Oxygen Barrier BTEX Remediation in New Mexico

Contaminants	Application Method	Soil Type	Groundwater Velocity
BTEX	Oxygen Barrier	Clay over Sand	0.1 ft/day

Introduction:

A major field demonstration of an ORC Oxygen Barrier was carried out in New Mexico in 1995, with the objective of achieving enhanced intrinsic bioremediation of dissolved phase BTEX. Before the Oxygen Barrier was installed, a single ORC well pilot study was conducted during the months of August through December 1994 at a State Lead Site south of Albuquerque. Both the pilot study and the subsequent barrier installation were sponsored by the Underground Storage Tank Bureau of the New Mexico Environment Department.

In April 1995 as a result of the pilot study, which showed increased D.O. and reduced BTEX concentrations, a full scale remediation system using ORC was installed. The full scale remediation system consists of twenty, 6-inch ORC source wells placed five feet on center and 54 monitoring points downgradient of the source wells. The vertical distribution of DO and BTEX was measured with probes located 7, 14, and 21 feet below ground surface (bgs). A total of 342 of the ORC socks (1' x 5 3/8") were strung together and lowered into the screened intervals of the 20 PVC wells.

Figure 1 is the overall site plan which shows the QFD (experimental study) region and the location of the excavated source area. Figure 2 details the placement of the Oxygen Barrier and the array of monitoring points. Due to the existence of an overhead power line on the east side of the site, the oxygen barrier was split into two unequal sections as shown. The main objective of the ORC wells was to control the plume and draw the leading edge back toward the source.

The placement of the ORC source wells is perpendicular to the prevailing groundwater flow direction. One row of monitoring points (MPs) is located 10 feet downgradient of the source wells. These include MP-4 to MP-18 which are spaced two feet on center and the series consisting of MP-1 to MP-4, MP-18 to MP-27, and MP-101 to MP-106 which are spaced four feet on center. Another series of monitoring points, MP-201 to MP-210, is 20 feet downgradient with a 3 foot on center spacing. The source wells have three KVA miniature shield points fastened to the outside of the well casings at 7 feet, 14 feet and 21 feet below ground surface (bgs). The average vertical position of these probes are referred to as the C-zone, B-zone and A-zone respectively.

Results:

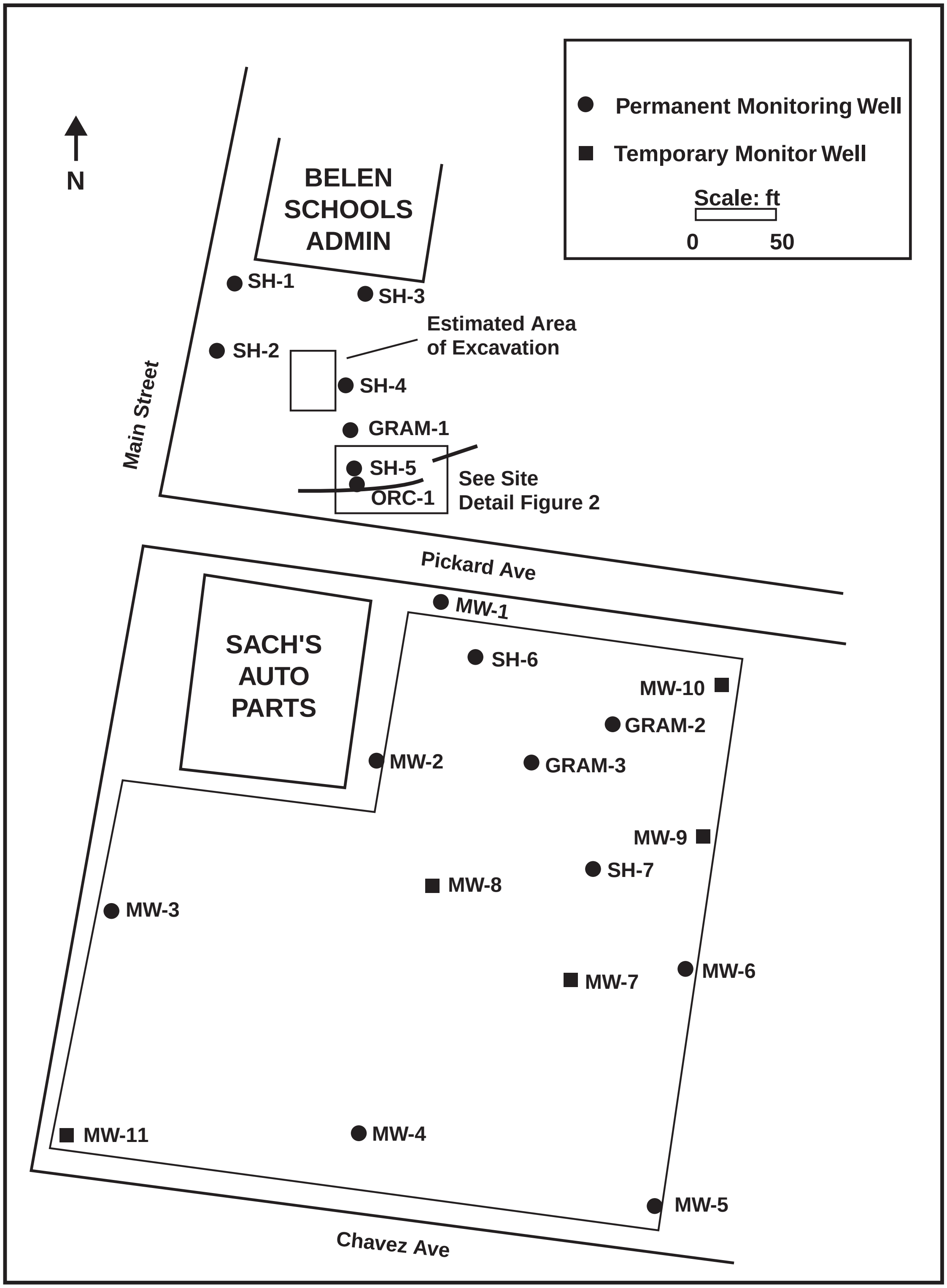
We are now able to report on the performance of the oxygen barrier after a full year of useincluding a partial recharge of the barrier (47%) after 9.1 months of operation. This is the longest continuous monitoring of performance of an ORC oxygen barrier to date. Total mass of BTEX and dissolved oxygen in the vicinity of the long (16 well) and short (4 well) portions of the barrier are presented in Figures 3 and 4 respectively. With respect to the long barrier, it is clear that oxygen was being liberated from the barrier for at least 200 days (April 3 to October 20). It became clear that the BTEX levels were being recharged as the oxygen source was becoming depleted - so 162 new ORC socks were added to the barrier at Day 279 (January 7). Data from Day 288 (January 15) shows oxygen levels being restored by a factor of greater than 3, after which consumption became evident as noted between Day 288 and Day 365 (April 3). BTEX levels are once again shown to be decreasing in proportion to the availability of oxygen.

With respect to the short barrier, a virtually identical pattern is observed in the dynamics of oxygen and BTEX changes over the course of a year. Since the contaminant load was only about 20% of the load present at the large barrier, the results after 365 days show a much greater amount (94%) of the mass being removed.

Of great significance, from a risk reduction standpoint, is the impact of ORC on the downgradient compliance point, SH-6, located 120 feet downgradient of the barrier (Figure 1). BTEX levels were observed to be decreased from several hundred ppb to ND. In essence, natural attenuation had generated BTEX levels of several hundred ppb at SH-6 compared to about 10 ppm in the vicinity of the barrier. Following the installation of ORC, BTEX levels further decreased to ND. This particular result serves as a graphic example of the principle of enhanced instrinsic bioremediation; the presence of the oxygen barrier served to pull the control point back towards the source with respect to SH-6.

This work is the largest of several field studies that have demonstrated the use of ORC in passive bioremediation systems and have highlighted the potential of these methods for the prevention of the migration, and/or reducing the source, of aerobically biodegradable contaminants. These systems are alternatives to slurry wall or pump and treat installations where intrinsic remediation is not applicable or reliable. ORC based systems can also be viewed as a lightly engineered and cost effective method of enhancing intrinsic remediation. ORC systems can be used as a sole treatment method or be employed in conjunction with more conventional technologies, that might be planned for- or that already exist on a site. These efforts may serve to supplement limits that exist with air-sparging arrays or pump and treat systems, or to function as a polishing step- as when pump and treat systems reach a treatment asymptote, or may be used on a stand alone basis to reduce the plume contaminant mass, shrink the leading edges and reduce overall risk.

Figure 1



Permanent Monitoring Well
Temporary Monitor Well
Scale: ft
0
50
N
BELEN SCHOOLS ADMIN
Main Street
SH-1
SH-3
SH-2
Estimated Area of Excavation
SH-4
GRAM-1
SH-5
ORC-1
See Site Detail Figure 2
Pickard Ave
MW-1
SACH'S AUTO PARTS
SH-6
MW-10
GRAM-2
MW-2
GRAM-3
MW-9
SH-7
MW-8
MW-3
MW-7
MW-6
MW-11
MW-4
MW-5
Chavez Ave

Figure 2

DETAILED SITE MAP

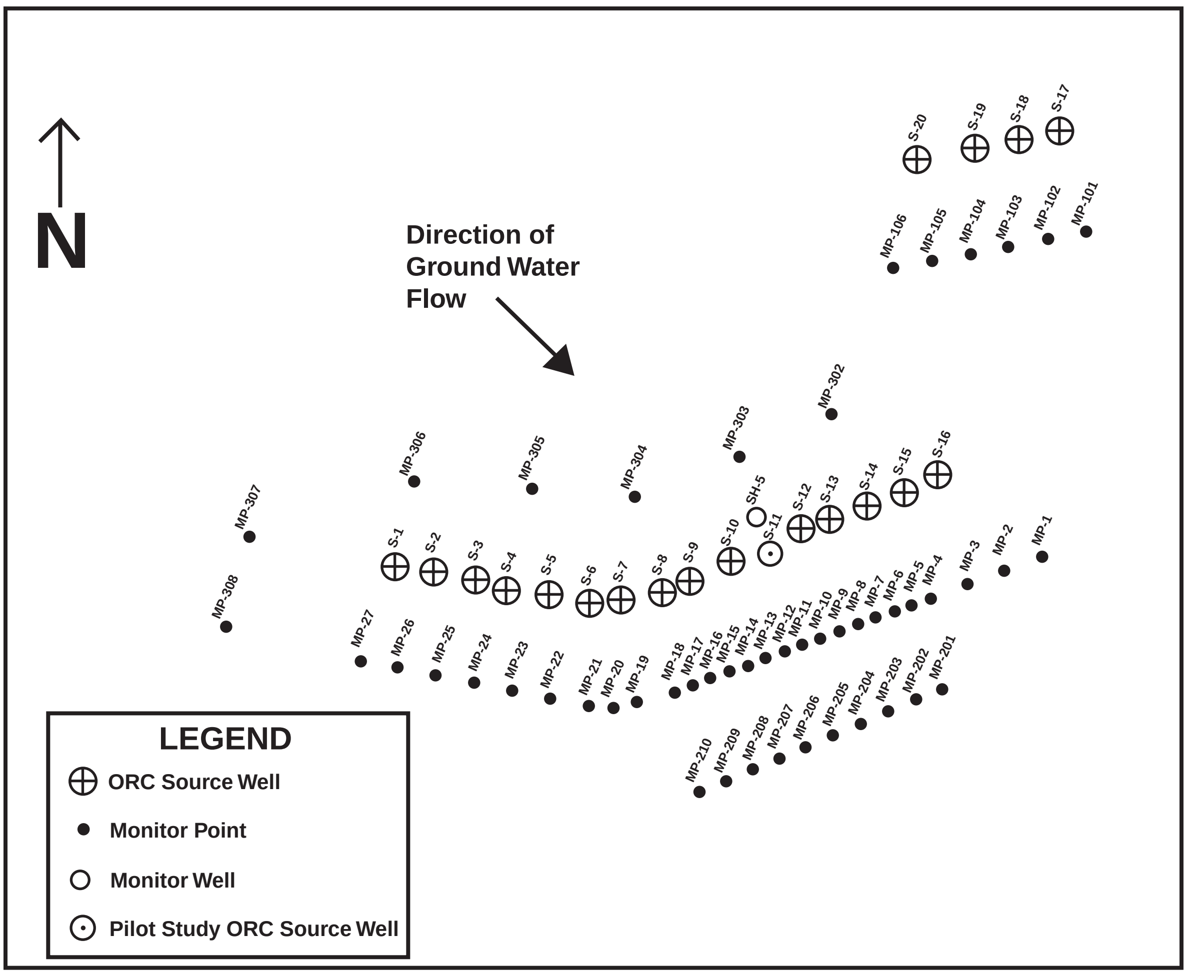


Figure 3

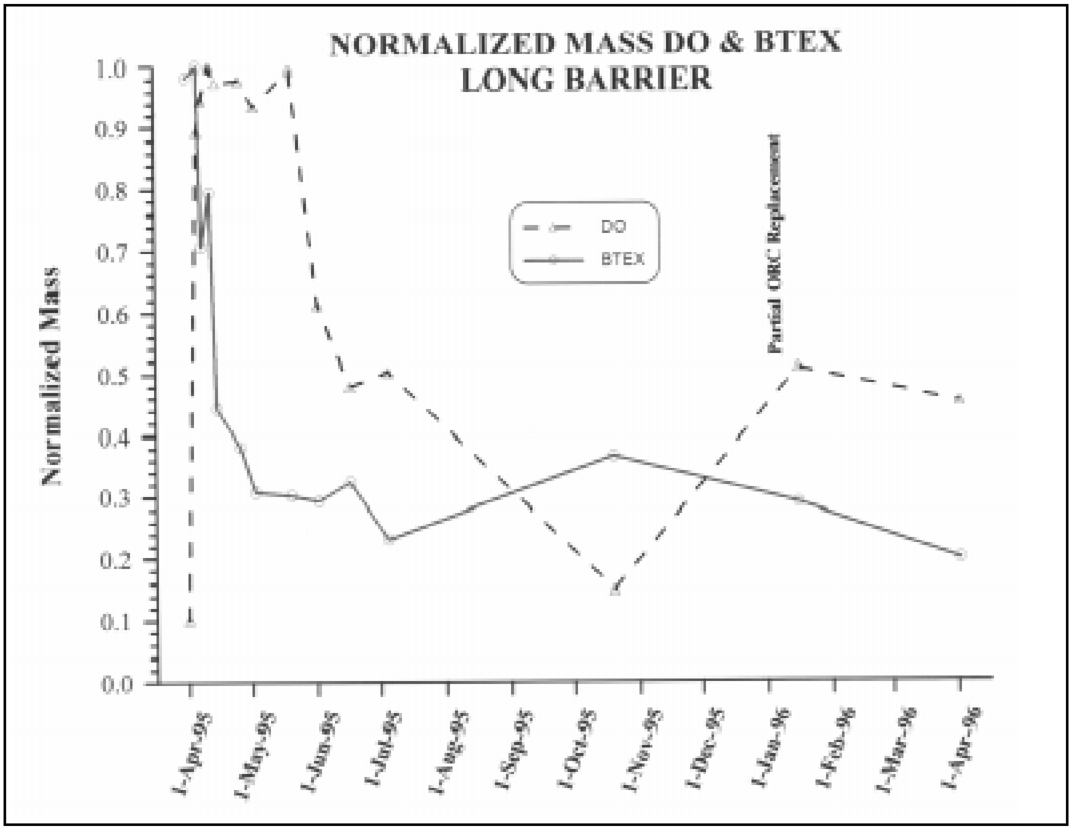
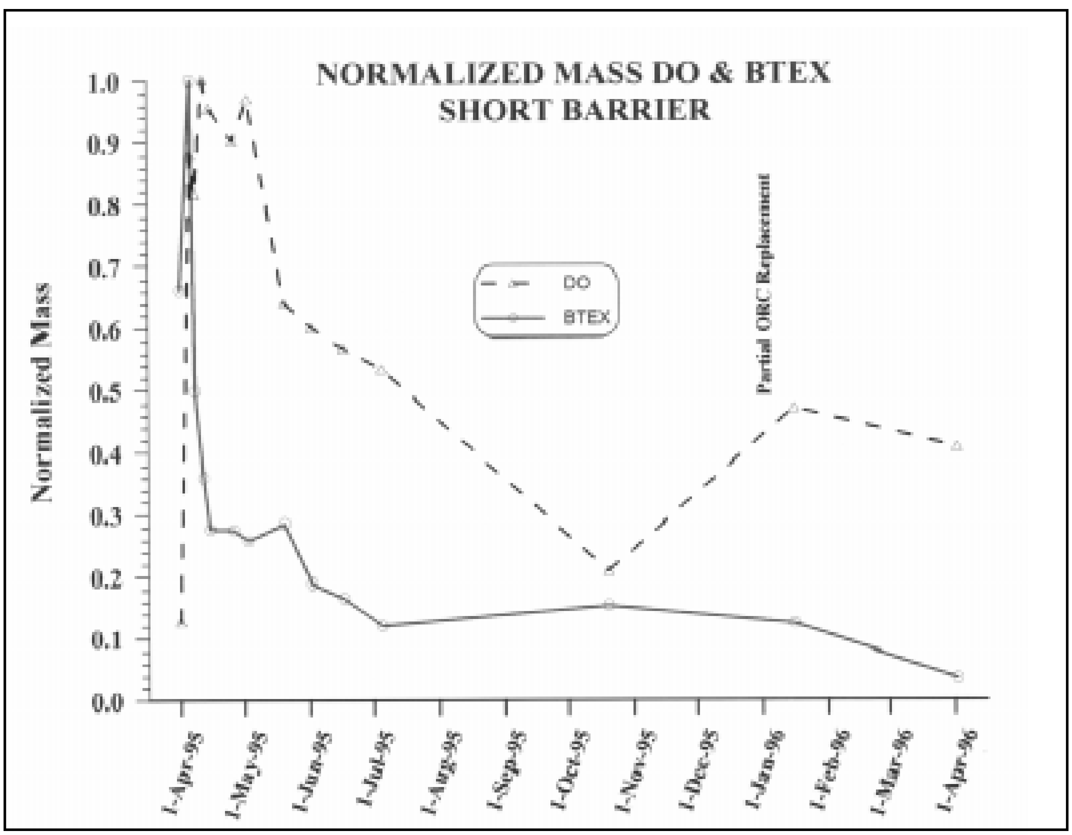


Figure 4



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