



RAPID, HOT-SPOT, OZONE REMEDIATION OF DISSOLVED HYDROCARBONS
Former Automobile Sales and Service Center, Bound Brook, New Jersey

BLUE LIGHTNING UNDERGROUND ENTERPRISES (BLUE)
Moorestown, New Jersey 08057, U.S.A.

INTRODUCTION

We were contracted to conduct a hot-spot groundwater remediation for residual gasoline contamination following a UST removal and contaminated soil excavation and groundwater pumping removal project. The subject site was a former automobile sales and gasoline service center located in northern New Jersey that was razed for redevelopment as a retail pharmacy. The NJDEP required 'no further action' at monitoring well-1/1R for volatile organic compounds (VOCs).



SITE CHARACTERIZATION

Several gasoline underground storage tanks were removed from the site, and contaminated soils and weathered shale bedrock were excavated. Impacted groundwater was extracted from the former UST excavations, via vac-truck, prior to backfilling. Subsequent groundwater monitoring indicated that shallow groundwater in the weathered shale bedrock exhibited residual benzene impacts in one well, at concentrations exceeding the State cleanup criteria.

Several Vacuum Enhanced Groundwater Extraction events were conducted on the impacted well in an attempt to mitigate the hydrocarbon concentrations; however, remnant dissolved phase hydrocarbons were mobilized toward the well, resulting in a three-order-of-magnitude concentration increase (**Table 1**).

Well ID#	Date	Benzene	Toluene	Ethylbenzene	Xylenes	Total BTEX	
MW - 1 / 1R	05/30/2000	160	93	26	240	519	
	09/20/2000	140	6.2	12	110	268.2	
	UST EXCAVATION & DEWATERING						
	02/05/2001	3.1	ND	ND	1.6	4.7	
	04/05/2001	4.2	ND	ND	0.4	4.6	
	06/11/2001	2.9	ND	ND	ND	2.9	
	09/28/2001	180	88	73	290	631	
	1 VACUUM ENHANCED GROUNDWATER EXTRACTION						
	01/03/2002	4,600	1,900	1,400	6,100	14,000	
	2 VACUUM ENHANCED GROUNDWATER EXTRACTIONS						
	03/26/2002	3,600	1,700	1,000	5,300	11,600	
	FOUR OZONE INJECTION APPLICATIONS						
	06/17/2002	ND	ND	ND	ND	ND	
	09/06/2002	ND	ND	0.8	6.4	7.6	

REMEDIATION: DESIGN, CONSTRUCTION & OPERATION

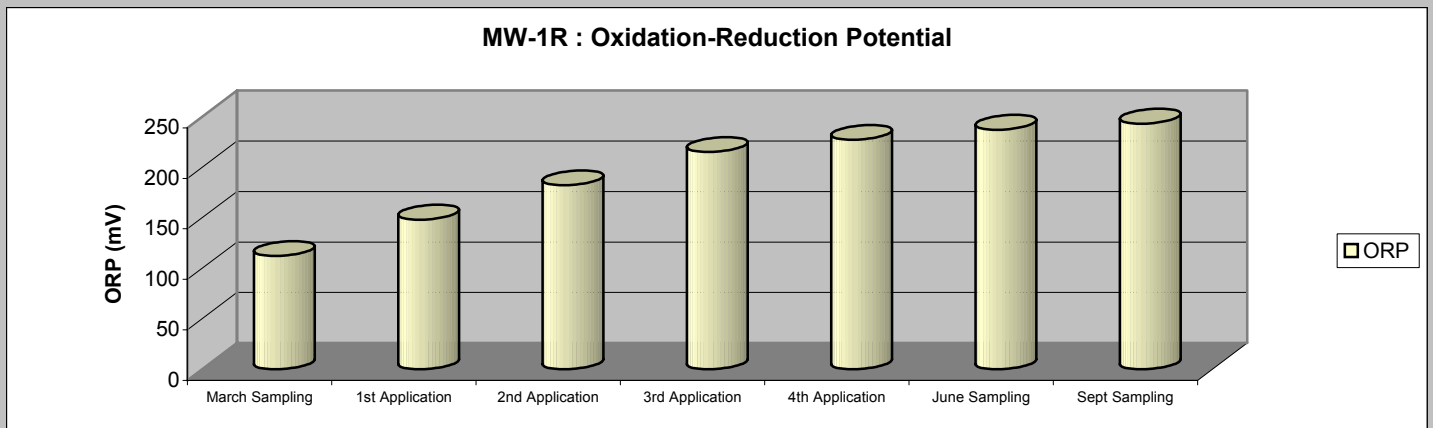
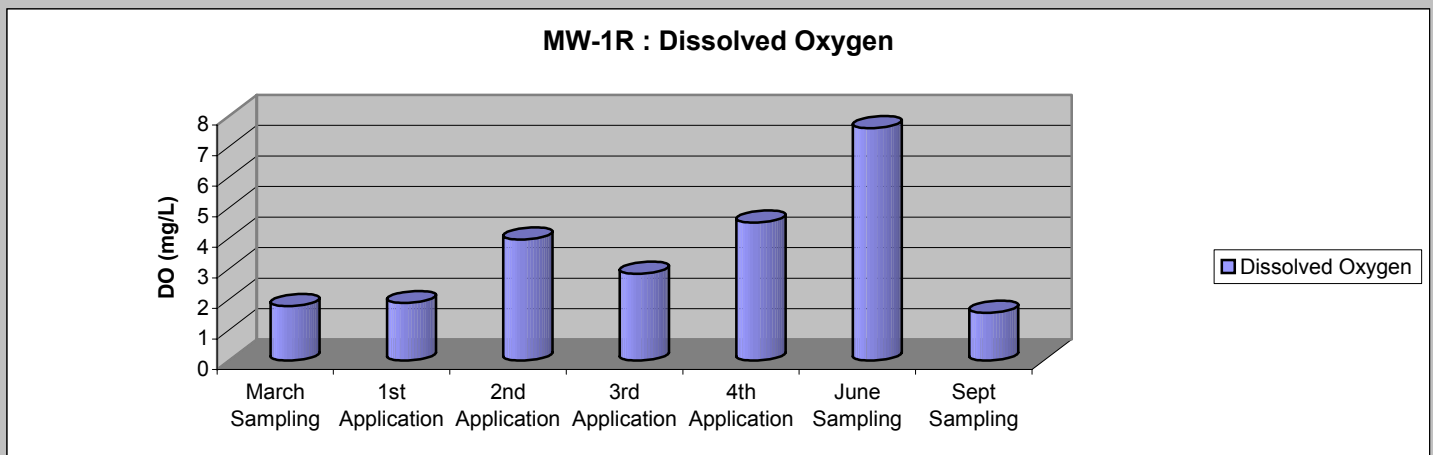
Due to the short time constraints required to mitigate the residual groundwater impacts prior to completion of site redevelopment, we were retained to implement a series of four, daily, ozone injection applications at the site. Groundwater impacts were confined to a single monitoring well, and the area of impact was estimated to cover approximately 1,000 square feet. Groundwater ranged from 6 to 12 feet below grade, within glacial fill over weathered shale.

We conducted four, daily, ozone remediation applications at the subject site over a two-month period from April to May 2002. During each application, 6% ozone gas in a 90% oxygen stream was injected at a low flow rate (<0.5 scfm) to below the water table, using **RemedOzone™** systems and process. A soil vapor extraction system was available to control emissions, as required and adjacent monitoring wells were gauged.

This approach is designed to directly oxidize hydrocarbon compounds through reaction with ozone, as well as promote enhanced bioremediation through the addition of oxygen to the subsurface. Any hydrocarbons not fully oxidized by the ozone, should be degraded to less toxic and more easily biodegraded compounds.

RESULTS

As indicated in Table 1, total BTEX concentrations in well MW-1R were reduced from greater than 11,000 ug/L, during the March 2002 sampling event, to Non-Detectable during the June 2002 sampling event conducted two weeks following the final ozone application. In addition to this 100% reduction in hydrocarbon concentration in well MW-1R, an associated increase in dissolved oxygen, dissolved carbon dioxide concentrations and Oxidation-Reduction Potential (ORP) was noted in well MW-1R and in well MW-6 located approximately 50 ft away. Little to no rebound in dissolved concentrations was observed during the subsequent quarterly sampling event, and concentration remained well below cleanup standards.



SUMMARY & CONCLUSIONS

This case history demonstrates that ozone is an effective approach for rapidly mitigating dissolved phase hydrocarbon concentrations, such that attainment of remediation standards can be accomplished in a timely and efficient manner. An NFA for groundwater was issued by the NJDEP.