OZONE CASE STUDY
Former Manufactured Gas Plant Site
Bay Shore / Brightwaters, New York

Background

This former MGP facility, a high profile NYSDEC/EPA Superfund site, had significant soil and groundwater contamination. MGP sites have two major waste materials: coal tars and purifier waste. The main contaminants are volatile organic compounds, specific VOC is benzene and the second semi-volatile organic compounds are poly-cyclic aromatic hydrocarbons (PAH).

Site was excavated to remove free product as long term approaches were determined. Excavation and backfilling was completed in 2008 with an estimated 100,000 tons being removed.

A large-scale solution was needed for site-wide remediation and at-tenuation of off-site groundwater impacts. There are multiple reme-diation efforts in place at OU-1 (see below).

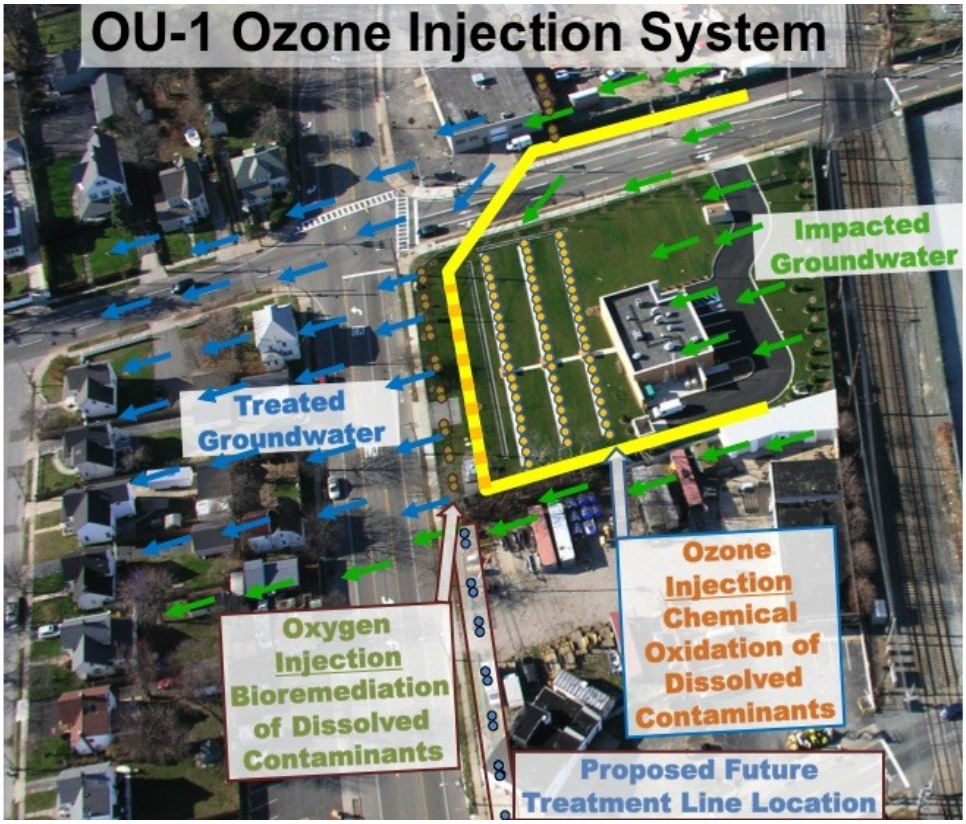
Solution

Ozone injection was chosen for the groundwater treatment zone because it is a powerful fast-acting oxidant that can be delivered with minimal operator supervision and with no storage and handling issues. Ozone is generated on-site within the treatment building and delivered to the injection points directly. Ozone is highly soluble in water (12 times more soluble than oxygen).

Ozone is injected continuously into the groundwater behind the barrier wall. The ozone injection is sequenced so that the injec-tion cycles through each of the 63 injection wells one well at a time. The injection cycle can be adjusted so that more ozone can be injected into different areas of the plume. The oxidation reac-tion between ozone and the BTEX and PAH contaminants in the groundwater results in carbon dioxide and water." [as published by National Grid and online at http://www.bayshoreworksmgp.com/proj_descr.html]

National Grid has multiple online documents illustrating the proven success of ozone remediation technology on the Bay Shore former MGP facility. "Remedial Action Plan for Operable Unit 1" was finalized by the NYSDEC in August, 2004. The Final Remedial Action Plan includes:

- Excavating contaminant source areas in the southern half of the site from surface to a depth of 8 feet;
- Excavating source areas in four locations to approximate depths of at least 16 feet and to a maximum depth of 25 feet based on field conditions, removal and off-site thermal desorption of impacted soil;
- Backfilling excavated areas to restore existing grades;
- Performing in-situ chemical oxidation to treat residual source material beneath the excavated areas;
- Constructing a subsurface barrier wall at the down gradient edge of OU-1 with in-situ groundwater treat-ment immediately up gradient of the barrier;
- Recovering mobile tar or dense non-aqueous phase liquid (DNAPL) via extraction wells where possible;
- Implementing institutional controls and a site management plan to manage future subsurface disturbance and resultant potential exposures.
- Long term operation, monitoring, and maintenance of the containment and treatment systems.



Details of ozone results along with the entire National Grid project are available online for review. Due to success of additional "off-site" oxygen systems we will provide oxygen sparging as a component of the ozone system. A full project description can be found on National Grid's Bay Shore website.

Oxygen systems were quickly added to enhance aerobic bioremediation of organic compounds, specifically BTEX and naphthalene. The addition of oxygen down gradient to the ozone system, which in itself produces oxygen, provided increased dissolved oxygen to biodegrade the dissolved-phase contaminants. This factor is important as equipment Piper Environmental Group, Inc. provides to critical applications involves full redundancy including air, oxygen, and ozone sparging mechanisms in one building.

Ozone Generation

- Two (2) ozone generators producing 25.8 pounds per day each
- Two (2) chillers
- Two (2) air compressors
- Two (2) air dryers
- Two (2) refrigerated air dryers
- Final gas stream composition: ~2.5% concentration ozone

Soil Vapor Extraction System

- Two (2) redundant SVE systems
- Vapor extraction wells
- Ozone destruct - heated
- Ozone monitoring system
- Carbon vessels

Ozone Monitoring System

- High concentration ozone monitor on the ozone distribution line to verify output and calculate injection
- Ambient ozone leak detection automatically shuts down ozone production

Ozone System Distribution Manifold

- One blending manifold with 3 primary distribution points to remote injection points
- Each distribution manifold includes, pressure gauge and ozone-compatible flowmeter for verification and adjustments
- 63 Injection Points: Depths: 28', 38', 48'

System Control

All facets of programming run time and injection sequence is achieved through a 12" full color touch screen operator interface. Fully integrated SCADA software package for remote monitoring/control and system alerts. The PLC control logic continually monitors equipment status and multiple system processes through the use of strategically integrated electronic instrumentation. Inputs and processes monitored include ambient ozone levels inside/ outside structures, gas pressure/flow, coolant flow/temperature and ozone concentration.

In the event any parameters fall out of the programmed operating range during start up or operation, the system starts selectively turning off predefined outputs, and automatically sends email describing the nature of the fault.

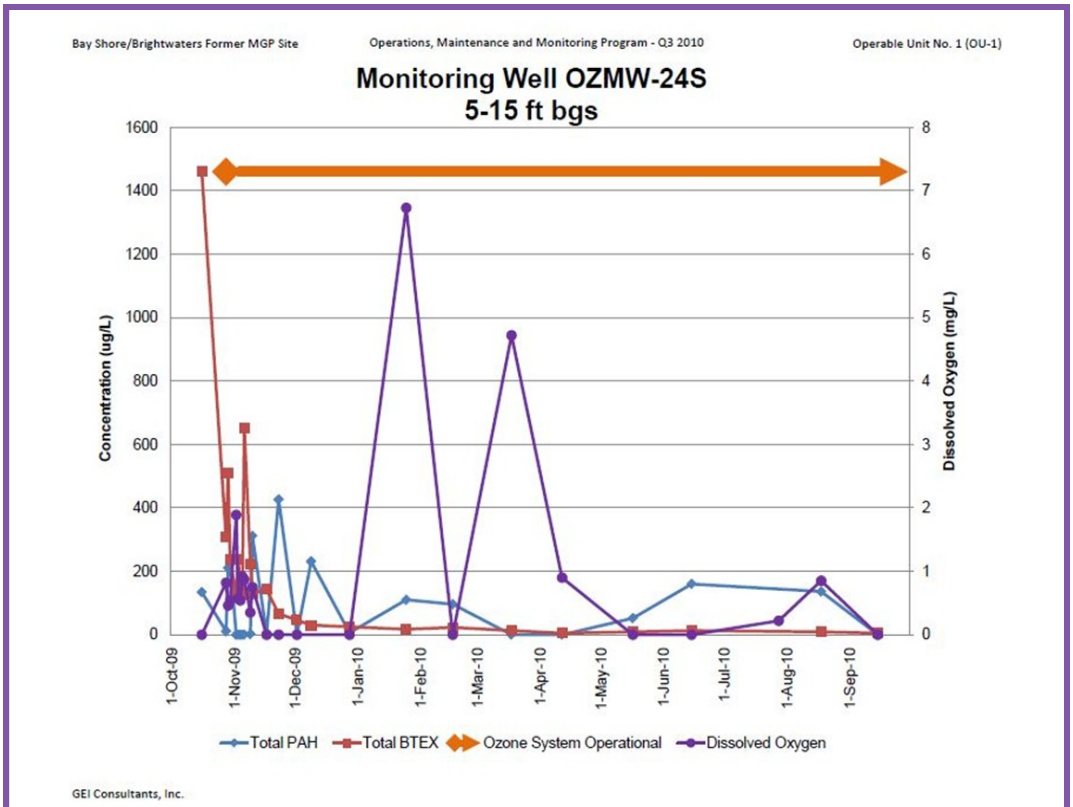
Results

Ozone Injection Started October, 2009

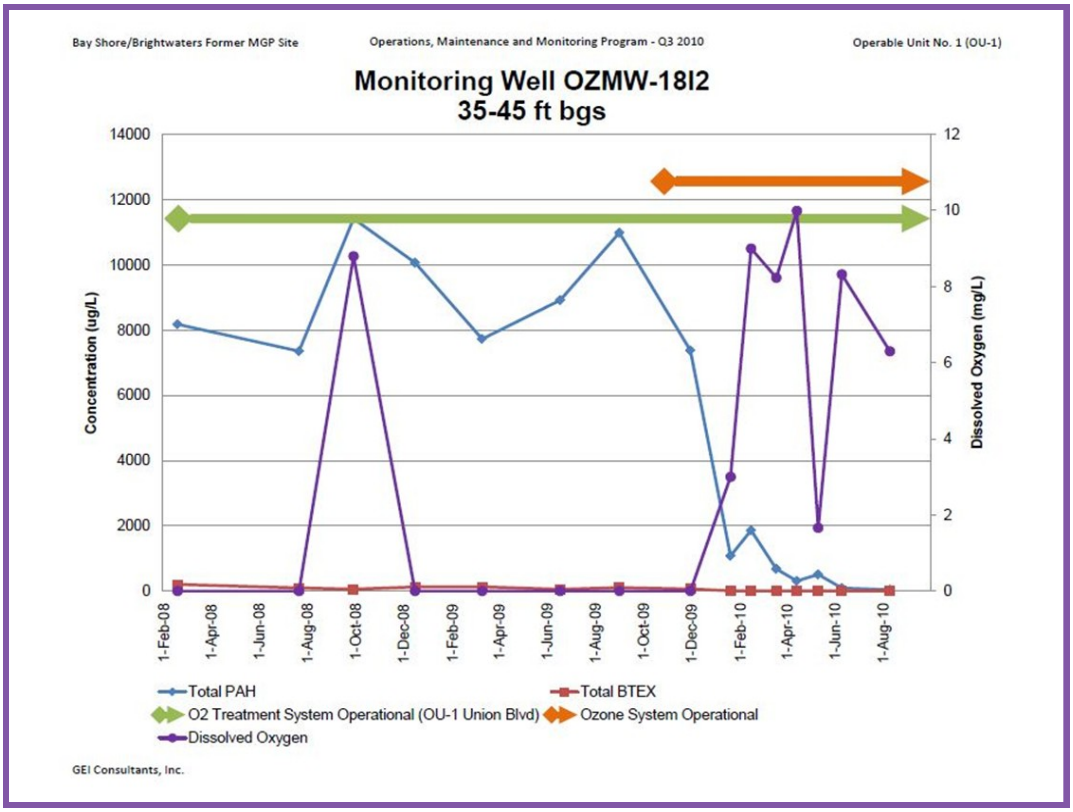
Ozone injection started in October of 2009. Significant fluctuations are common during first few weeks or months of ozone injection and are not alarming and to be expected. Ozone injection depths were 28, 38 and 48 feet bgs. Note that even at a very shallow 5-15 feet bgs the influence of ozone is immediate. No daylighting has occurred.

Total BTEX drops to near less than 5 ug/l within a couple of months of starting ozone injection.

Total PAH fluctuated until downward trend in September, 2010.



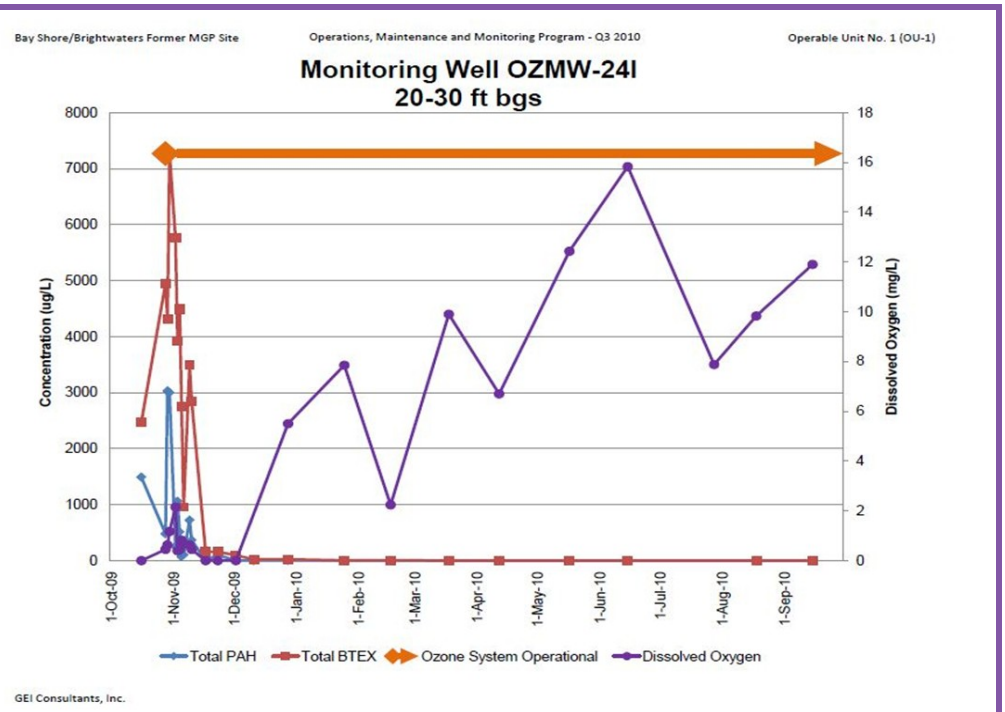
Oxygen Injection Started February, 2008



Total PAH fluctuates at high levels with oxygen treatment and rebounds.

With ozone injection starts, the Total PAH drops immediately and becomes non detectable within a couple months.

The dissolved oxygen was unable to increase consistently until ozone removed the oxidant demand. After ozone reduced contaminants, the dissolved oxygen levels increased and continue to stay elevated. In sum, oxygen and ozone injections are compatible as designed here. Byproduct of ozone is oxygen and assists bioremediation.



Ozone is made from oxygen. Ozone reverts to oxygen, it's more stable form. In all ozone generation systems, additional oxygen is injected with ozone.

After ozone start-up and expected fluctuations, the COC (Total PAH and Total BTEX) decreased. As oxidant demand decreased with the reduced COC, dissolved oxygen started to increase. **This is typical.**

When ozone is no longer being consumed totally by-COC, oxygen starts increasing in concentration, thus aiding in bioremediation.

Ozone in MGP Plants

Ozone has emerged as a leading in-situ remediation technology world-wide, having been used by top engineering and consulting companies for soil and groundwater remediation on diverse sites including residential properties, dry cleaners, gas stations, oil terminals, MGP, DOD, and DOE sites. Our primary area of expertise and what we bring to affiliation here as your air~oxygen~ozone remediation partner, is vast experience with a wide range of injection applications, sizing, distribution, control and monitoring.

Piper Environmental Group, Inc. has prior experience and is currently successfully remediating decommissioned manufactured gas plants. We have documented successes with Southern California Edison in Long Beach, CA and Santa Barbara, CA, Peoples Gas in Dubuque, IA, and National Grid in Bay Shore, Long Island, NY. Our knowledge and experience utilizing ozone uniquely qualifies us to partner with you on small to large scale remediation projects.

A short history of on-line documented projects:

1980's – Ozone first used for in-situ remediation in bench and field trials (USC-Irvine)

1994 – GTI performs R&D, pilot test, and full-scale site remediation work on projects nationally.

1999 – Ozone sparging begins at the Southern Cal Edison site in Long Beach, CA. Piper . updates and maintains ozone equipment.

2000 – People's Natural Gas site in Dubuque, IA. starts ozone sparging . Piper provides oxygen/ozone equipment and commissioning/start up.

2002 – Ozone used for remediation of a residential site built on a former MGP site.

2002- Southern Cal Edison site in Santa Barbara, CA. begins ozone sparging. Piper provides design, ozone equipment, controls, start up and maintenance.

2009 – GEI – Bay Shore, Long Island - installed and started October, 2009. Piper provides consultation, design, ozone equipment, start up, controls, off-site remote monitoring and maintenance.

Additional products and services for in-situ and ex-situ applications are here: http://www.peg-inc.com

National Grid Bay Shore information is found online: http://www.bayshoreworksmgp.com/proj_descr.html

Company Profile

Piper Environmental Group, Inc. offers ozone technology, equipment, and services for a wide-range of environmental applications. The company designs, manufactures, and integrates ozone systems and related equipment for short and long-term projects, offering equipment for rent or purchase. Services include project design assistance, oxidation pilot studies, contract service, equipment repair, consulting. Our area of expertise is large remediation projects.

Piper Environmental Group, Inc.

Ozone Solutions for a Cleaner Earth ™

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