

CANTON / MASSACHUSETTS

In November 2000, GBI implemented Butane Biostimulation Technologies™ at a Sunoco service station located in Canton, Massachusetts. The primary environmental contractor for the Site is GBI. The objective of the cleanup effort was to remediate petroleum pollutants to below drinking water quality standards in all Site groundwater monitoring wells. During the removal of three gasoline underground storage tanks (USTs) at this 3.4 acre site in 1995, volatile organic vapor concentrations were detected above 100 ppm in soil headspace. The site was classified by the Massachusetts Department of Environmental Protection (DEP) as Tier IB in 1996. Between 1995 and 2000, approximately 2,000 cubic yards of impacted soil were removed from the site for recycling and landfill. In August 2000, a biofeasibility study was conducted which confirmed that butane-utilizing bacteria are present in the groundwater at the site in the proposed treatment zone, and the populations of these bacteria would develop in sufficient numbers to complete full microbial oxidation of injected butane as well as the cometabolism of benzene, MTBE and other gasoline constituents, the primary contaminants at the site. The depth to groundwater at the site ranges from 3 to 10 feet below grade. The station property is underlain by brown fine to medium sand and fine to coarse gravel to a depth of approximately 10 feet below grade. The soil locally grades to a dark brown peat with silt to a depth of approximately 15 feet below grade. A layer of light gray silt and clay is encountered from approximately 20 to 25 feet below grade. Groundwater flow direction is radial, with a horizontal hydraulic gradient of 0.043 feet per foot (ft/ft) and groundwater flow velocity estimated to be 1.57 feet per year (ft/yr) across the property. The site is located within both a DEP Approved Zone II, and a Medium Yield Potentially Productive Aquifer. Public drinking water is supplied from several groundwater intake stations north and south of the site.

GBI installed two Butane Injector 2000™ systems at the Site under a DEP approved RAM Plan. A total of 12 Butane Biosparge™ injection wells were installed on-site by Handex of New England. The Butane Biosparging system was shutdown on October 29, 2002, because groundwater conditions at the Site were approaching background. GBI is currently preparing a closure document (Response Action Outcome) for the Site.

**BUTANE BIOSTIMULATION TECHNOLOGIES™
Site Photos**



**Summary of Groundwater Quality Data
Canton, Massachusetts
System Startup – November 2000
System Shut Down – October 2002**

SAMPLE LOCATION	SAMPLE DATE	BENZENE	ETHYL-BENZENE	TOLUENE	XYLENES	MTBE	NAPHTH-ALENE	C5 - C8 ALIPHATICS	C9 - C12 ALIPHATICS	C9 - C10 AROMATICS
MW-1	4/5/1996	110	160	67	710	5.4	NA	NA	NA	NA
	9/29/1997	65.9	34.2	<1	89.9	11	NA	NA	NA	NA
	7/28/1998	45.9	38.4	6	80.8	9.3	5.8	455	236	284
	3/10/1999	69.8	68.2	7.9	57.9	13.6	9.8	329	<100	515
	3/10/2000	73.1	90.4	10.6	394	58.3	7.3	504	<100	752
	10/24/2000	9.9	7.9	< 5.0	30	37	< 10	< 50	< 50	80
	1/17/2001	9.3	<5.0	<5.0	24	19	<10	97	<50	70
	4/19/2001	<5.0	<5.0	<5.0	<5.0	11	<10	<50	<50	<50
	7/25/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	10/22/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	1/15/2002	8.1	11	<5.0	34	18	<10	<50	79	<50
	4/30/2002	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	8/1/2002	<5.0	<5.0	16	<5.0	<5.0	<10	68	<50	<50
	10/29/2002	<5.0	<5.0	16	11	7	<10	68	<50	<50
	4/1/2003	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/1/2003	<5.0	<5.0	<5.0	<5.0	<5.0	<20	<40	<15	<55
MW-2	4/5/1996	250	94	37	430	200	NA	NA	NA	NA
	9/29/1997	281	83.7	36.3	301	102	NA	NA	NA	NA
	7/28/1998	57.2	33	5.3	38.3	99.3	4.8	409	174	157
	3/10/1999	18.4	12.6	25	60.5	49.4	<10	<200	<200	<200
	3/10/2000	137	68.8	<25	370	45.7	<25	<500	<500	<500
	10/24/2000	270	< 50	< 50	360	84	< 100	< 500	510	< 500
	1/17/2001	<5.0	<5.0	<5.0	5.1	49	<10	<50	<50	<50
	4/19/2001	7.6	<5.0	<5.0	<5.0	96	<10	<50	<50	<50
	7/25/2001	<5.0	<5.0	<5.0	<5.0	50	<10	<50	<50	<50
	10/22/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	1/15/2002	6.4	<5.0	<5.0	<5.0	10	<10	<50	<50	<50
	4/30/2002	60	14	<5.0	101	6	<10	<50	60	90
	8/1/2002	<5.0	<5.0	18	<5.0	<5.0	<10	64	60	<50
	10/29/2002	12	6	<5.0	33	6	<10	<50	<50	<50
	4/1/2003	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<40	<15	<55
	10/1/2003	<5.0	<5.0	<5.0	<5.0	<5.0	<20	<40	<15	<55
MW-3	4/5/1996	1,000	360	670	1,200	2,500	NA	NA	NA	NA
	9/29/1997	1,200	363	692	1,290	1,840	NA	NA	NA	NA
	7/28/1998	920	294	718	1,271	1,370	26.6	3,240	1,050	1,200
	3/10/1999	1,000	401	1,060	2,006	676	38.1	1,110	<200	1,630
	3/10/2000	794	284	583	1,288	740	24.6	1,350	<100	1,190
	10/24/2000	850	380	830	2,000	370	110	1,900	660	1,700
	1/17/2001	35	14	21	61	12	<10	98	<50	65
	4/19/2001	350	150	230	790	250	<50	870	<250	640
	7/25/2001	12	<5.0	<5.0	17	150	<10	<50	<50	<50
	10/22/2001	<5.0	<5.0	<5.0	<5.0	52	<10	<50	<50	<50
	1/15/2002	89	13	<5.0	53	110	<10	150	84	<50
	4/30/2002	<5.0	<5.0	<5.0	<5.0	6	<10	<50	<50	<50
	8/1/2002	<5.0	<5.0	22	<5.0	27	<10	69	70	<50
	10/29/2002	8	<5.0	<5.0	10	12	<10	<50	123	76
	4/1/2003	<5.0	<5.0	<5.0	<5.0	42.2	<10	<40	<15	<55
	10/1/2003	<5.0	<5.0	<5.0	<5.0	<5.0	<20	<40	<15	<55

SAMPLE LOCATION	SAMPLE DATE	BENZENE	ETHYL-BENZENE	TOLUENE	XYLENES	MTBE	NAPHTH-ALENE	C5 - C8 ALIPHATICS	C9 - C12 ALIPHATICS	C9 - C10 AROMATICS
MW-4	4/5/1996	130	280	100	1,800	260	NA	NA	NA	NA
	9/29/1997	198	11	4.1	12	90	NA	NA	NA	NA
	7/28/1998	67.1	95	101	456	241	266	376	1,340	1,570
	3/10/1999	64.6	7.2	12.6	29.3	62.4	19.2	<100	<100	<100
	3/10/2000	12.3	<5.0	<5.0	6.1	239	11.5	<100	<100	<100
	10/24/2000	28	<5.0	<5.0	<5.0	32	<10	60	<50	<50
	1/17/2001	9.1	6.5	5.7	25	35	<10	66	58	<50
	4/19/2001	<5.0	<5.0	<5.0	<5.0	5.6	<10	<50	<50	<50
	7/25/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	55	<50
	10/22/2001	<5.0	<5.0	<5.0	<5.0	52	<10	<50	<50	<50
	1/15/2002	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	4/30/2002	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	8/1/2002	<5.0	<5.0	24	<5.0	<5.0	<10	64	121	116
	10/29/2002	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	57	<50
	4/1/2003	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/1/2003	<5.0	<5.0	<5.0	<5.0	<5.0	<20	<40	<15	<55
MW-5	4/5/1996	<2.0	3.5	5.1	27.3	34.3	<2.0	131	61	60.2
	9/29/1997	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100	<100	<100
	7/28/1998	<5.0	<5.0	<5.0	<5.0	19.9	<5.0	<100	<100	<100
	3/10/1999	<5.0	<5.0	<5.0	<5.0	8.9	<10	<50	<50	<50
	3/10/2000	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	10/24/2000	<5.0	<5.0	<5.0	<5.0	8.9	<10	<50	<50	<50
	1/17/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	4/19/2001	<5.0	<5.0	<5.0	<5.0	5.6	<10	<50	<50	<50
	7/25/2001	<5.0	<5.0	<5.0	<5.0	160	<10	<50	<50	<50
	10/22/2001	<5.0	<5.0	<5.0	<5.0	29	<10	<50	<50	<50
	1/15/2002	<5.0	<5.0	<5.0	<5.0	9.7	<10	<50	<50	<50
	4/30/2002	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
	8/1/2002	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
	10/29/2002	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
	4/1/2003	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/1/2003	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW-6	4/5/1996	<2.0	<2.0	4.2	10.1	15.7	6.1	42.2	29.6	24.5
	9/29/1997	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100	<100	<100
	7/28/1998	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100	<100	<100
	3/10/1999	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	3/10/2000	<5.0	<5.0	<5.0	<5.0	56	<10	<50	<50	<50
	10/24/2000	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	1/17/2001	<5.0	<5.0	<5.0	<5.0	56	<10	<50	<50	<50
	4/19/2001	<5.0	<5.0	<5.0	<5.0	8.7	<10	<50	<50	<50
	7/25/2001	<5.0	<5.0	<5.0	<5.0	7.2	<10	<50	<50	<50
	10/22/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	1/15/2002	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4/30/2002	<5.0	<5.0	<5.0	<5.0	6	<10	<50	<50	<50
	8/1/2002	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
	10/29/2002	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	4/1/2003	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/1/2003	<5.0	<5.0	<5.0	<5.0	<5.0	<20	<40	<15	<55

SAMPLE LOCATION	SAMPLE DATE	BENZENE	ETHYL-BENZENE	TOLUENE	XYLENES	MTBE	NAPHTH-ALENE	C5 - C8 ALIPHATICS	C9 - C12 ALIPHATICS	C9 - C10 AROMATICS
MW-8S	4/5/1996	<2.0	<2.0	3.1	4.6	16.8	<2.0	56.4	17.8	15.4
	9/29/1997	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100	<100	<100
	7/28/1998	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100	<100	<100
	3/10/1999	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	3/10/2000	<5.0	<5.0	<5.0	<5.0	56	<10	<50	<50	<50
	10/24/2000	<5.0	<5.0	<5.0	<5.0	28	<10	<50	<50	<50
	1/17/2001	<5.0	<5.0	<5.0	5	16	<10	<50	<50	<50
	4/19/2001	<5.0	<5.0	<5.0	<5.0	16	<10	<50	<50	<50
	7/25/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	10/22/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	1/15/2002	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	4/30/2002	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	<50	<50
	8/1/2002	<5.0	<5.0	21	<5.0	<5.0	<10	64	<50	<50
	10/29/2002	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<50	59	<50
	4/1/2003	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/1/2003	<5.0	<5.0	<5.0	<5.0	<5.0	<20	<40	<15	<55
GW-1 STANDARD		5	700	1,000	10,000	70	20	400	4,000	200
GW-2 STANDARD		2,000	30,000	6,000	6,000	50,000	6,000	1,000	1,000	5,000
GW-3 STANDARD		7,000	4,000	50,000	50,000	50,000	6,000	4,000	20,000	4,000

NOTES: All concentrations expressed in µg/l (ppb)
NA indicates not analyzed
Bold values exceed GW-1, GW-2 and/or GW-3 Standards
Yellow shading indicates background sampling results

REFERENCES

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