



# Petroleum Pollutants Case Study

## SUNOCO SERVICE STATION / MASSACHUSETTS

After 12 months of operation, the application of *Butane Biostimulation Technologies™* to remediate petroleum pollutants at a Massachusetts Sunoco service station achieved drinking water quality in all site groundwater monitoring wells.

During the removal of three gasoline USTs at this 3.4 acre site in 1995, volatile organic vapor (VOV) concentrations were detected above 100 ppm in soil headspace. The site was classified by the 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 lo-

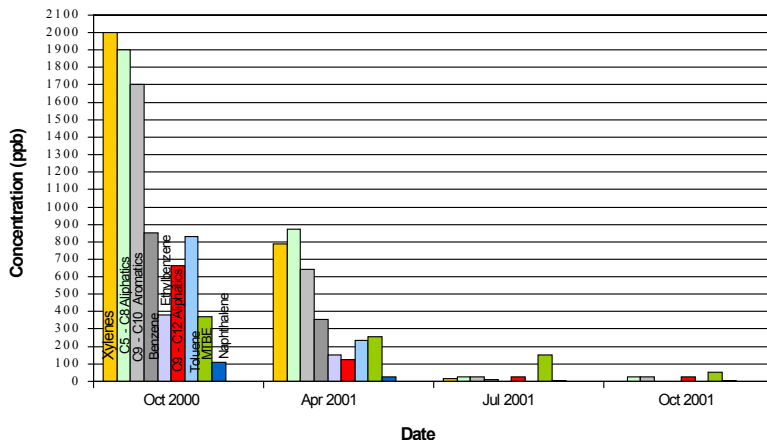
cally grades to a dark brown peat with silt to a depth of approximately 15 feet below grade. A layer of light gray silt and clay is encountered from approximately 20 to 25 feet below grade. Groundwater flow direction is radial, with a horizontal hydraulic gradient of 0.043 feet per foot (ft/ft) and groundwater 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. Two nearby surface water bodies are classified as Class B waters, identified as habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation. The property is also adjacent to a wetlands area. The site is located within an Area of Critical Environmental Concern with an area of Protected Open Space located within approximately 150 feet of the property.

A total of 12 injection wells were installed on-site, and in October, 2000, GBI installed two butane injection panels equipped with air compressors under a DEP approved RAM Plan. Four monitoring wells, MW-1 through MW-4 are located inside the butane treatment zone. Groundwater sampling was conducted by Handex Corporation for Sunoco.

### BUTANE BIOSTIMULATION TECHNOLOGIES™

#### Petroleum Pollutant Degradation (Groundwater)

MW-3



Global BioSciences, Inc.

#### Results

##### October 2000

##### (Pre-Butane Injection)

Xylenes = 2,000 ppb  
 C5-C8 Aliphatics = 1,900 ppb  
 C9-C10 Aromatics = 1,700 ppb  
 Benzene = 850 ppb  
 Ethylbenzene = 380 ppb  
 C9-C12 Aliphatics = 660 ppb  
 Toluene = 830 ppb  
 MTBE = 370 ppb  
 Naphthalene = 110 ppb

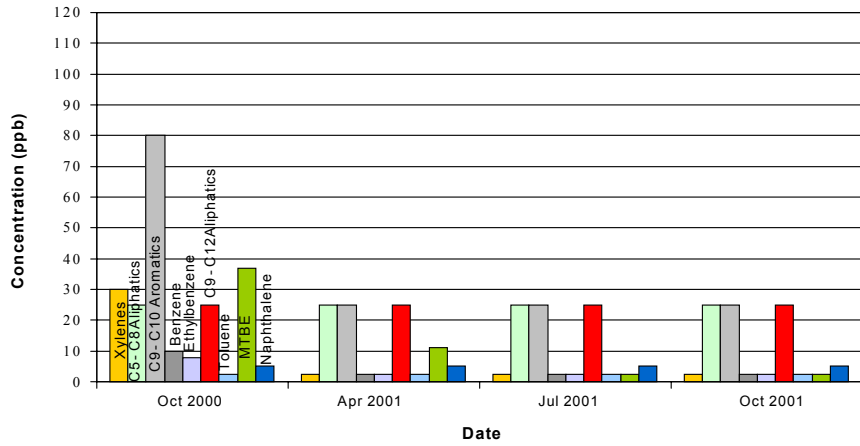
##### October 2001

##### (Post Butane Injection)

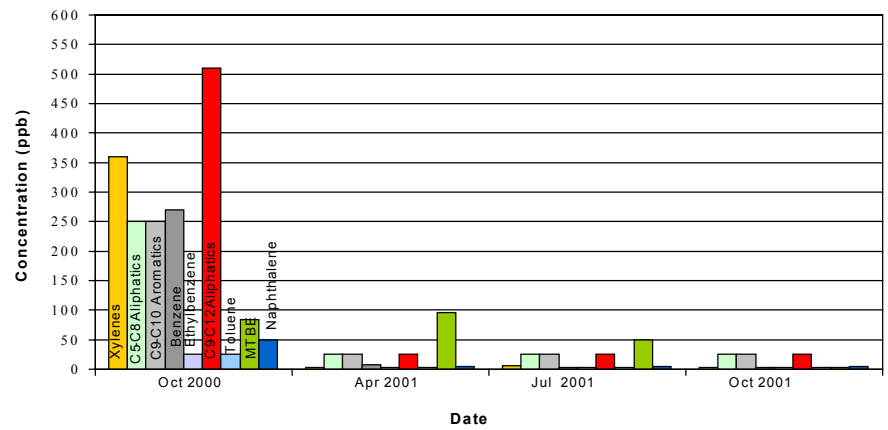
Xylenes < 5 ppb  
 C5-C8 Aliphatics < 50 ppb  
 C9-C10 Aromatics < 50 ppb  
 Benzene < 5 ppb  
 Ethylbenzene < 5 ppb  
 C9-C12 Aliphatics < 50 ppb  
 Toluene < 5 ppb  
 MTBE = 52 ppb  
 Naphthalene < 10 ppb

Non-detects graphed as one half MDL

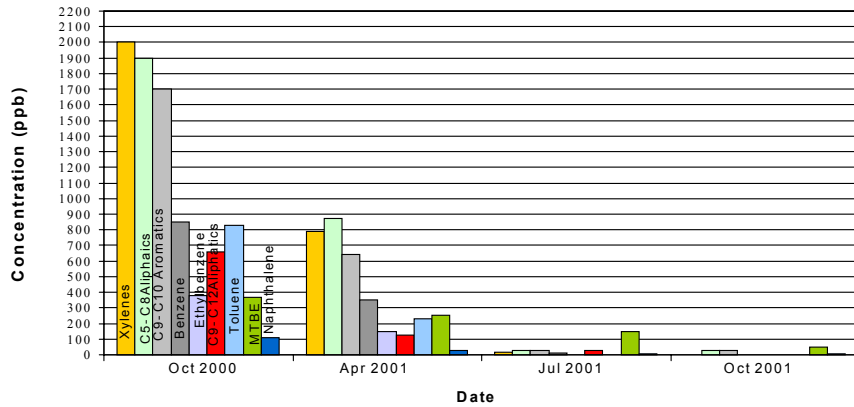
M W -1



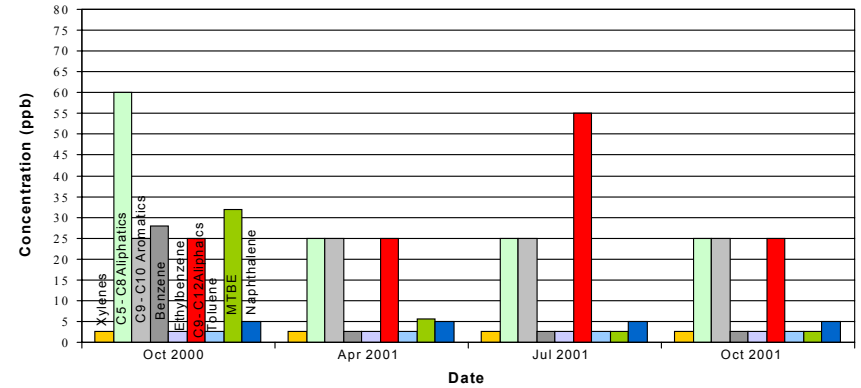
M W -2



M W -3



M W -4



Sample Location	Sample Date	Benzene	Ethylbenzene	Toluene	Xylenes	MTBE	Naphthalene	C5 - C8 Aliphatics	C9 - C12 Aliphatics	C9 - C10 Aromatics
MW-1	10/24/2000	9.9	7.9	<5	30	37	< 10	< 50	< 50	80
	1/17/2001	9.3	<5	<5	24	19	<10	97	<50	70
	4/19/2001	<5	<5	<5	<5	11	<10	<50	<50	<50
	7/25/2001	<5	<5	<5	<5	<5	<10	<50	<50	<50
	10/22/01	<5	<5	<5	<5	<5	<10	<50	<50	<50
MW-2	10/24/2000	270	< 50	< 50	360	84	< 100	< 500	510	< 500
	1/17/2001	<5	<5	<5	5.1	49	<10	<50	<50	<50
	4/19/2001	7.6	<5	<5	<5	96	<10	<50	<50	<50
	7/25/2001	<5	<5	<5	<5	50	<10	<50	<50	<50
	10/22/01	<5	<5	<5	<5	<5	<10	<50	<50	<50
MW-3	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	<5	17	150	<10	<50	<50	<50
	10/22/01	<5	<5	<5	<5	52	<10	<50	<50	<50
MW-4	10/24/2000	28	<5	<5	<5	32	< 10	60	< 50	< 50
	1/17/2001	9.1	6.5	5.7	25	35	<10	66	58	<50
	4/19/2001	<5	<5	<5	<5	5.6	<10	<50	<50	<50
	7/25/2001	<5	<5	<5	<5	<5	<10	<50	55	<50
	10/22/01	<5	<5	<5	<5	<5	<10	<50	<50	<50
GW-1 Standard (Drinking Quality)		5	700	1,000	10,000	70	20	400	4,000	200