



EXECUTIVE SUMMARY

SUBJECT: Preliminary Soil Vapor Extraction Step Test Data for Fuel Leak Case No. RO0000324, Livermore Gas and Mini Mart, 160 Holmes Street, Livermore, California

Date: December 30, 2009

To: Mr. Jerry Wickham, Alameda County Environmental Health Services (ACEH)

This document is intended to provide ACEH with data collected during recently completed soil vapor extraction (SVE) step test activities and provide recommendations for pilot scale SVE operations. This information will be formally documented and submitted to ACEH in the Pilot Scale VES Results Report.

Step Test Information

Allterra completed a SVE step test at the site from December 7 to December 11, 2009. The step test was conducted using an Internal Combustion (IC) Engine for vapor extraction and abatement. The Test Well, EW-3, is located in the middle of the previously identified contaminant source area and has a screen interval from 25 to 30 feet bgs. Other site wells were used as Observation Wells, where depth to water and induced vacuum measurements were collected.

Summary of Field Activities

During the step test, six different vacuums were applied to well EW-3 and flow rate and vapor influent contaminant levels data was collected. Additionally, depth to water and induced vacuum data was collected from observation wells. The vacuums applied were 10 inches Water Column (WC), 20 inches WC, 30 inches WC, 40 inches WC, 50 inches WC, and 90 inches WC.

Summary of Results

Radius of Influence: Induced vacuum was not observed in Observation Wells. The nearest Observation Wells were wells EW-1 and EW-2, which are located approximately 32 feet from EW-3. Therefore, we estimate the radius of influence to be less than 32 feet.

Depth to Water in EW-3: In general, the groundwater elevation in well EW-3 increased with increasing vacuums applied. At 50 inches WC, depth to water was measured at 28.85 feet bgs, which was within the well's screen interval (25 to 30 feet bgs) and likely impacted the vapor extraction flow rate. At 90 inches WC, depth to water was measured at 27.77 feet bgs, which is within EW-3's screen interval. We suspect that the water level in EW-3 rose to above 25 feet bgs while a vacuum of 90 inches WC was applied, resulting in a submerged well screen and irregular data.

Flow Rate: Extracted vapor flow rates ranged from <1 standard cubic foot per minute (scfm) at 10 inches WC to 8.8 scfm at 40 and 50 inches WC. In general, flow rate increased with increases to applied vacuum until the 50 inches WC step, when flow rate leveled off at 8.8 scfm. At a vacuum of 90 inches WC a flow rate of 44 scfm was measured; however the high flow rate was likely due to a short circuit in the well.

Influent Vapor Contaminant Levels: Influent vapor levels for each applied vacuum were measured with a PID. The lowest PID measurement (1,900 ppm) was collected at an applied vacuum of 50 inches WC and the highest (3,400 ppm) was collected at 20 inches WC. PID readings at 40 inches of WC ranged from 2,100 ppm to 2,600 ppm and averaged 2,300 ppm. Of note, a PID measurement of 5,000 ppm was collected at 90 inches WC; however, the reading is unreliable and not used due to a likely short circuit in the well.

After the second day of testing, it was determined that 40 inches WC was the optimum vacuum to apply on well EW-3 for the combination of flow rate, influent VOC level, and IC Engine operation. Therefore, on December 8 through 11, 2009 vapor samples were collected in tedlar bags for laboratory analyses while a vacuum of 40 inches WC was applied on EW-3. Sample data indicated TPHg levels up to 11,000 ppb, benzene levels up to 39 ppb, and MTBE levels up to 4,100 ppb.

Contaminant Mass Removal Estimates: Contaminant mass removal estimates were made using vapor extraction flow rate data and laboratory analytical results for influent samples. Over the five-day step test (approximately 38 hours of operation), an estimated 8.2 pounds of TPHg, 0.030 pounds of benzene, and 3.6 pounds of MTBE were removed. These data extrapolated to a 24-hour period indicates removal estimates of 5.2 pounds per day (ppd) TPHg, 0.019 ppd benzene, and 2.3 ppd MTBE.

Step Test Conclusion and Recommendation

After testing each vacuum level, it was determined that 40 inches WC was the optimum vacuum to apply on well EW-3 for the combination of flow rate, influent VOC level, and IC Engine performance. Therefore, Allterra recommends operating the Pilot Scale VES at 40 inches WC.

Note Regarding BAAQMD Permit

The BAAQMD Permit was submitted in early December 2009 and the permit application fees (\$5,820) were paid. As soon as we receive the approved permit we will notify you. We cannot operate the VES until the permit is approved.

Data Tables and Laboratory Reports

This document also includes four preliminary data tables:

- Table 1: Soil Vapor Extraction Step Test Data for EW-3
- Table 2: Soil Vapor Analytical Results for EW-3
- Table 3: Step Test Flow Rate and Concentration Data for EW-3
- Table 4: SVE Contaminant Mass Removal Data

Table 1
Soil Vapor Extraction Step Test Data for EW-3
 160 Holmes Street, Livermore, California

Date	Time (hours)	EW-3				MW-1B		EW-2		MW-7B		MW-7C		MW-8A		MW-8B	
		Screen Interval (feet bgs)	Vacuum (Inches Water)	Flow Rate (scfm)	EW-3 Depth to Water (feet)	Depth to Water (feet)	Vacuum (Inches Water)	Depth to Water (feet)	Vacuum (Inches Water)	Depth to Water (feet)	Vacuum (Inches Water)	Depth to Water (feet)	Vacuum (Inches Water)	Depth to Water (feet)	Vacuum (Inches Water)	Depth to Water (feet)	Vacuum (Inches Water)
12/7/09	0.0	25-30	10	<1	31.93	30.73	0.00	31.45	0.00	32.28	0.00	32.28	0.00	31.86	0.00	31.68	0.00
12/7/09	2.0		10	<1	31.74	30.74	0.00	31.44	0.00	32.08	0.00	32.28	0.00	31.86	0.00	31.68	0.00
12/7/09	2.0		20	4.4	31.74	30.74	0.00	31.44	0.00	32.08	0.00	32.28	0.00	31.86	0.00	31.68	0.00
12/7/09	4.5		20	4.4	31.70	30.70	0.00	31.41	0.00	32.03	0.00	32.24	0.00	31.86	0.00	31.66	0.00
12/7/09	4.5		30	6.6	31.70	30.70	0.00	31.41	0.00	32.03	0.00	32.23	0.00	31.85	0.00	31.66	0.00
12/7/09	7.0		30	6.6	31.59	30.71	0.00	31.41	0.00	32.03	0.00	32.23	0.00	31.85	0.00	31.66	0.00
12/8/09	0.0	25-30	40	8.8	31.89	30.95	0.00	31.66	0.00	32.30	0.00	32.53	0.00	31.93	0.00	31.91	0.00
12/8/09	2.5		40	8.8	31.41	30.96	0.00	31.66	0.00	32.35	0.00	32.54	0.00	31.93	0.00	31.92	0.00
12/8/09	2.5		50	8.8	NM	30.97	0.00	31.65	0.00	32.35	0.00	32.54	0.00	31.93	0.00	31.92	0.00
12/8/09	5.0		50	8.8	28.85	30.90	0.00	31.65	0.00	32.33	0.00	32.54	0.00	31.93	0.00	31.92	0.00
12/8/09	5.0		90	44*	NM	30.90	0.00	31.65	0.00	NM	NM	NM	NM	NM	NM	NM	NM
12/8/09	7.0		90	44*	27.77	30.94	0.00	31.63	0.00	NM	NM	NM	NM	NM	NM	NM	NM
12/9/09	0.0	25-30	40	8.8	NM	31.72	0.00	31.02	0.00	NM	NM	NM	NM	NM	NM	NM	NM
12/9/09	8.0		40	8.8	NM	31.65	0.00	30.95	0.00	NM	NM	NM	NM	NM	NM	NM	NM
12/10/09	0.0	25-30	40	8.8	NM	31.01	0.00	31.70	0.00	NM	NM	NM	NM	NM	NM	NM	NM
12/10/09	8.0		40	8.8	NM	30.94	0.00	31.64	0.00	NM	NM	NM	NM	NM	NM	NM	NM
12/11/09	0.0	25-30	40	8.8	NM	30.99	0.00	31.69	0.00	NM	NM	NM	NM	NM	NM	NM	NM
12/11/09	6.0		40	8.8	NM	30.99	0.00	31.72	0.00	NM	NM	NM	NM	NM	NM	NM	NM

Notes:

scfm: standard cubic feet per minute

bgs: below ground surface

NM: Not measured

* = High vapor flow rate may have been caused by short circuit in the well due to the high applied vacuum

Dry Wells: MW-1A, MW-2A, MW-3A, MW-4A, MW-7A

No vacuum observed at MW-1A, MW-2A, MW-3A, MW-7A

Approximate distance from Test Well EW-3:

MW-1A/B = 33 feet

MW-2A = 77 feet

MW-3A = 72 feet

MW-4A = 159 feet

MW-5A/B = 240 feet

MW-6 = 316 feet

MW-7A/B/C = 128 feet

MW-8A/B = 143 feet

MW-9A/B = 213 feet

EW-1 = 32 feet

EW-2 = 32 feet

Table 2
Soil Vapor Analytical Results for EW-3
 160 Holmes Street, Livermore, California

Sample ID	Date	Total Petroleum Hydrocarbons as Gasoline	Aromatic Volatile Organic Compounds				MTBE
			Benzene	Toluene	Ethylbenzene	Xylenes	
VES-40	12/8/09	9,500	39	340	110	770	4,100
VES-40	12/9/09	3,900	23	140	16	69	3,300
VES-40	12/10/09	11,000	22	130	13	90	3,100
VES-40	12/11/09	5,200	27	200	29	160	2,400

Notes:

Samples analyzed for Total Petroleum Hydrocarbons as Gasoline by EPA Method 8015CM and benzene, toluene, ethylbenzene, and xylenes and MTBE by EPA Method 8021B

All samples collected from well EW-3 with an applied vacuum of 40 inches of water.

All concentrations listed in micrograms per liter

MTBE = methyl tertiary butyl ether

Table 3
Step Test Flow Rate and Concentration Data for EW-3
 160 Holmes Street, Livermore, California

Well ID	Date	Vacuum (Inches of Water)	Soil Vapor Flow Rate (ft/min)	Soil Vapor Flow Rate (scfm)	Average PID Result (ppm)	Sample Result for TPHg* (µg/L)	Sample Result for MTBE* (µg/L)
EW-3	12/7/09	10	<25	<1	3,000	NS	NS
	12/7/09	20	200	4.4	3,400	NS	NS
	12/7/09	30	300	6.6	2,200	NS	NS
EW-3	12/8/09	40	400	8.8	2,100	9,500	4,100
	12/8/09	50	400	8.8	1,900	NS	NS
	12/8/09	90	2,000	44	5,000	NS	NS
EW-3	12/9/09	40	400	8.8	2,100	3,900	3,300
EW-3	12/10/09	40	400	8.8	2,500	11,000	3,100
EW-3	12/11/09	40	400	8.8	2,600	5,200	2,400

Notes:

scfm: standard cubic feet per minute

ft/min: feet per minute

µg/L: micrograms per liter

ppm: parts per millions

NS: Not sampled

*: Results from vapor samples collected from well EW-3 with and induced vacuum of 40 inches of water column (see Table 2)

Table 4
SVE Contaminant Mass Removal Data
 160 Holmes Street, Livermore, California

Date	Influent Concentration			Total Cubic Feet Processed**	Mass Removed (pounds)		
	TPHg	Benzene	MTBE		TPHg	Benzene	MTBE
12/7/09*	7,400	28	3,225	1,824	0.84	0.0032	0.36
12/8/09	9,500	39	4,100	4,224	2.5	0.010	1.1
12/9/09	3,900	23	3,300	4,224	1.0	0.0060	0.86
12/10/09	11,000	22	3,100	4,224	2.9	0.0058	0.81
12/11/09	5,200	27	2,400	3,168	1.0	0.0053	0.47
Total Mass Removed					8.2	0.030	3.6

Definitions and Notes:

Total operation time was approximately 38 hours.

All concentrations listed in micrograms per liter (mg/m3)

All masses listed in pounds (lb)

TPHg = total petroleum hydrocarbons as gasoline

MTBE = methyl tertiary butyl ether

* = TPHg, benzene, and MTBE levels listed are the average of the four sample results from 12/8/09 through 12/11/09.

** = total cubic feet processed determined by the average vapor flow rate for that day multiplied by test duration. 12/7/09 - 3.8 scfm and 8 hrs; 12/8/09 - 8.8 scfm and 8 hrs; 12/9/09 - 8.8 scfm and 8 hrs; 12/10/09 - 8.8 scfm and 8 hrs; 12/11/09 - 8.8 scfm and 6 hrs