



WALTHAM / MASSACHUSETTS

In June 2002, GBI began injecting butane to remediate petroleum impacted soil and groundwater at a retail gasoline station located in Waltham, Massachusetts. The source of the release of petroleum pollutants was faulty fuel dispensers, which were replaced in 1997. In June 2001, the property owner contracted GBI to implement *Butane Biostimulation Technologies™* under a Release Abatement Measure (RAM) plan to clean up the site. Concurrently with a *Butane Biosparging™* System, GBI operated a *Butane Bioventing™* System (a type of soil vapor extraction / vapor reinjection system) to control migration of VOCs, further oxygenate soils and recirculate extracted soil gas back into the butane biotreatment zone. A total of six *Butane Biosparge™* wells, each 15 feet deep, were installed on the half acre site to inject butane and air into the groundwater to enhance microbial degradation of petroleum pollutants. Site geology varies from dense till overlying bedrock at a depth of 6 feet in the northern and western portions of the site, to 10 feet of sand and gravel overlying sand and silt. Bedrock is located at a depth 17 feet below ground surface at the eastern and southern portions of the site, including the area of the petroleum release. The site is completely paved, with a commercial building to the northeast, and residential dwellings on the remaining sides of the property. There are no municipal or private water wells within 500 feet of the property.

Remedial objectives for the Site include reducing groundwater and soil concentrations of the contaminants of concern to below Massachusetts Contingency Plan (MCP) GW-2, GW-3, S-2/GW-2 and S-2/GW-3 standards for volatile petroleum hydrocarbons (VPH) and extractable petroleum hydrocarbons (EPH) and eliminating the potential for migration of contaminants from the soil in the source area to the groundwater. The *Butane Biosparging™* and *Butane Bioventing™* Systems were shut down in August 2003. The Site is currently undergoing post-remedial monitoring and sampling. After completing two additional groundwater sampling events, GBI will file a Site closure document (Response Action Outcome) in January 2004.

BUTANE BIOSTIMULATION TECHNOLOGIES™

Site Photos



Summary of Groundwater Quality Data
Waltham, Massachusetts
System Startup – June 2002 : System Shut Down – August 2003

SAMPLE LOCATION	SAMPLE DATE	BENZENE	ETHYL-BENZENE	TOLUENE	XYLENES	MTBE	NAPHTH-ALENE	C5 - C8 ALIPHATICS	C9 - C12 ALIPHATICS	C9 - C10 AROMATICS
MW-1	10/18/2001	<5	<5	<5	<5	<5	<5	<10	<10	<10
MW-2R	10/18/2001	<300	580	<300	970	29,000	<300	<500	1,400	1,100
MW-3R	10/18/2001	2,000	630	530	1,500	6,400	<50	<100	330	1,500
MW-4	10/18/2001	1,700	830	<300	<300	26,000	<300	<500	<500	3,000
MW-5	10/18/2001	400	150	<50	120	3,700	<50	<100	290	370
GBI-1	10/18/2001	540	<500	<500	1,600	71,000	<500	1,300	1,600	<1,000
GBI-2	10/18/2001	<50	<50	<50	<50	6,300	<50	<100	350	<100
GBI-3	10/18/2001	<5	<5	<5	<5	<5	<5	<10	<10	<10
GBI-4	10/18/2001	<30	<30	<30	57	1900	<30	<50	<50	72
MW-1	1/25/2002	<5	<5	<5	<5	<5	<20	<40	<15	<55
MW-2R	1/25/2002	113	259	25.9	504	7,850	43.2	<400	<15	576
MW-3R	1/25/2002	511	284	12.7	658	1,700	73	<400	<150	586
MW-4	1/25/2002	1,785	779	19	357	20,940	175	<2000	<750	<2,750
MW-5	1/25/2002	50.2	300	61.4	381	1,580	53.4	<40	<15	540
GBI-1	1/25/2002	520	1,860	401	7,280	34,400	258	<4,000	<1,500	<5,500
GBI-2	1/25/2002	93.9	86	7.55	73.7	1,430	<20	<400	<150	<550
GBI-3	1/25/2002	<5	<5	<5	<5	<5	<20	<40	<15	<55
GBI-4	1/25/2002	25.6	5.86	<5	13.5	955	<20	<40	24.7	65.7
MW-1	4/23/2002	<5	<5	<5	<5	<5	<20	<40	<15	<55
MW-2R	4/23/2002	89.8	451	374	1427	7,270	82	<400	<150	1,610
MW-3R	4/23/2002	1,430	348	29	777.7	2,720	92	<400	<150	1,450
MW-4	4/23/2002	2,010	867	87.2	853.8	31,800	229	<2,000	<750	5,770
MW-5	4/23/2002	840	349	83.6	578.4	1,980	97.3	<400	<150	1,190
GBI-1	4/23/2002	238	2,070	1,590	12,610	25,500	<2,000	<4,000	<1,500	8,860
GBI-2	4/23/2002	150	112	ND	32.25	1,900	<20	<40	<15	324
GBI-3	4/23/2002	<5	<5	<5	<5	<5	<20	<40	<15	<55
GBI-4	4/23/2002	<5	<5	<5	<5	2,290	<20	<40	<15	134
MW-1	7/29/2002	<5	<5	<5	<5	<5	<20	<40	<15	<55
MW-2R	7/29/2002	190	505	608	6,140	6,790	117	<400	<150	3,020
MW-3R	7/29/2002	14	10.5	7.1	42.4	3,740	<20	<400	<15	<55
MW-4	7/29/2002	1,050	625	28.7	130	14,600	111	<2,000	973	2,360
MW-5	7/29/2002	575	275	49.7	365.6	1,330	70.3	<400	<15	747
GBI-1	7/29/2002	130	601	118	1,180	16,800	113	<4,000	359	1,510
GBI-2	7/29/2002	125	113	11.8	64.7	4,010	<20	<400	55.3	262
GBI-3	7/29/2002	<5	<5	<5	<5	<5	<20	<40	<15	<55
GBI-4	7/29/2002	<5	<5	<5	<5	1,430	<20	<400	<15	<55
MW-1	10/24/2002	<5	<5	<5	<5	<5	<20	<40	<15	<55
MW-2R	10/24/2002	96.9	312	12.4	214.7	15,200	97	<800	962	961
MW-3R	10/24/2002	<5	<5	<5	<5	25	<20	<40	<15	<55
MW-4	10/24/2002	403	76	<5	18	2,330	<20	557	906	1,130
MW-5	10/24/2002	26.2	164	25.6	155.6	509	46.3	749	321	314
GBI-1	10/24/2002	123	145	15.2	147.9	23,800	29.2	<400	380	427
GBI-2	10/24/2002	21.5	22	<5	<5	1,270	<20	<200	92	109
GBI-3	10/24/2002	<5	<5	<5	<5	<5	<5	46	20.7	<55
GBI-4	10/24/2002	<5	<5	<5	<5	552	<20	<40	37	<55

SAMPLE LOCATION	SAMPLE DATE	BENZENE	ETHYL-BENZENE	TOLUENE	XYLENES	MTBE	NAPHTH-ALENE	C5 - C8 ALIPHATICS	C9 - C12 ALIPHATICS	C9 - C10 AROMATICS
MW-1	2/26/2003	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-2R	2/26/2003	51	843	19.7	200	3,710	115	<40	43.8	810
MW-3R	2/26/2003	60	<5	<5	22	1,720	<20	<40	29.4	<55
MW-4	2/26/2003	81	91.4	<5	14.8	2,230	<20	333	217	282
MW-5	2/26/2003	842	458	69.5	432	537	<200	3,980	186	688
GBI-1	2/26/2003	14	540	135	987	7,070	112	<40	<15	997
GBI-2	2/26/2003	28	7.7	<5	<5	744	<20	<40	17.7	<55
GBI-3	2/26/2003	<5	<5	<5	<5	<5	<20	<40	<15	<55
GBI-4	2/26/2003	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-1	6/25/2003	<5	<5	<5	<5	<5	<20	<40	<15	<55
MW-2R	6/25/2003	31	213	42.2	232	819	32.3	<40	<15	317
MW-3R	6/25/2003	<5	<5	<5	<5	250	<20	<40	<15	<55
MW-4	6/25/2003	73.5	260	<5	30.8	610	<20	<40	<15	55
MW-5	6/25/2003	326	147	30.7	190	300	61.2	<40	<15	463
GBI-1	6/25/2003	9.5	325	<5	188	1,760	32.1	<40	<15	744
GBI-2	6/25/2003	<5	<5	<5	<5	<5	<20	67	92	109
GBI-3	6/25/2003	<5	<5	<5	<5	<5	<20	<40	<15	<55
GBI-4	6/25/2003	<5	<5	<5	<5	342	<20	<40	<15	<55
MW-1	10/7/2003	<5	<5	<5	<5	<5	<20	<40	<15	<55
MW-2R	10/7/2003	44.8	134	<5	17.2	2,950	<20	<40	<15	292
MW-3R	10/7/2003	55.9	21.1	<5	<5	22,000	<20	<40	<15	68.2
MW-4	10/7/2003	62.9	105	<5	15.2	188	<20	189	<15	870
MW-5	10/7/2003	487	233	41	184.6	237	59.8	106	<15	506
GBI-1	10/7/2003	77.4	210	11.2	91.4	21,300	20.9	<40	<15	425
GBI-2	10/7/2003	<5	<5	<5	<5	1,990	<20	<40	<15	<55
GBI-3	10/7/2003	<5	<5	<5	<5	<5	<20	70	<15	<55
GBI-4	10/7/2003	<5	<5	<5	<5	221	<20	<40	<15	<55
MW-1	2/17/2004	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-2R	2/17/2004	28	<20	<20	<20	1,230	<50	<250	<250	<250
MW-3R	2/17/2004	525	103	<100	<100	8,720	<200	<1,000	<1,000	<1,000
MW-4	2/17/2004	30	81	<10	<10	406	<20	106	<100	386
MW-5	2/17/2004	406	316	35	221	130	<50	1,170	<250	780
GBI-1	2/17/2004	<100	230	<100	174	11,100	<200	<1,000	<1,000	1,690
GBI-2	2/17/2004	<20	<20	<20	<20	947	<50	<250	<250	<250
GBI-3	2/17/2004	<5	<5	<5	<5	<5	<10	<50	<50	<50
GBI-4	2/17/2004	<5	<5	<5	<5	50	<10	<50	<50	<50
GBI-1	3/10/2004	54.3	278	16.2	326	5,830	45.7	<800	<15	726
GBI-5	3/10/2004	727	373	65.4	435.4	160	99.8	138	<15	908
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 µg/l (ppb)

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

Yellow shading indicates pre-treatment groundwater concentration

REFERENCES

The Woodside Corporation
Pat and Robert Woodside
(781) 899-4150

Global BioSciences, Inc.
2125 1st Ave Suite 1501
Seattle, WA 98121
(206) 369-7736
mike.gbi@mcast.net