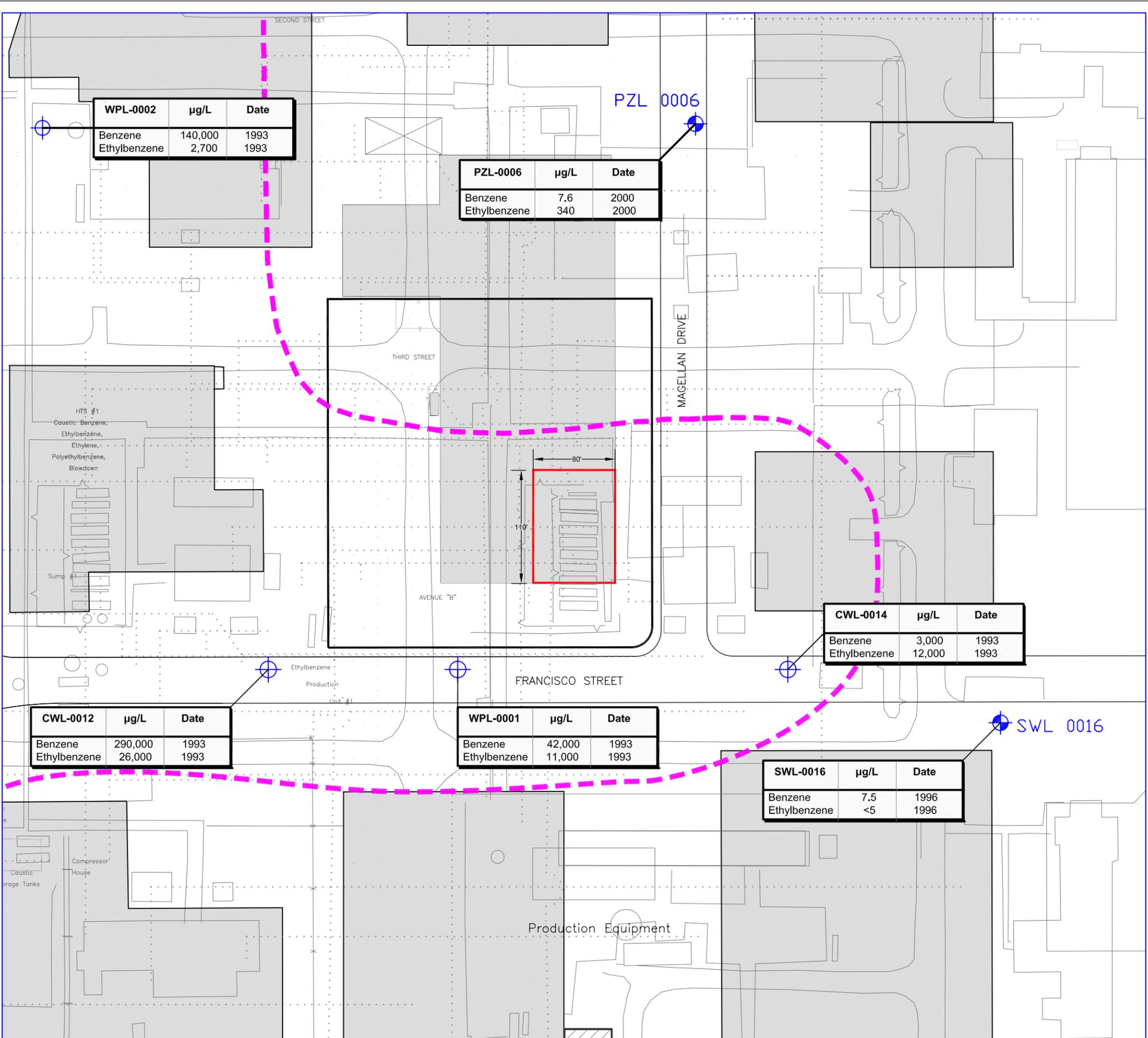
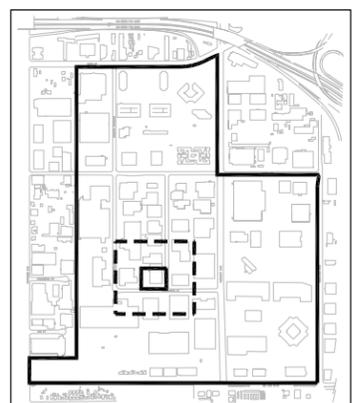


SOURCE AREA 8

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- ### Legend
-  Assumed extent of NAPL based on dissolved VOC concentrations and locations of former facilities
 -  Area where LNAPL could potentially be present based on dissolved concentrations in groundwater (>5% of solubility)
 -  Approximate location of former underground pipelines with a potential to have transported VOC-containing fluids
 -  Parcel boundary
 -  Outlines of historical features with use/contents indicated
 -  Monitoring well location in water table zone
 -  Temporary well point with historical data



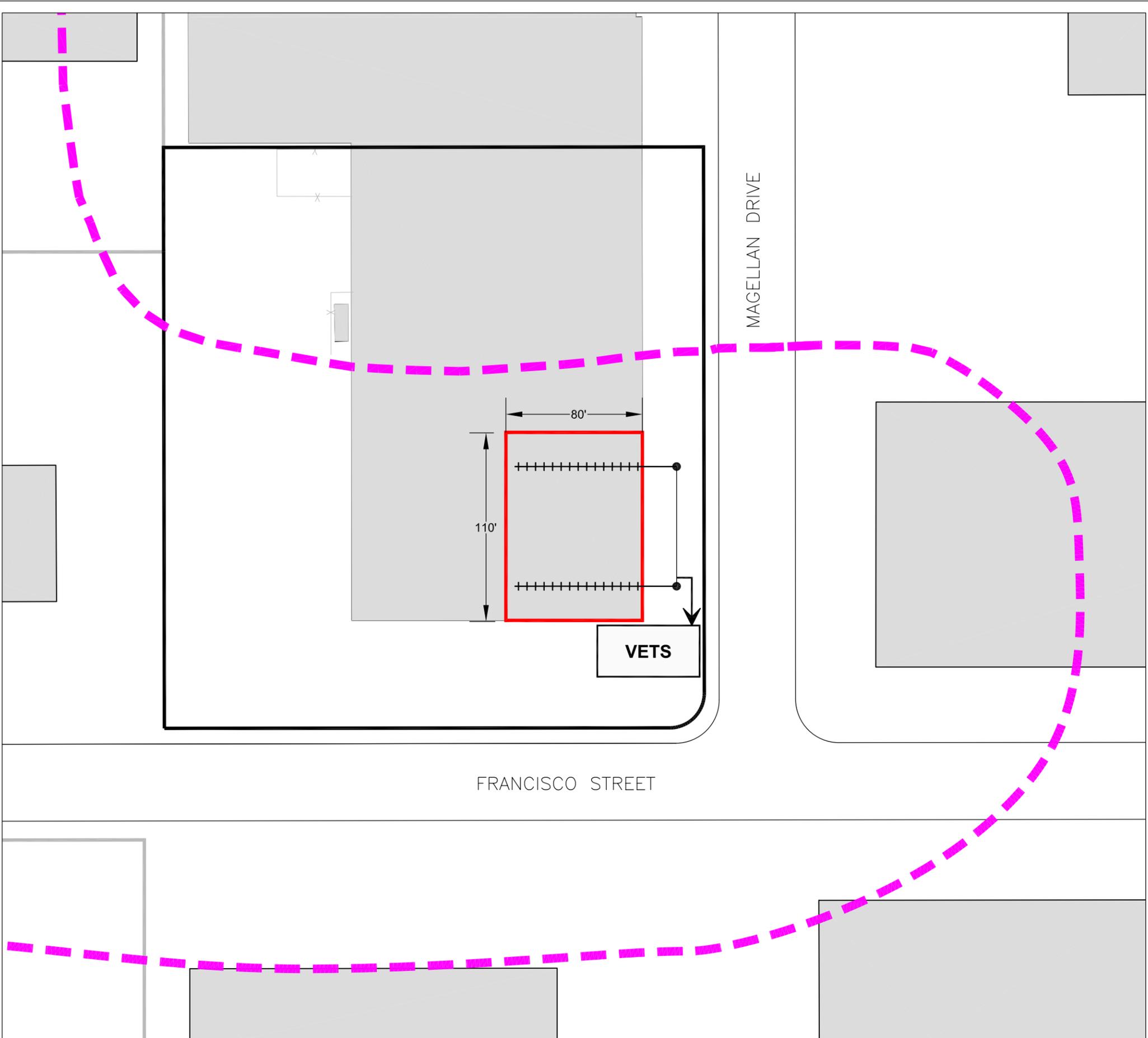
Area shown in this map



FIGURE 7.9-1
ASSUMED EXTENT OF NAPL CONTAMINATION
Parcel No. 7351-034-047
 Source Area 8
 Del Amo Soil + NAPL FS



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Legend

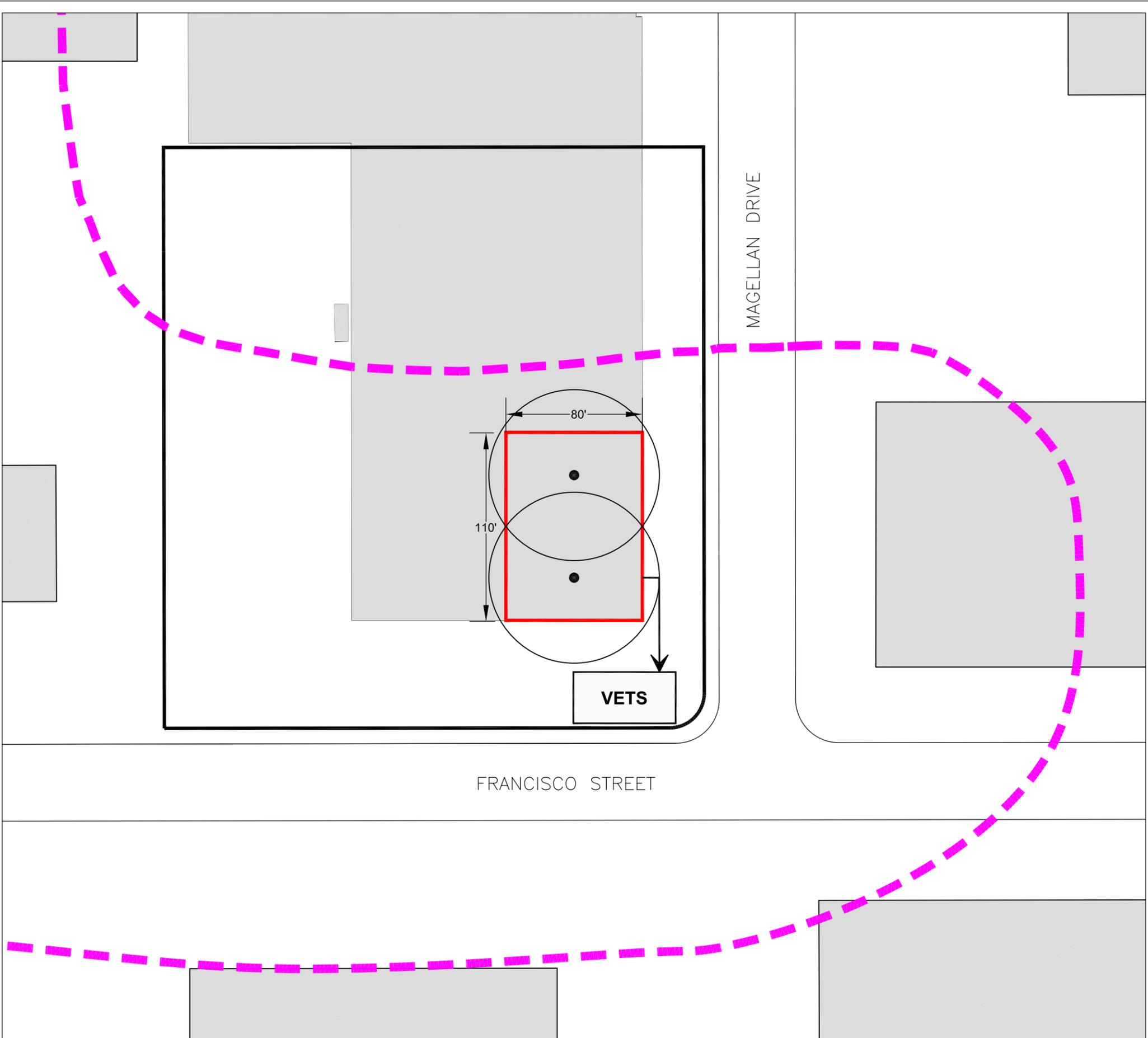
-  Assumed extent of NAPL source area based on benzene concentrations in one or more water table temporary well points and locations of former facilities
-  Area where LNAPL could potentially be present based on dissolved concentrations in groundwater (>5% of solubility)
-  Parcel boundary
-  Vapor Extraction Treatment System
-  Horizontal SVE/BV well (70-foot spacing) for deep soil under building (approximately 30-35 feet bgs)



FIGURE 7.9-2
Alternative 3
SOIL VAPOR EXTRACTION/BIOVENTING (UB),
ICS AND MONITORING
- HORIZONTAL WELLS
Parcel No. 7351-034-047
 Source Area 8
 Del Amo Soil + NAPL FS



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Legend

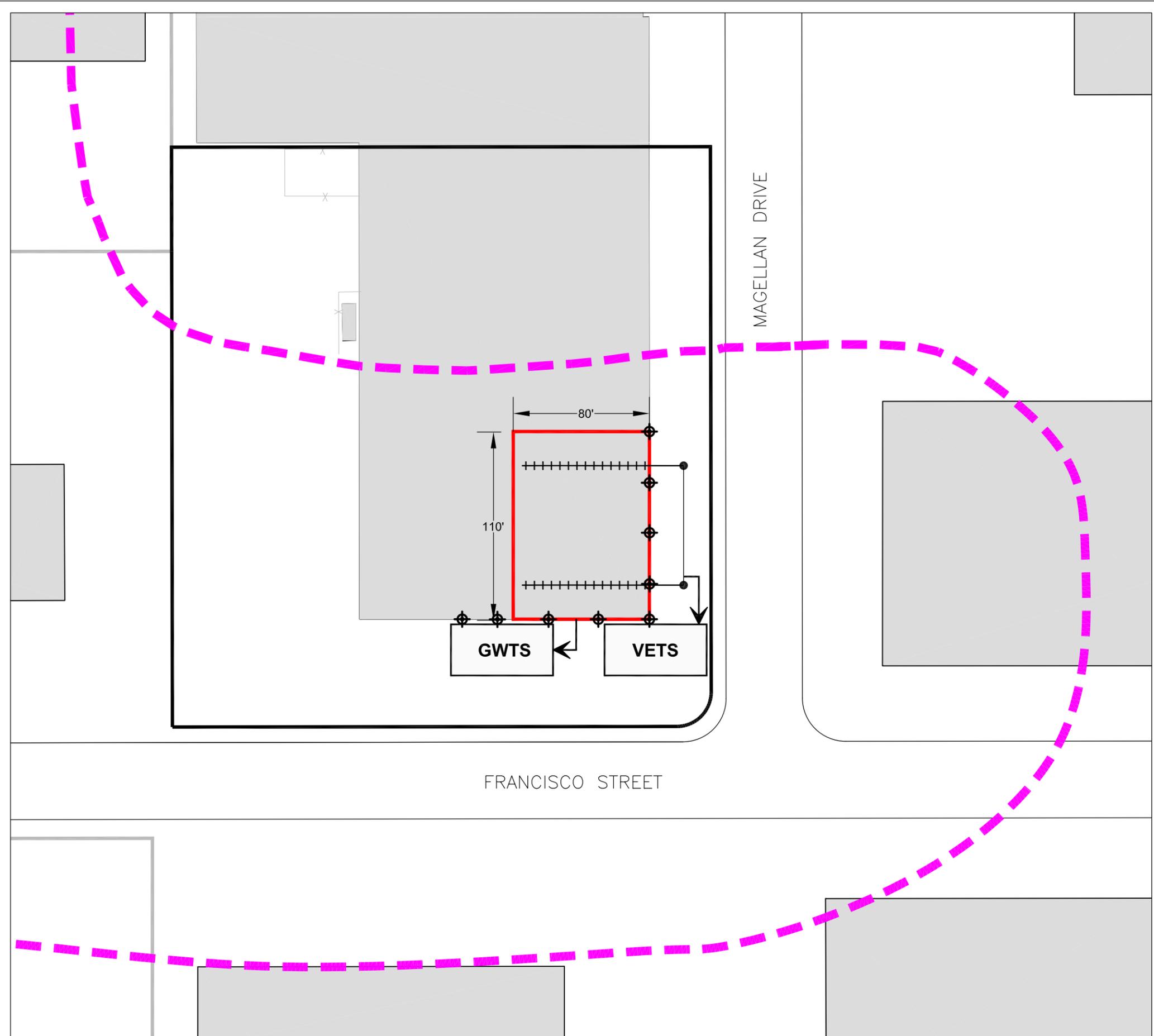
-  Assumed extent of NAPL based on dissolved VOC concentrations and locations of former facilities
-  Area where LNAPL could potentially be present based on dissolved concentrations in groundwater (>5% of solubility)
-  Parcel boundary
-  VETS
Vapor Extraction Treatment System
-  SVE/BV vertical well (70-foot spacing), circle denotes assumed 50-foot radius of influence



FIGURE 7.9-2A
Alternative 3A
SOIL VAPOR EXTRACTION/BIOVENTING (UB),
ICS AND MONITORING
- VERTICAL WELLS
Parcel No. 7351-034-047
 Source Area 8
 Del Amo Soil + NAPL FS



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Legend

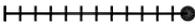
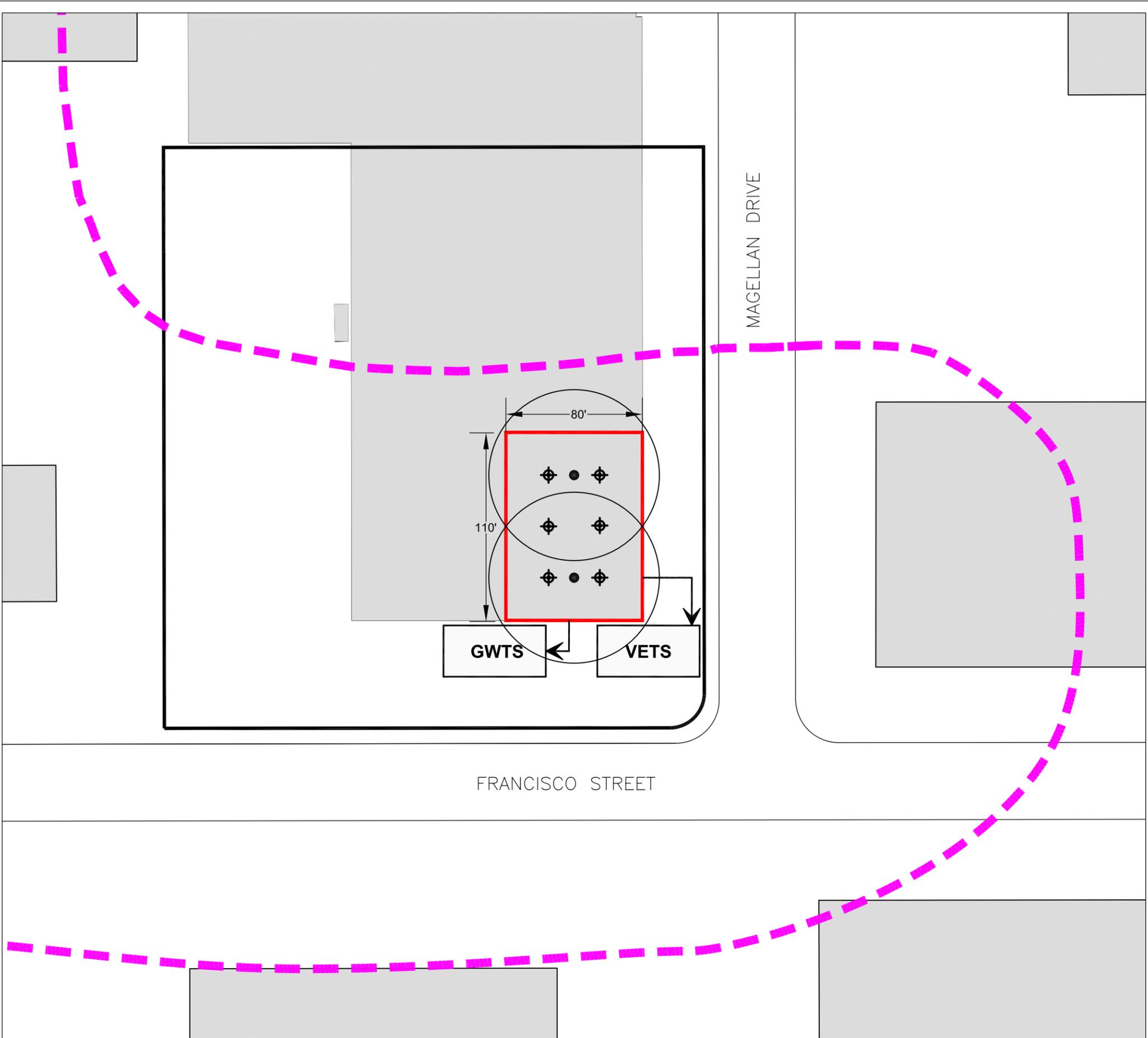
-  Assumed extent of NAPL based on dissolved VOC concentrations and locations of former facilities
-  Area where LNAPL could potentially be present based on dissolved concentrations in groundwater (>5% of solubility)
-  Parcel boundary
-  Groundwater Extraction Well, (30-foot spacing)
-  VETS
Vapor Extraction Treatment System
-  GWTS
Groundwater Treatment System
-  Horizontal SVE/BV well (70-foot spacing) for deep soil under building (approximately 30-35 feet bgs)



FIGURE 7.9-3
Alternative 4
HYDRAULIC EXTRACTION, SVE/BV (UB),
ICS AND MONITORING
- HORIZONTAL WELLS
Parcel No. 7351-034-047
 Source Area 8
 Del Amo Soil + NAPL FS



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Legend

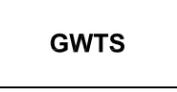
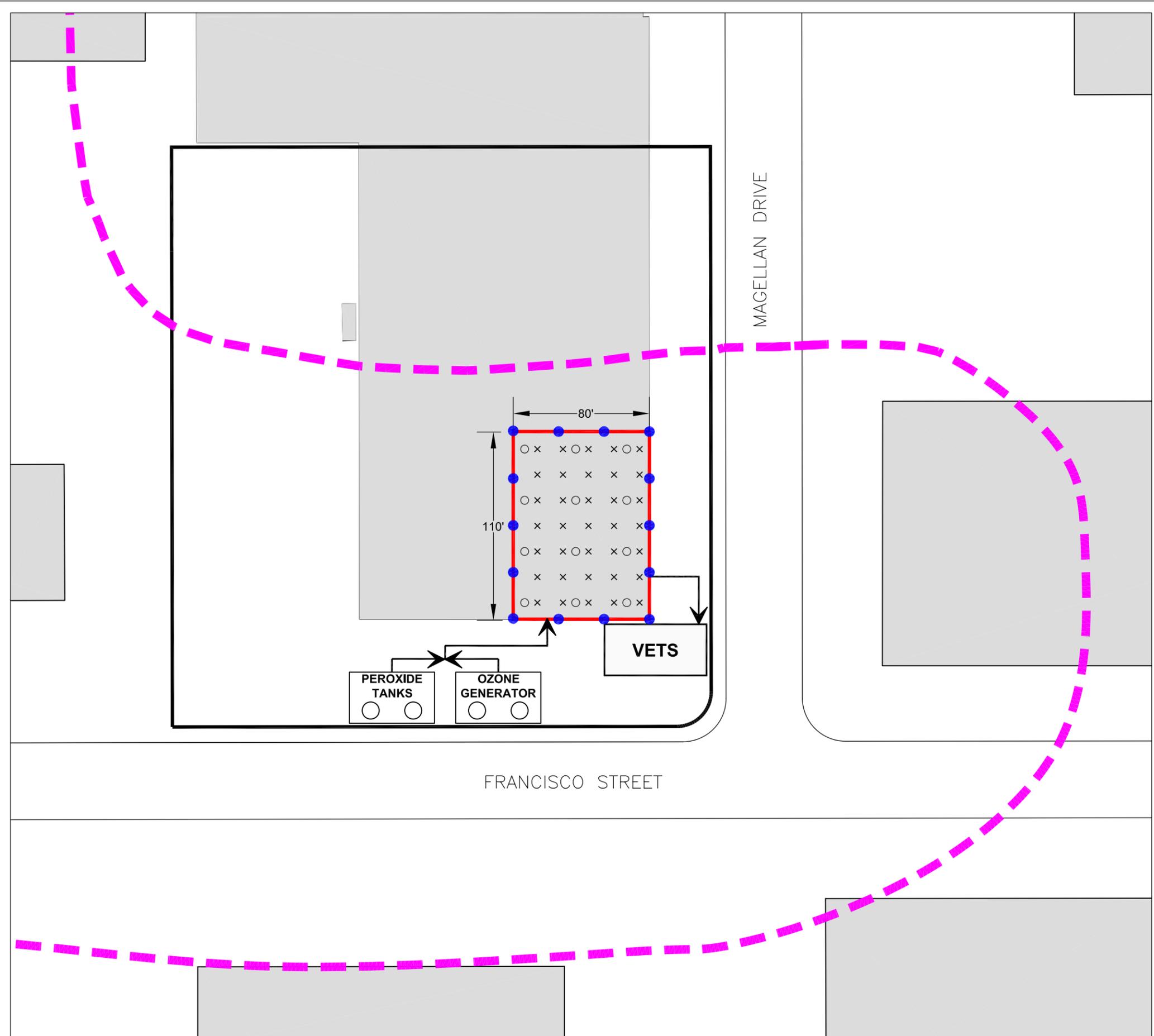
-  Assumed extent of NAPL based on dissolved VOC concentrations and locations of former facilities
-  Area where LNAPL could potentially be present based on dissolved concentrations in groundwater (>5% of solubility)
-  Parcel boundary
-  Groundwater Extraction Well (30-foot spacing)
-  Vapor Extraction Treatment System
-  Groundwater Treatment System
-  SVE/BV vertical well (approximately 70-foot spacing).



FIGURE 7.9-3A
Alternative 4A
 HYDRAULIC EXTRACTION, SVE/BV (UB),
 ICS AND MONITORING
 - VERTICAL WELLS
 Parcel No. 7351-034-047
 Source Area 8
 Del Amo Soil + NAPL FS



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Legend

- Assumed extent of NAPL based on dissolved VOC concentrations and locations of former facilities
- Area where LNAPL could potentially be present based on dissolved concentrations in groundwater (>5% of solubility)
- Parcel boundary
- VETS Vapor Extraction Treatment System
- x ISCO injection well (15-foot spacing)
- SVE sentry well (30-foot spacing)
- SVE interior well, dual screen (30-foot spacing)

Notes:

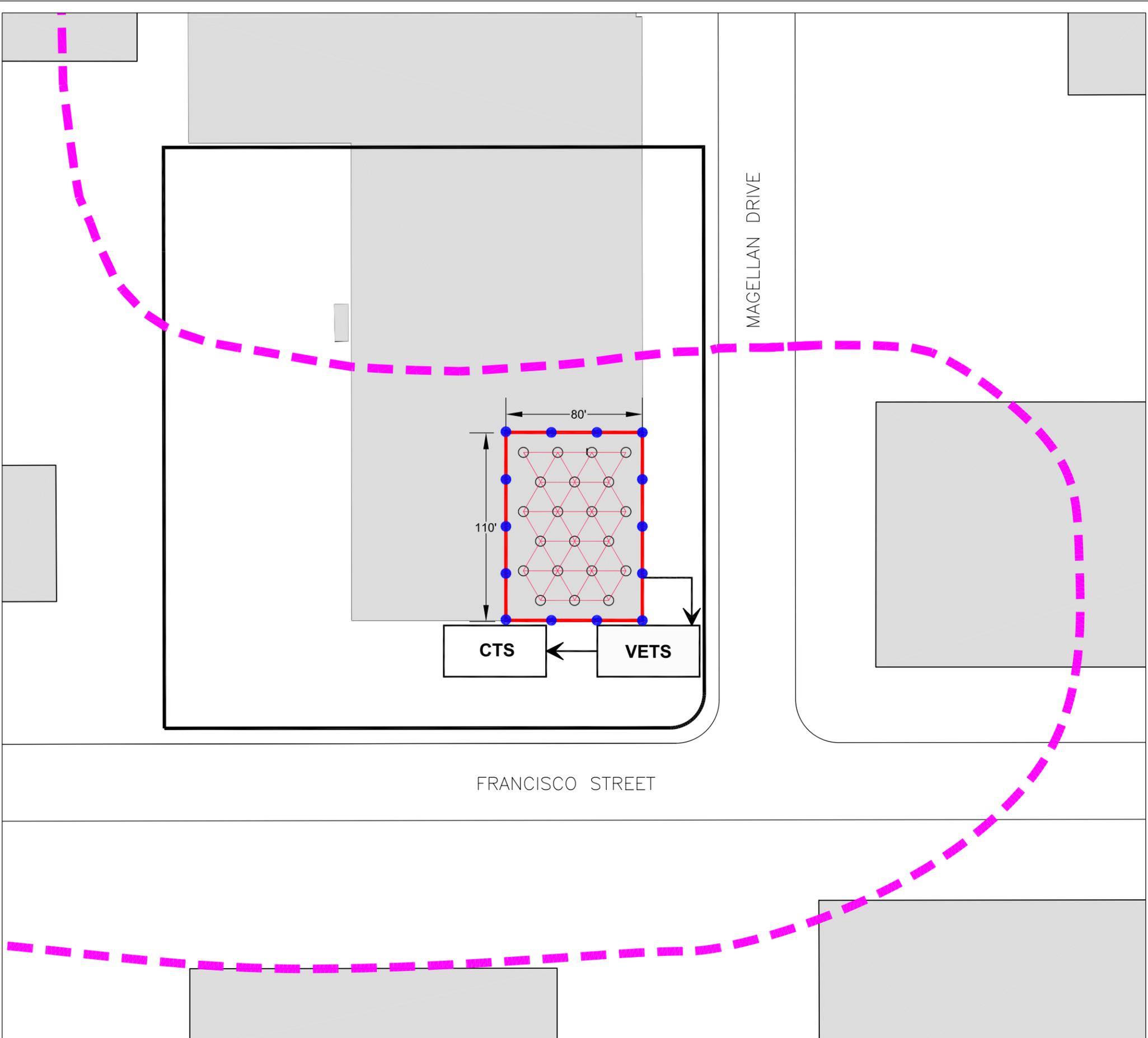
- (1) Temperature monitoring points are not shown on the figure. These points would typically be distributed throughout the source area at a 50-75 foot spacing.
- (2) SVE radius of influence circles are not shown for each well due to the large number of closely spaced wells in the figure.



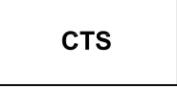
FIGURE 7.9-4
Alternative 5
IN-SITU CHEMICAL OXIDATION, SVE,
ICS AND MONITORING
Parcel No. 7351-034-047
 Source Area 8
 Del Amo Soil + NAPL FS



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Legend

-  Assumed extent of NAPL based on dissolved VOC concentrations and locations of former facilities
-  Area where LNAPL could potentially be present based on dissolved concentrations in groundwater (>5% of solubility)
-  Parcel boundary
-  VETS Vapor Extraction Treatment System
-  SVE sentry well (30-foot spacing)
-  ERH electrode and SVE interior well, dual screen (20-foot spacing)
-  CTS Condensate Treatment System

Notes:

- (1) Temperature monitoring points are not shown on the figure. These points would typically be distributed throughout the source area at a 50-75 foot spacing.
- (2) SVE radius of influence circles are not shown for each well due to the large number of closely spaced wells in the figure.



FIGURE 7.9-5
Alternative 6
IN-SITU SOIL HEATING, SVE,
ICS AND MONITORING
Parcel No. 7351-034-047

Source Area 8
 Del Amo Soil + NAPL FS



TABLE E.8-1
SOURCE AREA 8 - REMEDIAL ALTERNATIVE 2
ICs + MONITORING COST ESTIMATE
Soil and NAPL FS
Del Amo Superfund Site

	Description	Estimated Quantity	Unit	Unit Cost	Estimated Cost
Item No.	Direct Capital Costs				
1	ICs Design, Documentation, Implementation	1	ls	\$ 5,110	\$ 5,110
Direct Capital Total					\$ 5,000
Item No.	Indirect Capital Costs				
1	Project Management	10%	of	\$ 5,000	\$ 500
Indirect Capital Subtotal					\$ 500
Total Direct + Indirect Capital Cost					\$ 5,500
Item No.	Operation and Maintenance Costs				
1	Institutional Controls, Inspections, Monitoring	1	year	\$ 2,175	\$ 2,175
2	Groundwater Monitoring	1	year	\$ 15,000	\$ 15,000
ICs Annual Operation and Maintenance Subtotal					\$ 17,175
Present Worth of ICs Operation and Maintenance Costs (5%, 100 Years)					\$ 341,000
Contingency (20% of total project cost)					\$ 69,000
Total Capital and ICs O&M Cost					\$ 416,000

NOTES/ASSUMPTIONS

1. ICs include IC layers 1 and 2.
2. ICs capital and O&M costs are estimated based on applicable IC layers per parcel as shown in Tables D3-1 and D3-2.

TABLE E.8-2
SOURCE AREA 8 - REMEDIAL ALTERNATIVE 3
SVE/BV COST ESTIMATE
Soil and NAPL FS
Del Amo Superfund Site

	Description	Estimated Quantity	Unit	Unit Cost	Estimated Cost
Item No.	Direct Capital Costs				
1	Site Investigation/Delineation	1	ls	\$ 56,000	\$ 56,000
2	Mobilization/Demobilization	8,800	sf	\$ 1.25	\$ 11,000
3	Electrical Service/ hookup/Utilities	1	ls	\$ 20,000	\$ 20,000
4	Site Preparation/Geophysical	8,800	sf	\$ 0.8	\$ 8,000
5	SVE Wells	2	ea	\$ 25,000	\$ 50,000
6	Well Headworks/Vault (24" traffic rated)	2	ea	\$ 3,000	\$ 6,000
7	VETS Installation and Startup	1	ls	\$ 50,000	\$ 50,000
8	SVE Blower + Thermal Oxidizer; 400 cfm	1	ls	\$ 80,000	\$ 80,000
9	Control and Instrumentation	1	ls	\$ 6,000	\$ 6,000
10	Misc Treat System: Tanks, Piping, Pumps, Fittings	1	ls	\$ 10,000	\$ 10,000
11	Trenching, Piping, Backfill and Resurfacing	300	lf	\$ 30	\$ 9,000
12	Equipment Pad/Enclosure/Fence	1	ea	\$ 20,000	\$ 20,000
13	Post Treatment Sampling + Analysis	4	borings	\$ 7,000	\$ 28,000
Direct Capital Total					\$ 354,000
Item No.	Indirect Capital Costs				
1	Engineering, Design, and Permitting	15%	of	\$ 354,000	\$ 54,000
2	Project Management, Agency Reporting/Coordination	8%	of	\$ 354,000	\$ 29,000
3	Construction Management	10%	of	\$ 354,000	\$ 36,000
Indirect Capital Subtotal					\$ 119,000
Total Direct + Indirect Capital Cost					\$ 473,000
Item No.	Operation and Maintenance Cost				
1	Fuel: Natural Gas (Thermal Oxidizer)	12	mths	\$ 8,000	\$ 96,000
2	Electricity: SVE blower, misc equip	12	mths	\$ 2,700	\$ 32,400
3	Operations & Maintenance	12	mths	\$ 5,000	\$ 60,000
4	Maintenance (hardware, filters, monitoring equipment)	12	mths	\$ 2,000	\$ 24,000
5	Vapor Treatment System Influent/Effluent Monitoring/Lab Costs	12	mths	\$ 3,000	\$ 36,000
6	Project Management/Consultant support/Reports	12	mths	\$ 4,000	\$ 48,000
7	Waste/NAPL/Water Disposal	12	mths	\$ 2,000	\$ 24,000
8	Health & Safety/Air Monitoring	1	ls	\$ 3,000	\$ 3,000
9	Miscellaneous: Equipment rentals, PID/FID	12	mths	\$ 3,000	\$ 36,000
SVE Annual Operation and Maintenance Subtotal					\$ 360,000
SVE Present Worth of Operation and Maintenance Costs (5%, 4 Years)					\$ 1,277,000
Present Worth of ICs + Monitoring (5%, 100 Years) Costs					\$ 416,000
Contingency (20% of SVE)					\$ 350,000
Total Capital and O&M Cost Present Worth					\$ 2,516,000

NOTES/ASSUMPTIONS

1. Benzene SVE (UB) system: Uses 2 H-SVE wells with average 80 feet screens installed @ 30 feet bgs.
2. Vapor treatment system uses thermal oxidizer, 400 scfm, positive displacement (PD) blower.
3. Assume SVE operation for 4 years.

TABLE E.8-2A
SOURCE AREA 8 - REMEDIAL ALTERNATIVE 3A
SVE/BV COST ESTIMATE
Soil and NAPL FS
Del Amo Superfund Site

Description		Estimated Quantity	Unit	Unit Cost	Estimated Cost
Item No.	Direct Capital Costs				
1	Site Investigation/Delineation	1	ls	\$ 56,000	\$ 56,000
1	Mobilization/Demobilization	8,800	sf	\$ 1.25	\$ 11,000
2	Electrical Service/ hookup/Utilities	1	ls	\$ 20,000	\$ 20,000
3	Site Preparation/Geophysical	8,800	sf	\$ 0.8	\$ 8,000
4	SVE Vertical Wells	2	ea	\$ 7,500	\$ 15,000
5	Well Headworks/Vault (24" traffic rated)	2	ea	\$ 3,000	\$ 6,000
6	VETS Installation and Startup	1	ls	\$ 50,000	\$ 50,000
7	SVE Blower + Thermal Oxidizer; 150 cfm	1	ls	\$ 60,000	\$ 60,000
8	Control and Instrumentation	1	ls	\$ 5,000	\$ 5,000
9	Misc Treat System: Tanks, Piping, Pumps, Fittings	1	ls	\$ 10,000	\$ 10,000
10	Trenching, Piping, Backfill and Resurfacing	200	lf	\$ 50	\$ 10,000
11	Equipment Pad/Enclosure/Fence	1	ea	\$ 20,000	\$ 20,000
12	Post Treatment Sampling + Analysis	4	borings	\$ 7,000	\$ 28,000
Direct Capital Total					\$ 299,000
Item No.	Indirect Capital Costs				
1	Engineering, Design, and Permitting	15%	of	\$ 299,000	\$ 45,000
2	Project Management, Agency Reporting/Coordination	8%	of	\$ 299,000	\$ 24,000
3	Construction Management	10%	of	\$ 299,000	\$ 30,000
Indirect Capital Subtotal					\$ 99,000
Total Direct + Indirect Capital Cost					\$ 398,000
Item No.	Operation and Maintenance Cost				
1	Fuel: Natural Gas (Thermal Oxidizer)	12	mths	\$ 5,000	\$ 60,000
2	Electricity: SVE blower, misc equip	12	mths	\$ 1,500	\$ 18,000
3	Operations & Maintenance	12	mths	\$ 5,000	\$ 60,000
4	Maintenance (hardware, filters, monitoring equipment)	12	mths	\$ 2,000	\$ 24,000
5	Vapor Treatment System Influent/Effluent Monitoring/Lab Costs	12	mths	\$ 3,000	\$ 36,000
6	Project Management/Consultant support/Reports	12	mths	\$ 4,000	\$ 48,000
7	Waste/NAPL/Water Disposal	12	mths	\$ 2,000	\$ 24,000
8	Health & Safety/Air Monitoring	1	ls	\$ 3,000	\$ 3,000
9	Miscellaneous: Equipment rentals, PID/FID	12	mths	\$ 3,000	\$ 36,000
SVE Annual Operation and Maintenance Subtotal					\$ 309,000
SVE Present Worth of Operation and Maintenance Costs (5%, 4 Years)					\$ 1,096,000
Present Worth of ICs + Monitoring (5%, 100 Years) Costs					\$ 416,000
Contingency (20% of SVE)					\$ 299,000
Total Capital and O&M Cost Present Worth					\$ 2,209,000

NOTES/ASSUMPTIONS

1. SVE (OS) system: Uses 2 V-SVE wells, 30-50 feet bgs screens.
2. Vapor treatment system uses thermal oxidizer, 150 scfm, positive displacement (PD) blower.
3. Assume SVE operation for 4 years.

TABLE E.8-3
SOURCE AREA 8 - REMEDIAL ALTERNATIVE 4
HYDRAULIC EXTRACTION AND SVE/BV COST ESTIMATE
Soil and NAPL FS
Del Amo Superfund Site

Description		Estimated Quantity	Unit	Unit Cost	Estimated Cost
Item No.	Direct Capital Costs				
1	Site Investigation/Delineation	1	ls	\$ 56,000	\$ 56,000
2	Mobilization/Demobilization	8,800	sf	\$ 1.25	\$ 11,000
3	Electrical Service/Hookup	1	ls	\$ 40,000	\$ 40,000
4	Site Preparation/Geophysical	8,800	sf	\$ 0.8	\$ 8,000
5	SVE Horizontal Wells	2	ea	\$ 25,000	\$ 50,000
6	Groundwater Extraction Wells	9	ea	\$ 9,500	\$ 86,000
7	Well Headworks/Vault/Extraction Pumps (24" traffic rated)	11	ea	\$ 3,000	\$ 33,000
8	Treatment System Installation and Startup (SVE + Hyd Ext)	1	ls	\$ 100,000	\$ 100,000
9	SVE Blower + Thermal Oxidizer; 500 cfm	1	ls	\$ 80,000	\$ 80,000
10	Control and Instrumentation	1	ls	\$ 19,000	\$ 19,000
11	Advanced Oxidation Treatment system (9 gpm) (HyPOx)	1	ls	\$ 195,000	\$ 195,000
12	Air Stripping Unit+Blower (STAT 30)	1	ls	\$ 11,000	\$ 11,000
13	Carbon Adsorption Vessels - VPGAC and LPGAC	4	ls	\$ 10,000	\$ 40,000
14	Misc Treat System: OWS, Tanks, Piping, Pumps	1	ls	\$ 30,000	\$ 30,000
15	Trenching, Piping, Cables, Backfill and Resurfacing	500	lf	\$ 50	\$ 25,000
16	Equipment Pad/Enclosure/Fence	1	ea	\$ 30,000	\$ 30,000
17	Post Treatment Sampling + Analysis	4	borings	\$ 7,000	\$ 28,000
Direct Capital Total					\$ 842,000
Item No.	Indirect Capital Costs				
1	Engineering, Design, and Permitting	12%	of	\$ 842,000	\$ 102,000
2	Project Management, Agency Reporting/Coordination	6%	of	\$ 842,000	\$ 51,000
3	Construction Management	8%	of	\$ 842,000	\$ 68,000
Indirect Capital Subtotal					\$ 221,000
Total Direct+Indirect Cost					\$ 1,063,000
Item No.	Operation and Maintenance Cost				
1	Fuel:Natural Gas (Thermal oxidizer)	12	mths	\$ 9,000	\$ 108,000
2	Electricity (SVE blower, HiPOx, Air Stripper blower)	12	mths	\$ 7,500	\$ 90,000
3	Operations & Maintenance	12	mths	\$ 7,000	\$ 84,000
4	Chemicals for HiPOx: H2O2	12	mths	\$ 375	\$ 4,500
5	Carbon - Liquid Phase	12	mths	\$ 2,000	\$ 24,000
6	Carbon - Vapor Phase (post-thermal/catox)	12	mths	\$ 2,000	\$ 24,000
7	Groundwater/Vapor Treatment System Influent/Effluent Monitoring/Lab Costs	12	mths	\$ 8,000	\$ 96,000
8	Project Management/Consultant support/Reports	12	mths	\$ 8,000	\$ 96,000
9	Waste/NAPL/Water Disposal	12	mths	\$ 4,000	\$ 48,000
10	Health & Safety/Air Monitoring	1	ls	\$ 6,000	\$ 6,000
11	Miscellaneous: Equipment rentals, PID/FID	12	mths	\$ 5,000	\$ 60,000
SVE Annual Operation and Maintenance Subtotal					\$ 339,000
Present Worth of SVE Operation and Maintenance Costs (5%, 4 Years)					\$ 1,203,000
Hydraulic Extraction Annual Operation and Maintenance Subtotal					\$ 303,000
Present Worth of Hydraulic Extraction Operation and Maintenance Costs (5%, 10 Years)					\$ 2,340,000
Present Worth of ICs + Monitoring (5%, 100 Years) Costs					\$ 416,000
Contingency (20% of Hydraulic Extraction)					\$ 454,000
Total Capital and O&M Cost Present Worth					\$ 5,944,000

NOTES/ASSUMPTIONS

1. Benzene SVE (UB) system: Uses 2 H-SVE wells with average 80 feet screens installed @ 30-35 feet bgs.
2. Vapor treatment system uses thermal oxidizer, 500 scfm, positive displacement (PD) blower.
3. Assume SVE operation for 4 years.
4. Hydraulic extraction system: Uses 9 groundwater extraction wells, 50-80 feet bgs screens with a max extraction flow rate of 9 gpm.
5. Water is treated by oil-water separator (OWS), APT's HiPOx (H2O2+Ozone) system and air stripping with discharge to storm drain.
6. Liquid phase carbon is used as a backup or polishing treatment process. Assumes 2 carbon changeouts per month.
7. Assume hydraulic extraction operation for 10 years.
8. Vapor phase carbon is used after SVE operation is completed to treat air stripper discharge. Assumes 1 carbon changeout/month.
9. Groundwater is extracted from UBF/MBF and some wells are expected to go dry.

TABLE E.8-3A
SOURCE AREA 8 - REMEDIAL ALTERNATIVE 4A
HYDRAULIC EXTRACTION AND SVE/BV COST ESTIMATE
Soil and NAPL FS
Del Amo Superfund Site

	Description	Estimated Quantity	Unit	Unit Cost	Estimated Cost
Item No.	Direct Capital Costs				
1	Site Investigation/Delineation	1	ls	\$ 56,000	\$ 56,000
2	Mobilization/Demobilization	8,800	sf	\$ 1.25	\$ 11,000
3	Electrical Service/Hookup	1	ls	\$ 40,000	\$ 40,000
4	Site Preparation/Geophysical	8,800	sf	\$ 0.8	\$ 8,000
5	SVE Vertical Wells	2	ea	\$ 7,500	\$ 15,000
6	Groundwater Extraction Wells	6	ea	\$ 11,500	\$ 69,000
7	Well Headworks/Vault/Extraction Pumps (24" traffic rated)	8	ea	\$ 3,000	\$ 24,000
8	Treatment System Installation and Startup (SVE + Hyd Ext)	1	ls	\$ 100,000	\$ 100,000
9	SVE Blower + Thermal Oxidizer; 300 cfm	1	ls	\$ 75,000	\$ 75,000
10	Control and Instrumentation	1	ls	\$ 19,000	\$ 19,000
11	Advanced Oxidation Treatment system (6 gpm) (HiPOx)	1	ls	\$ 195,000	\$ 195,000
12	Air Stripping Unit+Blower (STAT 30)	1	ls	\$ 11,000	\$ 11,000
13	Carbon Adsorption Vessels - VPGAC and LPGAC	4	ls	\$ 10,000	\$ 40,000
14	Misc Treat System: OWS, Tanks, Piping, Pumps	1	ls	\$ 30,000	\$ 30,000
15	Trenching, Piping, Cables, Backfill and Resurfacing	500	lf	\$ 50	\$ 25,000
16	Equipment Pad/Enclosure/Fence	1	ea	\$ 50,000	\$ 50,000
17	Post Treatment Sampling + Analysis	4	borings	\$ 7,000	\$ 28,000
Direct Capital Total					\$ 796,000
Item No.	Indirect Capital Costs				
1	Engineering, Design, and Permitting	12%	of	\$ 796,000	\$ 96,000
2	Project Management, Agency Reporting/Coordination	6%	of	\$ 796,000	\$ 48,000
3	Construction Management	8%	of	\$ 796,000	\$ 64,000
Indirect Capital Subtotal					\$ 208,000
Total Direct+Indirect Cost					\$ 1,004,000
Item No.	Operation and Maintenance Cost				
1	Fuel:Natural Gas (Thermal oxidizer)	12	mths	\$ 7,000	\$ 84,000
2	Electricity (SVE blower, HiPOx, Air Stripper blower)	12	mths	\$ 6,600	\$ 79,200
3	Operations & Maintenance	12	mths	\$ 7,000	\$ 84,000
4	Chemicals for HiPOx: H2O2	12	mths	\$ 375	\$ 4,500
5	Carbon - Liquid Phase	12	mths	\$ 2,000	\$ 24,000
6	Carbon - Vapor Phase (post-thermal/catox)	12	mths	\$ 2,000	\$ 24,000
7	Groundwater/Vapor Treatment System Influent/Effluent Monitoring/Lab Costs	12	mths	\$ 8,000	\$ 96,000
8	Project Management/Consultant support/Reports	12	mths	\$ 8,000	\$ 96,000
9	Waste/NAPL/Water Disposal	12	mths	\$ 4,000	\$ 48,000
10	Health & Safety/Air Monitoring	1	ls	\$ 6,000	\$ 6,000
11	Miscellaneous: Equipment rentals, PID/FID	12	mths	\$ 5,000	\$ 60,000
SVE Annual Operation and Maintenance Subtotal					\$ 309,000
Present Worth of SVE Operation and Maintenance Costs (5%, 4 Years)					\$ 1,096,000
Hydraulic Extraction Annual Operation and Maintenance Subtotal					\$ 297,000
Present Worth of Hydraulic Extraction Operation and Maintenance Costs (5%, 10 Years)					\$ 2,294,000
Present Worth of ICs + Monitoring (5%, 100 Years) Costs					\$ 416,000
Contingency (20% of Hydraulic Extraction)					\$ 879,000
Total Capital and O&M Cost Present Worth					\$ 5,689,000

NOTES/ASSUMPTIONS

- SVE (OS) system: Uses 2 V-SVE wells, 30-50 feet bgs screens.
- Vapor treatment system uses thermal oxidizer, 300 scfm, positive displacement (PD) blower.
- Assume SVE operation for 4 years.
- Hydraulic extraction system: Uses 6 groundwater extraction wells, 50-80 feet bgs screens with a max extraction flow rate of 6 gpm.
- Water is treated by oil-water separator (OWS), APT's HiPOx (H2O2+Ozone) system and air stripping with discharge to storm drain.
- Liquid phase carbon is used as a backup or polishing treatment process. Assumes 2 carbon changeouts per month.
- Assume hydraulic extraction operation for 10 years.
- Vapor phase carbon is used after SVE operation is completed to treat air stripper discharge. Assumes 1 carbon changeout/month.
- Groundwater is extracted from UBF/MBF and some wells are expected to go dry.

TABLE E.8-4
SOURCE AREA 8 - REMEDIAL ALTERNATIVE 5
IN-SITU CHEMICAL OXIDATION AND SVE COST ESTIMATE
Soil and NAPL FS
Del Amo Superfund Site

	Description	Estimated Quantity	Unit	Unit Cost	Estimated Cost
Item No.	Direct Capital Costs				
1	Site Investigation/Delineation	1	ls	\$ 128,000	\$ 128,000
2	Mobilization/Demobilization	8,800	sf	\$ 1.5	\$ 14,000
3	Electrical Service/Hookup	1	ls	\$ 40,000	\$ 40,000
4	Site Preparation/Geophysical survey	8,800	sf	\$ 0.8	\$ 8,000
5	Chemical Injection Points/Wells	105	ea	\$ 4,800	\$ 504,000
6	Vapor Extraction Wells (Interior)	12	ea	\$ 7,500	\$ 90,000
7	Vapor Extraction Wells (Sentry)	14	ea	\$ 7,500	\$ 105,000
8	Monitoring Wells/Temp Mon Points	2	ea	\$ 12,000	\$ 24,000
9	Well Headworks/Vault - Injection Wells (36-inch traffic rated)	35	ea	\$ 4,000	\$ 140,000
10	Well Headworks/Vault - SVE/Monit. Wells (24-inch traffic rated)	28	ea	\$ 3,000	\$ 84,000
11	Treatment System Installation and Startup	1	ls	\$ 100,000	\$ 100,000
12	Misc. Treatment Sys Equipment: tanks, piping..	1	ls	\$ 40,000	\$ 40,000
13	SVE Equipment : 500 CFM Blower+ThermOx	1	ls	\$ 80,000	\$ 80,000
14	Ozone Generation System, 20 ppd (air supply, generator, and manifold system)	1	units	\$ 120,000	\$ 120,000
15	Control and Instrumentation (includes ozone / peroxide distribution manifold and controls)	1	ls	\$ 31,200	\$ 32,000
16	Trenching, Piping, Backfill and Resurfacing	1,100	lf	\$ 50	\$ 55,000
17	Equipment Pad/Enclosure/Fence	1	ea	\$ 40,000	\$ 40,000
18	Post Treatment Sampling + Analysis	4	borings	\$ 7,000	\$ 28,000
				Direct Capital Total	\$ 1,632,000
Item No.	Indirect Capital Costs				
1	Engineering, Design, and Permitting	8%	of	\$ 1,632,000	\$ 131,000
2	Project Management, Agency Reporting/Coordination	5%	of	\$ 1,632,000	\$ 82,000
3	Construction Management	6%	of	\$ 1,632,000	\$ 98,000
				Indirect Capital Subtotal	\$ 311,000
				Total Direct + Indirect Capital Cost	\$ 1,943,000
Item No.	Operation and Maintenance Cost				
1	Fuel: Natural Gas (Thermal oxidizer)	12	mths	\$ 9,000	\$ 108,000
2	Electricity: (SVE Blower, Ozone Gen, misc electrical equip)	12	mths	\$ 9,600	\$ 115,200
3	SVE System Operation and Monitoring Labor	12	units	\$ 8,000	\$ 96,000
4	SVE Maintenance Materials and Expenses	12	mths	\$ 4,000	\$ 48,000
5	Chemicals: H2O2 (refer to note 5)	35	wells	\$ 4,000	\$ 140,000
6	ISCO Consultant Oversight	12	mths	\$ 8,000	\$ 96,000
7	SVE Vapor Treatment System Influent/Effluent Monitoring/Lab Costs	12	mths	\$ 5,000	\$ 60,000
8	SVE / ISCO Soil and Groundwater Monitoring/Sampling Analytical Lab Costs (semi annually)	2	rounds	\$ 35,000	\$ 70,000
9	Project Management/Consultant support/Reports	12	mths	\$ 10,000	\$ 120,000
10	Waste Disposal	12	mths	\$ 5,000	\$ 60,000
11	H&S/Air Monitoring	1	ls	\$ 8,000	\$ 8,000
12	Miscellaneous: Equipment rentals, PID/FID	12	mths	\$ 8,000	\$ 96,000
				SVE Annual Operation and Maintenance Subtotal	\$ 555,000
				Present Worth of SVE Operation and Maintenance Costs (5%, 4 Years)	\$ 1,969,000
				ISCO Annual Operation and Maintenance Subtotal	\$ 463,000
				Present Worth of ISCO Operation and Maintenance Costs (5%, 2 Years)	\$ 861,000
				Present Worth of ICs + Monitoring (5%, 100 Years) Costs	\$ 416,000
				Contingency (40% of ISCO)	\$ 1,910,000
				Total Capital and O&M Cost Present Worth	\$ 7,099,000

NOTES/ASSUMPTIONS

1. Assume 12 SVE wells with dual screens 15-30 and 30-50 feet bgs and 14 SVE sentry wells with 15-30 feet bgs screens.
2. Vapor treatment system uses thermal oxidizer, 500 scfm, positive displacement (PD) blower.
3. Assume SVE operation for 4 years.
4. ISCO uses 35 direct push injection wells, each well a cluster of three 3/4"-SS injection points screened at 3 depths between 50-80 feet bgs.
5. Assume injection of 4,000 gal of 20% H2O2 per well for 2 year treatment for total of 140,000 gal of H2O2.
6. Assume injection of 300 lbs of O3 per well for 2 year treatment for total of 10,500 lbs. of O3.
7. Assume ISCO treatment system operates continuously for 2-year treatment with a 70% up time equivalent to 511 days.

TABLE E.8-5
SOURCE AREA 8 - REMEDIAL ALTERNATIVE 6
IN-SITU SOIL HEATING AND SVE COST ESTIMATE
Soil and NAPL FS
Del Amo Superfund Site

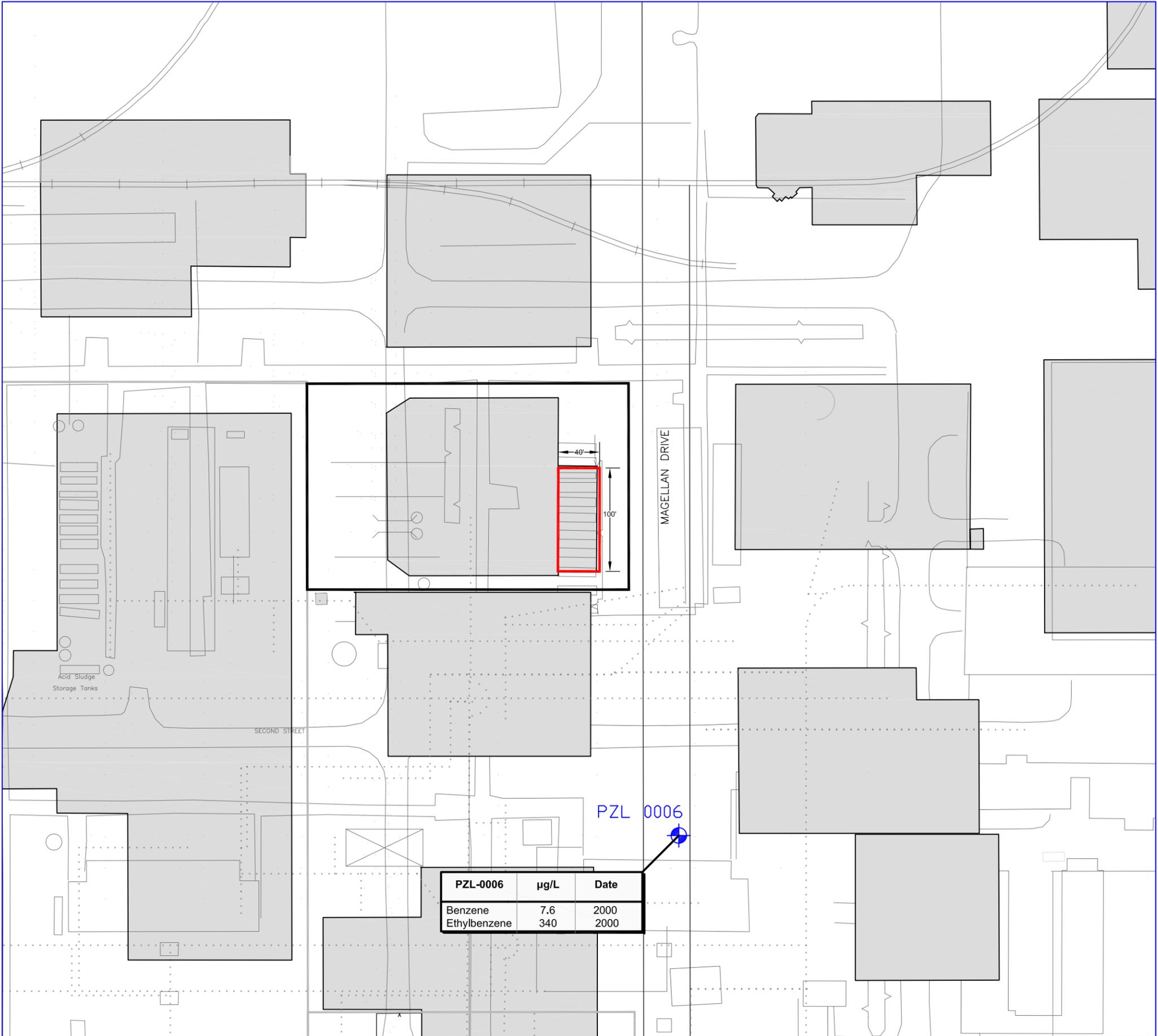
Description		Estimated Quantity	Unit	Unit Cost	Estimated Cost
Item No.	Direct Capital Costs				
1	Site Investigation/Delineation	1	ls	\$ 128,000	\$ 128,000
2	Mobilization/Demobilization	8,800	sf	\$ 1.5	\$ 14,000
3	Electrical Service/ hookup 12kV, 60A, 3Φ	1	ls	\$ 50,000	\$ 50,000
4	Site Preparation/Geophysical	8,800	sf	\$ 0.8	\$ 8,000
5	Transformers/Power Controls	1	ls	\$ 120,000	\$ 120,000
6	Electrode/Vapor Extraction Wells	21	ea	\$ 13,000	\$ 273,000
7	Vapor Extraction Wells - Sentry	14	ea	\$ 7,500	\$ 105,000
8	Monitoring Wells	4	ea	\$ 12,000	\$ 48,000
9	Temperature Monitoring Points/Thermocouples	4	ea	\$ 12,000	\$ 48,000
10	Well Headworks/Vault (24" traffic rated)	43	ea	\$ 3,000	\$ 129,000
11	Treatment System Installation and Startup (Vapor and Liquid)	1	ls	\$ 120,000	\$ 120,000
12	High Vac Blower + Thermal Oxidizer; 1,500 cfm	1	unit	\$ 130,000	\$ 130,000
13	Control and Instrumentation	1	ls	\$ 45,000	\$ 45,000
14	Condensed Water Treatment System, 10 gpm (HiPOx, LPGAC)	1	ls	\$ 210,000	\$ 210,000
15	Trenching, Piping, Cables, Backfill and Resurfacing	1,200	lf	\$ 50	\$ 60,000
16	Equipment Pad/Enclosure/Fence/Berms/Trailer	1	ea	\$ 50,000	\$ 50,000
17	PreTreatment Sampling+Analysis (Sampling during well installation)	1	ls	\$ 50,000	\$ 50,000
18	Post Treatment Sampling + Analysis	4	borings	\$ 7,000	\$ 28,000
Direct Capital Total					\$ 1,616,000
Item No.	Indirect Capital Costs				
1	Engineering, Design, and Permitting	12%	of	\$ 1,616,000	\$ 194,000
2	Project Management, Agency Reporting/Coordination	6%	of	\$ 1,616,000	\$ 97,000
3	Construction Management	8%	of	\$ 1,616,000	\$ 130,000
Indirect Capital Subtotal					\$ 421,000
Total Direct + Indirect Capital Cost					\$ 2,037,000
Item No.	Operation and Maintenance Cost				
1	Electricity - ERH for soil heating	12	units	\$ 24,400	\$ 292,800
2	Electricity - SVE, HiPOx and misc elec equip	12	units	\$ 11,600	\$ 139,200
3	Operations & Maintenance	12	mths	\$ 30,000	\$ 360,000
4	Fuel: Natural Gas (Thermal Oxidizer)	12	mths	\$ 21,000	\$ 252,000
5	Liquid Phase Carbon	12	mths	\$ 4,000	\$ 48,000
6	Chemicals for water treatment: H2O2	12	mths	\$ 375	\$ 5,000
7	Labor - Groundwater/Vapor Treatment System Influent/Effluent Monitoring	12	mths	\$ 15,000	\$ 180,000
8	Project Management/Consultant Support/Reports	12	mths	\$ 15,000	\$ 180,000
9	Waste/NAPL/Water Disposal	12	mths	\$ 6,000	\$ 72,000
10	Health & Safety/Air Monitoring	12	mths	\$ 8,000	\$ 96,000
11	Miscellaneous: Equipment rentals, PID/FID	12	mths	\$ 10,000	\$ 120,000
SVE + ERH Annual Operation and Maintenance Subtotal					\$ 1,745,000
Present Worth of SVE Operation and Maintenance Costs (5%, 2 Years)					\$ 3,245,000
Present Worth of ICs + Monitoring (5%, 100 Years) Costs					\$ 416,000
Contingency (40% of ERH)					\$ 2,113,000
Total Capital and O&M Cost Present Worth					\$ 7,811,000

NOTES/ASSUMPTIONS

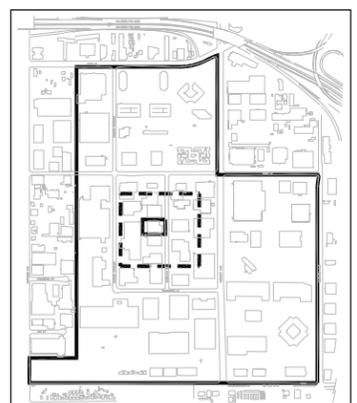
1. Assume 21 electrode SVE wells with dual conductive interval 25-50 and 50-80 ft bgs, dual-completed SVE with 15-30 and 30-50 ft bgs screens.
2. Assume 14 SVE sentry wells with 15-30 feet bgs screens.
3. Vapor treatment system uses thermal oxidizer, 1,500 scfm, positive displacement (PD) blower.
4. Condensate treatment system designed to treat 10 gpm using APT's HiPOx (H2O2+O3) system and LPGAC with discharge to storm drain.
5. Assume ERH+SVE operation for 2 years.
6. Assume average power usage of 163,000 KWhr/month and total electrical energy of 3.9 million KWhr for soil heating.
7. Assume system heating time on average of 50% of days in year.
8. Power conditioning unit (transformer) assumed to be rented.

SOURCE AREA 5

T:\Del_Amo\2007\treatment_system\figs_7-10_V4.dwg 5/22/08 (Santa Barbara Office)



- ### Legend
- Assumed extent of source area based on locations of former facilities
 - Approximate location of former underground pipelines with a potential to have transported VOC-containing fluids
 - Parcel boundary
 - Outlines of historical features with use/contents indicated
 - + Monitoring well location in water table zone



Area shown in this map

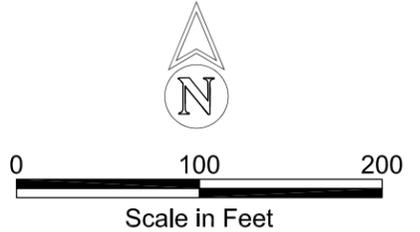
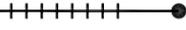


FIGURE 7.10-1
ASSUMED EXTENT OF CONTAMINATION
Parcel No. 7351-034-041

Source Area 5
 Del Amo Soil + NAPL FS

Legend

-  Assumed extent of NAPL source area based on locations of former facilities
-  Parcel boundary
-  Vapor Extraction Treatment System
-  Horizontal SVE/BV well (70-foot spacing) for deep soil under building (approximately 30-35 feet bgs)

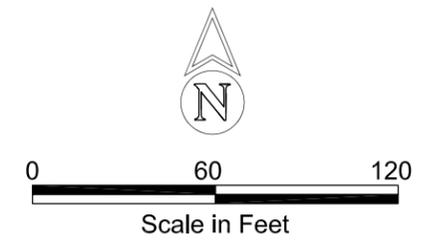
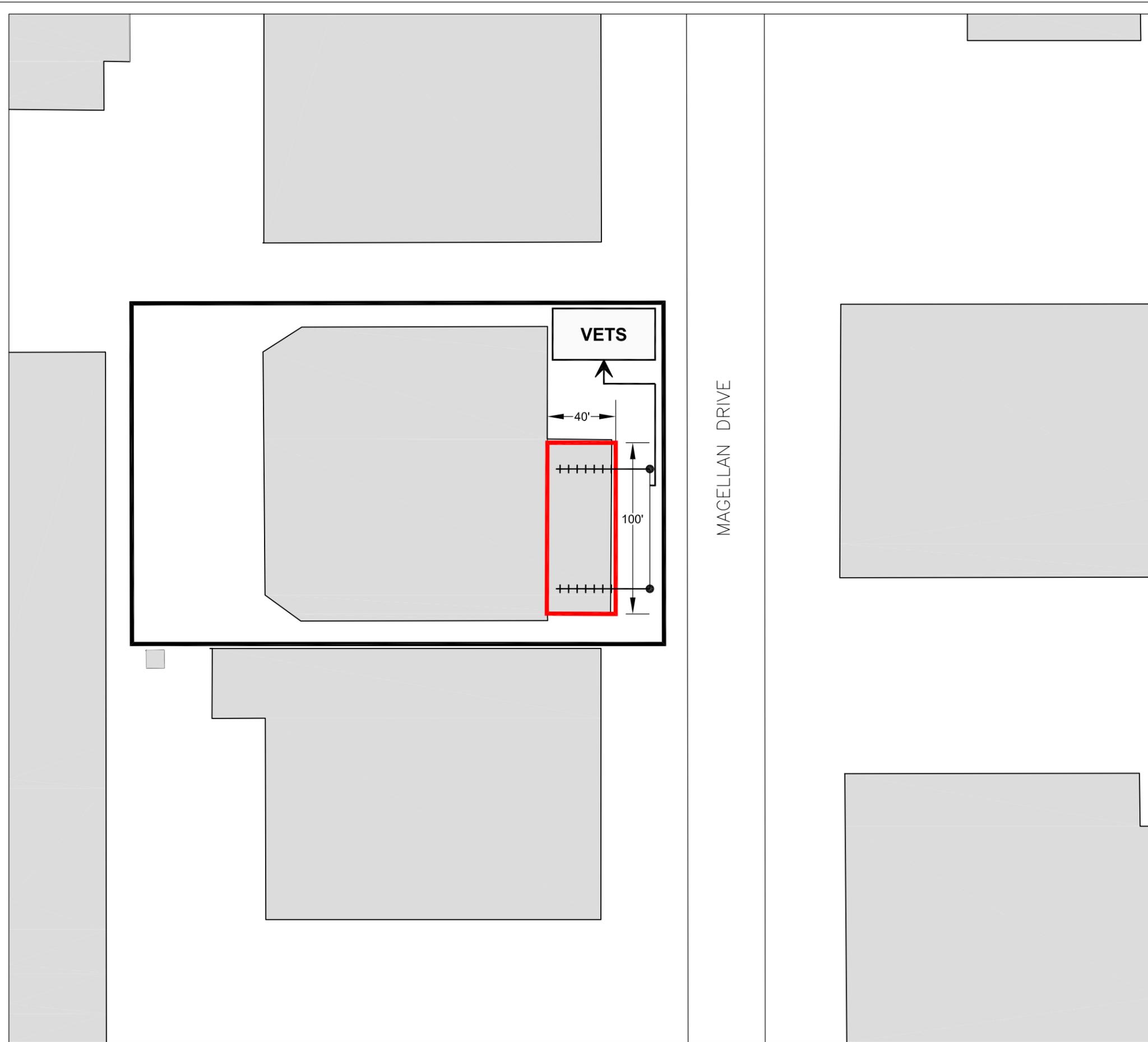
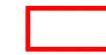


FIGURE 7.10-2
Alternative 3
SOIL VAPOR EXTRACTION/BIOVENTING (UB),
ICS AND MONITORING
- HORIZONTAL WELLS
Parcel No. 7351-034-041
Source Area 5
Del Amo Soil + NAPL FS



Legend



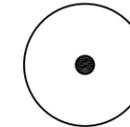
Assumed extent of source area based on locations of former facilities



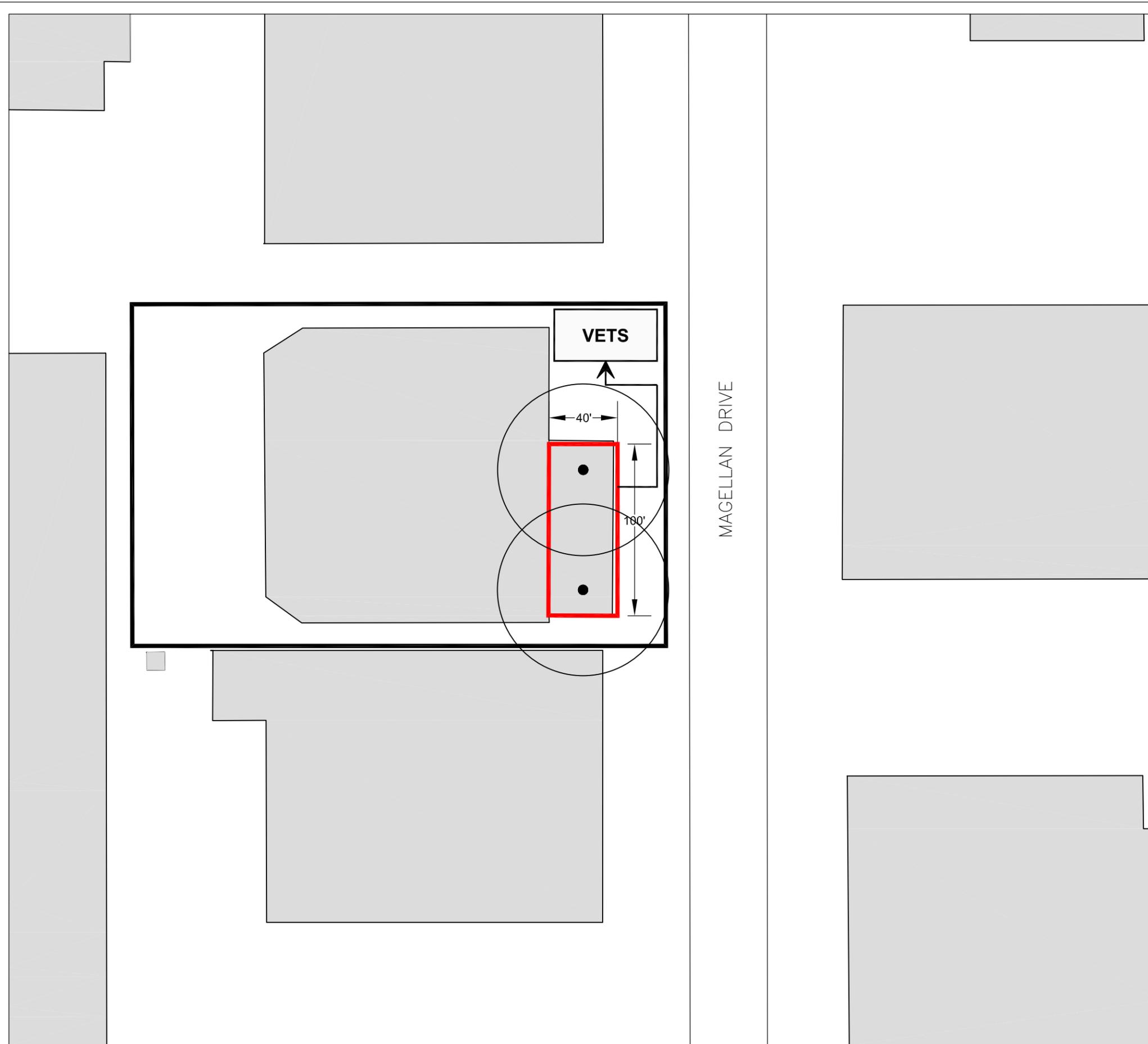
Parcel boundary



VETS Vapor Extraction Treatment System



SVE/BV vertical well (70-foot spacing), circle denotes assumed 50-foot radius of influence



Scale in Feet

FIGURE 7.10-2A

Alternative 3A
SOIL VAPOR EXTRACTION/BIOVENTING (UB),
ICS AND MONITORING
- VERTICAL WELLS
Parcel No. 7351-034-041
Source Area 5
Del Amo Soil + NAPL FS



TABLE E.9-1
SOURCE AREA 5 - REMEDIAL ALTERNATIVE 2
ICs + MONITORING COST ESTIMATE
Soil and NAPL FS
Del Amo Superfund Site

	Description	Estimated Quantity	Unit	Unit Cost	Estimated Cost
Item No.	Direct Capital Costs				
1	ICs Design, Documentation, Implementation	1	ls	\$ 5,110	\$ 5,110
Direct Capital Total					\$ 5,000
Item No.	Indirect Capital Costs				
1	Project Management	10%	of	\$ 5,000	\$ 500
Indirect Capital Subtotal					\$ 500
Total Direct + Indirect Capital Cost					\$ 5,500
Item No.	Operation and Maintenance Costs				
1	Institutional Controls, Inspections, Monitoring	1	year	\$ 2,175	\$ 2,175
2	Groundwater Monitoring	1	year	\$ 15,000	\$ 15,000
ICs Annual Operation and Maintenance Subtotal					\$ 17,175
Present Worth of ICs Operation and Maintenance Costs (5%, 100 Years)					\$ 341,000
Contingency (20% of total project cost)					\$ 69,000
Total Capital and ICs O&M Cost					\$ 416,000

NOTES/ASSUMPTIONS

1. ICs include IC layers 1 and 2.
2. ICs capital and O&M costs are estimated based on applicable IC layers per parcel as shown in Tables D3-1 and D3-2.

TABLE E.9-2
SOURCE AREA 5 - REMEDIAL ALTERNATIVE 3
SVE/BV COST ESTIMATE
Soil and NAPL FS
Del Amo Superfund Site

Description		Estimated Quantity	Unit	Unit Cost	Estimated Cost
Item No.	Direct Capital Costs				
1	Site Investigation/Delineation	1	ls	\$ 36,000	\$ 36,000
2	Mobilization/Demobilization	4,000	sf	\$ 1.25	\$ 5,000
3	Electrical Service/ hookup/Utilities	1	ls	\$ 15,000	\$ 15,000
4	Site Preparation/Geophysical	4,000	sf	\$ 0.8	\$ 4,000
5	SVE Wells	2	ea	\$ 25,000	\$ 50,000
6	Well Headworks/Vault (24" traffic rated)	2	ea	\$ 3,000	\$ 6,000
7	VETS Installation and Startup	1	ls	\$ 50,000	\$ 50,000
8	SVE Blower + Thermal Oxidizer; 200 cfm	1	ls	\$ 65,000	\$ 65,000
9	Control and Instrumentation	1	ls	\$ 5,000	\$ 5,000
10	Misc Treat System: Tanks, Piping, Pumps, Fittings	1	ls	\$ 10,000	\$ 10,000
11	Trenching, Piping, Backfill and Resurfacing	300	lf	\$ 30	\$ 9,000
12	Equipment Pad/Enclosure/Fence	1	ea	\$ 20,000	\$ 20,000
13	Post Treatment Sampling + Analysis	2	borings	\$ 7,000	\$ 14,000
Direct Capital Total					\$ 289,000
Item No.	Indirect Capital Costs				
1	Engineering, Design, and Permitting	15%	of	\$ 289,000	\$ 44,000
2	Project Management, Agency Reporting/Coordination	8%	of	\$ 289,000	\$ 24,000
3	Construction Management	10%	of	\$ 289,000	\$ 29,000
Indirect Capital Subtotal					\$ 97,000
Total Direct + Indirect Capital Cost					\$ 386,000
Item No.	Operation and Maintenance Cost				
1	Fuel: Natural Gas (Thermal Oxidizer)	12	mths	\$ 6,000	\$ 72,000
2	Electricity: SVE blower, misc equip	12	mths	\$ 1,700	\$ 20,400
3	Operations & Maintenance	12	mths	\$ 4,000	\$ 48,000
4	Maintenance (hardware, filters, monitoring equipment)	12	mths	\$ 2,000	\$ 24,000
5	Vapor Treatment System Influent/Effluent Monitoring/Lab Costs	12	mths	\$ 3,000	\$ 36,000
6	Project Management/Consultant support/Reports	12	mths	\$ 4,000	\$ 48,000
7	Waste/NAPL/Water Disposal	12	mths	\$ 2,000	\$ 24,000
8	Health & Safety/Air Monitoring	1	ls	\$ 3,000	\$ 3,000
9	Miscellaneous: Equipment rentals, PID/FID	12	mths	\$ 3,000	\$ 36,000
SVE Annual Operation and Maintenance Subtotal					\$ 312,000
SVE Present Worth of Operation and Maintenance Costs (5%, 4 Years)					\$ 1,107,000
Present Worth of ICs + Monitoring (5%, 100 Years) Costs					\$ 416,000
Contingency (20% of SVE)					\$ 299,000
Total Capital and O&M Cost Present Worth					\$ 2,208,000

NOTES/ASSUMPTIONS

1. Benzene SVE (UB) system: Uses 2 H-SVE wells with average 40 feet screens installed @ 30 feet bgs.
2. Vapor treatment system uses thermal oxidizer, 200 scfm, positive displacement (PD) blower.
3. Assume SVE operation for 4 years.

TABLE E.9-2A
SOURCE AREA 5 - REMEDIAL ALTERNATIVE 3A
SVE/BV COST ESTIMATE
Soil and NAPL FS
Del Amo Superfund Site

Description		Estimated Quantity	Unit	Unit Cost	Estimated Cost
Item No.	Direct Capital Costs				
1	Site Investigation/Delineation	1	ls	\$ 36,000	\$ 36,000
2	Mobilization/Demobilization	4,000	sf	\$ 1.25	\$ 5,000
3	Electrical Service/ hookup/Utilities	1	ls	\$ 15,000	\$ 15,000
4	Site Preparation/Geophysical	4,000	sf	\$ 0.8	\$ 4,000
5	SVE Wells	2	ea	\$ 7,500	\$ 15,000
6	Well Headworks/Vault (24" traffic rated)	2	ea	\$ 3,000	\$ 6,000
7	VETS Installation and Startup	1	ls	\$ 50,000	\$ 50,000
8	SVE Blower + Thermal Oxidizer; 150 cfm	1	ls	\$ 60,000	\$ 60,000
9	Control and Instrumentation	1	ls	\$ 5,000	\$ 5,000
10	Misc Treat System: Tanks, Piping, Pumps, Fittings	1	ls	\$ 10,000	\$ 10,000
11	Trenching, Piping, Backfill and Resurfacing	200	lf	\$ 50	\$ 10,000
12	Equipment Pad/Enclosure/Fence	1	ea	\$ 20,000	\$ 20,000
13	Post Treatment Sampling + Analysis	2	borings	\$ 7,000	\$ 14,000
Direct Capital Total					\$ 250,000
Item No.	Indirect Capital Costs				
1	Engineering, Design, and Permitting	15%	of	\$ 250,000	\$ 38,000
2	Project Management, Agency Reporting/Coordination	8%	of	\$ 250,000	\$ 20,000
3	Construction Management	10%	of	\$ 250,000	\$ 25,000
Indirect Capital Subtotal					\$ 83,000
Total Direct + Indirect Capital Cost					\$ 333,000
Item No.	Operation and Maintenance Cost				
1	Fuel: Natural Gas (Thermal Oxidizer)	12	mths	\$ 5,000	\$ 60,000
2	Electricity: SVE blower, misc equip	12	mths	\$ 1,500	\$ 18,000
3	Operations & Maintenance	12	mths	\$ 4,000	\$ 48,000
4	Maintenance (hardware, filters, monitoring equipment)	12	mths	\$ 2,000	\$ 24,000
5	Vapor Treatment System Influent/Effluent Monitoring/Lab Costs	12	mths	\$ 3,000	\$ 36,000
6	Project Management/Consultant support/Reports	12	mths	\$ 4,000	\$ 48,000
7	Waste/NAPL/Water Disposal	12	mths	\$ 2,000	\$ 24,000
8	Health & Safety/Air Monitoring	1	ls	\$ 3,000	\$ 3,000
9	Miscellaneous: Equipment rentals, PID/FID	12	mths	\$ 3,000	\$ 36,000
SVE Annual Operation and Maintenance Subtotal					\$ 297,000
SVE Present Worth of Operation and Maintenance Costs (5%, 4 Years)					\$ 1,054,000
Present Worth of ICs + Monitoring (5%, 100 Years) Costs					\$ 416,000
Contingency (20% of SVE)					\$ 278,000
Total Capital and O&M Cost Present Worth					\$ 2,081,000

NOTES/ASSUMPTIONS

1. SVE (OS) system: Uses 2 V-SVE wells, 30-50 feet bgs screens.
2. Vapor treatment system uses thermal oxidizer, 150 scfm, positive displacement (PD) blower.
3. Assume SVE operation for 4 years.

APPENDIX E-2

NAPL SITES THERMAL TECHNOLOGY REVIEW

**TABLE E2-1
REVIEW OF THERMAL TECHNOLOGY PERFORMANCE AT OTHER SITES
DEL AMO SOIL AND NAPL FEASIBILITY STUDY**

Site	Comparison to Del Amo Site Conditions					Treatment Technology	Horiz extent SF	# wells	Treat Zone	Volume CY	COC Soil Conc. (mg/kg)		COC GW Conc. (mg/L)		Mass Removal Efficiency	Cost
	COCs	Geology	GW Depth	Site Development	NAPL Present						Pre-Treat	Post-Treat	Pre-Treat	Post-Treat		
DOE Young-Rainey Largo, FL Area A	TCE, DCE TPH, Toluene	fine sand clay bottom	30 feet bgs	Open land, no adjacent buildings	LNAPL/ DNAPL	Steam Injection + Electric Resistance Heating (ERH) + SVE	10,000	64 (elec, steam)	10-35 ft bgs	13,000	250 120 650 23	0.11 0.12 0.0082 0.42	0.56 4.2 6.8 1.8	0.029 0.076 0.013 0.038	3,000 lb VOC >90% TPH>60%	\$3,800,000 \$292/CY
East Gate Disposal Yard Ft. Lewis, WA	TCE TPH	Glacial drift with sand, silt, and gravels	5 feet bgs	Open land, no adjacent buildings	DNAPL	ERH + SVE	3 areas 20,000 ea	106	30-50' bgs	30,000	94	0.12	0.192 to 0.322	0.001 to 0.106	25,000-95,000 lb >90%	\$108-\$178/cy \$12,000,000
Air Force Plant #4 Ft. Worth, TX	TCE	Sand, gravel, clay, and silt with weathered limestone	25 feet bgs	Within building with access to site personnel	DNAPL	ERH + SVE	20,000	74	5-35'	30,000	3,958	0.391	33.194	3.743	85% to 95% 1,400 lbs Elevated diss conc 30-50 mg/L	\$2,300,000 \$140/CY
North Hill Manor (Shell) Calgary, Alberta Canada	Benzene TPH	Silt, clayey silt, silty clay	13 feet bgs	Installed within apartment unit with other units occupied	No NAPL present	ERH + Dual Phase Extraction	900	10 elec 19 SVE	0-15' bgs	600	7.6	0.03	0.15	<0.4	3,000 lb removed 400,000 gal water treated	\$580,000 \$700/CY
Avery Dennison Co. Waukegan, IL	MeCl	silty clay	6-25 feet bgs	Adjacent and beneath building	DNAPL	ERH + SVE (previous SVE, air sparge)	20,000	95 elec 35 SVE 5 hor SVE	6'-28' bgs	16,000	1,389	2.51	NA	NA	15,000 lb MeCl 1,800,000 kWhr	NA
Manufacturing facility Skokie, IL	TCE TCA, DCE	silty sand with clay lenses	7 feet bgs	Within and adjacent to manufacturing building.	DNAPL	ERH + SVE (previous steam inj)	26,000	185 elec 37 SVE	10-24' bgs	23,000	NA	NA	38.4 37 17.9	0.4 0.2 0.24	NA	NA
Lawrence Livermore Livermore, CA	Gasoline BTEX, TPH	coarse sand/gravels silt/clay zones	100 feet bgs	Adjacent to buildings	LNAPL 30 feet below WT smear zone	Steam Injection + ERH + DPE	11,400	6 inj 3 ext	60-140' bgs	34,000	NA	NA	3.65	0.29	7,600 gal recovered	\$11,000,000 \$200-\$300/CY

NOTES

This table is a summary of primary sites reviewed for performance of thermal technologies that was used to evaluate thermal technologies for the Del Amo site.

NA	Not available	Elec	Electrode well
COC	Contaminant of Concern	Ext	Extraction
DOE	Department of Energy	Inj	Injection
LNAPL	Light Nonaqueous Phase Liquid	DNAPL	Dense Nonaqueous Phase Liquid
SVE	Soil Vapor Extraction	ERH	Electric Resistance Heating

TABLE E2-2
THERMAL TECHNOLOGY SITES THAT ENCOUNTERED IMPLEMENTATION OR EFFECTIVENESS CHALLENGES
DEL AMO SOIL AND NAPL FEASIBILITY STUDY

Site	Contaminants	Hydrogeology	Treatment Technology	RAO	# wells	Treat Zone feet	Volume CY	Summary
Silresim Superfund site Lowell, MA	TCE, TCA, MC Dichlorobenzene	low perm silt WT 24 feet bgs	ERH (pilot) (Vendor=CES) previous SVE, P+T McMillan McGee	TCE=0.25 mg/kg	6	10-40' bgs	1,250	Full scale not implemented 1,400 lbs removed; >80% Did not achieve concentration goals Implem problems: high temp piping failure
Wyckoff Eagle Harbor Superfund site Eagle Harbor, WA	Creosote Pentachlorophenol PAHs, TPH VOCs	sand WT 5-15 feet bgs	Steam Injection (pilot) US Army Corps of Engrs	Maximize NAPL removal	16 inj 7 ext	10-30' bgs	15,000	Full scale not implemented Treatment equipment failure Nonuniform heating <20% of NAPL recovered (2,000 gal) System shutdown in 3-4 months
Rocky Mountain Arsenal Superfund (Hex Pits) Commerce City, CO	Hex - hexachloro cyclopentadiene Pesticides VOCs	WT 15 feet bgs	Thermal conduction Heating Vendor=TerraTherm	Maximize NAPL removal	266 6' spacing	3-15' bgs	4,000	Full scale system shut down in 1 week Equipment and piping failure due to high temp acid vapors \$2M capital investment
Stauffer Management Co Carson, CA	1,2-DCA, TCE	silty clay	Thermal Conduction Heating (Pilot) Vendor=Terratherm	NA	NA	10-37' bgs	8,000	Full scale not implemented Concentration increased initially Mass reduction not quantified
Guadalupe Oil field Guadalupe, CA	TPH, diluent	sand	Steam Injection (pilot) Vendor=SteamTech	Maximize NAPL removal	4 inj 9 ext	10-70' bgs	12,000	Full scale not implemented 25,000 gallons NAPL recovered in 1 year but significant remaining NAPL Cleanup goals not achieved; high cost Aerobic microbes impacted by steam
Edwards Air Force Base Palmdale, CA	TCE TPH	fracture	Thermal cond heating TerraTherm	Maximize NAPL removal	6	15-60' bgs	2,000	Full scale not implemented >50% mass removed (>1,000 lbs)
Lemoore Naval Air Station Lemoore, CA	TPH JP-5	sand WT 10 feet bgs	Steam Injection (Pilot) Udell, Consultant=OHM	Maximize NAPL removal	2 inj 8 ext	5-16' bgs	1000	Full-scale not implemented Large amts of NAPL removed but NAPL reappeared after 3 years Concern with NAPL smearing with steam Full-scale MPE proposed instead
Launch Complex 34 Cape Canaveral, FL	TCE, PCE	WT 5 feet bgs Upper sand 0-25' Silt 25-35' Lower sand 35'-45'	ERH (Vendor=CES) Steam (Vendor=IWT)	90%	13 elec 13 SVE	10-45' bgs	4,000	Full scale implementation >80%, some NAPL migration max 860 mg/L to 210 mg/L hurricane, WT rise problem with uniform heating
Fort Richardson, AK Alaska	TCE, PCE	tight soil glacial till	ERH (Vendor=CES)	5 ug/kg 5 ug/L	21 elec 9 SVE 4 arrays	8-40' ngs	7,300	50-75% removed; 1,385 lbs RAOs not achieved
Lowry Landfill Waste Pit, CO	PCE	clay, silt, sand WT 20 feet bgs	ERH (Vendor=TRS)	90%	107 elec 7 MPE	9'-24' bgs	NA	70% reduction, 30,000 lbs removed RAOs not achieved TCE max 200 mg/kg to 63 mg/kg

NOTES

RAO	Remedial Action Objective	MPE	Multiphase Extraction	TPH	Total Petroleum Hydrocarbons
WT	Water Table	SVE	Soil Vapor Extraction	TCE	Trichloroethylene
CY	cubic yard	P+T	Pump and Treat	DCA	Dichloroethane
JP-5	Jet Fuel	PAH	Polycyclic Aromatic Hydrocarbons	MC	Methylene chloride

APPENDIX E-3
SUPPORTING INFORMATION

**TABLE E3-1
GREENHOUSE GAS EMISSIONS BY SOURCE AREA AND REMEDIAL ALTERNATIVE
Soil and NAPL FS
Del Amo Superfund Site**

Source Area	Alt No.	Remedial Alternatives	Estimated Total Electricity (KWHr)	Estimated Total Natural Gas (Therms)	Metric Tons of Carbon Dioxide ¹			
					Based on Electricity Use ²	Based on Natural Gas Use	Based on Oxidant (H ₂ O ₂) Production ³	Totals
12	3	SVE (4 years)	544,000	265,585	301	1,328		1,630
	4	Hydraulic Extraction (10 years) + SVE (4 years)	9,104,000	708,226	5,035	3,541		8,580
	5	ISCO (2 years) + SVE (4 years)	1,024,000	398,377	566	1,992	1,124	3,680
	6	ISSH + SVE (2 years)	15,701,600	464,773	8,683	2,324		11,000
3	3	SVE (4 years)	1,152,000	442,641	637	2,213		2,850
	4	Hydraulic Extraction (10 years) + SVE (4 years)	15,392,000	1,659,904	8,512	8,300		16,810
	5	ISCO (2 years) + SVE (4 years)	2,528,000	929,546	1,398	4,648	2,878	8,920
	6	ISSH + SVE (2 years)	38,784,000	1,106,603	21,448	5,533		26,980
6	3	SVE (4 years)	864,000	354,113	478	1,771		2,250
	4	Hydraulic Extraction (10 years) + SVE (4 years)	10,464,000	907,414	5,787	4,537		10,320
	5	ISCO (2 years) + SVE (4 years)	3,840,000	663,962	2,124	3,320	484	5,930
	6	ISSH + SVE (2 years)	16,384,000	730,358	9,060	3,652		12,710
11	3	SVE (4 years)	704,000	309,849	389	1,549		1,940
	4	Hydraulic Extraction (10 years) + SVE (4 years)	10,304,000	863,150	5,698	4,316		10,010
	5	ISCO (2 years) + SVE (4 years)	3,840,000	663,962	2,124	3,320	604	6,050
	6	ISSH + SVE (2 years)	19,504,000	730,358	10,786	3,652		14,440
9	3	SVE (4 years)	704,000	309,849	389	1,992		2,380
	4	Hydraulic Extraction (10 years) + SVE (4 years)	8,144,000	641,830	4,504	5,312		9,820
	5	ISCO (2 years) + SVE (4 years)	3,840,000	663,962	2,124	4,648	448	7,220
	6	ISSH + SVE (2 years)	14,352,000	730,358	7,937	3,652		11,590
4	3	Horizontal SVE (4 years)	1,024,000	398,377	566	1,992		2,560
	3A	Vertical SVE (4 years)	544,000	265,585	301	1,328		1,630
	4	Hydraulic Extraction (10 years) + Horiz SVE (4 years)	5,984,000	730,358	3,309	3,652		6,960
	4A	Hydraulic Extraction (10 years) + Vert SVE (4 years)	5,824,000	597,565	3,221	2,988		6,210
	5	ISCO (2 years) + SVE (4 years)	3,456,000	531,169	1,911	2,656	240	4,810
	6	ISSH + SVE (2 years)	9,760,000	730,358	5,397	3,652		9,050
7	3	Horizontal SVE (4 years)	864,000	354,113	478	1,771		2,250
	3A	Vertical SVE (4 years)	480,000	221,321	265	1,107		1,370
	4	Hydraulic Extraction (10 years) + Horiz SVE (4 years)	4,944,000	464,773	2,734	2,324		5,060
	4A	Hydraulic Extraction (10 years) + Vert SVE (4 years)	4,480,000	442,641	2,477	2,213		4,690
	5	ISCO (2 years) + SVE (4 years)	3,072,000	398,377	1,699	1,992	120	3,810
	6	ISSH + SVE (2 years)	5,632,000	464,773	3,114	2,324		5,440
8	3	Horizontal SVE (4 years)	864,000	354,113	478	1,771		2,250
	3A	Vertical SVE (4 years)	480,000	221,321	265	1,107		1,370
	4	Hydraulic Extraction (10 years) + Horiz SVE (4 years)	4,704,000	464,773	2,601	2,324		4,930
	4A	Hydraulic Extraction (10 years) + Vert SVE (4 years)	4,560,000	442,641	2,522	2,213		4,730
	5	ISCO (2 years) + SVE (4 years)	3,072,000	398,377	1,699	1,992	140	3,830
	6	ISSH + SVE (2 years)	5,760,000	464,773	3,185	2,324		5,510
5	3	Horizontal SVE (4 years)	528,000	232,387	411	1,162		1,570
	3A	Vertical SVE (4 years)	640,000	265,585	265	1,107		1,370

Notes:

- Metric tons of CO₂-equivalent is a measure of the carbon footprint of remedial alternatives that is based on electrical energy and natural gas usage presented in individual SA cost spreadsheets. In addition, for the ISCO alternative the CO₂ contribution of the total oxidant (as a result of the H₂O₂ manufacturing process) injected is included.
- CO₂ Emission Factor for electricity generation in Southern California is 0.553 Metric Tons per MWh based on recent data from City of Los Angeles Department of Water and Power. Reference: Final Integrated Resource Plan, City of Los Angeles Department of Water and Power, December 2007.
- Total CO₂ Emissions for ISCO alternatives adjusted to include gross air emissions associated with production of H₂O₂ (materials and energy inputs and outputs). Assumes 1.2 Kg CO₂ emissions per Kg of H₂O₂ produced; (Reference: Ecoprofile of Hydrogen Peroxide, Dr. Ian Boustead, Boustead Consulting Ltd, U.K., and Dr Matthias Fawer, EMPA - The Swiss Federal Laboratories for Materials Testing and Research; Independent Experts in Ecoprofile Analysis, 1997)

Table E3-2 Estimated Electricity Usage (KWH) and Electrical Cost Per Month for NAPL Remedial Alternatives
Del Amo Surface Soil and NAPL RWFS

Alternative No.	Description	Electrical Equipment / Loads	Source Area								
			12	3	6	11	9	4 ⁶	7 ⁶	8 ⁶	5 ⁶
3	Soil Vapor Extraction	SVE Blower/Thermax Flow (cfm)	200	600	400	300	300	500	400	400	200
		Estimated KW									
		SVE Thermax and Blower Unit (460 V, 3ph) ¹	12.4	30.0	21.2	16.8	16.8	25.6	21.2	21.2	12.4
		Controls (2 circuits, 120VAC, 1ph, 15 amp)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
		Total KW Requirements:	16.0	33.6	24.8	20.4	20.4	29.2	24.8	24.8	16.0
		Total KWH Per Month (100% uptime)	11507	24179	17843	14675	14675	21011	17843	17843	11507
		Cost Per Month (\$0.15/KWH):	\$1,726	\$3,627	\$2,676	\$2,201	\$2,201	\$3,152	\$2,676	\$2,676	\$1,726
		Cost Per Month (rounded):	\$1,700	\$3,600	\$2,700	\$2,200	\$2,200	\$3,200	\$2,700	\$2,700	\$1,700
3A	Soil Vapor Extraction (Under Building)	SVE Blower/Thermax Flow (cfm)	--	--	--	--	--	200	150	150	150
		Estimated KW									
		SVE Thermax and Blower Unit (460 V, 3ph) ¹	--	--	--	--	--	12.4	10.2	10.2	10.2
		Controls (2 circuits, 120VAC, 1ph, 15 amp)	--	--	--	--	--	3.6	3.6	3.6	3.6
		Total KW Requirements:	--	--	--	--	--	16.0	13.8	13.8	13.8
		Total KWH Per Month (100% uptime)	--	--	--	--	--	11507	9923	9923	9923
		Cost Per Month (\$0.15/KWH):	--	--	--	--	--	\$1,726	\$1,488	\$1,488	\$1,488
		Cost Per Month (rounded):	--	--	--	--	--	\$1,700	\$1,500	\$1,500	\$1,500
4	Groundwater Extraction and Treatment	SVE Blower/Thermax Flow (cfm)	600	1500	850	750	600	750	500	500	--
		Air Stripper System Flow (cfm)	360	720	450	450	300	200	100	100	--
		APT HIPOx Flow (gpm)	24	56	42	45	32	15	10	9	--
		Estimated KW									
		SVE Thermax and Blower Unit (460 V, 3ph) ¹	30.0	69.6	41.0	36.6	30.0	36.6	25.6	25.6	--
		Groundwater Extraction Pumps ²	21.6	50.4	37.8	40.5	28.8	13.5	9	8.1	--
		Air Stripper System, 460V, 3 ph (see Carbonair STAT specifics)	11.1	11.1	11.1	11.1	11.1	3.8	3.8	3.8	--
		Advanced Oxidation System (see APT costs for electrical service cost) ³	48.4	63.9	42.2	39.9	33.1	29.7	30.2	28.5	--
		Controls (2 circuits, 120VAC, 1ph, 15 amp)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	--
		Total KW Requirements:	114.7	198.6	135.7	131.7	106.6	87.1	72.2	69.6	--
		Total KWH Per Month (100% uptime)	82549	142967	97697	94831	76727	62742	51993	50113	--
Cost Per Month (\$0.15/KWH):	\$12,382	\$21,445	\$14,655	\$14,225	\$11,509	\$9,411	\$7,799	\$7,517	--		
Cost Per Month (rounded):	\$12,400	\$21,400	\$14,700	\$14,200	\$11,500	\$9,400	\$7,800	\$7,500	--		
4A	Groundwater Extraction and Treatment (Vertical SVE)	SVE Blower/Thermax Flow (cfm)	--	--	--	--	--	500	300	300	--
		Air Stripper System Flow (cfm)	--	--	--	--	--	200	150	150	--
		APT HIPOx Flow (gpm)	--	--	--	--	--	16	6	6	--
		Number of Extraction Pumps	--	--	--	--	--	16	6	6	--
		Estimated KW									
		SVE Thermax and Blower Unit (460 V, 3ph) ¹	--	--	--	--	--	25.6	16.8	16.8	--
		Groundwater Extraction Pumps ²	--	--	--	--	--	14.4	5.4	5.4	--
		Air Stripper System, 460V, 3 ph (see Carbonair STAT specifics)	--	--	--	--	--	3.8	3.8	3.8	--
		Advanced Oxidation System (see APT costs for electrical service cost) ³	--	--	--	--	--	29.7	30.2	31.4	--
		Controls (2 circuits, 120VAC, 1ph, 15 amp)	--	--	--	--	--	3.6	3.6	3.6	--
		Total KW Requirements:	--	--	--	--	--	77.0	59.8	61.0	--
Total KWH Per Month (100% uptime)	--	--	--	--	--	55470	43065	43887	--		
Cost Per Month (\$0.15/KWH):	--	--	--	--	--	\$8,321	\$6,460	\$6,583	--		
Cost Per Month (rounded):	--	--	--	--	--	\$8,300	\$6,500	\$6,600	--		

**Table E3-2 Estimated Electricity Usage (KWH) and Electrical Cost Per Month for NAPL Remedial Alternatives
Del Amo Surface Soil and NAPL RWFS**

Alternative No.	Description	Electrical Equipment / Loads	Source Area								
			12	3	6	11	9	4 ⁶	7 ⁶	8 ⁶	5 ⁶
5	ISCO, Fentons	SVE Blower/Thermox Flow (cfm)	500	1500	--	--	--	--	--	--	--
		Estimated KW									
		SVE Thermox and Blower Unit (460 V, 3ph) ¹	25.6	69.6	--	--	--	--	--	--	--
		Controls (2 circuits, 120VAC, 1ph, 15 amp)	3.6	3.6	--	--	--	--	--	--	--
		Total KW Requirements:	29.2	73.2	--	--	--	--	--	--	--
		Total KWH Per Month (100% uptime)	21011	52691	--	--	--	--	--	--	--
		Cost Per Month (\$0.15/KWH):	\$3,152	\$7,904	--	--	--	--	--	--	--
		Cost Per Month (rounded):	\$3,200	\$7,900	--	--	--	--	--	--	--
5	ISCO, Ozone Peroxide	SVE Blower/Thermox Flow (cfm)	--	--	1000	1000	1000	750	500	500	--
		Ozone/Oxygen Generation System (ppd)	--	--	80	100	80	40	20	20	--
		Estimated KW									
		SVE Thermox and Blower Unit (460 V, 3ph) ¹	--	--	47.6	47.6	47.6	36.6	25.6	25.6	--
		Ozone/Oxygen Generation ⁴	--	--	56	56	56	56	56	56	--
		Controls (4 circuits, 120VAC, 1ph, 15 amp)	--	--	7.2	7.2	7.2	7.2	7.2	7.2	--
		Total KW Requirements:	--	--	110.8	110.8	110.8	99.8	88.8	88.8	--
		Total KWH Per Month (100% uptime)	--	--	79763	79763	79763	71843	63923	63923	--
Cost Per Month (\$0.15/KWH):	--	--	\$11,964	\$11,964	\$11,964	\$10,776	\$9,588	\$9,588	--		
Cost Per Month (rounded):	--	--	\$12,000	\$12,000	\$12,000	\$10,800	\$9,600	\$9,600	--		
6	ERH	SVE Blower/Thermox Flow (cfm)	1500	4000	2500	2500	2500	2500	1500	1500	--
		APT Water Condensate Treatment Flow (gpm)	20	20	10	10	10	10	10	10	--
		Estimated KW									
		SVE Thermox and Blower Unit (460 V, 3ph) ¹	69.6	179.6	113.6	113.6	113.6	113.6	69.6	69.6	--
		Advanced Oxidation System (see APT costs for electrical service cost) ³	48.4	48.4	30.2	30.2	30.2	30.2	30.2	30.2	--
		Electrical Heating Equipment ⁵	784	2,009	797	978	679	414	219	226	--
		Controls (4 circuits, 120VAC, 1ph, 15 amp)	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	--
		Total KW Requirements:	909	2,244	948	1,129	830	565	326	333	--
Total KWH Per Month (100% uptime)	654343	1615976	682729	812729	597396	406729	234449	239716	--		
Cost Per Month (\$0.15/KWH):	\$98,151	\$242,396	\$102,409	\$121,909	\$89,609	\$61,009	\$35,167	\$35,957	--		
Cost Per Month (rounded):	\$98,200	\$242,400	\$102,400	\$121,900	\$89,600	\$61,000	\$35,200	\$36,000	--		

Notes:

- ¹ Assume Blower Flow and alternative Motor FLA for SA based on database of systems found on internet.
- ² Assume 50% of total # of GW pumps (1 pump/well) in operation at any given time; 1.8 KW per pump
- ³ Based on annual electrical service cost estimate from APT adjusted to reflect use of \$.15/KWH
- ⁴ Electrical Usage of Ozone generation system based on pounds per day (ppd) size of unit
- ⁵ Based on vendor's estimate of total electricity usage. Assume soil heating is completed in 24 months for all SA's
- ⁶ SVE for source areas 4, 5, 7, and 8 address impacted areas under buildings and include horizontal wells

Table E3-3 Estimated Natural Gas Usage (Therms) and Natural Gas Cost Per Month for NAPL Remedial Alternatives
 Del Amo Surface Soil and NAPL RI/FS

Alternative No.	Description	Electrical Equipment / Loads	Source Area								
			12	3	6	11	9	4	7	8	5
			Estimated Blower Flow and BTU Rating								
3	Soil Vapor Extraction	SVE Blower / Thermox Flow (cfm)	200	600	400	300	300	500	400	400	200
		Estimated BTU/hr Rating:	728,433	1,328,233	1,028,333	878,383	878,383	1,178,283	1,028,333	1,028,333	728,433
		Therms per Month:	5,245	9,563	7,404	6,324	6,324	8,484	7,404	7,404	5,245
		Natural Gas Cost Per Month:	\$5,687	\$10,370	\$8,029	\$6,858	\$6,858	\$9,200	\$8,029	\$8,029	\$5,687
		Natural Gas Cost Per Month: (Rounded to 2 sig fig)	\$6,000	\$10,000	\$8,000	\$7,000	\$7,000	\$9,000	\$8,000	\$8,000	\$6,000
3A	Soil Vapor Extraction (Under Building)	SVE Thermox and Blower Unit	--	--	--	--	--	200	150	150	150
		Estimated BTU/hr Rating:	--	--	--	--	--	728,433	653,458	653,458	653,458
		Therms per Month:	--	--	--	--	--	5,245	4,705	4,705	4,705
		Natural Gas Cost Per Month:	--	--	--	--	--	\$5,687	\$5,102	\$5,102	\$5,102
		Natural Gas Cost Per Month: (Rounded to 2 sig fig)	--	--	--	--	--	\$6,000	\$5,000	\$5,000	\$5,000
4	Groundwater Extraction and Treatment	SVE Thermox and Blower Unit	600	1,500	850	750	600	750	500	500	--
		Estimated BTU/hr Rating:	1,328,233	2,677,783	1,703,108	1,553,158	1,328,233	1,553,158	1,178,283	1,178,283	--
		Therms per Month:	9,563	19,280	12,262	11,183	9,563	11,183	8,484	8,484	--
		Natural Gas Cost Per Month:	\$10,370	\$20,907	\$13,297	\$12,127	\$10,370	\$12,127	\$9,200	\$9,200	--
		Natural Gas Cost Per Month: (Rounded to 2 sig fig)	\$10,000	\$21,000	\$13,000	\$12,000	\$10,000	\$12,000	\$9,000	\$9,000	--
4A	Groundwater Extraction and Treatment (Under Building)	SVE Thermox and Blower Unit	--	--	--	--	--	500	300	300	--
		Estimated BTU/hr Rating:	--	--	--	--	--	1,178,283	878,383	878,383	--
		Therms per Month:	--	--	--	--	--	8,484	6,324	6,324	--
		Natural Gas Cost Per Month:	--	--	--	--	--	\$9,200	\$6,858	\$6,858	--
		Natural Gas Cost Per Month: (Rounded to 2 sig fig)	--	--	--	--	--	\$9,000	\$7,000	\$7,000	--

Table E3-3 Estimated Natural Gas Usage (Therms) and Natural Gas Cost Per Month for NAPL Remedial Alternatives
 Del Amo Surface Soil and NAPL RI/FS

Alternative No.	Description	Electrical Equipment / Loads	Source Area								
			12	3	6	11	9	4	7	8	5
			Estimated Blower Flow and BTU Rating								
5	ISCO, Fentons	SVE Thermox and Blower Unit	500	1,500	--	--	--	--	--	--	--
		Estimated BTU/hr Rating:	1,178,283	2,677,783	--	--	--	--	--	--	--
		Therms per Month:	8,484	19,280	--	--	--	--	--	--	--
		Natural Gas Cost Per Month:	\$9,200	\$20,907	--	--	--	--	--	--	--
		Natural Gas Cost Per Month: (Rounded to 2 sig fig)	\$9,000	\$21,000	--	--	--	--	--	--	--
5	ISCO, Ozone Peroxide	SVE Thermox and Blower Unit	--	--	1,000	1,000	1,000	750	500	500	--
		Estimated BTU/hr Rating:	--	--	1,928,033	1,928,033	1,928,033	1,553,158	1,178,283	1,178,283	--
		Therms per Month:	--	--	13,882	13,882	13,882	11,183	8,484	8,484	--
		Natural Gas Cost Per Month:	--	--	\$15,053	\$15,053	\$15,053	\$12,127	\$9,200	\$9,200	--
		Natural Gas Cost Per Month: (Rounded to 2 sig fig)	--	--	\$15,000	\$15,000	\$15,000	\$12,000	\$9,000	\$9,000	--
6	ERH	SVE Thermox and Blower Unit	1,500	4,000	2,500	2,500	2,500	2,500	1,500	1,500	--
		Estimated BTU/hr Rating:	2,677,783	6,426,533	4,177,283	4,177,283	4,177,283	4,177,283	2,677,783	2,677,783	--
		Therms per Month:	19,280	46,271	30,076	30,076	30,076	30,076	19,280	19,280	--
		Natural Gas Cost Per Month:	\$20,907	\$50,176	\$32,615	\$32,615	\$32,615	\$32,615	\$20,907	\$20,907	--
		Natural Gas Cost Per Month: (Rounded to 2 sig fig)	\$21,000	\$50,000	\$33,000	\$33,000	\$33,000	\$33,000	\$21,000	\$21,000	--

Notes:

1 Blower Flow for SA and BTU Rating based on database of Thermox systems found on internet. Did not use CATOX, which will be lower.

FIGURE E3-1
NAPL SOURCE LIFE vs % SATURATION REDUCTION
MW-20 NAPL (SOURCE AREA 3)

