MWH

March 23, 2007

Mr. Ramanand Pergadia, P.E.
New York State Department of Environmental Conservation
21 South Putt Corners Road
New Paltz, NY 12561-1696

RE: Proposed Continuation of the Remedial Action
American Candle Company (former Ferroxcube) Site, Saugerties, New York
Site Code #3-56-011
2007 Permanganate Injection Addendum

Dear Mr. Pergadia:

Enclosed please find the proposed addendum to the work plan for In Situ Chemical Oxidation (Additional Permanganate Injections) dated May 17, 2006 (**Attachment 1**). The original work plan was approved by the New York State Department of Environmental Conservation (NYSDEC) on June 27, 2006 as part of the remedial action for the American Candle Site (former Ferroxcube facility) in Saugerties, NY (the Site). Based on the results of the 2006 Permanganate Injection we have prepared this addendum to perform additional permanganate injections and monitoring of groundwater in the former Solvent Storage Shed area at the Site for your review and approval. This document describes the observed results of the 2006 permanganate injections including the reduction in residual VOCs in groundwater that was observed in this area of the Site the technical basis and procedures for completion of these tasks.

Residual VOCs have been detected at the Site at two locations resulting from former operations, including electronics manufacturing. These areas are the former Solvent Storage Shed Area (northern portion of the Site) and the Former TCA Storage Tank Area (southern portion of the Site) (**Figure 1**). Various remedial actions such as air sparging, soil vapor extraction, groundwater pump and treat and chemical oxidant in situ (sodium permanganate) have been implemented to remediate VOCs in the groundwater in the Solvent Storage Shed Area. Sodium permanganate has proven to be capable of recreating the VOC transport pathway and chemically oxidizing the residual VOC material with which it comes into contact during sodium permanganate injections performed in the past.

Two phases of additional Permanganate Injections occurred in 2006. Five 6-inch injection wells were installed in the area of the former Solvent Storage Shed Area using hollow stem auger methods (**Figure 2**). These wells were installed at depths varying between 8 and 14 feet below ground surface and using 2 to 3 feet of screen installed into the bedrock. The purpose of this construction was to deliver as much of the permanganate into the overburden-bedrock interface allowing the permanganate to seep into the soils in the same area where any

10 Airline Drive, Suite 200
Albany, New York 122051
Tel: 518 640-6010
Fax: 518 640-6006

releases may have occurred and to chemically oxidize any residual VOC material with which it comes into contact.

The first phase of injection occurred in August 2006. Ten gallons of 40% sodium permanganate solution was added to each of the five injection wells. After the permanganate was put into the wells, water was introduced into each of the wells to add hydraulic head. The greater density of the permanganate with respect to the groundwater would keep the permanganate at the bedrock-overburden interface, but by adding hydraulic head to the well, it would further displace the permanganate into the fractured bedrock zone.

A second phase of this injection took place in November 2006 but only in three of the five injection wells and only consisted of five gallons per well. Two of the injection wells did not receive permanganate during this phase because permanganate remained in them from the August injection. Instead, hydraulic head was put on all five injection wells to displace the permanganate out into the groundwater in the vicinity of the wells.

Upon completion of both injections, monitoring wells located in the former Solvent Storage Shed Area were monitored daily for the first week after each injection, and then on a weekly basis for up to twelve weeks to determine the transport route of the permanganate. Monitoring parameters include visual inspection of color, and measurements of oxidation-reduction potential. Since then, the monitoring wells have been monitored on a bimonthly basis.

Since the most recent permanganate activities have begun, the existing pump and treat system (P/T system) at recovery well RW-4 has been shut down to prevent the hydraulic capture of the permanganate by the P/T system. This also encouraged the permanganate to flow toward untreated shallow fractured areas along the bedrock. Within 24 hours of each permanganate injection, permanganate appeared at monitoring well BW-5 as determined by inspection the color of the water pumped from BW-5 during the monitoring. The purple coloration was observed to be very strong immediately after the injection indicating the presence of the permanganate and faded to faint pink until three to four weeks after injection.

After an initial observed increase in VOCs at monitoring wells in the Solvent Storage Shed Area, which resulted from the chemical oxidation of weak intermolecular forces that bind VOCs to soil, significant decreases in VOC concentration were observed at monitoring wells RW-4, BW-5, OW-10, Andreassen Well, and the K-Well. Due to these observed decreases in VOC concentrations, we are requesting your approval to continue the process by completing a third permanganate injection.

The proposed third phase of Permanganate Injection would follow the same technical procedures as the previous injections described in the Work Plan for In Situ Chemical Oxidation submitted in May 2006.

It is proposed that during this phase of injection, 20 gallons of 40% sodium permanganate solution would be injected in each of the five injection wells, 30 gallons be injected into monitoring wells RW-4, and 10 gallons be injected into monitoring well BW-5. In addition to monitoring wells OW-1S, OW-1D and the Andreassen Well, the K-Well and Miles Well will be used as sentinel wells to detect the flow of water containing permanganate toward the Worrad and Cunningham residences. Based on observations made during the last phase of

injection, the primary route of transport of the permanganate is eastward toward the area of BW-5. This appears to be an area where VOCs are trapped within fractures of the bedrock. This conclusion is based on the manner in which VOC concentrations have responded to seasonal groundwater elevation fluctuations and also on the results of the previous permanganate injections. It is intended that by placing permanganate in BW-5 and RW-4, in addition to the injection wells, a greater quantity of permanganate will be introduced into the fractures between RW-4 and BW-5 than by injection into the injection wells alone.

During the most recent permanganate injections, the P/T system had not been operating. The Andreassen Well is no longer being used as a residential water supply well. Therefore the groundwater in this area is currently following its natural flow path without influence. It is not expected that the route of transport of the permanganate will migrate significantly northwards of the P/T system, as it has been observed to migrate towards the northeast previously as indicated by its detection at BW-5 during the recent injections. This is a desired consequence, because it indicates that as the introduction of the permanganate extended into the primary bedrock fracture connection between BW-5 and RW-4.

As a precaution, the Miles well and the K-Well will also used as sentinel wells for the proposed 2007 permanganate injections in addition to OW-1S, OW-1D and the Andreassen Well during the monitoring period. After the permanganate injection activities have occurred, MWH will re-evaluate the need for a fourth permanganate injection or to restart the P/T system based on the conditions observed and the reduction of total VOC concentrations.

We look forward to discussing this proposed permanganate injection work scope with you, and look forward to continuing to work with you on this project.

Sincerely,
MWH Americas, Inc.

Priscilla Seaburg
Project Manager

Richard Hixon
Principal Hydrogeologist

Enc: Attachment 1, Work Plan for In-Situ Chemical Oxidation (Additional Permanganate Injections) Dated May 17, 2006
Figure 1, American Candle Company Site Plan
Figure 2, Former Solvent Storage Shed Area, Permanganate Injection Well Plan

MWH

May 17, 2006

Mr. Ramanand Pergadia, P.E.
New York State Department of Environmental Conservation
21 South Putt Corners Road
New Paltz, NY 12561-1696

RE: Proposed Augmentation of the Remedial Action
American Candle Company (former Ferroxcube) Site, Saugerties, New York
Site Code #3-56-011
Work Plan for In-Situ Chemical Oxidation (Additional Permanganate Injections)

Dear Mr. Pergadia:

Enclosed please find a proposed Work Plan for augmentation of the Remedial Action for the American Candle Site (Former Ferroxcube facility) in Saugerties, NY ("the Site"). This Work Plan describes the technical basis and procedures for completion of additional permanganate injections and monitoring of groundwater in the former Solvent Storage Shed area at the Site, as proposed to continue to mitigate the presence of residual volatile organic compounds (VOCs) in groundwater in this area of the Site.

Site Background

Philips Electronics North America Corporation ("Philips") purchased the Site from Ferroxcube. The Site was used for the manufacture of electronic components from 1961 until January 2001, at which time the Site was sold to a firm called ClearlyTech. The Site is currently vacant, but was most recently operated by a small perfume and candle-manufacturing company named American Candle. Halogenated VOC solvents had been used by Philips' production operations (e.g., degreasing), which resulted in releases to the soil and groundwater. Residual VOCs have been detected at the Site at two locations, the former Solvent Storage Shed Area (Northern Portion of the Site) and the Former TCA Storage Tank Area (Southern Portion of the Site). **Figure 1** shows these areas.

In 1982, the Ulster County Department of Health discovered the presence of halogenated hydrocarbons above drinking water standards in four nearby residential supply wells (Cunningham, Cole, Andreassen, and Knicely). Subsequently in 1984, two additional impacted residential wells were detected (Miles and Worrad wells). As a result, several site investigations were completed, culminating in a Remedial Investigation/Feasibility Study (RI/FS) submitted to the New York State Department of Environmental Conservation (NYSDEC) in 1992. The extent of VOC impacts to soils and groundwater both on- and off-site were determined by these investigations, and by a private well survey completed by the Ulster County Department of Health. Currently, Philips has purchased and vacated the Knicely, Cole, Miles, and Andreassen properties. Currently, the homes of the Cunningham and Worrad families are equipped with activated carbon wellhead filtration systems, and are also supplied with bottled potable water.

At the former Solvent Storage Shed Area, sampling completed during studies reported in the RI/FS detected the presence of VOCs in groundwater and soils including 1,1,1-trichloroethane (TCA), tetrachloroethene (PCE), trichloroethylene (TCE), 1,1-dichloroethyelene, (DCE) and Freon-113. The highest concentration of these compounds in groundwater was detected at the bedrock-overburden interface, where VOCs were detected at 134,000 ppb, total, in 1986. At that time, Freon-113 was the VOC detected at the highest concentration in groundwater. The cumulative effects of the remedial action implemented at the Site (including air sparging, soil vapor extraction, groundwater pump and treat, and permanganate treatments applied to chemically oxidize the VOCs in-situ) have dramatically reduced the concentrations of VOCs, with the effect that the highest concentration detected in wells adjacent to or related to the former Solvent Storage Shed Area at present (May 2006 Remedial Action Quarterly Status report) is less than 100 ppb, total VOCs). Currently, PCE presents as the VOC at highest concentration in groundwater. Although the impacted media, particularly overburden soil and groundwater have responded favorably to these measures, additional efforts are proposed to address the persistence of VOCs in bedrock wells on the Site and in peripheral off-site bedrock wells. To develop an effective remedy for these compounds, further consideration of the historic source areas for these compounds, as well as the mechanism for their transport from the source area to more distant bedrock wells, is warranted, as presented herein.

Hydrogeology and Contaminant Transport Model

The conceptual site model for subsurface release and transport of VOCs is based on previous reports of historic site operations, site soil boring and well completion data, and chemical analyses. Historic soil borings indicate that the overburden soils in the former Solvent Storage Shed Area consist of a relatively thin overburden stratum of clayey silt. Bedrock outcrops at grade near the former Solvent Storage Shed Area. The bedrock dips (or slopes) away from the former Solvent Storage Shed Area northward, eastward, and westward. Observations recorded during the installation of recovery well RW-4 reported the presence of a void or solution cavity encountered just below the overburden/bedrock interface, which contained water with a weathered solvent-like odor. Well RW-4 is currently extracting groundwater from this location.

Square and rectangular chunks of fractured limestone bedrock were observed during the course of installing a utility pole near the former Solvent Storage Shed Area approximately two years ago when the groundwater treatment system was reactivated at RW-4. This fractured rock was brought to the surface by the solid flight auger used to install the utility pole and suggests that the shallow bedrock, at its interface with the overburden, may be characterized by parallel and perpendicular fractures. The fact that the rock at the Site can easily be broken into chunks and brought up by a solid flight auger indicates that the rock is highly fractured at the overburden/bedrock interface. This condition is observed in bedrock outcroppings exposed at roadcuts along Kings Highway

and the New York State Thruway. The presence of large solution channels is also observed by inspection of these outcroppings. The preferential transport of VOCs in bedrock groundwater at the Site is indicated by the similarity in VOC concentrations in wells (RW-4, BW-5, and Andreassen well) oriented in a northwest-southeast trend across the Site and adjoining properties, which is consistent with the fracture orientation observed in bedrock outcrops.

These data and observations support the following conclusions with respect to a potential remedy for the persistent detections of VOCs in bedrock wells at the Site.

- If as indicated by the investigations completed at the Site, VOCs released from the former solvent storage shed percolated downward through soils, and ultimately encountered the fractured surface of bedrock, this would explain two circumstances that have been observed during the implementation of remedial actions to date at the Site.
    1. VOCs trapped within the matrix of parallel and perpendicular fractures at the bedrock surface would have been abated (by diffusion only) to a lesser degree than overburden soil and groundwater by the AS/SVE remedy, and would therefore account for the rebound in VOCs observed when the AS/SVE system was shut down.
    2. Fugitive VOCs within bedrock fractures and soil filled bedrock fractures would also respond to seasonal groundwater surcharge to the bedrock as precipitation percolated through overburden material, producing the seasonal fluctuations in VOCs observed at many of the peripheral on-site and off-site bedrock wells.
- During the course of historic releases from the former Solvent Storage Area, dissolved phase VOCs and/or non-aqueous phase liquids moving downward through soils and through the fractured surface of the bedrock would leave a residuum, and thereby result in the continued, albeit decreasing and fluctuating, concentrations of VOCs detected in bedrock wells. A soluble and relatively non-viscous liquid chemical oxidant formulation ought to be capable of recreating the VOC transport pathway and chemically oxidizing the residual VOC material with which it comes into contact.
- Ethene compounds such as TCE and PCE are effectively broken down by chemical oxidation.
- The installation of new injection wells close to the former Solvent Storage Shed area is proposed so that the injected permanganate will have the greatest opportunity to move through the fractured bedrock zone before it moves toward the larger solution voids (i.e., RW-4) and northwest-southeast trending solution channels.

Proposed Injection Plan

On March 16, 2006, a pilot test was conducted for the purpose of determining how much permanganate could be introduced into existing recovery and sparge/vent wells at the Site. The test was completed by using water from the supply well at the Site as a surrogate for the permanganate solution. At each well, a rising head test was completed as water was piped into the wells, and a falling head test was conducted by measuring the

rate of decline in head after the water flow into each well was discontinued. All the wells appeared to have limited flow capacity relative to their potential use as injection wells. Monitoring well RW-2 performed the best, but even it exhibited an infiltration rate of only 0.0455 gallons per minute (gpm), as calculated by measuring the decline in water level with time. Infiltration rates at other wells tested ranged from .0023 to 0.0255 gpm.

Therefore, for the intended purpose of use as injection wells for the chemical oxidant permanganate, the existing recovery and sparge/vent wells at the Site are not ideally suited due to their construction and recharge capacities, except RW-2, which is located too far from the former Solvent Storage Shed Area and too close to RW-4 to be an ideal injection point.

Due to the conditions described above preventing the use of the former sparge and vent wells as injection wells, five new permanganate injection wells are proposed (**Figure 2**). These wells would be located near the former Solvent Storage Shed Area, with 2-ft. sections of screen located at the bedrock interface, except for one proposed injection well which would be located adjacent to existing Vapor Extraction Well (VEP-1). This well would be shallow (VEP-1 is approximately 7 ft. deep), and will have a screen length of 3 – 4 feet, which would allow the injection of permanganate into the soils in the same area where the site history indicates that releases may have occurred. This construction is designed to deliver as much of the permanganate's oxidizing potential as possible to the fractured bedrock zone.

These new injection points will be drilled using hollow stem auger methods into the bedrock as deep as the fractured zone as determined by the driller during the time of installation. It is anticipated that the wells will be installed at a depth of 10 to15 feet below ground surface (bgs), except as described above for the location near VEP-1. The injection wells would be constructed with a 6-inch diameter 0.020" screened poly-vinyl chloride (PVC) casing. The injection wells will be completed with a protective steel casing and locking cap to prevent unauthorized access.

The new injection wells will be developed by surging and pumping. After development but immediately prior to injecting the permanganate, any groundwater entering the wells will be evacuated or pumped out, and then 10-gallons of 40% sodium permanganate solution would be added to each well. The greater density of the permanganate with respect to groundwater will keep it from being displaced by the groundwater which will ultimately fill the well, and will therefore allow the permanganate some residence time as it flows out into the fractured bedrock zone.

Upon completion of the injection, monitoring wells located in the area of the former solvent storage shed will be monitored daily for the first week after injection, and then on a weekly basis for up to twelve weeks to determine the transport route of the permanganate. Monitoring parameters will include visual inspection of color, and measurements of oxidation-reduction potential.

MWH proposes to shut down the pump and treat (P/T system) that is operating at recovery well RW-4 during the permanganate injection and subsequent monitoring period, to prevent the hydraulic attraction of the permanganate toward the P/T system. This will encourage the permanganate to flow toward untreated shallow fractured areas along the bedrock.

Monitoring wells OW-1S, OW-1D and the Andreassen Well will be used as sentinel wells to prevent the flow of permanganate water to the Worrad and Cunningham residences. If permanganate is observed at these locations (i.e., OW-1S, OW-D, or the Andreassen Well), then action (as discussed below) will be taken to prevent the permanganate from reaching the residential wells.

If it is determined that the route of transport of the permanganate is northward toward the area of the P/T system at RW-4, then pumping of BW-5 will begin. The purpose of pumping water from BW-5 will be to create a hydraulic gradient toward the eastern area of the Site and away from the RW-4 area. Water pumped from BW-5 will be routed to the P/T system for treatment and discharge under the parameters of the current Remedial Action authorization to discharge treated groundwater approved by the NYS DEC. If permanganate appears at BW-5 or the Andreassen well prior to being observed at RW-4, MWH will evaluate whether it is advisable to re-start the P/T system to limit the migration of permanganate to the east.

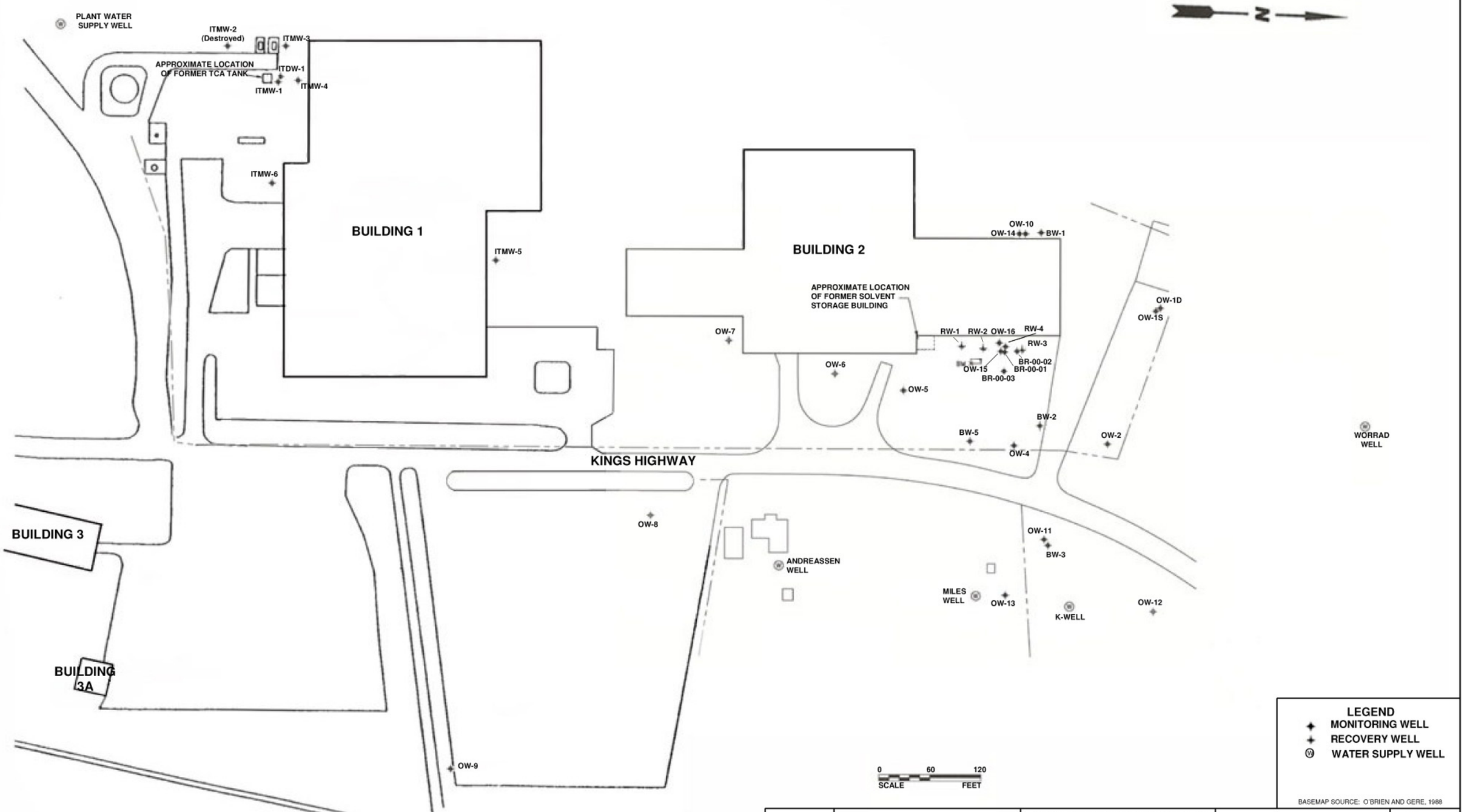
We look forward to discussing this proposed permanganate injection work scope with you, and look forward to continuing to work with you on this project.

Sincerely,
MWH Americas, Inc.

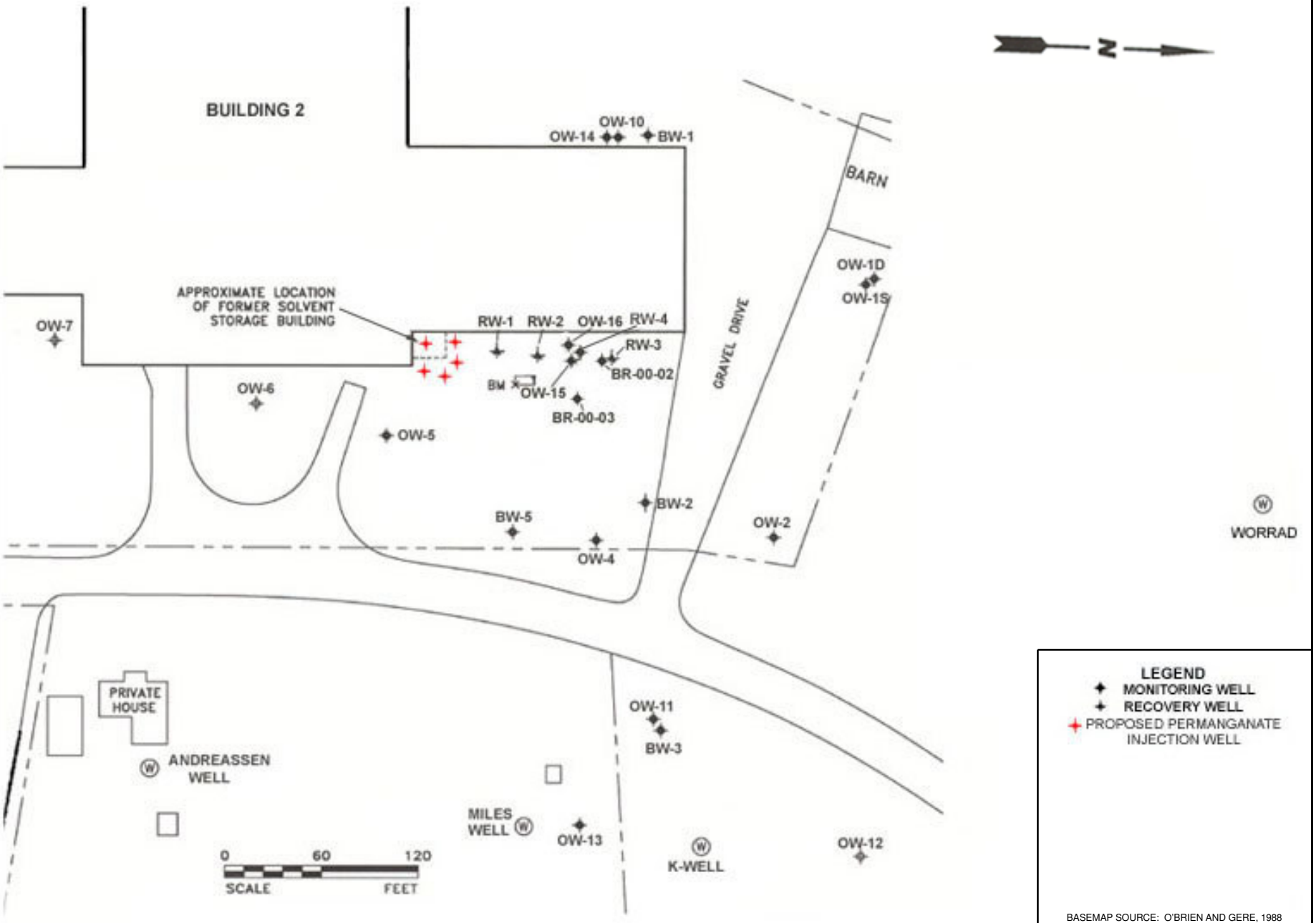
Priscilla Seaburg
Project Manager

Richard Hixon
Principal Hydrogeologist

Enc: Figure 1, American Candle Company Site Plan
Figure 2, Former Solvent Storage Shed Area, Permanganate Injection Well Plan



SCALE AS SHOWN	MWH MONTGOMERY WATSON HARZA	American Candle Company Site Former Ferroxcube Site 1033 Kings Highway Saugerties, NY	SITE PLAN	Figure 1



SCALE AS SHOWN	MWH MONTGOMERY WATSON HARZA	American Candle Company Site Former Ferroxcube Site 1033 Kings Highway Saugerties, NY	FORMER SOLVENT STORAGE SHED AREA PERMANGANATE INJECTION WELL PLAN	Figure 2