Drive and Francisco Street. The parcel area was formerly within the central portion of the styrene plancor. The eastern portion of the parcel was used for ethyl benzene production, a precursor to styrene.

Additional background information on this parcel is provided in the parcel-by-parcel summaries in Appendix A.

6.9.2 Data Summary and Risk

RI investigation data for EAPC 21 include 13 shallow soil gas samples and 4 indoor air samples collected at the locations shown on Figure 2-13. One soil gas sample at SGL0249 showed elevated concentrations of benzene and ethylbenzene at 4.9 and 64 ppmv respectively. The CRs for outdoor soil and indoor air at EAPC 21 were both less than 1E-06 in the BRA. However, a former sump and some VOC storage tank locations are under the current building and were not accessible for sampling. Groundwater contamination SA8 is located on this property. Figures showing sampling locations and screening criteria exceedances were presented in the Soil and NAPL RI Report (URS 2007b).

6.9.3 Description of Remedial Alternatives

For Group 2 parcels, only two alternatives are considered for evaluation in the FS.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – ICs + MONITORING

The ICs layering proposed for this parcel includes IC layers 1 and 2 as discussed in Section 5.4. Monitoring includes ICs monitoring.

6.10 GROUP 1 REPRESENTATIVE AREA (7351-031-017)

Group 1 includes non-EAPC exposure areas that are not in close proximity to NAPL and that do not contain former rubber plant facility locations that were targeted for sampling during the RI.

6.10.1 Background Information

Parcel (7351-031-017) is located at the northeast corner of Knox Street and Pacific Gateway. This parcel is located in the central portion of the former copolymer plancor. Plancor operations in this area included preparation of carbon black (soot), a reinforcing filler added to rubber.

Additional background information on this parcel is provided in the parcel-by-parcel summaries in Appendix A.

6.10.2 Data Summary and Risk

Ten shallow soil samples were collected for analysis from the parcel at the locations shown on Figures 2-8 through 2-11. There were no exceedances of PRGs or screening criteria at this parcel. This parcel was not designated as an EAPC due to low observed soil contamination and was not evaluated in the BRA.

6.10.3 Description of Remedial Alternatives

For Group 1 parcels, only two alternatives are considered for evaluation in the FS.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 –ICs + MONITORING

The ICs layering proposed for this parcel includes IC layers 1 and 2 as discussed in Section 5.4. Monitoring includes ICs monitoring.

7.0 DESCRIPTION OF NAPL SOURCE AREA REMEDIAL ALTERNATIVES

This section describes the remedial alternatives for the NAPL source areas identified at the former plant site. The description for each source area includes a general description and the nature and extent of the NAPL source area contamination.

7.1 ASSEMBLY OF REMEDIAL ALTERNATIVES

Based on the technology screening evaluation in Section 5, the retained technologies for NAPL source areas are assembled into remedial alternatives. Section 5 also described the retained technologies for NAPL, including assumptions for conceptual remedial designs that are common to all of the source areas. This section describes the remedial alternatives proposed for the different source areas and the assumptions and approach used for the FS evaluations.

7.1.1 Identification of Remedial Alternatives

As for the surface pathway in Section 6, the remedial alternatives considered for each NAPL source area evaluation range from no action through passive remediation (intrinsic biodegradation) to active remediation. The active remedial alternatives include the four most viable technology options derived from the screening of technologies detailed in Section 5: SVE/BV, hydraulic extraction, ISCO, and ISSH. Hydraulic extraction, ISCO and ISSH are more aggressive approaches that include SVE as a supplemental extraction technology component to remove VOCs from the vadose zone and as a control technology to prevent vapor migration to the surface during remediation.

The typical set of remedial alternatives to be considered for NAPL source areas includes:

(1) No Action
(2) Intrinsic Biodegradation + ICs + Monitoring
(3) SVE/BV + ICs + Monitoring
(4) Hydraulic Extraction + SVE/BV + ICs + Monitoring
(5) ISCO + SVE + ICs + Monitoring
(6) ISSH + SVE + ICs + Monitoring

These alternatives are applicable to SA12, SA3, SA6, SA11, and SA9. All of these areas have (or potentially have) NAPL adjacent to or in close proximity to a building, but for purposes of the FS evaluations, NAPL is assumed not to extend under the building in these source areas. The alternatives applicable to other source areas, including alternatives addressing NAPL beneath buildings, are presented later in this section.

Intrinsic biodegradation (also called natural attenuation) is the naturally occurring process of biodegradation of petroleum hydrocarbons; it is included as a passive remedial option in Alternative 2.

Alternative 3 includes SVE/BV as an active remedial option that would address deep soil without actively addressing groundwater. This remedial technology would address the portion of the contaminant mass present in the deep vadose zone soils. This could result in a reduction of the contaminant mass that comes into direct contact with groundwater in the event that the groundwater elevation continues to rise in the future. This result would also address the RAO to enhance the certainty of the site-wide groundwater remedy.

Alternative 4 includes hydraulic extraction (a pump-and-treat approach) as well as SVE/BV. Under this alternative, hydraulic extraction would reduce contaminant mass in the source area saturated zone. This alternative would also address the deep vadose zone by SVE/BV.

Alternative 5 is an aggressive remedial approach that includes ISCO to oxidize contaminants in the saturated zone, while SVE is used to remediate the deep soil vadose zone.

Alternative 6 is an aggressive approach that includes a thermally-enhanced SVE technology that involves soil heating (which for the FS evaluation is assumed to be ERH).

Other approaches that were retained in screening the technologies (Section 5), such as ISTD or steam injection were considered less cost effective but still technically viable. If the ROD selects a NAPL heating technology, the type of heating technology would be selected during remedial design.

ICs and Monitoring are included as components of all remedial alternatives other than the No Action alternative. ICs for the parcels at the Del Amo site primarily focus on controlling potential exposures to residual soil and groundwater contamination. Layering of ICs for the site parcels was discussed in Section 5.4.1 and the choice of applicable IC layers for any parcel is dependent on the risk/hazard estimates for the EAPC. All EAPCs in Groups 3, 4 or 5 and containing NAPL source areas were assigned groundwater restrictive covenants (IC layer 5). Monitoring for the NAPL remedial alternatives primarily includes groundwater monitoring, while appropriate soil gas monitoring, indoor air monitoring and ICs monitoring were included in the surface pathway FS evaluation. Details on Monitoring were discussed in Section 5.4.5.

For SA4, SA7 and SA8 (potential NAPL areas assumed to be entirely under a building), active remedial alternatives were evaluated for two scenarios. The first assumed the use of horizontal remediation wells under the building due to access limitations within the building interior. The second scenario assumed full access to the building interior and therefore included vertical remediation wells within the building footprint. The complete set of remedial alternatives considered for SA4, SA7, and SA8 are as follows:

(1) No Action
(2) Intrinsic Biodegradation + ICs + Monitoring
(3) SVE/BV (UB) + ICs + Monitoring (Horizontal Wells)
(3A) SVE/BV (UB) + ICs + Monitoring (Vertical Wells)
(4) Hydraulic Extraction + SVE/BV (UB) + ICs + Monitoring (Horizontal Wells)
(4A) Hydraulic Extraction + SVE/BV (UB) + ICs + Monitoring (Vertical Wells)
(5) ISCO + SVE (UB) + ICs + Monitoring (Vertical Wells)
(6) ISSH + SVE (UB) + ICs + Monitoring (Vertical Wells)

The horizontal wells option is not included for ISCO and ISSH because these technologies have not proven to be effective with horizontal wells at other sites.

Table 7-1 presents a summary of the source areas, parcel numbers and the EAPCs they are located in, contaminants of concern and the remedial alternatives considered in the FS evaluation. SA5 does not have NAPL but is evaluated as a soil contamination area, as requested by USEPA. The remedial alternatives for SA5 shown on Table 7-1 are the same as those for SA4 but exclude Alternatives 4, 4A, 5 and 6. The table also provides a rationale for not presenting a detailed FS evaluation for SA2 and SA1, as further explained in Sections 7.11 and 7.12, respectively.

7.1.2 Approach and Assumptions for the Evaluation

The following subsections present the details of the remedial alternatives for each of the groundwater contamination source areas in the NAPL FS evaluation. For each source area, a description of the source area contamination and the remedial alternatives is presented.

For the evaluation of active remedial alternatives, an estimate of the extent of impacted soil is required. The lateral and vertical extent of NAPL-impacted soil has been characterized in the MW-20 area (SA3). Delineations of impacted soil and NAPL-impacted areas at other source areas have not been performed. Additional subsurface characterization in the remedial design phase would be needed if active remediation is chosen for implementation in any of these other areas. To perform FS analysis, the horizontal extent of hydrocarbon contamination was assumed based on available NAPL characterization data, groundwater monitoring data, and the location of former rubber plant facilities that could have contributed to the subsurface contamination. In some cases, shallow soil and soil gas data can provide corroborating evidence of the source area. The vertical extent of contamination in these source areas is assumed to include the deep vadose zone soil (from 15 feet to down to the water table) and between 30 to 40 feet of the saturated zone below the water table. For NAPL SA12, SA3, SA6 and SA11, the NAPL is present adjacent to or in close proximity to the onsite buildings. Based on groundwater analytical laboratory results, groundwater contamination in the water table zone is present under the buildings on these properties.

In addition to the four active remedial technologies included in the remedial alternatives, other technologies such as ISTD and steam injection were retained during the screening process. For the ISSH alternative, ERH was assumed for the purposes of the FS evaluation because at this time it is the most widely used of these soil heating technologies. However, if a thermal technology is selected in the ROD, the ISTD and steam injection technologies would be available for consideration during remedial design.

The remedial alternatives are generally designed to minimize impacts on current facility or building operations. Each addressed NAPL source area (typically outside the building footprint) and/or its treatment compound were assumed to be enclosed within a chain-link fence for public safety. The issue of safety is especially important for the most aggressive alternatives such as ISCO and ISSH. For the other active remedial alternatives, only the treatment compound is typically required to be fenced off but the wells and fenced area would need to be accessed periodically for monitoring and maintenance. In most cases the fenced areas were assumed to be placed in what are at present parking areas for employees or business vehicles, which would then be inaccessible to the owner, tenant(s), and the public. The temporary or long-term removal of the parking areas may limit available onsite parking. In some cases, the fenced areas could be located on a portion of actively used driveways or loading docks. In general, the location of the source areas, remediation wells and treatment compound would likely result in some impact to operations at any facility or office building on the property.

The above assumptions and the inferred areas of impacted soil are described for each source area and are shown on appropriate figures located in Appendix E. The FS evaluation ratings in the detailed analysis are not expected to be significantly sensitive to these assumptions. This approach is anticipated to be adequate to support the contingent remedial decision-making process following completion of the FS. If active remedial measures are proposed for any of these source areas, during remedial design additional investigation may be necessary to define the actual areas and depths of contamination. This additional data will also be used to confirm that the selected remedy is appropriate for specific source areas and to provide the information needed to support remedy design. For active remedial measures, assumptions (based on knowledge of site lithology and experience with the technology at other sites) have been made about spacing of remediation wells and well screen intervals, since pilot testing data are typically not available for most technologies.

7.2 SOURCE AREA 12

7.2.1 Description of SA12 NAPL Contamination

SA12 is located in parcel 7351-033-017 (EAPC 5), within the area of the former butadiene plancor. Former plant facilities and their spatial relationship to the commercial office building currently present on the parcel are illustrated on Figure 7.2-1 located in Appendix E. Boring logs and CPT data (D&M 1998b) indicate that soil between 0 and 60 feet bgs in the vicinity of SA12 consists primarily of silt, with occasional layers of sandy silt or silty sand that are up to 5 feet thick. Between 60 and 90 feet bgs, the number of silty sand/sandy silt layers increases, and they make up approximately 50% of the soil present. Data from January 2004 (URS 2005) indicates the water table is present at a depth of approximately 40 feet bgs.

Extensive investigation has been conducted in this source area with 110 soil gas sampling locations and 32 soil boring locations (see Figures 2-4 through 2-14). During the Groundwater RI, several temporary and four permanent groundwater monitoring wells were constructed in the water table on or near this parcel (Figure 7.2-1 located in Appendix E). The permanent wells continue to be sampled periodically. This area was identified as a groundwater contamination source area based on the presence of NAPL, as observed at temporary monitoring wells (CWL0051, CWL0054) and detected in soil samples collected near the northeast side of the existing building (Figure 7.2-1 located in Appendix E). Based on analyses of soil and groundwater samples, the NAPL is inferred to be composed of a mixture of BTEX, styrene, and other VOCs and SVOCs in the C6-C23 range. Hydrocarbon-impacted soil in the area has not been fully delineated, but was inferred to extend laterally across an area of approximately 150 feet by 150 feet, located to the northeast of the current building as shown on Figure 7.2-1 located in Appendix E. The maximum observed vertical extent of the hydrocarbon occurred at soil boring SBL0123, where it was present nearly continuously from approximately 6 feet bgs to the water table, and intermittently thereafter at trace levels to approximately 90 feet bgs. NAPL saturations measured in the vadose zone ranged from 0% to 13.7% (pore space volume) with an average of 4%.

The estimated lateral extent of this groundwater contamination source area (shown on Figure 7.2-1 located in Appendix E) takes into consideration the available data and the location of former rubber plant facilities that may be associated with the NAPL release. The assumed source area is approximately 22,500 SF in area. It has an in-place soil volume of approximately 54,000 CY assuming the addressed source area extends from 15 to 80 feet bgs. The soil data suggest that the majority of the hydrocarbon mass is present in the vadose zone and shallow water table zone.

7.2.2 Risk Summary

The NAPL FS evaluation dealt primarily with contamination in deep soil (>15 feet bgs) and with protection of groundwater and thus did not consider surface pathway risks. Nevertheless, it should be understood that the presence of subsurface NAPL is not necessarily associated with elevated surface pathway risk. Recalculated CRs for EAPC 5 were presented in Section 6.6.2 and indicate that outdoor soil and indoor air risks are both less than 1E-06.

7.2.3 Description of Remedial Alternatives

The following paragraphs describe the remedial alternatives for SA12 that were used in the FS evaluation. Refer to Section 5.4 for additional design details for the technologies discussed here. The IC layers that apply to the parcels associated with this source area are presented in Section 5. The ICs and Monitoring components are the same for the Alternatives 2 through 6.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – INTRINSIC BIODEGRADATION + ICs + MONITORING

This alternative involves using the naturally occurring process of biodegradation of petroleum hydrocarbons as discussed in Section 5.4.4 and is included in this alternative as a passive component that prevents plume migration. SA12 is located in EAPC 5 which is an exposure area in Group 4, based on surface pathway risks. The IC layers that apply to this area were discussed in Section 5. Monitoring includes annual groundwater monitoring of four wells in the vicinity of SA12 to detect any significant lateral or vertical migration of hydrocarbons, either as NAPL or as high dissolved-phase concentrations, from the source area. Existing wells located in the vicinity of SA12, including PZL0011, PZL0012, SWL0060, and PZL0026, would be incorporated into an annual site-wide groundwater monitoring program.

ALTERNATIVE 3 – SVE/BV + ICs + MONITORING

This alternative uses SVE/BV technology to address soil contamination in the vadose zone. For the purposes of the conceptual design and evaluation, SVE is assumed rather than bioventing. If SVE/BV is selected in the ROD, then the appropriate proportion of SVE versus BV operation would be determined in the remedial design phase (refer to Section 5.4 for more details). Figure 7.2-2, located in Appendix E, shows the layout of the SVE wells and treatment system for this alternative. Six SVE wells are assumed to be spaced at approximately 70 feet on center across the extent of the source area. SVE wells are assumed to be 2-inch polyvinyl (PVC) wells screened in the more permeable zone between 30 feet bgs and 40 feet bgs. The primary objective of this SVE design is to address the permeable sandy zones to prevent leaching and thereby protect groundwater. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 200 scfm[19]. The final VETS will be evaluated and selected during the remedial design phase; however, for cost evaluation purposes, a thermal oxidizer[20] is assumed for vapor treatment. This alternative would be expected to operate for up to 4 years. Other vapor treatment options and more details about the conceptual design of the SVE system were presented in Section 5.4. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the wells and the fenced area for monitoring and maintenance.

ALTERNATIVE 4 – HYDRAULIC EXTRACTION + SVE/BV + ICs + MONITORING

This alternative includes the use of hydraulic extraction in the saturated zone combined with SVE in the source area, and uses SVE/BV technology to address soil contamination in the vadose zone. Figure 7.2-3, located in Appendix E, presents the conceptual design of the combined hydraulic extraction and SVE well layout for this remedial alternative. This alternative assumes that 24 hydraulic extraction wells would be located across the lateral extent of the source area at an approximate spacing of 30 feet. The hydraulic extraction wells would be screened in the saturated zone (40 feet to 80 feet bgs). For the conceptual design and evaluation, SVE is assumed rather than bioventing. If SVE/BV is selected in the ROD, then the appropriate proportion of SVE versus BV operation would be determined in the remedial design phase (refer to Section 5.4 for more details). Six SVE wells would be installed separately at 70-foot spacing as described in Alternative 3, and screened between 30 feet to 40 feet bgs with the objective of protecting groundwater from leaching vadose zone contaminants. The aboveground groundwater treatment system (GWTS) would be designed for a maximum flow rate of approximately 24 gpm. The GWTS is assumed to utilize multiple processes including a liquid-liquid separator, advanced oxidation (hydrogen peroxide+ozone oxidation of dissolved-phase hydrocarbons) and air stripping. As a conservative measure, liquid-phase carbon adsorption is assumed to be included in the treatment train as a polishing or backup treatment technology in the event of failure of one of the primary treatment processes. The treated water

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[19] The total flow rate and SVE system sizing was based on assumed well flows from the various lithotypes. For the permeable zone above the water table, we assumed a flow of 1-2 scfm/foot of permeable zone thickness.

[20] There is a history of public opposition toward thermal treatment of extracted VOC vapors at the Del Amo Waste Pit Area and carbon adsorption is now being used there.

is assumed to be discharged to the storm drain under a NPDES permit. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 600 scfm. The VETS would be similar to that in Alternative 3 but with a higher flow rate due to the vapor stream from the air stripper. For cost evaluation purposes, the vapor treatment system assumes the use of a thermal oxidizer. The hydraulic extraction component of this alternative would be expected to operate for up to 10 years and the SVE component for 4 years. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the wells and the fenced area for monitoring and maintenance.

ALTERNATIVE 5 – ISCO + SVE + ICs + MONITORING

The FS evaluation of this alternative incorporated the use of the acidified Fenton's process, which is considered more aggressive and better suited for the NAPL accumulation source areas. Figure 7.2-4, located in Appendix E, presents a conceptual design of the layout of the ISCO system. The design assumes the use of injection well clusters at an approximate spacing of 15 feet on center, a total of 75 injection well clusters. Each injection well cluster would consist of four multi-level ¾-inch injection points distributed in the treatment zone between 40 and 80 feet bgs to cover the entire depth of contamination in the saturated zone. Additional information on well construction was presented in Section 5.4. Based on average soil and groundwater concentrations in the source area (assumed based on available data), an ISCO vendor (Geocleanse) developed a conceptual design based on their experience at other sites. Their conceptual design assumes injection of 5,000 gallons of oxidant mixture[21] (20% hydrogen peroxide, acids) per injection well per injection cycle. The initial injection would include all injection wells and the four subsequent injection events would use alternately one-half of the wells for each semiannual event over 2 years. These injection activities would use a total of almost 1,125,000 gallons of oxidant mixture for the entire source area. Section 5.4 and Appendix E give more details on the assumptions for the injection cycles. Twenty-three SVE wells would be included in the interior of the source area at a spacing of 30 feet on center to remove VOCs in the vadose zone. A more closely spaced SVE system is utilized with this aggressive alternative to capture all VOCs released by the exothermic oxidation process. This SVE system would target both the 15 to 30 feet bgs lower permeability zone and the more permeable deeper zone with dual-completion SVE wells (dual screened 15 to 30 feet bgs and 30 to 40 feet bgs). Some of the interior SVE wells would be screened into the water table (down to 50 feet bgs) to serve as interim groundwater monitoring wells during the remediation. Four SVE sentry wells would also be included along the footprint of the building to prevent vapor migration and vapor intrusion of VOCs into the building (Figure 7.2-4 located in Appendix E) released from the exothermic oxidation process. A high-vacuum positive-displacement blower with a maximum flow rate of 500 scfm is proposed for the SVE system. An aboveground treatment system similar to that in Alternative 3 is included for addressing the VOCs in the SVE system influent. For cost evaluation purposes, the aboveground treatment for the SVE vapors assumes the use of thermal oxidizers. The ISCO component would be expected to operate for 2 years with multiple rounds of injections (assumed semiannually) and the SVE component would be expected to operate for 4 years before reaching the point of diminishing returns. For safety reasons, the entire source area and the treatment system would be enclosed within a chain-link

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[21] Oxidant volume is estimated based on vendor's (Geocleanse) experience at other NAPL sites.

fence to prevent access by the public. Maintenance personnel would require frequent access to the fenced area for monitoring and maintenance.

ALTERNATIVE 6 – ISSH + SVE + ICs + MONITORING

This alternative assumes the use of ERH to heat soil in the source area for hydrocarbon remediation. Figure 7.2-5, located in Appendix E, presents a conceptual design of the ERH system for this alternative. The design involves the placement of electrode wells, which would also serve as SVE wells, in the subsurface at a spacing of approximately 20 feet on center across the extent of the source area, totaling 53 electrode wells. Each electrode well would have a dual conductive interval from 25 to 45 feet bgs and 50 to 80 feet bgs and a dual-completion SVE well (dual screened 15 to 30 feet bgs and 30 to 40 feet bgs). The overall heated zone is expected to be between 15 and 80 feet bgs. The conceptual design for this source area assumes one 1,250 kW transformer with an average power usage of approximately 564,000 kilowatt hours (kWhr)[22] per month to heat the impacted area. Based on the design provided by the vendor (Thermal Remediation Services), the soil heating portion of the remedial alternative would consume approximately 13.5 million kWhr of electrical energy for 2-year operation. The SVE system is designed for this alternative with the dual purpose of removing volatile contaminants in the vadose zone and preventing uncontrolled vapor migration into the building. Four sentry SVE wells at 30-foot spacing would be included along the footprint of the building to prevent vapor migration and vapor intrusion into the building (Figure 7.2-5 located in Appendix E). The extracted vapors would be treated in an aboveground treatment system that would include condensation, phase separation, and vapor-phase treatment using a thermal oxidizer or internal combustion engine. Further description of the treatment system is presented in Section 5.4. The treatment system would include a vacuum blower (or multiple blowers) sized for a total flow of approximately 1,500 scfm. Condensed steam would be treated in a water treatment system designed to handle up to 20 gpm using advanced oxidation and carbon adsorption technology and discharged to the storm drain under an NPDES permit. Due to the volatile nature of the contaminants (benzene, toluene, ethylbenzene, etc.), the ERH system may need to be operated at low heating rates to control vapor influent concentrations and maintain safe conditions. The active remedial components of this alternative (ERH+SVE) are expected to operate for approximately 2 years before reaching the point of diminishing returns. For safety reasons, the entire source area and the treatment system would be enclosed within a chain-link fence to prevent access by the public. Maintenance personnel would require access to the fenced area on a daily basis for monitoring and maintenance.

7.3 SOURCE AREA 3

7.3.1 Description of SA3 NAPL Contamination

SA3, also known as the MW-20 area, is located in the northwestern corner of the former styrene plancor on Parcels 7351-034-057 (EAPC 23) and 7351-034-056 (EAPC 16). Former rubber plant facilities known to have been present in this area include a tank farm that began on the southwestern corner of current Parcel 7351-034-056 and continued further south into current Parcel 7351-034-057. The former rubber

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[22] The average power usage was estimated based on total energy (kWhr) needed for remediation divided by the total number of months of remediation (24 months). Actual usage per month would depend on heating implementation schedule.

plant facilities and their spatial relationship to the commercial buildings currently present on these parcels are illustrated on Figure 7.3-1 located in Appendix E. The groundwater, soil, soil gas sampling locations sampled for various analytes are shown on Figures 2-4 through 2-14.

Based on boring logs, soil in the vicinity of SA3 between 0 and 50 feet bgs consists primarily of low-permeability silt to sandy silt with interbedded silty sand and very fine to medium sand layers varying in thickness from 2 to 5 feet. A greater proportion of the more permeable sand and silty sand is present at depths greater than 50 feet bgs and below the water table, which is at approximately 50 feet bgs as of January 2004.

Significant investigation has been conducted at SA3 to evaluate the presence of NAPL contamination, particularly in the vicinity of monitoring well MW-20 where NAPL accumulation has been observed. The RI included approximately 110 shallow and 9 deep soil gas sampling locations, 2 shallow and 19 deep soil boring locations, and 5 groundwater monitoring wells in the SA3 footprint. In addition, a focused NAPL investigation (D&M 1993b), NAPL treatability studies (D&M 1993a, 1993d), and a hydraulic extraction pilot program (URS 2003c) have been conducted to assess the nature and extent of NAPL contamination and evaluate the efficacy of source remediation alternatives in the MW-20 area. The MW-20 pilot program included a detailed hydrostratigraphic investigation to assess the distribution of LNAPL in the subsurface and characterize the intrinsic properties of the soil in the impacted area. It also included installation of 3 extraction wells and 24 observation wells, hydraulic extraction, and pre- and post-pumping data collection to evaluate the impact of hydraulic extraction on the distribution of LNAPL.

The SA3 LNAPL is composed almost entirely (>95%) of benzene. The results of extensive MW-20 pilot program and the other investigations cited above, confirm that the LNAPL is present in only a limited portion of the "potential LNAPL area" (i.e., >5% of solubility) identified on Figure 7.3-1 located in Appendix E. Measurable accumulations of LNAPL have been consistently observed at monitoring wells XMW-20, SWL0032 and SWL0001 in the vicinity of SA3 during groundwater monitoring events completed annually, or more frequently, between 1993 and 2000. Observational and hydrocarbon saturation data for the MW-20 area indicate the LNAPL is discontinuously present within an approximately 30-foot smear zone within the saturated zone, extending from approximately 60 to 90 feet bgs. Laboratory NAPL saturation values range from less than 0.1 to 30%, averaging 2.4% (URS 2007b).

In contrast to the other NAPL areas, the lateral extent of the MW-20 NAPL at SA3 has been reasonably well delineated to the area shown on Figure 7.3-1 located in Appendix E, which encompasses an area of approximately 50,000 SF. This area takes into consideration the available data and the location of the former tank farm and other former facilities that may have been associated with NAPL releases in the area. The depth of the contamination is assumed to extend from 15 to 90 feet bgs. Based on these dimensions, SA3 includes an in-place impacted soil volume of approximately 140,000 CY.

7.3.2 Risk Summary

Surface pathway risks for EAPCs 16 and 23 were presented in Sections 6.4.2 and 6.5.2 respectively. CR at EAPC 16 ranged from 3E-06 (outdoor soil) to 9E-06 (indoor air). CR at EAPC 23 ranged from 1E-05 (outdoor soil) to 2E-05 (indoor air) after recalculation to account for elevated detection limits. However, the NAPL FS evaluation did not consider surface pathway risks and instead dealt with groundwater protection and contamination in deep soil (>15 feet bgs), where exposures are unlikely.

7.3.3 Description of Remedial Alternatives

The following paragraphs describe the remedial alternatives for SA3 that were used in the FS evaluation. The description of alternatives for SA3 is briefer than for SA12 because some of the remedial alternative details are similar to those already described for SA12. Refer to Section 5.4 for additional design details for the technologies discussed here. The IC layers that apply to the parcels associated with this source area are presented in Section 5. The ICs and Monitoring components are the same for the Alternatives 2 through 6.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – INTRINSIC BIODEGRADATION + ICs + MONITORING

This alternative is a passive approach similar to that discussed for SA12 in Section 7.2.2. SA3 is located in EAPC 23 and EAPC 16 which are Group 4 parcels, based on surface pathway risks. The IC layers that apply to these parcels were discussed in Section 5. Monitoring includes annual groundwater monitoring of four wells located at the source area to detect any significant lateral or vertical migration of hydrocarbons, either as NAPL or as high dissolved-phase concentrations. Existing wells located at or in the vicinity of SA3, including SWL0002, SWL0003, SWL0004, and SWL0054 would be incorporated into an annual site-wide groundwater monitoring program.

ALTERNATIVE 3 – SVE/BV + ICs + MONITORING

This alternative uses SVE/BV technology to address soil contamination in the vadose zone. For the purposes of the conceptual design and evaluation, SVE is assumed rather than bioventing. If SVE/BV is selected in the ROD, then the appropriate proportion of SVE versus BV operation would be determined in the remedial design phase (refer to Section 5.4 for more details). Figure 7.3-2, located in Appendix E, shows the layout of the SVE wells and treatment system for this alternative. Twelve SVE wells are assumed to be spaced at approximately 70 feet on center across the extent of the source area. SVE wells are assumed to be 2-inch PVC wells screened in the more permeable zone between 30 feet bgs and 50 feet bgs (the water table). The primary objective of this SVE design is to address the permeable sandy zones to prevent leaching and thereby protect groundwater. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 600 scfm[23]. The final VETS will be evaluated and selected during the remedial design; however, for cost evaluation purposes, a thermal oxidizer[24] is assumed for vapor treatment. This alternative would be expected to operate for up to 4 years. Other vapor treatment options and more details about the conceptual

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[23] The total flow rate and SVE system sizing was based on assumed well flows from the various lithotypes. For the permeable zone above the water table, we assumed a flow of 1-2 scfm/foot of permeable zone thickness.

[24] There is a history of public opposition toward thermal treatment of extracted VOC vapors at the Del Amo Waste Pit Area and carbon adsorption is now being used there.

design of the SVE system were presented in Section 5.4. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the wells and the fenced area for monitoring and maintenance.

ALTERNATIVE 4 – HYDRAULIC EXTRACTION + SVE/BV + ICs + MONITORING

This alternative includes the use of hydraulic extraction in the saturated zone combined with SVE in the source area, and uses SVE/BV technology to address soil contamination in the vadose zone. Figure 7.3-3, located in Appendix E, presents the conceptual design of the combined hydraulic extraction and SVE well layout for this remedial alternative. This alternative assumes that 56 hydraulic extraction wells would be located across the lateral extent of the source area at an approximate spacing of 30 feet. The hydraulic extraction wells would be screened in the saturated zone (50 feet to 90 feet bgs). For the conceptual design and evaluation, SVE is assumed rather than bioventing. Twelve SVE wells would be installed separately at 70-foot spacing as described in Alternative 3, and screened between 30 feet to 50 feet bgs with the objective of protecting groundwater from leaching vadose zone contaminants. The aboveground GWTS would be designed for a maximum flow rate of approximately 56 gpm. The GWTS is assumed to utilize multiple processes including a liquid-liquid separator, advanced oxidation (hydrogen peroxide+ozone oxidation of dissolved-phase hydrocarbons), air stripping and liquid-phase carbon adsorption, as discussed for SA12. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 1,500 scfm. For cost evaluation purposes, the vapor treatment system assumes the use of a thermal oxidizer. The hydraulic extraction component of this alternative would be expected to operate for up to 10 years and the SVE component for 4 years. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the wells and fenced area for monitoring and maintenance.

ALTERNATIVE 5 - ISCO + SVE + ICs + MONITORING

The FS evaluation of this alternative incorporated the use of the acidified Fenton's process, which is considered more aggressive and better suited for the NAPL accumulation source areas. Figure 7.3-4, located in Appendix E, presents a conceptual design of the layout of the ISCO system. The design assumes the use of injection well clusters at an approximate spacing of 15 feet on center, a total of 192 injection well clusters. Each injection well cluster would consist of four multi-level ¾-inch injection points distributed in the treatment zone between 50 and 90 feet bgs to cover the entire depth of contamination in the saturated zone. Additional information on well construction was presented in Section 5.4. The conceptual design, as discussed for SA12, assumes injection of 5,000 gallons of oxidant mixture (20% hydrogen peroxide, acids) per injection well per injection cycle. The initial injection event would include all injection wells and the four subsequent injection events would use alternately one-half of the wells for each semiannual event over 2 years. These injection activities would use a total of almost 2,880,000 gallons of oxidant mixture for the entire source area. Section 5.4 and Appendix E give more details on the assumptions for the injection cycles. Fifty-six SVE wells would be included in the interior of the source area at a spacing of 30 feet on center to remove VOCs in the vadose zone. A more closely spaced SVE system is included with this aggressive alternative to capture all VOCs released by the oxidation process. This SVE system would target both the 15 to 30 feet bgs lower permeability zone and the more permeable deeper zone with SVE wells that are dual screened 15 to 30 feet bgs and 30 to 50 feet bgs. Some of the interior SVE wells would be screened into the water table (down to 60 feet bgs) to serve as interim groundwater monitoring wells during the remediation. No sentry wells are required for this alternative because the source area does not directly abut the building footprint (Figure 7.3-4 located in Appendix E). A high-vacuum positive-displacement blower with a maximum flow rate of 1,500 scfm is proposed for the SVE system. An aboveground treatment system similar to that in Alternative 3 is included for addressing the VOCs in the SVE system influent. For cost evaluation purposes, the aboveground treatment for the SVE vapors assumes the use of thermal oxidizers. The ISCO component would be expected to operate for 2 years with multiple rounds of injections (assumed semiannually) and the SVE component would be expected to operate for 4 years before reaching the point of diminishing returns. For safety reasons, the entire source area and the treatment system should be enclosed within a chain-link fence to prevent access by the public. However, this source area is located beneath the primary access driveway for the warehouse facility on this property, and enclosing it completely would present significant conflicts with continued operation of the warehouse. Maintenance personnel would require frequent access to the fenced area for monitoring and maintenance.

ALTERNATIVE 6 – ISSH + SVE + ICs + MONITORING

This alternative assumes the use of ERH to heat soil in the source area for hydrocarbon remediation. Figure 7.3-5, located in Appendix E, presents a conceptual design of the ERH system for this alternative. The design involves the placement of electrode wells, which would also serve as SVE wells, in the subsurface at a spacing of approximately 20 feet on center across the extent of the source area, totaling 132 electrode wells. Each electrode well would have a dual conductive interval from 25 to 55 feet bgs and 60 to 90 feet bgs and a SVE well dual screened 15 to 30 feet bgs and 30 to 50 feet bgs. The overall heated zone is expected to be between 15 and 90 feet bgs. Given the extent of this source area, it has been divided into two regions and the heating implemented in two sequential phases so the transformer sizing requirements would not be excessive. The conceptual design for this source area assumed two 1,250 kW transformers with an average power usage of approximately 1,446,000 kWhr per month to heat the impacted area. Based on the design provided by the vendor (Thermal Remediation Services), the soil heating portion of the remedial alternative would consume approximately 34.7 million kWhr of electrical energy for 2-year operation. No sentry wells are required for this alternative because the source area does not directly abut the building footprint (Figure 7.3-5 located in Appendix E). The extracted vapors would be treated in an aboveground treatment system that would include condensation, phase separation, and vapor-phase treatment using a thermal oxidizer or internal combustion engine. Further description of the treatment system is presented in Section 5.4. The treatment system would include a vacuum blower (or multiple blowers) sized for a total flow of approximately 4,000 scfm. Condensed steam would be treated in a water treatment system designed to handle up to 20 gpm using advanced oxidation and carbon adsorption technology. Due to the high proportion of benzene present at SA3, the ERH system may need to be operated at low heating rates to control vapor influent concentrations and maintain safe conditions. The active remedial components of this alternative (ERH+SVE) are expected to operate for approximately 2 years before reaching the point of diminishing returns. For safety reasons, the entire source area and the treatment system would be enclosed within a chain-link fence to prevent access by the public. However, this source area is located beneath the primary access driveway for the warehouse facility on this property, and enclosing it completely would present significant conflicts with continued operation of the warehouse. Maintenance personnel would require access to the fenced area on a daily basis for monitoring and maintenance.

7.4 SOURCE AREA 6

7.4.1 Description of SA6 NAPL Contamination

SA6 is located approximately 400 feet to the southeast of MW-20 in the southeastern portion of Parcel 7351-034-057 (EAPC 23) within the former styrene plancor. The LNAPL in SA6 is inferred to be associated with releases from the former aboveground VOC storage tanks that were part of the tank farm near the western margin of the styrene plancor, as shown on Figure 7.4-1 located in Appendix E. The location of this tank farm and its spatial relationship to the commercial buildings currently present in this area are also illustrated on Figure 7.4-1 located in Appendix E. The soil, soil gas, and groundwater monitoring well sampling locations for this source area are shown on Figures 2-4 through 2-14.

Boring logs and CPT data indicate soil in the vicinity of SA6 between 0 and 45 feet bgs consists primarily of low-permeability silt to sandy silt, with a few interbedded layers of silty sand to sandy silt up to 5 feet thick. From approximately 45 to 90 feet bgs, the soil is predominantly fine sand or silty sand, with intervening layers of silt or sandy silt. January 2004 data indicate the water table is present at a depth of approximately 50 feet bgs.

The LNAPL in SA6 was only observed at trace amounts, preventing collection and analysis of a NAPL sample to directly determine its composition. However, laboratory results for shallow soil sampling location (SBL0125), shallow and deep soil gas sampling locations (SGL0035), and groundwater (XMW-21) from the area, collectively indicate that LNAPL is likely to be composed of benzene and ethylbenzene. Rapid Optical Screen Tool (ROST) profiles for the area show a hydrocarbon signature that is greatly reduced relative to other NAPL areas, and that is almost entirely limited to the vadose zone. Jar testing observations and hydrocarbon saturation tests were consistent with the ROST findings, and show the maximum hydrocarbon saturation at approximately 10 to 14 feet bgs at SBL0125. The maximum hydrocarbon saturation in this interval was 2.24%, while laboratory VOC data indicate an ethylbenzene concentration of 37 mg/kg. Trace indications of hydrocarbon were observed throughout much of the remainder of the vadose zone, mostly at non-detectable levels of hydrocarbon saturation. Trace NAPL occurrences are much less frequent within the saturated zone, but continue sporadically to near the maximum depth of the soil boring at 90 feet bgs. NAPL saturation data range from 0 to 2.24% with an average value of 0.4%. The lateral extent of the LNAPL is inferred to be limited to the immediate vicinity of the VOC storage tanks (URS 2007b).

The assumed lateral extent of SA6 is shown on Figure 7.4-1 located in Appendix E, which takes into consideration the available data and the location of the former VOC tank farm. A small portion of the source area may be under the existing building and is not addressed by the remedial evaluation. The estimated area outside the building that can be addressed by active remedial alternatives is approximately 33,000 SF. The majority of the hydrocarbon mass is anticipated to be present in the deep vadose zone and shallow water table zone. The in-place impacted volume is estimated to be approximately 75,000 CY, assuming the contamination from 15 feet to 80 feet bgs is addressed.

7.4.2 Risk Summary

Surface pathway risks for EAPC 23 were presented in Section 6.5.2. CR at EAPC 23 ranged from 1E-05 (outdoor soil) to 2E-05 (indoor air) after recalculation to account for elevated detection limits. However, the NAPL FS evaluation did not consider surface pathway risks and instead dealt with protection of groundwater and contamination in deep soil (>15 feet bgs), where exposures are unlikely.

7.4.3 Description of Remedial Alternatives

The following paragraphs describe the remedial alternatives for SA6 that were used in the FS evaluation. The IC layers that apply to the parcels associated with this source area are presented in Section 5. The ICs and Monitoring components are the same for the Alternatives 2 through 6.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – INTRINSIC BIODEGRADATION + ICs + MONITORING

SA6 is in EAPC 23 which is a parcel in Group 4, based on surface pathway risks. The IC layers that apply to this parcel were discussed in Section 5. Monitoring includes annual groundwater monitoring of three wells located at the source area to detect any significant lateral or vertical migration of hydrocarbons, either as NAPL or as high dissolved-phase concentrations. Wells located in the vicinity of SA6, including XMW-21, SWL0054 and XMW-28 would be incorporated into an annual site-wide groundwater monitoring program.

ALTERNATIVE 3 – SVE/BV + ICs + MONITORING

This alternative uses SVE/BV technology to address soil contamination in the vadose zone. For the purposes of the conceptual design and evaluation, SVE is assumed rather than bioventing. Figure 7.4-2, located in Appendix E, shows the layout of the SVE wells and treatment system for this alternative. Nine SVE wells are assumed to be spaced at approximately 70 feet on center across the extent of the source area. SVE wells are assumed to be 2-inch PVC wells screened in the more permeable zone between 30 feet bgs and 50 feet bgs (the water table). The primary objective of this SVE design is to address the permeable sandy zones to prevent leaching and thereby protect groundwater. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 400 scfm[25]. The final VETS will be evaluated and selected during the remedial design; however, for cost evaluation purposes, a thermal oxidizer[26] is assumed for vapor treatment. This

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[25] The total flow rate and SVE system sizing was based on assumed well flows from the various lithotypes. For the permeable zone above the water table, we assumed a flow of 1-2 scfm/foot of permeable zone thickness.

[26] There is a history of public opposition toward thermal treatment of extracted VOC vapors at the Del Amo Waste Pit Area and carbon adsorption is now being used there.

alternative would be expected to operate for up to 4 years. Other vapor treatment options and more details about the conceptual design of the SVE system were presented in Section 5.4. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the wells and fenced area for monitoring and maintenance.

ALTERNATIVE 4 – HYDRAULIC EXTRACTION + SVE/BV + ICs + MONITORING

This alternative includes the use of hydraulic extraction in the saturated zone combined with SVE in the source area, and uses SVE/BV technology to address soil contamination in the vadose zone. Figure 7.4-3, located in Appendix E, presents the conceptual design of the combined hydraulic extraction and SVE well layout for this remedial alternative. This alternative assumes that 42 hydraulic extraction wells would be located across the lateral extent of the source area at an approximate spacing of 30 feet. The hydraulic extraction wells would be screened in the saturated zone (50 feet to 80 feet bgs). For the conceptual design and evaluation, SVE is assumed rather than bioventing. Nine SVE wells would be installed separately at 70-foot spacing as described in Alternative 3, and screened between 30 feet to 50 feet bgs with the objective of protecting groundwater from leaching vadose zone contaminants. The aboveground GWTS would be designed for a maximum flow rate of approximately 42 gpm. The GWTS is assumed to utilize multiple processes including a liquid-liquid separator, advanced oxidation (hydrogen peroxide+ozone oxidation of dissolved-phase hydrocarbons), air stripping and liquid-phase carbon adsorption, as discussed for SA12. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 850 scfm. For cost evaluation purposes, the vapor treatment system assumes the use of a thermal oxidizer. The hydraulic extraction component of this alternative would be expected to operate for up to 10 years and the SVE component for 4 years. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the wells and fenced area for monitoring and maintenance.

ALTERNATIVE 5 – ISCO + SVE + ICs + MONITORING

The FS evaluation of this alternative assumed the use of peroxone oxidation as described in Section 5.4. Figure 7.4-4, located in Appendix E, presents a conceptual design of the layout of the ISCO system. The design assumes the use of injection well clusters at an approximate spacing of 15 feet on center, a total of 121 injection well clusters. Each injection well cluster would consist of three multi-level ¾-inch injection points distributed in the treatment zone between 50 and 80 feet bgs to cover the entire depth of contamination in the saturated zone. Additional information on well construction was presented in Section 5.4. The conceptual design for the peroxone system, based on the lower estimate of hydrocarbon concentrations in SA6, assumes a total injection of 4,000 gallons of 20% hydrogen peroxide and 300 pounds of ozone per injection well. This corresponds to a total injection of about 484,000 gallons of peroxide and 36,000 lb of ozone over a 2-year period. An 80-pound-per-day (ppd) ozone generator is proposed for this system. Section 5.4 and Appendix E provide additional details on the assumptions for the injection cycle. Twenty-six SVE wells would be included in the interior of the source area at a spacing of 30 feet on center to remove VOCs in the vadose zone. A more closely spaced SVE system is included with this aggressive alternative with SVE wells that are dual screened 15 to 30 feet bgs and 30 to 50 feet bgs. Some of the interior SVE wells would be screened into the water table (down to 60 feet bgs) to serve as interim groundwater monitoring wells during the remediation. Sixteen SVE sentry wells would also be included along the building footprint (Figure 7.4-4 located in Appendix E) to control migration of VOC and ozone vapors released from the oxidation process. A high-vacuum positive-displacement blower with a maximum flow rate of 1,000 scfm is proposed for the SVE system. For cost evaluation purposes, the aboveground treatment for the SVE vapors assumes the use of thermal oxidizers. The ISCO component would be expected to operate for 2 years and the SVE component would be expected to operate for 4 years before reaching the point of diminishing returns. For safety reasons, the entire source area and the treatment system would be enclosed within a chain-link fence to prevent access by the public. Maintenance personnel would require frequent access to the fenced area for monitoring and maintenance.

ALTERNATIVE 6 – ISSH + SVE + ICs + MONITORING

This alternative assumes the use of ERH to heat soil in the source area for hydrocarbon remediation. Figure 7.4-5, located in Appendix E, presents a conceptual design of the ERH system for this alternative. The design involves the placement of electrode wells, which would also serve as SVE wells, in the subsurface at a spacing of approximately 20 feet on center across the extent of the source area, totaling 81 electrode wells. Each electrode well would have a dual conductive interval from 25 to 55 feet bgs and 60 to 80 feet bgs and a SVE well dual screened 15 to 30 feet bgs and 30 to 50 feet bgs. The overall heated zone is expected to be between 15 and 80 feet bgs. The conceptual design for this source area assumed two 1,250 kW transformers with an average power usage of approximately 574,000 kWhr per month to heat the impacted area. Based on the design provided by the vendor (Thermal Remediation Services), the soil heating portion of the remedial alternative would consume approximately 13.8 million kWhr of electrical energy for 2-year operation. The SVE system is designed for this alternative with the dual purpose of removing volatile contaminants in the vadose zone and preventing uncontrolled vapor migration into the building. Sixteen sentry SVE wells at 30-foot spacing would be included along the footprint of the building to prevent vapor migration and vapor intrusion into the building (Figure 7.4-5 located in Appendix E). The extracted vapors would be treated in an aboveground treatment system that would include condensation, phase separation, and vapor-phase treatment using a thermal oxidizer or internal combustion engine. Further description of the treatment system is presented in Section 5.4. The treatment system would include a vacuum blower (or multiple blowers) sized for a total flow of approximately 2,500 scfm. Condensed steam would be treated in a water treatment system designed to handle up to 10 gpm using advanced oxidation and carbon adsorption technology. Due to the volatile nature of the contaminants the ERH system may need to be operated at low heating rates to control vapor influent concentrations and maintain safe conditions. The active remedial components of this alternative (ERH+SVE) are expected to operate for approximately 2 years before reaching the point of diminishing returns. For safety reasons, the entire source area and the treatment system would be enclosed within a chain-link fence to prevent access by the public. Maintenance personnel would require access to the fenced area on a daily basis for monitoring and maintenance.

7.5 SOURCE AREA 11

7.5.1 Description of SA11 NAPL Contamination

SA11 is located on the southern portion of the former butadiene plancor. SA11 extends laterally into three parcels: Parcels 7351-033-022 and -027 (EAPC 6 and 9) where aboveground tanks were used for storage of unspecified gas-phase products, isobutylene dimer, "Tolusol" (toluene), and fuel oil; and Parcel 7351-033-900 (EAPC 15) which consisted primarily of open space used as a corridor for high-voltage power lines by the LADWP during the period of former rubber plant operation. An underground benzene pipeline was located along this corridor, just north of the other two parcels (-022 and -027). Leakage from the benzene pipeline during the plancor's operational period is believed to have resulted in the release into soil and groundwater at SA11. The approximate location of the pipeline in the vicinity of the LNAPL area and its spatial relationship to the building currently present is indicated on Figure 7.5-1 located in Appendix E. The soil, soil gas, and groundwater monitoring well sampling locations for this source area are shown on Figures 2-4 through 2-14.

CPT profiles and boring logs show that sediments in SA11 are characterized primarily by interbedded silt and fine sand. A thick silty unit is present from the ground surface to approximately 34 feet bgs. Fine to medium sand is present from 34 to 52 feet bgs. Silt and clay with interbedded fine sands comprise the interval between 52 and 90 feet bgs. The water table is approximately 40 feet bgs based on monitoring in January 2004.

The LNAPL associated with the former benzene feedstock pipeline is known to be present based on soil core jar-testing observations and laboratory hydrocarbon saturation measurements. No accumulation of NAPL has been observed at wells in this source area. NAPL has not been observed in quantities sufficient to permit exclusive sampling and laboratory analysis. The NAPL at SA11 is inferred to be composed primarily of benzene based on analyses of numerous soil and groundwater samples completed as part of RI and non-RI investigations. This is consistent with the historical information indicating past leakage from the benzene pipeline. ROST profiles from the area show an intermittent hydrocarbon distribution from near surface to approximately 85 feet bgs. Pronounced hydrocarbon signatures from 10 to 20 feet bgs within the vadose zone and from approximately 50 to 75 feet bgs within the saturated zone are apparent in two (CPL0062 and CPL0063) of the three ROST profiles for the area. The third ROST profile (CPL0061) shows no appreciable hydrocarbon signature within the vadose zone, but has a saturated zone hydrocarbon distribution similar to the other two ROST locations.

ROST peaks and measurable hydrocarbon saturations correspond with soil core samples collected from soil boring SBL0124, where thin intervals of concentrated LNAPL were observed in the vadose zone at approximately 16 feet bgs and just below the groundwater table at approximately 52 feet bgs. Inspection of the soil core samples suggests that LNAPL detected in several saturated zone intervals is trapped in thin, high permeability units bounded by lower permeability units. The maximum hydrocarbon saturation of 8.95% was detected at 52 feet bgs (D&M 1998b).

While the lateral extent of the LNAPL has not been fully evaluated, the abrupt attenuation of dissolved benzene concentrations in the area suggests that the LNAPL is limited to the immediate vicinity of the benzene pipeline source area. The assumed lateral extent of the source area is shown on Figure 7.5-1 located in Appendix E, which takes into consideration the available soil, soil gas and groundwater data and the location of the former benzene pipeline. A small fraction of the source area may be under the existing building in Parcel 7351-033-027. The estimated area outside the building that can be addressed by active remedial alternatives is approximately 38,000 SF. The majority of the hydrocarbon mass is anticipated to be present in the deep vadose zone and the top 40 feet of the saturated zone, which extends from 15 feet to approximately 80 feet bgs, with an estimated in-place impacted soil volume of approximately 91,500 CY.

7.5.2 Risk Summary

Maximum risks for SA11 occur at EAPC 15. The outdoor soil CR at EAPC 15 is 4E-06 and the indoor air CR is 3E-05. Details regarding the surface pathway risks for all three of the EAPCs where SA11 is located are presented in Sections 8.3.2.1 (EAPC 6), 6.8 (EAPC 9) and 8.3.2.3 (EAPC 15). However, the NAPL FS evaluation did not consider surface pathway risks and instead dealt with contamination in deep soil (>15 feet bgs), where exposures are unlikely, and with protection of groundwater.

7.5.3 Description of Remedial Alternatives

The following paragraphs describe the remedial alternatives for SA11 that were evaluated in the FS evaluation. The IC layers that apply to the parcels associated with this source area are presented in Section 5. The ICs and Monitoring components are the same for the Alternatives 2 through 6.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – INTRINSIC BIODEGRADATION + ICs + MONITORING

SA11 is located in multiple parcels including portions of EAPCs 6 and 9 and a small portion in EAPC 15. The IC layers that apply to these parcels were discussed in Section 5. Monitoring includes annual groundwater monitoring of four wells located at the source area to confirm that there is no significant lateral or vertical migration of hydrocarbons, either as NAPL or as high dissolved-phase concentrations. Wells located in the vicinity of SA11, including XMW-01HD, XMW-02HD, XMW-03HD, XMW-04HD would be incorporated into an annual site-wide groundwater monitoring program.

ALTERNATIVE 3 – SVE/BV + ICs + MONITORING

This alternative uses SVE/BV technology to address soil contamination in the vadose zone. For the purposes of the conceptual design and evaluation, SVE is assumed rather than bioventing. Figure 7.5-2, located in Appendix E, shows the layout of the SVE wells and treatment system for this alternative. Nine SVE wells are assumed to be spaced at approximately 70 feet on center across the extent of the source area. SVE wells are assumed to be 2-inch PVC wells screened in the more permeable zone between 30 feet bgs and 40 feet bgs. The primary objective of this SVE design is to address the permeable sandy zones to prevent leaching and thereby protect groundwater. The extracted vapors would be treated in a

VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 300 scfm[27]. The final VETS will be evaluated and selected during remedial design; however, for cost evaluation purposes, a thermal oxidizer[28] is assumed for vapor treatment. This alternative would be expected to operate for up to 4 years. Other vapor treatment options and more details about the conceptual design of the SVE system were presented in Section 5.4. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the wells and fenced area for monitoring and maintenance.

ALTERNATIVE 4 – HYDRAULIC EXTRACTION + SVE/BV + ICs + MONITORING

This alternative includes the use of hydraulic extraction in the saturated zone combined with SVE in the source area, and uses SVE/BV technology to address soil contamination in the vadose zone. Figure 7.5-3, located in Appendix E, presents the conceptual design of the combined hydraulic extraction and SVE well layout for this remedial alternative. This alternative assumes that 45 hydraulic extraction wells would be located across the lateral extent of the source area at an approximate spacing of 30 feet. The hydraulic extraction wells would be screened in the saturated zone (40 feet to 80 feet bgs). For the conceptual design and evaluation, SVE is assumed rather than bioventing. Nine SVE wells would be installed separately at 70-foot spacing as described in Alternative 3, and screened between 30 feet to 40 feet bgs with the objective of protecting groundwater from leaching vadose zone contaminants. Installation of wells in the northern part of the source area (EAPC 15) may face challenges due to the presence of a utility corridor with pipelines and high voltage power lines. The aboveground GWTS would be designed for a maximum flow rate of approximately 45 gpm. The GWTS is assumed to utilize multiple processes including a liquid-liquid separator, advanced oxidation (hydrogen peroxide+ozone oxidation of dissolved-phase hydrocarbons), air stripping and liquid-phase carbon adsorption, as discussed for SA12. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 750 scfm. For cost evaluation purposes, the vapor treatment system assumes the use of a thermal oxidizer. The hydraulic extraction component of this alternative would be expected to operate for up to 10 years and the SVE component for 4 years. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the wells and fenced area for monitoring and maintenance.

ALTERNATIVE 5 – ISCO + SVE + ICs + MONITORING

The FS evaluation of this alternative assumed the use of peroxone oxidation as described in Section 5.4. Figure 7.5-4, located in Appendix E, presents a conceptual design of the layout of the ISCO system. The design assumes the use of injection well clusters at an approximate spacing of 15 feet on center, a total of 151 injection well clusters. Each injection well cluster would consist of four multi-level ¾-inch injection points distributed in the treatment zone between 40 and 80 feet bgs to cover the entire depth of contamination in the saturated zone. Additional information on well construction was presented in Section

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[27] The total flow rate and SVE system sizing was based on assumed well flows from the various lithotypes. For the permeable zone above the water table, we assumed a flow of 1-2 scfm/foot of permeable zone thickness.

[28] There is a history of public opposition toward thermal treatment of extracted VOC vapors at the Del Amo Waste Pit Area and carbon adsorption is now being used there.

5.4. The conceptual design for the peroxone system, based on the lower estimate of hydrocarbon concentrations in SA11, assumes a total injection of 4,000 gallons of 20% hydrogen peroxide and 300 pounds of ozone per injection well. This corresponds to a total injection of about 604,000 gallons of peroxide and 45,000 lb of ozone over a 2-year period. An 100-ppd ozone generator is proposed for this system. Section 5.4 and Appendix E give more details on assumptions used in the injection cycle. Installation of wells in the northern part of the source area (in EAPC 15) may face challenges due to the presence of a utility corridor with pipelines and high voltage power lines. Thirty-four SVE wells would be included in the interior of the source area at a spacing of 30 feet on center to remove VOCs in the vadose zone. Some of the interior SVE wells would be screened into the water table (down to 50 feet bgs) to serve as interim groundwater monitoring wells during the remediation. Six SVE sentry wells would also be included along the footprint of the building to prevent vapor migration and vapor intrusion into the building (Figure 7.5-4 located in Appendix E) to control migration of VOC and ozone vapors released from the oxidation process. A high-vacuum positive-displacement blower with a maximum flow rate of 1,000 scfm is proposed for the SVE system. For cost evaluation purposes, the aboveground treatment for the SVE vapors assumes the use of thermal oxidizers. The ISCO component would be expected to operate for 2 years and the SVE component would be expected to operate for 4 years before reaching the point of diminishing returns. For safety reasons, the entire source area and the treatment system would be enclosed within a chain-link fence to prevent access by the public. Maintenance personnel would require frequent access to the fenced area for monitoring and maintenance.

ALTERNATIVE 6 – ISSH + SVE + ICs + MONITORING

This alternative assumes the use of ERH to heat soil in the source area for hydrocarbon remediation. Figure 7.5-5, located in Appendix E, presents a conceptual design of the ERH system for this alternative. The design involves the placement of electrode wells, which would also serve as SVE wells, in the subsurface at a spacing of approximately 20 feet on center across the extent of the source area, totaling 99 electrode wells. Each electrode well would have a dual conductive interval from 25 to 50 feet bgs and 50 to 80 feet bgs and a SVE well dual screened 15 to 30 feet bgs and 30 to 40 feet bgs. Installation of wells in the northern part of the source area (in EAPC 15) may face challenges due to the presence of a utility corridor with pipelines and high voltage power lines. The overall heated zone is expected to be between 15 and 80 feet bgs. The conceptual design for this source area assumed two 1,250 kW transformers with an average power usage of approximately 704,000 kWhr per month to heat the impacted area. Based on the design provided by the vendor (Thermal Remediation Services), the soil heating portion of the remedial alternative would consume approximately 17.0 million kWhr of electrical energy for 2-year operation. The SVE system is designed for this alternative with the dual purpose of removing volatile contaminants in the vadose zone and preventing uncontrolled vapor migration into the building. Six sentry SVE wells at 30-foot spacing would be included along the footprint of the building to prevent vapor migration and vapor intrusion into the building (Figure 7.5-5 located in Appendix E). The extracted vapors would be treated in an aboveground treatment system that would include condensation, phase separation, and vapor-phase treatment using a thermal oxidizer or internal combustion engine. Further description of the treatment system is presented in Section 5.4. The treatment system would include a vacuum blower (or multiple blowers) sized for a total flow of approximately 2,500 scfm. Condensed steam would be treated in a water treatment system designed to handle up to 10 gpm using advanced oxidation and carbon adsorption technology. Due to the volatile nature of the contaminants the ERH system may need to be operated at low heating rates to control vapor influent concentrations and maintain safe conditions. The active remedial components of this alternative (ERH+SVE) are expected to operate for approximately 2 years before reaching the point of diminishing returns. For safety reasons, the entire source area and the treatment system would be enclosed within a chain-link fence to prevent access by the public. Maintenance personnel would require access to the fenced area on a daily basis for monitoring and maintenance.

7.6 SOURCE AREA 9

7.6.1 Description of SA9 Potential NAPL Contamination

SA9 is located on parcel 7351-034-058 (EAPC 24), within the area of the styrene plancor at the former plant site. Former rubber plant facilities and their spatial relationship to the commercial warehouse building currently present on the parcel are illustrated on Figure 7.6-1 located in Appendix E. The soil, soil gas and groundwater sampling locations for this source area are shown on Figures 2-4 through 2-14.

Soil in the vicinity of SA9 between 0 and 40 feet bgs consists primarily of low-permeability silt with interbedded silty sand or gravelly sand layers, based on boring logs. A permeable, gravelly sand layer approximately 5 to 8 feet thick is present at PZL0021 at approximately 35 feet bgs (D&M 1998b). Relatively permeable sand and silty sand are also present at depths greater than approximately 60 feet bgs. The water table is at approximately 50 feet bgs based on January 2004 data.

SA9 is identified as a potential NAPL area based on elevated concentrations of benzene in groundwater (200,000 µg/L at PZL0021 in January 2004) and the former presence of utility storage tanks at this location. No NAPL accumulation has been observed in wells located in SA9. Limited soil data indicate the presence of elevated concentrations of benzene in deep soil, below the water table (2,500 mg/kg at 56.5 feet bgs at PZL0021). Ethylbenzene was detected at 82 mg/kg in shallow soil at PZL0021.

The estimated lateral extent of the groundwater contamination source area for purposes of the FS is shown on Figure 7.6-1, located in Appendix E, which takes into consideration the available data and the location of former rubber plant facilities that may be associated with the NAPL release. Based on this assumed extent, a significant portion (almost half) of the source area is under the existing building and the recently extended section of the building. Only contamination that is outside the building area is assumed to be available for active remedial alternatives. Based on this assumption, an active remediation area of approximately 26,400 SF is estimated. Assuming contamination extends from 15 to 80 feet bgs, the volume of impacted soil available for active remediation is estimated to be 63,500 CY. The majority of the hydrocarbon mass is anticipated to be present in the deep vadose zone and shallow water table zone.

7.6.2 Risk Summary

Risks for EAPC 24 are presented in Section 8.3.4.4. The outdoor soil CR is less than 1E-06 and the indoor air CR is also less than 1E-06. However, the NAPL FS evaluation did not consider surface pathway risks and instead dealt with contamination in deep soil (>15 feet bgs), where exposure is unlikely, and with protection of groundwater.

7.6.3 Description of Remedial Alternatives

The following paragraphs describe the remedial alternatives for SA9 that were used in the FS evaluation. Because the source area is located in a warehouse's truck loading area, the active remedial alternatives could limit access to a portion of the truck loading area to varying degrees, which would negatively impact the warehouse operations. The IC layers that apply to the parcels associated with this source area are presented in Section 5. The ICs and Monitoring components are the same for the Alternatives 2 through 6.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – INTRINSIC BIODEGRADATION + ICs + MONITORING

ICs for the parcels at the Del Amo site are primarily focused towards controlling potential exposures to residual soil contamination. Layering of ICs for the site parcels was discussed in Section 5. Monitoring includes annual groundwater monitoring of four wells located in the vicinity of the source area to confirm that there is no significant lateral or vertical migration of hydrocarbons, either as NAPL or as high dissolved-phase concentrations. Wells located in the vicinity of this area could serve this purpose (e.g., PZL0021, XMW-28, XMW-29 and SWL0058) and could be included in the site-wide monitoring program.

ALTERNATIVE 3 – SVE/BV + ICs + MONITORING

This alternative uses SVE/BV technology to address soil contamination in the vadose zone. For the purposes of the conceptual design and evaluation, SVE is assumed rather than bioventing. If SVE/BV is selected in the ROD, then the appropriate proportion of SVE versus BV operation would be determined in the remedial design phase (refer to Section 5.4 for more details). Figure 7.6-2, located in Appendix E, shows the layout of the SVE wells and treatment system for this alternative. Six SVE wells are assumed to be spaced at approximately 70 feet on center across the extent of the source area. SVE wells are assumed to be 2-inch PVC wells screened in the more permeable zone between 30 feet bgs and 50 feet bgs (the water table). The primary objective of this SVE design is to address the permeable sandy zones to prevent leaching and thereby protect groundwater. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 300 scfm[29]. The final VETS will be evaluated and selected during the remedial design; however, for cost evaluation purposes, a thermal oxidizer[30] is assumed for vapor treatment. This alternative would be expected to operate for up to 4 years. Other vapor treatment options and more details about the conceptual

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[29] The total flow rate and SVE system sizing was based on assumed well flows from the various lithotypes. For the permeable zone above the water table, we assumed a flow of 1-2 scfm/foot of permeable zone thickness.

[30] There is a history of public opposition toward thermal treatment of extracted VOC vapors at the Del Amo Waste Pit Area and carbon adsorption is now being used there.

design of the SVE system were presented in Section 5.4. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the wells and fenced area for monitoring and maintenance.

ALTERNATIVE 4 – HYDRAULIC EXTRACTION + SVE/BV + ICs + MONITORING

This alternative includes the use of hydraulic extraction in the saturated zone combined with SVE in the source area, and uses SVE/BV technology to address soil contamination in the vadose zone. If SVE/BV is selected in the ROD, then the appropriate proportion of SVE versus BV operation would be determined in the remedial design phase (refer to Section 5.4 for more details. Figure 7.6-3, located in Appendix E, presents the conceptual design of the combined hydraulic extraction and SVE well layout for this remedial alternative. This alternative assumes that 32 hydraulic extraction wells would be located across the lateral extent of the source area at an approximate spacing of 30 feet. The hydraulic extraction wells would be screened in the saturated zone (50 feet to 80 feet bgs). For the conceptual design and evaluation, SVE is assumed rather than bioventing. Six SVE wells would be installed separately at 70-foot spacing as described in Alternative 3, and screened between 30 feet to 50 feet bgs with the objective of protecting groundwater from leaching vadose zone contaminants. The aboveground GWTS would be designed for a maximum flow rate of approximately 32 gpm. The GWTS is assumed to utilize multiple processes including a liquid-liquid separator, advanced oxidation (hydrogen peroxide+ozone oxidation of dissolved-phase hydrocarbons), air stripping and liquid-phase carbon adsorption, as discussed for SA12. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 600 scfm. For cost evaluation purposes, the vapor treatment system assumes the use of a thermal oxidizer. The hydraulic extraction component of this alternative would be expected to operate for up to 10 years and the SVE component for 4 years. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the wells and fenced area for monitoring and maintenance.

ALTERNATIVE 5 - ISCO + SVE + ICs + MONITORING

The FS evaluation of this alternative assumed the use of peroxone oxidation as described in Section 5.4. Figure 7.6-4, located in Appendix E, presents a conceptual design of the layout of the ISCO system. The design assumes the use of injection well clusters at an approximate spacing of 15 feet on center, a total of 112 injection well clusters. Each injection well cluster would consist of three multi-level ¾-inch injection points distributed in the treatment zone between 50 and 80 feet bgs to cover the entire depth of contamination in the saturated zone. Additional information on well construction was presented in Section 5.4. The conceptual design for the peroxone system, based on the lower estimate of hydrocarbon concentrations in SA9, assumes a total injection of 4,000 gallons of 20% hydrogen peroxide and 300 pounds of ozone per injection well. This corresponds to a total injection of about 448,000 gallons of peroxide and 34,000 lb of ozone over a 2-year period. An 80-ppd ozone generator is proposed for this system. Section 5.4 and Appendix E give more details on assumptions used for the injection cycles. Twenty-eight SVE wells would be included in the interior of the source area at a spacing of 30 feet on center to remove VOCs in the vadose zone. Some of the interior SVE wells would be screened into the water table (down to 60 feet bgs) to serve as interim groundwater monitoring wells during the remediation. Eight SVE sentry wells would also be included along the footprint of the building to prevent vapor migration and vapor intrusion into the building (Figure 7.6-4 located in Appendix E) to control migration of VOC and ozone vapors released from the oxidation process. A high-vacuum positive-displacement blower with a maximum flow rate of 1,000 scfm is proposed for the SVE system. For cost evaluation purposes, the aboveground treatment for the SVE vapors assumes the use of thermal oxidizers. The ISCO component would be expected to operate for 2 years and the SVE component would be expected to operate for 4 years before reaching the point of diminishing returns. For safety reasons, the entire source area and the treatment system would be enclosed within a chain-link fence to prevent access by the public. Maintenance personnel would require frequent access to the fenced area for monitoring and maintenance.

ALTERNATIVE 6 – ISSH + SVE + ICs + MONITORING

This alternative assumes the use of ERH to heat soil in the source area for hydrocarbon remediation. Figure 7.6-5, located in Appendix E, presents a conceptual design of the ERH system for this alternative. The design involves the placement of electrode wells, which would also serve as SVE wells, in the subsurface at a spacing of approximately 20 feet on center across the extent of the source area, totaling 63 electrode wells. Each electrode well would have a dual conductive interval from 25 to 55 feet bgs and 60 to 80 feet bgs and a SVE well dual screened 15 to 30 feet bgs and 30 to 50 feet bgs. The overall heated zone is expected to be between 15 and 80 feet bgs. The conceptual design for this source area assumed one 1,250 kW transformer with an average power usage of approximately 489,000 kWhr per month to heat the impacted area. Based on the design provided by the vendor (Thermal Remediation Services), the soil heating portion of the remedial alternative would consume approximately 11.8 million kWhr of electrical energy for 2-year operation. The SVE system is designed for this alternative with the dual purpose of removing volatile contaminants in the vadose zone and preventing uncontrolled vapor migration into the building. Eight sentry SVE wells at 30-foot spacing would be included along the footprint of the building to prevent vapor migration and vapor intrusion into the building (Figure 7.6-5 located in Appendix E). The extracted vapors would be treated in an aboveground treatment system that would include condensation, phase separation, and vapor-phase treatment using a thermal oxidizer or internal combustion engine. Further description of the treatment system is presented in Section 5.4. The treatment system would include a vacuum blower (or multiple blowers) sized for a total flow of approximately 2,500 scfm. Condensed steam would be treated in a water treatment system designed to handle up to 10 gpm using advanced oxidation and carbon adsorption technology. The active remedial components of this alternative (ERH+SVE) are expected to operate for approximately 2 years before reaching the point of diminishing returns. For safety reasons, the entire source area and the treatment system would be enclosed within a chain-link fence to prevent access by the public. Maintenance personnel would require access to the fenced area on a daily basis for monitoring and maintenance.

7.7 SOURCE AREA 4

7.7.1 Description of SA4 Potential NAPL Contamination

SA4 is located on parcel 7351-034-069 (EAPC 28), which is in the northern portion of the styrene plancor. Former plancor facilities identified within the parcel included aboveground tanks, styrene finishing/benzene purification, styrene production/propane cracking, oil separator tank and underground pipelines. Former plant facilities and their spatial relationship to the commercial building currently present on the parcel are illustrated on Figure 7.7-1 located in Appendix E. This building is a large warehouse that covers a significant portion of the property. Soil, soil gas and groundwater sampling locations for this parcel are shown on Figures 2-4 through 2-14.

SA4 is identified as a potential NAPL area based on elevated concentrations of benzene in groundwater (140,000 µg/L at WPL0002 on Figure 7.7-1 located in Appendix E) and the former presence of multiple VOC storage tanks. Based on available data, benzene is inferred to be present in the vadose zone and upper portions of the saturated zone (water table/UBF). Low-permeability silt and clay dominate the upper 15 feet bgs, below which there are thin interbedded layers of silty sand. Below approximately 60 feet bgs is the MBFB/C (merged) that includes fine to moderate sand. The water table is at approximately 50 feet bgs.

The groundwater contamination source area is assumed to be located entirely under the current building on the parcel, as shown on Figure 7.7-1 located in Appendix E. The source area is estimated to be approximately 16,100 SF with an impacted soil volume of approximately 39,000 CY. The depth of contamination is assumed to be between 15 and 80 feet bgs.

7.7.2 Risk Summary

Surface pathway risks at EAPC 28 are presented in Section 8.3.1.3. The outdoor soil CR is 8E-06 while the indoor air CR is less than 1E-06. However, the NAPL FS evaluation did not consider surface pathway risks and instead dealt with protection of groundwater and contamination in deep soil (>15 feet bgs), where exposure is unlikely.

7.7.3 Description of Remedial Alternatives

SA4 differs from the source areas discussed above because there is no defined source area in outdoor soil and the impacted soils are assumed to be entirely under the building. A range of remedial alternatives are presented here using the same technology options discussed earlier, with some modifications. Active remedial alternatives were evaluated for two scenarios. The first assumed the use of horizontal remediation wells under the building due to access limitations within the building interior. The second scenario assumed full access to the building interior and therefore included vertical remediation wells within the building footprint. Aggressive remedial technologies such as ISCO and ISSH were considered only for the second scenario because ISCO and ISSH cannot be implemented reliably using horizontal wells. Implementation of vertical wells inside the building assumes that the specific well locations are accessible and that clearance to the ceiling is adequate for drilling and installing wells. Practically, the assumed well locations may coincide with location of facility equipment or structures, and one or several wells may have to be moved or installed in slanted borings. This evaluation was based on an assumed NAPL area, and if any active remediation is contemplated in SA4, extensive sub-slab investigation of the soils under the building would need to be conducted before the existence and extent of a source area can be confirmed. The IC layers that apply to the parcels associated with this source area are presented in Section 5. The ICs and Monitoring components are the same for the Alternatives 2 through 6.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – INTRINSIC BIODEGRADATION + ICs + MONITORING

ICs for the parcels at the Del Amo site are primarily focused towards controlling potential exposures to residual soil contamination and were discussed as part of the soils portion of the FS in Section 5. Monitoring includes annual groundwater monitoring of three wells located in the vicinity of the source area to confirm that there is no significant migration of hydrocarbons, either as NAPL or as high dissolved-phase concentrations. Wells located in the vicinity of this area (e.g., PZL0009, PZL0006, SWL0047) would be included in the site-wide monitoring program.

ALTERNATIVES 3 AND 3A – SVE/BV (UB) + ICs + MONITORING

Alternative 3 uses SVE/BV technology to address soil contamination in the vadose zone. For the purposes of the conceptual design and evaluation, SVE is assumed rather than bioventing. Figure 7.7-2, located in Appendix E, shows the layout of the horizontal SVE wells and treatment system that are located in the existing truck loading dock area. This alternative assumes that vertical wells cannot be installed within the building. Four horizontal SVE wells are assumed to be spaced at approximately 70 feet on center across the extent of the source area. The horizontal SVE wells are assumed to be 2-inch PVC wells installed at a depth of 30 feet bgs and screened over a length of 70 feet. The primary objective of this SVE design is to address the permeable sandy zones to prevent leaching and thereby protect groundwater. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 500 scfm[31]. The final VETS will be evaluated and selected during the remedial design; however, for cost evaluation purposes, a thermal oxidizer[32] is assumed for vapor treatment. This alternative would be expected to operate for up to 4 years. Other vapor treatment options and more details about the conceptual design of the SVE system were presented in Section 5.4. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the fenced area for monitoring and maintenance.

Alternative 3A is a variation of Alternative 3 that assumes vertical wells can be installed within the building. Figure 7.7-2A, located in Appendix E, shows the layout of the vertical wells inside the building. Four vertical SVE wells are assumed to be spaced at approximately 70 feet on center across the extent of the source area. SVE wells are assumed to be 2-inch PVC wells screened in the more permeable zone between 30 feet bgs and 50 feet bgs (the water table). This conceptual design assumes that wells can be drilled at these specific well locations. For proposed well locations that cannot be drilled due to the presence of equipment or structures it may be necessary to use angled borings or alternate locations. The extracted vapors would be treated in a VETS located outside the building. The VETS would include a high-vacuum positive-displacement blower with a rated maximum flow of 200 scfm and a thermal

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[31] The total flow rate and SVE system sizing was based on assumed well flows from the various lithotypes. For the permeable zone above the water table, we assumed a flow of 1-2 scfm/foot of permeable zone thickness.

[32] There is a history of public opposition toward thermal treatment of extracted VOC vapors at the Del Amo Waste Pit Area and carbon adsorption is now being used there.

oxidizer. Periodically, access to the wells would be required for monitoring and maintenance. The other aspects of this alternative are similar to Alternative 3.

ALTERNATIVES 4 AND 4A– HYDRAULIC EXTRACTION + SVE/BV (UB) + ICs + MONITORING

Alternative 4 includes the use of hydraulic extraction in the saturated zone combined with SVE in the source area, and uses SVE/BV technology to address soil contamination in the vadose zone. Figure 7.7-3, located in Appendix E, presents a conceptual design that combines SVE using horizontal wells (as in Alternative 3) and hydraulic extraction using vertical wells along the footprint of the building nearest to the source area. This alternative assumes that vertical wells cannot be installed within the building. For the conceptual design and evaluation, SVE is assumed rather than bioventing. Twelve vertical hydraulic extraction wells would be located at an approximate spacing of 30 feet, and four horizontal SVE wells would be located and screened as in Alternative 3. The hydraulic extraction wells would be 4-inch PVC, screened in the saturated zone (50 feet to 80 feet bgs). The aboveground GWTS would be designed for a maximum flow rate of approximate 12 gpm. The GWTS is assumed to utilize multiple processes including a liquid-liquid separator, advanced oxidation (hydrogen peroxide+ozone oxidation of dissolved-phase hydrocarbons), air stripping and liquid-phase carbon adsorption, as discussed for SA12. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 750 scfm. For cost evaluation purposes, the vapor treatment system assumes the use of a thermal oxidizer. The hydraulic extraction component of this alternative would be expected to operate for up to 10 years and the SVE component for 4 years. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the fenced area for monitoring and maintenance.

Alternative 4A is a variation of Alternative 4 that assumes vertical wells can be installed within the building. Figure 7.7-3A, located in Appendix E, shows the layout of the vertical SVE and hydraulic extraction wells inside the building. Sixteen vertical hydraulic extraction wells would be located at an approximate spacing of 30 feet and four vertical SVE wells would be located and screened as in Alternative 3A. The well spacing is similar to that used for sources areas (such as SA12) located outside the building. This alternative assumes vertical wells can be drilled at specific locations inside the building. For proposed well locations that cannot be drilled due to the presence of equipment or structures it may be necessary to use angled borings or alternate locations. The extracted vapors and groundwater would be treated in a VETS and GWTS located outside the building. The VETS would include a high-vacuum positive-displacement blower with a rated maximum flow of 500 scfm and would assume the use of a thermal oxidizer. The GWTS would be designed to a maximum flow rate of approximately 16 gpm. Periodically, access to the wells would be required for monitoring and maintenance. The other aspects of this alternative are similar to Alternative 4.

ALTERNATIVE 5 - ISCO + SVE + ICs + MONITORING

The FS evaluation of this alternative assumed the use of peroxone oxidation as described in Section 5.4. Figure 7.7-4, located in Appendix E, presents a conceptual design of the layout of the ISCO system. The design assumes the use of injection well clusters at an approximate spacing of 15 feet on center, a total of

60 injection well clusters. Each injection well cluster would consist of three multi-level ¾-inch injection points distributed in the treatment zone between 50 and 80 feet bgs to cover the entire depth of contamination in the saturated zone. Additional information on well construction was presented in Section 5.4. The conceptual design for the peroxone system, based on the lower estimate of hydrocarbon concentrations in SA4, assumes a total injection of 4,000 gallons of 20% hydrogen peroxide and 300 pounds of ozone per injection well. This corresponds to a total injection of about 240,000 gallons of peroxide and 18,000 lb of ozone over a 2-year period. A 40-ppd ozone generator is proposed for this system. Section 5.4 and Appendix E gives more details on the assumptions used for the injection cycle. Sixteen SVE wells would be included in the interior of the source area at a spacing of 30 feet on center to remove VOCs in the vadose zone. A more closely spaced SVE system is included with this aggressive alternative with SVE wells that are dual screened 15 to 30 feet bgs and 30 to 50 feet bgs. Some of the interior SVE wells would be screened into the water table (down to 60 feet bgs) to serve as interim groundwater monitoring wells during the remediation. Twenty SVE sentry wells would also be included in the periphery of the source area (Figure 7.7-4 located in Appendix E) to control migration of VOC and ozone vapors released from the exothermic oxidation process. A high-vacuum positive-displacement blower with a maximum flow rate of 750 scfm is proposed for the SVE system. An aboveground treatment system similar to that in Alternative 3 is included for addressing the VOCs in the SVE system influent. For cost evaluation purposes, the aboveground treatment for the SVE vapors assumes the use of thermal oxidizers. The chemical storage tanks and VETS are assumed to be located outside the building. The ISCO component would be expected to operate for 2 years and the SVE component would be expected to operate for 4 years before reaching the point of diminishing returns. For safety reasons, the source area inside the building would be marked with caution tape and signage and the exterior treatment compound would be enclosed within a chain-link fence to prevent access by the public. Maintenance personnel would require frequent access to the remedial area inside the building and the fenced treatment equipment area for monitoring and maintenance.

ALTERNATIVE 6 – ISSH + SVE + ICs + MONITORING

This alternative assumes the use of ERH to heat soil in the source area for hydrocarbon remediation. Figure 7.7-5, located in Appendix E, presents a conceptual design of the ERH system for this alternative. The design involves the placement of electrode wells, which would also serve as SVE wells, in the subsurface at a spacing of approximately 20 feet on center across the extent of the source area, totaling 39 electrode wells. Each electrode well would have a dual conductive interval from 25 to 50 feet bgs and 50 to 80 feet bgs and a SVE well dual screened 15 to 30 feet bgs and 30 to 50 feet bgs. The overall heated zone is expected to be between 15 and 80 feet bgs. The conceptual design for this source area assumed one 1,250 kW transformer with an average power usage of approximately 298,000 kWhr per month to heat the impacted area. Based on the design provided by the vendor (Thermal Remediation Services), the soil heating portion of the remedial alternative would consume approximately 7.2 million kWhr of electrical energy for 2-year operation. The SVE system is designed for this alternative with the dual purpose of removing volatile contaminants in the vadose zone and preventing uncontrolled vapor migration into the building. Twenty sentry SVE wells at 30-foot spacing would be included along the boundary of the source area and footprint of the building to prevent vapor migration and vapor intrusion into the building (Figure 7.7-5 located in Appendix E). The extracted vapors would be treated in an aboveground treatment system that would include condensation, phase separation, and vapor-phase treatment using a thermal oxidizer or internal combustion engine. Further description of the treatment system is presented in Section 5.4. The treatment system would include a vacuum blower (or multiple blowers) sized for a total flow of approximately 2,500 scfm. Condensed steam would be treated in a water treatment system designed to handle up to 10 gpm using advanced oxidation and carbon adsorption technology. Due to the volatile nature of the contaminants the ERH system may need to be operated at low heating rates to control vapor influent concentrations and maintain safe conditions. The active remedial components of this alternative (ERH+SVE) are expected to operate for approximately 2 years before reaching the point of diminishing returns. For safety reasons, the source area inside the building would be marked with caution tape and signage and the exterior treatment compound would be enclosed within a chain-link fence to prevent access by the public. Maintenance personnel would require access to the remedial area inside the building and the fenced treatment equipment area on a daily basis for monitoring and maintenance.

7.8 SOURCE AREA 7

7.8.1 Description of SA7 Potential NAPL Contamination

SA7 is located on parcel 7351-034-052 (EAPC 22), which is in the central portion of the former styrene plancor. Former plancor facilities identified within the parcel included aboveground tanks storing benzene, styrene finishing/benzene purification process units, styrene production/propane cracking processes, oil separator tank and underground pipelines. Former rubber plant facilities and their spatial relationship to the commercial building that currently covers a large portion of the property are illustrated on Figure 7.8-1 located in Appendix E. The soil, soil gas and groundwater sampling locations for this parcel are shown on Figures 2-4 through 2-14.

SA7 is identified as a potential NAPL area based on elevated concentrations of benzene and ethylbenzene in groundwater at CWL0012 (benzene = 290,000 µg/L; ethylbenzene = 26,000 µg/L) and the former presence of VOC storage tanks. Soil and soil gas data for the parcel are limited and indicate only low (below RI screening criteria) or non-detectable concentrations of VOCs to be present near the southern margin of the existing parcel building. For the purposes of the FS, the source area is assumed to be entirely under the building in the area of the former VOC storage tanks (Figure 7.8-1 located in Appendix E). The subsurface lithology is assumed to be similar to SA4, with the contamination largely residing in the UBF. The source area is estimated to extend over an area of approximately 8,500 SF with an impacted soil volume of approximately 20,500 CY. The depth of contamination is assumed to be between 15 and 80 feet bgs.

7.8.2 Risk Summary

Surface pathway risks for EAPC 22 are presented in Section 8.3.4.6. The CRs for both outdoor soil and indoor air are less than 1E-06. However, the NAPL FS evaluation did not consider surface pathway risks and instead dealt with protection of groundwater and contamination in deep soil (>15 feet bgs), where exposure is unlikely.

7.8.3 Description of Remedial Alternatives

This source area is similar to SA4, where impacted soils are assumed to be entirely under an existing building. Active remedial alternatives were evaluated for two scenarios. The first assumed the use of horizontal remediation wells under the building due to access limitations within the building interior. The second scenario assumed full access to the building interior and therefore included vertical remediation wells within the building footprint. As discussed under SA4, aggressive remedial technologies such as ISCO and ISSH were considered only for the second scenario, with wells inside the building. If any active remediation is contemplated in SA7, extensive sub-slab investigation of the soils under the building would need to be conducted before the existence and extent of a source area can be confirmed. The IC layers that apply to the parcels associated with this source area are presented in Section 5. The ICs and Monitoring components are the same for the Alternatives 2 through 6.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – INTRINSIC BIODEGRADATION + ICs + MONITORING

ICs for the parcels at the Del Amo site are primarily focused towards controlling potential exposures to residual soil contamination and were discussed as part of the soils portion of the FS in Section 5. Monitoring includes annual groundwater monitoring of three wells located in the vicinity of the source area to confirm that there is no significant migration of hydrocarbons, either as NAPL or as high dissolved-phase concentrations. Wells located in the vicinity of this area (e.g., XMW-21, SWL0047, SWL0065) would be included in the site-wide monitoring program.

ALTERNATIVES 3 AND 3A – SVE/BV (UB) + ICs + MONITORING

Alternative 3 uses SVE/BV technology to address soil contamination in the vadose zone. For the purposes of the conceptual design and evaluation, SVE is assumed rather than bioventing. Figure 7.8-2, located in Appendix E, shows the layout of the horizontal SVE wells and treatment system that are located in the existing truck loading dock area. This alternative assumes that vertical wells cannot be installed within the building. Two horizontal SVE wells are assumed to be spaced at approximately 70 feet on center across the extent of the source area. The horizontal SVE wells are assumed to be 2-inch PVC wells installed at a depth of 30 feet bgs and screened over a length of 85 feet. The primary objective of this SVE design is to address the permeable sandy zones to prevent leaching and thereby protect groundwater. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 400 scfm[33]. The final VETS will be evaluated and selected during the remedial design; however, for cost evaluation purposes, a thermal oxidizer[34] is assumed for vapor treatment. This alternative would be expected to operate for up to 4 years. Other vapor treatment options and more details about the conceptual design of the SVE system were presented in Section 5.4. For safety reasons, the

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[33] The total flow rate and SVE system sizing was based on assumed well flows from the various lithotypes. For the permeable zone above the water table, we assumed a flow of 1-2 scfm/foot of permeable zone thickness.

[34] There is a history of public opposition toward thermal treatment of extracted VOC vapors at the Del Amo Waste Pit Area and carbon adsorption is now being used there.

treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the fenced area for monitoring and maintenance

Alternative 3A is a variation of Alternative 3 that assumes vertical wells can be installed within the building. Figure 7.8-2A, located in Appendix E, shows the layout of the vertical wells inside the building. Two vertical SVE wells are assumed to be spaced at approximately 70 feet on center across the extent of the source area. SVE wells are assumed to be 2-inch PVC wells screened in the more permeable zone between 30 feet bgs and 50 feet bgs (the water table). This conceptual design assumes that wells can be drilled at these specific well locations. For proposed well locations that cannot be drilled due to the presence of equipment or structures it may be necessary to use angled borings or alternate locations. The extracted vapors would be treated in a VETS located outside the building. The VETS would include a high-vacuum positive-displacement blower with a rated maximum flow of 150 scfm and a thermal oxidizer. Periodically, access to the wells would be required for monitoring and maintenance. The other aspects of this alternative are similar to Alternative 3.

ALTERNATIVES 4 AND 4A – HYDRAULIC EXTRACTION + SVE/BV (UB) + ICs + MONITORING

Alternative 4 includes the use of hydraulic extraction in the saturated zone combined with SVE in the source area, and uses SVE/BV technology to address soil contamination in the vadose zone. Figure 7.8-3, located in Appendix E, presents a conceptual design that combines SVE using horizontal wells (as in Alternative 3) and hydraulic extraction using vertical wells along the footprint of the building nearest to the source area. This alternative assumes that vertical wells cannot be installed within the building. For the conceptual design and evaluation, SVE is assumed rather than bioventing. Ten vertical hydraulic extraction wells would be located at an approximate spacing of 30 feet, and two horizontal SVE wells would be located and screened as in Alternative 3. The hydraulic extraction wells would be 4-inch PVC, screened in the saturated zone (40 feet to 80 feet bgs). The aboveground GWTS would be designed for a maximum flow rate of approximate 10 gpm. The GWTS is assumed to utilize multiple processes including a liquid-liquid separator, advanced oxidation (hydrogen peroxide+ozone oxidation of dissolved-phase hydrocarbons), air stripping and liquid-phase carbon adsorption, as discussed for SA12. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 500 scfm. For cost evaluation purposes, the vapor treatment system assumes the use of a thermal oxidizer. The hydraulic extraction component of this alternative would be expected to operate for up to 10 years and the SVE component for 4 years. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the fenced area for monitoring and maintenance.

Alternative 4A is a variation of Alternative 4 that assumes vertical wells can be installed within the building. Figure 7.8-3A, located in Appendix E, shows the layout of the vertical SVE and hydraulic extraction wells inside the building. Six vertical hydraulic extraction wells would be located at an approximate spacing of 30 feet and two vertical SVE wells would be located and screened as in Alternative 3A. The well spacing is similar to that used for sources areas (such as SA12) located outside the building. This alternative assumes vertical wells can be drilled at specific locations inside the building. For proposed well locations that cannot be drilled due to the presence of equipment or structures it may be necessary to use angled borings or alternate locations. The extracted vapors and groundwater would be treated in a VETS and GWTS located outside the building. The VETS would include a high-vacuum positive-displacement blower with a rated maximum flow of 300 scfm and would assume the use of a thermal oxidizer. The GWTS would be designed to a maximum flow rate of approximately 6 gpm. Periodically, access to the wells would be required for monitoring and maintenance. The other aspects of this alternative are similar to Alternative 4.

ALTERNATIVE 5 - ISCO + SVE + ICs + MONITORING

The FS evaluation of this alternative assumed the use of peroxone as described in Section 5.4. Figure 7.8-4, located in Appendix E, presents a conceptual design of the layout of the ISCO system. The design assumes the use of injection well clusters at an approximate spacing of 15 feet on center, a total of 30 injection well clusters. Each injection well cluster would consist of three multi-level ¾-inch injection points distributed in the treatment zone between 50 and 80 feet bgs to cover the entire depth of contamination in the saturated zone. Additional information on well construction was presented in Section 5.4. The conceptual design for the peroxone system, based on the lower estimate of hydrocarbon concentrations in SA7, assumes a total injection of 4,000 gallons of 20% hydrogen peroxide and 300 pounds of ozone per injection well. This corresponds to a total injection of about 120,000 gallons of peroxide and 9,000 lb of ozone over a 2-year period. A 20-ppd ozone generator is proposed for this system. Section 5.4 and Appendix E give more details on assumptions used for the injection cycle. Nine SVE wells would be included in the interior of the source area at a spacing of 30 feet on center to remove VOCs in the vadose zone. This SVE system would target both the 15 to 30 feet bgs lower permeability zone and the more permeable deeper zone with SVE wells that are dual screened 15 to 30 feet bgs and 30 to 50 feet bgs. Some of the interior SVE wells would be screened into the water table (down to 60 feet bgs) to serve as interim groundwater monitoring wells during the remediation. Twelve SVE sentry wells would also be included in the periphery of the source area (Figure 7.8-4 located in Appendix E) to control migration of VOC and ozone vapors released from the exothermic oxidation process. A high-vacuum positive-displacement blower with a maximum flow rate of 500 scfm is proposed for the SVE system. For cost evaluation purposes, the aboveground treatment for the SVE vapors assumes the use of thermal oxidizers. The chemical storage tanks and VETS are assumed to be located outside the building. The ISCO component would be expected to operate for 2 years and the SVE component would be expected to operate for 4 years before reaching the point of diminishing returns. For safety reasons, the source area inside the building would be marked with caution tape and signage and the exterior treatment compound would be enclosed within a chain-link fence to prevent access by the public. Maintenance personnel would require frequent access to the treatment area inside the building and the fenced treatment equipment area for monitoring and maintenance.

ALTERNATIVE 6 – ISSH + SVE + ICs + MONITORING

This alternative assumes the use of ERH to heat soil in the source area for hydrocarbon remediation. Figure 7.8-5, located in Appendix E, presents a conceptual design of the ERH system for this alternative. The design involves the placement of electrode wells, which would also serve as SVE wells, in the subsurface at a spacing of approximately 20 feet on center across the extent of the source area, totaling 24 electrode wells. Each electrode well would have a dual conductive interval from 25 to 50 feet bgs and 50 to 80 feet bgs and a SVE well dual screened 15 to 30 feet bgs and 30 to 50 feet bgs. The overall heated zone is expected to be between 15 and 80 feet bgs. The conceptual design for this source area assumed one 1,250 kW transformer with an average power usage of approximately 158,000 kWhr per month to heat the impacted area. Based on the design provided by the vendor (Thermal Remediation Services), the soil heating portion of the remedial alternative would consume approximately 3.9 million kWhr of electrical energy for 2-year operation. Twelve sentry SVE wells at 30-foot spacing would be included along the boundary of the source area and footprint of the building to prevent vapor migration and vapor intrusion into the building (Figure 7.8-5 located in Appendix E). The extracted vapors would be treated in an aboveground treatment system that would include condensation, phase separation, and vapor-phase treatment using a thermal oxidizer or internal combustion engine. Further description of the treatment system is presented in Section 5.4. The treatment system would include a vacuum blower (or multiple blowers) sized for a total flow of approximately 1,500 scfm. Condensed steam would be treated in a water treatment system designed to handle up to 10 gpm using advanced oxidation and carbon adsorption technology. Due to the volatile nature of the contaminants the ERH system may need to be operated at low heating rates to control vapor influent concentrations and maintain safe conditions. The active remedial components of this alternative (ERH+SVE) are expected to operate for approximately 2 years before reaching the point of diminishing returns. For safety reasons, the source area inside the building would be marked with caution tape and signage and the exterior treatment compound would be enclosed within a chain-link fence to prevent access by the public. Maintenance personnel would require access to the remedial area inside the building and the fenced treatment equipment area on a daily basis for monitoring and maintenance.

7.9 SOURCE AREA 8

7.9.1 Description of SA8 Potential NAPL Contamination

SA8 is located on parcel 7351-034-047 (EAPC 21), in the central portion of the styrene plancor at the former plant site. Former rubber plant facilities identified within the parcel included aboveground tanks storing benzene, ethylbenzene and other chemicals, a sump, and underground pipelines transporting wastewater. Former plant facilities and their spatial relationship to the commercial building that currently covers a large portion of the parcel are illustrated on Figure 7.9-1 located in Appendix E. The soil, soil gas and groundwater sampling locations for this parcel are shown on Figures 2-4 through 2-14.

SA8 is identified as a potential NAPL area based on elevated concentrations of ethylbenzene at downgradient sampling locations WPL0001 and CWL0014. Benzene is also a groundwater contaminant in this area. Subsurface contaminant data for the parcel are limited to 13 shallow soil gas sampling locations. Benzene and ethylbenzene were the primary contaminants detected, with maximum concentrations of 4.9 and 64 ppmv, respectively. Subsurface lithology and extent of contamination is assumed to be similar to SA4. The lateral extent of the source area is assumed to be located entirely under the existing building on the parcel, as shown on Figure 7.9-1 located in Appendix E. The source area is estimated to be approximately 8,800 SF with an impacted soil volume of approximately 21,200 CY. The depth of contamination is assumed to extend from 15 to 80 feet bgs.

7.9.2 Risk Summary

The outdoor soil CR for EAPC 21 (Group 2 parcel) is assumed to be significantly less than 1E-06 since COPCs were not identified at this parcel. The indoor air CR was below 1E-06. However, the NAPL FS evaluation did not consider surface pathway risks and instead dealt with protection of groundwater and contamination in deep soil (>15 feet bgs), where exposures are unlikely.

7.9.3 Description of Remedial Alternatives

This source area is similar to SA4, where impacted soils are assumed to be entirely under an existing building. Active remedial alternatives were evaluated for two scenarios. The first assumed the use of horizontal remediation wells under the building due to access limitations within the building interior. The second scenario assumed full access to the building interior and therefore included vertical remediation wells within the building footprint. As discussed under SA4, aggressive remedial technologies such as ISCO and ISSH were considered only for the second scenario, with wells inside the building. If any active remediation is contemplated in SA8, extensive sub-slab investigation of the soils under the building would need to be conducted before the existence and extent of a source area can be confirmed. Only IC layers 1 and 2 apply to EAPC 21 associated with this source area because this EAPC belongs to Group 2 (Section 5). The ICs and Monitoring components are the same for the Alternatives 2 through 6.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – INTRINSIC BIODEGRADATION + ICs + MONITORING

ICs for the parcels at the Del Amo site are primarily focused towards controlling potential exposures to residual soil contamination and were discussed as part of the soils portion of the FS in Section 5. Monitoring includes annual groundwater monitoring of three wells located in the vicinity of the source area to confirm that there is no significant migration of hydrocarbons, either as NAPL or as high dissolved-phase concentrations. Wells located in the vicinity of this area (e.g., PZL0006, SWL0016, SWL0036) would be included in the site-wide monitoring program.

ALTERNATIVES 3 AND 3A– SVE/BV (UB) + ICs + MONITORING

Alternative 3 uses SVE/BV technology to address soil contamination in the vadose zone. For the purposes of the conceptual design and evaluation, SVE is assumed rather than bioventing. Figure 7.9-2, located in Appendix E, shows the layout of the horizontal SVE wells and treatment system that are located in the existing truck loading dock area. This alternative assumes that vertical wells cannot be installed within the building. Two horizontal SVE wells are assumed to be spaced at approximately 70 feet on center across the extent of the source area. The horizontal SVE wells are assumed to be 2-inch PVC wells installed at a depth of 30 feet bgs and screened over a length of 80 feet. The primary objective of this SVE design is to address the permeable sandy zones to prevent leaching and thereby protect groundwater. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 400 scfm[35]. The final VETS will be evaluated and selected during the remedial design; however, for cost evaluation purposes, a thermal oxidizer[36] is assumed for vapor treatment. This alternative would be expected to operate for up to 4 years. Other vapor treatment options and more details about the conceptual design of the SVE system were presented in Section 5.4. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the fenced area for monitoring and maintenance.

Alternative 3A is a variation of Alternative 3 that assumes vertical wells can be installed within the building. Figure 7.9-2A, located in Appendix E, shows the layout of the vertical wells inside the building. Two vertical SVE wells are assumed to be spaced at approximately 70 feet on center across the extent of the source area. SVE wells are assumed to be 2-inch PVC wells screened in the more permeable zone between 30 feet bgs and 50 feet bgs (the water table). This conceptual design assumes that wells can be drilled at these specific well locations. For well locations that cannot be drilled due to the presence of equipment or structures it may be necessary to use angled borings or alternate locations. The extracted vapors would be treated in a VETS located outside the building. The VETS would include a high-vacuum positive-displacement blower with a rated maximum flow of 150 scfm and a thermal oxidizer. Periodically, access to the wells would be required for monitoring and maintenance. The other aspects of this alternative are similar to Alternative 3.

ALTERNATIVES 4 AND 4A– HYDRAULIC EXTRACTION + SVE/BV (UB) + ICs + MONITORING

Alternative 4 includes the use of hydraulic extraction in the saturated zone combined with SVE in the source area, and uses SVE/BV technology to address soil contamination in the vadose zone. Figure 7.9-3, located in Appendix E, presents a conceptual design that combines SVE using horizontal wells (as in Alternative 3) and hydraulic extraction using vertical wells along the footprint of the building nearest to the source area. This alternative assumes that vertical wells cannot be installed within the building. For the conceptual design and evaluation, SVE is assumed rather than bioventing. Nine vertical hydraulic extraction wells would be located at an approximate spacing of 30 feet, and two horizontal SVE wells would be located and screened as in Alternative 3. The hydraulic extraction wells would be 4-inch PVC, screened in the saturated zone (50 feet to 80 feet bgs). The aboveground GWTS would be designed for a maximum flow rate of approximate 9 gpm. The GWTS is assumed to utilize multiple processes including a liquid-liquid separator, advanced oxidation (hydrogen peroxide+ozone oxidation of dissolved-phase hydrocarbons), air stripping and liquid-phase carbon adsorption, as discussed for SA12. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 500 scfm. For cost evaluation purposes, the vapor treatment system assumes the use of a thermal oxidizer. The hydraulic extraction component of this alternative would be expected to operate for up to 10 years and the SVE component for 4 years. For safety reasons, the treatment system

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[35] The total flow rate and SVE system sizing was based on assumed well flows from the various lithotypes. For the permeable zone above the water table, we assumed a flow of 1-2 scfm/foot of permeable zone thickness.

[36] There is a history of public opposition toward thermal treatment of extracted VOC vapors at the Del Amo Waste Pit Area and carbon adsorption is now being used there.

would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the fenced area for monitoring and maintenance.

Alternative 4A is a variation of Alternative 4 that assumes vertical wells can be installed within the building. Figure 7.9-3A, located in Appendix E, shows the layout of the vertical SVE and hydraulic extraction wells inside the building. Six vertical hydraulic extraction wells would be located at an approximate spacing of 30 feet and two vertical SVE wells would be located and screened as in Alternative 3A. The well spacing is similar to that used for sources areas (such as SA12) located outside the building. This alternative assumes vertical wells can be drilled at specific locations inside the building. For proposed well locations that cannot be drilled due to the presence of equipment or structures it may be necessary to use angled borings or alternate locations. The extracted vapors and groundwater would be treated in a VETS and GWTS located outside the building. The VETS would include a high-vacuum positive-displacement blower with a rated maximum flow of 300 scfm and would assume the use of a thermal oxidizer. The GWTS would be designed to a maximum flow rate of approximately 6 gpm. Periodically, access to the wells would be required for monitoring and maintenance. The other aspects of this alternative are similar to Alternative 4.

ALTERNATIVE 5 - ISCO + SVE + ICs + MONITORING

The FS evaluation of this alternative assumed the use of peroxone oxidation as described in Section 5.4. Figure 7.9-4, located in Appendix E, presents a conceptual design of the layout of the ISCO system. The design assumes the use of injection well clusters at an approximate spacing of 15 feet on center, a total of 35 injection well clusters. Each injection well cluster would consist of three multi-level ¾-inch injection points distributed in the treatment zone between 50 and 80 feet bgs to cover the entire depth of contamination in the saturated zone. Additional information on well construction was presented in Section 5.4. The conceptual design for the peroxone system, based on the lower estimate of hydrocarbon concentrations in SA8, assumes a total injection of 4,000 gallons of 20% hydrogen peroxide and 300 pounds of ozone per injection well. This corresponds to a total injection of about 140,000 gallons of peroxide and 10,500 lb of ozone over a 2-year period. A 20-ppd ozone generator is proposed for this system. Appendix E gives more details on specific injection amounts and scheduling. Twelve SVE wells would be included in the interior of the source area at a spacing of 30 feet on center to remove VOCs in the vadose zone. Some of the interior SVE wells would be screened into the water table (down to 60 feet bgs) to serve as interim groundwater monitoring wells during the remediation. Fourteen SVE sentry wells would also be included in the periphery of the source area (Figure 7.9-4 located in Appendix E) to control migration of VOC and ozone vapors released from the exothermic oxidation process. A high-vacuum positive-displacement blower with a maximum flow rate of 500 scfm is proposed for the SVE system. For cost evaluation purposes, the aboveground treatment for the SVE vapors assumes the use of thermal oxidizers. The chemical storage tanks and VETS are assumed to be located outside the building. The ISCO component would be expected to operate for 2 years and the SVE component would be expected to operate for 4 years before reaching the point of diminishing returns. For safety reasons, the source area inside the building would be marked with caution tape and signage and the exterior treatment compound would be enclosed within a chain-link fence to prevent access by the public. Maintenance personnel would require frequent access to the treatment area inside the building and the fenced treatment equipment area for monitoring and maintenance.

ALTERNATIVE 6 – ISSH + SVE + ICs + MONITORING

This alternative assumes the use of ERH to heat soil in the source area for hydrocarbon remediation. Figure 7.9-5, located in Appendix E, presents a conceptual design of the ERH system for this alternative. The design involves the placement of electrode wells, which would also serve as SVE wells, in the subsurface at a spacing of approximately 20 feet on center across the extent of the source area, totaling 21 electrode wells. Each electrode well would have a dual conductive interval from 25 to 50 feet bgs and 50 to 80 feet bgs and a SVE well dual screened 15 to 30 feet bgs and 30 to 50 feet bgs. The overall heated zone is expected to be between 15 and 80 feet bgs. The conceptual design for this source area assumed one 1,250 kW transformer with an average power usage of approximately 163,000 kWhr per month to heat the impacted area. Based on the design provided by the vendor (Thermal Remediation Services), the soil heating portion of the remedial alternative would consume approximately 3.9 million kWhr of electrical energy for 2-year operation. The SVE system is designed for this alternative with the dual purpose of removing volatile contaminants in the vadose zone and preventing uncontrolled vapor migration into the building. Fourteen sentry SVE wells at 30-foot spacing would be included along the periphery to prevent vapor migration and vapor intrusion into the building (Figure 7.9-5 located in Appendix E). The extracted vapors would be treated in an aboveground treatment system that would include condensation, phase separation, and vapor-phase treatment using a thermal oxidizer or internal combustion engine. Further description of the treatment system is presented in Section 5.4. The treatment system would include a vacuum blower (or multiple blowers) sized for a total flow of approximately 1,500 scfm. Condensed steam would be treated in a water treatment system designed to handle up to 10 gpm using advanced oxidation and carbon adsorption technology. Due to the volatile nature of the contaminants the ERH system may need to be operated at low heating rates to control vapor influent concentrations and maintain safe conditions. The active remedial components of this alternative (ERH+SVE) are expected to operate for approximately 2 years before reaching the point of diminishing returns. For safety reasons, the source area inside the building would be marked with caution tape and signage and the exterior treatment compound would be enclosed within a chain-link fence to prevent access by the public. Maintenance personnel would require access to the remedial area inside the building and the fenced treatment equipment area on a daily basis for monitoring and maintenance.

7.10 SOURCE AREA 5

7.10.1 Description of SA5 Soil Contamination

SA5 is located on parcel 7351-034-041 (EAPC 18) in the northern portion of the former styrene plancor. Plancor processes associated with this area include styrene purification and wastewater treatment. Former rubber plant facilities identified within the parcel include storage tanks for styrene and ethylbenzene, a primary skimmer basin and underground pipelines for wastewater. Former rubber plant facilities and their spatial relationship to the commercial building that covers a large portion of the parcel are illustrated on Figure 7.10-1 located in Appendix E.

SA5 was designated a source area based on historically elevated concentrations of benzene in groundwater at nearby monitoring well PZL0006 (900 µg/L in 1995) and the former presence of multiple VOC storage tanks. The available data do not indicate the potential presence of NAPL, and the area is therefore evaluated in this FS as an area of likely soil contamination. RI sampling locations in the vicinity of the source area are indicated on Figures 2-4 through 2-14. Available subsurface data for the parcel are limited to 17 shallow soil gas sampling locations.

The majority of the former VOC storage tank footprint at the parcel area could not be sampled due to the existing building on the parcel. The primary contaminants detected in the soil gas samples were benzene (7.2 ppmv maximum), ethylbenzene (32 ppmv maximum) and toluene (9.2 ppmv maximum). The subsurface lithology and extent of contamination of SA5 is assumed to be similar to SA4. The estimated extent of contamination is assumed to be entirely under the building, based on the former rubber plant facility locations, as shown on Figure 7.10-1 located in Appendix E. The source area is estimated to be approximately 4,000 SF in area with an impacted soil volume of approximately 9,600 CY. Contamination is assumed to extend from 15 to 80 feet bgs.

7.10.2 Risk Summary

The outdoor soil CR for EAPC 18 (Group 2 parcel) is assumed to be significantly less than 1E-06 since COPCs were not identified at this parcel. The indoor air CR was below 1E-06. However, the NAPL FS evaluation did not consider surface pathway risks and instead dealt with protection of groundwater and contamination in deep soil (>15 feet bgs), where exposures are unlikely.

7.10.3 Description of Remedial Alternatives

This source area is similar to SA4, where impacted soils are assumed to be entirely under an existing building. Active remedial alternatives were evaluated for two scenarios. The first assumed the use of horizontal remediation wells under the building due to access limitations within the building interior. The second scenario assumed full access to the building interior and therefore included vertical remediation wells within the building footprint. Hydraulic extraction, ISCO and ISSH technologies are not included as alternatives for SA5 because this area is considered unlikely to contain NAPL below the water table. If any active remediation is contemplated in this area, extensive sub-slab investigation of the soils under the building would need to be conducted before the existence and extent of a soil source area can be confirmed. The IC layers that apply to the parcel associated with this source area are presented in Section 5.4.1.1. The ICs and Monitoring components are the same for the Alternatives 2, 3 and 3A.

ALTERNATIVE 1 – NO ACTION

This alternative is required in the FS evaluation by CERCLA.

ALTERNATIVE 2 – INTRINSIC BIODEGRADATION + ICs + MONITORING

ICs for the parcels at the Del Amo site are primarily focused towards controlling potential exposures to residual soil contamination which were discussed as part of the soils portion of the FS in Section 5. Monitoring includes annual groundwater monitoring of one well located in the vicinity of the source area to confirm that there is no significant migration of hydrocarbons, either as NAPL or as high dissolved-phase concentrations. The well located in the vicinity of this area could serve this purpose (PZL0006) would be included in the site-wide monitoring program.

ALTERNATIVES 3 AND 3A – SVE/BV (UB) + ICs + MONITORING

Alternative 3 uses SVE/BV technology to address soil contamination in the vadose zone. For the purposes of the conceptual design and evaluation, SVE is assumed rather than bioventing. Figure 7.10-2, located in Appendix E, shows the layout of the horizontal SVE wells and treatment system that are located in the existing truck loading dock area. This alternative assumes that vertical wells cannot be installed within the building. Two horizontal SVE wells are assumed to be spaced at approximately 70 feet on center across the extent of the source area. The horizontal SVE wells are assumed to be 2-inch PVC wells installed at a depth of 30 feet bgs and screened over a length of 40 feet. The primary objective of this SVE design is to address the permeable sandy zones to prevent leaching and thereby protect groundwater. The extracted vapors would be treated in a VETS that would include a high-vacuum positive-displacement blower with a rated maximum flow of 200 scfm[37]. The final VETS will be evaluated and selected during the remedial design; however, for cost evaluation purposes, a thermal oxidizer[38] is assumed for vapor treatment. This alternative would be expected to operate for up to 4 years. Other vapor treatment options and more details about the conceptual design of the SVE system were presented in Section 5.4. For safety reasons, the treatment system would be enclosed within a chain-link fence to prevent access by the public. Periodically, maintenance personnel would require access to the fenced area for monitoring and maintenance.

Alternative 3A is a variation of Alternative 3 that assumes vertical wells can be installed within the building. Figure 7.10-2A, located in Appendix E, shows the layout of the vertical wells inside the building. Two vertical SVE wells are assumed to be spaced at approximately 70 feet on center across the extent of the source area. SVE wells are assumed to be 2-inch PVC wells screened in the more permeable zone between 30 feet bgs and 50 feet bgs (the water table). This conceptual design assumes that wells can be drilled at these specific well locations. For well locations that cannot be drilled due to the presence of equipment or structures it may be necessary to use angled borings or alternate locations. The extracted vapors would be treated in a VETS located outside the building. The VETS would include a high-vacuum positive-displacement blower with a rated maximum flow of 150 scfm and a thermal oxidizer. Periodically, access to the wells would be required for monitoring and maintenance. The other aspects of this alternative are similar to Alternative 3.

7.11 SOURCE AREA 2 (NO EVALUATION)

SA2 is located along the western boundary of the former plant site on parcel 7351-034-015 (EAPC 16). DNAPL is potentially present at SA2 based on elevated concentrations of TCE and PCE in groundwater. TCE and PCE have also been detected in soil and soil gas samples from the vicinity of a former “pits and

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[37] The total flow rate and SVE system sizing was based on assumed well flows from the various lithotypes. For the permeable zone above the water table, we assumed a flow of 1-2 scfm/foot of permeable zone thickness.

[38] There is a history of public opposition toward thermal treatment of extracted VOC vapors at the Del Amo Waste Pit Area and carbon adsorption is now being used there.

trenches" feature on the parcel (see Figure 6.4-1 located in Appendix D). The pits and trenches were identified based on review of historical aerial photographs from the operational period of the former rubber plant.

SA2 was identified since TCE- and PCE-impacted shallow soil is present at the former plant site and water table groundwater data indicate these compounds are present at concentrations in excess of drinking water MCLs. However, it is the Respondents' position that SA2 is not associated with the pits and trenches feature or the former plant site for the following reasons:

(1) There is no documentation indicating the use of TCE or PCE at the pits and trenches or any other facility at the former plant site;

(2) Large chlorinated solvent storage tanks are known to have been formerly present immediately west of the former plant site and the pits and trenches feature (HartCrowser 2003);

(3) Maximum detected TCE and PCE concentrations in groundwater occur west of the pits and trenches footprint and the former plant site, as indicated in the Combined 2006 Baseline Groundwater Monitoring/TCE and Benzene Plumes Data Acquisition Report (URS 2007a) that was completed as part of recent groundwater remedial design activities. This area is in the immediate vicinity of the former chlorinated solvent storage tanks.

(4) Soil data indicate elevated concentrations of TCE and PCE in the area west of the former plant site. These data were presented in a November 20, 2003 memorandum e-mailed to USEPA (URS 2003d) and additional data is available within a report prepared for Paccar Inc. (HartCrowser 2003).

The lateral extent of the TCE/PCE-impacted shallow soil was not fully delineated as part of the RI due to the presence of the source areas to the west of the former plant site that are under separate investigation (outside of the Del Amo RI/FS) and an occupied building to the east and south of the pits and trenches area that limited access. USEPA's investigation of chlorinated solvents at the former plant site and vicinity is ongoing. Based on the above information that is strongly indicative of the NAPL source being offsite, no evaluation of remedial alternatives for SA2 was conducted.

The surface pathway evaluation for EAPC 16 addresses PCE and TCE in shallow vadose zone soils based on potential human health risks. As discussed in Section 5, ICs are proposed for EAPC 16 that would strengthen controls against any potential future exposures including restrictive covenants to limit land use that would be negotiated with the property owner. The following ICs are tentatively proposed to be applicable to this parcel:

- Site Registry (IC layer 1)
- Web-Based Information (IC layer 1)
- Land Activity Monitoring (IC layer 1)
- Building Permits (IC layer 2)
- Grading/Excavation Permits (IC layer 2)
- Zoning Restrictions (IC layer 3)
- Restrictive covenant for land use and sampling (IC layer 4A)
- Restrictive covenant for drilling to groundwater (IC layer 5)

7.12 SOURCE AREA 1 (NO EVALUATION)

SA1 is located on parcel 7351-031-007 (EAPC 4), within the area of the copolymer plancor at the former plant site. There is a large commercial office building currently located on the property. Former rubber plant facilities and their spatial relationship to the building are described in Appendix A.

SA1 was identified as a groundwater contamination source area based on detections of cyclohexane in downgradient wells SWL0007 and SWL0038 (1,200 µg/L maximum, 1994) and the former presence of tanks that are inferred to have stored cyclohexane. Cyclohexane is non-carcinogenic, has low hazard/toxicity compared to benzene, and has no federal or state MCL in groundwater. The tap water PRG for cyclohexane is 10,000 µg/L (USEPA 2004). Furthermore, the most recent cyclohexane data (1999) indicate the concentration has decreased to 130 µg/L for well SWL0007 and to less than 2 µg/L for SWL0038.

The low concentrations of cyclohexane present in groundwater are not indicative of NAPL presence. Based on this and on the relatively low toxicity/risk for this chemical, a CERCLA 9-criteria evaluation of remedial alternatives was not completed for this source area.

Layering of ICs for the former plant site parcels are discussed in Section 5. The following ICs have been tentatively identified to be applicable to this parcel:

- Site Registry (IC layer 1)
- Web-Based Information (IC layer 1)
- Land Activity Monitoring (IC layer 1)
- Building Permits (IC layer 2)
- Grading/Excavation Permits (IC layer 2)
- Zoning Restrictions (IC layer 3)
- Restrictive covenant for land use and sampling (IC layer 4A)

8.0 DETAILED EVALUATION OF SURFACE PATHWAY REMEDIAL ALTERNATIVES

This section presents the results of the detailed CERCLA 9-criteria analysis of the surface pathway remedial alternatives for the representative areas described in Section 6, and extends the analysis to other exposure areas in each of the exposure area groups.

8.1 DESCRIPTION OF CERCLA RI/FS 9-CRITERIA

Nine federal criteria have been developed to evaluate the extent to which remedial alternatives meet the statutory requirements of the National Contingency Plan. USEPA guidance describes these 9 criteria under three primary categories: threshold criteria, primary balancing criteria, and modifying criteria (USEPA 1988).

The following is a brief description of the 9 criteria:

Threshold Criteria are the criteria that must be met for an alternative to be considered or selected:

- **Overall Protection of Human Health and the Environment** assesses whether each alternative provides adequate protection of human health and the environment. The overall assessment of protection draws on the analyses conducted for other evaluation criteria, especially long-term effectiveness (LTE) and permanence, short-term effectiveness (STE), and compliance with ARARs. The assessment describes how site risks posed through each pathway are eliminated, reduced or controlled through treatment, engineering, or institutional controls. The assessment also allows for consideration of whether an alternative poses any unacceptable short-term or cross-media impacts.

- **Compliance with ARARs** addresses fulfillment of all applicable or relevant and appropriate requirements of federal or state law (as defined in CERCLA Section 121). The analysis summarizes which requirements are applicable or relevant and appropriate to an alternative and describes how the alternative meets these requirements. Compliance was evaluated for the three types of ARARs: chemical-specific ARARs, location-specific ARARs, and action-specific ARARs. The analysis also assesses whether waivers would be appropriate.

  Under certain circumstances, some ARARs may be waived. Only ARARs that apply to onsite remedial actions may be waived; other statutory requirements, such as the requirement that remedies be protective of human health and the environment, cannot be waived. The specific waivers provided by CERCLA Section 121(d)(4) include:

  Technical Impracticability - This waiver may be used where engineering feasibility and reliability of an alternative in achieving some of the ARARs are unfavorable. Cost is a factor, although not generally the major factor in the evaluation of technical impracticability.

Primary Balancing Criteria are used to assess the relative advantages and disadvantages of each alternative in terms of its performance. These include:

- **LTE** refers to the: (1) magnitude of residual risk, and (2) adequacy and reliability of controls. The residual risk of an alternative is related to the potential for persons or eco-receptors to be exposed to untreated waste, or treatment residuals, at the conclusion of remedial activities. Adequacy and reliability of controls addresses the uncertainties associated with long-term protection from residual contamination that may be left in place; the assessment of the potential need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risks posed should the remedial action need upgrading.

- **Reduction of Toxicity, Mobility, or Volume through Treatment (RTMV)** addresses the anticipated performance of the treatment technologies as measured by reduction in mass of contaminants. This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility and volume of the contaminants.

- **STE** addresses any adverse impacts on human health and the environment posed during the construction and implementation period until remedial action objectives are met. It primarily addresses human health risks during remedial actions like excavation, transportation of hazardous materials, air-quality impacts or noise impacts from treatment operations. It also addresses protection of workers from hazards during remedial actions, effects to eco-receptors, the effectiveness and reliability of protective measures to be taken, and any environmental impacts during remedial operation.

- **Implementability** addresses the technical and administrative feasibility of an alternative as well as the availability of required services and materials. Technical feasibility includes anticipated construction and operational difficulties and the reliability of the technology. Administrative feasibility includes coordination difficulties and difficulties in complying with agency requirements for permitting and obtaining construction rights-of-way. Administrative feasibility also includes consideration of property owner acceptance and conflicts between remedial alternatives and current land use. The third issue considered under implementability is the availability of services and materials for each alternative, including disposal services and storage capacity.

- **Costs** include budgetary capital, O&M costs, and present worth costs. Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs. Direct capital costs include equipment and installation costs. Indirect capital costs include engineering and design, permitting, startup and shakedown, and contingency costs. O&M costs include labor, materials, and energy costs once the remedy is constructed. A present worth analysis is used to evaluate costs that occur over the period of the remedial action by discounting future costs to a common base year. The present worth costs are estimated based on the number of years the remedy is operational. For an engineering control or an institutional control that can last indefinitely into the future, a 100-year time period is assumed. Cost estimates for the alternatives are developed to an accuracy of +50% to -30%.

Modifying Criteria are used to gauge agency and community acceptance at a later stage in the FS. Such input can be incorporated, at USEPA's discretion, into the final remedy. These include:

- **State Acceptance** describes acceptance of the alternative by the supporting local, state or federal agencies.
- **Community Acceptance** describes acceptance of the alternative by the community.

Of these 9 criteria, the first seven criteria are addressed in this FS report. The two modifying criteria, State Acceptance and Community Acceptance, will be addressed once USEPA has reviewed and commented on the FS report, and would be incorporated into the Proposed Plan.

Approximate cost estimates were developed for each remedial alternative based on the conceptual designs presented in Section 6. Preliminary vendor quotes were obtained to estimate costs for some technologies. For other technologies, costs were estimated based on our judgment and experience at other sites. The cost estimates are comprehensive estimates of direct and indirect capital costs and O&M costs. A 20% to 40% contingency is added to both capital and O&M costs depending on the uncertainties associated with the alternative as recommended in the USEPA cost guidance (USEPA 2000b). Alternatives with innovative technologies or other uncertainties use higher contingencies of 30% to 40%. Present worth costs are estimated based on the duration of the remedial alternative using a discount rate of 5%. Often, different technology components within an alternative have different durations or timeframes; these factors are accounted for in the present worth estimates. The detailed cost spreadsheets for the remedial alternatives are presented in Appendix D. The cost estimates reflect several uncertainties due to assumptions made about the lateral extent of the COC-impacted area, assumptions about radius of influence (ROI) that determine number of wells and well spacing, type of vapor treatment, and other operational parameters that impact cost such as influent vapor or groundwater concentrations. The cost estimates meet the accuracy requirements of the CERCLA guidance of +50% to -30%.

Section 8.2 presents the results of the 9-criteria analysis for each remedial alternative at each representative exposure area. The two threshold criteria are pass-fail type criteria, so the rating states "Yes" or "No" depending on whether the alternative satisfies the criterion or not. Compliance with ARARs sometimes is given a "not applicable" rating because for some alternatives there are no potential ARARs identified. The analysis uses a 10-point numerical rating scheme for the five balancing criteria ranging from 0 (worst rating) to 9 (best rating). For example, for the LTE criterion a high numerical rating would mean the residual risk after the implementation of the alternative would be low and conversely, a low numerical rating would mean the residual risk would be high. For the STE criterion, a high rating would mean that the implementation phase of the alternative would cause minimal impacts to human health or the environment. For the cost criterion, a high rating (9) is provided for a low cost (present worth) and conversely a low rating (0) for a very high cost. A non-linear scale with increasing cost intervals was devised based on a maximum cost range. Group 3A, 4A, 3B and 4B areas varied widely in cost estimate ranges so we utilized different cost ranges for these cost scales: 0 to $1.5 million for Group 3A areas, 0 to $2 million for Group 4A areas, 0 to $10 million for Group 3B areas, and 0 to $20 million for Group 4B areas (refer Appendix G for more information on cost scale). Analysis of the

ICs+Monitoring component is addressed in Alternative 2, then assumed to be the same for all remaining alternatives unless specified.

8.2 SURFACE PATHWAY EVALUATION FOR REPRESENTATIVE PARCELS

8.2.1 Group 5A (EAPC 2)

The following presents the results of the 9-criteria analysis for each alternative in a tabular form. The alternatives evaluation is summarized in Table 8-1. The primary COC at this EAPC is B(a)P (and other PAHs), while arsenic is a secondary COC.

8.2.1.1 9-Criteria Analysis

ALTERNATIVE 1 – NO ACTION

Criterion	Rating	Discussion
Protect Health & Environment	NO	This alternative does not reduce or control potential future exposure to surface pathway risks. It would not be protective because it does not include any remediation or long-term controls.
ARARs	NO	This alternative would not be in compliance with ARARs such as the State of California regulation (Civil Code 1471, CCR 67391.1) requiring restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	1	LTE is rated 1 because this alternative does not include appropriate maintenance of the existing asphalt nor permit review ICs to control potential future exposures. This alternative would not guarantee that the site would remain capped in the future.
RTMV	0	RTMV is rated 0 because there is no treatment or contaminant mass removal with this alternative.
STE	N/A	STE is not applicable because there is no action.
Implementability	9	Implementability is rated 9 because would be no challenges in taking no action.
Cost	9	Cost is rated 9 because there would be no costs associated with no action.

ALTERNATIVE 2 – ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would protect human health and the environment because the ICs would ensure that property owners, future construction workers, or commercial workers inside buildings onsite are made aware of the potential contamination, and warned to use appropriate safety practices. IC layers 1-4A, described in Section 5, including both permit review and land use covenants would control potential future exposures. The impacted outdoor soil area is covered in existing asphalt, concrete, grass or other covers, which provide control of direct exposure.
ARARs	YES	This alternative would be in compliance with the state ARAR requiring restrictive covenants when waste is left in place above UU/UE levels.
LTE	5	LTE is rated 5 because the PAH and arsenic contaminants are immobile, and the impacted areas are covered with asphalt, concrete, grass or other covers, which provide some protection to onsite commercial workers. This alternative does not include active remedial options to mitigate potential exposures and does not guarantee that the impacted areas of the site will remain capped in the long term. IC layers 1-4A, including both permit review and land use covenants, would control potential future exposures, but there would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	0	RTMV is rated 0 because with this alternative, contaminants are not removed. Contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	9	STE is rated 9 since there is no active remedy with this alternative, and therefore no added risks to health and environment. Short-term impacts during IC design and implementation are unlikely because the existing cap is effective at mitigating direct contact exposures, and interim ICs currently in place control exposures during construction projects that involve excavation in impacted areas.
Implementability	8	Implementability is rated 8 because the City of Los Angeles has implemented the permit review process (IC layer 2) as a pilot project for selected properties at the former plant site. A land use covenant (IC layer 4A) is assumed to be negotiable given USEPA's enforcement authority, and a zoning institutional control is likely implementable given the City's current political support.
Cost	9	Cost is rated 9 based on the present worth cost, estimated to be about \$98,000, with a capital cost of \$26,000 and annual cost of \$2,775 for 100 years. The cost for this alternative is primarily for setting up the various IC layers and monitoring.

ALTERNATIVE 3 – CAPPING (PAHs, ARSENIC) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative protects human health and the environment because asphalt capping would provide reliable control of exposure to PAH- and arsenic-impacted outdoor soils. IC layers 1-4B, including land use covenants, would restrict excavation and ensure the asphalt cap is protected.
ARARs	YES	This alternative would be in compliance with ARARs.
LTE	8	LTE is rated 8 because this alternative includes an asphalt cap to provide protection from potential direct contact with soil contaminants. This alternative incorporates IC layers 1-4B, including both permit review and land use covenants, would control potential future exposures. ICs would also include monitoring of the asphalt surface for erosional damage, periodic resealing as needed, and a land use covenant to protect the cap. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	0	RTMV is rated 0 because this alternative does not remove contaminant mass from the outdoor soil or from under buildings. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	8	STE is rated 8 because asphalt paving and sealing would have minimal impact on the environment, onsite commercial workers, or the community.
Implementability	8	Implementability is rated 8 because asphalt capping would present few technical challenges. Implementability of ICs is the same as Alternative 2.
Cost	5	Cost is rated 5 based on the present worth cost of this alternative, estimated to be $652,000, based on a capital cost of $180,000 and an annual cost of $18,275 for 100 years. The cost for this alternative includes cap O&M and the IC layers and monitoring.

ALTERNATIVE 4 – CAPPING (ARSENIC) + EXCAVATION (PAHs) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would provide adequate protection because the highest risk contaminants (PAHs) would be excavated and the lower risk arsenic-impacted soils would be capped with asphalt that would prevent exposure. IC layers 1-4B would provide long-term protection to the cap and control potential exposures from residual contamination.
ARARs	YES	This alternative would comply with ARARs including: SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	9	LTE is rated 9 because excavation would remove the PAHs (primary contaminant) and the asphalt cap would provide protection from exposure to arsenic. Arsenic is a secondary contaminant posing a significantly lower risk than the PAHs. IC layers 1-4B would protect the cap, increasing its effectiveness.
RTMV	7	RTMV is rated 7 because the excavation would remove the PAH-impacted soil (>90%), and PAHs are the primary RDCs at this EAPC. Arsenic-impacted soil would remain onsite under the asphalt cap but it may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	6	STE is rated 6 because of the potential for contaminant release in dust during excavation, and impact on the facility from staging and loading of soils for offsite disposal. Mitigation measures can provide reasonable dust control. Capping can be implemented without significant exposures or emissions of contaminants.
Implementability	7	Implementability is rated 7 because no significant technical or administrative challenges are anticipated for the shallow excavation. However, some impacts to the facility and onsite workers can be anticipated during the excavation which would pose modest challenges. Implementability of ICs is the same as Alternative 2.
Cost	4	Cost is rated 4 based on the present worth cost of this alternative, estimated to be $882,000 based on a capital cost of $520,000 and an annual cost of $9,275 for 100 years. The cost for this alternative includes cap O&M and the IC layers and monitoring.

ALTERNATIVE 5 – EXCAVATION (PAHs, ARSENIC) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would protect human health and the environment because both contaminants (PAHs, arsenic) would be excavated. In addition, IC layers 1 and 2 would provide long-term protection via information to owners and permit review through the City of Los Angeles. No land use covenants are included with this alternative because the contaminated soils would be removed.
ARARs	YES	This alternative would comply with ARARs including: SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors. The state ARAR requiring restrictive covenants would not be applicable under this alternative because the contamination is fully remediated.
LTE	9	LTE is rated 9 because excavation would remove both the PAHs and the arsenic-impacted soil. Because the site contamination is removed, only IC layers 1 and 2 would be part of this alternative, to provide protection from any additional areas of soil contamination that may be encountered in the future.
RTMV	9	RTMV is rated 9 because excavation would remove more than 90% of both the PAHs and arsenic contaminants.
STE	5	STE is rated 5 because the larger excavation would likely result in greater emissions of dust and contaminants compared to Alternative 4. This may impact onsite workers during the staging and loading of soils for offsite disposal. Mitigation measures can provide reasonable dust control.
Implementability	6	Implementability is rated 6 because moderate technical and administrative challenges can be anticipated during the excavation on this actively used property. No significant challenges are anticipated with the shallow excavation. The implementability of the ICs is the same as for Alternative 2 except this alternative includes only IC layers 1 and 2.
Cost	4	Cost is rated 4 based on the present worth cost of this alternative, estimated to be $953,000 based on a capital cost of $689,000 and an annual cost of $2,175 for 100 years. The cost for this alternative includes the IC layers and monitoring.

8.2.1.2 Comparative Analysis of Alternatives

Overall Protection of Human Health and the Environment

All remedial alternatives except Alternative 1 would be protective of human health and the environment.

Alt(s)	Rating
2-5	YES
1	NO

Compliance with ARARs

All remedial alternatives comply with ARARs except for Alternative 1 which would not be compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.

Alt(s)	Rating
2-5	YES
1	NO

Long-term Effectiveness

Alternatives 5 and 4 would remove the dominant risk contributor (PAHs including B(a)P). Alternative 3 would cap PAH- and arsenic-impacted areas. Alternative 2 would create ICs to supplement the existing asphalt coverage. There would be some uncertainty about maintaining IC effectiveness over the long term.

Alt(s)	Rating
4-5	9
3	8
2	5
1	1

Reduction of Toxicity, Mobility and Volume

Alternative 5 would remove both contaminants (PAHs, As). Alternative 4 would remove the dominant risk contributor (PAHs) but would use capping to address arsenic. Alternative 3 involves an engineering control and ICs that would effectively control exposure but would not remove contaminant mass. Alternative 3 ICs include a land use covenant and a permit review process for any excavation projects in this EAPC, which may result in removal of impacted soil. Alternative 2 would create ICs to supplement the existing asphalt coverage but would not directly remove contaminant mass.

Alt(s)	Rating
5	9
4	7
1-3	0

Short-term Effectiveness

Alternative 2 consists of ICs that do not pose any health risk during implementation. Alternative 3 involves asphalt paving and sealing which would have minimal impact. Alternative 5 is rated the lowest because it involves a larger excavation and a greater potential to release contaminants than Alternative 4 which involves the excavation of the dominant risk contributor (PAHs) along with capping for arsenic.

Alt(s)	Rating
2	9
3	8
4	6
5	5
1	N/A

Implementability

Alternative 2 consists of ICs, including permit review through the City of Los Angeles, which has been implemented as a pilot project. It is likely that a land use covenant can be negotiated given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support. Alternative 3 involves asphalt paving and sealing which is not expected to present technical or administrative challenges. Alternatives 4 and 5 are both shallow (5-foot deep) excavations that would present moderate technical challenges during the excavation due to the location at an actively operating facility. Since no significant technical or administrative challenges are anticipated, these alternatives are rated slightly lower than Alternatives 1-3.

Alt(s)	Rating
1	9
2-3	8
4	7
5	6

Cost

Each alternative is rated for its 100-year present worth cost.

Alt(s)	Rating	Cost
1	9	None
2	9	$98,000
3	5	$652,000
4	4	$882,000
5	4	$953,000

8.2.2 Group 4A (EAPC 7)

The following presents the results of the 9-criteria analysis for each alternative. The alternatives are summarized in Table 8-2. The primary COC at this EAPC is arsenic and VOCs are secondary COCs, including benzene, I-PB, I-PT and 1,2,4-TMB.

8.2.2.1 9-Criteria Analysis

ALTERNATIVE 1 – NO ACTION

Criterion	Rating	Discussion
Protect Health & Environment	NO	This alternative would not be protective because it does not include any remediation or long-term controls.
ARARs	NO	This alternative would not be in compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	1	LTE is rated 1 because this alternative does not include appropriate maintenance of the existing asphalt nor permit review ICs to control potential future exposures. This alternative would not guarantee that the site would remain capped in the future.
RTMV	0	RTMV is rated 0 because there is no contaminant mass removal with this alternative.
STE	N/A	STE is not applicable because there is no action.
Implementability	9	Implementability is rated 9 because would be no challenges in taking no action.
Cost	9	Cost is rated 9 because there would be no costs associated with no action.

ALTERNATIVE 2 – ICs + MONITORING

Criterion	**Rating**	**Discussion**
Protect Health & Environment	YES	This alternative would protect human health and the environment because the ICs would ensure that property owners, future construction workers, or commercial workers inside buildings onsite are made aware of the potential contamination, and warned to use appropriate safety practices. IC layers 1-4A, including both permit review and land use covenants, would control potential future exposures. The impacted outdoor soil area is covered in existing asphalt, concrete, grass or other covers which provide control of direct exposure.
ARARs	YES	This alternative would be in compliance with the state ARAR requiring restrictive covenants when waste is left in place above UU/UE levels.
LTE	5	LTE is rated 5 because the primary contaminant is arsenic, which is immobile, and the impacted areas are covered with asphalt, concrete, grass, or other covers which provide some protection to onsite commercial workers. VOCs are secondary contaminants with a CR <1E-06 and its impacted area is also covered with asphalt. This alternative does not include active remedial options to mitigate potential exposures and does not guarantee that the impacted areas of the site will remain capped in the long term. IC layers 1-4A, including both permit review and land use covenants, would control potential future exposures, but there would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	0	RTMV is rated 0 because with this alternative, contaminants are not removed. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	9	STE is rated 9 since there is no active remedy with this alternative, and therefore no added risks to health and environment. Short-term adverse effects during IC design and implementation are unlikely because the existing cap is effective at mitigating direct contact exposures, and interim ICs currently in place control exposures during construction projects that involve excavation in impacted areas.
Implementability	8	Implementability is rated 8 because the City of Los Angeles has implemented the permit review process (IC layer 2) as a pilot project for selected properties at the former plant site. A land use covenant (IC layer 4A) is assumed to be negotiable, given USEPA's enforcement authority, and a zoning institutional control is likely implementable given the City's current political support.

Criterion	Rating	Discussion
Cost	9	Cost is rated 9 based on the present worth cost, estimated to be about $98,000, with a capital cost of $26,000 and annual cost of $2,775 for a 100 years. The cost for this alternative is primarily for setting up the various IC layers and monitoring.

ALTERNATIVE 3 – CAPPING (ARSENIC, VOCs) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative protects human health and the environment because asphalt capping would provide reliable control of exposure to arsenic and VOC-impacted areas. IC layers 1-4B, including land use covenants, would restrict excavation and ensure the asphalt cap is protected.
ARARs	YES	This alternative would be in compliance with ARARs.
LTE	7	LTE is rated 7 because this alternative includes an asphalt cap to provide protection from potential direct contact with or exposure to soil contaminants. IC layers 1-4B, including both permit review and land use covenants, would control potential future exposures. ICs would also include monitoring of the asphalt surface for erosional damage, periodic resealing as needed, and a land use covenant to protect the cap. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	0	RTMV is rated 0 because this alternative does not remove contaminant mass from the outdoor soil or from under buildings. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	8	STE is rated 8 because asphalt paving and sealing would have minimal impact on the environment, onsite commercial workers, or the community.
Implementability	8	Implementability is rated 8 because the asphalt capping would face few technical challenges. Implementability of ICs is the same as Alternative 2.
Cost	5	Cost is rated 5 based on the present worth cost of this alternative, estimated to be $610,000 based on a capital cost of $165,000 and an annual cost of $17,275 for 100 years. The cost for this alternative includes cap O&M and the IC layers and monitoring.

ALTERNATIVE 4 – EXCAVATION (ARSENIC) + SVE/BV (VOCs) (OS) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would provide adequate protection because both the contaminants (arsenic, VOCs) would be remediated. IC layers 1 and 2 would provide long-term protection via information and permit review through the City of Los Angeles. No land use covenants would be included with this alternative because the contaminants would be remediated.
ARARs	YES	This alternative would comply with ARARs for aboveground treatment including: SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	9	LTE is rated 9 because excavation would remove the arsenic-impacted soil and the SVE/BV would remediate the VOCs. Because the contamination is removed, ICs would include only layers 1 and 2, which would provide protection from areas of soil contamination that may be encountered in the future.
RTMV	9	RTMV is rated 9 because the excavation and SVE/BV would remove more than 90% of both the arsenic and VOC contaminants.
STE	7	STE is rated 7 because arsenic emissions from excavation dust can be reasonably controlled and SVE treats VOCs in an aboveground treatment system. The technologies can control VOC emissions fairly effectively because VOC influent concentrations are not expected to be high.
Implementability	6	Implementability is rated 6 because of minor technical challenges with SVE/BV in the low-permeability silts in the shallow zone. Minor technical challenges are also anticipated with the shallow excavation in close proximity to a building due to implementation at an actively operating facility.
Cost	3	Cost is rated 3 based on the present worth cost of this alternative, estimated to be $1,166,000 based on a capital cost of $646,000 and an annual cost of $172,000 for 1.5 years for SVE and an annual cost of $2,175 for ICs and monitoring for 100 years.

ALTERNATIVE 5 – EXCAVATION (ARSENIC, VOCs) + ICs + MONITORING

Criterion	**Rating**	**Discussion**
Protect Health & Environment	YES	This alternative would protect human health and the environment because both contaminants (arsenic, VOCs) would be excavated. In addition, IC layers 1 and 2 would provide long-term protection via information to owners and permit review through the City of Los Angeles. No land use covenants are included with this alternative because the contaminated soils would be removed.
ARARs	YES	This alternative would comply with ARARs including: SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes and OSHA requirements for a health and safety program including Hazwoper-trained excavation. The state ARAR requiring restrictive covenants would not be applicable under this alternative because the contamination is remediated.
LTE	9	LTE is rated 9 because excavation would remove both the VOCs and the arsenic-impacted soil. Because the site contamination is removed, only IC layers 1 and 2 would be part of this alternative, to provide protection from any additional areas of soil contamination that may be encountered in the future.
RTMV	9	RTMV is rated 9 because excavation would remove more than 90% of both the arsenic and VOC contaminants.
STE	6	STE is rated 6 because the excavation would create moderate impacts to onsite facility workers due to emissions of dust and VOC contaminants from excavation, staging and loading of soils for offsite disposal. Mitigation measures can provide reasonable dust control.
Implementability	5	Implementability is rated 5. Moderate technical challenges are anticipated with the deeper 15-foot excavation and the implementation of the excavations at an actively operating facility.
Cost	3	Cost is rated 3 based on the present worth cost of this alternative, estimated to be $1,131,000 based on a capital cost of $826,000 and an annual cost of $2,175 for 100 years. The cost for this alternative includes the IC layers and monitoring.

8.2.2.2 Comparative Analysis of Alternatives

Overall Protection of Human Health and the Environment

All remedial alternatives except Alternative 1 would be protective of human health and the environment.

Alt(s)	Rating
2-5	YES
1	NO

Compliance with ARARs

All remedial alternatives comply with ARARs except for Alternative 1 which would not be in compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.

Alt(s)	Rating
2-5	YES
1	NO

Long-term Effectiveness

Alternatives 4 and 5 would remediate both COCs. Alternative 3 would cap arsenic- and VOC-impacted areas. Asphalt capping is assumed to be adequate for VOCs because of its low contribution to the CR less than 1E-06. Alternative 2 would create ICs to supplement the existing asphalt coverage. There would be some uncertainty about maintaining IC effectiveness over the long term.

Alt(s)	Rating
4-5	9
3	7
2	5
1	1

Reduction of Toxicity, Mobility and Volume

Alternatives 4 and 5 would remediate both COCs effectively (>90%). Alternative 3 involves an engineering control and ICs that would effectively control exposure but would not remove contaminant mass. Alternative 3 ICs include a land use covenant and a permit review process for any excavation projects in this EAPC, which may result in removal of impacted soil. Alternative 2 would create ICs to supplement the existing asphalt coverage but would not directly remove contaminant mass.

Alt(s)	Rating
4-5	9
1-3	0

Short-term Effectiveness

Alternative 2 consists of ICs that do not pose any health risk during implementation. Alternative 3 involves asphalt paving and sealing which would have minimal impact Alternatives 4 and 5 are rated lower because the excavation and SVE/BV alternative components could potentially cause emissions that would impact the facility workers or neighboring facilities. Alternative 5 is rated lower than Alternative 4 because of a greater potential for contaminant releases during excavation of VOCs than with SVE.

Alt(s)	Rating
2	9
3	8
4	7
5	6
1	N/A

Implementability

Alternative 2 consists of ICs, including permit review through the City of Los Angeles, which has been implemented as a pilot project. It is likely that a land use covenant can be negotiated given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support. Alternative 3 involves asphalt paving and sealing which is not expected to present technical or administrative challenges. Alternative 4 involves SVE-related construction and Alternative 5 involves deeper excavation (15 feet) that would present moderate technical challenges and hence rated lower.

Alt(s)	Rating
1	9
2-3	8
4	6
5	5

Cost

Each alternative is rated for its 100-year present worth cost.

Alt(s)	Rating	Cost
1	9	None
2	9	$98,000
3	5	$610,000
4	3	$1,166,000
5	3	$1,131,000

8.2.3 Group 4B (EAPC 16)

The following presents the results of the 9-criteria analysis for each alternative. The alternatives are summarized in Table 8-3. The primary COCs at this EAPC are the VOCs, PCE and TCE; while, the non-VOCs, DDT and NDPA are secondary COCs.

8.2.3.1 9-Criteria Analysis

ALTERNATIVE 1 – NO ACTION

Criterion	Rating	Discussion
Protect Health & Environment	NO	This alternative does not reduce or control potential future exposure to surface pathway risks because it does not include remediation or long-term controls.
ARARs	NO	This would not be in compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	1	LTE is rated 1 because this alternative does not include appropriate maintenance of the existing asphalt nor permit review ICs to control potential future exposures. This alternative would not guarantee that the site would remain capped in the future.
RTMV	0	RTMV is rated 0 because there is no contaminant mass removal with this alternative.
STE	N/A	STE is not applicable because there is no action.
Implementability	9	Implementability is rated 9 because would be no challenges in taking no action.
Cost	9	Cost is rated 9 because there would be no costs associated with no action.

ALTERNATIVE 2 – ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would protect human health and the environment because the ICs would ensure that property owners, future construction workers, or commercial workers inside buildings onsite are made aware of the potential contamination, and warned to use appropriate safety practices. This alternative incorporates IC layers 1-4A, and 5, described in Section 5, including both permit review and land use covenants that are designed to control potential future exposures. The impacted outdoor soil area is covered in existing asphalt, concrete, grass, or other covers which provide control of direct exposure.
ARARs	YES	This would be in compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.

Criterion	Rating	Discussion
LTE	4	LTE is rated 4 because this alternative does not include active remedial options to mitigate potential exposures. Impacted areas of the site are covered with asphalt, concrete, grass, or other covers. However, the alternative does not guarantee that the site will remain capped. This alternative incorporates IC layers 1-4A and 5, described in Section 5, including both permit review and land use covenants that are designed to control potential future exposures, but there would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	0	RTMV is rated 0 because with this alternative, contaminants are not removed. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	9	STE is rated 9 since there is no active remedy with this alternative, and therefore no added risks to health and environment. Short-term impacts during IC design and implementation are unlikely, because the existing cap is effective at mitigating direct contact exposures, and interim ICs currently in place control exposures during construction projects that involve excavation in impacted areas.
Implementability	8	Implementability is rated 8 because the City of Los Angeles has implemented the permit review process (IC layer 2) as a pilot project for selected properties at the former plant site. A land use covenant (IC layers 4A and 5) is assumed to be negotiable, given USEPA's enforcement authority, and a zoning institutional control is likely implementable given the City's current political support.
Cost	9	Cost is rated 9 based on the present worth cost, estimated to be about \$123,000, with a capital cost of \$37,000 and annual cost of \$3,275 for 100 years. The cost for this alternative is primarily for setting up the various IC layers and monitoring.

ALTERNATIVE 3 – CAPPING (NON-VOCs, VOCs) + HVAC MOD/SSV (UB) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative protects human health and the environment because asphalt capping would provide reliable control of exposure to VOCs and non-VOCs in outdoor soil, and HVAC mod/SSV would mitigate vapor intrusion into indoor air. It includes IC layers 1-5 including land use covenants that would restrict excavation and ensure the asphalt cap and the HVAC mod/SSV engineering controls are protected.

Criterion	Rating	Discussion
ARARs	YES	This alternative would be in compliance with ARARs, including SCAQMD requirements for emissions from the SSV activities, requirements for a worker health and safety program, and the state rule requiring a restrictive covenant when waste is left in place beyond UU/UE levels.
LTE	7	LTE is rated 7 because asphalt capping would control direct exposure to VOCs and non-VOCs in outdoor soil and HVAC mod/SSV would mitigate vapor intrusion into indoor air. IC layers 1-5 include permit review for control of potential exposure to outdoor soil by construction workers, and a land use covenant for protection of engineering controls such as capping and HVAC mod/SSV. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	2	RTMV is rated 2 because this alternative does not remove contaminant mass from the outdoor soil or from under buildings. However, SSV treats offgassing VOCs. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	7	STE is rated 7 because the construction activities associated with the SSV system could have moderate impact on the environment, onsite commercial workers, or the community due to emissions of dust and VOCs. HVAC modification would have a lower impact than SSV.
Implementability	6	Implementability is rated 6 because the installation of slotted piping in trenches inside the building as part of the SSV system could present significant challenges. HVAC modification would present moderate challenges but less than SSV. A building-specific evaluation will need to be conducted during remedial design.
Cost	6	Cost is rated 6 based on the present worth cost of this alternative, estimated to be $1,913,000 based on a capital cost of $486,000 and an annual cost of $55,775 for 100 years. The cost for this alternative includes cap and HVAC mod/SSV O&M and the IC layers and monitoring.

ALTERNATIVE 4 – CAPPING (NON-VOCs) + SVE (OS) + HVAC MOD/SSV (UB) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would provide adequate protection because VOC-impacted outdoor soil would be remediated by SVE. Engineering controls such as asphalt caps would provide direct exposure controls and HVAC mod/SSV would protect commercial workers in the building from vapor intrusion into indoor air. IC layers 1-5 are designed to control potential future exposures and protect the engineering controls.

Criterion	Rating	Discussion
ARARs	YES	This alternative would comply with ARARs for aboveground treatment including: SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	8	LTE is rated 8 because SVE would remediate VOCs in outdoor soil and capping would provide protection from direct contact exposure to non-VOCs in soil. The SSV engineering control would mitigate exposure from vapor intrusion into indoor air. This alternative incorporates IC layers 1-5, described in Section 5, including permit review as well as land use covenants designed to control potential future exposures and protect the engineering controls. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	6	RTMV is rated 6 because SVE would remediate VOC contamination (>90%) in outdoor soil but it does not remove VOC contamination under the building and non-VOC contamination in outdoor soil. SSV treats offgassing VOCs but does not remove the source. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	7	STE is rated 7 because SVE treats VOCs in an aboveground treatment system. The technologies can control VOC emissions except for emissions during drilling, or potential releases during process upsets and startup testing. During SSV system installation, which would involve digging trenches inside the building, the facility employees may face potential exposures. HVAC modification would have a lower impact than SSV.
Implementability	6	Implementability is rated 6. The technical reliability of SVE in outdoor soil is fairly good despite the low-permeability shallow soils. Challenges can be anticipated with SSV, where installation of slotted piping in trenches inside the building may have an impact on an operating facility, causing potential difficulties from the tenants or property owners. HVAC mod would pose moderate challenges.
Cost	5	Cost is rated 5 based on the present worth cost of this alternative, estimated to be $3,691,000 based on a capital cost of $1,186,000 and an annual cost of $499,000 for 3 years for SVE and an annual cost of $26,775 for 100 years of Cap and SSV O&M and the ICs layers and monitoring.

ALTERNATIVE 5 – CAPPING (NON-VOCs) + SVE (OS) + SVE (UB) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would protect human health and the environment because SVE would effectively address VOCs in outdoor soil. SVE for soils under the building would have reduced effectiveness because it is difficult to characterize soil under the building. Engineering controls such as asphalt caps for non-VOCs would provide direct exposure controls. Monitoring would include sub-slab monitoring to characterize the potential for vapor intrusion. IC layers 1-5 are designed to control potential future exposures and protect the engineering controls.
ARARs	YES	This alternative would comply with ARARs for aboveground treatment including: SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	8	LTE is rated 8 because SVE would remediate VOCs in outdoor soil and capping provides protection from direct contact exposure to non-VOCs in soil. SVE for soils under the building can remediate VOCs in soils under the building, but its effectiveness would be reduced because it is difficult to characterize soil under the building. If there is continuing vapor intrusion from deep soil or groundwater contamination, HVAC mod/SSV engineering controls may be needed to provide additional exposure control. ICs and monitoring can provide long-term protection from residual contamination. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	8	RTMV is rated 8 because SVE would remediate VOC contamination in outdoor soil (>90%). SVE for soils under the building would be reduced in effectiveness (50% to 90% removal) due to challenges with proper delineation of contamination and continued vapor intrusion from deep soil and groundwater. Non-VOC contamination would remain. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	6	STE is rated 6 because SVE treats VOCs in an aboveground treatment system. The technologies can control VOC emissions except for emissions during drilling, or potential releases during process upsets and startup testing. The facility employees may be impacted during SVE system installation, which would involve installation of horizontal wells under the building. The potential for commercial workers or neighboring businesses to be exposed to contamination is limited.

Criterion	Rating	Discussion
Implementability	5	Implementability is rated 5. Technical reliability of SVE in outdoor soil is moderate to good despite the low-permeability shallow soils. However, the reliability of SVE under the building has some uncertainty. The ability to install horizontal wells using the blind-drilling method can be challenging, as can characterizing the soil under the building, and success would depend on specific subsurface conditions at the site. Significant investigation activities inside the building (e.g., sub-slab investigation) can be disruptive to the operating facilities.
Cost	4	Cost is rated 4 based on the present worth cost of this alternative, estimated to be $5,185,000 based on a capital cost of $1,517,000 and an annual cost of $834,000 for 3 years for SVE. The capital cost includes the cost of converting the SVE(UB) wells into an SSV system. In addition, an annual cost of $26,775 for 100 years of SSV O&M, cap O&M and ICs is included.

ALTERNATIVE 6 – EXCAVATION (NON-VOCs, VOCs) + SVE (UB) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would provide adequate protection because the outdoor soil VOCs and non-VOCs would be addressed by excavation. SVE for soils under the building would have reduced effectiveness because it is difficult to characterize soil under the building. Monitoring would include sub-slab monitoring to further characterize the potential for vapor intrusion. IC layers 1-4A and 5 are designed to control potential future exposures.
ARARs	YES	This alternative would comply with ARARs for excavation and aboveground treatment, including SCAQMD requirements for emissions from excavations such as Rule 1166 for handling VOC-impacted soils and Rule 1401 for air toxics emissions, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	8	LTE is rated 8 because outdoor soil VOCs and non-VOCs are addressed by excavation. SVE for soils under the building can be effective, but its effectiveness would be reduced because it is difficult to characterize soil under the building. If there is continuing vapor intrusion from deep soil or groundwater contamination, HVAC mod/SSV may be needed to provide additional exposure control. There would be some uncertainty about maintaining IC effectiveness over the long term.

Criterion	Rating	Discussion
RTMV	8	RTMV is rated 8 because excavation would remediate VOC and non-VOC contamination in outdoor soil (>90%). SVE for soils under the building would be reduced in effectiveness (50% to 90% removal) due to challenges with proper delineation of contamination and continued vapor intrusion from deep soil and groundwater. Residual contaminant mass under the building may be removed from the impacted area in the in the course of future construction projects, which may be identified through the permit review IC.
STE	5	STE is rated 5 because the fairly large excavation would potentially expose the employees and neighboring businesses to dust and contaminant emissions from staging and loading of soils for disposal. Mitigation measures can provide some dust control. SVE is generally effective at controlling VOC emissions except for emissions during drilling, or potential releases during process upsets and startup testing.
Implementability	4	Implementability is rated 4. Technical reliability of excavation in outdoor soil is moderate because difficulties can be expected due to the depth of the excavation, the proximity of structures and the need for shoring. The ability to install horizontal wells using the blind-drilling method can be challenging, as can characterizing the soil under the building, and success would depend on specific subsurface conditions at the site. Intrusive activities are also disruptive to the operating facilities.
Cost	3	Cost is rated 3 based on the present worth cost of this alternative, estimated to be $8,404,000 based on a capital cost of $4,890,000 and an annual cost of $561,600 for 3 years for SVE. The capital cost includes the cost of converting the SVE(UB) wells into an SSV system. In addition, an annual cost of $15,275 for 100 years for ICs, SSV O&M and monitoring is included.

8.2.3.2 Comparative Analysis of Alternatives

Overall Protection of Human Health and the Environment

All remedial alternatives except Alternative 1 would be protective of human health and the environment.

Alt(s)	Rating
2-6	YES
1	NO

Compliance with ARARs

All remedial alternatives comply with ARARs except Alternative 1 which does not comply with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.

Alt(s)	Rating
2-6	YES
1	NO

Long-term Effectiveness

Alt(s)	Rating
4-6	8
3	7
2	4
1	1

Alternative 6 removes all contaminated outdoor soil in the remedial area while Alternative 5 removes most of the VOCs within the remedial area. Both include SVE under the building, which may have reduced effectiveness because VOCs in soil below the building are difficult to characterize precisely. Hence, there could be residual VOCs in soil under the building that than can pose a vapor intrusion risk. Alternative 4 is equivalent to Alternatives 5 and 6 for outdoor soil but it does not reduce contamination below the building. Instead, Alternative 4 provides long-term protection for indoor air using HVAC mod/SSV engineering controls. Alternative 3 is an engineering control alternative that provides adequate protection from exposures but does not remove contaminant mass. Alternative 2 would create ICs to supplement the existing asphalt coverage but does not guarantee the asphalt cap will remain indefinitely. There would be some uncertainty about maintaining IC effectiveness over the long term.

Reduction of Toxicity, Mobility and Volume

Alt(s)	Rating
5-6	8
4	6
3	2
1-2	0

Alternatives 5 and 6 would remove the most contaminant mass but there is significant uncertainty about contaminant reduction under the building because of the difficulties in contaminant characterization and hence the appropriate placement of the SVE wells. Alternative 4 would remove contaminant mass from outdoor soil like Alternatives 5 and 6, but would not remove contaminants from under the building. Alternative 3 involves an engineering control and ICs that would effectively control exposure but would not remove contaminant mass. Alternative 3 ICs include a land use covenant and a permit review process for any excavation projects in this EAPC, which may result in removal of impacted soil. Alternative 2 would not directly remove contaminant mass.

Short-term Effectiveness

Alt(s)	Rating
2	9
3-4	7
5	6
6	5
1	N/A

Alternative 2 consists of ICs that do not pose any health risk during implementation. Alternative 3 involves asphalt paving and sealing which would have minimal impact, and installation of SSV system, which would have a limited potential impact. Alternatives 5 and 6 are rated low because the excavation and SVE system installation would significantly impact the property owner. Anticipated impacts from this alternative include emissions and potential exposure to dust and VOCs. Alternative 4 is rated higher than Alternative 5 because it includes only vertical wells in outdoor soil (no horizontal wells below the building) and has a smaller SVE remedial system.

Implementability

Alt(s)	Rating
1	9
2	8
3	6
4	6
5	5
6	4

Alternative 2 consists of ICs, including permit review through the City of Los Angeles, which has been implemented as a pilot project. It is assumed that a land use covenant can be negotiated given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support. The asphalt paving included in Alternative 3 is not expected to present technical or administrative challenges. Alternatives 3 and 4 are rated lower than Alternative 2 because it involves implementation of SSV under a portion of the building. Selection of HVAC mod over SSV for Alternatives 3 and 4, would increase implementability because SSV installation is more intrusive to the facility owner and operations and would likely present more technical challenges and difficulties getting the cooperation of property owners/tenants. Alternative 5 is rated lower because it involves SVE under the building, which could pose both significant technical challenges and potential impact to property owners. Alternative 6, which includes a large excavation and SVE under the building, is expected to present the greatest technical and administrative challenges and is rated lowest. Implementation of SVE wells under the building at shallow depths to remove contaminants from shallow soil, as proposed in Alternatives 5 and 6, can be problematic because space is limited and wells may need to be installed by blind-hole drilling as opposed to surface-to-surface completions and because subsurface features under the building may interfere with drilling. Blind-hole drilling methods are known to be less reliable and frequently lead to well failures.

Cost

Each alternative is rated for its 100-year present worth cost.

Alt(s)	Rating	Cost
1	9	None
2	9	$123,000
3	6	$1,913,000
4	5	$3,691,000
5	4	$5,185,000
6	3	$8,404,000

8.2.4 Group 4B (EAPC 23)

The following presents the results of the 9-criteria analysis for each alternative. The alternatives are summarized in Table 8-4. There are two VOC COCs at this EAPC. The primary COC is benzene and the secondary COC is PCE.

8.2.4.1 9-Criteria Analysis

ALTERNATIVE 1 – NO ACTION

Criterion	Rating	Discussion
Protect Health & Environment	NO	This alternative does not reduce or control potential future exposure to surface pathway risks because it does not include remediation or long-term controls.
ARARs	NO	This would not be in compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	1	LTE is rated 1 because this alternative does not include appropriate maintenance of the existing asphalt nor permit review ICs to control potential future exposures. This alternative would not guarantee that the site would remain capped in the future.
RTMV	0	RTMV is rated 0 because there is no contaminant mass removal with this alternative.
STE	N/A	STE is not applicable because there is no action.
Implementability	9	Implementability is rated 9 because would be no challenges in taking no action.
Cost	9	Cost is rated 9 because there would be no costs associated with no action.

ALTERNATIVE 2 – ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would protect human health and the environment because the ICs would ensure that property owners, future construction workers, or commercial workers inside buildings onsite are made aware of the potential contamination, and warned to use appropriate safety practices. This alternative incorporates IC layers 1-4A and 5, described in Section 5, including both permit review and land use covenants that are designed to control potential future exposures. The impacted outdoor soil area is covered in existing asphalt, concrete, grass, or other covers which provide control of direct exposure.
ARARs	YES	This would be in compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	4	LTE is rated 4 because the alternative does not include active remedial options to mitigate potential exposures. Impacted areas of the site are covered with asphalt, concrete, grass or other covers. However, the alternative does not guarantee that the site will remain capped. The alternative incorporates IC layers 1-4A and 5, described in Section 5, including both permit review and land use covenants that are designed to control potential future exposures, but there would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	0	RTMV is rated 0 because with this alternative, contaminants are not removed. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	9	STE is rated 9 since there is no active remedy with this alternative, and therefore no added risks to health and environment. Short-term impacts during IC design and implementation are unlikely, because the existing cap is effective at mitigating direct contact exposures, and interim ICs currently in place control exposures during construction projects that involve excavation in impacted areas.
Implementability	8	Implementability is rated 8 because the City of Los Angeles has implemented the permit review process (IC layer 2) as a pilot project for selected properties at the former plant site. A land use covenant (IC layers 4A and 5) is assumed to be negotiable, given USEPA's enforcement authority, and a zoning institutional control is likely implementable given the City's current political support.
Cost	9	Cost is rated 9 based on the present worth cost, estimated to be about \$123,000, with a capital cost of \$37,000 and annual cost of \$3,275 for 100 years. The cost for this alternative is primarily for setting up the various IC layers and monitoring.

ALTERNATIVE 3 – CAPPING (VOCs) + HVAC MOD/SSV (UB) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative protects human health and the environment because asphalt capping would provide reliable control of exposure to VOCs in outdoor soil, and HVAC mod/SSV would mitigate vapor intrusion into indoor air. It includes IC layers 1-5 including land use covenants that would restrict excavation and ensure the asphalt cap and the HVAC mod/SSV engineering controls are protected.
ARARs	YES	This alternative would be in compliance with ARARs, including SCAQMD requirements for emissions from the SSV activities, requirements for a worker health and safety program, and the state rule requiring a restrictive covenant when waste is left in place beyond UU/UE levels.
LTE	7	LTE is rated 7 because asphalt capping would control direct exposure to VOCs and in outdoor soil and HVAC mod/SSV would mitigate vapor intrusion into indoor air. IC layers 1-5 include permit review for control of potential exposure to outdoor soil by construction workers, and a land use covenant for protection of engineering controls such as capping and HVAC mod/SSV. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	2	RTMV is rated 2 because this alternative does not remove contaminant mass from the outdoor soil or from under buildings. However, SSV treats offgassing VOCs. Contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	7	STE is rated 7 because the construction activities associated with the SSV system installation that covers the entire building could have a moderate impact on the environment and onsite commercial workers due to emissions of dust and VOCs. HVAC modification would have a lower impact than SSV.
Implementability	6	Implementability is rated 6 because the installation of slotted piping in trenches inside the building as part of the SSV system could present significant challenges. HVAC modification would present moderate challenges but less than SSV. A building-specific evaluation will need to be conducted during remedial design.
Cost	5	Cost is rated 5 based on the present worth cost of this alternative, estimated to be $3,374,000 based on a capital cost of $1,169,000 and an annual cost of $82,775 for 100 years. The cost for this alternative includes cap and HVAC mod/SSV O&M and the IC layers and monitoring.

ALTERNATIVE 4 – SVE/BV (OS) + HVAC MOD/SSV (UB) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would provide adequate protection because VOC-impacted outdoor soil is remediated by SVE. Engineering controls such as HVAC mod/SSV would protect commercial workers in the building from vapor intrusion into indoor air. IC layers 1-5 would control potential exposures from residual contamination.
ARARs	YES	This alternative would comply with ARARs for aboveground treatment including: SCAQMD requirements for emissions from SVE and SSV activities, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	8	LTE is rated 8 because SVE would remediate VOCs in outdoor soil. The HVAC mod/SSV engineering controls would mitigate exposure from vapor intrusion into indoor air. This alternative incorporates IC layers 1-5, described in Section 5, including permit review as well as land use covenants designed to control potential future exposures and protect the engineering controls. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	6	RTMV is rated 6 because SVE would remediate VOC contamination (>90%) in outdoor soil but does not remove VOC contamination under the building. SSV treats offgassing VOCs but does not remove the source. Contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	7	STE is rated 7 because SVE treats VOCs in an aboveground treatment system. The technologies can control VOC emissions except for emissions during drilling, or potential releases during process upsets and startup testing. During SSV system installation, which would involve digging trenches inside the building, the facility employees may present potential exposures. HVAC modification would have a lower impact than SSV.
Implementability	6	Implementability is rated 6. The technical reliability of SVE in outdoor soil is fairly good despite the low-permeability shallow soils. Technical reliability of HVAC mod/SSV is moderate and challenges can be anticipated with SSV, where installation of slotted piping in trenches inside the building may have an impact on an operating facility, causing potential difficulties from the tenants or property owners.
Cost	4	Cost is rated 4 based on the present worth cost of this alternative, estimated to be $5,063,000 based on a capital cost of $2,156,000 and an annual cost of $642,000 for 3 years for SVE and an annual cost of $15,775 for 100 years for SSV O&M, and the ICs layers and monitoring.

ALTERNATIVE 5 – SVE/BV (OS) + SVE/BV (UB) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would protect human health and the environment because SVE would effectively address VOCs in outdoor soil. SVE for soils under the building would have reduced effectiveness because it is difficult to characterize soil under the building. Engineering controls such as asphalt caps for non-VOCs would provide direct exposure controls. Monitoring would include sub-slab monitoring to characterize the potential for vapor intrusion. IC layers 1-4A and 5 are provided to control potential contaminant exposures.
ARARs	YES	This alternative would comply with ARARs for aboveground treatment including: SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	8	LTE is rated 8 because SVE would remediate VOCs in outdoor soil. SVE for soils under the building can remediate VOCs in soils under the building, but its effectiveness would be reduced because it is difficult to characterize soil under the building. If there is continuing vapor intrusion from deep soil or groundwater contamination, HVAC mod/SSV engineering control may be needed to provide additional exposure control. ICs and monitoring can provide long-term protection from residual contamination. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	8	RTMV is rated 8 because SVE would remediate VOC contamination in outdoor soil (>90%). SVE for soils under the building would be reduced in effectiveness (50% to 90% removal) due to challenges with proper delineation of contamination and continued vapor intrusion from deep soil and groundwater. Some potential for vapor intrusion would remain. Contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	6	STE is rated 6 because SVE treats VOCs in an aboveground treatment system. The technologies can control VOC emissions except for emissions during drilling, or potential releases during process upsets and startup testing. The facility employees may be impacted during SVE system installation, which would involve installation of horizontal wells under the building. The potential commercial workers or neighboring businesses to be exposed to contamination is limited.

Criterion	Rating	Discussion
Implementability	5	Implementability is rated 5. Technical reliability of SVE in outdoor soil is moderate to good despite the low-permeability shallow soils. However, the reliability of SVE under the building has some uncertainty. The ability to install horizontal wells using the blind-drilling method can be challenging, as can characterizing the soil under the building, and success would depend on specific subsurface conditions at the site. Significant investigation activities inside the building (e.g., sub-slab investigation) can be disruptive to the operating facilities.
Cost	4	Cost is rated 4 based on the present worth cost of this alternative, estimated to be $7,556,000 based on a capital cost of $2,425,000 and an annual cost of $1,310,000 for 3 years for SVE. The capital cost includes the cost of converting the SVE(UB) wells into an SSV system. In addition, an annual cost of $15,275 for 100 years for SSV O&M, ICs and monitoring is included.

ALTERNATIVE 6 – EXCAVATION (VOCs) + SVE/BV (UB) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would provide adequate protection because the outdoor soil VOCs would be addressed by excavation. SVE for soils under the building would have reduced effectiveness because it is difficult to characterize soil under the building. Monitoring would include sub-slab monitoring to further characterize the potential for vapor intrusion. IC layers 1-4A and 5 are designed to control potential future exposures and protect the engineering controls.
ARARs	YES	This alternative would comply with ARARs for excavation and aboveground treatment, including SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	8	LTE is rated 8 because outdoor soil VOCs are addressed by excavation. SVE for soils under the building can be effective, but its effectiveness would be reduced because it is difficult to characterize soil under the building. If there is continuing vapor intrusion from deep soil or groundwater contamination, HVAC mod/SSV may be needed to provide additional exposure control. There would be some uncertainty about maintaining IC effectiveness over the long term.

Criterion	Rating	Discussion
RTMV	8	RTMV is rated 8 because excavation would remediate VOC contamination in outdoor soil (>90%). SVE for soils under the building would be reduced in effectiveness (50% to 90% removal) due to challenges with proper delineation of contamination and continued vapor intrusion from deep soil and groundwater. Residual contaminant mass under the building may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	5	STE is rated 5 because the fairly large excavation required will have a significant impact on the facility operations and would potentially expose the employees and neighboring businesses to dust and contaminant emissions from staging and loading of soils for disposal. Mitigation measures can provide some dust control. SVE is generally effective at controlling VOC emissions except for emissions during drilling, or potential releases during process upsets and startup testing.
Implementability	4	Implementability is rated 4. Technical reliability of excavation in outdoor soil is moderate because difficulties can be expected due to the depth of the excavation, the proximity of structures and the need for shoring. The ability to install horizontal wells using the blind-drilling method can be challenging, as can characterizing the soil under the building, and success would depend on specific subsurface conditions at the site. Intrusive activities are also disruptive to the operating facilities.
Cost	2	Cost is rated 2 based on the present worth cost of this alternative, estimated to be $13,979,000 based on a capital cost of $8,725,000 and an annual cost of $791,000 for 3 years for SVE. The capital cost includes the cost of converting the SVE(UB) wells into an SSV system. In addition, an annual cost of $15,275 for 100 years for SSV O&M, ICs and monitoring is included.

8.2.4.2 Comparative Analysis of Alternatives

Overall Protection of Human Health and the Environment

All remedial alternatives except Alternative 1 would be protective of human health and the environment.

Alt(s)	Rating
2-6	YES
1	NO

Compliance with ARARs

All remedial alternatives comply with ARARS except Alternative 1 which does not comply with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.

Alt(s)	Rating
2-6	YES
1	NO

Long-term Effectiveness

Alternatives 5 and 6 remove the outdoor soil contamination in the remedial area and include SVE under the building, but because VOCs in soil below the building are difficult to characterize precisely, there could be residual VOCs in soil below the building that could pose a vapor intrusion risk. Alternative 4 is equivalent to Alternatives 5 and 6 for outdoor soil because it removes outdoor soil contamination and provides long-term protection for indoor air using HVAC mod/SSV engineering controls. Alternative 3 is an engineering control alternative that provides adequate protection from exposures but does not remove contaminant mass. Alternative 2 would create ICs to supplement the existing asphalt coverage. There would be some uncertainty about maintaining IC effectiveness over the long term.

Alt(s)	Rating
4-6	8
3	7
2	4
1	1

Reduction of Toxicity, Mobility and Volume

Alternatives 5 and 6 remove the outdoor soil contamination in the remedial area, but there is significant uncertainty about contaminant reduction under the building because of the difficulties in contaminant characterization and the appropriate placement of the SVE wells. Alternative 4 would remove contaminant mass from outdoor soil like Alternatives 5 and 6, but would not remove contaminants from under the building. Alternative 3 involves an engineering control and ICs that would effectively control exposure but would not remove contaminant mass. Alternative 3 ICs include a land use covenant and a permit review process for any excavation projects in this EAPC which may result in removal of impacted soil. Alternative 2 would not directly remove contaminant mass.

Alt(s)	Rating
5-6	8
4	6
3	2
1-2	0

Short-term Effectiveness

Alternative 2 consists of ICs that do not pose any health risk during implementation. Alternative 3 involves asphalt paving and sealing which would have minimal impact, but installation of SSV system across the entire building would have a moderate potential for impact from contaminant releases and hence is rated lower. If HVAC mod is selected over SSV then impacts would be lower. Alternative 4 is also rated the same due to similar impacts from SSV and SVE installation. Alternatives 5 and 6 are rated low because the excavation and SVE system installation under the building would significantly impact the property owner. Anticipated impacts from this alternative include contaminant emissions and potential exposure to dust and VOCs.

Alt(s)	Rating
2	9
3-4	7
5	6
6	5
1	N/A

Implementability

Alternative 2 consists of ICs, including permit review through the City of Los Angeles, which has been implemented as a pilot project. It is assumed that a land use covenant can be negotiated, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support. The asphalt paving included in Alternative 3 is not expected to present technical or administrative challenges. Alternatives 3 and 4 are rated lower than Alternative 2 because it involves implementation of SSV under the entire building. Selection of HVAC mod over SSV for Alternatives 3 and 4, would increase implementability rating because SSV installation is more intrusive to the facility owner and operations and would likely present more technical challenges and difficulties getting the cooperation of property owners/tenants. Alternative 5 is rated lower because it involves SVE under the

Alt(s)	Rating
1	9
2	8
3-4	6
5	5
6	4

building, which would present significant technical challenges and potential impact to property owners. Alternative 6, which includes a large excavation and SVE under the building, would have the greatest potential for impact to the facility and rated lowest. Implementation of SVE wells under the building at shallow depths to remove contaminants from shallow soil, as proposed in Alternatives 5and 6, can be problematic because space is limited and wells may need to be installed by blind-hole drilling as opposed to surface-to-surface completions and because subsurface features under the building may interfere with drilling. Blind-hole drilling methods are known to be less reliable and frequently lead to well failures.

Cost

Each alternative is rated for its 100-year present worth cost.

Alt(s)	Rating	Cost
1	9	None
2	9	$123,000
3	5	$3,374,000
4	4	$5,063,000
5	4	$7,556,000
6	2	$13,979,000

8.2.5 Group 4B (EAPC 5)

The following presents the results of the 9-criteria analysis for each alternative. The alternatives are summarized in Table 8-5. Benzene is the primary COC at this EAPC and 1,2,4-TMB and cyclohexane are secondary COCs.

8.2.5.1 9-Criteria Analysis

ALTERNATIVE 1 – NO ACTION

Criterion	Rating	Discussion
Protect Health & Environment	NO	This alternative does not reduce or control potential future exposure to surface pathway risks because it does not include remediation or long-term controls.
ARARs	NO	This would not be in compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	1	LTE is rated 1 because this alternative does not include appropriate maintenance of the existing asphalt nor permit review ICs to control potential future exposures. This alternative would not guarantee that the site would remain capped in the future.
RTMV	0	RTMV is rated 0 because there is no contaminant mass removal with this alternative.
STE	N/A	STE is not applicable because there is no action.
Implementability	9	Implementability is rated 9 because would be no challenges in taking no action.
Cost	9	Cost is rated 9 because there would be no costs associated with no action.

ALTERNATIVE 2 – ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would protect human health and the environment because the ICs would ensure that property owners, future construction workers, or commercial workers inside buildings onsite are made aware of the potential contamination, and warned to use appropriate safety practices. This alternative incorporates IC layers 1-4A and 5, described in Section 5, including both permit review and land use covenants that are designed to control potential future exposures. The impacted outdoor soil area is covered in existing asphalt, concrete, grass or other covers which provide control of direct exposure.
ARARs	YES	This would be in compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	4	LTE is rated 4 because this alternative does not include active remedial options to mitigate potential exposures. Impacted areas of the site are covered with asphalt, concrete, grass, or other covers. However, the alternative does not guarantee that the site will remain capped. The alternative incorporates IC layers 1-4A and 5, described in Section 5, including both permit review and land use covenants that are designed to control potential future exposures, but there would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	0	RTMV is rated 0 because with this alternative, contaminants are not removed. Contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	9	STE is rated 9 since there is no active remedy with this alternative, and therefore no added risks to health and environment. Short-term impacts during IC design and implementation are unlikely, because the existing cap is effective at mitigating direct contact exposures, and interim ICs currently in place control exposures during construction projects that involve excavation in impacted areas.
Implementability	8	Implementability is rated 8 because the City of Los Angeles has implemented the permit review process (IC layer 2) as a pilot project for selected properties at the former plant site. A land use covenant (IC layers 4A and 5) is assumed to be negotiable, given USEPA's enforcement authority, and a zoning institutional control is likely implementable given the City's current political support.
Cost	9	Cost is rated 9 based on the present worth cost for 100 years, estimated to be about \$123,000, with a capital cost of \$37,000 and annual cost of \$3,275. The cost for this alternative is primarily for setting up the various IC layers and monitoring.

ALTERNATIVE 3 – CAPPING (VOCs) + HVAC MOD/SSV (UB)[39] + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative protects human health and the environment because asphalt capping would provide reliable control of exposure to VOCs in outdoor soil, and HVAC mod/SSV would mitigate vapor intrusion into indoor air. It includes IC layers 1-5 including land use covenants that would restrict excavation and ensure the asphalt cap and the HVAC mod/SSV engineering controls are protected.
ARARs	YES	This alternative would be in compliance with ARARs, including SCAQMD requirements for emissions from the SSV activities, requirements for a worker health and safety program, and the state rule requiring a restrictive covenant when waste is left in place beyond UU/UE levels.
LTE	7	LTE is rated 7 because asphalt capping would control direct exposure to VOCs in outdoor soil and HVAC mod/SSV would mitigate vapor intrusion into indoor air. IC layers 1-5 include permit review for control of potential exposure to outdoor soil by construction workers, and a land use covenant for protection of engineering controls such as capping and HVAC mod/SSV. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	2	RTMV is rated 2 because this alternative does not remove contaminant mass from the outdoor soil or from under buildings. HVAC mod does not treat VOCs while SSV treats offgassing VOCs but not the source contamination. Contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	8	STE is rated 8 because the construction activities associated with the HVAC mod installation would have limited impact on the environment and commercial workers. If SSV is selected it would have greater impact than HVAC mod due to dust and VOC emissions from trenching inside the building for the SSV piping.
Implementability	7	Implementability is rated 7 because the HVAC modification would present moderate challenges. Installation of slotted piping in trenches inside the building as part of the SSV system could present greater challenges. A building-specific evaluation will need to be conducted during remedial design.
Cost	5	Cost is rated 5 based on the present worth cost of this alternative, estimated to be $3,365,000 based on a capital cost of $1,002,000 and an annual cost of $90,775 for 100 years. The cost for this alternative includes cap and HVAC mod/SSV O&M and the IC layers and monitoring.

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[39] For this alternative for EAPC 5, HVAC mod is assumed rather than SSV as discussed in Section 6.6.3.

ALTERNATIVE 4 – SVE/BV (OS) + HVAC MOD/SSV (UB)[40] + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would provide adequate protection because VOC-impacted outdoor soil would be remediated by SVE. HVAC mod/SSV would protect commercial workers in the building from vapor intrusion into indoor air. IC layers 1-5 would control potential exposures from residual contamination.
ARARs	YES	This alternative would comply with ARARs for aboveground treatment including: SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	8	LTE is rated 8 because SVE would remediate VOCs in outdoor soil. The HVAC mod/SSV engineering control would mitigate exposure from vapor intrusion into indoor air. This alternative incorporates IC layers 1-5, described in Section 5, including permit review as well as land use covenants designed to control potential future exposures and protect the engineering controls. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	6	RTMV is rated 6 because SVE/BV would remediate VOC contamination in outdoor soil (>90%) but does not remove VOC contamination under the building. HVAC mod does not treat VOCs while SSV treats offgassing VOCs but not the source contamination. Contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	7	STE is rated 7 because SVE treats VOCs in an aboveground treatment system. The technologies can control VOC emissions except for emissions during drilling, or potential releases during process upsets and startup testing. HVAC modification would have limited impact. If SSV is selected it would have greater impact than HVAC mod due to dust and VOC emissions from trenching inside the building for the SSV piping.
Implementability	6	Implementability is rated 6. The technical reliability of SVE in outdoor soil is fairly good despite the low-permeability shallow soils. Technical reliability of HVAC mod/SSV is moderate and moderate challenges can be anticipated with HVAC mod/SSV installation.
Cost	5	Cost is rated 5 based on the present worth cost of this alternative, estimated to be $4,520,000 based on a capital cost of $2,053,000 and an annual cost of $514,000 for 3 years of SVE and an annual cost of $15,775 for 100 years of HVAC O&M and the ICs layers and monitoring.

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[40] For this alternative for EAPC 5, HVAC mod is assumed rather than SSV as discussed in Section 6.6.3.

ALTERNATIVE 5 – SVE/BV (OS) + SVE/BV (UB) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would protect human health and the environment because SVE would effectively address VOCs in outdoor soil. SVE for soils under the building would have reduced effectiveness because it is difficult to characterize soil under the building. Monitoring would include sub-slab monitoring to characterize the potential for vapor intrusion. IC layers 1-4A and 5 are designed to control potential future exposures and protect the engineering controls.
ARARs	YES	This alternative would comply with ARARs for aboveground treatment including: SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	8	LTE is rated 8 because SVE would remediate VOCs in outdoor soil. SVE for soils under the building can remediate VOCs in soils under the building, but its effectiveness would be reduced because it is difficult to characterize soil under the building. If there is continuing vapor intrusion from deep soils or groundwater contamination, HVAC mod/SSV engineering control may be needed to provide additional exposure control from vapor intrusion. ICs and monitoring can provide long-term protection from residual contamination. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	8	RTMV is rated 8 because SVE would remediate VOC contamination in outdoor soil (>90%). SVE for soils under the building would be reduced in effectiveness (50% to 90% removal) due to challenges with proper delineation of contamination and continued vapor intrusion from deep soil and groundwater. Contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	6	STE is rated 6 because SVE treats VOCs in an aboveground treatment system. The technologies can control VOC emissions except for emissions during drilling, or potential releases during process upsets and startup testing. The facility employees may be impacted during SVE system installation, which would involve installation of horizontal wells under the building. The potential commercial workers or neighboring businesses to be exposed to contamination is limited.

Criterion	Rating	Discussion
Implementability	5	Implementability is rated 5. Technical reliability of SVE in outdoor soil is moderate to good despite the low-permeability shallow soils. However, the reliability of SVE under the building has some uncertainty. The ability to install horizontal wells using the blind-drilling method can be challenging, as can characterizing the soil under the building, and success would depend on specific subsurface conditions at the site. Significant investigation activities inside the building (e.g., sub-slab investigation) can be disruptive to the operating facilities.
Cost	4	Cost is rated 4 based on the present worth cost of this alternative, estimated to be $6,557,000 based on a capital cost of $2,613,000 and an annual cost of $935,000 for 3 years of SVE. The capital cost includes the cost of converting the SVE (UB) wells into an SSV system. In addition, an annual cost of $15,275 for 100 years for SSV O&M, ICs and monitoring is included.

ALTERNATIVE 6 – EXCAVATION (VOCs) + SVE/BV (UB) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would provide adequate protection because the outdoor soil VOCs would be addressed by excavation. SVE for soils under the building have reduced effectiveness because it is difficult to characterize soil under the building. Monitoring would include sub-slab monitoring to further characterize the potential for vapor intrusion. IC layers 1-4A and 5 are designed to control potential future exposures and protect the engineering controls.
ARARs	YES	This alternative would comply with ARARs for excavation and aboveground treatment, including SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	8	LTE is rated 8 because outdoor soil VOCs are addressed by excavation. SVE for soils under the building can be effective, but its effectiveness would be reduced because it is difficult to characterize soil under the building. If there is continuing vapor intrusion from deep soils or groundwater contamination, HVAC mod/SSV may be needed to provide additional exposure control. There would be some uncertainty about maintaining IC effectiveness over the long term.

Criterion	Rating	Discussion
RTMV	8	RTMV is rated 8 because excavation would remediate VOC contamination in outdoor soil (>90%). SVE for soils under the building would be reduced in effectiveness (50% to 90% removal) due to challenges with proper delineation of contamination and continued vapor intrusion from deep soil and groundwater. Residual contaminant mass under the building may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	5	STE is rated 5 because the fairly large excavation required will have a significant impact on the facility operations and would potentially expose the employees and neighboring businesses to dust and contaminant emissions from staging and loading of soils for disposal. Mitigation measures can provide some dust control. SVE is generally effective at controlling VOC emissions except for emissions during drilling, or potential releases during process upsets and startup testing.
Implementability	4	Implementability is rated 4. Technical reliability of excavation in outdoor soil is moderate because difficulties can be expected due to the depth of the excavation, the proximity of structures and the need for shoring. The ability to install horizontal wells using the blind-drilling method can be challenging, as can characterizing the soil under the building, and success would depend on specific subsurface conditions at the site. Intrusive activities are also disruptive to the operating facilities, and can result in difficulties in negotiating with the property owners or tenants.
Cost	2	Cost is rated 2 based on the present worth cost of this alternative, estimated to be $14,174,000 based on a capital cost of $9,202,000 and an annual cost of $673,000 for 3 years of SVE. The capital cost includes the cost of converting the SVE(UB) wells into an SSV system. In addition, an annual cost of $15,275 for 100 years for SSV O&M, ICs and monitoring is included.

8.2.5.2 Comparative Analysis of Alternatives

Overall Protection of Human Health and the Environment

All remedial alternatives except Alternative 1 would be protective of human health and the environment.

Alt(s)	Rating
2-6	YES
1	NO

Compliance with ARARs

All remedial alternatives comply with ARARS except Alternative 1 which does not comply with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.

Alt(s)	Rating
2-6	YES
1	NO

Long-term Effectiveness

Alt(s)	Rating
4-6	8
3	7
2	4
1	1

Alternatives 5 and 6 remove the outdoor soil contamination in the remedial area, and include SVE under the building, but because VOCs in soil below the building are difficult to characterize precisely, there could be residual VOCs in soil below the building that could pose a vapor intrusion risk. Alternative 4 is equivalent to Alternatives 5 and 6 for outdoor soil because it removes outdoor soil contamination and provides long-term protection for indoor air using engineering controls. Alternative 3 is an engineering control alternative that provides adequate protection from exposures but does not remove contaminant mass. Alternative 2 would create ICs to supplement the existing asphalt coverage. There would be some uncertainty about maintaining IC effectiveness over the long term.

Reduction of Toxicity, Mobility and Volume

Alt(s)	Rating
5-6	8
4	6
3	2
1-2	0

Alternatives 5 and 6 remove the outdoor soil contamination in the remedial area, but there is significant uncertainty about contaminant reduction under the building because of the difficulties in contaminant characterization and hence the appropriate placement of the SVE wells. Alternative 4 would remove contaminant mass from outdoor soil like Alternatives 5 and 6, but would not remove contaminants from under the building. Alternative 3 involves an engineering control and ICs that would effectively control exposure but would not remove contaminant mass. Alternative 3 ICs include a land use covenant and a permit review process for any excavation projects in this EAPC, which may result in removal of impacted soil. Alternative 2 would not directly remove contaminant mass.

Short-term Effectiveness

Alt(s)	Rating
2	9
3	8
4	7
5	6
6	5
1	N/A

Alternative 2 consists of ICs that do not pose any health risk during implementation. Alternative 3 involves asphalt paving and sealing which would have minimal impact and HVAC modification, which could have moderate impact. If SSV is selected over HVAC mod, then the impact would be greater. Alternatives 5 and 6 are rated low because the excavation and SVE system installation would significantly impact the property owner. Anticipated impacts from this alternative include contaminant emissions and potential exposure to dust and VOCs. Alternative 4 is rated higher than Alternative 5 because it includes only vertical wells in outdoor soil (no horizontal wells below the building) and has a smaller SVE remedial system.

Implementability

Alt(s)	Rating
1	9
2	8
3	7
4	6
5	5
6	4

Alternative 2 consists of ICs, including permit review through the City of Los Angeles, which has been implemented as a pilot project. It is assumed that a land use covenant can be negotiated, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support. The asphalt paving included in Alternative 3 is not expected to present technical or administrative challenges. Alternative 3 is rated somewhat lower than Alternative 2 because it involves implementation of HVAC mod in the building. Alternative 4 is rated lower than Alternative 3 because of the moderate challenges posed by SVE remediation. Selection of SSV over HVAC mod for Alternatives 3 and 4, would decrease implementability because HVAC modification is less intrusive to the facility owner and operations, and would likely present less technical challenges and difficulties getting the cooperation of property owners/tenants. Alternative 5 is rated lower because it involves SVE under the building, which has a high degree of technical complexity and potential impact to property owners. Alternative 6, which includes a large excavation and SVE under the building, would have the greatest technical complexity and rated lowest. Implementation of SVE wells under the building at shallow depths to remove contaminants from shallow soil, as proposed in Alternatives 5 and 6, can be problematic because space is limited and wells may need to be installed by blind-hole drilling as opposed to surface-to-surface completions and because subsurface features under the building may interfere with drilling. Blind-hole drilling methods are known to be less reliable and frequently lead to well failures.

Cost

Each alternative is rated for its 100-year present worth cost.

Alt(s)	Rating	Cost
1	9	None
2	9	$123,000
3	5	$3,365,000
4	5	$4,520,000
5	4	$6,557,000
6	2	$14,174,000

8.2.6 Group 3A (EAPC 32)

The following presents the results of the 9-criteria analysis for each alternative. The alternatives are summarized in Table 8-6. B(a)P is the only COC at this EAPC.

8.2.6.1 9-Criteria Analysis

ALTERNATIVE 1 – NO ACTION

Criterion	Rating	Discussion
Protect Health & Environment	NO	This alternative does not reduce or control potential future exposure to surface pathway risks because it does not include remediation or long-term controls.
ARARs	NO	This alternative would not be in compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	1	LTE is rated 1 because this alternative does not include appropriate maintenance of the existing asphalt nor permit review ICs to control potential future exposures. This alternative would not guarantee that the site would remain capped in the future.
RTMV	0	RTMV is rated 0 because there is no contaminant mass removal with this alternative.
STE	N/A	STE is not applicable because there is no action.
Implementability	9	Implementability is rated 9 because would be no challenges in taking no action.
Cost	9	Cost is rated 9 because there would be no costs associated with no action.

ALTERNATIVE 2 – ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would protect human health and the environment because the ICs would ensure that property owners, future construction workers, or commercial workers inside buildings onsite are made aware of the potential contamination and are warned to use appropriate safety practices. This alternative incorporates IC layers 1-4A, and 5, described in Section 5, including both permit review and land use covenants that are designed to control potential future exposures. The impacted outdoor soil area is covered in existing asphalt, concrete, grass, or other covers which provide control of direct exposure.
ARARs	YES	This alternative would be in compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	5	LTE is rated 5 because the B(a)P contaminant is immobile and the impacted areas are covered with asphalt, concrete, grass, or other covers which provide some protection to onsite commercial workers. However, the alternative does not guarantee that the impacted areas of the site will remain capped in the long term. The alternative does not include active remedial options to mitigate potential exposures. The alternative incorporates IC layers 1-4A and 5, described in Section 5, including both permit review and land use covenants that are designed to control potential future exposures, but there would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	0	RTMV is rated 0 because with this alternative, contaminants are not removed. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	9	STE is rated 9 since there is no active remedy with this alternative, and therefore no added risks to health and environment. Short-term impacts during IC design and implementation are unlikely, because the existing cap is effective at mitigating direct contact exposures, and interim ICs currently in place control exposures during construction projects that involve excavation in impacted areas.
Implementability	8	Implementability is rated 8 because the City of Los Angeles has implemented the permit review process (IC layer 2) as a pilot project for selected properties at the former plant site. A land use covenant (IC layers 4A and 5) is assumed to be negotiable, given USEPA's enforcement authority, and a zoning institutional control is likely implementable given the City's current political support.

Criterion	Rating	Discussion
Cost	9	Cost is rated 9 based on the present worth cost, estimated to be about \$123,000, with a capital cost of \$37,000 and annual cost of \$3,275 for 100 years. The cost for this alternative is primarily for setting up the various IC layers and monitoring.

ALTERNATIVE 3 – CAPPING (B(A)P) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative protects human health and the environment because asphalt capping would provide reliable control of exposure to B(a)P-impacted areas. It includes IC layers 1-5 including land use covenants that would restrict excavation and ensure the asphalt cap is protected.
ARARs	YES	This alternative would be in compliance with ARARs, including the state rule requiring a restrictive covenant when waste is left in place beyond UU/UE levels.
LTE	8	LTE is rated 8 because this alternative includes an asphalt cap to provide protection from potential direct contact with soil contaminants. This alternative incorporates IC layers 1-5, described in Section 5, including both permit review and land use covenants that are designed to control potential future exposures, and a land use covenant to protect the cap. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	0	RTMV is rated 0 because this alternative does not remove contaminant mass from the outdoor soil or from under buildings. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	8	STE is rated 8 because asphalt paving and sealing would have minimal impact on the environment, onsite commercial workers, or the community.
Implementability	8	Implementability is rated 8 because the asphalt capping would present few technical challenges
Cost	7	Cost is rated 7 based on the present worth cost of this alternative, estimated to be \$302,000 based on a capital cost of \$117,000 and an annual cost of \$6,775 for 100 years. The cost for this alternative includes cap O&M and the IC layers and monitoring.

ALTERNATIVE 4 – EXCAVATION (B(A)P) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would provide adequate protection because the B(a)P-impacted soils would be excavated. IC layers 1, 2 and 5 would provide long-term protection via information and permit review through the City of Los Angeles.
ARARs	YES	This alternative would comply with ARARs including: SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes and OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors. The state ARAR requiring restrictive covenants would not be applicable under this alternative because the contamination is remediated.
LTE	9	LTE is rated 9 because excavation would remove the B(a)P-impacted soil. Because the contamination is removed, ICs would include only layers 1, 2 and 5, which would provide protection from areas of soil contamination that may be encountered in the future.
RTMV	9	RTMV is rated 9 because the excavation would remove more than 90% of contaminant mass in the impacted soil.
STE	7	STE is rated 7 because the excavation would create minor impacts to facility onsite workers due to emissions of dust and contaminants from excavation, staging and loading of soils for offsite disposal. Mitigation measures can provide reasonable dust control.
Implementability	6	Implementability is rated 6 because no significant technical or administrative challenges are anticipated with the shallow excavation. However, some impacts to the facility and onsite workers can be anticipated during the excavation. The implementability of the ICs is the same as for Alternative 2 except that this alternative includes IC layers 1, 2 and 5.
Cost	7	Cost is rated 7 based on the present worth cost of this alternative, estimated to be $347,000 based on a capital cost of $213,000 and an annual cost of $2,675 for 100 years of ICs and monitoring.

8.2.6.2 Comparative Analysis of Alternatives

Overall Protection of Human Health and the Environment

All remedial alternatives except Alternative 1 would be protective of human health and the environment.

Alt(s)	Rating
2-4	YES
1	NO

Compliance with ARARs

All remedial alternatives comply with ARARS except for Alternative 1 which would not be in compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.

Alt(s)	Rating
2-4	YES
1	NO

Long-term Effectiveness

Alternative 4 would remove the B(a)P contaminant. Alternative 3 would cap PAH-impacted areas and would provide good protection in the long term considering that the B(a)P concentrations in soil are below urban background levels. Alternative 2 would create ICs to supplement the existing asphalt coverage. There would be some uncertainty about maintaining IC effectiveness over the long term.

Alt(s)	Rating
4	9
3	8
2	5
1	1

Reduction of Toxicity, Mobility and Volume

Alternative 4 would remove the B(a)P contaminant by excavation. Alternative 3 involves an engineering control and ICs that would effectively control exposure but would not remove contaminant mass. Alternative 3 ICs include a land use covenant and a permit review process for any excavation projects in this EAPC, which may result in removal of impacted soil. Alternative 2 would create ICs to supplement the existing asphalt coverage but would not directly remove contaminant mass.

Alt(s)	Rating
4	9
1-3	0

Short-term Effectiveness

Alternative 2 consists of ICs that do not pose any health risk during implementation. Alternative 3 involves asphalt paving and sealing which would have minimal impact. Alternative 4 is rated lower because excavation has the potential to cause air emissions of dust and contaminants.

Alt(s)	Rating
2	9
3	8
4	7
1	N/A

Implementability

Alternative 2 consists of ICs, including permit review through the City of Los Angeles, which has been implemented as a pilot project. It is assumed that a land use covenant can be negotiated, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support. The asphalt paving included in Alternative 3 is not expected to present technical or administrative challenges. Alternative 4 is rated slightly lower because this excavation alternative would modestly impact the onsite facility though technical challenges are not considered significant.

Alt(s)	Rating
1	9
2-3	8
4	6

Cost

Each alternative is rated for its 100-year present worth cost.

Alt(s)	Rating	Cost
1	9	None
2	9	$123,000
3	7	$302,000
4	7	$347,000

8.2.7 Group 3B (EAPC 9)

The following presents the results of the 9-criteria analysis for each alternative. The alternatives are summarized in Table 8-7. Benzene is the only COC at this EAPC.

8.2.7.1 9-Criteria Analysis

ALTERNATIVE 1 – NO ACTION

Criterion	Rating	Discussion
Protect Health & Environment	NO	This alternative does not reduce or control potential future exposure to surface pathway risks because it does not include remediation or long-term controls.
ARARs	NO	This alternative would not be in compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	1	LTE is rated 1 because this alternative does not include appropriate maintenance of the existing asphalt nor permit review ICs to control potential future exposures. This alternative would not guarantee that the site would remain capped in the future.
RTMV	0	RTMV is rated 0 because there is no contaminant mass removal with this alternative.
STE	N/A	STE is not applicable because there is no action.
Implementability	9	Implementability is rated 9 because would be no challenges in taking no action.
Cost	9	Cost is rated 9 because there would be no costs associated with no action.

ALTERNATIVE 2 – ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would protect human health and the environment because the ICs would ensure that property owners, future construction workers, or commercial workers inside buildings onsite are made aware of the potential contamination, and warned to use appropriate safety practices. This alternative incorporates IC layers 1-4A, and 5, described in Section 5, including both permit review and land use covenants that are designed to control potential future exposures. The impacted outdoor soil area is covered in existing asphalt, concrete, grass, or other covers which provide control of direct exposure.
ARARs	YES	This alternative would be in compliance with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	4	LTE is rated 4 because the alternative does not include active remedial options to mitigate potential exposures. Impacted areas of the site are covered with asphalt, concrete, grass, or other covers. However, the alternative does not guarantee that the site will remain capped. The alternative incorporates IC layers 1-4A and 5, described in Section 5, including both permit review and land use covenants that are designed to control potential future exposures, but there would be some uncertainty about maintaining IC effectiveness over the long term.

Criterion	Rating	Discussion
RTMV	0	RTMV is rated 0 because with this alternative, contaminants are not removed. Contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	9	STE is rated 9 since there is no active remedy with this alternative, and therefore no added risks to health and environment. Short-term impacts during IC design and implementation because the existing cap is effective at mitigating direct contact exposures, and interim ICs currently in place control exposures during construction projects that involve excavation in impacted areas.
Implementability	8	Implementability is rated 8 because the City of Los Angeles has implemented the permit review process (IC layer 2) as a pilot project for selected properties at the former plant site. A land use covenant (IC layers 4A and 5) is assumed to be negotiable, given USEPA's enforcement authority, and a zoning institutional control is likely implementable given the City's current political support.
Cost	9	Cost is rated 9 based on the present worth cost, estimated to be about $123,000, with a capital cost of $37,000 and annual cost of $3,275 for 100 years. The cost for this alternative is primarily for setting up the various IC layers and monitoring.

ALTERNATIVE 3 – CAPPING (BENZENE) + HVAC MOD/SSV (UB) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative protects human health and the environment because asphalt capping would provide reliable control of exposure to VOCs in outdoor soil, and HVAC mod/SSV would mitigate vapor intrusion into indoor air. It includes IC layers 1-5 including land use covenants that would restrict excavation and ensure the asphalt cap and the HVAC mod/SSV engineering controls are protected.
ARARs	YES	This alternative would be in compliance with ARARs, including SCAQMD requirements for emissions from the SSV activities, requirements for a worker health and safety program, and the state rule requiring a restrictive covenant when waste is left in place beyond UU/UE levels.

Criterion	**Rating**	**Discussion**
LTE	7	LTE is rated 7 because asphalt capping would control direct exposure to VOCs in outdoor soil and HVAC mod/SSV would mitigate vapor intrusion into indoor air. IC layers 1-5 include permit review for control of potential exposure to outdoor soil by construction workers, and a land use covenant for protection of engineering controls such as capping and HVAC mod/SSV. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	2	RTMV is rated 2 because this alternative does not remove contaminant mass from the outdoor soil or from under buildings. However, SSV treats offgassing VOCs under the building. Contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	7	STE is rated 7 because the construction activities associated with the SSV system installation could have moderate impact on the environment and commercial onsite workers due to emissions of dust and VOCs. HVAC modification would have a lower impact than SSV.
Implementability	6	Implementability is rated 6 because the installation of slotted piping in trenches inside the building as part of the SSV system could present significant challenges. HVAC modification would present moderate challenges but less than SSV. A building-specific evaluation will need to be conducted during remedial design.
Cost	5	Cost is rated 5 based on the present worth cost of this alternative, estimated to be $1,331,000 based on a capital cost of $438,000 and an annual cost of $33,775 for 100 years. The cost for this alternative includes cap and HVAC mod/SSV O&M and the IC layers and monitoring.

ALTERNATIVE 4 – SVE/BV (OS) + HVAC MOD/SSV (UB) + ICs + MONITORING

Criterion	**Rating**	**Discussion**
Protect Health & Environment	YES	This alternative would provide adequate protection because VOC-impacted outdoor soil would be remediated by SVE. HVAC mod/SSV would protect commercial workers in the building from vapor intrusion into indoor air. IC layers 1-5 would control potential exposures from residual contamination.
ARARs	YES	This alternative would comply with ARARs for aboveground treatment including: SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.

Criterion	Rating	Discussion
LTE	8	LTE is rated 8 because SVE would remediate VOCs in outdoor soil. The HVAC mod/SSV engineering control would mitigate exposure from vapor intrusion into indoor air. This alternative incorporates IC layers 1-5, described in Section 5, including permit review as well as land use covenants designed to control potential future exposures and protect the engineering controls. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	6	RTMV is rated 6 because SVE/BV would remediate VOC contamination in outdoor soil but does not remove VOC contamination under the building. SSV treats offgassing VOCs but does not remove the source. Contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	7	STE is rated 7 because SVE treats VOCs in an aboveground treatment system. The technologies can control VOC emissions except for emissions during drilling, or potential releases during process upsets and startup testing. During SSV system installation, which would involve digging trenches inside the building, the facility employees may face potential exposures. HVAC modification would have a lower impact than SSV.
Implementability	6	Implementability is rated 6. The technical reliability of SVE in outdoor soil is moderate to good despite the low-permeability shallow soils. Technical reliability of HVAC mod/SSV is moderate and challenges can be anticipated with SSV installation. Installation of slotted piping in trenches inside the building may have an impact on an operating facility, causing potential difficulties from the tenants or property owners.
Cost	3	Cost is rated 3 based on the present worth cost of this alternative, estimated to be $2,790,000 based on a capital cost of $993,000 and an annual cost of $374,000 for 3 years of SVE and an annual cost of $15,775 for 100 years of HVAC mod/SSV O&M and the ICs layers and monitoring.

ALTERNATIVE 5 – SVE/BV (OS) + SVE/BV (UB) + ICs + MONITORING

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would protect human health and the environment because SVE would effectively address VOCs in outdoor soil. SVE for soils under the building have reduced effectiveness because it is difficult to characterize soil under the building. Engineering controls such as asphalt caps for non-VOCs would provide direct exposure controls. Monitoring would include sub-slab monitoring to characterize the potential for vapor intrusion. IC layers 1-4A and 5 are provided to control potential contaminant exposures.

Criterion	Rating	Discussion
ARARs	YES	This alternative would comply with ARARs for aboveground treatment including: SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	8	LTE is rated 8 because SVE would remediate VOCs in outdoor soil. SVE for soils under the building can remediate VOCs in soils under the building, but its effectiveness would be reduced because it is difficult to characterize soil under the building. If there is continuing vapor intrusion from deep soil or groundwater contamination, HVAC mod/SSV engineering control may be needed to provide additional exposure control. ICs and monitoring can provide long-term protection from residual contamination. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	8	RTMV is rated 8 because SVE would remediate VOC contamination in outdoor soil. SVE for soils under the building would be reduced in effectiveness (50% to 90% removal) due to challenges with proper delineation of contamination and continued vapor intrusion from deep soil and groundwater. Some potential for vapor intrusion would remain. Contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	6	STE is rated 6 because SVE treats VOCs in an aboveground treatment system. The technologies can control VOC emissions except for emissions during drilling, or potential releases during process upsets and startup testing. The facility employees may be impacted during SVE system installation, which would involve installation of horizontal wells under the building. The potential to commercial workers or neighboring businesses to be exposed to contamination is limited.
Implementability	5	Implementability is rated 5. Technical reliability of SVE in outdoor soil is moderate to good despite the low-permeability shallow soils. The ability to install horizontal wells using the blind-drilling method can be challenging, as can characterizing the soil under the building, and success would depend on specific subsurface conditions at the site. Significant investigation activities inside the building (e.g., sub-slab investigation) can be disruptive to the operating facilities.

Criterion	**Rating**	**Discussion**
Cost	3	Cost is rated 3 based on the present worth cost of this alternative, estimated to be $3,745,000 based on a capital cost of $1,242,000 and an annual cost of $578,000 for 3 years of SVE. The capital cost includes the cost of converting the SVE(UB) wells into an SSV system. In addition, an annual cost of $15,275 for 100 years for SSV O&M, ICs and monitoring is included.

ALTERNATIVE 6 – EXCAVATION (BENZENE) + SVE/BV (UB) + ICs + MONITORING

Criterion	**Rating**	**Discussion**
Protect Health & Environment	YES	This alternative would provide adequate protection because the outdoor soil VOCs would be addressed by excavation. SVE for soils under the building have reduced effectiveness because it is difficult to characterize soil under the building. Monitoring would include sub-slab monitoring to further characterize the potential for vapor intrusion. IC layers 1-4A and 5 are designed to control potential future exposures.
ARARs	YES	This alternative would comply with ARARs for excavation and aboveground treatment, including SCAQMD requirements for emissions from excavations, RCRA or state requirements for recovered hazardous wastes, OSHA requirements for a health and safety program including Hazwoper-trained excavation contractors, and the state ARAR that requires restrictive covenants when waste is left in place beyond UU/UE levels.
LTE	8	LTE is rated 8 because outdoor soil VOCs are addressed by excavation. SVE for soils under the building can be effective, but its effectiveness would be reduced because it is difficult to characterize soil under the building. If there is continuing vapor intrusion from deep soil or groundwater contamination, HVAC mod/SSV may be needed to provide additional exposure control. IC layers 1-4A and 5 are designed to control potential future exposures. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	8	RTMV is rated 8 because excavation would remediate VOC contamination in outdoor soil. SVE for soils under the building would be reduced in effectiveness (50% to 90% removal) due to challenges with proper delineation of contamination and continued vapor intrusion from deep soil and groundwater. Residual contaminant mass under the building may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.

Criterion	Rating	Discussion
STE	5	STE is rated 5 because the fairly large excavation required will have a significant impact on the facility operations and would potentially expose the employees and neighboring businesses to dust and contaminant emissions from staging and loading of soils for disposal. Mitigation measures can provide some dust control. SVE is generally effective at controlling VOC emissions except for emissions during drilling, or potential releases during process upsets and startup testing.
Implementability	4	Implementability is rated 4. Technical reliability of excavation in outdoor soil is moderate because difficulties can be expected due to the depth of the excavation, the proximity of structures and the need for shoring. The ability to install horizontal wells using the blind-drilling method can be challenging, as can characterizing the soil under the building, and success would depend on specific subsurface conditions at the site. Intrusive activities are also disruptive to the operating facilities, and can result in difficulties in negotiating with the property owners or tenants.
Cost	2	Cost is rated 2 based on the present worth cost of this alternative, estimated to be $4,875,000 based on a capital cost of $2,536,000 and an annual cost of $389,000 for 3 years of SVE. The capital cost includes the cost of converting the SVE(UB) wells into an SSV system. In addition, an annual cost of $15,275 for 100 years for SSV O&M, ICs and monitoring is included.

8.2.7.2 Comparative Analysis of Alternatives

Overall Protection of Human Health and the Environment

All remedial alternatives except Alternative 1 would be protective of human health and the environment.

Alt(s)	Rating
2-6	YES
1	NO

Compliance with ARARs

All remedial alternatives comply with ARARS except Alternative 1 which does not comply with the state ARAR requiring restrictive covenants when waste is left in place beyond UU/UE levels.

Alt(s)	Rating
2-6	YES
1	NO

Long-term Effectiveness

Alternatives 5 and 6 remove the outdoor soil contamination in the remediation area, and include SVE under the building, but because VOCs in soil below the building are difficult to characterize precisely, there could be residual VOCs in soil below the building that could pose a vapor intrusion risk. Alternative 4 is equivalent to Alternatives 5 and 6 for outdoor soil because it removes outdoor soil contamination and provides long-term protection for indoor air using HVAC mod/SSV. Alternative 3 is an engineering control alternative that provides adequate protection from exposures but does not remove contaminant mass. Alternative 2 would create ICs to supplement the existing asphalt coverage. There would be some uncertainty about maintaining IC effectiveness over the long term.

Alt(s)	Rating
4-6	8
3	7
2	4
1	1

Reduction of Toxicity, Mobility and Volume

Alt(s)	Rating
5-6	8
4	6
3	2
1-2	0

Alternatives 5 and 6 remove the outdoor soil contamination in the remedial area, but there is significant uncertainty about contaminant reduction under the building because of the difficulties in contaminant characterization and hence the appropriate placement of the SVE wells. Alternative 4 would remove contaminant mass from outdoor soil like Alternatives 5 and 6, but would not remove contaminants from under the building. Alternative 3 involves an engineering control and ICs that would effectively control exposure but would not remove contaminant mass. Alternative 3 ICs include a land use covenant and a permit review process for any excavation projects in this EAPC, which may result in removal of impacted soil. Alternative 2 would not directly remove contaminant mass.

Short-term Effectiveness

Alt(s)	Rating
2	9
3-4	7
5	6
6	5
1	N/A

Alternative 2 consists of ICs that do not pose any health risk during implementation. Alternative 3 involves asphalt paving and sealing which would have minimal impact, but installation of SSV system across the entire building would have a moderate potential for impact from contaminant releases and hence is rated lower. If HVAC mod is selected over SSV, then the impact would be lower. Alternatives 5 and 6 are rated low because the excavation and SVE system installation would significantly impact the property owner. Anticipated impacts from this alternative include contaminant emissions and potential exposure. Alternative 4 is rated higher than Alternative 5 because it includes only vertical wells in outdoor soil (no horizontal wells below the building) and has a smaller SVE remedial system.

Implementability

Alt(s)	Rating
1	9
2	8
3	6
4	6
5	5
6	4

Alternative 2 consists of ICs, including permit review through the City of Los Angeles, which has been implemented as a pilot project. It is assumed that a land use covenant can be negotiated, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support. The asphalt paving included in Alternative 3 is not expected to present technical or administrative challenges. Alternatives 3 and 4 are rated lower than Alternative 2 because it involves implementation of SSV in the building. Selection of HVAC mod over SSV for Alternatives 3 and 4, would increase implementability rating because SSV installation is more intrusive to the facility owner and operations and would likely present more technical challenges and difficulties getting the cooperation of property owners/tenants. Alternative 5 is rated lower because it involves SVE under the building, which would present significant technical challenges and potential impact to property owners. Alternative 6, which includes a large excavation and SVE under the building, would have the greatest potential to impact to the facility and rated lowest. Implementation of SVE wells under the building at shallow depths to remove contaminants from shallow soil, as proposed in Alternatives 5 and 6, can be problematic because space is limited and wells may need to be installed by blind-hole drilling as opposed to surface-to-surface completions and because subsurface features under the building may interfere with drilling. Blind-hole drilling methods are known to be less reliable and frequently lead to well failures.

Cost
Each alternative is rated for its 100-year present worth cost.

Alt(s)	Rating	Cost
1	9	None
2	9	$123,000
3	5	$1,331,000
4	3	$2,790,000
5	3	$3,745,000
6	2	$4,875,000

8.2.8 Group 2 (EAPC 21)

Because parcels in Group 2 and Group 1 have lower risks, only Alternative 2 (ICs+Monitoring) and Alternative 1 (No Action) were evaluated. The results are presented in an abbreviated format.

Group 2 includes EAPCs with CR and RR ≤ 1E-06 and Hi_{com} and HI_{res} less than 1 and other exposure areas that were not evaluated in the BRA. The following is a comparative analysis of the ICs alternative and the No Action alternative for the representative Group 2 parcel that also applies to other Group 2 parcels.

8.2.8.1 Comparative Analysis

Overall Protection of Human Health and the Environment
Alternative 2 consists of ICs, including permit review (layer 2) and informational controls (layer 1), and monitoring. This alternative would provide more long-term protection from residual or unknown contamination than Alternative 1 (No Action).

Alt(s)	Rating
2	YES
1	NO

Compliance with ARARs
There are no ARARs for this EAPC because waste will not be left in place beyond UU/UE levels.

Alt(s)	Rating
2	YES
1	NO

Long-term Effectiveness
Alternative 2 (ICs and monitoring) would provide more long-term protection from any residual or unknown contamination in these exposure areas than Alternative 1 (No Action). There would be some uncertainty about maintaining IC effectiveness over the long term.

Alt(s)	Rating
2	7
1	1

Reduction of Toxicity, Mobility and Volume
There would be no active contaminant removal with either alternative. Alternative 2 would create ICs to supplement the existing asphalt coverage, providing more protection than Alternative 1 (No Action).

Alt(s)	Rating
1-2	0

Short-term Effectiveness
Alternative 2 does not involve any active remediation; therefore no adverse impacts are anticipated. This criterion is not applicable with Alternative 1.

Alt(s)	Rating
2	9
1	N/A

Implementability
No technical or administrative challenges are anticipated from implementation of these alternatives.

Alt(s)	Rating
1	9
2	8

Cost

Each alternative is rated for its 100-year present worth cost.

Alt(s)	Rating	Cost
1	9	None
2	9	$58,000

8.2.9 Group 1 (Parcel 7351-031-017)

Group 1 includes non-EAPC exposure areas as defined in Section 3.1.3. The following is a comparative analysis of the ICs alternative and the No Action alternative for the representative Group 1 parcel. This analysis also applies to other Group 1 parcels.

8.2.9.1 Comparative Analysis

Overall Protection of Human Health and the Environment

Alternative 2 consists of informational and permit review ICs (layers 1 and 2) and monitoring. This alternative would provide more long-term protection from residual or unknown contamination than Alternative 1.

Alt(s)	Rating
2	YES
1	NO

Compliance with ARARs

There are no ARARs for this EAPC because waste will not be left in place beyond a UU/UE level with either alternative.

Alt(s)	Rating
2	YES
1	NO

Long-term Effectiveness

Alternative 2 (ICs and monitoring) would provide more long-term protection than Alternative 1 (No Action) because it would provide protection from residual or unknown contamination, and notification to prospective owners that these parcels are part of the Del Amo Superfund site. There would be some uncertainty about maintaining IC effectiveness over the long term.

Alt(s)	Rating
2	7
1	1

Reduction of Toxicity, Mobility and Volume

There would be no active contaminant removal with either alternative. Alternative 2 would create ICs to supplement the existing asphalt coverage, providing more protection than Alternative 1 (No Action).

Alt(s)	Rating
1-2	0

Short-term Effectiveness

Alternative 2 does not involve any active remediation; therefore no adverse impacts are anticipated. This criterion is not applicable with Alternative 1.

Alt(s)	Rating
2	9
1	N/A

Implementability

No technical or administrative challenges are anticipated from implementation of these alternatives.

Alt(s)	Rating
1	9
2	8

Cost

Each alternative is rated for its 100-year present worth cost.

Alt(s)	Rating	Cost
1	9	None
2	9	$58,000

8.3 EXTENSION OF SURFACE PATHWAY EVALUATION TO OTHER AREAS

The following section extends the surface pathway evaluation of the representative exposure areas to other exposure areas in each risk-based group. Brief descriptions of each exposure area are provided below, including the RDCs and identification of COCs and remedial alternatives. Additional background information (e.g., historic rubber plant facility features, current land use and building type) for each exposure area is provided in Appendix A. The remedial alternatives for the exposure areas in each group are similar to that of the representative exposure area in some cases but in several cases the remedial alternatives are modified to reflect the area-specific considerations. Table 8-10 lists the IC layers that apply to the different remedial alternatives for each EAPC in Groups 3, 4 and 5.

The evaluation focused on the five balancing criteria with numerical ratings on a scale of 0-9. The ratings for an area follow the representative area evaluation discussed above except when there are differences in the remedial alternatives, contaminant type, use of the area (e.g., surface street), etc. All alternatives (except Alternative 1 – No Action) satisfy both threshold criteria, unless the criterion is rated "Not applicable" for that alternative. Table 8-11 shows a summary of the numerical evaluation ratings and present worth cost for each alternative and exposure area. The cost criterion has been given an approximate numerical rating based on a non-linear cost scale that varies by the risk group.[41] (Refer Appendix G for details on cost scale.) Cost estimates for these exposure areas including supporting figures are included in Appendix D.

8.3.1 Group 4A Exposure Areas

This section provides evaluations for EAPCs 29, 34, 28, 35, 10 and 14 based on the representative area, EAPC 7.

8.3.1.1 EAPC 29

This parcel (APN 7351-034-070) is located in the southwestern corner of the former plant site adjacent to EAPC 34 to the north and the Waste Pit Area to the east. EAPC 29 is currently undeveloped.

Summary of Risk and Risk-driving Chemicals: EAPC 29

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer risk	Hazard Index		
4A	Outdoor soil	2E-05	<1	Arsenic	1.9E-05
	Indoor air[a]	--	--	--	--

[a] No COCs in shallow soil identified for indoor air pathway for this EAPC.

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[41] Cost ratings - For Groups 4A and 5A, a non-linear scale in the range of $0 to $2,000,000 was used. The cost range was split into 10 parts of increasing cost intervals with the highest rating (9) for the lowest cost interval ($0-$150,000) and the lowest rating (0) for the highest cost interval (>$2M). Cost scale ranges were selected for each group based on the range of costs observed in the alternatives within each group. For Group 3A, a non-linear scale in the range of $0 to $1,500,000 was used. For Groups 4B and 3B, non-linear scales spanning $0 to $20,000,000 and $0 to $10,000,000 were used respectively. Refer to Appendix G for more details on the scale.

The primary RDC in outdoor shallow soil is arsenic. The outdoor soil CR is 2E-05 and the HI_{com} is less than 1. For the indoor air pathway, no COCs were identified in shallow soils. The RR is 8E-05 and the HI_{res} is greater than 1.

Areal Extent of Contamination for FS Evaluation

The primary COC for this EAPC is arsenic in outdoor soil. The areal extent of arsenic-impacted soil was defined by the locations where arsenic exceeded the RI background concentration of 10 mg/kg (a single composite sampling location). All three discrete sampling locations from the composite sample that were within the EAPC were assumed to be above background. The impacted extent was assumed to be contained in near-surface soil within three 50 feet by 50 feet areas (totaling 7,500 SF) near the central portion of the parcel, as shown on Figure 8.3-1, located in Appendix D. As with EAPC 7 (the representative parcel), the arsenic-impacted soil was assumed to be present down to 5 feet bgs with an in-place impacted soil volume of about 1,390 CY.

Remedial Alternatives

Since this EAPC has one non-VOC (arsenic) as the sole COC, the general form of the remedial alternative as presented in Section 6.1 is appropriate for the FS evaluation and is shown below:

1. No Action
2. ICs + Monitoring
3. Capping (Arsenic) + ICs + Monitoring
4. Excavation (Arsenic) + ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 29 is based on the representative parcel (EAPC 7) evaluation, and presents a comparative analysis for these alternatives focusing on the five balancing criteria.

Criterion	Alt	Rating	Discussion
LTE	2	5	ICs (layers 1-4A and 5) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
	3	8	Capping with ICs (layers 1-5) would provide better protection from exposures than with Alternative 2. ICs can be effective at controlling potential future construction worker exposures when properly maintained and enforced.
	4	9	Excavation would remove contaminants and provide the best long-term protection. Because the contamination is removed, ICs would include only layers 1, 2 and 5, which would provide protection from areas of soil contamination that may be encountered in the future.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may

Criterion	**Alt**	**Rating**	**Discussion**
			be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
	3	0	Capping with ICs would more effectively control exposure than Alternative 2 but would not remove contaminant mass.
	4	9	Excavating arsenic-impacted soil would remove contaminants from the site.
STE	2	9	ICs do not pose any health or environmental risks.
	3	8	Capping would have minimal impact on human health and the environment.
	4	7	Excavation could potentially cause emissions that would impact any onsite workers or neighboring facilities but impacts would be lower because excavation is shallow and the site is not developed.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
	3	8	Capping is not expected to present technical or administrative challenges.
	4	6	Excavation would not present any significant challenges but would have impacts to any onsite workers or neighboring facilities.
Cost	2	9	100-year present worth cost: $123,000
	3	5	100-year present worth cost: $606,000
	4	5	100-year present worth cost: $732,000

8.3.1.2 EAPC 34

This parcel (APN 7351-034-901) is a LADWP right-of-way that is not developed and contains petroleum pipelines and high-voltage power lines.

Summary of Risk and Risk-driving Chemicals: EAPC 34

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
4A	Outdoor soil	2E-05	<1	Arsenic	1.9E-05
	Indoor air[a]	--	--	--	--
	Indoor air (GW)	7E-06	<1	Benzene	6.9E-06

[a] No COCs in shallow soil identified for indoor air pathway for this EAPC.

The primary RDC in outdoor shallow soil is arsenic. For the indoor air pathway, there were no COCs in shallow soil. However, there were elevated VOC concentrations in groundwater due to the proximity of this parcel to groundwater contamination source areas. The CR for the indoor air pathway due to vapor intrusion of benzene from groundwater was estimated to be 7E-06. The CR for outdoor soil was estimated to be 2E-05 and the HI_{com} was less than 1. The outdoor soil RR is 9E-05 and the HI_{res} is greater than 1. This parcel is not likely to be developed with buildings in the future due to the presence of pipelines and high voltage electrical lines, as well as the narrow width of the parcel.

Areal Extent of Contamination for FS Evaluation

The primary COC for this EAPC is arsenic in outdoor soil. Benzene is not considered a COC for this FS evaluation for two reasons: 1) benzene was not found in shallow soils; and, 2) buildings are unlikely to be erected on this parcel. The areal extent of arsenic-impacted soil was defined by the sampling locations that exceeded the RI background arsenic concentration of 10 mg/kg. There were two composite sampling locations with arsenic exceedances and each of the six discrete sampling locations that make up the composite samples were assumed to exceed background. One of these locations also showed exceedance of the cleanup level for 4,4′-DDT. The extent of impacted soil was assumed to be contained in near-surface soil within six 50 feet by 50 feet areas (totaling 15,000 SF), as shown on Figure 8.3-2, located in Appendix D. Based on the observed limited vertical distribution of arsenic and its low mobility characteristics, the arsenic-impacted soil was assumed to be present down to 5 feet bgs with an in-place impacted soil volume of about 2,780 CY.

Remedial Alternatives

Since this EAPC has arsenic as the primary COC, the general form of the remedial alternative as presented in Section 6.1 is appropriate for the FS evaluation and is shown below:

(1) No Action
(2) ICs + Monitoring
(3) Capping (Arsenic) + ICs + Monitoring
(4) Excavation (Arsenic) + ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 34 is based on the representative parcel (EAPC 7) evaluation, and presents a comparative analysis for these alternatives focusing on the five balancing criteria.

Criterion	Alt	Rating	Discussion
LTE	2	5	ICs (layers 1-4A and 5) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
	3	8	Capping with ICs (layers 1-5) would provide better protection from exposures than Alternative 2. ICs can be effective at controlling potential future construction worker exposures when properly maintained and enforced.

Criterion	Alt	Rating	Discussion
	4	9	Excavation would remove contaminants and provide the best long-term protection. Because the contamination is removed, ICs would include only layers 1, 2 and 5, which would provide protection from areas of soil contamination that may be encountered in the future.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
	3	0	Capping with ICs would more effectively control exposure than Alternative 2 but would not remove contaminant mass.
	4	9	Excavating arsenic-impacted soil would remove contaminants from the site and is rated highest.
STE	2	9	ICs do not pose any health or environmental risks.
	3	8	Capping would have minimal impact on human health and the environment
	4	7	Excavation could potentially cause emissions that would impact onsite workers or neighboring facilities but impacts would be lower because excavation is shallow and the site is not developed.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City’s current political support.
	3	8	Capping is not expected to present technical or administrative challenges. Uncertainty with ICs implementation is expected to be minor.
	4	5	Excavation would present significant challenges due to presence of pipelines and power lines on this property.
Cost	2	9	100-year present worth cost: $123,000
	3	3	100-year present worth cost: $1,000,000
	4	3	100-year present worth cost: $1,214,000

8.3.1.3 EAPC 28

This parcel (APN 7351-034-069) is located in the northern portion of the former styrene plancor, on Pacific Gateway Drive.

Summary of Risk and Risk-driving Chemicals: EAPC 28

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
4A	Outdoor soil	8E-06	<1	B(a)P	4.8E-06
	Indoor air	<1E-06	<1	PCE	<1E-06

B(a)P in outdoor soil, with a CR of 4.8E-06, is the dominant risk contributor for this parcel. Other PAHs with chemical-specific risk values less than 1E-06 contribute to the overall parcel CR of 8E-06. The outdoor soil RR is 9E-05 and the HI_{res} is greater than 1. The maximum B(a)P concentration is 2.2 mg/kg, which is the only instance where it is greater than its background value of 0.9 mg/kg. For the indoor air pathway, the cumulative CR is less than 1E-06 but the RR is greater than 1E-06, with PCE as a risk contributor that is equivalent to a Group 3 risk. The maximum PCE soil gas concentration of 22 ppmv (SGL0687) exceeded the risk-based threshold level of 6 ppmv (Table 4-3). One other location, GPL0010, showed an exceedance of the PCE cleanup level of 0.06 mg/kg but this sample location is under the building. Benzene has a lower risk contribution than PCE at EAPC 28, which is also a groundwater contamination source area based on elevated benzene concentrations detected in groundwater. The maximum benzene concentration of 0.17 mg/kg detected at this parcel was collected from GPL0016 at a depth of 4.8 feet bgs. This maximum concentration was lower than the risk-based threshold level of 0.90 mg/kg for benzene via the indoor air pathway. In addition, there were two exceedances of residential PRGs for thallium at 12 and 11 mg/kg, with HI_{res} greater than 1.

Areal Extent of Contamination for FS Evaluation

The primary COC for this EAPC is B(a)P in outdoor soil while PCE is a secondary COC. The areal extent of impacted soil was defined by the locations that exceeded the background level of 0.9 mg/kg for B(a)P or 6 ppmv for PCE. The B(a)P impacted extent was assumed to be present in a 50 feet by 50 feet area down to 5 feet bgs as shown on Figure 8.3-3 located in Appendix D. The B(a)P-impacted area is located west of the building, totaling 2,500 SF. The impacted area for PCE is one 50 feet by 15 feet area (750 SF) located on the east side of the parcel where the PCE-impacted soil was assumed to be present down to 15 feet bgs. This impacted area abuts the building on the east side of the property and it is assumed that the VOC contamination does not extend under the building. The location in the vicinity of GPL0010 was not considered in the impacted area because it is under the building and effectively capped. The total volume of impacted soil in this parcel is estimated to be 880 CY. Benzene is not considered a COC because the maximum benzene concentration (0.17 mg/kg) is lower than the risk-based threshold level of 0.90 mg/kg.

Remedial Alternatives

Since this EAPC has one non-VOC (B(a)P) as the primary COC and PCE as a secondary COC, the general form of the remedial alternative as presented in Section 6.1 is appropriate for the FS evaluation and is shown below:

1. No Action
2. ICs + Monitoring
3. Capping (B(a)P, PCE) + ICs + Monitoring
4. Excavation (B(a)P) + SVE (PCE)(OS) + ICs + Monitoring
5. Excavation (B(a)P, PCE) + ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 28 is based on the representative parcel (EAPC 7) evaluation, and presents a comparative analysis for these alternatives focusing on the five balancing criteria.

Criterion	Alt	Rating	Discussion
LTE	2	5	ICs (layers 1-4A and 5) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
	3	8	Capping with ICs (layers 1-5) would provide better protection from exposures than Alternative 2. ICs can be effective at controlling potential future construction worker exposures from when properly maintained and enforced.
	4	9	Excavation and SVE would remove contaminants and provide the best long-term protection by removing most contaminant mass. Because the contamination is removed, ICs would include only layers 1, 2 and 5, which would provide protection from areas of soil contamination that may be encountered in the future.
	5	9	Excavation of both COCs would remove contaminants and provide long-term protection. Because the contamination is removed, ICs would include only layers 1, 2 and 5, which would provide protection from areas of soil contamination that may be encountered in the future.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
	3	0	Capping with ICs would more effectively control exposure than Alternative 2 but would not remove contaminant mass.
	4	9	Excavation and SVE would remove the site contaminants.
	5	9	Excavation of soil impacted by both COCs would remove contaminants from the site.
STE	2	9	ICs do not pose any health or environmental risks.
	3	8	Capping would have minimal impact on human health, the environment or the facility.

Criterion	**Alt**	**Rating**	**Discussion**
	4	7	Excavation and SVE installation and operation could potentially cause contaminant emissions that would impact facility workers or neighboring facilities.
	5	7	Excavation could potentially cause emissions that would impact facility workers or neighboring facilities.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
	3	8	Capping is not expected to present technical or administrative challenges. Uncertainty with ICs implementation is same as Alternative 2.
	4	6	Excavation and SVE installation would face modest technical challenges and potential impacts to facility operations.
	5	5	Excavation includes deep excavation (up to 15 feet bgs) with shoring adjacent to the building and would present moderate technical challenges and have moderate impacts to facility operations.
Cost	2	9	100-year present worth cost: $123,000
	3	7	100-year present worth cost: $394,000
	4	3	100-year present worth cost: $1,080,000
	5	5	100-year present worth cost: $676,000

8.3.1.4 EAPC 35

This exposure area was located in the central portion of the former styrene plancor and is currently a surface street called Magellan Drive.

Summary of Risk and Risk-driving Chemicals: EAPC 35

Group	**Medium/Pathway**	**Commercial Worker Risk (recalculated)** [a]		**Risk-driving Chemicals**	**Chemical-specific Risk**
		Cancer Risk	**Hazard Index**		
4A	Outdoor soil	3E-05	<1	B(a)P B(a)A[b] B(k)F[b] Benzene	2.0E-05 3.0E-06 1.0E-06 1.7E-06
	Indoor air	2E-06	<1	Benzene	1.9E-06

[a] Risk estimates in the BRA were influenced by elevated DLs. Risks for this EAPC were recalculated by the RAGS method as described in USEPA's Risk Assessment Guidance, Part D, Chapter 5, 2001 (RAGS 2001).

[b] B(a)A and B(k)F are secondary RDCs that are co-located with B(a)P in the same sample.

B(a)P in outdoor soil with a chemical-specific CR of 2E-05 is the dominant risk contributor for this exposure area. The RR for outdoor soil is 1E-04 but the HI_{res} is less than 1. The CR for indoor air (Tiers 1+2) was determined in the BRA to be 8E-06, which was impacted by elevated detection limits. After recalculation of the risk as discussed in Section 3, benzene is the only VOC risk driver in outdoor soil and indoor air. For indoor air, the RR is 4E-05 and the HI_{res} is less than 1 (refer to Appendix B). Since EAPC 35 is a surface street, it is assumed that there will be no buildings on this property, and the focus of the remedial evaluation for benzene is driven by benzene risk in outdoor soil and not indoor air.

Areal Extent of Contamination for FS Evaluation

The primary COCs are PAHs in outdoor soil and the secondary COC is benzene in outdoor soil. The areal extent of impacted soil is defined by the locations that exceeded the background level of 0.9 mg/kg for B(a)P and the risk-based threshold level of 0.90 mg/kg for benzene. The impacted extent is assumed to be contained within three 50 feet by 50 feet areas (totaling 7,500 SF) in outdoor soil as shown on Figure 8.3-4 located in Appendix D. In two of these areas, benzene-impacted soil was assumed to be present down to 15 feet bgs and in the third one, PAH-impacted soil was assumed to be present down to 5 feet bgs. The total volume of impacted soil in this parcel is estimated to be 3,240 CY.

Remedial Alternatives

Since this EAPC has a non-VOC (PAHs) and a VOC (benzene) as COCs, the general form of the remedial alternative as presented in Section 6.1 is appropriate for the FS evaluation and is shown below:

(1) No Action
(2) ICs + Monitoring
(3) Capping (PAHs, Benzene) + ICs + Monitoring
(4) Excavation (PAHs) + SVE/BV (Benzene)(OS) + ICs + Monitoring
(5) Excavation (PAHs, Benzene) + ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 35 is based on the representative parcel (EAPC 7) evaluation, and presents a comparative analysis for these alternatives focusing on the five balancing criteria.

Criterion	Alt	Rating	Discussion
LTE	2	5	ICs (layers 1-4A and 5) would supplement the existing asphalt coverage provided by Magellan Drive. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
	3	8	Capping with ICs (layers 1-5) would provide better protection from exposures than Alternative 2. ICs can be effective at controlling potential future construction worker exposures when properly maintained and enforced.

Criterion	Alt	Rating	Discussion
	4	9	Excavation and SVE would provide protection by removing most contaminant mass. Because the contamination is removed, ICs would include only layers 1, 2 and 5, which would provide protection from areas of soil contamination that may be encountered in the future.
	5	9	Excavation of both COCs would provide the best long-term protection. Because the contamination is removed, ICs would include only layers 1, 2 and 5, which would provide protection from areas of soil contamination that may be encountered in the future.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
	3	0	Capping with ICs would more effectively control exposure than Alternative 2 but would not remove contaminant mass.
	4	9	Excavation and SVE would remove most of the contaminant mass.
	5	9	Excavation of soil impacted by both COCs would remove contaminants from the site and is rated the highest.
STE	2	9	ICs do not pose any health or environmental risks.
	3	8	Capping would have minimal impact on human health, the environment or the facility.
	4	7	Excavation and SVE would have impacts to workers in facilities adjacent to this street, and the potential to damage utilities present on the street.
	5	7	Excavation would have impacts to workers in facilities adjacent to this street, and the potential to damage utilities present on the street.
Implementability	2	8	ICs are not expected to present significant technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City’s current political support.
	3	8	Capping is not expected to present technical or administrative challenges. Uncertainty with ICs implementation is the same as for Alternative 2.
	4	6	Excavation of a surface street which has numerous utilities buried below the pavement has a higher degree of risk and faces moderate technical challenges.
	5	5	Excavation to a depth of 15 feet bgs of a surface street which has numerous utilities buried below the pavement has a higher degree of risk and faces greater technical challenges than Alternative 4.
Cost	2	9	100-year present worth cost: $123,000
	3	5	100-year present worth cost: $609,000
	4	2	100-year present worth cost: $1,286,000
	5	2	100-year present worth cost: $1,340,000

8.3.1.5 EAPC 10

This parcel (APN 5371-033-030) is located in the south-central portion of the former butadiene plancor on Vermont Avenue.

Summary of Risk and Risk-driving Chemicals: EAPC 10

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
4A	Outdoor soil	<1E-06	<1	Copper	<1E-06
	Indoor air	<1E-06 [a]	<1 (a)	--	--

[a] Risks based on indoor air/Tier 1 – shallow analysis.

Copper in outdoor soil is the primary contributor to the HI_{com} of less than 1 for this parcel. For the indoor air pathway, the cumulative CR and HI_{com} are less than 1E-06 and less than 1 respectively, based on the indoor air (Tier 1) risk analysis. The RR for outdoor soil is less than 1E-06, but the HI_{res} is greater than 1.

Areal Extent of Contamination for FS Evaluation

The primary COC for this EAPC is copper in outdoor soil. The areal extent of copper-impacted outdoor soil is defined by the locations that exceeded the Residential PRG of 3,100 mg/kg for copper. Only one sample exceeded the residential PRG for copper (SBL0465 at 5,750 mg/kg). However, this sample is lower than the industrial PRG of 41,000 mg/kg. The extent of impacted soil exceeding the residential PRG is shown as an area approximately 30 feet by 50 feet (1,500 SF) located north of the structure shown on Figure 8.3-14 located in Appendix D. However, because the HI_{com} is significantly less than one and because the copper concentration is significantly lower than the industrial PRG, no active remedial alternatives are proposed for this EAPC.

Remedial Alternatives

Since this EAPC has one non-VOC COC (copper) and no assumed impacted area, the general form of the remedial alternative as presented in Section 6.1 is modified to exclude capping and excavation alternatives:

(1) No Action
(2) ICs +Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 10 is based on the representative parcel (EAPC 7) evaluation, and presents an analysis of Alternatives 1 and 2 based on the five balancing criteria. Alternative 1 (No Action) does not satisfy threshold criteria.

Criterion	Alt	Rating	Discussion
LTE	2	5	ICs (layers 1-4A) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	2	9	ICs do not pose any health or environmental risks.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City’s current political support.
Cost	2	9	100-year present worth cost: $98,000

8.3.1.6 EAPC 14

This parcel (APN 7351-033-009) is located in the northwestern corner of the former butadiene plancor on Vermont Avenue.

Summary of Risk and Risk-driving Chemicals: EAPC 14

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
4A	Outdoor soil	<1E-06	1	Copper	<1E-06
	Indoor air	<1E-06 [a]	<1 (a)	--	--

[a] Risks based on indoor air/Tier 1 – Shallow analysis

Copper in outdoor soil is the primary contributor to the CR less than 1E-06 and an HI_{com} less than 1 for this parcel. For the indoor air pathway, the cumulative CR and HI_{com} are less than 1E-06 and less than 1 respectively, based on the indoor air (Tier 1) risk analysis. The RR for outdoor soil is less than 1E-06 but the HI_{res} is greater than 1.

Areal Extent of Contamination for FS Evaluation

The primary COC for this EAPC is copper in outdoor soil. The areal extent of copper-impacted outdoor soil is defined by the locations that exceeded the Residential PRG of 3,100 mg/kg for copper. Two samples exceeded the Residential PRG (SBL0274 and SBL0275 at 40,700 and 20,200 mg/kg). Both these samples were below the industrial PRG of 41,000 mg/kg. The impacted extent is assumed to be contained within an area approximately 50 feet by 75 feet (3,750 SF) located east of the structure shown on Figure

8.3-15 located in Appendix D. The maximum depth of copper-impacted soil is assumed to be 15 feet bgs with an in-place impacted soil volume of about 2,080 CY.

Remedial Alternatives

Since this EAPC has one non-VOC COC (copper), the general form of the remedial alternative as presented in Section 6.1 is appropriate for the FS evaluation and is shown below:

1. No Action
2. ICs + Monitoring
3. Capping (Copper) + ICs + Monitoring
4. Excavation (Copper) + ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 14 is based on the representative parcel evaluations (EAPC 7), and presents a comparative analysis for these alternatives focusing on the five balancing criteria.

Criterion	Alt	Rating	Discussion
LTE	2	5	ICs (layers 1-4A) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
	3	8	Capping would provide better protection from exposures than Alternative 2. ICs (layers 1-4B) can be effective at controlling potential future construction worker exposures when properly maintained and enforced.
	4	9	Excavation would remove contaminants and provide the best long-term protection. Because the contamination is removed, ICs would include only layers 1 and 2, which would provide protection from areas of soil contamination that may be encountered in the future.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
	3	0	Capping would effectively control exposure than Alternative 2 but would not remove contaminant mass.
	4	9	Excavating copper-impacted soil would remove most contamination (>90%) from the site and is rated highest.
STE	2	9	ICs do not pose any health or environmental risks.
	3	8	Capping would have minimal impact on human health and the environment.
	4	6	Excavation could potentially cause emissions that would impact the facility, the facility workers or neighboring facilities.

Criterion	Alt	Rating	Discussion
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
	3	8	Capping is not expected to present technical or administrative challenges. Uncertainty with ICs implementation is expected to be minor.
	4	5	Excavation would present moderate technical challenges due to the 15-foot depth of excavation and potential impacts to facility operations.
Cost	2	9	100-year present worth cost: $98,000
	3	7	100-year present worth cost: $381,000
	4	4	100-year present worth cost: $870,000

8.3.2 Group 4B Exposure Areas

This section provides evaluations for three EAPCs, 6, 11 and 15 based on the representative areas, EAPCs 5, 16 and 23. Table 8-11 provides a list of numerical ratings for the balancing criteria.

8.3.2.1 EAPC 6

This parcel (APN 7351-033-022) is located in the southeastern corner of the former butadiene plancor and its current location is at the corner of Del Amo Boulevard and Vermont Avenue. This parcel has been developed with a single-story commercial building.

Summary of Risk and Risk-driving Chemicals: EAPC 6

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
4B	Outdoor soil	3E-06	<1	Benzene	3.2E-06
	Indoor air	4E-06	<1	Benzene	3.7E-06

Benzene is the primary RDC for both the indoor air and outdoor soil pathways. The CR is 3E-06 and the HI_{com} is less than 1 for the outdoor soil pathway. The CR is 4E-06 and the HI_{com} is less than 1 for the indoor air pathway. The RR is 2E-04 and the HI_{res} is less than 1. This EAPC, along with EAPCs 9 and 15, contain groundwater contamination SA11, with benzene as the primary COC in deep soil and groundwater.

Areal Extent of Contamination for FS Evaluation

The primary COC is benzene in both outdoor soil and indoor air for this parcel. The areal extent of impacted soil is approximately defined by a rectangular area that exceeded the risk-based threshold level of 120 ppmv for benzene in soil gas. The impacted extent is conservatively assumed to be contained within the 210 feet by 140 feet area (29,400 SF) located west of the structure shown on Figure 8.3-5 located in Appendix D. In addition, an area of about 125 feet by 140 feet of soil (17,500 SF) under the building is assumed to be impacted based on former plant facilities. The benzene-impacted shallow soil is assumed to be present down to 15 feet bgs with an in-place impacted soil volume of outdoor soil of about 16,300 CY and soil under building of about 9,700 CY for a total impacted volume of 26,000 CY.

Remedial Alternatives

Since this EAPC has one VOC COC (benzene), the general form of the remedial alternatives as presented in Section 6.1 is appropriate for the FS evaluation and is shown below:

(1) No Action
(2) ICs + Monitoring
(3) Capping (Benzene) + HVAC mod/SSV (UB)[42] + ICs + Monitoring
(4) SVE/BV (OS) + HVAC mod/SSV (UB) + ICs + Monitoring
(5) SVE/BV (OS) + SVE/BV (UB) + ICs + Monitoring
(6) Excavation (Benzene) + SVE/BV (UB) + ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 6 is based on the representative parcel (EAPC 23) evaluation, and presents a comparative analysis for these alternatives focusing on the five balancing criteria.

Criterion	Alt	Rating	Discussion
LTE	2	4	This alternative incorporates IC layers 1-4A and 5, including both permit review and land use covenants that are designed to control potential future exposures. ICs would supplement the existing asphalt and other coverage that provides protection from direct contact exposures to soil. But this alternative would not guarantee the site would remain capped. There would be some uncertainty about maintaining IC effectiveness over the long term.
	3	7	Capping, HVAC mod/SSV and ICs (layers 1-5) would provide better protection from direct contact and vapor intrusion exposures than Alternative 2.
	4	8	SVE in outdoor soil combined with capping, HVAC mod/SSV and ICs (layers 1-5) would provide better protection to onsite workers than Alternative 3 by removing most contaminant mass in outdoor soil.

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[42] SSV is assumed for the evaluation instead of HVAC mod.

Criterion	Alt	Rating	Discussion
	5	8	SVE in outdoor soil would provide protection by removing >90% contaminant mass. SVE can remediate soils under the building but would be reduced in effectiveness due to challenges in accurate delineation of contamination. ICs (layers 1-4A and 5) are included to provide protection from any residual contamination.
	6	8	Excavation would provide protection by removing >90% contaminant mass in outdoor soil. SVE can remediate soils under the building but would be reduced in effectiveness due to challenges in accurate delineation of contamination. ICs (layers 1-4A and 5) are included to provide protection from any residual contamination.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not remove contaminant mass.
	3	2	Capping and HVAC mod/SSV would effectively control exposure but would not remove contaminant mass. However, SSV does treat low levels of offgassing VOCs.
	4	6	SVE would remove most contaminant mass (>90%) in outdoor soil and engineering control would limit exposure by vapor intrusion.
	5	8	SVE would remove contaminants (>90%) in outdoor soil but its effectiveness would be reduced under the building. SVE under building is assumed to remove 50% to 90% of contaminant mass.
	6	8	Excavation would remove contaminants (>90%) in outdoor soil but SVE effectiveness would be reduced under the building. SVE under building is assumed to remove 50% to 90% of contaminant mass.
STE	2	9	ICs do not pose any health or environmental risks.
	3	7	Capping would have minimal impact but SSV installation could potentially cause exposures through emissions of dust and VOCs during SSV trench installation. HVAC modification would have lower impact than SSV.
	4	7	SVE and SSV installation could potentially cause exposures and impact the office workers or neighboring facilities. Emissions from routine SVE operation can be controlled well except for emissions during drilling, or potential releases during process upsets and startup testing. HVAC mod/SSV installation would have impacts as discussed for Alternative 3.
	5	6	A large SVE installation in outdoor soil and under the building could potentially cause greater exposures and impact office workers or neighboring facilities than Alternative 4.
	6	5	The large excavation and SVE installation under the building could potentially cause greater exposures and impact office workers or neighboring facilities due to the potential for releases of contaminants as dust and VOCs than Alternative 5.

Criterion	Alt	Rating	Discussion
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
	3	6	Capping would not present challenges but SSV is expected to present moderate to significant technical challenges and hence is rated lower than Alternative 2. If HVAC mod is selected lesser challenges are anticipated.
	4	6	Some challenges can be expected with SVE in outdoor soil but more challenges would be faced by the implementation of the SSV.
	5	5	Significant challenges can be expected with SVE under the building, and a larger SVE system would have greater impacts than for Alternative 4.
	6	4	Excavation and SVE would be a complex remediation that would present greater technical challenges and impact to facility operations than Alternative 5.
Cost	2	9	100-year present worth cost: $123,000
	3	6	100-year present worth cost: $2,279,000
	4	5	100-year present worth cost: $3,358,000
	5	5	100-year present worth cost: $4,619,000
	6	3	100-year present worth cost: $9,073,000

8.3.2.2 EAPC 11

This parcel (APN 7351-033-034) is located in the central portion of the former butadiene plancor and is currently on Hamilton Avenue in the east side of the former plant site. This parcel has been developed with a warehouse distribution building.

Summary of Risk and Risk-driving Chemicals: EAPC 11

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
4B	Outdoor soil	2E-05	<1	Arsenic Benzene	8.8E-06 6.1E-06
	Indoor air	7E-06	<1	Benzene	7E-06

Benzene and arsenic are RDCs at this EAPC. Arsenic is the primary risk driver in outdoor soil while benzene is the primary risk driver by the indoor air pathway. The CR is 2E-05 and the HI_{com} is less than 1 for the outdoor soil pathway. The CR is 7E-06 and the HI_{com} is less than 1 for the indoor air pathway. The

RR is 1E-04 and the HI_{res} is less than 1. This parcel is adjacent to NAPL SA12 which is located in the parcel to the south.

Areal Extent of Contamination for FS Evaluation

The primary COCs for this parcel are arsenic in outdoor soil and benzene in indoor air. The areal extent of impacted soil is defined by the locations that exceeded the risk-based threshold level of 120 ppmv for benzene in soil gas and the RI background concentration of 10 mg/kg for arsenic. The arsenic concentrations were all below 25 mg/kg, a concentration previously considered by USEPA to be consistent with background levels of arsenic in California soils for the Waste Pits OU. The benzene-impacted extent is assumed to be contained within one 45 feet by 100 feet area (4,500 SF) located south of the building shown on Figure 8.3-6 located in Appendix D. A portion of the soil under the building (100 feet by 100 feet, 10,000 SF) based on former facility location is assumed also to be impacted by benzene. The arsenic-impacted extent is assumed to be contained within one 40 feet by 50 feet area (2,000 SF) located north of the building. The benzene-impacted soil is assumed to be present down to 15 feet bgs, so the total volume of benzene-impacted soil is estimated to be 2,500 CY of outdoor soil and 5,550 CY of soil under the building for a total of 8,050 CY. The arsenic-impacted soil is assumed to be present down to 5 feet bgs, so the arsenic-impacted soil is 370 CY for a total impacted soil volume of 8,420 CY.

Remedial Alternatives

Since this EAPC has one VOC (benzene) and one non-VOC COC (arsenic), the general form of the remedial alternatives as presented in Section 6.1 is appropriate for the FS evaluation and is shown below:

(1) No Action
(2) ICs + Monitoring
(3) Capping (Benzene, Arsenic) + HVAC mod/SSV (UB) + ICs + Monitoring
(4) Capping (Arsenic) + SVE/BV (OS) + HVAC mod/SSV (UB) + ICs + Monitoring
(5) Capping (Arsenic) + SVE/BV (OS) + SVE/BV (UB) + ICs + Monitoring
(6) Excavation (Benzene, Arsenic) + SVE/BV (UB) + ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 11 is based on the representative parcel evaluations (EAPC 16, 23 and 5), and presents a comparative analysis for these alternatives focusing on the five balancing criteria.

Criterion	**Alt**	**Rating**	**Discussion**
LTE	2	4	This alternative incorporates IC layers 1-4A and 5, described in Section 5, including both permit review and land use covenants that are designed to control potential future exposures. ICs would supplement the existing asphalt coverage that provides protection from direct contact exposures. This alternative would not guarantee the site would remain capped. There would be some uncertainty about maintaining IC effectiveness over the long term.

Criterion	Alt	Rating	Discussion
	3	7	Capping and HVAC mod/SSV would provide better protection from direct contact and vapor intrusion exposures than Alternative 2. IC layers 1-5 provide protection from direct contact exposures and protect engineering controls.
	4	8	Capping of arsenic-impacted soil and HVAC mod/SSV would control exposures. SVE would provide better protection than Alternative 3 by removing most contaminant mass in outdoor soil. IC layers 1-5 provide protection from direct contact exposures and protect engineering controls.
	5	8	Capping of arsenic-impacted soil would effectively control exposures. SVE would provide protection by removing contaminant mass in outdoor soil and under the building. However, SVE under the building would have reduced effectiveness because it is difficult to characterize soil under buildings. IC layers 1-5 provide protection from direct contact exposures and protect engineering controls.
	6	8	Excavation of both COCs in outdoor soil would provide long-term protection. SVE under the building would provide protection by removing some contaminant mass. However, SVE under the building would have reduced effectiveness because it is difficult to characterize soil under buildings. IC layers 1-4A and 5 provide protection from direct contact exposures.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not remove contaminant mass.
	3	2	Capping and HVAC mod/SSV would effectively control exposure but would not remove contaminant mass. However, SSV does treat low levels of offgassing VOCs.
	4	6	SVE would remove most VOC contaminant mass (>90%) in outdoor soil. Capping and HVAC mod/SSV would control exposure but not remove contaminant mass.
	5	8	Capping would control exposure, and SVE would remove most VOC contaminant mass (>90%) in outdoor soil but SVE effectiveness would be reduced under the building (assumed 50% to 90% mass removal).
	6	8	Excavation and SVE would remove contaminants from outdoor soil but SVE effectiveness would be reduced under the building (assumed 50% to 90% mass removal).
STE	2	9	ICs do not pose any health or environmental risks.
	3	7	Capping would have minimal impact but SSV could potentially cause exposures through emissions of dust and VOCs during SSV trench installation. If HVAC mod is selected, the potential for exposures would be lower than SSV.

Criterion	Alt	Rating	Discussion
	4	7	SVE and SSV installation could potentially cause exposures and impact facility workers. Emissions from routine SVE operation can be controlled well except for emissions during drilling, or potential releases during process upsets and startup testing. HVAC mod/SSV installation would have moderate impacts as discussed for Alternative 3. Capping would have minimal impact.
	5	6	SVE installation in outdoor soil and under building would be a larger SVE system and could potentially cause greater exposures and impact facility workers more than Alternative 4.
	6	5	The large excavation and SVE installation under the building could potentially cause greater exposures and impact to facility workers than Alternative 5 due to the potential for releases of contaminants as dust and VOCs.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City’s current political support.
	3	6	SSV would present moderate to significant technical challenges during installation; while no challenges are likely with capping. If HVAC mod is selected lesser challenges are anticipated.
	4	6	Some challenges can be expected with SVE in outdoor soil, in addition to the challenges faced by SSV in Alternative 3.
	5	5	More significant technical challenges can be expected with SVE under the building, and a larger SVE system would have larger impacts to the facility and site workers than Alternative 4.
	6	4	Excavation and SVE under the building would present greater technical challenges and impact facility workers and operations more than Alternative 5.
Cost	2	9	100-year present worth cost: $123,000
	3	7	100-year present worth cost: $1,133,000
	4	6	100-year present worth cost: $2,005,000
	5	5	100-year present worth cost: $3,085,000
	6	5	100-year present worth cost: $3,945,000

8.3.2.3 EAPC 15

This parcel (APN 7351-033-900) is a LADWP right-of-way that is not developed and contains petroleum pipelines and high-voltage power lines.

Summary of Risk and Risk-driving Chemicals: EAPC 15

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
4B	Outdoor soil	4E-06	<1	Benzene	3.4E-06
	Indoor air	3E-05 [a]	<1	Benzene	3E-05

[a] Risk estimate is indoor air/Tiers 1+2 (deep soil)

Benzene in indoor air is the primary RDC for this parcel. The contamination might be from the benzene pipeline leakage during the operational period of the former butadiene plancor, which resulted in benzene-contaminated soil and groundwater (SA11) in the vicinity of the central portion of the parcel. Benzene is also the dominant risk contributor for the outdoor soil pathway with a CR of 3.4E-06 and an HI_{com} less than 1. The CR is 3E-05 and the HI_{com} is less than 1 for the indoor air pathway. The RR is 5E-04 and the HI_{res} is equal to 1. During the plant's operational period, this parcel was primarily open space used as a corridor for high-voltage power lines and benzene pipelines. The current uses are similar and it is assumed not likely to be developed with buildings in the future.

Areal Extent of Contamination for FS Evaluation

The primary COC for this parcel is benzene in both indoor air and outdoor soil. The areal extent of impacted soil is defined by the locations that exceeded the risk-based threshold level of 0.90 mg/kg for benzene. The benzene-impacted extent is assumed to be contained within one 25 feet by 50 feet area (1,250 SF) located in the center portion of the parcel shown on Figure 8.3-7 located in Appendix D. The benzene-impacted soil is assumed to be present down to 15 feet bgs with an estimated soil volume of about 700 CY.

Remedial Alternatives

Since this EAPC has only one VOC COC (benzene) and because there are no buildings on this property, the general form of the remedial alternatives as presented in Section 6.1 is modified as shown below:

(1) No Action
(2) ICs + Monitoring
(3) Capping (Benzene) + ICs + Monitoring
(4) SVE/BV (OS) + ICs + Monitoring
(5) Excavation (Benzene) + ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 15 presents a comparative analysis for these alternatives focusing on the five balancing criteria.

Criterion	Alt	Rating	Discussion
LTE	2	4	This alternative incorporates IC layers 1-4A and 5, including both permit review and land use covenants that are designed to control potential future exposures. ICs would provide adequate protection, because this parcel is not readily accessible to the public. This parcel is only periodically accessed by workers from LADWP and other pipeline companies and hence the potential for exposures is reduced. There would be some uncertainty about maintaining IC effectiveness over the long term.
	3	7	Capping with ICs (layers 1-5) would provide better protection from exposures than Alternative 2.
	4	8	SVE would provide better protection than Alternative 3 by removing contaminant mass, but contamination removal is reduced due to the proximity to pipelines and power lines. IC layers 1-4A and 5 would provide protection from any residual or unforeseen contamination.
	5	8	Excavation would provide long-term protection by removing contaminant mass but contamination removal is reduced due to the proximity to pipelines and power lines. IC layers 1-4A and 5 would provide protection from any residual or unforeseen contamination.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposures but would not remove contaminant mass.
	3	0	Capping with ICs would effectively control exposure but would not remove contaminant mass.
	4	8	SVE would remove most contaminant mass (>80%) in outdoor soil but would be limited by proximity to pipelines and power lines.
	5	8	Excavation would remove most contaminants (>80%) in outdoor soil but would be limited by proximity to pipelines and power lines.
STE	2	9	ICs do not pose any health or environmental risks.
	3	7	Capping would have minimal impact.
	4	6	SVE installation could potentially impact drillers due to hazards associated with pipelines and power lines. Emissions from routine SVE operation can be controlled well except for emissions during drilling, or potential releases during process upsets and startup testing. Workers on to the property or at neighboring facilities could be impacted.
	5	5	Excavation could potentially impact excavation workers due to hazards associated with pipelines and power lines. Workers at neighboring facilities could be impacted by potential releases of contaminants as dust and VOCs.

Criterion	Alt	Rating	Discussion
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
	3	7	Capping is not expected to present technical or administrative challenges.
	4	6	SVE installation would present moderate technical challenges with drilling and trenching adjacent to pipelines and high voltage lines.
	5	4	Excavation would present significant technical challenges in excavating as deep as 15 feet bgs around pipelines and high voltage power lines.
Cost	2	9	100-year present worth cost: $123,000
	3	8	100-year present worth cost: $275,000
	4	7	100-year present worth cost: $922,000
	5	7	100-year present worth cost: $558,000

8.3.3 Group 3A Exposure Areas

This section provides evaluations for EAPCs 4, 30, 36, 3, 12 and 13, based on the representative area EAPC 32. Table 8-11 provides a summary of the numerical ratings for the balancing criteria.

8.3.3.1 EAPC 4

This parcel (APN 7351-031-007) is located in the western portion of the former copolymer plancor and is on northern portion of Pacific Gateway Drive.

Summary of Risk and Risk-driving Chemicals: EAPC 4

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3A	Outdoor soil	3E-06	<1	B(a)P	1.9E-06
	Indoor air	<1E-06 [a]	<1	--	--

[a] Risks based on indoor air/Tier 1 & 2 – Groundwater.

B(a)P in outdoor soil with a CR of 1.9E-06 is the primary risk contributor for this parcel. Other PAHs with CRs less than 1E-06 contribute to the overall CR estimate of 3E-06. The RR for outdoor soil is 1E-05 and the HI_{res} is less than 1. For the indoor air pathway, the cumulative CR and HI_{com} are less than 1E-06 and less than 1 respectively, based on the indoor air (Tier 1) risk analysis.

Areal Extent of Contamination for FS Evaluation

The primary COC for this EAPC is B(a)P in outdoor soil. The areal extent of B(a)P-impacted outdoor soil is defined by the locations that exceed the background level of 0.9 mg/kg. The maximum observed B(a)P concentration is 0.25 mg/kg at SBL0415 located east of the building shown on Figure 8.3-8 located in Appendix D. There are no locations that exceed the background levels in this area and hence no assumed impacted area.

Remedial Alternatives

Since this EAPC has only one non-VOC COC (B(a)P) and no assumed impacted area, the general form of the remedial alternatives as presented in Section 6.1 is modified to exclude the capping and excavation alternatives:

1. No Action
2. ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 4 is based on the representative parcel (EAPC 32) evaluation, and presents an analysis of Alternative 2 based on the five balancing criteria. Alternative 1 (No Action) does not satisfy threshold criteria.

Criterion	Alt	Rating	Discussion
LTE	2	5	ICs (layers 1-4A and 5) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	2	9	ICs do not pose any health or environmental risks.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City’s current political support.
Cost	2	9	100-year present worth cost: $123,000

8.3.3.2 EAPC 30

This parcel (APN 7351-034-072) is located near the southwestern corner of the former copolymer plancor at the southeastern corner of Knox Street and Pacific Gateway Drive.

Summary of Risk and Risk-driving Chemicals: EAPC 30

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3A	Outdoor soil	3E-06	<1	B(a)P	1.7E-06
	Indoor air	<1E-06 [a]	<1	--	--

[a] Risks based on indoor air/Tier 1 – shallow analysis.

B(a)P in outdoor soil with a chemical-specific CR of 1.7E-06 is the dominant risk contributor for this parcel. Other PAHs with chemical-specific CR values less than 1E-06 contribute to the overall CR of 3E-06 and a HI_{com} less than 1. The RR for outdoor soil is 9E-06 and the HI_{res} is less than 1. For the indoor air pathway, the cumulative CR and HI_{com} are less than 1E-06 and less than 1 respectively, based on the indoor air (Tier 1) risk analysis.

Areal Extent of Contamination for FS Evaluation

The primary COC for this EAPC is B(a)P in outdoor soil. The areal extent of B(a)P-impacted outdoor soil is defined by the locations that exceed the background level of 0.9 mg/kg. The maximum observed B(a)P concentration is 0.22 mg/kg at SBL0265 located north of the building shown on Figure 8.3-9 located in Appendix D. There are no locations that exceed the background levels in this area and hence no assumed impacted area.

Remedial Alternatives

Since this EAPC has only one non-VOC COC (B(a)P) and there is no assumed impacted area, the general form of the remedial alternatives as presented in Section 6.1 is modified to exclude the capping and excavation alternatives:

1. No Action
2. ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 30 is based on the representative parcel (EAPC 32) evaluation, and presents an analysis of Alternative 2 based on the five balancing criteria. Alternative 1 (No Action) does not satisfy threshold criteria.

Criterion	Alt	Rating	Discussion
LTE	2	5	ICs (layers 1-4A) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.

Criterion	Alt	Rating	Discussion
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	2	9	ICs do not pose any health or environmental risks.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
Cost	2	9	100-year present worth cost: $98,000

8.3.3.3 EAPC 36

This street segment, the north segment of Pacific Gateway Drive within the former plant site, was part of the former copolymer plancor.

Summary of Risk and Risk-driving Chemicals: EAPC 36

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3A	Outdoor soil	2E-06	<1	B(a)P	<1E-06
	Indoor air	<1E-06 [a]	<1 (a)	--	--

[a] Risks based on indoor air/Tier 1 – shallow analysis.

B(a)P in outdoor soil is the primary RDC for this parcel. PAHs with chemical-specific CR values less than 1E-06 contribute to the overall parcel CR estimate of 2E-06 and the HI_{com} less than 1. The RR for outdoor soil is 6E-06 and the HI_{res} is less than 1. For the indoor air pathway, the cumulative CR and HI_{com} are less than 1E-06 and less than 1 respectively, based on the indoor air (Tier 1) risk analysis.

Areal Extent of Contamination for FS Evaluation

The primary COC for this EAPC is B(a)P in outdoor soil. Figure 8.3-10 located in Appendix D depicts one soil boring SBL0261 containing B(a)P (0.095 mg/kg) and dibenzo(a,h)anthracene (0.021 mg/kg) at a depth of 1.5 feet bgs. No areal extent or impacted soil volume was estimated since all shallow soil detections were lower than the background levels and risk-based threshold levels for these PAHs.

Remedial Alternatives

Since this EAPC has only one non-VOC COC (B(a)P) and no assumed impacted area, the general form of the remedial alternatives as presented in Section 6.1 is modified to exclude the capping and excavation alternatives:

(1) No Action
(2) ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 36 is based on the representative parcel (EAPC 32) evaluation, and presents an analysis of Alternative 2 based on the five balancing criteria. Alternative 1 (No Action) does not satisfy threshold criteria.

Criterion	Alt	Rating	Discussion
LTE	2	5	ICs (layers 1-4A) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	2	9	ICs do not pose any health or environmental risks.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
Cost	2	9	100-year present worth cost: $98,000

8.3.3.4 EAPC 3

This parcel (APN 7351-031-031) is located in the northwestern corner of the former copolymer plancor at the corner of 190th Street and Pacific Gateway Drive.

Summary of Risk and Risk-driving Chemicals: EAPC 3

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3A	Outdoor soil	4E-06	<1	Arsenic	3.2E-06
	Indoor air	<1E-06	<1	--	--

The primary RDC is arsenic in outdoor soil with a chemical-specific CR risk of 3.2E-06. Other chemicals such as cadmium, chromium, and Aroclor 1260, with chemical-specific CR values less than 1E-06, contribute to the overall parcel CR of 4E-06 and the HI_{com} less than 1. The RR for outdoor soil is 4E-05 and the HI_{res} is less than 1. The primary contributor to RR is arsenic with PCBs also contributing to the overall residential risk. For the indoor air pathway, the CR and RR are less than 1E-06 and the HI_{com} and Hi_{res} are less than 1, respectively.

Areal Extent of Contamination for FS Evaluation

Figure 8.3-11 located in Appendix D shows one location with an exceedance for arsenic above the RI background level (10 mg/kg), but below 25 mg/kg, a concentration previously considered by USEPA to be consistent with background levels of arsenic in California soils for the Waste Pits OU. No assumed extent of impacted soil was proposed as this location is under the building. Hence this exceedance is effectively capped and does not pose a potential exposure.

Remedial Alternatives

Since this EAPC has one non-VOC COC (arsenic) and no assumed impacted area, the general form of the remedial alternative as presented in Section 6.1 is modified to exclude capping and excavation alternatives:

1. No Action
2. ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 3 is based on the representative parcel (EAPC 32) evaluation, and presents an analysis of Alternative 2 based on the five balancing criteria. Alternative 1 (No Action) does not satisfy threshold criteria.

Criterion	Alt	Rating	Discussion
LTE	2	5	ICs (layers 1-4A) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	2	9	ICs do not pose any health or environmental risks.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City’s current political support.
Cost	2	9	100-year present worth cost: $98,000

8.3.3.5 EAPC 12

This parcel (APN 7351-033-040) is located in the central portion of the former butadiene plancor on Hamilton Drive along the western portion of the former rubber plant.

Summary of Risk and Risk-driving Chemicals: EAPC 12

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3A	Outdoor soil	9E-06	<1	Arsenic	8.8E-06
	Indoor air	<1E-06	<1	--	--

The primary contributor to the overall parcel CR of 9E-06 and HI_{com} less than 1 for outdoor soil is arsenic, with a chemical-specific CR of 8.8E-06 . For the indoor air pathway, the cumulative CR and HI_{com} are less than 1E-06 and less than 1, respectively. The RR for outdoor soil is 4E-05 and HI_{res} is less than 1.

Areal Extent of Contamination for FS Evaluation

The primary COC for this EAPC is arsenic in outdoor soil. The areal extent of arsenic-impacted soil is defined by sampling locations that exceeded the RI background arsenic concentration of 10 mg/kg, but all arsenic detections were below 25 mg/kg, a concentration previously considered by USEPA to be consistent with background levels of arsenic in California soils for the Waste Pits OU. Exceedances of the RI background criteria were limited to a single composite sample (14 mg/kg at SSL0037-0042) taken from two locations on this the parcel and both sampling locations were conservatively assumed to be background exceedances. The impacted extent is assumed to be contained in near-surface soil within two 50 feet by 50 feet areas (totaling 5,000 SF) shown on Figure 8.3-12 located in Appendix D in the western portion of the parcel. As with EAPC 7 (the representative parcel), the arsenic-impacted soil was assumed to be present down to 5 feet bgs with an in-place impacted soil volume of about 925 CY.

Remedial Alternatives

Since this EAPC has one non-VOC (arsenic) as the sole COC, the general form of the remedial alternative as presented in Section 6.1 is appropriate for the FS evaluation and is shown below:

1. No Action
2. ICs + Monitoring
3. Capping (Arsenic) + ICs + Monitoring
4. Excavation (Arsenic) + ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 12 is based on the representative parcel evaluations (EAPC 32), and presents a comparative analysis for these alternatives focusing on the five balancing criteria.

Criterion	Alt	Rating	Discussion
LTE	2	5	ICs (layers 1-4A) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
	3	8	Capping would provide better protection from exposures than Alternative 2. ICs (layers 1-4B) can be effective at controlling potential future construction worker exposures when properly maintained and enforced.
	4	9	Excavation would provide long-term protection. Because the contamination is removed, ICs would include only layers 1 and 2, which would provide protection from unforeseen soil contamination that may be encountered in the future.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
	3	0	Capping would more effectively control exposure than Alternative 2 but would not remove contaminant mass.
	4	9	Excavating arsenic-impacted soil would remove contaminants from the site.
STE	2	9	ICs do not pose any health or environmental risks.
	3	8	Capping would have minimal impact to human health and the environment.
	4	7	Excavation could potentially cause emissions that would impact facility workers or neighboring facilities but impacts would be lower because excavation is shallow and the site is not developed.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
	3	8	Capping is not expected to present technical or administrative challenges. Uncertainty with ICs implementation would be the same as for Alternative 2.
	4	6	Excavation would present modest technical challenges with excavation adjacent to building foundation and may have modest impacts to facility operations.
Cost	2	9	100-year present worth cost: $98,000
	3	6	100-year present worth cost: $452,000
	4	6	100-year present worth cost: $523,000

8.3.3.6 EAPC 13

This parcel (APN 7351-033-045) is located in the central portion of the former butadiene plancor on Vermont Avenue.

Summary of Risk and Risk-driving Chemicals: EAPC 13

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3A	Outdoor soil	1E-05	<1	Arsenic	1.1E-05
	Indoor air	<1E-06	<1	--	--

The primary RDC is arsenic in outdoor soil, which has a chemical-specific CR of 1.1E-05, and contributes to the overall parcel CR of 1E-05 and HI_{com} less than 1. For the indoor air pathway, the cumulative CR and HI_{com} are less than 1E-06 and less than 1 respectively. The RR for outdoor soil is 5E-05 and HI_{res} is less than 1.

Areal Extent of Contamination for FS Evaluation

The primary COC for this EAPC is arsenic in outdoor soil. The areal extent of arsenic-impacted soil is defined by the locations that exceeded the RI background arsenic concentration of 10 mg/kg, but all arsenic detections were below 25 mg/kg, a concentration previously considered by USEPA to be consistent with background levels of arsenic in California soils for the Waste Pits OU. There were two exceedances of the arsenic background level in samples SBL0470 and SSL039-042 at 17.5 and 14 mg/kg. The second sample is a composite sample taken from two locations on this parcel and both sampling locations are conservatively assumed to be background exceedances. Hence, the extent of arsenic impacted soil is assumed to be contained in near-surface soil within three areas: one 40 feet by 65 feet area, one 100 feet by 15 feet area, and one 50 feet by 50 feet area (totaling 6,600 SF) shown on Figure 8.3-13 located in Appendix D. The impacted soil was assumed to be present down to 5 feet bgs with an in-place impacted soil volume of about 1,222 CY.

Remedial Alternatives

Since this EAPC has one non-VOC (arsenic) as the sole RDC, the general form of the remedial alternative as presented in Section 6.1 is appropriate for the FS evaluation and is shown below:

(1) No Action
(2) ICs + Monitoring
(3) Capping (Arsenic) + ICs + Monitoring
(4) Excavation (Arsenic) + ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 13 is based on the representative parcel evaluations (EAPC 32), and presents a comparative analysis for these alternatives focusing on the five balancing criteria.

Criterion	Alt	Rating	Discussion
LTE	2	5	ICs (layers 1-4A) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
	3	8	Capping would provide better protection from exposures than Alternative 2. ICs (layers 1-4B) can be effective at controlling potential future construction worker exposures when properly maintained and enforced.
	4	9	Excavation would provide long-term protection. Because the contamination is removed, ICs would include only layers 1 and 2, which would provide protection from areas of soil contamination that may be encountered in the future.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
	3	0	Capping would effectively control exposure but would not remove contaminant mass.
	4	9	Excavating arsenic-impacted soil would remove contaminants from the site.
STE	2	9	ICs do not pose any health or environmental risks.
	3	8	Capping would have minimal impact.
	4	7	Excavation could potentially cause emissions that would impact facility workers or neighboring facilities but impacts would be lower because excavation is shallow and the site is not developed.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
	3	8	Capping is not expected to present technical or administrative challenges. Uncertainty with ICs implementation would be the same as for Alternative 2
	4	6	Excavation would present modest technical challenges with excavation adjacent to building foundation and may have modest impacts to facility operations.
Cost	2	9	100-year present worth cost: \$98,000
	3	6	100-year present worth cost: \$519,000
	4	5	100-year present worth cost: \$645,000

8.3.4 Group 3B Exposure Areas

This section provides evaluations for EAPCs 8, 17, 20, 24, 19, 22, and 33 based on the evaluation for the representative area EAPC 9. Table 8-11 shows the numerical ratings and costs for these EAPCs that are extrapolated based on unit costs derived from the representative area (EAPC 9).

8.3.4.1 EAPC 8

This parcel (APN 7351-033-026) is located in the southwestern corner of the former butadiene plancor at the northeastern corner of Vermont Avenue and Del Amo Boulevard. This parcel is developed with a single-story commercial building.

Summary of Risk and Risk-driving Chemicals: EAPC 8

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3B	Outdoor soil	<1E-06	<1	Benzene	<1E-06
	Indoor air	<1E-06	<1	Benzene	<1E-06

For both outdoor soil and indoor air, the cumulative CR and HI_{com} are less than 1E-06 and less than 1, respectively. This parcel is in Group 3B because the RR for the indoor air pathway (6E-06) is greater than 1E-06 and the HI_{res} is less than 1. Benzene is the primary RDC for this parcel.

Areal Extent of Contamination for FS Evaluation

The primary COC is benzene in both outdoor soil and indoor air for this parcel with the areal extent of impacted soil defined by the locations that exceed the risk-based threshold level of 0.90 mg/kg for benzene. There is one location (GP-6) at 5.5 feet bgs of a benzene concentration of 0.89 mg/kg that is nearly at the cleanup level. A higher concentration of 2.1 mg/kg is present in the same boring at a depth of 20.5 feet bgs. We have assumed a benzene-impacted extent of shallow soil to be 25 feet by 25 feet area (625 SF) located at the northeast corner of the parcel, as shown on Figure 8.3-16 located in Appendix D. The benzene-impacted soil is assumed to be present down to 15 feet bgs with an in-place impacted soil volume of about 350 CY. This impacted soil location is away from the existing building and it is assumed that there is no VOC-impacted soil under the building.

Remedial Alternatives

Since this EAPC has one VOC (benzene) as the sole COC, the general form of the remedial alternative as presented in Section 6.1 is modified by removing the HVAC mod/SSV engineering control for vapor intrusion:

(1) No Action
(2) ICs + Monitoring
(3) Capping (Benzene) + ICs + Monitoring

(4) SVE/BV (OS) + ICs + Monitoring
(5) Excavation (Benzene) + ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 8 is based on the representative parcel (EAPC 9) evaluation, and presents a comparative analysis for these alternatives focusing on the five balancing criteria.

Criterion	**Alt**	**Rating**	**Discussion**
LTE	2	4	This alternative incorporates IC layers 1-4A and 5, including both permit review and land use covenants that are designed to control potential future exposures. ICs would supplement the existing asphalt coverage but would not guarantee that the site would remain capped in the future. There would be some uncertainty about maintaining IC effectiveness over the long term.
	3	7	Capping would provide protection from exposures than Alternative 2. ICs (layers 1-5) in addition protects the engineering control.
	4	9	SVE would provide more protection than Alternative 3 by removing contaminant mass. ICs (layers 1, 2 and 5) provide protection from any unforeseen contamination.
	5	9	Excavation would provide long-term protection by removing contaminant mass. ICs (layers 1, 2 and 5) provide protection from any unforeseen contamination.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure and thereby reduces risk.
	3	0	Capping would effectively control exposure but would not remove contaminant mass.
	4	9	SVE would remove contaminants (>90%) in outdoor soil.
	5	9	Excavation would remove contaminants (>90%) in outdoor soil.
STE	2	9	ICs do not pose any health or environmental risks.
	3	8	Capping would have minimal impact.
	4	7	SVE installation could potentially impact facility workers or neighboring facilities. Emissions from routine SVE operation can be controlled well except for emissions during drilling, or potential releases during process upsets and startup testing.
	5	7	Excavation could potentially cause emissions of dust and VOCs that would impact facility workers or neighboring facilities.

Criterion	Alt	Rating	Discussion
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
	3	8	Capping is not expected to present technical or administrative challenges.
	4	6	SVE installation and operation would present modest technical challenges and limited impacts to the workers in the office buildings in the vicinity.
	5	5	Excavation would present moderate technical challenges due to the 15-foot depth of excavation and the proximity to the pipeline and power lines. There also may be some impact to workers in the office buildings.
Cost	2	9	100-year present worth cost: $123,000
	3	8	100-year present worth cost: $253,000
	4	6	100-year present worth cost: $869,000
	5	8	100-year present worth cost: $320,000

8.3.4.2 EAPC 17

This parcel (APN 7351-034-039) is located in the northern portion of the former styrene plancor on Magellan Drive.

Summary of Risk and Risk-driving Chemicals: EAPC 17

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3B	Outdoor soil	9E-07	<1	Benzene	9E-07
	Indoor air	1E-06	<1	Benzene	1E-06

Benzene is the primary RDC for both the indoor air and outdoor soil pathways. The CR is 9E-07 and the HI_{com} is less than 1. For the indoor air pathway, the CR is 1E-06 and the HI_{com} is less than 1. The RR for the indoor air pathway (2E-05) is greater than 1E-06, the HI_{res} is less than 1. Based on these criteria, EAPC 17 is a Group 3 parcel.

Areal Extent of Contamination for FS Evaluation

The primary COC is benzene in both outdoor soil and indoor air for this parcel. The areal extent of impacted soil is defined by the locations that exceeded the risk-based threshold level of 120 ppmv for benzene in soil gas. There is one soil gas sampling location that shows an exceedance at SGL0704 at 210 ppmv of benzene. The impacted extent is assumed to be contained within one 30 feet by 50 feet area (1,500 SF) located south of the building shown on Figure 8.3-18 located in Appendix D. In addition, an area of about 30 feet by 50 feet of soil (1,500 SF) under the building is assumed to be impacted based on former facilities. The benzene-impacted shallow soil is assumed to be present down to 15 feet bgs with an in-place impacted outdoor soil volume of 830 CY, another 830 CY under the building for a total impacted soil volume of about 1,660 CY.

Remedial Alternatives

Since this EAPC has one VOC COC (benzene), the general form of the remedial alternatives as presented in Section 6.1 is appropriate for the FS evaluation and is shown below:

(1) No Action
(2) ICs + Monitoring
(3) Capping (Benzene) + HVAC mod/SSV (UB) + ICs + Monitoring
(4) SVE/BV (OS) + HVAC mod/SSV (UB) + ICs + Monitoring
(5) SVE/BV (OS) + SVE/BV (UB) + ICs + Monitoring
(6) Excavation (Benzene) + SVE/BV (UB) + ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 17 is based on the representative parcel (EAPC 9) evaluation, and presents a comparative analysis for these alternatives focusing on the five balancing criteria.

Criterion	Alt	Rating	Discussion
LTE	2	4	This alternative incorporates IC layers 1-4A and 5, including both permit review and land use covenants that are designed to control potential future exposures. ICs would supplement the existing asphalt coverage. But alternative would not guarantee the site would remain capped. There would be some uncertainty about maintaining IC effectiveness over the long term.
	3	7	Capping, HVAC mod/SSV and ICs (layers 1-5) would provide better protection from direct contact and vapor intrusion exposures than Alternative 2.
	4	8	SVE in outdoor soil combined with capping and HVAC mod would provide better protection to onsite workers than Alternative 3 by removing contaminant mass in outdoor soil. IC layers 1-5 protect from direct contact exposures and protect engineering controls.
	5	8	SVE in outdoor soil and under building would provide better protection by removing some contaminant mass than Alternative 4. However, SVE under the building would have reduced effectiveness because it is difficult to characterize soil under buildings. IC layers 1-4A and 5 would provide protection from any residual or unforeseen contamination.
	6	8	Excavation would provide protection by removing contaminant mass in outdoor soil. However, SVE under the building would have reduced effectiveness because it is difficult to characterize soil under buildings. IC layers 1-4A and 5 would provide protection from any residual or unforeseen contamination.

Criterion	Alt	Rating	Discussion
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure and thereby reduces risk but does not remove contaminant mass.
	3	2	Capping and HVAC mod/SSV would effectively control exposure but would not remove contaminant mass. However, SSV does treat low levels of offgassing VOCs.
	4	6	SVE would remove most contaminant mass (>90%) in outdoor soil and the HVAC mode would control exposure by vapor intrusion.
	5	8	SVE would remove contaminants (>90%) in outdoor soil but effectiveness would be reduced under the building (50% to 90%).
	6	8	Excavation would remove contaminants (>90%) in outdoor soil but SVE effectiveness would be reduced under the building (50% to 90%).
STE	2	9	ICs do not pose any health or environmental risks.
	3	7	Capping would have minimal impact but HVAC modification could modestly impact the facility. SSV would have greater potential to release contaminants and cause exposure.
	4	7	SVE and HVAC modification could potentially impact the facility workers or neighboring facilities. Emissions from routine SVE operation can be controlled well except for emissions during drilling, or potential releases during process upsets and startup testing. HVAC mod/SSV installation would have impacts as discussed for Alternative 3.
	5	6	SVE installation in outdoor soil and under building is a larger SVE system and could have greater impact to facility workers or neighboring facilities than Alternative 4.
	6	5	Excavation and SVE installation could potentially impact facility workers or neighboring facilities.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City’s current political support.
	3	6	Capping would not present challenges but SSV would present modest to significant technical challenges. If HVAC mod is selected lesser challenges are anticipated.
	4	6	Minor challenges can be expected with SVE in outdoor soil, in addition to the challenges with implementation of SSV.
	5	5	Significant challenges can be expected with SVE under the building, and a larger SVE system would have larger impacts.
	6	4	Excavation and SVE would present significant technical challenges with horizontal wells installation and would impact facility operations.

Criterion	**Alt**	**Rating**	**Discussion**
Cost	2	9	100-year present worth cost: $123,000
	3	7	100-year present worth cost: $664,000
	4	5	100-year present worth cost: $1,447,000
	5	4	100-year present worth cost: $1,634,000
	6	4	100-year present worth cost: $1,830,000

8.3.4.3 EAPC 20

This parcel (APN 7351-034-045) is located in the northern portion of the former styrene plancor on Magellan Drive.

Summary of Risk and Risk-driving Chemicals: EAPC 20

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3B	Outdoor soil	<1E-06	-- [a]	--	--
	Indoor air	2E-06 [b]	<1 [b]	Benzene	2E-06 [b]

[a] No COPCs selected in BRA for outdoor soil pathway.

[b] Risks based on indoor air/Tiers 1+2 – groundwater analysis.

The primary RDC for this parcel is benzene in indoor air. The CR for the indoor air pathway by vapor intrusion of benzene from groundwater was estimated to be 2E-06 and the HI_{com} is less than 1 according to the results from the indoor air (Tiers 1+2) – groundwater analysis. The cumulative CR is less than 1E-06 for outdoor soil. The RR for indoor air is 1E-05 and the HI_{res} is less than 1. No COPCs were selected for hazard index estimation for the outdoor soil pathway in the BRA.

Areal Extent of Contamination for FS Evaluation

The primary COC is benzene in indoor air by vapor intrusion from groundwater based on the risks estimated from the indoor air/Tiers 1+2 – groundwater analysis. However, the estimation of vapor intrusion risks from groundwater present at 50 feet bgs by modeling is considered to have a significant uncertainty. No areal extent of impacted shallow soil was proposed on Figure 8.3-19 located in Appendix D since no exceedances for shallow soil or soil gas were identified in this EAPC.

Remedial Alternatives

Since there is no impacted area identified, no active remedial alternatives were considered. The following two alternatives were evaluated:

Since this EAPC has one VOC COC (benzene) and no assumed impacted area, the general form of the remedial alternative as presented in Section 6.1 is modified to exclude capping or active remedial alternatives:

(1) No Action
(2) ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 20 presents an analysis of Alternative 2 based on the five balancing criteria. Alternative 1 (No Action) does not satisfy threshold criteria. The representative area, EAPC 9 is not referenced here because it is significantly different from EAPC 20 with respect to the nature and extent of contamination.

Criterion	Alt	Rating	Discussion
LTE	2	4	ICs (layers 1-4A and 5) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	2	9	ICs do not pose any health or environmental risks.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
Cost	2	9	100-year present worth cost: $123,000

8.3.4.4 EAPC 24

This parcel (APN 7351-034-058) is located in the southwestern portion of the former styrene plancor at the southern corner of Pacific Gateway Drive and Francisco Street.

Summary of Risk and Risk-driving Chemicals: EAPC 24

Group	Medium/Pathway	Commercial Worker Risk (recalculated) [a]		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3B	Outdoor soil	<1E-06	<1	--	--
	Indoor air	<1E-06	<1	--	--

[a] Risk estimates in the BRA were influenced by elevated DLs. Risks for this EAPC were recalculated by the RAGS method as described in USEPA's Risk Assessment Guidance, Part D, Chapter 5, 2001 (RAGS 2001).

Based on the results reported in the BRA, the outdoor shallow soil CR and indoor air (Tiers 1+2) CR were 4E-05 and 5E-05, respectively. After accounting for the chemicals with elevated DLs, both outdoor shallow soil and indoor air CRs were reduced to less than 1E-06 and a HI_{com} less than 1. The corresponding RR was less than 1E-06 and HI_{res} residential was less than 1. The CR for deep soil was unchanged at an elevated level of 2E-04, but this risk estimate is considered to have high uncertainty. Groundwater contamination SA9 is located in the central portion of the parcel at the location of former facility tanks south of the building. The CR and RR less than 1E-06 would have put EAPC 24 in Group 2, but because it was a parcel with a potential NAPL source area with an elevated deep soil CR, EAPC 24 was placed in Group 3B.

Areal Extent of Contamination for FS Evaluation

One soil gas sampling point SGL0144 is depicted on Figure 8.3-20 located in Appendix D with a maximum benzene concentration of 0.05 ppmv at 6.5 feet bgs (much lower than the risk-based threshold level of 120 ppmv for benzene). Elevated benzene levels were detected in deep soil and groundwater. However, no areal extent of impacted soil was proposed as no exceedances from shallow soil were identified in this parcel.

Remedial Alternatives

Since this EAPC has no assumed impacted area, the general form of the remedial alternative as presented in Section 6.1 is modified to exclude capping or active remedial alternatives:

(1) No Action
(2) ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

A construction project was recently conducted (in early 2006) at this EAPC for a loading dock and truck well along the south side of the building near the location of the former utility tanks. Shallow soils were excavated in certain locations south of the warehouse building for foundation construction and sent offsite for disposal.

Summary Evaluation

The summary evaluation for EAPC 24 presents an analysis of Alternative 2 based on the five balancing criteria. Alternative 1 (No Action) does not satisfy threshold criteria. The representative area, EAPC 9 is not referenced here because it is significantly different from EAPC 24 with respect to the nature and extent of contamination.

Criterion	Alt	Rating	Discussion
LTE	2	4	ICs (layers 1-4A and 5) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.

Criterion	Alt	Rating	Discussion
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	2	9	ICs do not pose any health or environmental risks.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
Cost	2	9	100-year present worth cost: $123,000

8.3.4.5 EAPC 19

This parcel (APN 7351-034-043) is located in the northern portion of the former styrene plancor on Magellan Drive.

Summary of Risk and Risk-driving Chemicals: EAPC 19

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemical	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3B	Outdoor soil	<1E-06	-- [a]	--	--
	Indoor air	<1E-06 (b)	<1 [b]	PCE	<1E-06 (b)

[a] No COCs selected for specified medium.

[b] Risks based on indoor air/Tier 1 – shallow analysis.

PCE is the primary RDC. The CR is less than 1E-06 for the outdoor soil and indoor air pathways and the HI_{com} for indoor air was less than 1. The RR is 4E-06 and the HI_{res} is less than 1. No COPCs were selected for HI estimation in the outdoor soil pathway.

Areal Extent of Contamination for FS Evaluation

The primary COC for this parcel is PCE in indoor air. One soil gas sampling point SGL0779 is depicted on Figure 8.3-21 located in Appendix D with a maximum PCE concentration of 3.4 ppmv at 7 feet bgs (lower than the risk-based threshold level of 6.0 ppmv for PCE). No areal extent of impacted soil was proposed as no exceedances from shallow soil were identified in this parcel.

Remedial Alternatives

Since this EAPC has one VOC COC (PCE) and no assumed impacted area, the general form of the remedial alternative as presented in Section 6.1 is modified to exclude capping or active remedial alternatives:

(1) No Action
(2) ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 19 presents an analysis of Alternative 2 based on the five balancing criteria. Alternative 1 (No Action) does not satisfy threshold criteria. The representative area, EAPC 9 is not referenced here because it is significantly different from EAPC 19 with respect to the nature and extent of contamination.

Criterion	Alt	Rating	Discussion
LTE	2	4	ICs (layers 1-4A and 5) would supplement the existing asphalt coverage. However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	2	9	ICs do not pose any health or environmental risks.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
Cost	2	9	100-year present worth cost: $123,000

8.3.4.6 EAPC 22

This parcel (APN 7351-034-052) is located in the central portion of the former styrene plancor at the northeastern corner of Pacific Gateway Drive and Francisco Street.

Summary of Risk and Risk-driving Chemicals: EAPC 22

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3B	Outdoor soil	<1E-06	<1	--	--
	Indoor air	<1E-06 (a)	<1 [a]	TCE	<1E-06 [a]

[a] Risks based on indoor air/Tier 1 – shallow analysis.

TCE is the primary RDC. The CR and HI_{com} for the outdoor soil and indoor air pathways are less than 1E-06 and less than 1, respectively. The RR is 2E-06 and the HI_{res} is less than 1 based on the indoor air (Tier 1) – shallow analysis.

Areal Extent of Contamination for FS Evaluation

The primary COC is TCE in indoor air for this parcel. One soil gas sampling point SGL0246 is depicted on Figure 8.3-22 located in Appendix D with a maximum TCE concentration of 1.6 ppmv at 6.5 feet bgs (lower than the risk-based threshold level of 20 ppmv for TCE). No areal extent of impacted soil was proposed as no exceedances from shallow soil were identified in this parcel.

Remedial Alternatives

Since this EAPC has one VOC COC (TCE) and no assumed impacted area, the general form of the remedial alternative as presented in Section 6.1 is modified to exclude capping or active remedial alternatives:

(1) No Action
(2) ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 22 is based on the representative parcel (EAPC 9) evaluation, and presents an analysis of Alternative 2 based on the five balancing criteria. Alternative 1 (No Action) does not satisfy threshold criteria. The representative area, EAPC 9 is not referenced here because it is significantly different from EAPC 22 with respect to the nature and extent of contamination.

Criterion	Alt	Rating	Discussion
LTE	2	4	ICs (layers 1-4A and 5) would supplement the existing asphalt coverage However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	2	9	ICs do not pose any health or environmental risks.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City's current political support.
Cost	2	9	100-year present worth cost: $123,000

8.3.4.7 EAPC 33

This parcel (APN 7351-034-803) is located in the eastern portion of the former styrene plancor. It is a long, narrow parcel that is currently undeveloped and is accessible from Francisco Street.

Summary of Risk and Risk-driving Chemicals: EAPC 33

Group	Medium/Pathway	Commercial Worker		Risk-driving Chemicals	Chemical-specific Risk
		Cancer Risk	Hazard Index		
3B	Outdoor soil	2E-06	-- [a]	B(a)P	2E-06
	Indoor air	2E-06 [b]	<1 [b]	PCE	2E-06 [b]

[a] No COCs selected for specified medium.

[b] Risks based on indoor air/Tiers 1+2 – groundwater analysis.

PCE in indoor air is the primary RDC with a chemical-specific CR of 2E-06, as estimated by the indoor air (Tiers 1+2) – Groundwater analysis risk. B(a)P, with a chemical-specific CR of 2E-06 is the dominant contributor to risk for the outdoor soil pathway. The CR for the outdoor soil pathway was 2E-06 and HI_{com} was less than 1 for the indoor air pathway. The RR for indoor air was 1E-05 and the HI_{res} was less than 1. No COPCs were selected for the estimation of outdoor soil HI in the BRA.

Areal Extent of Contamination for FS Evaluation

The primary COCs are PCE in indoor air and B(a)P in outdoor soil; however, no PCE exceedances from shallow soil were identified in this parcel. The maximum B(a)P concentration (0.26 mg/kg) was detected in soil boring SBL0322 at a depth of 1.5 feet bgs shown on Figure 8.3-23 located in Appendix D. This B(a)P concentration is significantly below the urban background level of 0.9 mg/kg. Hence no impacted soil is assumed to be addressed in the evaluation.

Remedial Alternatives

Since this EAPC has one VOC (PCE) and one non-VOC COC (B(a)P) and no assumed impacted area, the general form of the remedial alternative as presented in Section 6.1 is modified to exclude capping or active remedial alternatives:

(1) No Action
(2) ICs + Monitoring

Table 8-10 shows the applicable IC layers for each alternative.

Summary Evaluation

The summary evaluation for EAPC 33 presents an analysis of Alternative 2 based on the five balancing criteria. Alternative 1 (No Action) does not satisfy threshold criteria. The representative area, EAPC 9 is not referenced here because it is significantly different from EAPC 33 with respect to the nature and extent of contamination.

Criterion	**Alt**	**Rating**	**Discussion**
LTE	2	4	ICs (layers 1-4A and 5) would supplement the existing asphalt coverage However, this alternative does not guarantee that the impacted areas of the site will remain capped in the long term. There would be some uncertainty about maintaining IC effectiveness over the long term.
RTMV	2	0	Existing asphalt cover provides protection from direct contact exposure but does not reduce contaminant mass. However, contaminant mass may be removed from the impacted area in the course of future construction projects, which may be identified through the permit review IC.
STE	2	9	ICs do not pose any health or environmental risks.
Implementability	2	8	ICs are not expected to present technical or administrative challenges. The City has implemented the permit review process (IC layer 2) as a pilot project. A land use covenant is assumed to be negotiable, given USEPA's enforcement authority. A zoning IC is likely implementable given the City’s current political support.
Cost	2	9	100-year present worth cost: $123,000

8.3.5 Group 2 Exposure Areas

The evaluation of the Group 2 areas would be identical to the representative area (EAPC 21 – Parcel No. 7351-034-047), so no separate evaluations for other Group 2 areas are presented here.

8.3.6 Group 1 Exposure Areas

The evaluation of the Group 1 areas would be identical to the representative area (Parcel No. 7351-031-017), so no separate evaluations are presented here.

9.0 DETAILED EVALUATION OF NAPL SOURCE AREAS

This section presents the results of the detailed CERCLA 9-criteria analysis of the remedial alternatives for the NAPL source areas that were described in Section 7. Similar to the structure of Section 8, this section presents a detailed analysis of SA12, and then extends the analysis to SA3, SA11, SA6 and SA9, for which the evaluation is largely similar. NAPL is present or potentially present at these source areas in close proximity to onsite buildings. NAPL is potentially present under existing buildings at SA4, SA7, SA8 and SA5. The evaluations for these source areas also reference the SA12 evaluation, and focus on identifying the differences. Sections 7.11 and 7.12 provide a rationale for not presenting a detailed FS evaluation for SA2 and SA1, respectively.

The nine criteria for the detailed analysis were described in Section 8.1. The detailed analysis is summarized in Tables 9-1 through 9-9, showing the 9 criteria evaluation for each remedial alternative at each source area. The two threshold criteria (overall protection of human health and environment, and compliance with ARARs) are pass-fail criteria, so that the rating is stated as “Yes” or “No” depending on whether the alternative satisfies the criterion or not. The analysis uses a 10-point numerical rating for the five balancing criteria ranging from 0 (worst rating) to 9 (best rating) as discussed in Section 8. In addition to the criteria and factors considered in the detailed evaluation in Section 8, the NAPL evaluation in this section includes estimates of greenhouse gas (GHG) generation. The GHG information is included in the “Overall protection of human health and environment” and “short term effectiveness” evaluations, although the intent is not to use the information to alter the remedy selection criteria or process. Rather, the intent of the information is to provide a baseline look at the energy needs of the alternatives and associated impacts (GHG emissions) of each alternative on the environment in order to then facilitate opportunities to increase energy efficiency and sustainability while reducing dependency on non-renewable energy sources later in the remedial process. The GHG emissions estimates are presented in Table E3-1 in Appendix E-3.

Approximate cost estimates were developed for each remedial alternative based on the conceptual designs presented in Section 7. Preliminary vendor quotes were obtained in order to estimate costs for ERH and ISCO. For other technologies, costs were estimated based on our judgment, knowledge of contamination, and experience at other sites. Cost was given a numerical rating based on a cost scale[43] for NAPL alternatives. In general because the NAPL contaminants and site lithology are similar across the source areas, the cost for any active remedial alternative varies between source areas based on extent of the treatment zone (e.g., area, volume). To a lesser extent it depends on other factors such as contaminant mass. As discussed in Section 8, the cost estimates are comprehensive estimates of capital and O&M costs, including a contingency. The contingency varied from 20% for the well developed technologies (e.g., SVE) to 40% for the innovative technologies (e.g., ISSH) (USEPA 2000b). Present worth costs are estimated based on the duration of the remedial alternative using a discount rate of 5%. The detailed cost spreadsheets for the remedial alternatives for the NAPL source areas are presented in Appendix E. There are several uncertainties with the cost estimates due to assumptions made about the lateral extent of the

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[43] For NAPL alternatives, a non-linear cost scale in the range of $0 to $30,000,000 was used. The cost range was split into 10 parts of increasing cost intervals with the highest rating (9) for the lowest cost interval ($0-$2,000,000) and the lowest rating (0) for the highest interval (>$30M). Refer to Appendix G for details.

COC-impacted area, the radius of influence for each well that determines the well spacing, and other operational parameters that impact cost such as influent concentrations or oxidant dosage. The cost estimates meet the accuracy requirements of the CERCLA FS guidance of +50% to −30%.

ICs included in the NAPL source area alternatives are the same as the ICs included for the EAPC(s) containing the source area. Cost totals for the NAPL alternatives include the same IC costs as the totals for the surface pathway alternatives. If integrated costs are developed for EAPCs with source areas then efforts will be made to ensure that ICs costs are not double-counted.

In order to develop an appropriate evaluation for the ISSH technology (a thermal technology used in Alternative 6, Section 7), efforts were made to collect published and unpublished reports on the implementation of this technology at other sites across the country. The review of the performance of this technology focused on understanding effectiveness and implementability issues from field pilot or full scale implementations. From the larger list of sites initially identified, a smaller number of sites with similarities to the NAPL source areas at Del Amo site were developed. The selected sites focused on those that had VOC contaminants in the saturated zone, were in close proximity to buildings and had low-permeability soil conditions similar to the Del Amo site. Seven selected sites where the technology was relatively successful are presented in Table E2-1 in Appendix E-2. This table provides a brief summary of the site information and includes site name, location, contaminants, remedial approach, soil conditions, soil volume, contaminant removal efficiency and cost. Additional examples of sites where thermal technologies faced problems with effectiveness or implementability are listed in Table E2-2 in Appendix E-2. Overall, the review of the performance of the ISSH technology at these sites helped inform the 9-criteria evaluation for Alternative 6, specifically for assigning ratings for the balancing criteria (LTE, RTMV, Implementability and STE) for the various source areas. In addition, this review provided a basis for the assumption of 60% to 90% VOC mass removal efficiency by this thermal technology at the Del Amo site.

9.1 SOURCE AREA 12

This section presents the results of the 9-criteria evaluation of the remedial alternatives for SA12 located in EAPC 5. The SA12 alternatives were described in Section 7.2 and illustrated on Figures 7.2-1 through 7.2-5 located in Appendix E. ICs and Monitoring are included for all the alternatives except the No Action alternative. The ICs component for EAPC 5 includes IC layers 1-5, described in Section 5.4.

9.1.1 9-Criteria Analysis for SA12

The 9-criteria evaluation text for each alternative is presented below in tabular form with three columns. The first column lists the criteria, the second column provides the rating and the third column provides the rationale for the rating. Table 9-1 summarizes the 9-criteria ratings for SA12.

Alternative 1 - No Action

Criterion	Rating	Discussion
Protect Health & Environment	NO	This alternative does not reduce or control potential future exposure to subsurface contamination.
ARARs	NO	This alternative would not meet the State ARAR requiring restrictive covenants where waste is left in place above UU/UE levels.
LTE	0	This alternative does not include provisions to reduce contamination, monitoring to observe natural attenuation or warn of contaminant migration, nor adequate ICs to prevent potential future exposures to residual NAPL or groundwater contamination.
RTMV	0	No treatment is actively employed to reduce contaminant mass. Contaminant mass reduction will occur slowly via biodegradation by naturally-occurring subsurface microbes. Benzene and the other non-halogenated VOCs are biodegradable in the dissolved phase and will be converted to benign compounds like carbon dioxide and water. NAPL mobility and saturations are already low, so future migration of NAPL is highly unlikely.
STE	N/A	STE is not applicable because there is no action.
Implementability	9	Implementability is rated 9 because there would be no technical or administrative challenges in taking no action.
Cost	9	There are no costs for this alternative.

Alternative 2 – Intrinsic Biodegradation + ICs + Monitoring

Criterion	Rating	Discussion
Protect Health & Environment	YES	Historic groundwater monitoring data indicate that contaminant distributions at this source area are holding steady or decreasing (see LTE). This alternative would not reduce the time for which the groundwater containment zone is needed but would provide adequate long-term protection of human health and environment because ICs would control potential exposure to subsurface contamination and Monitoring would provide warning of any future contaminant migration.
ARARs	YES	This source area is within the TI waiver zone, where compliance with chemical-specific ARARs (called in-situ groundwater standards [ISGS] in the Groundwater ROD) is not required. There are no location-specific ARARs for the Del Amo Site and there are no action-specific ARARs for this passive remedial alternative which does not include aboveground treatment. The state ARAR requiring restrictive covenants where waste is left in place above UU/UE levels would be met by the ICs for this parcel.

<table>
<tr><th>Criterion</th><th>Rating</th><th>Discussion</th></tr>
<tr><td>LTE</td><td>2</td><td>Intrinsic biodegradation of hydrocarbon contaminants (BTEX, TPH) has been shown to be vigorous in the dissolved-phase groundwater at the former plant site. Based on historic groundwater monitoring, contaminant distributions in this source area are holding steady or decreasing. Benzene and other non-halogenated VOCs that undergo intrinsic biodegradation will attenuate slowly in the dissolved plume, posing a decreasing risk in the long term. Mobility of NAPL in the future is considered unlikely as NAPL at low hydrocarbon saturations has been shown to be immobile. Although significant contaminant mass will remain in the subsurface in the long term, ICs and existing legal groundwater use restrictions would prevent potential exposures to subsurface contamination. Monitoring would provide a warning in the unexpected event of future contaminant migration. The timeframe for aquifer restoration for this alternative is estimated to be about 10,500 years based on modeling performed during the MW-20 pilot study (URS 2003c). There would be some uncertainty about maintaining ICs effectively over the long term.</td></tr>
<tr><td>RTMV</td><td>0</td><td>No active treatment would be employed to reduce contaminant mass. Contaminant mass reduction will occur slowly via biodegradation by naturally-occurring subsurface microbes. Benzene and the other non-halogenated VOCs are biodegradable in the dissolved phase and will be converted to benign compounds like carbon dioxide and water. NAPL mobility and saturations are already low, so future migration of NAPL is unlikely.</td></tr>
<tr><td>STE</td><td>9</td><td>The only active field work involved in this alternative is periodic groundwater monitoring at existing wells. No impacts to human health and environment are expected.</td></tr>
<tr><td>Implementability</td><td>8</td><td>This alternative does not require construction activities. Implementability is good for intrinsic biodegradation because BTEX and other petroleum hydrocarbons are well documented to be biodegradable in the dissolved phase, primarily by aerobic biodegradation at the fringes of the plume. Groundwater monitoring is already being implemented site-wide. Some uncertainties exist regarding ICs but restrictive covenants are assumed to be negotiable, given USEPA's enforcement authority.</td></tr>
<tr><td>Cost</td><td>9</td><td>Total cost is based on the present worth cost of 100-year ICs and Monitoring and includes a 20% contingency.
<table>
<tr><th></th><th>Monitoring[(a)]</th><th>ICs[(b)]</th><th>Total</th></tr>
<tr><td>Capital Cost</td><td></td><td>$37,400</td><td>$37,400</td></tr>
<tr><td>Annual Cost</td><td>$15,000</td><td>$3,275</td><td>$18,275</td></tr>
<tr><td>Present Worth</td><td>$358,000</td><td>$123,000</td><td>$481,000</td></tr>
</table>
(a) No monitoring well installation costs are included because these wells already exist. Annual cost includes annual monitoring of four wells.
(b) Assumes IC layers 1-5.</td></tr>
</table>

Alternative 3 – SVE/BV + ICs + Monitoring

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would modestly reduce the time the groundwater containment zone is needed by removing contaminant mass in the vadose zone. This would moderately increase the long-term certainty of the groundwater protection remedy. IC layers 1-5 would control potential exposure to subsurface contamination and Monitoring would provide warning of any future contaminant migration. This alternative is rated adequate with respect to protection of human health and environment though it would leave significant hydrocarbon mass in the subsurface. Also, this technology would result in emissions of about 1,630 metric tons of GHG[44] that can contribute to global warming and thus impact the environment.
ARARs	YES	This source area is within the TI waiver zone, where compliance with chemical-specific ARARs (called ISGS in the Groundwater ROD) is not required. Aboveground treatment of extracted benzene vapors will need to comply with action-specific ARARs including SCAQMD discharge requirements. Compliance with discharge ARARs would be a challenge but is expected to be technically feasible. An appropriately designed thermal oxidation or adsorption (either carbon or resin) system combined with control of the influent flow rates would be likely to meet the ARARs for this alternative. The state ARAR requiring restrictive covenants when waste is left in place above UU/UE levels would be met by the ICs in this alternative.
LTE	5	SVE would remove some but not all contaminant mass (see RTMV). Groundwater concentrations of NAPL constituents, such as benzene, would not decrease significantly during remediation. However, even limited source reduction in soil would reduce concentrations of benzene in groundwater in the longer term, with an associated reduction in risk. This increases the certainty of the groundwater remedy's effectiveness (as defined in the Groundwater ROD) in the long term. ICs would control potential exposure to subsurface contamination and Monitoring would provide a warning of any future contaminant migration. There would be some uncertainty about maintaining ICs effectively over the long term. The timeframe for aquifer restoration for this alternative is estimated as >7,000 years.
RTMV	4	SVE would achieve modest contaminant mass removal in the vadose zone soils, and none at all in the saturated zone. SVE can effectively remove contamination in the vadose zone where soils are permeable, but the significant thickness of the low-permeability silt formation would present

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[44] The greenhouse gas estimate is a CO_2-equivalent mass emission that would result from implementation of this alternative based on the assumed conceptual design of equipment and operational duration. The emissions include greenhouse gas emissions corresponding to the electric energy (kilowatt-hours) and the volume of fuel (therms of natural gas) used.

Criterion	**Rating**	**Discussion**
		challenges. Interbedded layers of more permeable silty sand/sandy silt would provide air flow and facilitate hydrocarbon mass removal; approximately 20% to 30% of hydrocarbon mass[45] in the source area is likely to be removed in four years of SVE operation. This would leave significant residual contaminant mass in the addressed source area as well as significant contaminant mass that is assumed to lie under the building. As a result, benzene concentrations in groundwater are likely to be still elevated (in the hundreds of milligrams per liter), and a significant risk reduction is not expected. However, in the long term, benzene concentrations would decrease moderately faster than with Alternative 2. This alternative would reduce NAPL mobility somewhat, but it should be noted that NAPL mobility and saturations are already low.
STE	8	Under this alternative, extracted groundwater and vapors with high concentrations of benzene, and some explosive vapors, would be treated aboveground in close proximity to active businesses. The installation and operation of the SVE system would have a small impact on the site occupants and neighboring community.[46] Small releases of contaminants (within allowable regulatory limits) would occur during normal operation of the remediation system. However, emissions of a larger magnitude are possible during system construction and from process upsets during system operation that could potentially pose a risk or other impacts to site occupants and the neighboring community. This technology would result in emissions of about 1,630 metric tons of GHG over the operational duration that can contribute to global warming and thus impact the environment.
Implementability	7	Implementation of SVE is readily feasible from a technical perspective, but there would be some administrative challenges in undertaking remedial action at this source area due to the impacts of the long-term operation of this remediation system to the onsite businesses and community at large. There is a history of public opposition toward thermal treatment of extracted VOC vapors at the former plant site which may mean that thermal oxidizers are not a publicly popular option even though vendors and equipment for the SVE system with thermal oxidation are readily available. Alternate vapor treatment technologies such as resin adsorption or carbon adsorption with steam regeneration are not as widely available or as economical. The permit review IC has been implemented for this parcel with the City of Los Angeles. Some uncertainties exist regarding ICs but restrictive covenants are assumed to be negotiable, given USEPA's enforcement authority.

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[45] Mass removal is presented as a percentage of all the NAPL in the vadose zone and saturated zone based on the assumed SVE design on Figure 7.2-2 in Appendix E.

[46] Based on experience operating SVE systems at other facilities in close proximity to onsite workers, worker complaints about odors may potentially affect operations.

<table>
<tr><th>Criterion</th><th>Rating</th><th>Discussion</th></tr>
<tr><td>Cost</td><td>8</td><td>There are several uncertainties with this cost estimate resulting from uncertainties about the lateral extent of the source area, average influent hydrocarbon concentrations, and other factors. This cost estimate assumes the use of thermal oxidizers for vapor-phase treatment. The present worth cost includes a 20% contingency.
<table>
<tr><th></th><th>SVE^(a)</th><th>ICs+Monitoring^(b)</th><th>Total</th></tr>
<tr><td>Capital Cost</td><td>$597,000</td><td>$37,400</td><td>$634,400</td></tr>
<tr><td>Annual Cost</td><td>$318,000</td><td>$18,275</td><td>$336,275</td></tr>
<tr><td>Present Worth</td><td>$2,070,000</td><td>$481,000</td><td>$2,551,000</td></tr>
</table>
(a) For 4-year operation of SVE
(b) For 100-year operation of ICs and Monitoring</td></tr>
</table>

Alternative 4 – Hydraulic Extraction + SVE/BV + ICs + Monitoring

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would moderately reduce the time the groundwater containment zone is needed by removing contaminant mass in the vadose zone. This would moderately increase the long-term certainty of the groundwater protection remedy. ICs would control potential exposure to subsurface contamination and Monitoring would provide warning of any future contaminant migration. This alternative is rated adequate with respect to protection of human health and environment, though it would leave significant hydrocarbon mass in the subsurface. Also, this alternative would result in emissions of about 8,580 metric tons of GHG that can contribute to global warming and thus impact the environment.
ARARs	YES	This source area is within the TI waiver zone, where compliance with chemical-specific ARARs (called ISGS in the Groundwater ROD) is not required. Aboveground treatment of the extracted benzene-impacted groundwater and benzene vapors will need to comply with action-specific ARARs including SCAQMD discharge requirements. Compliance with discharge ARARs would be a challenge but is expected to be technically feasible. A combination of technologies such as advanced oxidation and air stripping for groundwater and thermal oxidation or adsorption (either carbon or resin) would be likely to meet the ARARs for this alternative. Ancillary water treatment may be necessary to comply with NPDES standards, including treatment required by NPDES for groundwater constituents that are not site contaminants. For example, detections of total dissolved solids (TDS) and some metals are often higher in site groundwater than are allowed by NPDES requirements. Sewer discharge of treated groundwater may be approved only if treatment to NPDES standards is shown to be infeasible.

Criterion	**Rating**	**Discussion**
		These ancillary treatment requirements complicate the treatment train by requiring additional treatment steps and increasing the complexity of operations, but they are in most cases technically feasible. The state ARAR requiring restrictive covenants when waste is left in place above UU/UE levels would be met by the ICs in this alternative.
LTE	7	Hydraulic extraction and SVE would remove some contaminant mass (more than SVE alone) but not all of it (see RTMV). However, even limited source reduction in soil would reduce concentrations of benzene in groundwater in the longer term, with an associated reduction in risk. This increases the certainty of the groundwater remedy's effectiveness in the long term. ICs would control potential exposures to subsurface contamination. There would be some uncertainty about maintaining ICs effectively over the long term. Monitoring would provide a warning of future contaminant migration. The timeframe for aquifer restoration is estimated as >5,000 years.
RTMV	6	HE and SVE would achieve modest contaminant mass removal in these subsurface conditions. Dewatering tight soils with significant silts and clays is inherently difficult. SVE can effectively remove contamination in the vadose zone where soils are permeable, but the significant thickness of the low-permeability silt formation would present challenges. Hydraulic extraction is well known for its limitations as a source removal technology, as shown by the tailing of groundwater concentrations after a few years. Based on experience with pump-and-treat at other sites, an estimated maximum of 40% to 50% of the hydrocarbon mass outside of the building footprint would be removed in 10 years of operation. This would leave significant residual contaminant mass in the addressed source area, as well as significant contaminant mass believed to be under the building. There would be proportional reduction in volumes of NAPL and NAPL-impacted soil, but benzene concentrations in groundwater are likely to be still elevated (>100 milligrams per liter [mg/L]) and a significant risk reduction is not expected. This alternative would reduce NAPL mobility somewhat, but it should be noted that NAPL mobility and saturations are already low.
STE	6	Under this alternative, extracted groundwater and vapors with high concentrations of benzene, and some explosive vapors, would be treated aboveground in close proximity to active businesses. Small releases of contaminants (within allowable regulatory limits) would occur during normal operation of the remediation system. However, emissions of a larger magnitude are possible during system construction and from process upsets during system operation that could potentially pose a risk or other impact to site occupants and the neighboring community. These contaminant releases could exceed those that might occur with Alternative 3 due to higher vapor concentrations and flow rates. The treatment of impacted groundwater

Criterion	**Rating**	**Discussion**
		(considered a RCRA hazardous waste) would be complex and would have potential for process upset conditions. Also, operation of a pump-and-treat system for 10 years would be likely to cause the unwanted migration of offsite contaminant plumes into the former plant site. This technology is moderately energy intensive and would result in emissions of about 8,580 metric tons of GHG over the operational duration that can contribute to global warming and thus impact the environment.
Implementability	6	Implementation of hydraulic extraction and SVE is technically feasible, but there would be some administrative challenges in undertaking remedial action at this source area due to the impacts of the long-term operation of this remediation system on the onsite businesses and community at large. There is a history of public opposition toward thermal treatment of extracted VOC vapors at the former plant site which may mean that thermal oxidizers are not a publicly popular option even though vendors and equipment for the SVE system with thermal oxidation are readily available. Alternate vapor treatment technologies such as resin adsorption or carbon adsorption with steam regeneration are not as widely available or as economical. The permit review IC with the City of Los Angeles has been implemented for this parcel. Some uncertainties exist regarding ICs but restrictive covenants are assumed to be negotiable, given USEPA's enforcement authority.
Cost	6	There are several uncertainties with this cost estimate resulting from uncertainties about the lateral extent of the source area, average influent hydrocarbon concentrations, and other factors. This cost estimate assumes the use of thermal oxidizers for vapor-phase treatment. The present worth cost includes a 20% contingency.

	HE+SVE[(a)]	ICs+Monitoring[(b)]	Total
Capital Cost	$1,810,000	$37,400	$1,852,400
Annual Cost	$785,000	$18,275	$803,275
Present Worth	$7,392,000	$481,000	$7,873,000

(a) $375,000/year for 10-year operation of HE, $410,000/year for 4-year operation of SVE

(b) For 100-year operation of ICs and Monitoring

Alternative 5 – ISCO + SVE + ICs + Monitoring

Criterion	**Rating**	**Discussion**
Protect Health & Environment	YES	This alternative would moderately reduce the time the groundwater containment zone is needed by removing contaminant mass. This would moderately increase long-term certainty of the groundwater protection remedy. ICs would control potential exposure to subsurface contamination

Criterion	Rating	Discussion
		and Monitoring would provide warning of any future contaminant migration. This alternative is rated adequate with respect to protection of human health and environment though it would leave significant hydrocarbon mass in the subsurface and possibly cause some NAPL migration. Also, this technology would result in emissions of about 3,680 metric tons of GHG that can contribute to global warming and thus impact the environment.
ARARs	YES	This source area is within the TI waiver zone, where compliance with chemical-specific ARARs (called ISGS in the Groundwater ROD) is not required. Aboveground treatment of the extracted benzene-impacted groundwater and benzene vapors will need to comply with action-specific ARARs including SCAQMD discharge requirements. Compliance with discharge ARARs would be a challenge but is expected to be technically feasible. Injection of large quantities of chemicals (oxidants, acids, catalysts) can impact groundwater quality and cause violations of some groundwater standards. Compliance will be required with the Los Angeles RWQCB requirements and the Waste Discharge Requirements (WDRs) for subsurface injection. Concerns such as the potential oxidation of naturally occurring metals in soils or other byproducts can usually be addressed during bench-scale testing and mitigated during implementation by adjusting the chemical injectant formulation. The state ARAR requiring restrictive covenants when waste is left in place above UU/UE levels would be met by the ICs in this alternative.
LTE	7	ISCO would remove some but not all contaminant mass (see RTMV). However, even limited source reduction in soil would reduce concentrations of benzene in groundwater in the longer term, with an associated reduction in risk. This increases the certainty of the groundwater remedy’s effectiveness in the long term. ICs would control potential exposures to subsurface contamination. There would be some uncertainty about maintaining ICs effectively over the long term. Monitoring would provide a warning of future contaminant migration. The timeframe for aquifer restoration is estimated as >5,000 years.
RTMV	6	ISCO and SVE would achieve moderate contaminant mass removal in these subsurface conditions. Based on analytical data most of the contaminant mass is in the vadose and shallow saturated zone where most of the low-permeability silts are present. Based on experience from other sites, and assuming similar chemical oxidation parameters (e.g., natural oxidant demand), an estimated 40% to 50% of the hydrocarbon mass that is outside of the building footprint would be removed in 2 years (initial event plus 4 additional rounds) of oxidant injection. This would leave significant residual contaminant mass in the addressed source area, as well as the significant

Criterion	Rating	Discussion
		contaminant mass that is assumed to lie under the building. As a result, benzene concentrations in groundwater are likely to be still elevated (>100 mg/L), and a significant risk reduction is not expected. This contaminant mass removal estimate reflects significant uncertainty about the effectiveness of ISCO in this low-permeability lithology, due to factors such as potential clogging, natural oxidant demand, etc. This alternative assumes conventional acidified Fenton's oxidation but other oxidants would need to be bench-scale or field tested for an effective comparison, if this alternative is selected for implementation at this source area. This alternative would reduce NAPL mobility somewhat, but it should be noted that NAPL mobility and saturations are already low.
STE	5	Storing and injecting strong oxidants like hydrogen peroxide can be hazardous because they cause exothermic reactions/degassing in the subsurface. Risks include potential for uncontrolled vapor migration and explosions. Explosion risks can be mitigated to some extent by modifying the remedial system using more dilute oxidant solutions and other engineering controls. Also the injection of large volumes of oxidants (up to 1.125 million gallons of 20% H_2O_2 including acids, catalysts) introduces a risk of NAPL migration by displacement. This risk is evident because the pore volume of the saturated zone where the injection occurs is estimated to be about 2 million gallons assuming a porosity of 30%. Small releases of contaminants (within allowable regulatory limits) would occur during normal operation of the remediation system. However, emissions of a larger magnitude are possible during system construction and from process upsets during system operation that could potentially pose a risk or other impact to site occupants and the neighboring community. These contaminant releases could exceed those that might occur with Alternative 3 due to higher vapor concentrations and flow rates. There is a greater potential for process upsets due to the greater complexity of the remediation system than with Alternative 3. This technology is moderately energy intensive and would result in emissions of about 3,680 metric tons of GHG over the operational duration that can contribute to global warming and thus impact the environment.
Implementability	3	Technical difficulties can be expected in injection of chemicals (oxidants, catalysts, acids) into low-permeability silts where both ROI and injection rates can be very low. Large quantities of chemicals may be needed to overcome alkalinity, natural oxidant demand, and pH buffering of groundwater. There would be potential contaminant migration from the source area. Implementation of SVE is feasible but the vacuum influence in the low-permeability silt zones will be poor. Reliability of the vapor extraction technology is uncertain in the low-permeability soils. Remedial

<table>
<tr><th>Criterion</th><th>Rating</th><th>Discussion</th></tr>
<tr><td></td><td></td><td>action at this source area would present some administrative challenges due to the impacts of the long-term operation of this remediation system on the onsite businesses and community at large. A portion of the parking area would be taken up by the fenced-in remediation system and injection wells, and this area would not be accessible to the office workers at this location. There is a history of public opposition toward thermal treatment of extracted VOC vapors at the former plant site which may mean that thermal oxidizers are not a publicly popular option even though vendors and equipment for the SVE system with thermal oxidation are readily available. Alternate vapor treatment technologies such as resin adsorption or carbon adsorption with steam regeneration are not as widely available or as economical. The permit review IC has been implemented for this parcel with the City of Los Angeles. Some uncertainties exist regarding ICs but restrictive covenants are assumed to be negotiable, given USEPA's enforcement authority.</td></tr>
<tr><td>Cost</td><td>5</td><td>There are several uncertainties with this cost estimate resulting from uncertainties about the lateral extent of the source area, natural oxidant demand, timeframe for remediation, and other factors. This cost estimate assumes the use of thermal oxidizers for vapor-phase treatment. The present worth cost includes a higher contingency of 40% for this ISCO alternative.
<table>
<tr><th></th><th>ISCO+SVE(a)</th><th>ICs+Monitoring(b)</th><th>Total</th></tr>
<tr><td>Capital Cost</td><td>$3,904,000</td><td>$37,400</td><td>$3,941,400</td></tr>
<tr><td>Annual Cost</td><td>$1,641,000</td><td>$18,275</td><td>$1,659,275</td></tr>
<tr><td>Present Worth</td><td>$10,925,000</td><td>$481,000</td><td>$11,406,000</td></tr>
</table>
(a) $1,139,000/year for 2-year operation of ISCO, $502,000/year for 4-year operation of SVE
(b) For 100-year operation of ICs and Monitoring</td></tr>
</table>

Alternative 6 – ISSH + SVE + ICs + Monitoring

Criterion	Rating	Discussion
Protect Health & Environment	YES	This alternative would significantly reduce the time the groundwater containment zone is needed by removing contaminant mass. This would significantly increase the long-term certainty of the groundwater protection remedy. ICs would control potential exposure to subsurface contamination and Monitoring would provide warning of any future contaminant migration. This alternative is rated adequate with respect to protection of human health and environment though it would leave some hydrocarbon mass in the subsurface and possibly cause NAPL or vapor migration. This technology is the most energy intensive of the alternatives and would result in emissions of about 11,000 metric tons of GHG that can contribute to global warming and thus impact the environment.
ARARs	YES	This source area is within the TI waiver zone, where compliance with chemical-specific ARARs (called ISGS in the Groundwater ROD) is not required. Aboveground treatment of the extracted benzene vapors from the heated subsurface would need to comply with action-specific ARARs including SCAQMD discharge requirements. Compliance with discharge ARARs would be a challenge but is expected to be technically feasible. As with Alternative 5, water recovered from condensed steam would need to be treated and discharged in accordance with RWQCB and NPDES requirements for storm drain discharge, which is technically feasible. Limiting subsurface heating to reduce the rate of extraction of VOCs such as benzene could overcome these technical challenges, but it would extend the treatment time and associated O&M costs. The state ARAR requiring restrictive covenants when waste is left in place above UU/UE levels would be met by the ICs in this alternative.
LTE	8	ERH would remove a significant amount but not all contaminant mass (see RTMV). This source reduction in soil would reduce concentrations of benzene in groundwater in the longer term, with an associated reduction in risk. This increases the certainty of the groundwater remedy's effectiveness in the long term. ICs would control potential exposures to subsurface contamination. There would be some uncertainty about maintaining ICs effectively over the long term. Monitoring would provide a warning of future contaminant migration. The timeframe for aquifer restoration is estimated to be between 1,000 and 4,000 years.
RTMV	8	ERH and SVE would achieve significant contaminant mass removal in these subsurface conditions, but possibly none under the building (pending future design decisions). Based on experience from other sites and assuming similar electrical resistivity parameters, an estimated 60% to 90% of the hydrocarbon mass that is outside of the building footprint would be removed

Criterion	Rating	Discussion
		in 2 years. Overall, a lower percentage of the total contaminant mass in this source area would be removed by this alternative if significant contamination is present under the building. Also, benzene concentrations in groundwater are likely to be still elevated (>50 mg/L), and there would be limited risk reduction. There are uncertainties about the effectiveness of ERH due to factors such as potential clogging, uneven heating due to subsurface heterogeneity, etc. If this active remediation approach is selected for implementation at this source area, then a laboratory-scale and field-scale pilot test would need to be conducted, after which a more precise estimate of contaminant mass removal can be obtained. The duration of the active portion of this remedy is expected to be about 2 years before reaching its cost-effectiveness limit. This alternative would reduce NAPL mobility, but it should be noted that NAPL mobility and saturations are already low.
STE	5	This alternative would use electric heating, which would release contaminant vapors at a high rate from the subsurface, increasing the challenges of aboveground vapor containment and treatment. Vapor migration would be mitigated by the sentry SVE system. Due to the high density of large diameter wells necessary, there is a greater potential for impacts to site occupants and the neighboring community during system construction compared to other alternatives. Vapor influent concentrations would be higher than other alternatives due to soil heating and, consequently, any releases from process upsets during system operation would result in short term emissions of a larger magnitude than for other alternatives. There would also be small contaminant releases (within allowable regulatory limits) during normal operation of the treatment system. Potential risks include explosions when vapor concentrations exceed the LEL, vapors escaping the vapor capture system, and toxic vapor releases to the atmosphere during process upsets. In addition, high temperatures decrease NAPL viscosity, which adds to the risk of NAPL migration. Challenges can be anticipated in complying with SCAQMD discharge requirements. This technology is also very energy intensive (using 13.5 million kWhr for soil heating) and would result in emissions of about 11,000 metric tons of GHG over a 2-year period that can contribute to global warming and thus impact the environment.
Implementability	5	ERH is technically implementable, but heating would be uneven due to the heterogeneous nature of the subsurface resulting in nonuniform temperature distribution across the remedial area. Only a limited number of vendors are available for this technology. Closely spaced extraction wells would be required to achieve the vacuum influence necessary to address the contaminants trapped in the low-permeability silts. The reliability of the vapor extraction technology under the site's lithologic conditions has some uncertainties. Remedial action at this source area presents some

Criterion	Rating	Discussion
		administrative challenges due to the impact of implementation of an aggressive, large-scale, high-density ERH and vapor extraction system in close proximity to the onsite office building. A portion of the parking area would be taken up by the fenced-in remediation system and the injection wells and would not be accessible to the onsite office workers. Loss of parking and other general nuisance impacts would be greater than for the other alternatives for onsite businesses and the community at large. There is a history of public opposition toward thermal treatment of extracted VOC vapors at the former plant site which may mean that thermal oxidizers are not a publicly popular option even though vendors and equipment for the SVE system with thermal oxidation are readily available. The permit review IC has been implemented for this parcel with the City of Los Angeles. Some uncertainties exist regarding ICs but restrictive covenants are assumed to be negotiable, given USEPA's enforcement authority.
Cost	5	There are several uncertainties with this cost estimate, the largest of which is the result of uncertainty about the lateral extent of the source area. This cost estimate assumes the use of thermal oxidizers or internal combustion engines for vapor-phase treatment. The present worth cost includes a higher contingency of 40% for this ISSH alternative.

	ERH+SVE[(a)]	ICs+Monitoring[(b)]	Total
Capital Cost	$3,420,000	$37,400	$3,457,400
Annual Cost	$2,397,000	$18,275	$2,415,275
Present Worth	$11,030,000	$481,000	$11,511,000

(a) For 2-year operation of ERH + SVE

(b) For 100-year operation of ICs and Monitoring.

9.1.2 Comparative Analysis of Alternatives

This section presents a comparative analysis of the alternatives for each of the criteria being evaluated with embedded mini-tables to compare ratings. In general, Alternative 1 fails the threshold criteria evaluation and hence is not discussed in the comparative analysis.

Overall Protection of Human Health and the Environment

As required by CERCLA for this threshold criterion, the rating for this alternative only reflects whether the alternative provides adequate protection. It does not compare the protection provided by each of these alternatives. In reality, however, there are differences in the degree and nature of protection provided by the Alternatives 2-6.

Alt(s)	Rating
2-6	YES
1	NO

Alternative 2 does not involve active remediation, but intrinsic biodegradation will slowly degrade the contaminant mass at the fringes of the dissolved-phase plume. Alternatives 3-6 are active remedial alternatives that would remove a portion of the hydrocarbon contaminant mass present in the source area but would leave significant residual hydrocarbon mass (from an estimated >70% for Alternative 3 to an estimated range of 10% to 40% for Alternative 6). Elevated concentrations of benzene in groundwater would remain after the active remediation (>100mg/L for most alternatives). However, even limited contaminant removal would shorten the time needed for aquifer restoration (from 10,500 years for Alternative 2 to a range of 1,000 to 4,000 years for Alternative 6).

Implementation of Alternatives 3-6 would cause some increased risk to human health from VOC emissions, potentially explosive conditions, vapor migration or toxic releases from possible process upsets during these aggressive remedial actions. The perception of health risk to the community/site workers from remediation can be as big an impediment as the real risk. Alternative 6 would have the greatest impact with respect to emissions of GHG, followed by Alternatives 4, 5 and 3 in decreasing order. NAPL migration is an additional risk associated with Alternatives 5 and 6. Alternatives 3-6 provide adequate protection of human health because they include ICs and Monitoring as with Alternative 2. The ICs component includes multiple layers of ICs that provide protection from shallow soil contamination and groundwater.

Compliance with ARARs

Alt(s)	Rating
2-6	YES
1	NO

The evaluation of the ability of the alternatives to comply with ARARs included a review of chemical-specific and action-specific ARARs presented in Section 4.3. SA12 is within the TI waiver zone, where compliance with chemical-specific ARARs (called ISGS in the Groundwater ROD) is not required. There are no location-specific ARARs for this source area. It is technically feasible for Alternatives 3-6 to meet all of their respective action-specific ARARs, though some alternatives may be challenging in the complexity of treating high flow rates and high concentrations of benzene vapors or treating groundwater to meet stringent discharge limits of the SCAQMD or the Los Angeles RWQCB. Also, Alternative 5 would need to meet the WDR requirements of the RWQCB for oxidant injection. The ICs in Alternatives 2-6 would meet the state ARAR requiring restrictive covenants when waste is left in place above UU/UE levels.

Long-term Effectiveness

Alt(s)	Rating
6	8
4-5	7
3	5
2	2
1	0

All of the active remedial alternatives would leave behind significant residual contamination, and would need ICs and Monitoring to provide adequate control of residual risk. Alternative 2 is rated lower than Alternatives 3-6 because it would leave more residual contamination. The timeframe for aquifer restoration is lower for the active remedial alternatives but under all alternatives it would be in the thousands of years (estimated 1,000 to 10,500 years). There would be some uncertainty about maintaining ICs effectively over the long-term.

Reduction of Toxicity, Mobility and Volume

Alt(s)	Rating
6	8
4-5	6
3	4
1-2	0

All of the active remedial alternatives would result in partial contaminant mass reduction in the addressed source area (Alternative 3: 20% to 30%; Alternative 4: 40% to 50%; Alternative 5: 40% to 50%; Alternative 6: 60% to 90%). Contaminant mass that may be present under the building can be partially addressed by remedial wells placed in proximity to the building perimeter, but significant contaminant mass would be likely to be left in place under the building. There is uncertainty in the contaminant reduction percentage range for Alternative 5 because of injection limitations in the low-permeability subsurface and due to the uncertainty in chemical oxidant design parameters. Alternative 6 also has a high uncertainty because the contaminant mass removal percentage range is based on performance of ISSH at other sites. Alternative 2 is rated "0" because it does not involve active treatment, although it would result in slow contaminant mass reduction via intrinsic biodegradation.

Short-term Effectiveness

Alt(s)	Rating
2	9
3	8
4	6
5-6	5
1	N/A

Alternative 2 involves no active remediation and would have no impact on onsite workers or community. Alternative 3 (SVE) would have moderate impacts to the facility. It is the least aggressive of the active remedial alternatives and is the lowest in risk, followed by Alternative 4 which extracts contaminants in both the vapor and liquid phases. Alternative 5 rated low because of risks due to reactivity of the oxidants in the subsurface, storage and handling issues, and potential for NAPL migration due to injection of large quantities of oxidant (up to 1.125 million gallons). Alternative 6 may cause toxic emissions during the period of treatment, and would increase the risk of hazardous conditions (e.g., explosive concentrations above LEL, toxic releases due to process upsets). Alternatives 5 and 6 are expected to have the greatest impacts with respect to contaminant releases during well installation and trenching followed by Alternatives 4 and 3. Alternative 6 is anticipated to have the greatest impact with respect to emissions of GHG, followed by Alternatives 4, 5 and 3 (refer to Appendix E-3 for more details). Vapor migration and NAPL migration are additional risks associated with Alternatives 5 and 6 and dissolved phase contamination migration could occur with Alternative 4.

Implementability

Alt(s)	Rating
1	9
2	8
3	7
4	6
6	5
5	3

Alternative 2 consists of ICs, including permit review through the City of Los Angeles, which has been implemented for the source area parcel. Some uncertainties exist regarding ICs, but it is assumed that a land use covenant can be negotiated with the property owner, given USEPA's enforcement authority. However, this assumption would need to be confirmed in discussions with property owners that are planned in the near future. Alternative 3 includes SVE which is a well-developed technology, but is expected to face some technical challenges addressing contamination in low-permeability silt zones. Alternative 4 adds hydraulic extraction which would increase the complexity of the aboveground treatment system significantly. Alternative 5 involves injecting large volumes of oxidants into low-permeability formations and has significant uncertainties in reliability. Alternative 6 involves complex, innovative electric heating technology that would require closely-spaced wells in close proximity to onsite workers. Both Alternatives 5 and 6 will need the entire remediation area and treatment compound fenced off which would impact the onsite business. Alternatives 5 and 6 are rated lower than other alternatives with Alternative 5 rated the lowest. All active remedial alternatives would be likely to face technical challenges in meeting stringent discharge standards for benzene and other ancillary chemicals and administrative challenges during implementation of the technology. There is already a history of the community taking an unfavorable stance toward extraction and treatment of VOC vapors at the Del Amo Waste Pits site, and political challenges could adversely affect implementation of such systems. The perceived risks of aboveground treatment of extracted site contaminants could adversely affect administrative implementability of Alternatives 3-6.

Cost

ICs and Monitoring costs for Alternatives 3-6 are the same as for Alternative 2, and 100-year ICs and Monitoring present worth costs are included for those alternatives. Alternatives 5 and 6 are more aggressive remedial technologies. (Alternatives 3 and 4 assume operation periods of 4 and 10 years respectively. These costs were developed from a comprehensive estimate of the capital and O&M costs, based on experience at other sites, and on a series of assumptions (as detailed in Section 7 and Appendix E). Costs for Alternatives 2, 3 and 4 include a contingency amount of 20% and costs for Alternatives 5 and 6 are considered innovative and include a contingency amount of 40%.

Alt(s)	Rating	Cost
1	9	None
2	9	$481,000
3	8	$2,551,000
4	6	$7,873,000
5	5	$11,406,000
6	5	$11,511,000

9.2 SOURCE AREA 3

This section presents the results of the 9-criteria evaluation of the remedial alternatives for SA3 located in EAPC 23 and EAPC 16. The SA3 alternatives were described in Section 7.3 and illustrated on Figures 7.3-1 through 7.3-5 located in Appendix E.

9.2.1 9-Criteria Analysis for SA3

The remedial alternatives and 9-criteria analysis for SA3 are largely similar to SA12. The presentation here references the SA12 text from Section 9.1 in order to avoid repetition. The primary differences at SA3 include:

- The contaminant is almost pure benzene, which has a higher volatility and solubility than the hydrocarbons at SA12;
- The source area extent is larger and is located outside of the building footprint;
- Groundwater contamination, though not necessarily NAPL, is expected to be present under the building;
- The source area straddles two EAPCs (23 and 16) and is located beneath driveways that are used daily by trucks associated with the onsite businesses. In addition, a truck loading dock that is in constantly use is located over the portion of SA3 that extends into EAPC 16;
- The site lithology has a higher fraction of permeable sandy soils above the water table;
- The water table is deeper (around 50 feet bgs); and,
- The benzene contamination is present to a maximum depth of approximately 90 feet bgs.

Minor differences in the contaminant mass removal estimates, aquifer restoration timeframes, and other factors are noted below. The ICs component for SA3 (EAPCs 23 and 16) includes the same IC layers 1-5 as the ICs component for SA12 (EAPC 5)[47]. The differences in cost for the active remedial alternatives are primarily due to the larger horizontal extent and soil volume for this source area. Table 9-2 summarizes the 9-criteria analysis for SA3.

Alternative 1 – No Action

Same as for SA12.

Alternative 2 – Intrinsic Biodegradation + ICs + Monitoring

Same as for SA12.

Alternative 3 – SVE/BV + ICs + Monitoring

Contaminant mass removal with SVE at SA3 was projected to be higher than at SA12, because the contaminant composition is almost pure benzene which is more volatile than the contaminants at SA12. Also, because of a larger fraction of permeable soils in the deep vadose zone, estimated mass reduction is higher at SA3 (30% to 40%) than at SA12 (20% to 30%). Active SVE remediation would still leave significant residual contamination (60% to 70%) at SA3 with the aquifer restoration timeframe estimated to be greater than 6,000 years.

Alternative 4 – Hydraulic Extraction + SVE/BV + ICs + Monitoring

The primary difference from the SA12 evaluation is the estimated mass reduction (50% to 60% vs. 40% to 50% at SA12) and associated cost. A slightly higher contaminant mass removal was projected with this alternative at SA3 because benzene is more volatile and soluble than the mix of hydrocarbon contaminants at SA12. This active remediation would still leave significant residual contamination (40% to 50%), with the aquifer restoration timeframe estimated to be greater than 4,000 years.

Alternative 5 – ISCO + SVE + ICs + Monitoring

The primary difference from the SA12 evaluation is the estimated mass reduction (50% to 60% vs. 40% to 50% at SA12) and associated cost. As described above, a slightly higher mass reduction in the vadose zone was projected for the SVE component. Active remediation would still leave significant residual contamination (40% to 50%) with the aquifer restoration timeframe estimated to be greater than 4,000 years. Approximately 2.88 million gallons of oxidant (acidified Fenton's process using H_2O_2, catalyst, acids) would be injected into SA3 to implement this alternative.

Alternative 6 – ISSH + SVE + ICs + Monitoring

The estimated contaminant mass removal by this alternative is 60% to 90%, which is the same as for SA12. This active remediation would still leave significant residual contamination (10% to 40%), with

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[47] IC layer 4 includes 4A or 4A+4B as discussed in Section 5 and for the purposes of this section they are considered the same IC layer.

the aquifer restoration timeframe estimated to be in the range of 1,000 to 4,000 years. Approximately 34.7 million kWhr of electricity is estimated to be used at SA3 for soil heating with this alternative.

9.2.2 Comparative Analysis of Alternatives

This section presents a comparative analysis of the alternatives for each of the criteria being evaluated with embedded mini-tables to compare ratings.

Overall Protection of Human Health and Environment

Alternative 2 is a passive remedial option but includes ICs and Monitoring to protect human health and the environment. It would be effective because groundwater concentrations are holding steady or decreasing, and NAPL saturations are low, making NAPL migration unlikely. Alternatives 3-6 are active remedial alternatives that would remove a portion of the hydrocarbon contaminant mass and include ICs and Monitoring to provide long-term protection. Alternative 6 has the greatest impact with respect to generation of GHG, followed by Alternatives 4, 5 and 3 in decreasing order.

Alt(s)	Rating
2-6	YES
1	NO

Compliance with ARARs

Alternatives 3-6 would meet action-specific and chemical-specific ARARs. However, challenges can be anticipated in meeting benzene vapor discharge requirements from SCAQMD with SVE, benzene discharge requirements for water from RWQCB requirements and WDR requirements for chemical injection from the RWQCB. There are no location-specific ARARs. SA3 is within the TI waiver zone, where compliance with chemical-specific ARARs (called ISGS in the Groundwater ROD) is not required. Alternatives 2-6 would meet the state ARAR requiring restrictive covenants when waste is left in place above UU/UE levels.

Alt(s)	Rating
2-6	YES
1	NO

Long-term Effectiveness

All of the active remedial alternatives (Alternatives 3-6) would leave behind significant residual contamination (see RTMV), and would need ICs and Monitoring to provide adequate control of residual risk. Alternative 2 is rated lower than the active remedial alternatives because it would leave more residual contamination. The timeframe for aquifer restoration is lower for the active remedial alternatives but under all alternatives it would be in the thousands of years (estimated 1,000 to 10,500 years). There would be some uncertainty about maintaining ICs effectively over the long term.

Alt(s)	Rating
6	8
4-5	7
3	5
2	2
1	0

Reduction of Toxicity, Mobility and Volume

All of the active remedial alternatives would result in partial contaminant mass reduction in the addressed source area (Alternative 3: 30% to 40%; Alternatives 4 and 5: 50% to 60%; Alternative 6: 60% to 90%). Alternative 2 does not involve active treatment, although it would result in slow contaminant mass reduction via intrinsic biodegradation.

Alt(s)	Rating
6	8
4-5	7
3	5
1-2	0

Short-term Effectiveness

Alt(s)	Rating
2	9
3	8
4	6
5-6	5
1	N/A

Alternative 2 involves no active remediation and would cause no impacts to onsite workers or community. Alternative 3 (SVE) would have some small impacts on the onsite workers and community due to potential chemical releases during installation and operation. Alternative 4 has higher risk, and the pump-and-treat system could also cause undesired migration of offsite contaminants (e.g., TCE sources that are upgradient) into the former plant site. Alternative 5 rated low because of risks due to reactivity of the oxidants in the subsurface, storage and handling issues, and potential for NAPL migration due to injection of large quantities of oxidant. Alternative 6 may cause toxic emissions during the period of treatment, and would increase the risk of hazardous conditions (e.g., explosive concentrations above LEL, toxic releases due to process upsets). Alternatives 5 and 6 are expected to have the greatest impact with respect to contaminant releases during system installation followed by Alternatives 4 and 3. Alternative 6 would have the greatest impact with respect to release of GHG, followed by Alternatives 4, 5 and 3 in decreasing order (refer to Appendix E-3 for estimates). Vapor migration and NAPL migration are additional risks associated with Alternatives 5 and 6.

Implementability

Alt(s)	Rating
1	9
2	8
3	7
4	6
5-6	4

Alternative 2 consists of ICs, including permit review through the City of Los Angeles, which has been implemented for the two parcels in which the source area is located. Some uncertainties exist regarding ICs, but it is assumed that a land use covenant can be negotiated with the property owner. Alternative 3 (SVE) is rated lower because of anticipated challenges with vapor treatment at this location. Alternative 4 (HE+SVE) has greater technical complexity and would pose greater technical and administrative challenges. Alternatives 5 and 6 have both high complexity and greater potential to impact onsite businesses, and therefore they are rated lowest. Implementation of Alternatives 5 and 6 may face significant administrative challenges due to resistance from the property owners or onsite business tenants at the two impacted properties (EAPC 23, EAPC 16) because the remediation area, located in heavily used driveways and loading docks, would need to be fenced off for the duration of the ISCO or ERH treatment (assumed 2 years).

Cost

Alt(s)	Rating	Cost
1	9	None
2	9	$481,000
3	8	$4,000,000
4	5	$11,965,000
5	2	$23,279,000
6	2	$21,322,000

ICs and Monitoring costs for Alternatives 3-6 are the same as for Alternative 2, and 100-year ICs and Monitoring present worth costs are included for those alternatives. The more aggressive remedial technologies (Alternatives 5 and 6) would operate for shorter periods than the other active alternatives (Alternatives 3 and 4), and costs were estimated accordingly. Costs for Alternatives 2, 3 and 4 include a contingency amount of 20% and costs for Alternatives 5 and 6 include a contingency amount of 40%.

9.3 SOURCE AREA 6

This section presents the results of the 9-criteria evaluation of the remedial alternatives for SA6 located in EAPC 23. The SA6 alternatives were described in Section 7.4 and illustrated on Figures 7.4-1 through 7.4-5 located in Appendix E.

9.3.1 9-Criteria Analysis for SA6

The remedial alternatives and 9-criteria analysis for SA6 are similar to SA12. The primary differences at SA6 include:

- Contamination is a combination of benzene and ethylbenzene, without a significant fraction of heavier hydrocarbons as in SA12;
- The site lithology has a slightly higher fraction of permeable sandy soils above the water table; and,
- The water table is deeper (around 50 feet bgs).

SA6 is in the same EAPC (23) as SA3, with some important differences:

- NAPL at SA6 is at residual saturations, with a lower hydrocarbon contaminant mass;
- SA6 lies adjacent to and partially under the property's main building; and,
- Based on the ROST profile, more contaminant mass is contained in the vadose zone.

For the ISCO alternative, peroxone (peroxide and ozone) injection was assumed because it is a less aggressive technology and typically has less severe environmental impacts than acidified Fenton's. The less aggressive peroxone injection was deemed appropriate because NAPL saturation levels at SA6 are lower than at SA3 or SA12. The ICs component for SA6 (EAPC 23) includes the same IC layers 1-5 as the ICs component for SA12 (EAPC 5)[48]. For this FS evaluation, only the source area extent outside the building footprint is considered for active remediation. However, some of the technologies such as SVE or hydraulic extraction would influence contamination below the building over a period of time. Minor differences in the contaminant mass removal estimates, aquifer restoration timeframes, etc. are noted below. Table 9-3 summarizes the 9-criteria analysis for SA6.

Alternative 1 – No Action

Same as for SA12

Alternative 2 – Intrinsic Biodegradation + ICs + Monitoring

The Intrinsic Biodegradation, ICs and Monitoring components are the same as for SA12. The aquifer restoration timeframe is assumed to be the same as for SA12.[49] The only difference noted in the evaluation is that the LTE of this alternative is rated higher because this source area has NAPL at lower residual saturations implying a lower mass of NAPL contamination present than at SA12.

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[48] IC layer 4 includes 4A or 4A+4B as discussed in Section 5 and for the purposes of this section they are considered the same IC layer.

[49] Aquifer restoration timeframe was estimated based on modeling for SA3 (MW-20 Pilot Study). Other source areas (SA12, SA6, SA11 and SA9) are assumed to have similar timeframes. However, for SA6, SA11 and SA9 this assumption may be less reliable because of the lower saturation levels and contaminant mass. More reliable restoration timeframe estimates could be derived following more detailed characterization of these source areas.

Alternative 3 – SVE/BV + ICs + Monitoring

A higher fraction of contaminant mass removal was projected with SVE at SA6 (30% to 40% vs. 20% to 30% at SA12) because the contamination is composed of lighter hydrocarbons including benzene and ethylbenzene, which are more volatile than the mix of contaminants at SA12. Contaminant mass removal would also be higher than at SA12 because a higher proportion of the contaminant mass is contained in the vadose zone. Active SVE remediation would still leave significant residual contamination (60% to 70%), with the aquifer restoration timeframe estimated to be greater than 6,000 years.

Alternative 4 – Hydraulic Extraction + SVE/BV + ICs + Monitoring

A higher contaminant mass removal was projected with this alternative at SA6 (50% to 60% vs. 40% to 50% at SA12) because the contamination is composed of benzene and ethylbenzene, which are more volatile and soluble than the mix of hydrocarbon contaminants at SA12. Also, there is a larger zone of permeable sandy soils above the water table at SA6, increasing the effectiveness of the technology. This active remediation would still leave significant residual contamination (40% to 50%), with the aquifer restoration timeframe estimated to be greater than 4,000 years.

Alternative 5 - ISCO+ SVE + ICs + Monitoring

Peroxone injection was assumed instead of the acidified Fenton's approach used at SA12. Mass reduction with this remedial alternative would be 50% to 60%. Active remediation would still leave significant residual contamination (40-50%), with the aquifer restoration timeframe estimated to be greater than 4,000 years. A total of 484,000 gallons of hydrogen peroxide and 36,000 lbs of ozone would be injected into SA6 to implement this alternative. These are generally lower dosages of oxidant than used at SA12 or SA3, because of the lower hydrocarbon mass assumed to be present here.

Alternative 6 – ISSH + SVE + ICs + Monitoring

The estimated contaminant mass removal by this alternative is 60% to 90%, which is the same as for SA12. This active remediation would still leave significant residual contamination (10% to 40%) with the aquifer restoration timeframe estimated to be in the range of 1,000 to 4,000 years. Approximately 13.8 million kWhr of electricity is estimated to be used for soil heating at SA6 with this alternative.

9.3.2 Comparative Analysis of Alternatives

This section presents a comparative analysis of the alternatives for each of the criteria being evaluated with embedded mini-tables to compare ratings.

Overall Protection of Human Health and Environment

Alt(s)	Rating
2-6	YES
1	NO

Alternative 2 is a passive remedial option but includes ICs and Monitoring to protect human health and the environment. It would be effective because groundwater concentrations are holding steady or decreasing, and NAPL saturations are low, making NAPL migration unlikely. Alternatives 3-6 are active remedial alternatives that would remove a portion of the hydrocarbon contaminant mass and include ICs and Monitoring to provide long-term protection. Alternative 6 would have the greatest impact with respect to emission of GHG, followed by Alternatives 4, 5 and 3 in decreasing order.

Compliance with ARARs

Alt(s)	Rating
2-6	YES
1	NO

Alternatives 3-6 would meet action-specific and chemical-specific ARARs. However, challenges can be anticipated in meeting benzene vapor discharge requirements from SCAQMD with SVE, benzene discharge requirements for water from RWQCB requirements and WDR requirements for chemical injection from the RWQCB. There are no location-specific ARARs. SA6 is within the TI waiver zone, where compliance with chemical-specific ARARs (called ISGS in the Groundwater ROD) is not required. Alternatives 2-6 would meet the state ARAR requiring restrictive covenants when waste is left in place above UU/UE levels.

Long-term Effectiveness

Alt(s)	Rating
6	8
4-5	7
3	5
2	4
1	0

All of the active remedial alternatives (Alternatives 3-6) would leave behind significant residual contamination (see RTMV), and would need ICs and Monitoring to provide adequate control of residual risk. Alternative 2 is rated lower than the active remedial alternatives because it would leave more residual contamination. The timeframe for aquifer restoration is lower for the active remedial alternatives but under all alternatives it would be in the thousands of years (estimated 1,000 to 10,500 years). There would be some uncertainty about maintaining ICs effectively over the long-term.

Reduction of Toxicity, Mobility and Volume

Alt(s)	Rating
6	8
4-5	7
3	5
1-2	0

All of the active remedial alternatives would result in partial contaminant mass reduction in the addressed source area (Alternative 3: 30% to 40%; Alternatives 4 and 5: 50% to 60%; Alternative 6: 60% to 90%). Contaminant mass that may be present under the building can be partially addressed by remedial wells placed in proximity to the building perimeter, but significant contaminant mass would be likely to be left in place under the building. The percentage of mass removed could be lower due to the likely presence of contamination below the building. Alternative 2 does not involve active treatment, although it would result in slow contaminant mass reduction via intrinsic biodegradation.

Short-term Effectiveness

Alt(s)	Rating
2	9
3	8
4, 6	6
5	5
1	N/A

Alternative 2 does not involve active remediation and would not impact onsite workers or the community. Alternative 3 (SVE) would have moderate impacts to the facility and other businesses in the vicinity. Alternatives 4-6 are more aggressive remediation approaches and thus have higher risks for human health and environment. Due to well installation trenching and system operation, Alternatives 5 and 6 are expected to have the greatest impacts with respect to contaminant releases, followed by Alternatives 4 and 3. Alternatives 4-6 may also cause contaminant migration, for which Alternative 5 is likely to have the greatest impact on the environment. Alternative 6 would have the greatest impact with respect to emissions of GHG, followed by Alternatives 4, 5 and 3 in decreasing order (refer to Appendix E-3 for emission estimates).

Implementability

Alternative 2 consists of ICs, including permit review through the City of Los Angeles, which has been implemented for this parcel. Some uncertainties exist regarding ICs, but it is assumed that a land use covenant can be negotiated with the property owner. Alternative 3 (SVE) is rated lower because of anticipated administrative challenges with implementation. Alternative 4 (HE+SVE) has greater technical complexity and would pose greater technical and administrative challenges. Alternatives 5 and 6 have both high complexity and greater potential to impact onsite business. The impacted area at this source area is close to the main entrance of the office portion of the warehouse building. Fencing off the remediation area and treatment compound would likely be a significant impact on the facility. Hence, Alternatives 5 and 6 would pose significant administrative challenges and are rated the lowest.

Alt(s)	Rating
1	9
2	8
3	7
4	6
5-6	4

Cost

ICs and Monitoring costs for Alternatives 3-6 are the same as for Alternative 2, and 100-year ICs and Monitoring present worth costs are included for those alternatives. The more aggressive remedial technologies (Alternatives 5 and 6) would operate for shorter periods than the other active alternatives (Alternatives 3 and 4), and costs were estimated accordingly. Costs for Alternatives 2-6 include contingency costs.

Alt(s)	Rating	Cost
1	9	None
2	9	$481,000
3	8	$3,040,000
4	6	$8,934,000
5	4	$12,577,000
6	4	$14,396,000

9.4 SOURCE AREA 11

This section presents the results of the 9-criteria evaluation of the remedial alternatives for SA11 located in EAPCs 6, 9 and 15. The SA11 alternatives were described in Section 7.5 and illustrated on Figures 7.5-1 through 7.5-5 located in Appendix E.

9.4.1 9-Criteria Analysis for SA11

The remedial alternatives and 9-criteria analysis for SA11 are similar to SA12. The primary difference at SA11 is that the contaminant here is a benzene plume without a significant fraction of heavier hydrocarbons. For this FS evaluation, only the source area extending outside the building footprint is considered for active remediation. However, some of the technologies such as SVE or hydraulic extraction will influence contamination below the building over a period of time. For the ISCO technology, peroxone injection was assumed as for SA6. The ICs component for SA11 (EAPCs 6, 9 and 15) includes the same IC layers 1-5 as the ICs component for SA12 (EAPC 5). Minor differences in the contaminant mass removal estimates, aquifer restoration timeframes, etc. are noted in the discussion below. Table 9-4 summarizes the 9-criteria analysis for SA11.

Alternative 1 – No Action

Same as for SA12

Alternative 2 – Intrinsic Biodegradation + ICs + Monitoring

The Intrinsic Biodegradation, ICs and Monitoring components are the same as for SA12. The aquifer restoration timeframe is assumed to be the same as for SA12. The only difference noted in the evaluation is that the LTE for this alternative is rated higher because this source area has NAPL at residual saturations implying a lower mass of NAPL contamination present than at SA12.

Alternative 3 – SVE/BV + ICs + Monitoring

A higher fraction of contaminant mass removal was projected with SVE at SA11 (30% to 40% vs. 20% to 30% at SA12) because the contamination is composed primarily of benzene, which is more volatile than the mix of contaminants at SA12. Active SVE remediation would still leave significant residual contamination (60% to 70%), with the aquifer restoration timeframe estimated to be greater than 6,000 years.

Alternative 4 – Hydraulic Extraction + SVE/BV + ICs + Monitoring

A higher contaminant mass removal was projected with this alternative at SA11 (50% to 60% vs. 40% to 50% at SA12) because the contamination is composed primarily of benzene, which is more volatile and soluble than the mix of hydrocarbon contaminants at SA12. This active remediation would still leave significant residual contamination (40% to 50%), with the aquifer restoration timeframe estimated to be greater than 4,000 years.

Alternative 5 - ISCO+ SVE + ICs + Monitoring

Peroxone injection was assumed for SA11 as for SA6. Mass reduction with this remedial alternative is estimated to be 50% to 60%. The contaminant mass removal would be higher than at SA12 because of a greater proportion of permeable soil zones favorable for SVE and ISCO. Active remediation would still leave significant residual contamination (40% to 50%), with the aquifer restoration timeframe estimated to be greater than 4,000 years. A total of 604,000 gallons of hydrogen peroxide and 45,000 lbs of ozone would be injected into SA11 to implement this alternative.

Alternative 6 – ISSH + SVE + ICs + Monitoring

The estimated contaminant mass removal by this alternative is 60% to 90%, which is the same as for SA12. This active remediation would still leave significant residual contamination (10% to 40%), with the aquifer restoration timeframe estimated to be in the range of 1,000 to 4,000 years. Approximately 17 million kWhr of electricity is estimated to be used for soil heating at SA11 with this alternative.

9.4.2 Comparative Analysis of Alternatives

This section presents a comparative analysis of the alternatives for each of the criteria being evaluated with embedded mini-tables to compare ratings.

Overall Protection of Human Health and Environment

Alt(s)	Rating
2-6	YES
1	NO

Alternative 2 is a passive remedial option but includes ICs and Monitoring to protect human health and the environment. It would be effective because groundwater concentrations are holding steady or decreasing, and NAPL saturations are low, making NAPL migration unlikely. Alternatives 3-6 are active remedial alternatives that would remove a portion of the hydrocarbon contaminant mass and include ICs and Monitoring to provide long-term protection. Alternative 6 would have the greatest impact with respect to emission of GHG, followed by Alternatives 4, 5 and 3 in decreasing order.

Compliance with ARARs

Alt(s)	Rating
2-6	YES
1	NO

Alternatives 3-6 would meet action-specific and chemical-specific ARARs. However, challenges can be anticipated in meeting benzene vapor discharge requirements from SCAQMD with SVE, benzene discharge requirements for water from RWQCB requirements and WDR requirements for chemical injection from the RWQCB. There are no location-specific ARARs. SA11 is within the TI waiver zone, where compliance with chemical-specific ARARs (called ISGS in the Groundwater ROD) is not required. Alternative 2 would meet the state ARAR requiring restrictive covenants when waste is left in place above UU/UE levels.

Long-term Effectiveness

Alt(s)	Rating
6	8
4-5	7
3	5
2	4
1	0

All of the active remedial alternatives would leave behind significant residual contamination (see RTMV), and would need ICs and Monitoring to provide adequate control of residual risk. Alternative 2 is rated lower than the active remedial alternatives because it would leave more residual contamination. The timeframe for aquifer restoration is lower for the active remedial alternatives but under all alternatives it would be in the thousands of years (estimated 1,000 years to 10,500 years). There would be some uncertainty about maintaining ICs effectively over the long-term.

Reduction of Toxicity, Mobility and Volume

Alt(s)	Rating
6	8
4-5	7
3	5
1-2	0

All of the active remedial alternatives would result in partial contaminant mass reduction in the addressed source area (Alternative 3: 30% to 40%; Alternatives 4 and 5: 50% to 60%; Alternative 6: 60% to 90%). Contaminant mass that may be present under the building can be partially addressed by remedial wells placed in proximity to the building perimeter, but significant contaminant mass would be likely to be left in place under the building. The percentage of contaminant mass removed could be lower due to the likely presence of contamination below the building. Alternative 2 does not involve active treatment, although it would result in slow contaminant mass reduction via intrinsic biodegradation.

Short-term Effectiveness

Alt(s)	Rating
2	9
3	8
4, 6	6
5	5
1	N/A

Alternative 2 does not involve active remediation and would not impact onsite workers or the community. Alternative 3 (SVE) would have moderate impacts to onsite workers and the community. Alternatives 4-6 are more aggressive remediation approaches and thus have higher risks for human health and the environment. Due to well installation trenching and system operation, Alternatives 5 and 6 are expected to have the greatest impact with respect to contaminant releases, followed by Alternatives 4 and 3.

Alternatives 4-6 may also cause contaminant migration, for which Alternative 5 is likely to have the greatest impact on the environment. Alternative 6 would have the greatest impact with respect to emissions of GHG, followed by Alternatives 4, 5 and 3 in decreasing order (refer to Appendix E-3 for emission estimates).

Implementability

Alt(s)	Rating
1	9
2	8
3	7
4	6
5-6	4

Alternative 2 consists of ICs, including permit review through the City of Los Angeles which has been implemented for this parcel. Some uncertainties exist regarding ICs, but it is assumed that a land use covenant can be negotiated with the property owner. Alternative 3 (SVE) is rated lower because of anticipated technical and administrative challenges with vapor treatment. Alternatives 4-6 have greater technical complexity and hence greater challenges. Alternatives 5 and 6 would significantly impact the onsite businesses, because the impacted area is in close proximity to the building footprint and fencing it off might limit building access. There would also be loss of parking areas. Alternatives 5 and 6 would pose significant administrative challenges and hence are rated the lowest. All active remedial alternatives would face challenges with well and piping installation in the northern portion of the source area (in EAPC 15) due to the presence of pipelines and high voltage power lines in the utility corridor.

Cost

Alt(s)	Rating	Cost
1	9	None
2	9	$481,000
3	8	$3,072,000
4	6	$9,835,000
5	4	$15,377,000
6	4	$15,013,000

ICs and Monitoring costs for Alternatives 3-6 are the same as for Alternative 2, and 100-year ICs and Monitoring present worth costs are included for those alternatives. The more aggressive remedial technologies (Alternatives 5 and 6) would operate for shorter periods than the other active alternatives (Alternatives 3 and 4), and costs were estimated accordingly. Costs for Alternatives 2-6 include contingency costs.

9.5 SOURCE AREA 9

This section presents the results of the 9-criteria evaluation of the remedial alternatives for SA9 located on EAPC 24. The SA9 alternatives were described in Section 7.6 and illustrated on Figures 7.6-1 through 7.6-5 located in Appendix E.

9.5.1 9-Criteria Analysis for SA9

SA9 is a potential NAPL area (i.e., no NAPL has been observed) identified based on dissolved groundwater VOC concentrations. This source area is characterized by a benzene plume without a significant fraction of heavier hydrocarbons. The source area in soil has not been defined at this area, but for this FS evaluation, the extent of the source area is assumed based on the location of the former plant's storage tank and piping. A significant portion of the former storage tank is under the existing building, but the addressed source area is assumed only in outdoor soil. The impacted extent of SA9 is beneath an actively used loading dock. If the selected remedy caused the dock to be inaccessible, it would significantly impact the onsite business. The remedial alternatives and 9-criteria analysis for SA9 are similar to SA12. The ICs component for SA9 (EAPC 24) include the same IC layers 1-5 as for SA12 (EAPC 5). Minor differences in the contaminant mass removal estimates, aquifer restoration timeframes, etc. are noted below. Table 9-5 summarizes the 9-criteria analysis for SA9.

Alternative 1 – No Action

Same as for SA12

Alternative 2 – Intrinsic Biodegradation + ICs + Monitoring

The Intrinsic Biodegradation, ICs and Monitoring components are the same as for SA12. The aquifer restoration timeframe is assumed to be the same as for SA12. The only difference noted in the evaluation is that the LTE for this alternative is rated higher because this is a potential NAPL source area likely to have lower residual saturations and a lower mass of NAPL contamination present than at SA12.

Alternative 3 – SVE/BV + ICs + Monitoring

The estimated mass reduction with this remedial alternative is 30% to 40%. Active SVE remediation would still leave significant residual contamination (60% to 70%), with the aquifer restoration timeframe estimated to be greater than greater than 4,000 years.

Alternative 4 – Hydraulic Extraction + SVE/BV + ICs + Monitoring

A higher contaminant mass removal was projected with this alternative at SA9 (50% to 60%) than for SA12 because the contamination is composed primarily of benzene, which is more volatile and soluble than the mix of hydrocarbon contaminants at SA12. This active remediation would still leave significant residual contamination (40% to 50%), with the aquifer restoration timeframe estimated to be greater than 4,000 years.

Alternative 5 – ISCO + SVE + ICs + Monitoring

Peroxone injection was assumed for SA9 as for SA6. Mass reduction with this remedial alternative is estimated to be 50% to 60%. The contaminant mass removal would be higher because of a greater proportion of permeable soil zones that is favorable for SVE and ISCO. Active remediation would still leave significant residual contamination (40% to 50%), with the aquifer restoration timeframe estimated to be greater than 5,000 years. A total of 448,000 gallons of hydrogen peroxide and 34,000 lbs of ozone would be injected into SA9 to implement this alternative.

Alternative 6 – ISSH + SVE + ICs + Monitoring

The estimated contaminant mass removal by this alternative is 60% to 90%, which is the same as for SA12. This active remediation would still leave significant residual contamination (10% to 40%), with the aquifer restoration timeframe estimated to be in the range of 1,000 to 4,000 years. Approximately 11.8 million kWhr of electricity is estimated to be used for soil heating at SA9 with this alternative.

9.5.2 Comparative Evaluation of Alternatives

This section presents a comparative analysis of the alternatives for each of the criteria being evaluated with embedded mini-tables to compare ratings.

Overall Protection of Human Health and Environment

Alt(s)	Rating
2-6	YES
1	NO

Alternative 2 is a passive remedial option but includes ICs and Monitoring to protect human health and the environment. It would be effective because groundwater concentrations are holding steady or decreasing, and NAPL saturations are low, making NAPL migration unlikely. Alternatives 3-6 are active remedial alternatives that would remove a portion of the hydrocarbon contaminant mass and include ICs and Monitoring to provide long-term protection. Alternative 6 would have the greatest impact with respect to emission of GHG, followed by Alternatives 4, 5 and 3 in decreasing order.

Compliance with ARARs

Alt(s)	Rating
2-6	YES
1	NO

Alternatives 3-6 would meet action-specific and chemical-specific ARARs. However, challenges can be anticipated in meeting benzene vapor discharge requirements from SCAQMD with SVE, benzene discharge requirements for water from RWQCB requirements and WDR requirements for chemical injection from the RWQCB. There are no location-specific ARARs. SA9 is within the TI waiver zone, where compliance with chemical-specific ARARs (called ISGS in the Groundwater ROD) is not required. Alternatives 2-6 would meet the state ARAR requiring restrictive covenants when waste is left in place above UU/UE levels.

Long-term Effectiveness

Alt(s)	Rating
6	8
4-5	7
3	5
2	4
1	0

All of the active remedial alternatives would leave behind significant residual contamination (see RTMV), and would need ICs and Monitoring to provide adequate control of residual risk. Alternative 2 is rated lower than the active remedial alternatives because it would leave more residual contamination. The timeframe for aquifer restoration is lower for the active remedial alternatives but under all alternatives it would be in the thousands of years (estimated 1,000 years to 10,500 years). There would be some uncertainty about maintaining ICs effectively over the long-term.

Reduction of Toxicity, Mobility and Volume

Alt(s)	Rating
6	8
4-5	7
3	5
1-2	0

All of the active remedial alternatives would result in partial contaminant mass reduction in the addressed source area (Alternative 3: 30% to 40%; Alternatives 4 and 5: 50% to 60%; Alternative 6: 60% to 90%). Contaminant mass that may be present under the building can be partially addressed by remedial wells placed in proximity to the building perimeter, but significant contaminant mass would be likely to be left in place under the building. The percentage of contaminant mass removed could be lower due to the likely presence of contamination below the building. Alternative 2 does not involve active treatment, although it would result in slow contaminant mass reduction via intrinsic biodegradation.

Short-term Effectiveness

Alt(s)	Rating
2	9
3	8
4, 6	6
5	5
1	N/A

Alternative 2 does not involve active remediation and would not impact onsite workers or the community. Alternative 3 (SVE) would have some small impacts to the onsite workers and community. Alternatives 4-6 are more aggressive remediation approaches and thus have higher risks. The most aggressive technologies (Alternatives 5 and 6) would be likely to pose a moderate risk to onsite workers and the community due to the close proximity of the remediation area to the building and loading dock. A portion of the loading dock would also need to be fenced off. Alternatives 4-6 may also cause contaminant migration, for which Alternative 5 is likely to have the greatest impact on the environment. Alternative 6 is judged to have the greatest impact with respect to emission of GHG, followed by Alternatives 4, 5 and 3 in decreasing order (refer to Appendix E-3 for emission estimates).

Implementability

Alt(s)	Rating
1	9
2	8
3	6
4	5
5-6	4

Alternative 2 consists of ICs, including permit review through the City of Los Angeles, which has been implemented for this parcel. Some uncertainties exist regarding ICs, but it is assumed that a land use covenant can be negotiated with the property owner. Alternatives 3 and 4 are rated lower than SA12 because of anticipated challenges with remediation at the actively operating loading dock at SA9. Also, if a portion of the source area contamination is below the building, then installation of horizontal wells would pose challenges. Alternatives 4-6 have greater technical complexity and hence greater implementation challenges. Alternatives 5 and 6 would significantly impact the onsite business because they would take a portion of the loading dock out of service. Alternatives 5 and 6 would pose significant administrative challenges and hence are rated the lowest.

Cost

Alt(s)	Rating	Cost
1	9	None
2	9	$481,000
3	8	$2,795,000
4	6	$9,015,000
5	5	$11,967,000
6	5	$12,157,000

ICs and Monitoring costs for Alternatives 3-6 are the same as for Alternative 2, and 100-year ICs and Monitoring present worth costs are included for those alternatives. The more aggressive remedial technologies (Alternatives 5 and 6) would operate for shorter periods than the other active alternatives (Alternatives 3 and 4), and costs were estimated accordingly. Costs for Alternatives 2-6 include contingency costs.

9.6 SOURCE AREA 4

This section presents the results of the 9-criteria evaluation of the remedial alternatives for SA4 located in EAPC 28. The SA4 alternatives were described in Section 7.7 and illustrated on Figures 7.7-1 through 7.7-3 located in Appendix E. As discussed in Section 7, SA4 is a potential source area that is assumed to be entirely under the building on the property.

9.6.1 9-Criteria Analysis for SA4

SA4 is identified as a potential NAPL area based on elevated dissolved-phase concentrations of benzene and ethylbenzene in downgradient monitoring wells (WPL0002, XMW-21, CWL0012, and CWL0001). There is a large warehouse-type building which covers a significant portion of the property. The site lithology is assumed to be similar to other source areas in the vicinity (SA3) with the contamination largely residing in the UBF. The estimated lateral extent of the groundwater contamination source area for purposes of the FS is assumed to lie entirely under the building, based on the former facility location (Figure 7.7-1 located in Appendix E). The source area is estimated to be approximately 16,100 SF with an impacted soil volume of about 39,000 CY. As with other source areas, the depth of contamination is assumed to be between 15 and 80 feet bgs. The water table is present at about 40 feet bgs. As discussed in Section 7.7.3, Alternatives 3 and 4 were evaluated for two scenarios. The first assumed the use of horizontal remediation wells under the building due to access limitations within the building interior. The second scenario assumed full access to the building interior and therefore included vertical remediation wells within the building footprint.

The 9-criteria evaluation text is presented below in tabular form as presented earlier for SA12. The evaluation is presented briefly by comparing with the SA12 evaluation and noting the differences. Table 9-6 summarizes the 9-criteria analysis for SA4.

Alternative 1 – No Action

Same as for SA12.

Alternative 2 – Intrinsic Biodegradation + ICs + Monitoring

The Intrinsic Biodegradation, ICs and Monitoring components are the same as for SA12. The aquifer restoration timeframe is assumed to be the same as for SA12. The only difference noted in the evaluation is that the LTE for this alternative is rated higher because this is a potential NAPL source area likely to have lower residual saturations and a lower mass of NAPL contamination present than at SA12. The cost for this alternative is the same as for SA12.

Alternative 3 – SVE/BV (UB) + ICs + Monitoring

The primary difference between SA4 and SA12 is that contaminant removal is expected to be less effective at SA4, as the fraction of the residual contaminant mass left after remediation would be higher at SA4. Because it is inherently difficult to characterize the contamination extent under the building, the horizontal wells approach may not be as effective as the outdoor soil SVE. Also, installation of the horizontal wells under the building is expected to pose significant implementation challenges, as discussed in Section 5.

Criterion	Rating	Discussion
LTE	5	LTE would be the same as for SA12 with partial mass removal. There would be some uncertainty about maintaining ICs effectively over the long term. The timeframe for aquifer restoration is >8,000 years assuming the MW-20 modeling results are applicable to SA4.

<table>
<tr><th>Criterion</th><th>Rating</th><th>Discussion</th></tr>
<tr><td>RTMV</td><td>3</td><td>RTMV would be poorer than for SA12 due to challenges with characterization. If the horizontal wells are not positioned in the most appropriate location, contaminant mass removal could be in the range of 15% to 20% as compared to 20% to 30% for SA12.</td></tr>
<tr><td>STE</td><td>7</td><td>STE is rated lower than for SA12 due to impacts on the facility and workers during horizontal well installation and system operation. There could be larger contaminant releases or other adverse impacts during upsets of the remedial system. This alternative would result in 2,560 metric tons of GHG emissions, more than for SA12.</td></tr>
<tr><td>Implementability</td><td>4</td><td>Implementability is rated significantly lower than for Alternative 3 for SA12 because of the challenges of the horizontal well installation. The blind-drilling (single completion) method is assumed because of the presence of large buildings on the property and limited available land for conducting the double-completion (surface-to-surface completion) method. Also, the treatment compound is likely to be located in close proximity to the truck loading dock and may hinder loading operations at this facility. The permit review IC has been implemented for this parcel with the City of Los Angeles. Some uncertainties exist regarding ICs but restrictive covenants are assumed to be negotiable, given USEPA's enforcement authority.</td></tr>
<tr><td>Cost</td><td>8</td><td>
<table>
<tr><th></th><th>SVE (a)</th><th>ICs+Monitoring(b)</th><th>Total</th></tr>
<tr><td>Capital Cost</td><td>$655,000</td><td>$37,400</td><td>$692,400</td></tr>
<tr><td>Annual Cost</td><td>$378,000</td><td>$18,275</td><td>$396,275</td></tr>
<tr><td>Present Worth</td><td>$2,396,000</td><td>$481,000</td><td>$2,877,000</td></tr>
</table>
(a) For 4-year operation of SVE
(b) For 100-year operation of ICs and Monitoring
</td></tr>
</table>

Alternative 3A – SVE/BV (UB) + ICs + Monitoring

Alternative 3A is a variation of Alternative 3 that assumes vertical wells can be installed within the building. This alternative is expected to remove a greater percentage of contaminant mass than Alternative 3 because of more accurate targeting of the contamination with vertical wells. However, it is expected to be poorer with respect to implementability because the building is in active use. Drilling, trenching and placement of piping would pose a significant impact on the operating facility and its workers. Also, installation of vertical wells can be challenging if the ceiling heights are not adequate for use of drilling equipment. Regarding short term effectiveness, there is a greater potential for the onsite workers to be exposed to site contaminants that would be extracted during well drilling or system operation.

Criterion	Rating	Discussion
LTE	5	LTE would be the same as for Alternative 3. The timeframe for aquifer restoration is >7,000 years assuming the MW-20 modeling results are applicable to SA4.
RTMV	4	RTMV would be better than for Alternative 3 because the vertical wells would be able to target the various soil types more accurately than horizontal wells. Contaminant mass removal is estimated to be 20% to 30% which is the same as for SA12.
STE	6	STE is rated lower than for Alternative 3 due to the potential for contaminant releases and other adverse impacts on the onsite workers during well drilling and system operation due to their close proximity to the remediation area inside the building. This alternative would result in 1,630 metric tons of GHG emissions, the same as for SA12.
Implementability	3	Implementability is rated lower than for Alternative 3 because of administrative challenges in gaining access to the inside of an active building. There are also likely to be technical challenges with well drilling due to ceiling height limitations or other factors such as obstructions from machinery or structures inside the building. Some uncertainties exist regarding ICs but restrictive covenants are assumed to be negotiable, given USEPA's enforcement authority.
Cost	8	See cost table below.

	SVE [(a)]	ICs+Monitoring[(b)]	Total
Capital Cost	$559,000	$37,400	$596,400
Annual Cost	$324,000	$18,275	$342,275
Present Worth	$2,050,000	$481,000	$2,531,000

(a) For 4-year operation of SVE

(b) For 100-year operation of ICs and Monitoring

Alternative 4 – Hydraulic Extraction + SVE/BV (UB) + ICs + Monitoring

The primary difference between SA4 and SA12 is that effectiveness of contaminant removal is expected to be poorer because it is inherently difficult to characterize the contamination extent under the building. As a result the horizontal wells approach may not be as effective as the outdoor soil SVE and the fraction of residual contaminant mass with this alternative is expected to be higher than with SA12. Also, the implementation of the horizontal wells under the building is expected to pose significant challenges. For, the hydraulic extraction component this alternative uses vertical wells along the building footprint at locations that are close to but not within the impacted source area. Hence, the hydraulic extraction wells will not be as effective as at SA12 and are rated lower.

<table>
<tr><th>Criterion</th><th>Rating</th><th>Discussion</th></tr>
<tr><td>LTE</td><td>6</td><td>LTE would be lower than for SA12 because horizontal wells would leave a larger residual contaminant mass. There would be some uncertainty about maintaining ICs effectively over the long term. The timeframe for aquifer restoration is >6,000 years assuming the MW-20 modeling results are applicable to SA4.</td></tr>
<tr><td>RTMV</td><td>5</td><td>RTMV would be lower than for SA12 due to challenges with characterization. If the horizontal wells are not positioned in the most appropriate location, contaminant mass removal could be in the range of 30% to 40% as compared to 40% to 50% for SA12.</td></tr>
<tr><td>STE</td><td>6</td><td>STE is rated the same as for SA12. This alternative would result in emissions of 6,960 metric tons of GHG, less than for SA12.</td></tr>
<tr><td>Implementability</td><td>4</td><td>Implementability is rated significantly lower than for Alternative 4 for SA12 because of the challenges of the horizontal well installation. The blind-drilling (single completion) method is assumed because of the presence of large buildings on the property and limited available land for conducting the double-completion (surface-to-surface completion) method. Also, the treatment compound and hydraulic extraction wells are likely to be located in close proximity to the truck loading dock and may hinder loading operations at this facility. The permit review IC has been implemented for this parcel with the City of Los Angeles. Some uncertainties exist regarding ICs but restrictive covenants are assumed to be negotiable, given USEPA's enforcement authority.</td></tr>
<tr><td>Cost</td><td>7</td><td>
<table>
<tr><th></th><th>HE+SVE^(a)</th><th>ICs+Monitoring^(b)</th><th>Total</th></tr>
<tr><td>Capital Cost</td><td>$1,374,000</td><td>$37,400</td><td>$1,411,400</td></tr>
<tr><td>Annual Cost</td><td>$727,000</td><td>$18,275</td><td>$745,275</td></tr>
<tr><td>Present Worth</td><td>$6,332,000</td><td>$481,000</td><td>$6,813,000</td></tr>
</table>
(a) $317,000/year for 10-year operation of HE, $410,000/year for 4-year operation of SVE
(b) For 100-year operation of ICs and Monitoring
</td></tr>
</table>

Alternative 4A – Hydraulic Extraction + SVE/BV (UB) + ICs + Monitoring

Alternative 4A is a variation of Alternative 4 that assumes vertical wells can be installed within the building. This alternative is expected to remove a greater percentage of contaminant mass than Alternative 4 because of better targeting of the contamination with vertical wells placed within the source area. However, it is expected to be poorer with respect to implementability because the building is in active use. Drilling, trenching and placement of piping would pose a significant impact on the operating facility and its workers. Installation of the deep vertical hydraulic extraction wells can also be challenging if the ceiling heights are not adequate for use of drilling equipment. Regarding short term effectiveness, there is a greater potential for the onsite workers to be exposed to site contaminants during well drilling or system operation.

<table>
<tr><th>Criterion</th><th>Rating</th><th>Discussion</th></tr>
<tr><td>LTE</td><td>6</td><td>LTE would be the same as for Alternative 4. The timeframe for aquifer restoration is >5,000 years assuming the MW-20 modeling results are applicable to SA4.</td></tr>
<tr><td>RTMV</td><td>6</td><td>RTMV would be higher than for Alternative 4 because vertical wells will provide better targeting of contamination and contaminant mass removal is estimated to be 40% to 50%, which is the same as for SA12.</td></tr>
<tr><td>STE</td><td>5</td><td>STE is rated lower than for Alternative 4 due to the potential for contaminant releases and other adverse impacts on the onsite workers during well drilling and system operation due to their close proximity to the remediation area inside the building. This alternative would result in emissions of 6,210 metric tons of GHG, less than for SA12.</td></tr>
<tr><td>Implementability</td><td>3</td><td>Implementability is rated lower than for Alternative 4 because of administrative challenges in gaining access to the inside of an active building. Frequent access to the inside of the building would be needed during operations for maintenance and sampling. There may also be technical challenges with well drilling due to ceiling height limitations or other factors such as obstructions from machinery or structures inside the building. Some uncertainties exist regarding ICs but restrictive covenants are assumed to be negotiable, given USEPA's enforcement authority.</td></tr>
<tr><td>Cost</td><td>7</td><td>
<table>
<tr><th></th><th>HE+SVE[(a)]</th><th>ICs+Monitoring[(b)]</th><th>Total</th></tr>
<tr><td>Capital Cost</td><td>$1,374,000</td><td>$37,400</td><td>$1,411,400</td></tr>
<tr><td>Annual Cost</td><td>$678,000</td><td>$18,275</td><td>$696,275</td></tr>
<tr><td>Present Worth</td><td>$6,088,000</td><td>$481,000</td><td>$6,569,000</td></tr>
</table>
(a) $310,000/year for 10-year operation of HE, $368,000/year for 4-year operation of SVE
(b) For 100-year operation of ICs and Monitoring
</td></tr>
</table>

Alternative 5 – ISCO + SVE (UB) + ICs + Monitoring

This alternative is similar to Alternative 5 for SA12 but is implemented inside the building and assumes that: (1) complete access to the area inside the building that corresponds to the source area is available for the duration of this alternative; and (2) vertical wells can be installed inside the building. This alternative is different from SA12 Alternative 5 in that it assumes sentry SVE wells around the entire perimeter of the source area. This alternative is expected to have poor implementability because the building is in active use. Drilling, trenching and placement of piping in the source area would pose a significant impact on the operating facility and its workers. Installation of vertical injection or SVE wells can also be challenging if the ceiling heights are not adequate for use of drilling equipment. There is a greater potential for the onsite workers to be exposed to site contaminants during well drilling or system operation than for SA12. Vapor migration can be a risk with this alternative because chemical oxidation is occurring directly under the building. Other issues such as potential NAPL migration due to injection are similar to the SA12 alternative.

<table>
<tr><th>Criterion</th><th>Rating</th><th>Discussion</th></tr>
<tr><td>LTE</td><td>6</td><td>LTE is rated lower than for SA12 because it would leave a somewhat larger residual contaminant mass. The timeframe for aquifer restoration is >5,000 years assuming the MW-20 modeling results are applicable to SA4.</td></tr>
<tr><td>RTMV</td><td>6</td><td>RTMV is rated the same as for SA12. There would be challenges with access and with characterization of the contamination under the building. This would result in a contaminant mass removal in the range of 40% to 50%.</td></tr>
<tr><td>STE</td><td>4</td><td>STE is rated lower than for SA12 due to the potential for contaminant releases during implementation of this aggressive ISCO technology inside an operating facility. This technology would involve injection of 240,000 gallons of hydrogen peroxide solution and 18,000 lbs of ozone. The exothermic reactions could release vapors into the building and the large volume of oxidants injected could impact the environment. This alternative would result in 4,810 tons of GHG emissions, less than for SA12.</td></tr>
<tr><td>Implementability</td><td>3</td><td>Implementability is rated just as for SA12 because of the administrative challenges of implementing this aggressive technology inside an operating facility. There could also be technical challenges with well installation inside the building. The treatment compound and hydraulic extraction wells are also likely to be located in close proximity to the truck loading dock, impeding access. Some uncertainties exist regarding ICs but restrictive covenants are assumed to be negotiable, given USEPA's enforcement authority.</td></tr>
<tr><td>Cost</td><td>6</td><td>
<table>
<tr><th></th><th>ISCO+SVE$^{(a)}$</th><th>ICs+Monitoring$^{(b)}$</th><th>Total</th></tr>
<tr><td>Capital Cost</td><td>$3,017,000</td><td>$37,400</td><td>$3,054,400</td></tr>
<tr><td>Annual Cost</td><td>$1,103,000</td><td>$18,275</td><td>$1,121,275</td></tr>
<tr><td>Present Worth</td><td>$8,435,000</td><td>$481,000</td><td>$8,916,000</td></tr>
</table>
(a) $536,000/year for 2-year operation of ISCO, $567,000/year for 4-year operation of SVE
(b) For 100-year operation of ICs and Monitoring
</td></tr>
</table>

Alternative 6 – ISSH + SVE (UB) + ICs + Monitoring

This alternative is similar to Alternative 6 for SA12 but it is implemented inside the building and assumes that: (1) complete access to the area inside the building that corresponds to the source area is available for the duration of this alternative; and (2) vertical wells can be installed inside the building. This alternative is different from SA12 Alternative 5 in that it assumes sentry SVE wells around the entire perimeter of the source area. This alternative is expected to have poor implementability because the building is in active use. Drilling, trenching and placement of piping in the source area would pose a significant impact to the operating facility and its workers. Installation of vertical ERH or SVE wells can also be challenging if the ceiling heights are not adequate for use of drilling equipment. There is a potential for onsite workers to be exposed to site contaminants during well drilling or system operation. Vapor migration can be a risk with this alternative because electric heating is occurring directly under the building. Other issues such as potential NAPL migration are similar to the SA12 alternative. Approximately 7.2 million kWhr of electricity is estimated to be used for soil heating at SA4 with this alternative.

<table>
<tr><th><u>Criterion</u></th><th><u>Rating</u></th><th><u>Discussion</u></th></tr>
<tr><td>LTE</td><td>7</td><td>LTE would be lower than for SA12 because challenges with characterization of contamination under the building and positioning of wells inside the building would result in a larger residual contaminant mass. The timeframe for aquifer restoration is 2,000 to 5,000 years assuming the MW-20 modeling results are applicable to SA4.</td></tr>
<tr><td>RTMV</td><td>7</td><td>RTMV would be lower than for SA12 due to challenges with contaminant characterization and positioning of wells. Contaminant mass removal would be in the range of 50% to 80%.</td></tr>
<tr><td>STE</td><td>4</td><td>STE is rated lower than for SA12 due to the potential for contaminant releases inside an operating facility. This would result in 9,050 metric tons of GHG emissions, less than for SA12.</td></tr>
<tr><td>Implementability</td><td>3</td><td>Implementability is rated significantly lower than for SA12 because of the administrative challenges of implementing this aggressive technology inside an operating facility. There could also be technical challenges with well installation and operations inside the building. The treatment compound and hydraulic extraction wells are also likely to be located in close proximity to the truck loading dock and may hinder access. Some uncertainties exist regarding ICs but restrictive covenants are assumed to be negotiable, given USEPA's enforcement authority.</td></tr>
<tr><td>Cost</td><td>5</td><td>
<table>
<tr><th></th><th>ISSH+SVE^(a)</th><th>ICs+Monitoring^(b)</th><th>Total</th></tr>
<tr><td>Capital Cost</td><td>$2,811,000</td><td>$37,400</td><td>$2,848,400</td></tr>
<tr><td>Annual Cost</td><td>$2,189,000</td><td>$18,275</td><td>$2,207,275</td></tr>
<tr><td>Present Worth</td><td>$9,635,000</td><td>$481,000</td><td>$10,116,000</td></tr>
</table>
(a) For 2-year operation of ERH + SVE
(b) For 100-year operation of ICs and Monitoring
</td></tr>
</table>

9.6.2 Comparative Analysis of Alternatives

This section presents a comparative analysis of the alternatives for each of the criteria being evaluated with embedded mini-tables to compare ratings.

Overall Protection of Human Health and Environment

Alternative 2 is a passive remedial option but includes ICs and Monitoring to protect human health and the environment. It would be effective because groundwater concentrations are holding steady or decreasing, and NAPL saturations are low, making NAPL migration unlikely. Alternatives 3-6 are active remedial alternatives that would remove a portion of the hydrocarbon contaminant mass (20% to 80%) and include ICs and Monitoring to provide long-term protection. The ICs and Monitoring component include multiple layers of ICs that provide protection from shallow soil and groundwater contamination. Alternative 6 would have the greatest impact with respect to emission of GHG, followed by Alternatives 4/4A, 5 and 3/3A in decreasing order.

Alt(s)	Rating
2-6	YES
1	NO

Compliance with ARARs

It is technically feasible for Alternatives 3-6 to meet action-specific and chemical-specific ARARs. However, challenges can be anticipated in meeting benzene vapor discharge requirements from SCAQMD with SVE, benzene discharge requirements for water from RWQCB requirements and WDR requirements for chemical injection from the RWQCB. There are no location-specific ARARs. SA4 is within the TI waiver zone, where compliance with chemical-specific ARARs (called ISGS in the Groundwater ROD) is not required. Alternatives 2-6 would meet the state ARAR requiring restrictive covenants when waste is left in place above UU/UE levels.

Alt(s)	Rating
2-6	YES
1	NO

Long-term Effectiveness

All of the active remedial alternatives would leave behind significant residual contamination (see RTMV), and would need ICs and Monitoring to provide adequate control of residual risk. Alternative 2 is rated lower than Alternatives 3-6 because it would leave more residual contamination. The timeframe for aquifer restoration is lower for the active remedial alternatives but under all alternatives it would be in the thousands of years (estimated 2,000 years to 10,500 years). There would be uncertainty about the maintaining ICs effectively over the long term.

Alt(s)	Rating
6	7
4,4A,5	6
3, 3A	5
2	4
1	0

Reduction of Toxicity, Mobility and Volume

All of the active remedial alternatives would result in partial contaminant mass reduction in the addressed source area (Alternative 3: 15% to 20%; Alternative 3A: 20% to 30%; Alternative 4: 30% to 40%; Alternative 4A:40% to 50%; Alternative 5: 40% to 50%; Alternative 6: 50% to 80%). Alternative 2 is rated “0” because it does not involve active treatment, although it would result in slow contaminant mass reduction via intrinsic biodegradation.

Alt(s)	Rating
6	7
4A,5	6
4	5
3A	4
3	3
1-2	0

Short-term Effectiveness

Alt(s)	Rating
2	9
3	7
3A,4	6
4A	5
5-6	4
1	N/A

Alternative 2 does not involve active remediation and would not impact onsite workers or the community. Alternative 3 (SVE) would have moderate impacts to the onsite workers in the vicinity of the horizontal well installation and SVE operation. Alternative 3A is rated lower for greater potential impacts because it involves installation and operation of a remediation system inside an occupied building. Alternative 4 is a more aggressive remediation approach and thus has higher risks. Alternative 4A is rated lower because of the proximity of the workers in the building. Alternatives 5 and 6 are aggressive technologies that would have the greatest impacts on building workers. Alternative 6 would have the greatest impact with respect to emission of GHG, followed by Alternatives 4/4A, 5 and 3/3A in decreasing order (refer to Appendix E-3 for more details).

Implementability

Alt(s)	Rating
1	9
2	8
3,4	4
3A,4A,5,6	3

Alternative 2 consists of ICs, including permit review through the City of Los Angeles, which has been implemented for the parcel containing this source area. Some uncertainties exist regarding ICs, but it is assumed that a land use covenant can be negotiated with the property owner. Alternative 3 (SVE) is rated significantly lower because of anticipated technical challenges with horizontal well installation under the building and vapor treatment. Alternative 4 includes groundwater treatment in addition to SVE, but is rated the same because the most significant challenges are with the horizontal well installation. Alternatives 3A and 4A are rated lower because of administrative and technical challenges with installation and operation of the remediation inside the building. Alternatives 5 and 6 are rated the lowest because they are aggressive technologies that would significantly impact the facility and its workers. In addition, Alternatives 3-6 would use thermal oxidizers for which there is already a history of unfavorable community response, and political challenges could adversely affect implementation of such systems.

Cost

Alt(s)	Rating	Cost
1	9	None
2	9	$481,000
3	8	$2,877,000
3A	8	$2,531,000
4	7	$6,813,000
4A	7	$6,569,000
5	6	$8,916,000
6	5	$10,116,000

ICs and Monitoring costs for Alternatives 3 and 4 are the same as for Alternative 2, and 100-year ICs and Monitoring present worth costs are included for those alternatives. Costs for Alternatives 2-6 include contingency costs.

9.7 SOURCE AREA 7

This section presents the results of the 9-criteria evaluation of the remedial alternatives for SA7 located in EAPC 22. The SA7 alternatives were described in Section 7.8 and illustrated on Figures 7.8-1 through 7.8-3 located in Appendix E.

SA7 is identified as a potential NAPL area based on elevated dissolved-phase concentrations of benzene and ethylbenzene in downgradient monitoring wells (XMW-21, CWL0012, and CWL0001). There is a warehouse-type building which covers a significant portion of the property. Site lithology is assumed to be similar to other source areas in the vicinity (SA4) with the contamination largely residing in the UBF The estimated lateral extent of the groundwater contamination source area for purposes of the FS is assumed to lie entirely under the building based on the former facility location (Figure 7.8-1 located in Appendix E). The source area is estimated to be approximately 8,500 SF with an impacted soil volume of about 20,400 CY. As with other source areas, the depth of contamination is assumed to be between 15 and 80 feet bgs. As for SA4, Alternatives 3 and 4 each have a scenario where access inside the building is available and another where it is not available.

9.7.1 9-Criteria Analysis for SA7

Since the evaluation is similar to SA4, no detailed analysis is presented. Table 9-7 summarizes the 9-criteria analysis for SA7.

9.7.2 Comparative Analysis of Alternatives

The remedial alternatives and evaluation for SA7 are largely similar to those for SA4, so the text presents only the comparative analysis of alternatives in order to reduce the repetition of text.

Overall Protection of Human Health and Environment
Same as for SA4.

Compliance with ARARs
Same as for SA4.

Long-term Effectiveness
Same as for SA4.

Reduction of Toxicity, Mobility and Volume
Same as for SA4.

Short-term Effectiveness
Same as for SA4 except the GHG emissions are lower (refer to Appendix E-3 for estimates for each alternative).

Implementability
Same as for SA4.

Cost
ICs and Monitoring costs for Alternatives 3 and 4 are the same as for Alternative 2, and 100-year ICs and Monitoring present worth costs are included for those alternatives. Costs for Alternatives 2-6 include contingency costs.

Alt(s)	Rating	Cost
1	9	None
2	9	$481,000
3	8	$2,556,000
3A	8	$2,255,000
4	7	$5,925,000
4A	7	$5,621,000
5	7	$6,535,000
6	6	$7,696,000

9.8 SOURCE AREA 8

This section presents the results of the 9-criteria evaluation of the remedial alternatives for SA8 located in EAPC 21. The SA8 alternatives were described in Section 7.9 and illustrated on Figures 7.9-1 through 7.9-3 located in Appendix E.

SA8 is identified as a potential NAPL area based on elevated dissolved-phase concentrations of benzene and ethylbenzene in downgradient monitoring wells (CWL0001, CWL0012, and CWL0014). There is a warehouse-type building which covers a significant portion of the property. Site lithology is assumed to be similar to other source areas in the vicinity (SA4) with the contamination largely residing in the UBF. The estimated lateral extent of the groundwater contamination source area for purposes of the FS is assumed to lie entirely under the building based on the former facility location (Figure 7.9-1 located in Appendix E). The source area is estimated to be approximately 8,800 SF with an impacted soil volume of about 21,180 CY. As with other source areas, the depth of contamination is assumed to be between 15 and 80 feet bgs.

9.8.1 9-Criteria Analysis for SA8

The remedial alternatives for SA8 are the same as for SA4 except that the ICs only include layers 1 and 2 because this parcel is in Group 2. Since the evaluation for each alternative is similar to SA4, no detailed analysis is presented. Table 9-8 summarizes the 9-criteria analysis for SA8.

9.8.2 Comparative Analysis of Alternatives

The remedial alternatives and evaluation are similar to those for SA4.

Overall Protection of Human Health and Environment
Same as for SA4 except the ICs only include layers 1 and 2.

Compliance with ARARs
Same as for SA4.

Long-term Effectiveness
Same as for SA4 except the ICs only include layers 1 and 2.

Reduction of Toxicity, Mobility and Volume
Same as for SA4.

Short-term Effectiveness
Same as for SA4 except the GHG emissions are lower (refer to Appendix E-3 for estimates for each alternative).

Implementability
Same as for SA4 except the ICs only include layers 1 and 2.

Cost
ICs and Monitoring costs for Alternatives 3 and 4 are the same as for Alternative 2, and 100-year ICs and Monitoring present worth costs are included for those alternatives. ICs cost is different from the cost for SA4 because ICs only include layers 1 and 2. Costs for Alternatives 2-6 include contingency costs.

Alt(s)	Rating	Cost
1	9	None
2	9	$416,000
3	8	$2,516,000
3A	8	$2,209,000
4	7	$5,944,000
4A	7	$5,689,000
5	6	$7,099,000
6	6	$7,811,000

9.9 SOURCE AREA 5

This section presents the results of the 9-criteria evaluation of the remedial alternatives for SA5 located in EAPC 18. The SA5 alternatives were described in Section 7.10 and illustrated on Figures 7.10-1 and 7.10-2 located in Appendix E.

SA5 is located in the northern portion of the former styrene plancor. SA5 was designated a potential groundwater contamination source area based on elevated VOC concentrations in downgradient monitoring wells (PZL0006) and temporary well point (WPL00002). SA5 is characterized as NAPL unlikely but is evaluated as a soil contamination area. Site lithology is assumed to be similar to other source areas in the vicinity (SA4) with the contamination largely residing in the UBF. The estimated lateral extent of contamination for the purposes of the FS is assumed to lie entirely under the building based on the former facility location (Figure 7.10-1 located in Appendix E). The source area is estimated to be approximately 4,000 SF with an impacted soil volume of about 9,600 CY. As with other source areas, a depth of contamination between 15 and 80 feet bgs is assumed. There are only 4 remedial alternatives evaluated for this source area: (1) No Action; (2) Intrinsic Biodegradation + ICs + Monitoring; (3) SVE (Horizontal wells, outside building) + ICs + Monitoring; and (3A) SVE (Vertical wells, inside building) + ICs + Monitoring. The ICs for this parcel only include layers 1 and 2 because this parcel is in Group 2.

9.9.1 9-Criteria Analysis for SA5

Since the evaluation is similar to SA4, no 9-criteria analysis text is presented. Table 9-9 summarizes the 9-criteria analysis for SA5.

9.9.2 Comparative Analysis of Alternatives

The remedial alternatives and evaluation are similar to those for SA4 for Alternatives 1, 2, 3 and 3A. Alternatives 4 to 6 are not included for SA5.

Overall Protection of Human Health and Environment
Same as for SA4 except the ICs only include layers 1 and 2.

Compliance with ARARs
Same as SA4.

Long-term Effectiveness

Same as for SA4 except that Alternatives 4, 4A, 5 and 6 are not included and ICs only include layers 1 and 2.

Reduction of Toxicity, Mobility and Volume

Same as for SA4 except that Alternatives 4, 4A, 5 and 6 are not included.

Short-term Effectiveness

Same as for SA4 except that Alternatives 4, 4A, 5 and 6 are not included and the GHG emissions are lower (refer to Appendix E-3 for estimates for each alternative).

Implementability

Same as for SA4 except that Alternatives 4, 4A, 5 and 6 are not included and ICs only include layers 1 and 2.

Cost

ICs and Monitoring costs for Alternative 3 and 3A are the same as for Alternative 2, and 100-year ICs and Monitoring present worth costs are included for that alternative. ICs cost is different from the cost for SA4 because ICs only include layers 1 and 2. Costs for Alternatives 2 and 3 include contingency costs.

Alt(s)	Rating	Cost
1	9	None
2	9	$416,000
3	8	$2,208,000
3A	8	$2,081,000

10.0 FS SUMMARY, LIMITATIONS AND UNCERTAINTIES

The FS for the Soil and NAPL OU incorporated two separate evaluations: a surface pathway evaluation and a NAPL source area evaluation. The findings of both evaluations are summarized below, followed by a description of the FS limitations and uncertainties.

10.1 SUMMARY OF FS EVALUATIONS

10.1.1 Surface Pathway Evaluation

Remedial alternatives for the surface pathway were evaluated using a risk-based approach for areas of impacted soil. The areas of impacted soil were delineated based on former plant site facility locations and soil and soil gas COC concentrations that correspond to commercial worker risk levels exceeding 1E-06 (see Table 4-3). A range of remedial alternatives was evaluated for each impacted soil area following the FS evaluation process described in CERCLA and associated USEPA guidance documents.

Surface pathway remedial alternatives address impacted shallow soil both outdoors and under buildings. While previously presented according to risk group and property, the table below summarizes the surface pathway remedial alternatives differently, presenting the alternatives for the site as a whole, while distinguishing those for outdoor soil from those for soil under buildings. “Shallow soil under buildings” alternatives are equivalent to those previously described as addressing the indoor air pathway.

SUMMARY OF SHALLOW SOIL REMEDIAL ALTERNATIVES

Media	Remedial Alternatives
Outdoor Shallow Soil	No Action
	Institutional Controls (ICs)+Monitoring
	ICs+Monitoring, Capping$_{\text{VOCs + non-VOCs}}$
	ICs+Monitoring, Soil Vapor Extraction/Bioventing(SVE/BV)$_{\text{VOCs}}$, Capping$_{\text{non-VOCs}}$
	ICs+Monitoring, SVE/BV$_{\text{VOCs}}$, Excavation$_{\text{non-VOCs}}$
	ICs+Monitoring, Excavation$_{\text{VOCs + non-VOCs}}$
Shallow Soil Under Buildings	No Action
	ICs+Monitoring
	ICs+Monitoring, Sub-Slab Venting (SSV)/HVAC Modification (HVAC mod)
	ICs+Monitoring, SVE/BV$_{\text{VOCs}}$

10.1.2 NAPL Source Area Evaluation

Remedial actions for NAPL were previously considered by USEPA in the groundwater ROD for the Montrose and Del Amo sites. As discussed in Section 2.2.7, USEPA determined that it was technically impracticable to remove enough NAPL using currently available technologies to reduce dissolved phase groundwater contaminants to below drinking water standards (USEPA, 1999). The ROD therefore established a TI waiver zone, within which NAPL containment was mandated without imposing requirements for achieving drinking water standards in groundwater. The ROD deferred any decision regarding the need for NAPL removal until after additional investigation and evaluation, which have now been accomplished through the Soil and NAPL RI (URS, 2006) and this FS. USEPA's future decision regarding the need for NAPL removal will be presented in the Proposed Plan and subsequent ROD for the Soil and NAPL OU.

The groundwater ROD indicates that USEPA will consider NAPL removal actions due to the potential for NAPL migration and due to uncertainty regarding the long-term effectiveness of the selected groundwater remedy, which relies primarily on monitored natural attenuation for the benzene plume. Therefore, while the FS surface pathway evaluation focused on risks associated with contaminants in shallow soil (≤ 15 feet bgs), the NAPL source area evaluation focused primarily on deeper soil (>15 feet bgs) and groundwater protection. The NAPL evaluation additionally presented information on remedial alternatives pertaining to sustainability, including energy use and greenhouse gas (GHG) emission estimates (see Sections 7 and 9, and Appendix E-3). Presentation of sustainability information was limited to the NAPL evaluation because the associated remedial alternatives are much more energy intensive and generate a larger carbon footprint than those for the surface pathway remedial alternatives.

The table below summarizes the remedial alternatives for NAPL source areas at the site:

SUMMARY OF NAPL SOURCE AREA REMEDIAL ALTERNATIVES

Medium	Remedial Alternatives
Deep Soil/NAPL	No Action
	ICs+Monitoring, Intrinsic Biodegradation
	ICs+Monitoring, SVE/BV
	ICs+Monitoring, SVE/BV, Hydraulic Extraction (HE)
	ICs+Monitoring, SVE, In-Situ Chemical Oxidation (ISCO)
	ICs+Monitoring, SVE, In-Situ Soil Heating (ISSH)

10.2 COMBINED SURFACE PATHWAY AND NAPL PRESENTATION

Table 10-1 summarizes the pathways/media of concern along with their associated risk-driving contaminant types, risk values, and remedial alternatives for each of the site properties within the five identified risk groups. This table provides an overview of the FS evaluation for the site, compiling information that was previously provided in separate tables.

Commercial and residential surface pathway risks are low for the 40 site properties in risk groups 1 and 2 indicated in Table 10-1. Remedial alternatives evaluated for the surface pathway at these properties were therefore limited to informational and permit review ICs (layers 1 and 2) and long-term monitoring. For the remaining 29 properties in risk groups 3-5, commercial and/or residential risks are elevated (cancer risk >1E-06 or HI>1) and additional IC layers are appropriate. These additional IC layers (3-5) are parcel-specific, but include zoning restrictions and restrictive covenants regarding land use, sampling, engineering controls, and groundwater. Evaluation of active remediation alternatives for the surface pathway was limited to those properties with elevated risk under the current commercial land use scenario. These active remediation alternatives included capping, SVE/BV, HVAC mod/SSV, and excavation.

Active remediation alternatives were evaluated for nine NAPL source areas at the site, independently from the surface pathway evaluations. While most NAPL source areas are assumed to be limited to a single property, SA11 extends over portions of three properties (EAPCs 6, 9 and 15), and SA3 extends over portions of two properties (EAPCs 16 and 23). EAPC 23 also includes a second NAPL source area, SA6. Active remediation alternatives evaluated for NAPL included SVE/BV, HE, ISCO, and ISSH.

The nine-criteria evaluation is described for the surface pathway and NAPL areas in Sections 8.1 and 9.0, respectively. The surface pathway and NAPL evaluation nine-criteria ratings and estimated present worth costs are summarized for each property in Table 10-2. Estimated 100-year present worth costs range from $58,000 for basic ICs (layers 1 and 2 only) and monitoring at properties where there is no significant surface pathway risk and no NAPL, up to $56,987,000 at parcel 7351-034-057 (EAPC 23), where the highest cost remedial alternative includes ICs and monitoring, SVE/BV, excavation, and ISCO to address VOCs in shallow soil and two NAPL source areas.

10.3 LIMITATIONS AND UNCERTAINTIES

There are several types of uncertainties in the FS evaluation. The most significant of these are discussed below.

10.3.1 Contaminant Distribution Uncertainty

The FS identified applicable remedial alternatives for areas based on results of the RI and BRA. Based on data limitations, assumptions were made regarding the extent of COCs and/or NAPL for some areas. This uncertainty primarily originated from the presence of existing commercial buildings that limited access for sampling in areas of former rubber plant facilities and/or areas of potential soil contamination. In these cases, the area of impacted soil and/or NAPL was inferred based on former rubber plant facility locations and available data for the area adjacent to the current building footprint.

For evaluation purposes, the assumed extent of impacted outdoor soil is further based on exceedance of risk-based cleanup levels developed in the FS using a CR threshold value of 1E-06. Conservative, higher-end estimates of the extent of impacted soil were used for the FS evaluations, and the FS evaluation ratings are not expected to be significantly sensitive to these assumptions. Regardless, additional investigation will be necessary as the initial step of the remedial design process to better define the horizontal and vertical extent of contamination for areas where active remedial measures are ultimately required by the ROD.

10.3.2 Effectiveness Uncertainty

Pilot testing of many of the technologies evaluated in the FS has not been performed at the former plant site. For example, SVE/BV has been implemented at the Waste Pit Area in sandy deep soil, but not in shallow soil (0-15 feet bgs) where permeability is known to be significantly lower. Evaluations for this technology were presented based on available laboratory soil permeability data and SVE/BV experience at the Waste Pit Area and other sites. Similarly, neither bench-scale nor field-scale testing has been performed at the former plant site for the more innovative and aggressive technologies included in this FS evaluation. Evaluations of these aggressive technologies were therefore based on published and unpublished information regarding their application and performance at other sites with similar subsurface conditions. This information allows for the estimation of mass removal percentages; however, because of the variation and complexity of the subsurface environment, variety of COC mixtures, and the various human activities performed at different sites, no two sites containing NAPL are the same. Therefore, it should be recognized that the mass removal percentages included within this evaluation could increase or decrease based on site-specific conditions. If any innovative technologies are ultimately incorporated into the selected remedy for the Soil and NAPL OU, then additional assessment and pilot testing will need to be performed during the remedial design process to verify their effectiveness, including mass removal percentages.

10.3.3 Implementability Uncertainty

There is uncertainty associated with the administrative and technical implementability of the active remedial technology alternatives. The administrative implementability uncertainty is primarily related to an incomplete understanding of the impacts of the active remediation alternatives on the private property owners, their operating facilities and their tenants. Discussions with property owners would be needed to more reliably gauge the impacts of these alternatives on the properties, and the impacts may be greater for some properties than others. Additional administrative uncertainty arises due to a current SCAQMD moratorium on air permits for aboveground vapor treatment systems, which could potentially impact those alternatives with large, aboveground treatment systems. The technical implementability uncertainty is more significant with the more aggressive technologies because bench-scale or pilot test studies have not been completed for several of these technologies. For example, it is not known whether injections of oxidants into the low permeability soil zones can be achieved for the ISCO alternative.

10.3.4 Cost Uncertainty

The cost estimates included in Table 10-2 show the present worth cost estimates for each surface pathway exposure area and NAPL source area alternative, respectively. The cost estimates are approximate, with an accuracy of +50% and -30%, as required by the CERCLA FS guidance. These costs include present worth cost estimates for the active remedial technology component(s) in each alternative based on the number of operational years for that component. These cost estimates also include the present worth costs for ICs, engineering controls and Monitoring for 100 years using a discount factor of 5%. The cost estimates are based on estimated capital and O&M costs and include a contingency cost that ranges between 20% and 40%. As discussed in Sections 6 and 7, capital and O&M costs are based on the assumed extent of contamination and on estimated conceptual design parameters such as radius of influence, influent concentrations, and timeframe for remediation. Assumptions and other details developed and used in the cost estimates are presented in the cost spreadsheets included in Appendices D and E.

The area and volume of impacted soil is a significant factor in the uncertainty of the cost estimates for both the surface pathway and NAPL source area alternatives. This uncertainty is increased for assumed areas of impacted soil and/or NAPL under an existing building. Conservative, higher-end estimates of the areas and volumes of soil contamination based on current knowledge were used in view of this uncertainty, but more accurate estimates will generally need to be established through additional assessment that would be completed as the initial step in the remedial design process.

The lack of pilot testing data for certain technologies and the resultant use of estimated or assumed values for parameters such as radius of influence, influent vapor concentration, and operational period also result in cost uncertainty. The influent vapor concentration and the operational period significantly impact the O&M costs for the SVE/BV alternative. Additionally, the SVE/BV cost estimate does not factor in impacts on the property owner/facility. For example, if a source area is located below the main driveway of a warehouse facility, installation of deep wells in this area may require special accommodations to allow continued operations at that facility which can significantly increase costs.

A potential consequence of the SCAQMD moratorium on air permits for aboveground vapor treatment systems (see 10.3.3 above) is that emission offsets may need to be purchased in the future. The availability and cost of the offsets is unknown, presenting significant additional cost uncertainty.

11.0 REFERENCES

Carus 2006	Presentation titled "ISCO with Permanganate: Effective Application", Carus Chemical Company, March 2006.
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C2REM 2004	Follow-up Full-Scale SVE Monitoring Event Report of Findings, Del Amo Waste Pits OU, C2REM, March, 2004.
C2REM 2005	Prefinal Design Report Addendum, Del Amo Waste Pits OU, C2 REM, September 2005.
C2REM 2006	Soil Vapor Extraction/Insitu Biodegradation Technology SVE/IBT Final Design Report, Del Amo Waste Pits, Los Angeles, California, January 2006.
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