



Updated
SALEM / MASSACHUSETTS

The Site is a Citgo gasoline station located in Salem, Massachusetts. On May 26, 2000, during routine groundwater sampling activities, personnel of Handex of New England had discovered dissolved concentrations of petroleum hydrocarbons in the groundwater at the Site totaling greater than five parts per million in two monitoring wells located less than 30 feet from occupied residential structures. During subsequent tightness testing, an underground delivery line failed.

On May 14, 2002, an IRA Plan Modification was submitted to the DEP that documented the proposed remediation of soil and groundwater at the Site using *Butane Biostimulation Technologies*TM. A Phase III Remedial Action Plan (RAP) was prepared in December 2003 and a Phase IV Remedy Implementation Plan (Phase IV RIP) was prepared in June 2004. An Immediate Response Action Completion Report was prepared for the Site in July 2004.

Six *Butane Biosparging*TM injection wells were installed in the area of the pump islands and the USTs in July 2002 by GBI personnel. In general, subsurface conditions at the Site consists of sand with some silt and gravel. The *Butane Biosparging*TM and *Butane Bioventing*TM systems were installed at the Site and began operation on December 2, 2002. The bioventing system oxygenates the soil resulting in enhanced microbial degradation of the petroleum compounds in the capillary fringe and in the vadose zone. In addition, the bioventing system controls the potential migration of VOCs from the treatment area into adjacent buildings, thus allowing for vapor control while reducing the overall O&M costs by eliminating the need for carbon replacement and by recycling the butane gas. All equipment was inspected to insure that the remediation system would meet the projected design standards with the ultimate goal of achieving a *Permanent Solution* for the Site.

The last sampling event occurred in November 2005. The data indicated that groundwater conditions have improved significantly due to operation of the butane biostimulation system and no exposure points were identified above applicable DEP Method 1 GW-2 or GW-3 Risk Characterization Standards with the exception of monitoring wells MW-2. The complete analytical results are shown in Table 1. MTBE dropped from 306,000 µg/L (December 2004) to 6,900 µg/L (November 2005) in monitoring well MW-4 (the leaking sensor in the overfill containment sump was replaced).

BUTANE BIOSTIMULATION TECHNOLOGIESTM

Site Photos



TABLE 1
SUMMARY OF GROUNDWATER DATA: VPH (ug/L)
CITGO SERVICE STATION
105 NORTH STREET, SALEM, MASSACHUSETTS

System Startup in December 2002

SAMPLE LOCATION	SAMPLE DATE	BENZENE	ETHYL-BENZENE	TOLUENE	XYLENES	MTBE	NAPHTH-ALENE	C5 - C8 ALIPHATICS	C9 - C12 ALIPHATICS	C9 - C10 AROMATICS
MW-2	10/28/2002	36.8	623	791	2,945	326	371	456	12,100	4,150
MW-2	1/13/2003	<5.0	<5.0	<5.0	<5.0	6,370	<20	6,230	<15	<55
MW-2	6/24/2003	171	140	156	864	1,890	<20	<40	<15	<55
MW-2	10/30/2003	<5.0	52.9	16	236	445	<20	<40	<15	252
MW-2	3/1/2004	<50	408	340	2550	152	114	<500	793	2,420
MW-2	6/2/2004	11	441	348	4,450	919	253	<400	<150	4,980
MW-2	12/13/2004	<5	465	38.6	512	120	<20	96.4	243	1,100
MW-2	7/27/2005	156	1,960	394	5,212	1,370	754	<2,500	3,920	9,360
MW-2	11/8/2005	<100	730	351	3,650	478	<500	<2,500	3,730	5,270
MW-3	10/28/2002	787	66.3	211	322	206,000	58	< 8000	897	935
MW-3	1/13/2003	<5000*	<5000*	<5000*	<5000*	151,000	<20,000*	<40,000*	<15,000*	<55,000*
MW-3	6/24/2003	<5.0	<5.0	<5.0	<5.0	4,090	<20	<40	<15	<55
MW-3	10/30/2003	<5.0	<5.0	<5.0	<5.0	240	<20	<40	<15	<55
MW-3	3/1/2004	8	8	<5	<5	4,830	<10	<50	<50	115
MW-3	6/2/2004	<5	<5	<5	<5	5,350	<20	<40	<150	<55
MW-3	12/13/2004	<5	<5	<5	<5	1,200	<20	<200	16.0	<55
MW-3	7/27/2005	<1,000	<1,000	<1,000	<1,000	30,800	<5,000	<25,000	<25,000	<25,000
MW-3	11/8/2005	<100	<100	<100	<100	4,390	<500	<2,500	<2,500	<2,500
MW-4	10/28/2002	5,800	65	192	740	298,000	231	176,000 ¹	1,750	1,840
MW-4	1/13/2003	351	90.6	70.7	1,076	523,000	<200	<400	<150	1,320
MW-4	6/24/2003	<2,500*	<2,500*	<2,500*	<2,500*	166,000	<10,000*	12,000	<15	<55
MW-4	10/30/2003	<5,000*	<5,000*	<5,000*	<5,000*	215,000	<20,000*	<40,000*	<15,000*	<55,000*
MW-4	3/1/2004	409	204	322	680	175,000	167	<500	680	3,330
MW-4	6/2/2004	<2,500*	<2,500*	<2,500*	<2,500*	224,000	<10,000*	<20,000*	<7,500*	<27,500*
MW-4	12/13/2004	253	184	51.1	464	306,000	220	<40,000*	962	2,520
MW-4	7/27/2005	<100	<100	<100	<100	4,500	<500	<2,500	<2,500	<2,500
MW-4	11/8/2005	<100	<100	<100	<100	6,900	<500	<2,500	<2,500	<2,500
MW-8	10/28/2002	30.9	7.4	5.6	40.8	4790	<20	<400	40.4	85.8
MW-8	1/13/2003	<5.0	<5.0	<5.0	<5.0	39.3	<20	<40	<15	<55
MW-8	6/24/2003	<5.0	<5.0	<5.0	<5.0	<5.0	<20	<40	<15	<55
MW-8	10/30/2003	<5.0	<5.0	<5.0	<5.0	1,630	<20	<400	<15	<55
MW-8	3/1/2004	<50	<50	<50	<50	2,300	<100	<500	<500	<500
MW-8	6/2/2004	<5	<5	<5	<5	947	<20	843	<150	<55
MW-8	12/13/2004	<5	<5	<5	<5	5,900	<20	<800	<15	<55
MW-8	7/27/2005	<100	<100	<100	<100	3,770	<500	<2,500	<2,500	<2,500
MW-8	11/8/2005	<40	<40	<40	<40	1,740	<200	<1,000	<1,000	<1,000
PZ-3	10/28/2002	706	19	215	161.6	125,000	24.5	< 8000	<15	2,300
PZ-3	1/13/2003	15.1	15.1	18.3	75.3	43,100	<20	<40	<15	350
PZ-3	6/24/2003	<500*	<500*	<500*	<500*	52,300	<2,000*	<40	<15	<55
PZ-3	10/30/2003	50.4	<5.0	<5.0	6.4	3,690	457	<40	<15	3,100
PZ-3	3/1/2004	<50	<50	<50	<50	3,150	<100	<500	<500	<500
PZ-3	6/2/2004	<50	<50	<50	<50	1,230	<200	<400	<150	<550
PZ-3	12/13/2004	63	<5	<5	45.7	1,480	<20	<400	<15	<55
PZ-3	7/27/2005	<1,000*	<1,000*	<1,000*	<1,000*	79,400	<5,000*	<25,000*	<25,000*	<25,000*
PZ-3	11/8/2005	<10	<10	<10	<10	327	<50	<250	<250	<250
PZ-4	10/28/2002	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<40	16	<55
PZ-4	1/13/2003	<5.0	<5.0	<5.0	<5.0	<5.0	<20	331	<15	<55
PZ-4	6/24/2003	<5.0	<5.0	<5.0	<5.0	96.2	<20	<40	<15	<55
PZ-4	10/30/2003	<5.0	<5.0	<5.0	<5.0	<5.0	<20	137	<15	<55
PZ-4	3/1/2004	<5	<5	<5	<5	<5	<10	<50	<50	<50
PZ-4	6/2/2004	<5	<5	<5	<5	<5	<20	<40	<15	<55
PZ-4	12/13/2004	<5	<5	<5	<5	6	<20	64.3	64.7	<55
PZ-4	7/27/2005	<2	<2	<2	<2	49.3	<10	<50	<50	<50
PZ-4	11/8/2005	<2	<2	<2	<2	<3	<10	<50	<50	<50
GW-2		2,000	30,000	6,000	6,000	50,000	6,000	1,000	1,000	5,000
GW-3		7,000	4,000	50,000	50,000	50,000	6,000	4,000	20,000	4,000

NOTES: All concentrations expressed in ug/L (ppb).

Bold values exceed GW-2 and/or GW-3 Standards.

* Elevated detection limits due to detected MTBE concentrations.

1 = Concentration not accurate due to elevated concentration of MTBE.

Line testing near MW-4 did uncover a new leak (leaking sensor) in the overfill containment sump. The leaking sensor was replaced.

REFERENCES

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