APPENDIX E

SVE/Air Sparge Pilot Study Results
Training Area T-6, Parcel 183(6) and Cane Creek Training Area, Parcel 510(7), McClellan, Anniston, Alabama

T6 SVE/AS Pilot Study Results

Introduction

On April 1, 2008 Matrix Environmental Services (MES) performed a Soil Vacuum Extraction (SVE) and Air Sparge (AS) technology pilot study at Training Area T-6 (Naylor Field), Parcel 183(6) and Cane Creek Training Area, Parcel 510(7). A scanned copy of the field book for this pilot study is included as an attachment to this summary report. The pilot study was performed as described in the *Draft Corrective Measure Implementation Plan*, shown in Design Drawing 7, using a 10 HP blower and a 5 HP compressor. Exhaust form the blower was directed through two granular activated carbon (GAC) 55-gallon drums. Throughout the pilot study, volatile organic compound (VOC) concentrations were measured using Summa canisters in the air streams from the test SVE wells and from the effluent at the GAC drums. Upon receipt of the Summa canisters, the initial pressure was measured to verify adequate vacuum. Following sample collection and prior to shipment to the laboratory for analysis, the pressures were measured again for verification of sample integrity upon laboratory receipt, as shown in Table 1. Additionally, vacuum was measured on the nearby adjacent wells using Magnehelic gauges to attempt to determine the radius of influence of the SVE and AS wells. Vacuum gauge data is located in Table 2.

Following 72 hours of SVE operation on CWM-183-MW07, the SVE system was relocated to CWM-183-MW23 and the AS system was connected to CWM-183-MW22 for the SVE/AS pilot study. CWM-183-MW23 provided a second data location for assessing compatibility of the Site geology to full-scale design and also provided an opportunity to collect groundwater samples before and after the SVE/AS pilot study, as CWM-183-MW07 was dry and did not afford this opportunity.

Results

Air sample results are show in Table 3 and Figures 1 and 2, and groundwater results are shown in Table 4 and Figure 3. VOC concentrations were observed in the SVE air stream, but no VOCs were detected in the effluent air stream exiting the GAC drums. CWM-183-MW07 showed a decrease in air stream VOC concentrations, which may be due to the screen size of the groundwater monitoring well casing and the likely scaled or plugged screened interval. Conversely, CWM-183-MW23 exhibited a progressive increase in air stream VOC concentration as the 72 hour SVE/AS pilot study proceeded. This “hockey stick” shaped graph is exactly the desired result from the pilot study because it indicates proximity of the source area for targeting the full-scale design. These results demonstrate that the Site is a favorable candidate for full-scale SVE/AS.

Conclusions

The results of the SVE/AS pilot are positive and MES is proceeding to full-scale design for the Site. VOC emissions are considered in the full-scale design. The Air Division of ADEM does not regulate organic emissions for facilities with a potential VOC emission rate of less than 100 tons/year as specified in the ADEM Air Division regulations concerning the Control of Organic Emissions (335-3-6).

Total emission rate is calculated by multiplying:

$$Average\ Concentration \times Average\ Flow\ Rate = Emission\ Rate$$

Using the maximum VOC concentrations in the air stream from the pilot study results and the maximum flow rate capacity for the full-scale SVE system:

$$Maximum\ VOC\ Concentration\ from\ Pilot\ Study = \frac{1631.7\ \mu g}{m^3}$$

$$Maximum\ Flow\ Rate\ of\ SVE\ System = \frac{300\ ft^3}{\min}$$

One can calculate the maximum anticipated annual emission rate for the remediation system:

$$\frac{1631.7\ \mu g}{m^3} \times \frac{m^3}{35.3\ ft^3} \times \frac{300\ ft^3}{\min} \times \frac{525948 \min}{yr} \times \frac{g}{1E6\ \mu g} \times \frac{ton}{907184\ g} = 0.00804 \frac{ton}{yr}$$

The maximum anticipated VOC emission rate is significantly less than the permit requirement of 100 tons in the ADEM air regulations (335-3-6). Therefore, no permit for VOC emissions is required and the minimal concentrations from the system can be vented directly to the atmosphere.

TABLES

Table 1
T-6 Pilot Study
Summa Canister Pressures

Canister Number	Initial Vacuum (in Hg)	Post Sampling Vacuum (in Hg)	Sample Date
35683	29.5	5.3	4/3/2008
35655	29.1	0.0	4/2/2008
35599	29.9	0.0	4/7/2008
34669	29.9	5.1	4/4/2008
34640	29.8	6.0	4/5/2008
34582	29.6	5.3	4/2/2008
34140	29.7	8.0	4/1/2008
34180	29.8	0.0	4/8/2008
34111	29.6	5.1	4/8/2008
33638	29.6	0.0	4/1/2008
14522	29.6	0.0	4/4/2008
12355	29.7	0.0	4/3/2008
11822	Bad Threads		
9379	29.1	0.0	4/9/2008
2137	29.7	0.0	4/2/2008
1362	29.6	0.0	4/6/2008
SC10	19.5	Too little vacuum	
34166	29.5	5.0	4/7/2008
1364	29.4	4.5	4/6/2008

Table 2
T-6 Pilot Study
System Pressures and Flow Rates

Date	Time	Pressure (inches H2O)							Air Sparge Flow (scfm)
		MW08	MW09	MW11	MW21	MW6	MW07	MW23	
4/1/2008	1500	0.00	0.00	0.00	0.00	0.00	74	--	--
4/1/2008	1530	0.02	0.00	0.40	0.00	0.00	72	--	--
4/1/2008	1600	0.02	0.00	0.42	0.00	0.00	72	--	--
4/1/2008	1630	0.01	0.00	0.35	0.00	0.00	72	--	--
4/1/2008	1700	0.04	0.00	0.55	0.00	0.00	72	--	--
4/2/2008	0700	0.20	0.10	0.50	0.00	0.00	0*	--	--
4/2/2008	0930	0.00	0.20	0.40	0.00	0.00	74	--	--
4/2/2008	1615	0.00	0.00	0.40	0.00	0.00	72	--	--
4/3/2008	0700	0.00	0.00	0.50	0.00	0.00	72	--	--
4/3/2008	1605	0.00	0.00	0.40	0.00	0.00	72	--	--
4/4/2008	0730	0.00	0.10	0.50	0.00	0.00	72	--	--
4/4/2008	1445	0.00	0.00	0.75	0.00	0.00	72	--	--
4/5/2008	1430	0.00	0.00	0.00	0.00	0.00	--	74	10
4/6/2008	0750	--	--	--	--	--	--	78	10
4/6/2008	1135	--	--	--	--	--	--	64	10
4/6/2008	1730	--	--	--	--	--	--	62	10
4/6/2008	1745	0.21	0.30	0.62	0.00	1.60	--	--	--
4/7/2008	0745	0.20	0.41	0.74	0.00	0.12	--	62	10
4/7/2008	1345	0.19	0.21	0.71	0.10	0.08	--	66	10
4/7/2008	1650	0.18	0.15	0.50	0.05	0.10	--	66	10
4/8/2008	0750	0.20	0.20	0.47	0.05	0.16	--	67	10
4/8/2008	1610	0.18	0.06	0.40	0.05	0.15	--	68	10

Notes:
*SVE system was shut down at 0700 to sample well without vacuum operational.
-- not measured

Table 3
T-6 Pilot Study
Air Sample Results

		183-GAC1-080401160	183-GAC1-080402160	183-GAC1-080404151	183-GAC1-080405153	183-GAC1-080407170	183-GAC1-080408160	183-GAC2-080403160	183-GAC2-080406153	183-MW07-080401160	183-MW07-080402093	183-MW07-080402160	183-MW07-080403160	183-MW07-080404151	183-MW23-080405153	183-MW23-080406153	183-MW23-080407170	183-MW23-080408160
Parameter	**DF:**	**2.13**	**2.13**	**2.09**	**2.02**	**2.16**	**2.09**	**2.05**	**2.09**	**5.64**	**2.02**	**2.53**	**2.53**	**2.53**	**2.53**	**2.42**	**6.75**	**9.88**
1,1,2,2-Tetrachloroethane	ppbv	<	<	<	<	<	<	<	<	32	1.2	2.6	1.8	1.5	4	12	32	52
1,2,4-Trimethylbenzene	ppbv	<	<	<	<	<	<	25	<	<	1.9	<	<	1.3	<	<	<	<
1,3,5-Trimethylbenzene	ppbv	<	<	<	<	<	<	5.6	<	<	<	<	<	<	<	<	<	<
2,2,4-Trimethylpentane	ppbv	12	<	<	<	<	<	2	<	<	<	<	<	<	<	<	<	<
2-Butanone (MEK)	ppbv	1.9	1.1	<	<	<	<	1.6	<	14	7	8.6	8.8	3.4	1.4	5.7	12	24
2-Propanol	ppbv	<	<	<	<	<	<	<	<	<	<	5.6	<	<	8	14	<	22
4-Ethyltoluene	ppbv	1.7	<	<	<	<	<	15	<	<	<	<	<	<	<	<	<	<
Acetone	ppbv	19	7.8	4.6	<	<	<	9.5	<	<	6.2	<	11	5 J	6.7	8.2	<	<
Benzene	ppbv	22	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	9.1
Chloroethane	ppbv	<	<	<	<	<	<	2.3	<	<	<	<	<	<	<	<	<	<
Chloroform	ppbv	<	<	<	<	<	<	<	<	9.8	<	1.6	1.6	1.3	<	<	<	<
cis-1,2-Dichloroethene	ppbv	<	<	<	<	<	<	<	<	<	<	<	<	<	1.8	3.7	8.5	14
Cyclohexane	ppbv	9.3	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	7.2
Ethanol	ppbv	<	4.2 J	<	<	<	<	13	<	<	<	<	<	<	<	<	<	<
Ethyl Benzene	ppbv	8.5	<	<	<	<	<	6.1	<	<	<	<	<	<	<	<	<	<
Heptane	ppbv	12	<	<	<	<	<	1.5	<	<	<	<	<	<	<	<	<	5.4
Hexane	ppbv	16	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	10
m,p-Xylene	ppbv	20	<	<	<	<	<	24	<	<	1.4	<	<	1.7	<	<	3.4	13
Methylene Chloride	ppbv	<	<	<	1.1	<	<	<	<	<	<	<	<	<	<	<	<	<
o-Xylene	ppbv	1.9	<	<	<	<	<	11	<	<	<	<	<	<	<	<	<	<
Propylbenzene	ppbv	<	<	<	<	<	<	3.1	<	<	<	<	<	<	<	<	<	<
Tetrachloroethene	ppbv	<	<	<	<	<	<	<	<	9.9	1.2	1.8	1.5	<	11	15	38	57
Tetrahydrofuran	ppbv	<	<	<	<	<	<	<	<	11	2.6	6.1	5.5	1.9	<	3.6	9.7	18
Toluene	ppbv	<	<	<	2	<	<	11	<	<	<	<	<	<	<	<	<	<
Trichloroethene	ppbv	<	<	<	<	<	<	<	<	660	84	110	96	78	200	360	920	1400

Notes:
DF - Dillution Factor
ppbv - parts per billion volume
J = Estimated value. The analyte is positively identified and the concentration is less than the reporting limit but greater than the method detection limit.

Table 4
T-6 Pilot Study
MW23 Groundwater Sample Results

Parameter	4/4/2008 Concentration (ug/L)	4/8/2008 Concentration (ug/L)
1,1,1,2-Tetrachloroethane	1.7	0.5
1,1,2,2-Tetrachloroethane	2400	770
1,1,2-Trichloroethane	1.9	0.51
Chloroform	9.3	3.2
cis-1,2-Dichloroethene	38	13
Tetrachloroethene	73	33
trans-1,2-Dichloroethene	2.2	0.75
Trichloroethene	2000	840

FIGURES

Figure 1 - T6 SVE/Sparging Pilot Study PCE Air Data

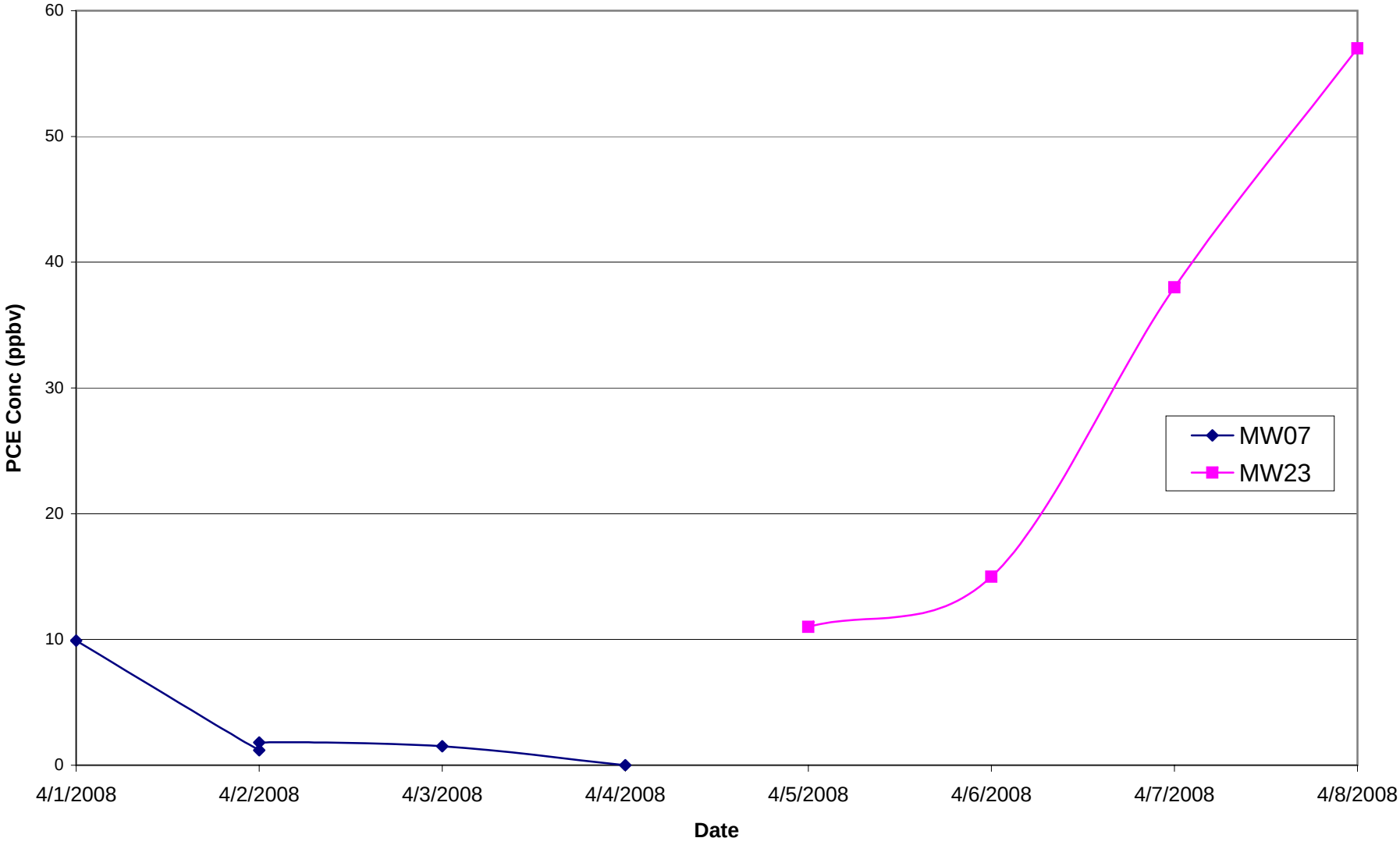


Figure 2 - T6 SVE/Sparging Pilot Study TCE Air Data

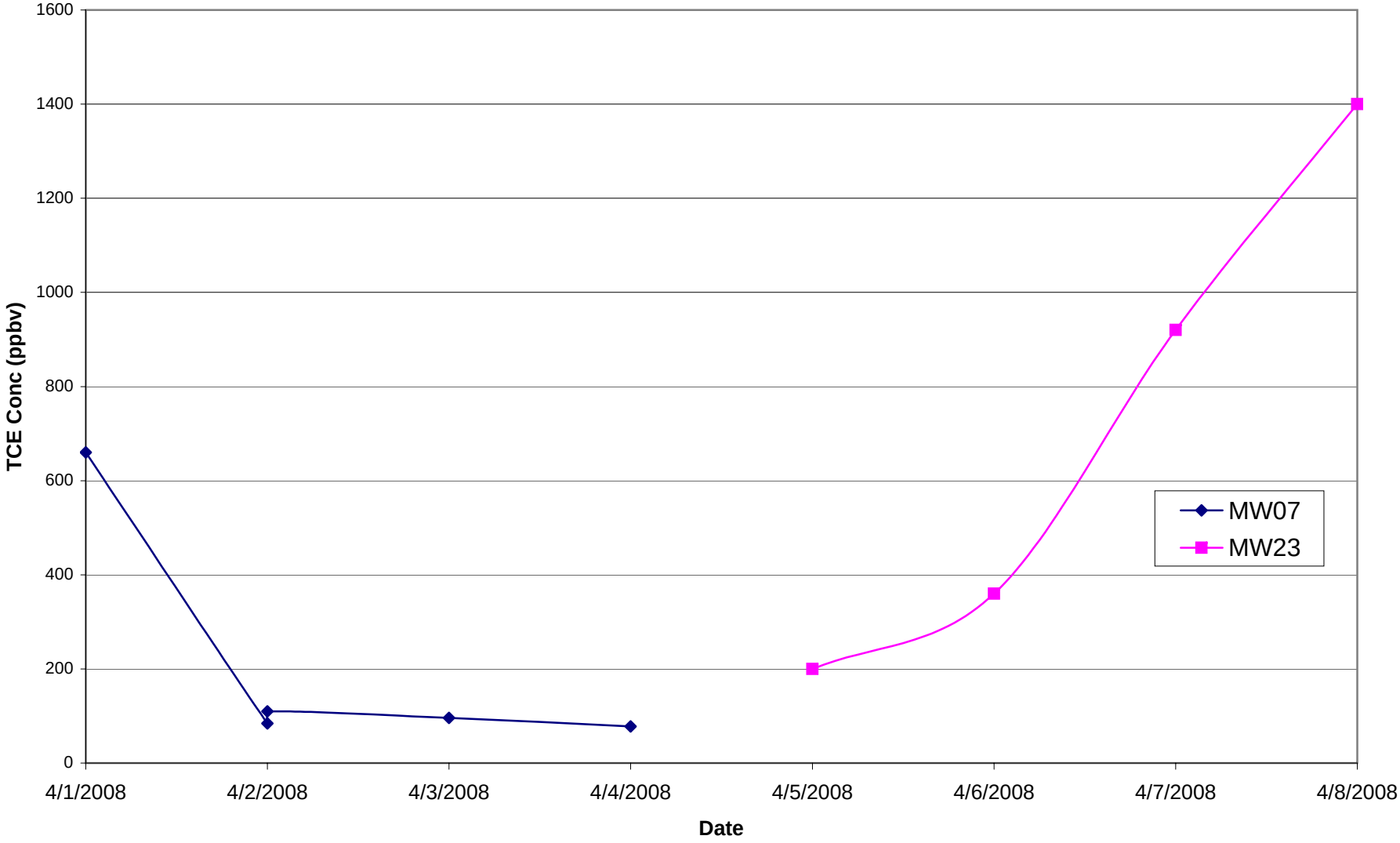
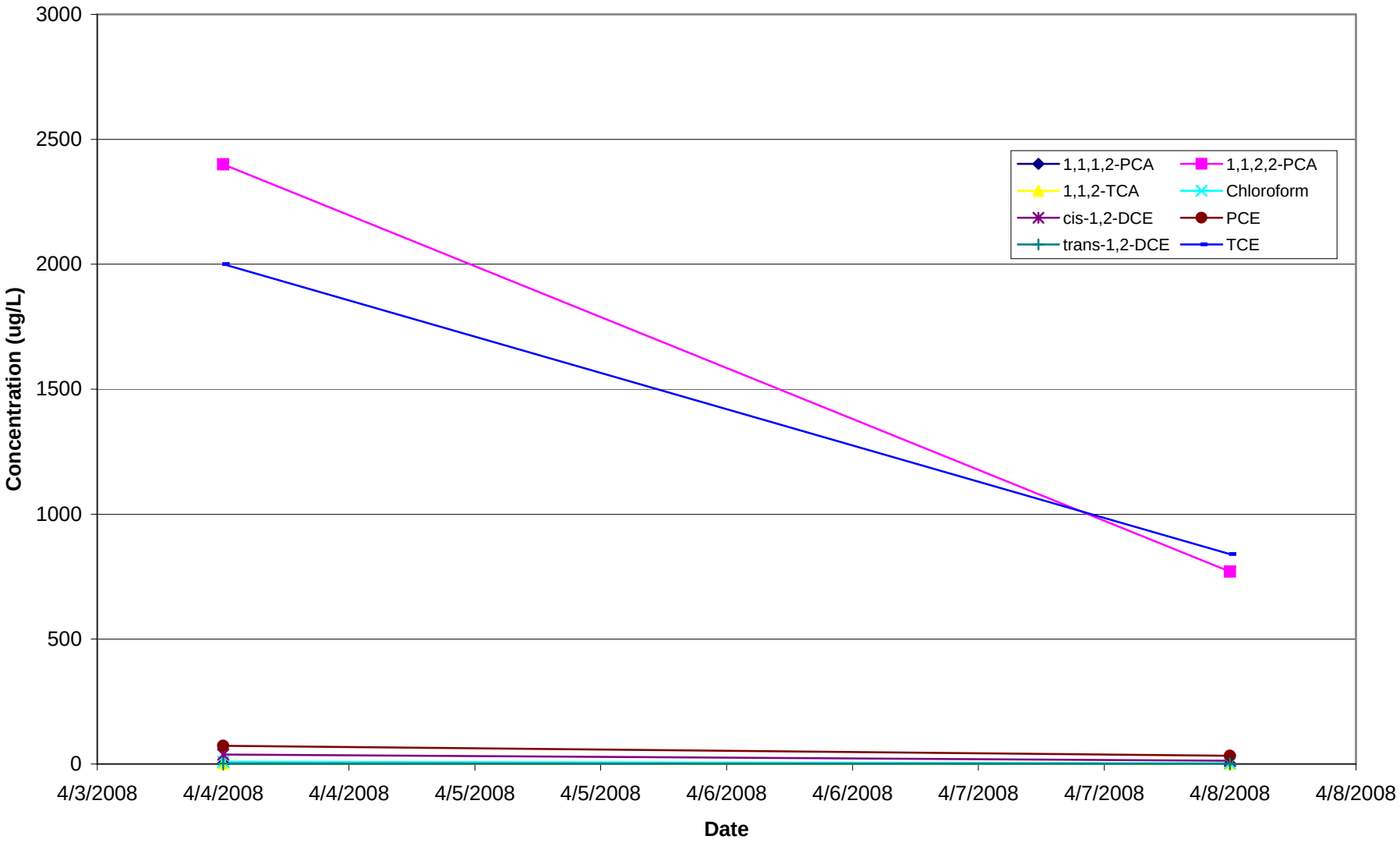


Figure 3 - T6 SVE/Sparging Pilot Study MW23 GW Data



FIELD NOTES

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MW 04	17.20'
MW 06	22.68'
MW 07	DRY (TOTAL MW DEPTH: 19.35')
MW 08	16.16'
MW 09	25.92'
MW 12	31.75'
MW 21	28.30'
MW 22	29.10'
MW 23	33.65'

T-6 PILOT SVE TEST

4/1/08 SUMMA CANISTER PRESSURE CHECK

SUMMA #	(in. Hg) INITIAL	(in. Hg) POST SAMPLE
35683	29.5	5.3 4/3/08
35655	29.1	0.0 4/2/08
35599	29.9	0.0 ~~4/7~~/08
34669	29.9	5.1 4/4/08
34640	29.8	6.0 4/5/08
34582	29.6	5.3 4/2/08
34140	29.7	8.0 4/1/08
34180	29.8	0.0 4/8/08
34111	29.6	5.1 4/8/08
33638	29.6	0.0 4/1/08
14522	29.6	0.0 4/4/08
12355	29.7	0.0 4/3/08
11822 - BAD THREADS -		
9379	29.1	0.0 4/5/08
(MW 07) 2137 MW#(0804020937)	29.7	0.0 4/2/08
1362	29.6	0.0 4/6/08
SC10 - BAD -	19.5	
34166 4/5/08	29.5	5.0 ~~4/7~~/08 ~~0.0 4/6~~
1364 4/5/08	29.4	4.5 4/6/08

4/1/08

SVE PILOT TEST @ 1500

W/O AIR SPARGE

SVE APPLIED @ MW07	GAGE #
MW's 8	1 A
9	1 B
11	3
21	4

4-1-08 GAGE INCHES H_2O

	MW	8	9	11	21	6
1500		∅	∅	∅	∅	∅
1530		0.02	∅	0.4	∅	∅
1600		0.02	∅	0.42	∅	∅
1630		0.01	∅	0.35	∅	∅
1700		0.04	∅	0.55	∅	∅

4/2/08

	MW	8	9	11	21	6
0700		0.2 ~~0.02~~	0.1 ~~0.4~~	0.5	∅	∅

SHUT SVE DOWN TO TAKE READINGS AT MW-07 WELL INSIDE CASING VIA SUMMA & FID

FID (PPM) GAC 2 GAC 1

GAC #1 ∅ PPM 1501
GAC #2 ∅ 1501

MW-∅7 1500 74 IN H_2O
MW-07 1530 72 " H_2O
MW-07 1600 72" H_2O
GAC #1 1600 ∅ PPM ~ 95°F
GAC #2 1600 ∅ PPM ~ 90°F

SUMMA

34140 MW-∅7 4/1/08 1600
33638 GAC #1 4/1/08 1600

GAC 1 1630 ∅ PPM ~ 100°F
GAC 2 1630 ∅ PPM ~ 110°F

MW ∅7 1700 72" H_2O

4/2/08
MW ∅7 0700 72" H_2O
GAC 1 0700 ∅ PPM ~ 118°F
GAC 2 0700 ∅ PPM ~ 110°F

SUMMA
2137 MW-∅7 4/2/08 0937

4/2/08

MW	B	9	11	21	6
0700	0.2	0.1	0.5	∅	∅
0950	0.0	0.2	0.4	∅	∅
1615	0.0	0.0	0.4	∅	∅

4/2/08

0700 SVE SHUT DOWN ON MW-07

0945 SVE RESTART ON MW-07

FID = 0.0 MW-07 MW-11
MW-23 MW-06

TOOK SUMMA MW-07 @ 0937

0945 SVE @ 74" H20

1600

GAC 1 @ 152 °F

GAC 2 @ 130 °F

SVE @ MW-07 @ 72" H_2O

SUMMA 34582 @ MW-07

SUMM 35655 @ GAC 1

4/3/08 IN H_2O

MW	8	9	11	21	6
0700	0.0	0.0	0.5	0.0	0.0
1605	0.0	0.0	0.4	0.0	0.0

4/3/08

0700 GAC 1 Ø PPM
0700 GAC 2 Ø PPM

1600 GAC 1 Ø PPM ~132°F
1600 GAC 2 Ø PPM ~120°F

1600 SUMMA 12355 GACZ
1600 SUMMA 35603 MW Ø7

4/4/08 IN H_2O

MW	8	9	11	21	6
0730	ØØ	Ø.1	Ø5	ØØ	Ø.Ø
1445	Ø.Ø	Ø.Ø	Ø.75	Ø.Ø	Ø.Ø

4/4/08

0730	GAC1	Ø.Ø ppm ~122°F
0730	GAC2	Ø.Ø ppm ~122°F
0730	MW-07	72" H_2O
~~0~~		
1445	MW-Ø7	72" H_2O
1445	GAC 1	Ø ppm ~ 130°F
1445	GAC 2	Ø ppm ~ 128°F

SUMMA 14522 GAC 1

SUMMA 34669 MW Ø7

MW	8	9	11	21	6
4/5/08 @1430	0.0	0.0	0.0	0.0	0.0

4/5/08

MOVE SVE / AIR SPARGE TO NEW LOCATION MW-023
RESTART SVE @ MW-023 @ 1400
START AIR SPARGE @ MW-22 @ 1400

SUMMA 3460
SUMMA 183-MW ~~07~~ 23 -080405 1530

SUMMA 9379
183-GAC1-080405 1530

SVE ~~04~~ 74" H_2O @ ~ ~~0~~ 74 SCFM
AIR SPARGE @ 3 SCFM

NOTE: [redacted] TORNADO WATCHES & WARNINGS ALONG WITH HEAVY RAINS

MW	8	9	11	21	6
4/6/08 @ 1545	0.21	0.30	0.62	~~N/A~~ 0.0	1.6

4/6/08

0750 SVE @ 78" H_2O
AIR SPARGE @ ~ 10 SCFM

H_2O IN MW23 @ ~ 30.92 TOC

0800 CHANGE VACUUM TO ~60 " H_2O
DRAINED ~3 gal FROM KNOCK-OUT

1135 SVE @ 64" H_2O
AIR SPARGE ~ 10 SCFM
MW-23 H_2O @ 30.34 TOC

1230 SVE @ 62" H_2O
AIR SPARGE ~ 10 SCFM

SUMMA 1364 ~~MW-23~~ MW-23
SUMMA 1362 GAC 2
GAC 1 @ 130°F
GAC 2 @ 132°F

4/7/08

			(in H_2O)		
MW	8	9	11	21	6
0745	0.20	0.41	0.74	0.0	0.12
1345	0.19	0.21	0.71	0.10	0.08
1650	0.18	0.15	0.50	0.05	0.10

4/7/08

0745 SVE @ 62" H_2O
Air Sparge @ ~10 cfm

GAC 1 @ 112°F
GAC 2 @ 110°F

MW 23 H_2O @ 30.35' TOC
H.

1345 SVE @ 66" H_2O
Air Sparge @ ~10 cfm

UTILITY POLE ID (@ UXO GATE)
2-052945

UTILITY POLE ID (2 POLES SOUTH OF SPA GATE)
2-052955

1700 SVE @ 66" H_2O
AIR SPARGE @ ~10 SCFM
GAC 1 ~120°F
GAC 2 ~130°F
SUMMA 34166 MW-23
SUMMA 35599 GAC I
MW-23 H_2O @ 30.14' TOC

4/8/08

(in H_2O)

MW	8	9	11	21	6
0750	0.20	0.20	0.47	0.05	0.16
1610	0.18	0.06	0.40	0.05	0.15

4/8/08

0750 SVE @ 67" H_2O
Air Sparge @ ~ 10 cfm
MW-23 · H_2O @ 30.26' TOC

1600 SUMMA 34111 - MW-23
1600 SUMMA 34180 - GAC 1

1610 GAC I ~ 146°F
1615 GAC 2 ~ 135°F
SVE @ 68" H_2O
AIR SPARGE @ ~ 10 SCFM
STOPPED @ 1630 4/8/08
GENERATOR HOURS 2476.29 END
2330.59 START
146 HRS

4/9/08 H_2O LEVELS

MW	H_2O @ TOC	
04	17.22	
06	22.53	
07	14.81	19.30 TD
08	15.53	
09	23.97	
12	30.85	
21	24.47	
22	25.33	
23	32.54	
11	26.78	
28	19.40	
20	16.23	
24	17.66	
13	19.53	~~[illegible]~~