Appendix E

Final Operations, Maintenance, and Monitoring Plan

GEI Consultants

Geotechnical
Environmental and
Water Resources
Engineering

Final Operation, Maintenance, and Monitoring Plan

Bay Shore Former MGP Site

Operable Unit No. 2
Bay Shore, New York
AOC Index No. D1-0001-98-11

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1. Introduction

On behalf of our client, KeySpan Corporation (KeySpan), GEI Consultants, Inc. (GEI) has prepared this Final Operations, Maintenance, and Monitoring Plan for Operable Unit No. 2 (OU-2) of the Bay Shore Former Manufactured Gas Plant (MGP) Site located in Bay Shore, Suffolk County, New York in support of an IRM implemented to remedy the dissolved phase contaminant plume emanating from the former MGP site via the injection of oxygen into the mid and tail sections of the plume to enhance the bioremediation of MGP-related contaminants dissolved in the groundwater.

The Bay Shore former MGP site, Operable Unit No. 1 (OU-1), is located in Bay Shore, in the Town of Islip, in Suffolk County, New York. OU-2 encompasses an area that extends from the former MGP site in a southerly direction (downgradient) approximately 3,400 feet to the head of Lawrence Creek. Prior studies, including the recent remedial investigation at the Site, have identified dissolved contaminants within the groundwater that appear to be traveling from OU-1 and entering the head of Lawrence Creek, just south of Lawrence Lake in the vicinity of the intersection of Manatuck and Garner Lanes. These dissolved phase contaminants principally consist of BTEX (benzene, toluene, ethyl benzene, and xylene) and naphthalene.

KeySpan will implement and maintain an IRM to reduce the concentration of contaminants discharging to the head of the creek. The IRM OM&M will continue until the following performance based goals are met.

- A permanent remedy is implemented at the Bay Shore site (OU-1) leading to control of the source of the groundwater contamination; and, a final Remedial Action (RA) can be implemented for OU-2; or

- A permanent remedy is implemented at the Bay Shore site (OU-1) leading to control of the source of the groundwater contamination and this IRM becomes the final RA implemented for OU-2; or

- Continued operation of the IRM produces diminishing returns as indicated by periodic groundwater monitoring up and downgradient of the IRM treatment system.

GEI developed this OM&M plan with input from TRC Environmental Corporation (TRC) and Matrix Environmental (Matrix).

In addition, the following documents were used to develop this work plan:

Final Remedial Investigation Report, Bay Shore/Brightwaters Former Manufactured Gas Plant, Bay Shore, New York, Dvirka & Bartilucci (D&B), January 2003.

Technology Evaluation Report OU-2 Groundwater Plume, Bay Shore/Brightwaters Former Manufactured Gas Plant, Bay Shore, New York, TRC, December 2002.

Draft Work Plan for the Interim Remedial Measure for the Bay Shore Former MGP Site, Off-Site Groundwater Plume, Operable Unit No. 2, TRC, January 2003

1.1 IRM Summary

The IRM has been put in place to reduce levels of dissolved phase BTEX and naphthalene prior to the discharge of groundwater to Lawrence Creek. The performance objective of this IRM is to reduce the concentration of MGP-related contaminants in the groundwater plume discharging into Lawrence Creek by 75 to 90%. The actual reduction of the concentration of MGP-related contaminants in the groundwater plume will be assessed during start-up and operation. It is anticipated that system parameters may have to be adjusted during the IRM to optimize contaminant reductions.

While the target reduction of 75 to 90% is significant, it is not the final measure to address groundwater contamination associated with the Bay Shore former MGP site. A Remedial Action Plan (RAP) to address the MGP-related contamination at OU-1 (the source of the OU-2 plume) has been approved by the NYSDEC. Remedial measures will be implemented as part of the OU-1 RAP to mitigate contamination discharge from the former Bay Shore MGP site to OU-2. The reduction in the flux of MGP-related contaminants to OU-2 following the implementation of the OU-1 RAP will over time reduce or eliminate the discharge to Lawrence Creek.

The IRM consists of oxygen injection via a series of injection wells installed along the mid and tail portions of the plume. The oxygen injection wells are connected via high density polyethylene piping to oxygen generation and air compressing equipment housed in a system enclosure near the mid plume area. The injected oxygen enhances the biodegradation of organic contaminants within the groundwater by native microorganisms. The system consists of a total of 57 poly-vinyl chloride (PVC) microwells along two transects of the plume: mid plume at Montauk Highway (30 microwells), and at the tail of the plume along the intersection of Garner and Manatuck Lanes (27 microwells). The oxygen injection wells were installed to depths between 25 and 68 feet below grade. The details of the oxygen injection system installations are included in the *IRM Summary Report - Oxygen Injection System Installation, Bay Shore Former Manufactured Gas Plant (MGP) Site, Operable Unit No. 2*, dated October 19, 2006 (IRM Summary Report). Tables 2 and 3 in the IRM Summary Report for specific injection well

depths, screening intervals, and Figure 3 for locations for the mid plume and plume tail injection wells.

Additional details of the contamination, geology, and hydrogeology, and a site history and description can be found in the *Interim Remedial Measure Work Plan and Design, Bay Shore Former MGP Site, Operable Unit No. 2,* dated December 2004 (IRM Work Plan).

1.2 OM&M Plan Organization

Section 1 of this plan presents the introduction and a summary of the IRM. Section 2 provides a description of the IRM construction and technology being implemented. Section 3 presents the operation and maintenance activities to be carried out for the mechanical components of the IRM. Section 4 provides a description of the environmental monitoring to be implemented to gauge the effectiveness of the IRM. Section 5 describes the reporting requirements that will be used to document and communicate the operation of the IRM.

2. Remedial System Description

An oxygen injection system is being utilized to enhance bioremediation of BTEX and naphthalene present in the OU-2 groundwater plume. The system includes an oxygen injection system enclosure, system instruments and controls (air compressor, oxygen purifying equipment, pressure tanks, and flow controls), conveyance piping, oxygen supply lines, and injection wells housed within small access boxes.

2.1 System Overview

The system generates compressed air that is dried and filtered to remove particulates. The compressed air is then run through a pressure swing adsorption oxygen generator. The nitrogen in the compressed air is selectively adsorbed in the media and the resultant oxygen stream is approximately 90-95% oxygen. This oxygen-enriched air is then stored in a receiving tank. From this receiving tank, gate valves and timer controlled solenoids mounted within the system enclosure allow for control of the injection flow rates and pressures as well as the timing of injection.

Individual supply lines convey the oxygen to the injection points. Each injection point is installed in a curb box to protect the well and to provide access. The injection points are 1-inch in diameter and are equipped with a bentonite seal installed above the sand pack that surrounds the screened interval. The pressurized oxygen is injected into groundwater through the screened interval.

By controlling the oxygen flow rate, pressure, and the timing of the injection, the operation of the injection system can be optimized. Optimal system performance would meet the remediation goals while minimizing the operation time of the injection system. Field and groundwater analytical data will be evaluated to optimize system performance.

2.2 Description of Mechanical Equipment

The oxygen injection system has the following specifications:

- Oxygen Production Capacity of 160 standard cubic feet per hour (SCFH)
- Oxygen Delivery Manifold with 60 points (6 banks of 10)
- Power Supply = Three phase 230-volts
- Six foot by 14-foot insulated double axle cargo trailer with rear locking double doors, trailer jacks, lighting, wall-mounted heater, ceiling-mounted ventilator and 120-volt duplex receptacle.

- AirSep Model AS-160 oxygen generator with a 120-gallon surge tank and regulator. Single phase/60 Hz/110 volts.
- Kaeser SM-8 rotary screw air compressor with air dryer, pressure tank with auto drain, and low sound enclosure. Rated for 32 ACFM @ 100 PSIG. 7.5 HP TEFC motor, three phase/60 Hz/230 volts. The compressor should include a programmable logic controller.
- Manifold for 60 injection points to include individual pressure gauge (0-30 PSI) and Dwyer variable area flow meter (10-100 SCFH).
- Six adjustable timers and solenoid valves (per set of ten points) to control oxygen flow for pulse injection.
- 125-amp electrical panel (NEMA 1 load center) with breakers located inside the trailer and 100-amp (NEMA 3R rainproof) safety switch on outside of trailer. All wiring is copper in Liquid-Tight flexible conduit (steel jacket) or UL listed SCH40 PVC rigid electrical conduit.
- Fully integrated remediation system with all plumbing, electrical, and mechanical components installed.
- All pressure tanks will be ASME National Board Certified for compressed gas storage (200 PSI rating).
- The pressure relief valve will be muffled for noise reduction.
- U.L. certification.
- Operations manual with plumbing and instrumentation diagrams.

2.3 Description of Injection Wells

Each oxygen injection well was installed to the following specifications.

- Injection points are constructed of Schedule 40 PVC risers.
- Injection point screens are constructed of a 1-foot long 1-inch diameter PVC sump fitted to a 1-inch diameter 1-foot long 0.010 slot PVC screen, fitted to 1-inch diameter PVC riser.
- The 1-inch PVC riser is attached to a 1-inch to ¾-inch threaded tee at approximately 2-feet below grade surface.
- The ¾-inch threaded tee is attached to a ¾-inch PVC threaded barb.
- The 1-inch tee is fitted with a 1-inch diameter riser to grade.
- The annular space is filled with #00 Silica Sand to at least 1-foot above the screen interval, a minimum two-foot thick bentonite seal, Portland cement/bentonite grout to 3-feet blow grade, and native material to grade.
- The wellheads are completed with flush mount valve boxes or well housings large enough to allow access for cleaning, adjustment or measurement within their respective road boxes.

3. Oxygen Injection System Operations & Maintenance

The purpose of the oxygen injection system operation and maintenance (O&M) is to monitor routine operation and maintain the oxygen injection system to ensure proper function and to detect problems. The specific task objectives are as follows.

- Perform routine operating and maintenance on the mechanical equipment that comprises the oxygen injection system.
- Monitor the performance of the oxygen injection system and measure groundwater injection parameters.
- Record monitoring data to determine optimal system operational parameters and provide documentation for quarterly OM&M reports.
- Monitor the purity of the oxygen being manufactured by the system.

In order to accomplish the objectives of the post construction operation and monitoring program, the schedule and tasks described below will be followed. A binder that contains manuals provided by the equipment manufacturers will be stored in the equipment enclosure for as-needed reference during performance of the O&M activities.

3.1 Operation and Maintenance Schedule

During system start-up, O&M activities will be performed daily. During the first month of operation, O&M activities will be performed weekly. Following the first month of operation, O&M activities will be performed monthly. Oxygen purity monitoring and a general system check will be made twice a month. If needed, system adjustment and maintenance of fluid levels, lubrication, filtration units, and connectors will be performed during each site visit. Full maintenance of the mechanical components of the oxygen injection system will be performed every six months or as recommended by the equipment manufacturers.

3.2 Operation and Maintenance for Mechanical Systems

O&M tasks for the mechanical components include system inspection, data recording, and field measurements. During each monthly inspection visit, the following tasks will be performed:

- Inspection of the system enclosure and mechanical equipment for security problems, vandalism, system damage, operating anomalies, equipment or conveyance malfunction, connection integrity, power outages, or environmental effects.

- Inspection of fluid levels, filter conditions, connectors, and timer settings.

- Recording of Airsep AS-80 Oxygen Generator, Kaesar Compressor, and Pulse Cycle Timer settings and/or readings.

- Recording of the Oxygen Purity from the Oxygen Feed Tank.

- Documentation of the inspection results on the field log form.

The maintenance checklist is included in Appendix A and the O&M Log Sheet is included in Appendix B. These forms will be filled out in duplicate during each O&M event. One copy will be stored in the system enclosure and one copy will be maintained in the project file.

Approximately every six months, or as recommended by the equipment manufacturers, additional maintenance tasks will be performed on the oxygen injection mechanical equipment. These tasks will include changing out air and oil filters, replacing gaskets on the filter housings, and replacing lubricating oils used in the mechanical equipment. In addition, valves, motors, and belts will be checked to ensure that they are in good condition and additional maintenance will be performed if warranted.

Used lubricating oils and oil filters will be taken to a recycling facility for proper disposal. Air filters and gaskets replaced during system maintenance will be disposed of as solid waste.

3.3 Operation and Maintenance for the Injection Wells

O&M tasks for the injection wells are minimal because there are no mechanical components. During each monthly inspection visit, the following tasks will be performed:

- Recording of oxygen injection pressures and flow rates for each of the injection wells that are connected to the injection manifold in the system enclosure.

- Documentation of the inspection results in a field book and on the field log form.

During the inspection visits, periodic field adjustments in delivery pressures and flow rates may be needed and will be based upon office evaluation of the collected field and groundwater analytical data. In addition, recorded data will be evaluated in the field to determine if there is a

problem with any of the injection wells (e.g., any injection well with high flow rates but lower than expected pressures may have leaks).

3.4 Tools and Spare Parts

All tools required for the O&M tasks will be stored in the oxygen injection equipment enclosure. One complete set of spare parts used in the six-month maintenance tasks (e.g., oil, filters, gaskets) will be obtained from the equipment vendors and stored in the system enclosure. These spare parts will be available at all times in case repairs are required during any of the O&M site visits. An additional set will be ordered prior to performance of the six month maintenance tasks so that they can be available for future site visits.

Personal protective equipment, (e.g., gloves, earplugs), will be maintained in the system enclosure for use during the site visits. Housekeeping supplies, (e.g., towels, broom), will also be stored in the system enclosure so that the working space and equipment can be kept clean and in orderly condition. Used PPE and cleaning supplies will be disposed of as solid waste.

3.5 System Shutdown and Restart

The oxygen injection system is equipped with two pressure sensors on the outlet of the receiver tank attached to the compressor and the receiver tank attached to the oxygen generator. If the system shuts down, pressure in the compressor tank or the oxygen tank will drop and the sensor will activate an autodialer that will be programmed to contact the system operator. The autodialer is also interfaced with the digital output of the compressor unit allowing for remote access to system information. Following notification of shutdown, the operator will go to the system enclosure location to determine the cause of the shutdown and make the system operational, if possible. Specialized support from the remedial system or equipment vendors may be needed and this will be arranged if needed.

4. Remedial Effectiveness Monitoring

Groundwater monitoring will be performed to determine the effectiveness of the IRM. The goal of the IRM is to reduce groundwater contaminant concentrations by 75% to 90% prior to discharge to Lawrence Creek. Upgradient groundwater data will be compared to data collected downgradient of the treatment systems, as well as comparing existing post-treatment conditions versus pretreatment historic data to determine if the remediation goal is being achieved. In addition, groundwater analytical data will be evaluated so that system performance can be optimized. All of the monitoring wells and pre-installation historic data from the area of the IRM can be found in the IRM Work Plan.

The purpose of the groundwater monitoring is to provide analytical data that can be used to evaluate the effectiveness of the system. Both field parameters and laboratory analytical data will be used in the treatment system evaluation. Instrument readings will be collected to ensure that the system is operating properly and that oxygen injection rates are correct.

The field parameters and evaluation criteria include:

- Dissolved oxygen (DO) concentrations to measure any increase in groundwater oxygen content.
- pH levels to confirm that groundwater pH remains within a range (5 to 9 standard units) that is optimal for biodegradation.
- Temperature to evaluate possible seasonal impacts on microbe growth.
- Conductivity, which it is a possible indirect indicator of bio-growth (dissolved iron concentrations often increase in groundwater during biodegradation, causing an increase in conductivity).
- Oxidation-reduction potential (ORP or eH), which also is a possible indirect indicator of bio-growth (in locations where the ORP is negative, a significant degree of bacterial degradation is indicated).

Field parameters will be evaluated to ensure that subsurface conditions are present to support bioremediation. Field parameters will be monitored monthly.

4.1 Groundwater Monitoring

A minimum of two weeks following completion of system installation, all wells currently included in the OU-2 monitoring program will be sampled for BTEX and PAHs. The results of this sampling round, together with previously collected data, will be used as a baseline to evaluate system performance.

Field parameters will be determined at all of the downgradient monitoring locations at one-month intervals following startup. Groundwater samples will be collected from all wells in the OU-2 monitoring program and tested for BTEX and MTBE via Method 8260B and total PAHs via Method 8270 on a quarterly basis in accordance with the current site-wide monitoring program. The monitoring data will be presented and discussed in the Quarterly Operations, Maintenance & Monitoring Reports

Groundwater purging and sampling of the monitoring wells will be conducted according to the KeySpan MGP Program documents found in Appendix D of the IRM Work Plan (or most recent version).

Although RI activities did not show any evidence of nonaqueous phase liquid (NAPL) in this area, if a substantial light nonaqueous phase liquid (LNAPL) or dense nonaqueous phase liquid (DNAPL) accumulation is present in any well, then no groundwater sample will be collected for laboratory analysis. If DNAPL is found to accumulate in a well, then the DNAPL will be bailed from the well and the recovery rate of the DNAPL will be assessed.

Purge water and other wastes generated during sampling will be handled under the provisions specified in the IRM Work Plan. The validated sampling results will be included in the Quarterly Reports (Section 5). Samples and analytical data will be managed and analyzed in accordance with Appendix D of the IRM Work Plan.

5. Reporting

IRM performance will be evaluated and reported to the NYSDEC as part of the existing site-wide monitoring program on a quarterly basis. IRM performance reporting will be submitted within the Quarterly Operations, Maintenance & Monitoring Report for the Bay Shore Site.

Each quarterly report will contain:

- Data tables presenting analytical data from groundwater monitoring.
- Figures plotting the results for groundwater monitoring for organics (BTEX and total PAHs) and dissolved oxygen. These figures will be evaluated to determine if any trends are noticeable in the data. The need for additional figures and data evaluation will also be determined and discussed.
- An evaluation of remedial effectiveness and a determination of whether or not IRM remedial goals have been achieved.
- An evaluation of possible remedial system and operation, maintenance, and monitoring procedure improvements.

6. Contingency Plan

A contingency plan is included in the site HASP. A copy of the HASP will be kept within the system enclosure. The contingency plan includes the following as required by NYSDEC DER-10:

- Emergency Contact List with phone numbers
- Response procedures, including procedures for auto dialers
- An evacuation plan, which should include a map and route to the nearest hospital

Any changes to the contingency plan information (e.g., changed phone numbers or contact personnel) will be updated immediately upon receipt of the new information. The copy in the system enclosure will be updated on the following site O&M visit. Every six months the contingency plan will be evaluated to determine if additional changes are required based on site conditions (e.g., hospital closures, evacuation route changes). If any are required they will be made and the plan updated.

Appendix A

OU-2 IRM Maintenance Checklist

OU-2 IRM Maintenance Checklist

1) Inspect site enclosure and landscaping, record condition of fencing and landscaping noting any vandalism or other problems. Also record any corrective actions or contacts made to initiate corrective actions.

_____

_____

_____

_____

2) Inspect trailer (interior and exterior) and mechanical equipment, record condition of trailer and the presence of any problems with mechanical equipment (e.g., oil leaks). Also record any corrective actions or contacts made to initiate corrective actions.

_____

_____

_____

_____

3) Perform operation and maintenance tasks and list observations on Oxygen Injection Operation and Maintenance Log Sheet.

4) Record system condition when leaving the site (e.g., trailer and enclosure locked, trash removed from interior and exterior of trailer, whether or not the system is functioning, and any abnormal site conditions).

_____

_____

_____

_____

Appendix B

Oxygen Injection Operation and Maintenance Log Sheet

OXYGEN INJECTION OPERATION AND MAINTENANCE LOG SHEET
Bay Shore OU-2 Oxygen Injection Remedial System

Oxygen Injection Remedial System
KeySpan Corporation
OU-2 Interim Remedial Measure
Project No. 982482-14-2401

Date: _____
Time: _____
Weather: _____
Outdoor Temperature: _____
Inside Trailer Temperature: _____
Performed By: _____

O_2 Generator (AirSep AS-80)

Hours _____

Feed Air Pressure * _____ (psi)

Cycle Pressure * _____ (psi)

Oxygen Receiver Pressure * _____ (psi)

Oxygen Receiver Tank Pressure (reading from blue tank) _____ (psi)

Oxygen Purity _____ (percent)

* maximum reading during loading cycle

Compressor (Kaesar Rotary Screw)

Compressor Tank * _____ (psi)

(readings below are made from control panel)

Delivery Air _____ (psi)

Element Outlet Temperature _____ (^{o}F)

Dewpoint _____

Running Hours _____ (hours)

Loading Hours _____ (hours)

Motor Starts _____

Regular Hours _____ (hours)

Maximum Pressure _____ (psi)

* maximum reading during loading cycle

MID PLUME O_2 Injection System

MID PLUME Injection Bank 1			MID PLUME Injection Bank 2			MID PLUME Injection Bank 3		
	Depth	scfh/psi		Depth	scfh/psi		Depth	scfh/psi
Point 1	25		Point 11	25		Point 21	27	
Point 2	25		Point 12	50		Point 22	65.5	
Point 3	25		Point 13	25		Point 23	25	
Point 4	25		Point 14	68		Point 24	50	
Point 5	25		Point 15	25		Point 25	25	
Point 6	25		Point 16	50		Point 26	25	
Point 7	25		Point 17	25		Point 27	25	
Point 8	25		Point 18	66		Point 28	25	
Point 9	50		Point 19	25		Point 29	25	
Point 10	25		Point 20	50		Point 30	25	
Target Injection Rates and Presures								
Points 1 - 10			Points 11 - 20			Points 21-30		

Comments:

Date: _____

OXYGEN INJECTION OPERATION AND MAINTENANCE LOG SHEET
Bay Shore OU-2 Oxygen Injection Remedial System

TAIL PLUME O_2 Injection System

TAIL PLUME Injection Bank 4			TAIL PLUME Injection Bank 5			TAIL PLUME Injection Bank 6		
	Depth	scfh/psi		Depth	scfh/psi		Depth	scfh/psi
Point 1	25		Point 11	45		Point 21	30	
Point 2	27		Point 12	47		Point 22	30	
Point 3	30		Point 13	45		Point 23	30	
Point 4	35		Point 14	40		Point 24	25	
Point 5	35		Point 15	35		Point 25	25	
Point 6	40		Point 16	35		Point 26	25	
Point 7	45		Point 17	35		Point 27	25	
Point 8	45		Point 18	35				
Point 9	45		Point 19	35				
Point 10	45		Point 20	30				
Target Injection Rates and Presures								
Points 1 - 10			Points 11 - 20			Points 21-27		

Comments:

OPERATIONAL NOTES

GA5 Air Compressor

1) Oil Level Checked with system unloaded* Yes _____ No _____
   * Unload system, wait until Delivery Air Pressure is less than 9 psi
2) Oil Level with system unloaded
   Low (red) _____ Normal (green) _____ High (orange) _____
3) Oil added Yes _____ No _____
4) Oil changed Yes _____ No _____
5) Oil filter changed Yes _____ No _____
6) Air filter Changed Yes _____ No _____
7) Oil separator changed Yes _____ No _____
8) Terminal strips checke Yes _____ No _____

AS-80 O_2 Generator

1) Prefilter changed Yes _____ No _____
2) Coalescing changed Yes _____ No _____

Date: _____

OXYGEN INJECTION OPERATION AND MAINTENANCE LOG SHEET
Bay Shore OU-2 Oxygen Injection Remedial System

GENERAL SYSTEM NOTES

Trailer

1) Performed general housekeeping (i.e. sweep, collect trash inside and out, etc.)
   Yes _____ No _____

2) Abnormal conditions observed (e.g. vandalism _____

3) Other major activities completed _____

4) Supplies needed _____

5) Visitors _____

Record routine activities such as any alarm/shutdowns, sampling, maintenance, material transported off-site, oil/filter/gasket and/or any other abnormal operating conditions:

Action Items