



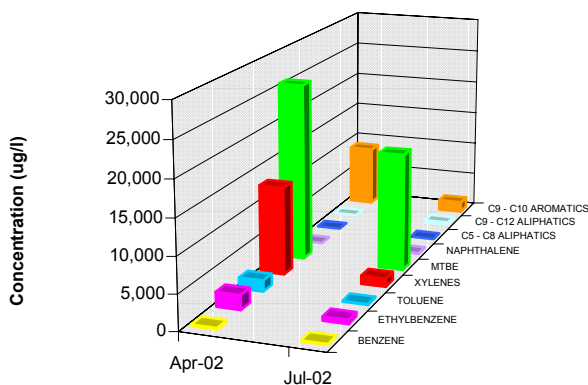
Petroleum Pollutants Case Study

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 is operating a Butane Bioventing™ System (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 VPH and EPH and eliminating the potential for migration of contaminants from the soil in the source area to the groundwater. Groundwater petroleum pollutant test data collected after one month of system operation is presented here for two monitoring wells with initial concentrations exceeding the MCP limits.

GBI-1 Groundwater Petroleum Pollutant Test Data
System Start-up June 2002



	4/23/2002	7/29/2002
BENZENE	238	130
ETHYLBENZENE	2,070	601
TOLUENE	1,590	118
XYLENES	* 12,610	1,180
MTBE	25,500	16,800
NAPHTHALENE	0	113
C5 - C8 ALIPHATICS	0	0
C9 - C12 ALIPHATICS	0	359
C9 - C10 AROMATICS	* 8,860	1,510

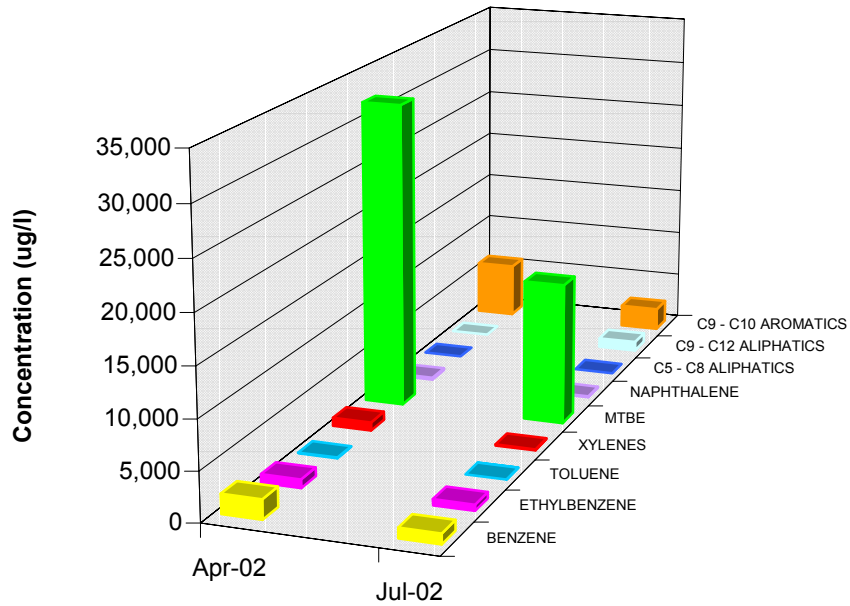
All concentrations reported in µg/l
Non - detects graphed as zeros

* Concentration exceeds MCP GW-2 and/or GW-3 limit

	Benzene	Ethylbenzene	Toluene	Xylenes	MTBE	Naphthalene	C5-C8 Aliphatic	C9-C12 Aliphatic	C9-C10 Aromatic
MCP GW-2	2,000	30,000	6,000	6,000	50,000	6,000	1,000	1,000	5,000
MCP GW-3	7,000	4,000	50,000	50,000	50,000	6,000	4,000	20,000	4,000

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MW-4 Groundwater Petroleum Pollutant Test Data *System Start-up June 2002*



	4/23/2002	7/29/2002
■ BENZENE	* 2,010	1,050
■ ETHYLBENZENE	867	625
■ TOLUENE	87.2	28.7
■ XYLENES	853.8	130
■ MTBE	31,800	14,600
■ NAPHTHALENE	229	111
■ C5 - C8 ALIPHATICS	0	0
■ C9 - C12 ALIPHATICS	0	973
■ C9 - C10 AROMATICS	* 5,770	2,360

All concentrations reported in µg/l
Non - detects graphed as zeros
* Concentration exceeds MCP GW-2 and/or GW-3 limit

	Benzene	Ethylbenzene	Toluene	Xylenes	MTBE	Naphthalene	C5-C8 Aliphatic	C9-C12 Aliphatic	C9-C10 Aromatic
MCP GW-2	2,000	30,000	6,000	6,000	50,000	6,000	1,000	1,000	5,000
MCP GW-3	7,000	4,000	50,000	50,000	50,000	6,000	4,000	20,000	4,000