In-Situ Chemical Oxidation Injection Pilot Study Work Plan

Former Duso Chemical Site
Poughkeepsie, Dutchess County, New York
NYSDEC Site No. 3-14-103

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Quality information

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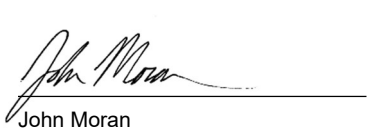
		
John Moran Staff Engineer	Lindsay Mitchell Project Manager, PE	Matthew J. Zenker, Senior Engineer, PhD, PE, BCEE

Prepared for:

New York State Department of Environmental Conservation

Prepared by:

AECOM USA, Inc.
40 British American Boulevard
Latham, New York 12110
518-951-2200

Table of Contents

Appendices

Tables

Figures

1. Introduction

AECOM USA, Inc. (AECOM) has developed this work plan for the New York State Department of Environmental Conversation (NYSDEC) to implement an in-situ chemical oxidation (ISCO) pilot study at the Former Duso Chemical New York State Superfund Site ("Duso Site") located in Poughkeepsie, New York. This work will be performed by the NYSDEC's call-out contractor, Precision Environmental Services, Inc. (PES). AECOM will provide oversight and sampling services. EA Engineering, Science, and Technology, Inc. (EA) will perform baseline groundwater sampling of existing monitoring wells.

The Duso Site was formerly occupied by the Duso Chemical Company where volatile organic compounds (VOCs) were released to the soil and groundwater as a result of historic operations. VOCs from the Duso Site also impact the adjacent former Western Publishing property portion of the Mid-Hudson Business Park ("MHBP Treatment Area") and a former railroad right-of-way (ROW)/drainage swale. A site location map is provided as **Figure 1-1**.

The NYSDEC issued a Record of Decision (ROD) on March 31, 2008 (NYSDEC, 2008), establishing remedial goals and selecting remedies for the Duso Site and MHBP Treatment Area to address VOC-impacted soils and groundwater. As defined in the ROD, Site remedial goals are to eliminate or reduce to the extent practical:

- Exposures of persons at or around the site to VOCs in soil and groundwater;
- The release of contaminants from the saturated soil into groundwater that may create exceedances of groundwater quality standards; and
- The release of contaminants from groundwater into indoor air through soil vapor intrusion.

Further, the remediation goals for the site include attaining to the extent practicable:

- Commercial soil criteria; and
- Ambient groundwater quality standards.

To achieve these goals, Enhanced *In Situ* Biological Treatment (EISB) and *In Situ* Thermal Desorption (i.e., conductive heating) were selected as remedies for the Duso Site and the MHBP Treatment Area, respectively. ROD remedy implementation was completed between 2013 and 2017 at the Duso Site and MHBP Treatment Area and both remedies were generally effective in reducing VOC concentrations in target areas; however, groundwater samples collected between 2018 and 2021 indicate elevated VOC concentrations remain in select areas post-ROD remedy implementation. Additionally, there is preliminary evidence that VOC-impacted groundwater from the Duso Site is migrating into the MHBP Treatment Area and increasing VOC concentrations above their respective NYSDEC Ambient Water Quality Standards (AWQS) or Guidance Values (GV).

1.1 ISCO Injection Pilot Study Objectives

The primary purpose of the proposed pilot study is to evaluate the effectiveness of implementing ISCO injections at the Duso Site to address residual VOC impacts in soil and groundwater along the western edge of the Duso Site and prevent offsite migration of VOC-impacted groundwater to the MHBP Treatment Area. The pilot study objectives include:

- Evaluate distribution of injection amendments within the target injection interval;
- Collect information necessary to design an ISCO injection layout (e.g., oxidant loading rates, injection spacing, and injection rates) as a potential site-wide remedial action;
- Evaluate the effectiveness of ISCO at reducing VOCs (including residual chloroethane concentrations) along the western edge of the Duso Site; and,

- Reduce VOC concentrations along the edge of the Duso Site to limit downgradient migration of VOC-impacted groundwater to the MHBP Treatment Area.

2. Site Overview

2.1 Site Description

The Duso Site is located in the Town of Poughkeepsie in Dutchess County, New York, approximately one-half mile east of the Hudson River near the intersection of Fulton Street and North Road (**Figure 2-1**). The Duso Site and MHBP properties comprise an approximately 6.5-acre area, with the MHBP Treatment Area (where thermal remediation activities took place) consisting of approximately 2 acres and the Duso Site consisting of 0.7 acres. Additionally, the former railroad right-of-way (ROW)/drainage swale that exists between the two properties is a small part of a large, upside-down "V"-shaped parcel near Route 9 in Poughkeepsie. The MHBP Treatment Area is in the southeastern portion of the MHBP property located at the corner of North Road (Route 9N) and Fulton Street.

At this time, the Duso Site is owned by Rich Muellerleile of Star Gas Properties, Inc. and the MHBP Treatment Area is owned by Midhudson Center LLC/TFS MidHudson LLC. Additionally, the former railroad ROW/drainage swale in between the two properties is owned by the County of Dutchess.

2.2 Site History

A review of Sanborn records from 1950 through 1990 indicates that the previous property owner of the Duso Site prior to Star Gas was the Duso Chemical Company. The Duso Chemical Company operated a chemical warehouse and distribution business from 1950 through 1963. In 1972, the Duso property was bought by and is still currently occupied by Star Gas Products, Inc., a propane distribution facility. As a result of a fire at the warehouse in 1963 (Chazen, 1998) and historic site operations, releases of various VOCs occurred to the environment on both the Duso Site and off-site MHBP properties. Migration of contaminants from the Duso Site, through the Conrail (now County of Dutchess) property, and to the MHBP Treatment Area likely took place following a sudden discharge of chemicals during the fire and subsequent fire-fighting activities.

From 1910 to 1917, FIAT of Poughkeepsie manufactured approximately 2,000 automobiles at what is now the MHBP property. Western Publishing began production in a corner of the property in 1935. By the 1950s the plant grew to nearly 400,000 square feet. Operations at the facility included photography, lithography plate production, printing operations, coating, gluing and binding operations, and general plant operations and maintenance. The facility used inks, dyes and solvents, which were transported to the facility by truck and tanker. Large items like roll paper and some ink products were transported to the facility by rail. Types of chemicals used at the facility, as identified by a former employee, included acetone, benzene, carbon tetrachloride, isopropyl alcohol, kerosene, Salvasol #5, 1,1,1-trichloroethane (1,1,1-TCA) and trichloroethene (TCE). Some of these chemicals were reported to have been purchased from the Duso Chemical Company (Chazen, 1998).

2.3 Geology and Hydrogeology

The Duso Site and MHBP Treatment Area geology consists of three distinguishable unconsolidated soil deposits overlying bedrock. Based on the Remedial Investigation and supplemental investigations (O'Brien and Gere, 2007a), three unconsolidated deposits appear to be continuous across the Duso Site and MHBP Treatment Area. The uppermost deposit is a brown fine sand and silt which is described as ranging from 6 to 15 feet in thickness for both areas. A gray silt and clay deposit is encountered underlying the sand which is described in thickness ranging from 15 to 40 feet for the Duso Site and 35 to 60 feet for the MHBP Treatment Area. A coarse sand and gravel till deposit directly overlies the bedrock encountered beneath the MHBP Treatment Area and is described in thickness ranging from 1 to 5 feet for both areas. The unconsolidated deposits form a wedge of soil that increases in thickness across the MHBP Treatment Area toward the south. Saturated soil on the Duso Site and MHBP Treatment Area has been identified in soil borings at depths ranging from approximately 3 to 6 feet below ground surface (ft.

bgs). Specifically, saturated soils on the Duso Site range from approximately 3 to 4 ft. bgs and saturated soils in the MHBP Treatment Area range from approximately 4.5 to 6 ft. bgs.

The Duso Site's and MHBP Treatment Area's hydrogeological setting consists of two aquifers: the unconsolidated soil aquifer and the shallow bedrock aquifer. The unconsolidated soil aquifer exists in an unconfined state and responds to changes in seasonal weather conditions. Groundwater in the unconsolidated soil aquifer flows across the MHBP Treatment Area to the west and south with an apparent local influence from the intermittent stream. Groundwater flow in the unconsolidated soil aquifer on the Duso Site and further east generally mimics the topography and flows west until it is influenced by the intermittent stream and subsurface utilities located on the County of Dutchess property. The intermittent stream flows north to south along the abandoned railroad tracks of the County of Dutchess property, and is directed into a drain and drainage structures to flow below Fulton Street and continues south. Shallow and deep groundwater contour maps are provided in **Figure 2-2** and **Figure 2-3**.

2.4 Relevant Site Assessment and Remediation Summary

Several investigations were performed at the MHBP property and the Duso Site between 1994 and 2007. Investigation activities identified high concentrations of contaminants of concern (COCs) in soil and groundwater at the Duso Site and the MHBP treatment aera. Identified COCs in soil and groundwater consist of 1,1,1-TCA, 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA), tetrachloroethene (PCE), TCE, and 1,2-dichloroethene (1,2-DCE). A feasibility study was developed in 2007 and recommended EISB as the remedy for the Duso Site and in situ thermal treatment (ISTT) for the MHBP Treatment Area (O'Brien & Gere, 2007b). Supplemental site investigations, including a Membrane Interface Probe® (MIP) investigation at the MHBP Treatment Area, were completed in 2011 and 2012 to support design and planning of the proposed remedies.

In Situ Thermal Treatment (ISTT) via electrical resistance heating (ERH) was implemented in the MHBP Treatment Area between December 2015 and June 2017 to treat VOC-impacted soil and groundwater. ERH operations achieved significant concentration reductions and mass removal of up to 99% in the subsurface at the MHBP Treatment Area. Soil samples collected from the MHBP Treatment Area in 2016 and 2017 indicated VOC source mass was still present at select sample locations within the treatment area; however, diminishing mass removal rates indicated further operation of the ERH system was no longer cost effective and the system was shut down. Subsequent groundwater samples collected from monitoring wells on the MHBP property indicate VOC concentrations were significantly reduced, although select compounds remain above NYSDEC AWQS/GV in some wells. Additional details regarding the ERH design and implementation are included in the Final Engineering Report (FER) (AECOM, 2022d).

In June 2013, an EISB pilot study was initiated on the Duso Site to address VOC impacts in soils and groundwater. EISB modifies groundwater geochemistry to create reducing conditions that are conducive to the progressive dechlorination of CVOCs by bacteria through the addition of a carbon substrate, which serves as a source of an electron donor (hydrogen) and a microbial energy source. An emulsified vegetable oil (EVO) and a reductive amendment (EHC®) that included zero valent iron (ZVI) and a slow-release carbon source were injected at pre-determined volumes into the subsurface using direct-push tooling (DPT). Temporary injection points were advanced using DPT drill rigs, where a bottom-up injection approach was utilized targeting injection intervals between 4 and 26 ft. bgs. The EISB pilot study was temporarily halted due to injection material resurfacing in the drainage swale but was completed in November 2013 following modifications to the injection plan. The EISB pilot study was generally effective in reducing VOC concentrations in the pilot study area and establishing sustained reducing conditions. However, chloroethane (a dechlorination daughter product of 1,1,1-TCA, 1,1-DCA, and 1,2-DCA) cannot be treated via EISB and groundwater samples collected between 2016 and 2021 indicate elevated chloroethane concentrations persist in the pilot study area. Additional design, injection, and monitoring details are included in the EISB Pilot Study Summary Report (AECOM, 2022a).

A detailed summary of historical investigations and remedial actions are included in the Site Management Plan submitted in October 2022 (AECOM, 2022c).

3. ISCO Remedy Selection

The following sections provide the basis for evaluating ISCO as a remedy to address remaining VOC impacts at the Duso Site.

3.1 Current Conditions

As described in **Section 2.4**, an EISB pilot study was completed in 2013 and ISTT was implemented in the MHBP Treatment Area between December 2015 and June 2017. ISTT significantly reduced soil and groundwater VOC concentrations in the MHBP Treatment Area during implementation, and continued impacts on VOC concentrations in groundwater were observed during subsequent annual monitoring events. By June 2019, VOC concentrations in groundwater were below their respective NYSDEC AWQS/GV at all four MHBP Treatment Area monitoring wells with the exception of 1,1-DCA at monitoring wells MHC-29 (12 micrograms per liter [µg/L]) and MHBP-13S (52 µg/L), and chloroethane at MHBP-13S (600 µg/L). Based on groundwater samples collected between 2012 and 2021, the EISB pilot study was generally effective in reducing VOC concentrations, particularly chloroethenes (PCE, TCE, cis-1,2-DCE, 1,1-DCE, and vinyl chloride) and chloroethane parent compounds (1,1,1-TCA, 1,1-DCA, and 1,2-DCA). Reducing conditions were established and maintained in both the shallow and deep groundwater intervals, thus promoting continued VOC concentration reductions in the pilot study area years after injections were complete. However, degradation of chloroethane parent compounds resulted in a significant increase in chloroethane concentrations throughout the pilot study area. EISB is not known to be capable of reducing concentrations of chloroethane, thus the existing groundwater conditions at the Duso Site are likely incapable of naturally reducing chloroethane concentrations below the NYSDEC AWQS of 5 µg/L.

Between June 2019 and November 2021, a notable increase in VOC concentrations was observed at MHBP Treatment Area monitoring well MHBP-11. Concentrations of 1,1,1-TCA (<1.0 µg/L to 660 µg/L), 1,1-DCA (1.0 µg/L to 380 µg/L) and chloroethane (<2.0 µg/L to 31 µg/L) significantly increased, resulting in exceedances of the NYSDEC AWQS for all three compounds. Monitoring well MHBP-11 is positioned downgradient of monitoring well pairs BIW-1S/D and BIW-5S/D, where VOC concentrations remain orders of magnitude above NYSDEC AWQS and may provide preliminary evidence of downgradient migration of impacted groundwater from the Duso Site to the MHBP Treatment Area. Additionally, chloroethane parent compounds 1,1,1-TCA, 1,1-DCA, and 1,2-DCA exhibited increasing concentration trends between 2018 and 2021 at deep Duso Site monitoring well BIW-5D. Residual, lingering chloroethane concentrations along the western edge of the Duso Site coupled with evidence of downgradient migration of impacted groundwater at MHBP-11 indicate additional remedial action is necessary to achieve the remedial goals as outlined in the ROD.

Figures 3-1 and **3-2** include tabulated VOC concentration data at shallow and deep groundwater monitoring wells, respectively, between 2018 and 2021. **Figures 3-3** and **3-4** include total VOC iso-concentration maps from the November 2021 groundwater sampling event for shallow and deep groundwater monitoring wells, respectively.

3.2 Bench-Scale Treatability Studies

Two bench-scale treatability studies were performed by Evonik Active Oxygens, LLC (Evonik), formerly Peroxychem, in 2019 and 2022 using impacted soil and groundwater from the eastern portion of the MHBP Treatment Area and the western portion of the Duso Site, respectively. The objective of the studies was to evaluate the ability of abiotic chemical reduction, biotic reductive dechlorination and chemical oxidation processes to degrade concentrations of VOCs within soil and groundwater at the Duso Site. The first study evaluated various reactive amendments for their ability to reduce aqueous concentrations of VOCs in a reactive barrier. The two amendments studied included EHC® and EHC® Plus. EHC® is a fermentable carbon substrate with ZVI intended to stimulate biotic and abiotic reductive dechlorination and EHC® Plus includes an additional powdered activated carbon for adsorption. The second study evaluated EHC®, GeoForm™ ER, ELS® Microemulsion and sodium/potassium persulfate. GeoForm™

ER is a fermentable carbon substrate with ferrous iron and sulfate, intended to stimulate biotic and abiotic reductive dechlorination. ELS® Microemulsion is an emulsified edible oil that is intended to stimulate biotic reductive dechlorination. The sodium/potassium persulfates were intended to chemically oxidize VOCs.

The results of both bench-scale treatability studies demonstrate that amendments designed to stimulate biotic and/or abiotic reduction (via ZVI or other iron minerals) are capable of biotransforming more highly chlorinated VOCs but will accumulate chloroethane. The accumulated chloroethane will continue to degrade, but the rate of degradation of chloroethane is much slower compared to parent compounds. It is unknown to what extent these biotic/abiotic mechanisms can achieve reduction of chloroethane. Chemical oxidation treatments, however, were observed to reduce most of the CVOCs by over 99 percent, although the reduction of 1,1,1-TCA was only observed to be approximately 50 percent. Additional details regarding the 2019 and 2022 treatability studies are documented in the Summary of Bench-Scale Treatability Studies submitted in September 2022 (AECOM, 2022b).

Based on the rapid oxidation of chloroethane, 1,1-DCA, and 1,2-DCA observed during the treatability study, ISCO was selected for pilot scale field implementation to evaluate ISCO injection logistics and effectiveness. Additionally, results from the bench tests indicate ISCO injections along the western edge of the Duso Site will have the added benefit of rapidly reducing VOC concentrations upgradient of monitoring well MHBP-11.

4. ISCO Pilot Study Design and Implementation

The following sections detail the design components and implementation steps for the ISCO injection pilot study. The pilot study layout is included as **Figure 4-1**.

4.1 ISCO Amendments

The proposed ISCO injections will utilize a combination of alkaline activated sodium persulfate (Klozur® SP) and potassium persulfate (Klozur® KP) to meet the soil and VOC oxidant demand. Klozur® SP is highly soluble and will primarily account for the high natural soil oxidant demand (SOD) identified in the bench-scale treatability studies (AECOM, 2022b). Klozur® KP is less soluble than Klozur® SP and is designed to slowly dissolve over time to provide an extended release of the oxidant. The higher solubility of Klozur® SP allows the sodium persulfate to rapidly meet the SOD and therefore extend the longevity of the slow-release potassium persulfate in Klozur® KP to meet the oxidant demand of residual VOCs. The persulfate amendments will be activated with a combination of hydrated lime and a 25% solution of sodium hydroxide (NaOH). The NaOH solution is highly soluble and will rapidly activate the Klozur® SP while hydrated lime provides an extended release of an alkaline source for the Klozur® KP to sustain oxidant release over a longer period. Proposed pilot study amendment injection quantities are included in **Table 4-1**.

Selection of the ISCO amendments and calculated quantities were determined by Evonik in coordination with AECOM. ISCO calculations and assumptions used to determine caustic and persulfate injection quantities are included in **Appendix A**. Based on discussions between Evonik and AECOM, injection material quantities were increased proportionally from the initial estimate to account for a larger proposed target injection volume. Safety data sheets for the proposed ISCO amendments are included in **Appendix B**.

4.2 Injection Layout

The ISCO pilot study will target an injection interval of 5 to 25 ft. bgs to address residual VOC concentrations identified in both shallow and deep monitoring wells along the western edge of the Duso Site and the eastern edge of the former railroad ROW/drainage swale. Based on historic boring logs and results from the EISB pilot study, the proposed injection interval will cross two distinguishable unconsolidated soil deposits: a shallower layer of silty sands with higher hydraulic conductivity and a deeper layer of clayey silts with lower hydraulic conductivity. The ISCO pilot injections will target both deposits to address residual VOC mass and evaluate injection performance and amendment distribution in each zone.

Injection points are grouped in two rows along the western edge of the Duso Site and the eastern edge of the former railroad ROW/drainage swale. Each row will contain eight injection points spaced approximately 12-ft. apart and are intended to form an overlapping barrier intercepting VOC-impacted groundwater upgradient of monitoring well MHBP-11 and treat VOCs near monitoring well pair BIW-5S/D. Injection point locations may be adjusted to avoid identified subsurface or overhead features or prevent injection material resurfacing (daylighting) at the injection point or into the drainage swale. The approximate locations of the proposed injection points are included on **Figure 4-1**.

4.3 Proposed Performance Monitoring Well Installation

To monitor ISCO effectiveness and amendment distribution, two new multi-level monitoring well pairs (PMW-1S/PMW-1D and PMW-2S/PMW-2D) are proposed within the pilot study area. The proposed performance monitoring wells will be installed between existing well clusters BIW-1S/D, BIW-5S/D and monitoring well MHC-23 to add monitoring locations across the proposed ISCO pilot study area. Proposed monitoring well locations are presented on **Figure 4-1**. Final well locations will be determined in the field and are contingent upon approval by the property owners.

Performance monitoring wells will be constructed of 2-inch diameter PVC well casing with a 5-foot long screen. The screened intervals of each well were selected to evaluate pilot study depths with limited screen coverage from existing monitoring wells. The well screen will have a 0.010-inch slot size and the annular space between the well screen and the borehole will be backfilled with an appropriately sized silica sand filter pack. The filter pack will be followed by a 2-foot thick bentonite seal. The balance of the annular space will then be backfilled with grout, and the well head will be completed below grade with an 8-inch steel vault. Following installation, the wells will be developed to remove fine material and establish hydraulic continuity with the surrounding aquifer. Proposed monitoring well construction details are summarized in **Table 4-2**.

During installation, soil samples will be collected from the PMW-1D and PMW-2D boreholes for analysis of SOD and VOCs. Four, 5-ft. long samples will be collected from each of the two soil borings, from 5 to 25 ft. bgs, for a total of eight baseline soil samples. AECOM anticipates that soil samples will be sent to Evonik for laboratory analysis of SOD and to an NYSDEC call-out laboratory for analysis of VOCs. These values will be compared to post-injection soil samples collected from a nearby location, as described in **Section 4.7**. Drill cuttings and development water from the monitoring well installations will be containerized separately and sampled for appropriate characterization and disposed offsite by a disposal contractor.

4.4 Proposed Porewater Sampling Points

Three temporary porewater monitoring points (TPW-1 through TPW-3) will be installed in the drainage swale to evaluate injection influence beneath the swale between the MHBP Treatment Area and the Duso Site. Porewater monitoring points will be constructed of 2-inch diameter PVC well casing installed to a total depth of 15 ft. bgs with 10-feet of 0.010-inch slot size well screen and the borehole backfilled with appropriately sized silica sand. The monitoring point casing will extend approximately 3-ft. above ground surface and be sealed with a compression well cap to prevent inadvertent migration of drainage swale surface water into shallow groundwater.

Porewater sampling points will be monitored for groundwater field parameters and groundwater level throughout injection activities. Changing groundwater field parameters or increasing groundwater levels are indicators of injection influence; however, they could also provide evidence of potential injection daylighting into the drainage swale. Porewater sampling points will provide AECOM with additional monitoring points to both evaluate injection influence and take proactive measures to prevent daylighting during injection activities. The proposed locations of the porewater sampling points are presented on **Figure 4-1**.

4.5 Injection Implementation

Injection amendments will be shipped by freight directly to the Duso Site. Klozur® KP, Klozur® SP, and the hydrated lime will be shipped in 50 and 55-pound (lb.) bags staged on pallets. The NaOH solution will be delivered in 2,500 lb. totes. All injection amendments must be stored in accordance with best practices provided by Evonik, inside a temporary storage container or other protective structure throughout the entire pilot study in order to remain dry. Potable water for batching and injection will be delivered by tanker truck or by other means as appropriate. Prior to commencing injections, the potable water source will be identified and laboratory analysis performed for VOCs and metals. Electricity to power remediation equipment will be provided by a gasoline-powered generator or by other means as appropriate. PES will set up a materials and equipment storage/staging area on the MHBP Treatment Area property as coordinated with the property owner.

Amendment slurry batches will be prepared using a ChemGrout (or equivalent mixing unit) and adding appropriate quantities of Klozur® KP, Klozur® SP, hydrated lime, and water to achieve the selected dilution concentration. Due to the rapid reaction between persulfate and NaOH, the NaOH solution cannot be mixed into the amendment slurry before injection. The 25% NaOH solution will be delivered in pre-mixed totes for direct injection. Hoses and pumps will be used to convey the amendment slurry and

NaOH solution directly to injection points. The amendment slurry and NaOH solution will be injected at pre-determined volumes (see **Table 4-1**) into the subsurface using a DPT drill rig. Temporary injection points will be advanced to the deepest injection interval of 25-ft. bgs then pulled up in one foot injection intervals (bottom-up). Top-down injection methods may be utilized if bottom-up techniques do not achieve satisfactory distribution. The amendment slurry will be injected between doses of the NaOH solution at each one-foot injection interval to create a "sandwich effect" to ensure the persulfate is well mixed with the highly soluble caustic solution for rapid alkaline activation. For example, approximately 5.5 gallons of NaOH solution will be injected first, followed by all 24 gallons of the amendment slurry, then finished with a final 5.5 gallons of NaOH solution. This process is repeated across the entire injection interval to evenly and systematically distribute injection material. A manifold with flow totalizers, pressure gauges, and flow control valves will be used to regulate injection flow rates and pressure while injecting in multiple points. All injection equipment, including hoses, pumps, instrumentation, valves, and DPT accessories will be compatible with persulfate. To minimize mounding and improve amendment delivery, injections will generally not be performed at adjacent points at the same time.

Based on the results of the EISB pilot study injections, NaOH solution injections are anticipated to require lower pressure (5 to 10 pounds per square inch [psi]) and achieve flow rates of approximately one gallon per minute (gpm). Amendment slurry injections will require a higher injection pressure of approximately 100 psi with a resulting flow rate of approximately 5 gpm. Although higher flow rates are likely achievable, flow and pressure will be regulated throughout the pilot injections to prevent daylighting in the drainage swale adjacent to the pilot study area. Additional details regarding daylighting mitigation are included in **Section 5.3**.

During injections, AECOM and PES will maintain field logs to record the solution composition, the volume of solution delivered into each injection point, the length of time required for injection, and the injection pressure. Additionally, AECOM will deploy four multiparameter water quality meters (AquaTroll 200 or equivalent) at select monitoring wells and porewater sampling locations to monitor changes in groundwater composition during injection activities.

Following ISCO pilot injections, remediation derived waste (empty bags, pallets, PPE, and miscellaneous trash) will be disposed of as municipal trash, as none of this waste is anticipated to come in contact with contaminated materials in the subsurface. Empty NaOH totes will be disposed of offsite by a disposal contractor. All injection points, new monitoring wells and porewater sampling locations will be surveyed by a licensed surveyor.

4.6 Performance Monitoring

Performance monitoring will be conducted to evaluate the distribution of ISCO amendments and the change in VOC concentrations over time. Groundwater samples will be collected from six existing monitoring wells (BIW-1S/D, BIW-5S/D, MHC-23, and MHC-26) and four new monitoring wells (PMW-1S/D and PMW-2S/D) using low-flow sampling techniques. Water quality field parameters including temperature, specific conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP), and pH will be recorded at the time of sampling. All samples will be collected in laboratory-supplied bottleware and shipped to an NYSDEC call-out laboratory for analysis. Sampling procedures and analyses will adhere to those detailed in the Site Management Plan submitted in October 2022 (AECOM, 2022c). EA will collect baseline groundwater samples from the six existing monitoring wells indicated above, while AECOM will collect baseline samples from the four new monitoring wells following well development.

Due to the rapid nature of ISCO reactions, the performance monitoring period is expected to last only six months. In addition to baseline sampling, four performance monitoring events are proposed to be performed by AECOM. Following the end of the performance monitoring period, AECOM will evaluate pilot study area groundwater conditions and determine if additional analyses should be added to the Monitoring and Sampling Plan detailed in the Site Management Plan (AECOM, 2022c) to continue monitoring impacts of the ISCO pilot study injections. **Table 4-3** presents the monitoring parameters and frequency for the ISCO pilot study performance monitoring program, and sample locations are included on **Figures 2-1** and **4-1**.

4.7 Confirmation Soil Sampling

Following completion of the six-month performance monitoring period, soil samples will be collected from two borings within the pilot study area to evaluate the effects of ISCO on VOC mass sorbed to soils and the oxidant demand of soils within the pilot study area. Based on the results of the bench-scale treatability studies, SOD is the primary factor in determining oxidant demand at the Duso Site and is independent of the oxidant demand from site VOCs. A decrease in the pilot study area SOD would indicate the persulfate injection quantities were sufficient to overcome the background SOD. A significant reduction in VOC concentrations would indicate the remaining persulfate (post-SOD consumption) was sufficient to meet the oxidant demand from VOCs on the Duso Site. The objective of confirmation soil sampling is to determine if pilot study persulfate quantities were sufficient to meet the pilot study objectives.

Soil samples will be collected by AECOM from two soil borings using a DPT drill rig provided by PES or their subcontractor. Four, 5-ft. samples will be collected from each of the two soil borings from 5 to 25 ft. bgs for a total of eight confirmation soil samples. Soil samples will be sent to Evonik for laboratory analysis of SOD and to the NYSDEC call-out laboratory for analysis of VOCs. Proposed soil sample locations are shown on **Figure 4-1**.

5. Pilot Study Preparation Activities

The following sections detail the pilot study preparation activities required before ISCO injection activities can commence.

5.1 Permitting

Injection of remedial amendments falls under the requirements of United States Environmental Protection Agency's (USEPA) Underground Injection Control (UIC) program. Currently NYS has not requested program primacy for the federal UIC program. The Former Duso Chemical Site is a state-lead site, therefore the NYSDEC Division of Environmental Remediation (DER), or its call-out contractor (PES), is responsible for making the notification to USEPA. In accordance with DER Internal Guidance Procedure 22 (IGP-22), an injection inventory spreadsheet will be provided to USEPA Region 2 as part of the notification of injection activities. Injections used to enhance or effect remediation are generally authorized by rule and the notification is all that is required at least 30 prior days prior to commencement of direct-push injection or well construction.

Permitting is also required by the County of Dutchess, which owns the former railroad ROW/drainage swale property. Required permit applications, plans and fees will be provided by PES or AECOM as applicable. Additionally, Central Hudson Gas & Electric (CHG&E) requires an access agreement for the project due to the location of a portion of the drilling and injection activities in their utility right-of-way.

5.2 Utility Location

Utilities will be located within the treatment area prior to any drilling activities. Utility clearance procedures will involve utility location and marking by notifying UDig New York as well as a private utility locator, which will be procured by AECOM. Injection points will be relocated as necessary to maintain five feet of clearance from any identified underground utilities. All utilities will be located prior to beginning DPT borings. If hand-clearing is required, the cleared boring will be backfilled with bentonite prior to being advanced with DPT for the injections, to prevent shallow daylighting.

5.3 Stormwater Protection Plan

During the 2013 EISB injections, daylighting of injection materials was observed in the drainage swale located between the MHBP Treatment Area and the Duso Site. Resurfaced injection material seeped into the surface water that flowed through the drainage swale and was transported into the Town of Poughkeepsie's storm water collection system. To minimize further daylighting during EISB injections and prevent further infiltration of injection material into the storm water collection system, AECOM prepared and implemented a Storm Water Protection Plan before resuming injection activities. During the ISCO pilot study, a stormwater protection plan will be prepared and implemented, including:

- Continuous monitoring and documentation of the drainage swale for evidence of daylighting; and
- Installation of a temporary by-pass pipe in the drainage swale to divert influent stormwater through the injection area to prevent potential contact with daylighting injection material.

In the event daylighting is observed in the drainage swale, injection activities will stop and a berm will be installed until the resurfaced material can be removed from the swale using a trash pump and containerized. Berms will be left in place for the remainder of injection activities in the event additional injection material daylights through the same pathway. Following daylighting clean-up activities, injections activities will resume; however, the injection procedure will be modified to reduce daylighting, including reduction of flow rates, pressures, or the abandonment select injection points.

Additionally, AECOM will routinely monitor the porewater monitoring points installed in the drainage swale with a water quality meter for changes in shallow groundwater chemistry that could indicate imminent

injection material daylighting. Adjustments to the injection procedure or injection point locations will be evaluated if shallow groundwater beneath the drainage swale is impacted by injection material.

5.4 Access Agreements

As identified by the pilot study area shown in **Figure 4-1**, implementation of the ISCO pilot study will require access to several private properties. These include the Star Gas property (Tax Map ID: 134689-6162-05-042826-0000), the County of Dutchess right of way spur property (Tax Map ID: 134689-6162-05-011773-0000), and the Mid Hudson Business Park (Tax Map ID: 134689-6162-05-005836-0000). NYSDEC will be responsible for obtaining formal access to these properties and AECOM, PES and their subcontractors will be required to abide by the terms in the access agreements during all phases of work.

6. Schedule and Coordination

6.1 Proposed Schedule

The current milestone and daily schedules for the ISCO pilot study implementation are included below, along with the responsible party or parties. The full pilot study program is expected to take approximately one year to complete. PES and AECOM will keep NYSDEC apprised via e-mail correspondence and/or telephone calls of schedule changes as they develop.

Activity or Milestone	Estimated Date
PES - Confirm Field Schedule	March 28, 2023
PES - Procure Persulfate (Evonik) and Caustic (Evonik or other vendors)	April 2023
PES and AECOM - Mobilize and Begin Well and Porewater Sampling Point Installation; Collect Baseline Soil Samples	May 9 - May 12, 2023
EA and AECOM - Collect Baseline Groundwater Samples	Late April and Early May 2023
PES - Swale By-pass Construction	May 18 and 19, 2023
PES and AECOM - Mobilize and Begin ISCO Field Injections	May 22, 2023
PES and AECOM - Complete ISCO Field Injections	June 14, 2023
AECOM - Collect 1-Month Post-Injection Groundwater Samples	July 2023
AECOM - Collect 2-Month Post-Injection Groundwater Samples	August 2023
AECOM - Collect 3-Month Post-Injection Groundwater Samples	September 2023
PES and AECOM - Collect 6-Month Post-Injection Groundwater and Soil Samples	December 2023
AECOM - Submit Final Report	March 2024

Responsible Party	**7:30AM-8:00AM**	**8:00AM - 3:00PM**	**3:00PM-4:00PM**	**4:00PM - 5:30PM**	**5:30 - 8:00PM**
PES/ REGENESIS	Arrive on site; mobilization activities including H&S briefing, scope & schedule review; Equipment inspections; Prep. injection solutions	Move rig to injection location, advance probe and inject ISCO amendments	Remove equipment from Star Gas driveway; finish injection or break down and cap rods prior to 3PM arrival of trucks. Perform cleanup or QA/QC activities as needed until restart	Resume injections as practical and/or begin end-of-day activities; secure equipment & materials and manage IDW	Additional work window as needed depending on progress
AECOM	Attend H&S briefing, scope & schedule review; oversight of equipment inspections and injection solution prep.	Oversight of injections, monitoring of MWs and Pore Water wells			Additional oversight as necessary

Notes:

1) REGENESIS will be working 10 hour days (standard); targeting 7:30am start.

2) Construction activities permitted by noise ordinance between the hours of 7am and 8pm.

3) Road closure for access road at rear of the MHBP anticipated to be enforced during working days for the duration of injection activities beginning May 22nd.

6.2 Subcontractors

Implementation of the ISCO pilot study will require the following subcontracted services:

- Direct-Push Injections (PES/REGENESIS)
- Monitoring Well Installation (PES/Core Down Drilling, LLC)
- Injection Equipment and Labor (PES/REGENESIS)
- ISCO Amendment Supplier/Soil Analysis (SOD) (PES/Evonik Corporation/Evonik Active Oxygens, LLC)
- Analytical Laboratory – Soil VOCs and Groundwater (NYSDEC call-out laboratory, Pace Analytical)
- Waste Disposal (PES/subcontractor to be determined)
- Utility Clearance (AECOM/Enviroprobe Service, Inc.)
- Survey (PES/subcontractor to be determined)

6.3 Cost Estimate

A cost estimate for PES and its subcontractors as well as the NYSDEC call-out laboratory to implement the ISCO injection pilot study described in this work plan is provided in **Appendix C**.

7. References

AECOM, 2022a. Enhanced *In-Situ* Bioremediation Pilot Study Summary Report, Former Duso Chemical Site, Poughkeepsie, New York, NYSDEC Site No. 3-14-103. September 2022.

AECOM, 2022b. Summary of Bench-Scale Treatability Studies, Former Duso Chemical Site, Poughkeepsie, New York, NYSDEC Site No. 3-14-103. September 2022.

AECOM, 2022c. Site Management Plan, Former Duso Chemical Site, Poughkeepsie, New York, NYSDEC Site No. 3-14-103. October 2022.

AECOM, 2022d. Final Engineering Report, MHBP Treatment Area, Former Duso Chemical Site, Poughkeepsie, Dutchess County, New York, NYSDEC Site No. 314103. December 2022.

Chazen Environmental Services, Inc. 1998. Supplemental Remedial Investigation, Poughkeepsie, New York. February 1998.

NYSDEC, 2008. Record of Decision, Duso Site, Poughkeepsie, Dutchess County, New York, Site Number 3-14-103. March 2008.

O'Brien & Gere, 2007a. Remedial Investigation, Duso Site, Poughkeepsie, New York. August 2007.

O'Brien & Gere, 2007b. Feasibility Study, Duso Site, NYSDEC. November 2007.

Tables

Table 4-1
Proposed Injection Material Quantities
ISCO Pilot Test Work Plan
Former Duso Chemical Site
Poughkeepsie, New York

Description		Volume (gal)	Mass (lbs)
Injection Quantities Per 1-ft Interval	Reagent Slurry	24	358
	NaOH Solution	11	117
	Total	35	475
Injection Quantities Per Point	Reagent Slurry	485	7,157
	NaOH Solution	220	2,333
	Total	706	9,491
Total Injection Event Quantities	Reagent Slurry	7,767	114,517
	NaOH Solution	3,522	37,333
	Total	11,289	151,851

Notes and Abbreviations:

1. Reagent slurry to include a mixture of Klozur KP (potassium persulfate), Klozur SP (sodium persulfate), hydrated lime, and water.

2. NaOH solution is 25% w/w.

3. Total injection event quantities are estimates assuming 16 total injection points with injection intervals between 5 and 25 ft bgs.

% w/w - Percent by weight
ft bgs - feet below ground surface
gal - gallons
lbs- pounds
NaOH - Sodium hydroxide

Table 4-2
Pilot Test Area Well Construction Details
ISCO Pilot Test Work Plan
Former Duso Chemical Site
Poughkeepsie, New York

Well ID	Proposed/Existing	Well Location	Well Construction	Total Depth (ft bgs)	Screen Length (ft)	Screened Interval (ft bgs)		
Shallow Monitoring Wells								
BIW-1S	Existing	Duso Site	2" Sch 40 PVC	16	10	6	-	16
BIW-5S	Existing	Duso Site	2" Sch 40 PVC	12	7	5	-	12
MHBP-11	Existing	MHBP Treatment Area	2" Sch 40 PVC	20	10	10	-	20
MHBP-12	Existing	MHBP Treatment Area	2" Sch 40 PVC	20	10	10	-	20
MHC-23	Existing	Duso Site	2" Sch 40 PVC	13	10	3	-	13
MHC-26	Existing	Duso Site	2" Sch 40 PVC	13	10	3	-	13
PMW-1S	Proposed	Duso Site	2" Sch 40 PVC	15	5	10	-	15
PMW-2S	Proposed	Duso Site	2" Sch 40 PVC	15	5	10	-	15
Deep Monitoring Wells								
BIW-1D	Existing	Duso Site	2" Sch 40 PVC	26	7	19	-	26
BIW-5D	Existing	Duso Site	2" Sch 40 PVC	20	5	15	-	20
PMW-1D	Proposed	Duso Site	2" Sch 40 PVC	25	5	20	-	25
PMW-2D	Proposed	Duso Site	2" Sch 40 PVC	25	5	20	-	25

Notes
ft - feet
ft bgs - feet below ground surface
PVC - poly vinyl chloride
sch - schedule

Table 4-3
Proposed Performance Monitoring Plan
ISCO Pilot Test Work Plan
Former Duso Chemical Site
Poughkeepsie, New York

Sampling Parameter	Baseline	Month 1	Month 2	Month 3	Month 6
Water Quality Parameters					
Dissolved Oxygen	x	x	x	x	x
Oxidation Reduction Potential	x	x	x	x	x
pH	x	x	x	x	x
Temperature	x	x	x	x	x
Specific Conductance	x	x	x	x	x
Laboratory Analytical Samples					
VOCs	x	x	x	x	x
TOC	x				x
Sulfate	x	x	x	x	x
TPH	x				x
Iron	x				x
Alkalinity	x				x
Soil oxidant demand and VOCs (Evonik)	x				x

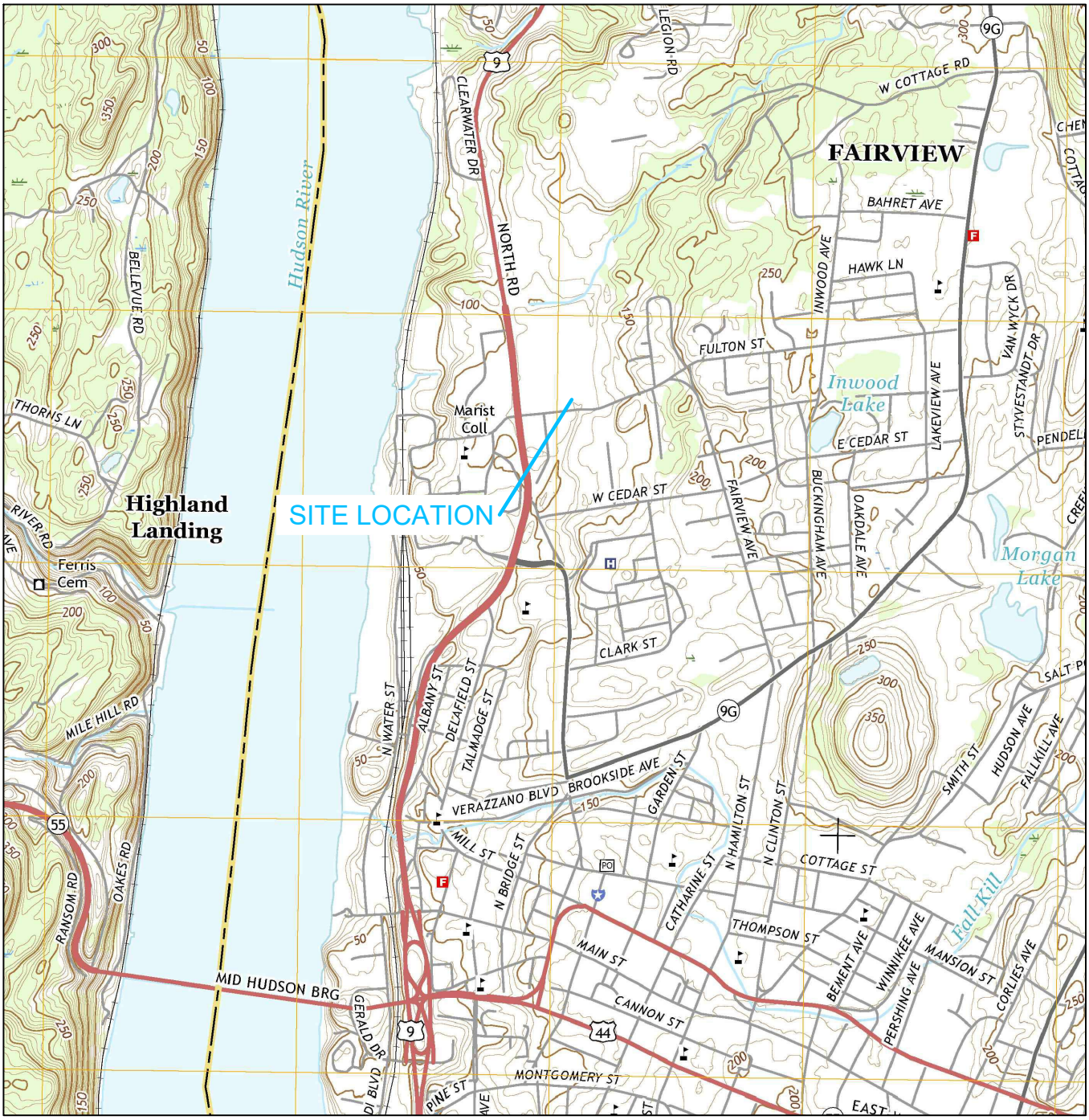
Notes and Abbreviations:

1. Pilot test performance monitoring samples will be collected from the following wells:
BIW-1S/D, BIW-5S/D, MHC-23, MHC-26, PMW-1S/D, PMW-2S/D

TOC - Total Organic Compounds
TPH - Total Petroleium Hydrocarbons
VOCs - Volatile Organic Compounds

Figures

Last saved by: SPLAWNM(2022-03-29) Last Plotted: 2022-03-29 Project Management Initials: Designer:_____ Checked:_____ Approved:_____ ANSI A 8.5" x 11"
Filename: \\NA.AECOMNET.COM\LFS\AMER\GREENVILLE-USGRN1\LEGACY\GROUP\EARTH\LATHAM NY WORK\NYSDEC FORMER DUSO CHEM SITE\SITE LOCATION MAP\FIGURE 1-1 - SITE LOCATION MAP.DWG



0' 2000' 4000'

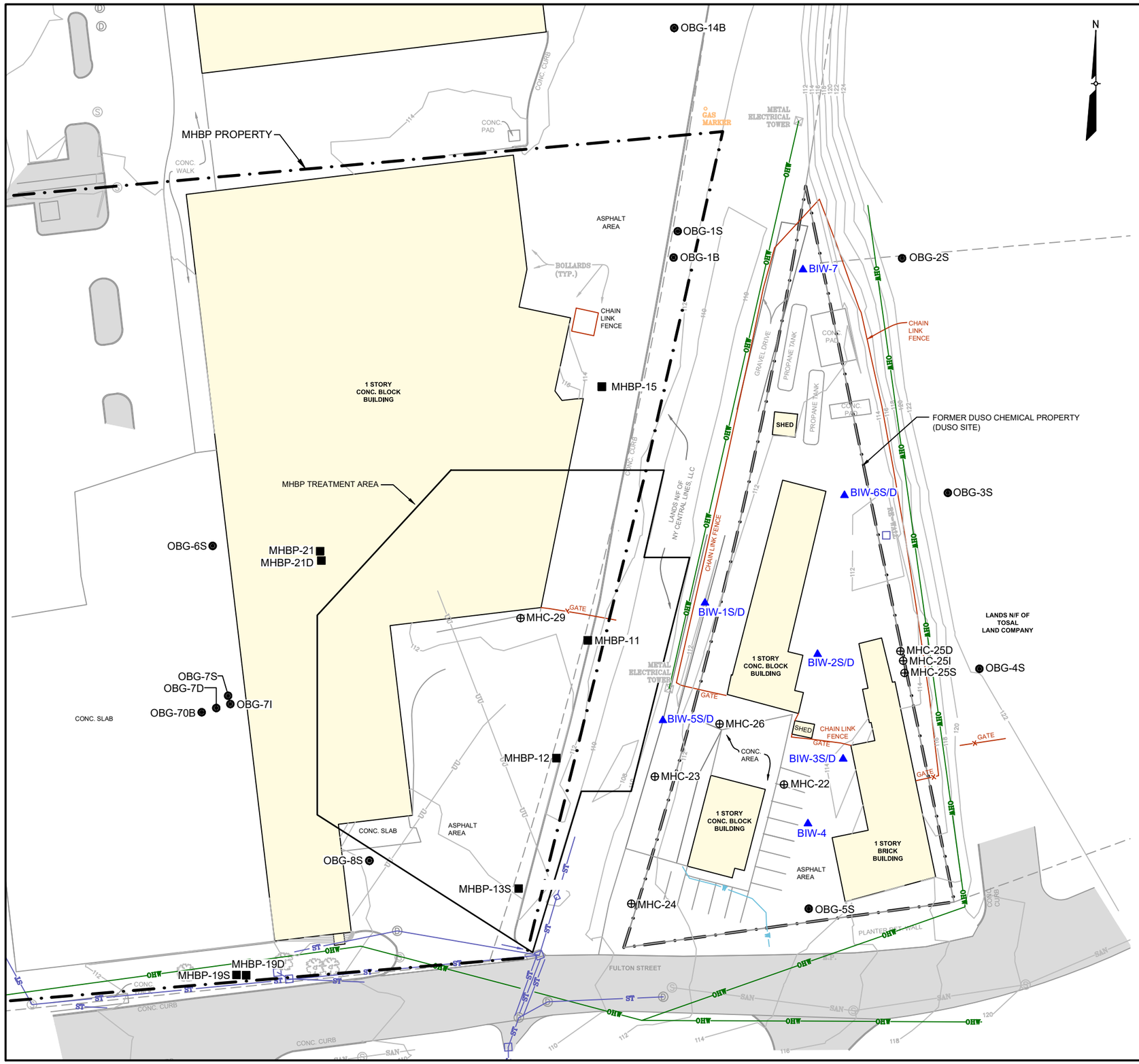
NOTE: MAP DERIVED FROM U.S.G.S. 7.5 MINUTE TOPOGRAPHIC QUADRANGLE, POUGHKEEPSIE, NY, DATED 2016.

FORMER DUSO CHEMICAL FACILITY
FULTON STREET AND NORTH ROAD
POUGHKEEPSIE, NEW YORK
Project No.: 60647169 Date: 2022/03/28

SITE LOCATION MAP

AECOM

Figure: 1-1



LEGEND

- BIW-1S/D ▲ BIOREMEDIATION INJECTION WELL LOCATION (2012)
- OBG-2S ⊙ O'BRIEN & GERE WELL LOCATION (2005 & 2007) (APPROXIMATE)
- MHBP-11 ■ MID-HUDSON BUSINESS PARK WELL LOCATION (1993-1994, 2015)
- MHC-30 ⊕ WELL LOCATION (1990s)
- CATCH BASIN
- MANHOLES
- TREES
- BUILDING
- ROAD / PAVEMENT
- TOPOGRAPHIC CONTOURS
- PROPERTY BOUNDARY
- FENCE (APPROXIMATE)
- PARCEL BOUNDARY
- OVERHEAD WIRES
- UNDERGROUND WATER
- SANITARY SEWER LINE
- STORMWATER LINE
- UNKNOWN UNDERGROUND UTILITIES
- UNDERGROUND GAS
- MHBP TREATMENT AREA (APPROXIMATE IC BOUNDARIES)
- DUSO SITE BOUNDARY (APPROXIMATE IC BOUNDARIES)

0 55 110

SCALE IN FEET

SOURCE: - BASEMAP WAS PROVIDED BY S.Y. KIM LAND SURVEYOR, JOB NO: 5D-316-11, AUGUST 16, 2011.
- MHBP AND MHC WELL LOCATIONS FROM COORDINATES IN GROUNDWATER SAMPLING FIELD SHEET SUMMARY SPREADSHEET, PROVIDED BY CHAZEN.

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FIGURE 2-1
SITE PLAN AND MONITORING WELL LOCATIONS

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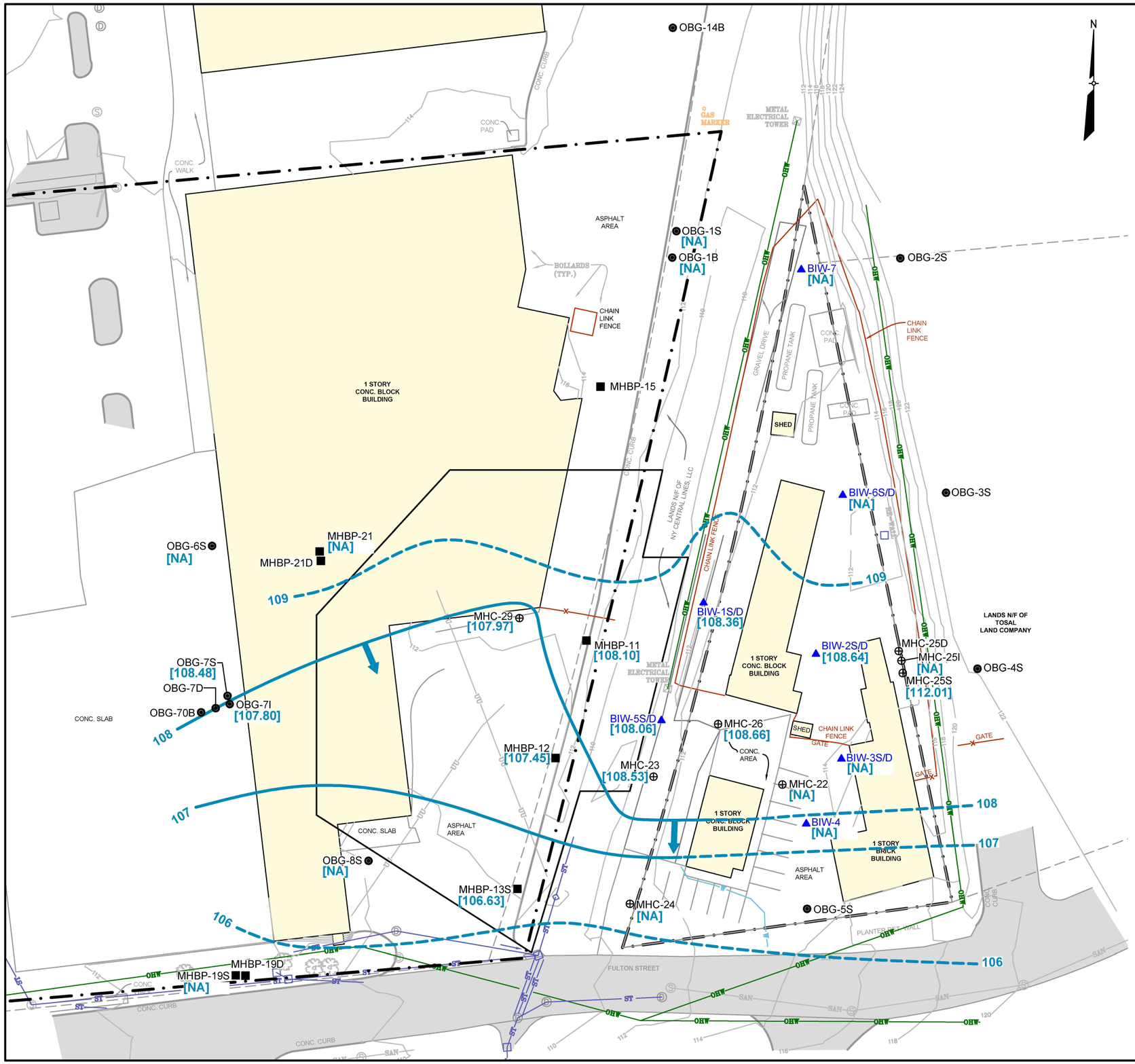
POUGHKEEPSIE, DUTCHESS COUNTY, NEW YORK

MARCH 2022 60647169



LEGEND

- BIW-1S/D ▲ NESTED BIOREMEDIATION INJECTION WELL LOCATION (2012)
- OBG-2S ● O'BRIEN & GERE WELL LOCATION (2005 & 2007) (APPROXIMATE)
- MHBP-11 ■ MID-HUDSON BUSINESS PARK WELL LOCATION (1993-1994, 2015)
- MHC-30 ⊕ WELL LOCATION (1990s)
- CATCH BASIN
- MANHOLES
- TREES
- GROUNDWATER FLOW DIRECTION
- [107.26] GROUNDWATER CONTOUR (FT. ABOVE MEAN SEA LEVEL) (DASHED WHERE INFERRED)
- [NA] NOT AVAILABLE
- BUILDING
- ROAD / PAVEMENT
- TOPOGRAPHIC CONTOURS
- PROPERTY BOUNDARY
- FENCE (APPROXIMATE)
- PARCEL BOUNDARY
- OVERHEAD WIRES
- UNDERGROUND WATER
- SANITARY SEWER LINE
- STORMWATER LINE
- UNKNOWN UNDERGROUND UTILITIES
- MHBP TREATMENT AREA (APPROXIMATE IC BOUNDARIES)
- DUSO SITE BOUNDARY (APPROXIMATE IC BOUNDARIES)

* MHC-25S NOT CONTOURED, OUTLIER

0 55 110

SCALE IN FEET

SOURCE: - BASEMAP WAS PROVIDED BY S.Y. KIM LAND SURVEYOR, JOB NO: 5D-316-11, AUGUST 16, 2011.
- MHBP AND MHC WELL LOCATIONS FROM COORDINATES IN GROUNDWATER SAMPLING FIELD SHEET SUMMARY SPREADSHEET, PROVIDED BY CHAZEN.

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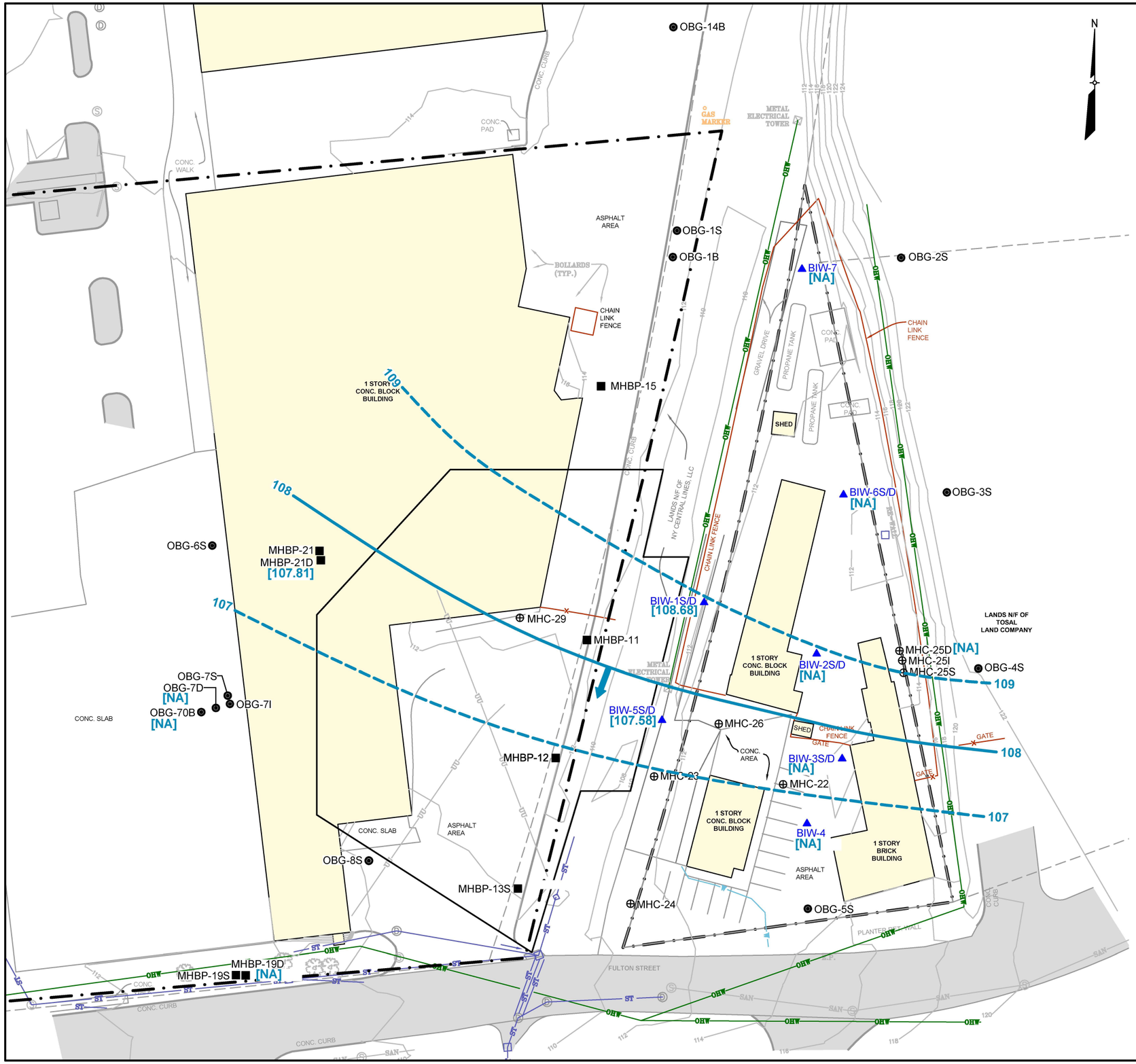
FIGURE 2-2
GROUNDWATER ELEVATION CONTOUR MAP SHALLOW MONITORING WELLS NOVEMBER 1, 2021

FORMER DUSO CHEMICAL FACILITY
FULTON STREET AND NORTH ROAD
POUGHKEEPSIE, DUTCHESS COUNTY, NEW YORK

MARCH 2022 60647169



LEGEND

- BIW-1S/D ▲ NESTED BIOREMEDIATION INJECTION WELL LOCATION (2012)
- OBG-2S ● O'BRIEN & GERE WELL LOCATION (2005 & 2007) (APPROXIMATE)
- MHBP-11 ■ MID-HUDSON BUSINESS PARK WELL LOCATION (1993-1994, 2015)
- MHC-30 ⊕ WELL LOCATION (1990s)
- CATCH BASIN
- MANHOLES
- TREES
- GROUNDWATER FLOW DIRECTION
- [106.83] GROUNDWATER CONTOUR (FT. ABOVE MEAN SEA LEVEL) (DASHED WHERE INFERRED)
- [NA] NOT AVAILABLE
- BUILDING
- ROAD / PAVEMENT
- TOPOGRAPHIC CONTOURS
- PROPERTY BOUNDARY
- FENCE (APPROXIMATE)
- PARCEL BOUNDARY
- OVERHEAD WIRES
- UNDERGROUND WATER
- SANITARY SEWER LINE
- STORMWATER LINE
- UNKNOWN UNDERGROUND UTILITIES
- MHBP TREATMENT AREA (APPROXIMATE IC BOUNDARIES)
- DUSO SITE BOUNDARY (APPROXIMATE IC BOUNDARIES)

N

0 55 110

SCALE IN FEET

SOURCE: - BASEMAP WAS PROVIDED BY S.Y. KIM LAND SURVEYOR, JOB NO: 5D-316-11, AUGUST 16, 2011.
- MHBP AND MHC WELL LOCATIONS FROM COORDINATES IN GROUNDWATER SAMPLING FIELD SHEET SUMMARY SPREADSHEET, PROVIDED BY CHAZEN.

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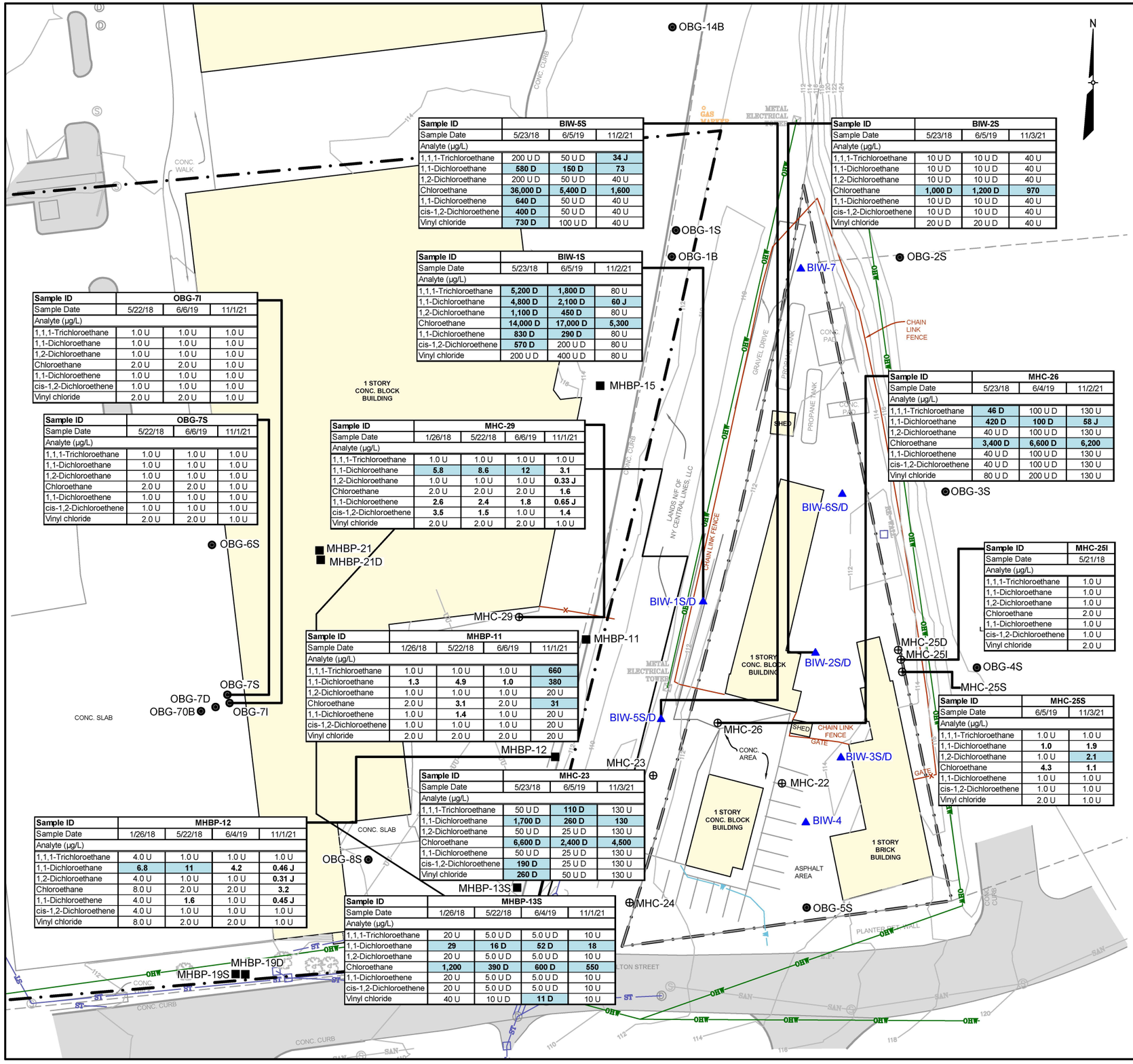
FIGURE 2-3
GROUNDWATER ELEVATION CONTOUR MAP
DEEP MONITORING WELLS
NOVEMBER 1, 2021

FORMER DUSO CHEMICAL FACILITY
FULTON STREET AND NORTH ROAD
POUGHKEEPSIE, DUTCHESS COUNTY, NEW YORK

MARCH 2022 60647169



Sample ID	BIW-5S		
Sample Date	5/23/18	6/5/19	11/2/21
Analyte (µg/L)			
1,1,1-Trichloroethane	200 U D	50 U D	**34 J**
1,1-Dichloroethane	**580 D**	**150 D**	**73**
1,2-Dichloroethane	200 U D	50 U D	40 U
Chloroethane	**36,000 D**	**5,400 D**	**1,600**
1,1-Dichloroethene	**640 D**	50 U D	40 U
cis-1,2-Dichloroethene	**400 D**	50 U D	40 U
Vinyl chloride	**730 D**	100 U D	40 U

Sample ID	BIW-2S		
Sample Date	5/23/18	6/5/19	11/3/21
Analyte (µg/L)			
1,1,1-Trichloroethane	10 U D	10 U D	40 U
1,1-Dichloroethane	10 U D	10 U D	40 U
1,2-Dichloroethane	10 U D	10 U D	40 U
Chloroethane	**1,000 D**	**1,200 D**	**970**
1,1-Dichloroethene	10 U D	10 U D	40 U
cis-1,2-Dichloroethene	10 U D	10 U D	40 U
Vinyl chloride	20 U D	20 U D	40 U

Sample ID	BIW-1S		
Sample Date	5/23/18	6/5/19	11/2/21
Analyte (µg/L)			
1,1,1-Trichloroethane	**5,200 D**	**1,800 D**	80 U
1,1-Dichloroethane	**4,800 D**	**2,100 D**	**60 J**
1,2-Dichloroethane	**1,100 D**	**450 D**	80 U
Chloroethane	**14,000 D**	**17,000 D**	**5,300**
1,1-Dichloroethene	**830 D**	**290 D**	80 U
cis-1,2-Dichloroethene	**570 D**	200 U D	80 U
Vinyl chloride	200 U D	400 U D	80 U

Sample ID	OBG-7I		
Sample Date	5/22/18	6/6/19	11/1/21
Analyte (µg/L)			
1,1,1-Trichloroethane	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0 U	1.0 U	1.0 U
Chloroethane	2.0 U	2.0 U	1.0 U
1,1-Dichloroethene	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	1.0 U	1.0 U	1.0 U
Vinyl chloride	2.0 U	2.0 U	1.0 U

Sample ID	OBG-7S		
Sample Date	5/22/18	6/6/19	11/1/21
Analyte (µg/L)			
1,1,1-Trichloroethane	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0 U	1.0 U	1.0 U
Chloroethane	2.0 U	2.0 U	1.0 U
1,1-Dichloroethene	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	1.0 U	1.0 U	1.0 U
Vinyl chloride	2.0 U	2.0 U	1.0 U

Sample ID	MHC-29			
Sample Date	1/26/18	5/22/18	6/6/19	11/1/21
Analyte (µg/L)				
1,1,1-Trichloroethane	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**5.8**	**8.6**	**12**	**3.1**
1,2-Dichloroethane	1.0 U	1.0 U	1.0 U	**0.33 J**
Chloroethane	2.0 U	2.0 U	2.0 U	**1.6**
1,1-Dichloroethene	**2.6**	**2.4**	**1.8**	**0.65 J**
cis-1,2-Dichloroethene	**3.5**	**1.5**	1.0 U	**1.4**
Vinyl chloride	2.0 U	2.0 U	2.0 U	1.0 U

Sample ID	MHC-26		
Sample Date	5/23/18	6/4/19	11/2/21
Analyte (µg/L)			
1,1,1-Trichloroethane	**46 D**	100 U D	130 U
1,1-Dichloroethane	**420 D**	**100 D**	**58 J**
1,2-Dichloroethane	40 U D	100 U D	130 U
Chloroethane	**3,400 D**	**6,600 D**	**6,200**
1,1-Dichloroethene	40 U D	100 U D	130 U
cis-1,2-Dichloroethene	40 U D	100 U D	130 U
Vinyl chloride	80 U D	200 U D	130 U

Sample ID	MHBP-11			
Sample Date	1/26/18	5/22/18	6/6/19	11/1/21
Analyte (µg/L)				
1,1,1-Trichloroethane	1.0 U	1.0 U	1.0 U	**660**
1,1-Dichloroethane	**1.3**	**4.9**	**1.0**	**380**
1,2-Dichloroethane	1.0 U	1.0 U	1.0 U	20 U
Chloroethane	2.0 U	**3.1**	2.0 U	**31**
1,1-Dichloroethene	1.0 U	**1.4**	1.0 U	20 U
cis-1,2-Dichloroethene	1.0 U	1.0 U	1.0 U	20 U
Vinyl chloride	2.0 U	2.0 U	2.0 U	20 U

Sample ID	MHC-23		
Sample Date	5/23/18	6/5/19	11/3/21
Analyte (µg/L)			
1,1,1-Trichloroethane	50 U D	**110 D**	130 U
1,1-Dichloroethane	**1,700 D**	**260 D**	**130**
1,2-Dichloroethane	50 U D	25 U D	130 U
Chloroethane	**6,600 D**	**2,400 D**	**4,500**
1,1-Dichloroethene	50 U D	25 U D	130 U
cis-1,2-Dichloroethene	**190 D**	25 U D	130 U
Vinyl chloride	**260 D**	50 U D	130 U

Sample ID	MHBP-12			
Sample Date	1/26/18	5/22/18	6/4/19	11/1/21
Analyte (µg/L)				
1,1,1-Trichloroethane	4.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**6.8**	**11**	**4.2**	**0.46 J**
1,2-Dichloroethane	4.0 U	1.0 U	1.0 U	**0.31 J**
Chloroethane	8.0 U	2.0 U	2.0 U	**3.2**
1,1-Dichloroethene	4.0 U	**1.6**	1.0 U	**0.45 J**
cis-1,2-Dichloroethene	4.0 U	1.0 U	1.0 U	1.0 U
Vinyl chloride	8.0 U	2.0 U	2.0 U	1.0 U

Sample ID	MHBP-13S			
Sample Date	1/26/18	5/22/18	6/4/19	11/1/21
Analyte (µg/L)				
1,1,1-Trichloroethane	20 U	5.0 U D	5.0 U D	10 U
1,1-Dichloroethane	**29**	**16 D**	**52 D**	**18**
1,2-Dichloroethane	20 U	5.0 U D	5.0 U D	10 U
Chloroethane	**1,200**	**390 D**	**600 D**	**550**
1,1-Dichloroethene	20 U	5.0 U D	5.0 U D	10 U
cis-1,2-Dichloroethene	20 U	5.0 U D	5.0 U D	10 U
Vinyl chloride	40 U	10 U D	**11 D**	10 U

Sample ID	MHC-25I
Sample Date	5/21/18
Analyte (µg/L)	
1,1,1-Trichloroethane	1.0 U
1,1-Dichloroethane	1.0 U
1,2-Dichloroethane	1.0 U
Chloroethane	2.0 U
1,1-Dichloroethene	1.0 U
cis-1,2-Dichloroethene	1.0 U
Vinyl chloride	2.0 U

Sample ID	MHC-25S	
Sample Date	6/5/19	11/3/21
Analyte (µg/L)		
1,1,1-Trichloroethane	1.0 U	1.0 U
1,1-Dichloroethane	**1.0**	**1.9**
1,2-Dichloroethane	1.0 U	**2.1**
Chloroethane	**4.3**	**1.1**
1,1-Dichloroethene	1.0 U	1.0 U
cis-1,2-Dichloroethene	1.0 U	1.0 U
Vinyl chloride	2.0 U	1.0 U

LEGEND

- BIW-1S/D ▲ NESTED BIOREMEDIATION INJECTION WELL LOCATION (2012)
- OBG-2S ● O'BRIEN & GERE WELL LOCATION (2005 & 2007) (APPROXIMATE)
- MHBP-11 ■ MID-HUDSON BUSINESS PARK WELL LOCATION (1993-1994, 2015)
- MHC-30 ⊕ WELL LOCATION (1990s)
- CATCH BASIN
- MANHOLES
- TREES
- BUILDING
- ROAD / PAVEMENT
- TOPOGRAPHIC CONTOURS
- PROPERTY BOUNDARY
- FENCE (APPROXIMATE)
- PARCEL BOUNDARY
- OVERHEAD WIRES
- UNDERGROUND WATER
- SANITARY SEWER LINE
- STORMWATER LINE
- UNKNOWN UNDERGROUND UTILITIES
- MHBP TREATMENT AREA (APPROXIMATE IC BOUNDARIES)
- DUSO SITE BOUNDARY (APPROXIMATE IC BOUNDARIES)

VOCs VOLATILE ORGANIC COMPOUNDS

ND NOT DETECTED

µg/L MICROGRAMS PER LITER

D THE REPORTED VALUE IS FROM A SECONDARY DILUTION ANALYSIS FACTOR.

J THE CONCENTRATION GIVEN IS AN APPROXIMATE VALUE.

RESULTS IN **BOLD** WERE DETECTED AT A CONCENTRATION GREATER THAN OR EQUAL TO THE METHOD DETECTION LIMIT (MDL).

RESULTS IN **BOLD** AND SHADED IN BLUE WERE DETECTED AT A CONCENTRATION GREATER THAN NEW YORK STATE AMBIENT WATER QUALITY STANDARDS (AWQS) OR GUIDANCE VALUES (GV).

0 55 110

SCALE IN FEET

SOURCE: - BASEMAP WAS PROVIDED BY S.Y. KIM LAND SURVEYOR, JOB NO: 5D-316-11, AUGUST 16, 2011.
- MHBP AND MHC WELL LOCATIONS FROM COORDINATES IN GROUNDWATER SAMPLING FIELD SHEET SUMMARY SPREADSHEET, PROVIDED BY CHAZEN.

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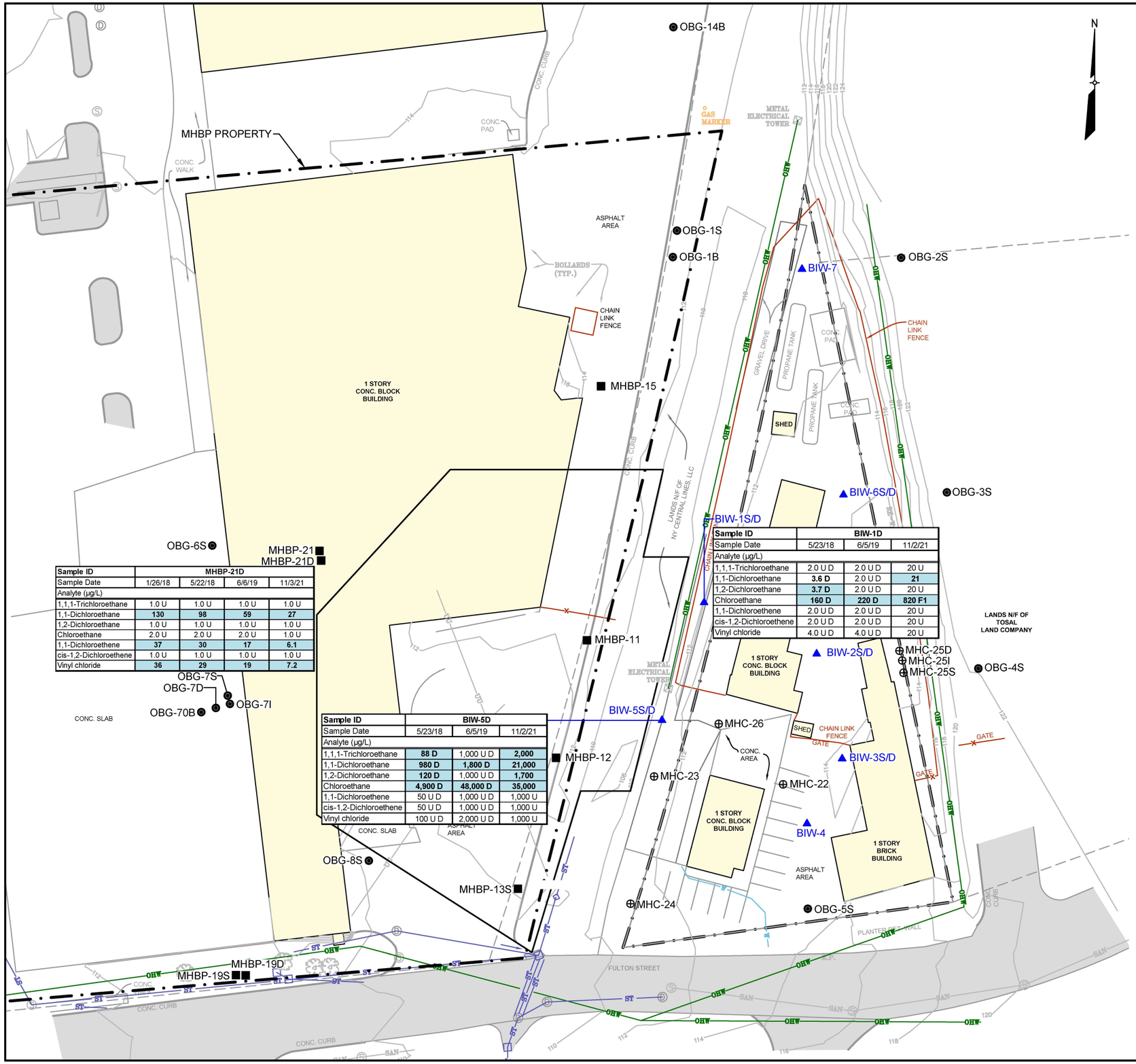
FIGURE 3-1
SITE-RELATED VOCs IN GROUNDWATER SHALLOW MONITORING WELLS 2018-2021

FORMER DUSO CHEMICAL FACILITY
FULTON STREET AND NORTH ROAD
POUGHKEEPSIE, DUTCHESS COUNTY, NEW YORK

MARCH 2022 60647169



Sample ID	MHBP-21D			
Sample Date	1/26/18	5/22/18	6/6/19	11/3/21
Analyte (µg/L)				
1,1,1-Trichloroethane	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**130**	**98**	**59**	**27**
1,2-Dichloroethane	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	2.0 U	2.0 U	2.0 U	1.0 U
1,1-Dichloroethene	**37**	**30**	**17**	**6.1**
cis-1,2-Dichloroethene	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl chloride	**36**	**29**	**19**	**7.2**

Sample ID	BIW-5D		
Sample Date	5/23/18	6/5/19	11/2/21
Analyte (µg/L)			
1,1,1-Trichloroethane	**88 D**	1,000 U D	**2,000**
1,1-Dichloroethane	**980 D**	**1,800 D**	**21,000**
1,2-Dichloroethane	**120 D**	1,000 U D	**1,700**
Chloroethane	**4,900 D**	**48,000 D**	**35,000**
1,1-Dichloroethene	50 U D	1,000 U D	1,000 U
cis-1,2-Dichloroethene	50 U D	1,000 U D	1,000 U
Vinyl chloride	100 U D	2,000 U D	1,000 U

Sample ID	BIW-1D		
Sample Date	5/23/18	6/5/19	11/2/21
Analyte (µg/L)			
1,1,1-Trichloroethane	2.0 U D	2.0 U D	20 U
1,1-Dichloroethane	**3.6 D**	2.0 U D	**21**
1,2-Dichloroethane	**3.7 D**	2.0 U D	20 U
Chloroethane	**160 D**	**220 D**	**820 F1**
1,1-Dichloroethene	2.0 U D	2.0 U D	20 U
cis-1,2-Dichloroethene	2.0 U D	2.0 U D	20 U
Vinyl chloride	4.0 U D	4.0 U D	20 U

LEGEND

- BIW-1S/D ▲ NESTED BIOREMEDIATION INJECTION WELL LOCATION (2012)
- OBG-2S ● O'BRIEN & GERE WELL LOCATION (2005 & 2007) (APPROXIMATE)
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- MANHOLES
- TREES
- BUILDING
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- PROPERTY BOUNDARY
- FENCE (APPROXIMATE)
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- SANITARY SEWER LINE
- STORMWATER LINE
- UNKNOWN UNDERGROUND UTILITIES
- MHBP TREATMENT AREA (APPROXIMATE IC BOUNDARIES)
- DUSO SITE BOUNDARY (APPROXIMATE IC BOUNDARIES)

VOCs VOLATILE ORGANIC COMPOUNDS

ND NOT DETECTED

µg/L MICROGRAMS PER LITER

D THE REPORTED VALUE IS FROM A SECONDARY DILUTION ANALYSIS FACTOR.

J THE CONCENTRATION GIVEN IS AN APPROXIMATE VALUE.

RESULTS IN **BOLD** WERE DETECTED AT A CONCENTRATION GREATER THAN OR EQUAL TO THE METHOD DETECTION LIMIT (MDL).

RESULTS IN **BOLD** AND SHADED IN BLUE WERE DETECTED AT A CONCENTRATION GREATER THAN NEW YORK STATE AMBIENT WATER QUALITY STANDARDS (AWQS) OR GUIDANCE VALUES (GV).

0 55 110

SCALE IN FEET

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FIGURE 3-2
SITE-RELATED VOCs IN GROUNDWATER DEEP MONITORING WELLS 2018-2021

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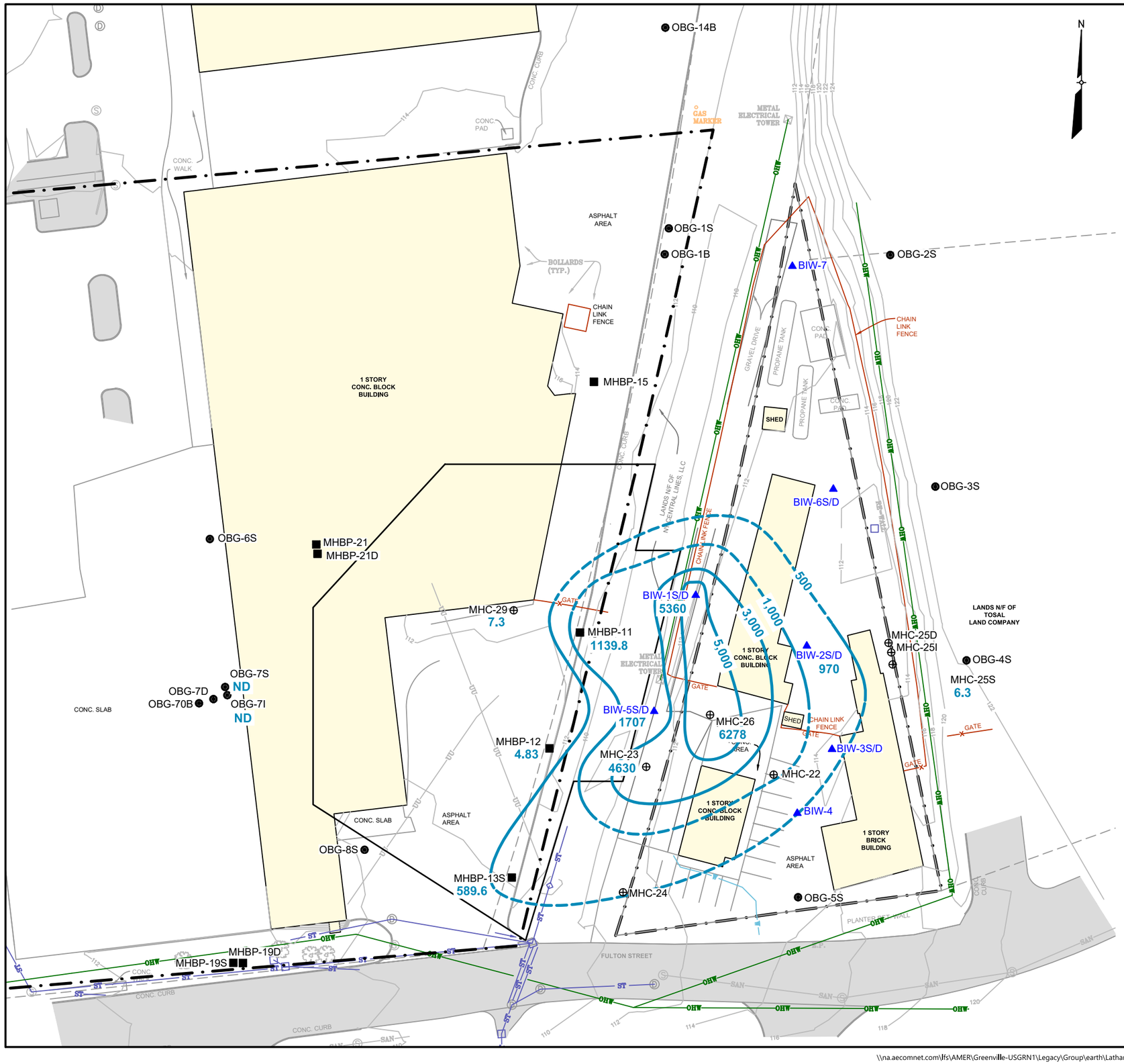
MARCH 2022 60647169



LEGEND

- BIW-1S/D ▲ BIOREMEDIATION INJECTION WELL LOCATION (2012)
- OBG-2S ● O'BRIEN & GERE WELL LOCATION (2005 & 2007) (APPROXIMATE)
- MHBP-11 ■ MID-HUDSON BUSINESS PARK WELL LOCATION (1993-1994, 2015)
- MHC-30 ⊕ WELL LOCATION (1990s)
- CATCH BASIN
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- BUILDING
- ROAD / PAVEMENT
- TOPOGRAPHIC CONTOURS
- PROPERTY BOUNDARY
- FENCE (APPROXIMATE)
- PARCEL BOUNDARY
- OVERHEAD WIRES
- UNDERGROUND WATER
- SANITARY SEWER LINE
- STORMWATER LINE
- UNKNOWN UNDERGROUND UTILITIES
- MHBP TREATMENT AREA (APPROXIMATE IC BOUNDARIES)
- DUSO SITE BOUNDARY (APPROXIMATE IC BOUNDARIES)
- TOTAL VOC ISOCONCENTRATION CONTOUR (DASHED WHERE INFERRED)
- 5360 RESULTS ARE PRESENTED IN MICROGRAMS PER LITER
- ND NON DETECT

0 55 110

SCALE IN FEET

SOURCE: - BASEMAP WAS PROVIDED BY S.Y. KIM LAND SURVEYOR, JOB NO: 5D-316-11, AUGUST 16, 2011.
- MHBP AND MHC WELL LOCATIONS FROM COORDINATES IN GROUNDWATER SAMPLING FIELD SHEET SUMMARY SPREADSHEET, PROVIDED BY CHAZEN.

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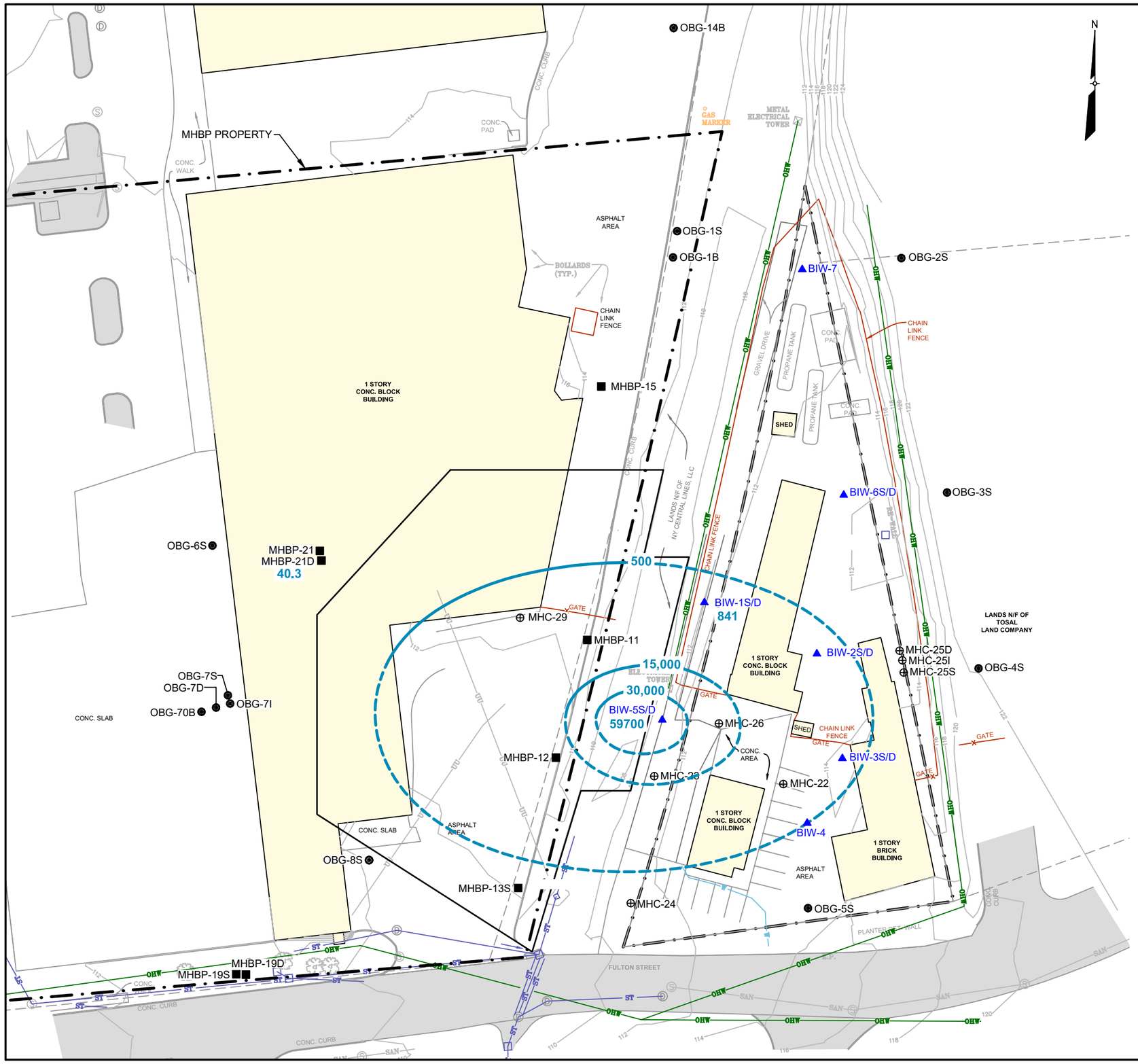
FIGURE 3-3
TOTAL VOC ISOCONCENTRATIONS - NOVEMBER 2021
SHALLOW MONITORING WELLS

FORMER DUSO CHEMICAL FACILITY
FULTON STREET AND NORTH ROAD
POUGHKEEPSIE, DUTCHESS COUNTY, NEW YORK

APRIL 2022 60647169

\\na.aecomnet.com\lfs\AMER\Greenville-USGRN1\Legacy\Group\earth\Latham NY Work\NYSDEC Former Duso Chem Site\60279080_096 Total VOC Isoconcentrations - Nov2021_Shallow MWs.dwg, 4/29/2022 12:30:06 PM, DWG To PDF.pc3



LEGEND

- BIW-1S/D ▲ BIOREMEDIATION INJECTION WELL LOCATION (2012)
- OBG-2S ● O'BRIEN & GERE WELL LOCATION (2005 & 2007) (APPROXIMATE)
- MHBP-11 ■ MID-HUDSON BUSINESS PARK WELL LOCATION (1993-1994, 2015)
- MHC-30 ⊕ WELL LOCATION (1990s)
- CATCH BASIN
- MANHOLES
- TREES
- BUILDING
- ROAD / PAVEMENT
- TOPOGRAPHIC CONTOURS
- PROPERTY BOUNDARY
- FENCE (APPROXIMATE)
- PARCEL BOUNDARY
- OVERHEAD WIRES
- UNDERGROUND WATER
- SANITARY SEWER LINE
- STORMWATER LINE
- UNKNOWN UNDERGROUND UTILITIES
- MHBP TREATMENT AREA (APPROXIMATE IC BOUNDARIES)
- DUSO SITE BOUNDARY (APPROXIMATE IC BOUNDARIES)
- TOTAL VOC ISOCONCENTRATION CONTOUR (DASHED WHERE INFERRED)
- 841 RESULTS ARE PRESENTED IN MICROGRAMS PER LITER

0 55 110

SCALE IN FEET

SOURCE: - BASEMAP WAS PROVIDED BY S.Y. KIM LAND SURVEYOR, JOB NO: 5D-316-11, AUGUST 16, 2011.
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FIGURE 3-4
TOTAL VOC ISOCONCENTRATIONS - NOVEMBER 2021
DEEP MONITORING WELLS

FORMER DUSO CHEMICAL FACILITY
FULTON STREET AND NORTH ROAD
POUGHKEEPSIE, DUTCHESS COUNTY, NEW YORK

APRIL 2022 60647169

LEGEND

- PROPOSED ISCO INJECTION POINT LOCATION
- PMW-1S/D — PROPOSED SHALLOW AND DEEP MONITORING WELL PAIR
- PROPOSED PORE WATER MONITORING POINT
- PROPOSED SOIL BORING LOCATION
- MANHOLES
- PROPERTY BOUNDARY
- FENCE (APPROXIMATE)
- PARCEL BOUNDARY
- OVERHEAD WIRES
- UNDERGROUND WATER
- SANITARY SEWER LINE
- STORMWATER LINE
- UNKNOWN UNDERGROUND UTILITIES
- MHBP TREATMENT AREA (APPROXIMATE IC BOUNDARIES)
- DUSO SITE BOUNDARY (APPROXIMATE IC BOUNDARIES)
- METAL ELECTRICAL TOWER

0 40 80

SCALE IN FEET

SOURCE: - BASEMAP WAS PROVIDED BY S.Y. KIM LAND SURVEYOR, JOB NO: 5D-316-11, AUGUST 16, 2011.
- MHBP AND MHC WELL LOCATIONS FROM COORDINATES IN GROUNDWATER SAMPLING FIELD SHEET SUMMARY SPREADSHEET, PROVIDED BY CHAZEN.

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FIGURE 4-1
PROPOSED ISCO PILOT TEST WORK LOCATIONS

FORMER DUSO CHEMICAL FACILITY
FULTON STREET AND NORTH ROAD
POUGHKEEPSIE, DUTCHESS COUNTY, NEW YORK

MAY 2023 60647169

Appendix A – Injection Quantity Calculations

Appendix A
Proposed Injection Material Quantity Calculations
ISCO Pilot Test Work Plan
Former Duso Chemical Site
Poughkeepsie, New York

		Units	15-ft injection interval, 10 points	20-ft injection interval, 16 points
Injection Design	Solid Mass per unit length	lbs/ft	179	179
	Number of injection points	--	10	16
	Injection Point spacing	ft	9.7	15
	Injection Interval	ft	15	20
Slurry (KP, SP, and Lime)	Injection Volume per Point	gal	364	485
	Injection Volume per unit length	gal/ft	24.3	24.3
	Injection Volume	gal	3,641	7,767
NaOH Solution	Injection Volume per Point	gal	165	220
	Injection Volume per unit length	gal/ft	11	11
	Injection Volume	gal	1,651	3,522

	Units	15-ft injection interval, 10 points	20-ft injection interval, 16 points
Klozur KP	lbs/ft	129	129
	lbs/point	1,934	2,579
	total lbs	19,340	41,259
Hydrated Lime	lbs/ft	50	50
	lbs/point	750	1,000
	total lbs	7,500	16,000
Klozur SP	lbs/ft	82	82
	lbs/point	1,223	1,631
	total lbs	12,232	26,095
25% NaOH Solution	lbs/ft	117	117
	lbs/point	1,750	2,333
	total lbs	17,500	37,333

= constant value provided by Evonik

Abbreviations:
gal - gallons
ft - feet
lbs - pounds

KLOZUR® KP

EVONIK Leading Beyond Chemistry

17-Nov-2022

Customer:	**AECOM**	**Prepared by:**	
Contact:	**Matt Zenker**	**Ravi Srirangam PhD**	
Site Location:	**Duso Site NY**	**1-312-480-5250**	
Proposal Number:	**EV-2022-21891**	**Ravi.Srirangam@evonik.com**	

Klozur® KP Demand Calculations and Cost Estimate

Item	Packaging Type	Quantity (lbs)	Unit Rate ($USD / lb)	Cost in $USD (FOB Origin)
Klozur® KP	55.1 lb bags	17,632	2.15	$37,909
	55.1 lb bags	1,708		$3,672
		19,340		
Klozur® SP	55.1 lb bags	11,020	1.58	$17,412
	55.1 lb bags	1,212		$1,915
	Total SP	**12,232**		
Klozur Activator(s)				
Hydrated Lime	50 lb Bag	7,500	0.45	$3,375
NaOH Solution	2500 lb Tote	17,500	0.55	$9,625
		Number of Deliveries	**Estimated Cost Per Delivery[4]**	
NaOH Solution Concentration				
25 % w/w	**Shipping**	N/A	N/A	$1,810
	Taxes[3]			Not Included
			Total:	**$75,718**

1) Number of packages needed is rounded up to nearest whole unit.

2) Price valid for 30 days from date at top of document. Terms: net 30 days. Prices are FOB Origin.

3) Any applicable taxes not included. Please provide a copy of your tax exempt certificate or resale tax number when placing your order. In accordance with the law, applicable state and local taxes will be applied at the time of invoicing if Evonik has not been presented with your fully executed tax exemption documentation.

4) If shipping not included, estimated freight rates available upon request. Freight rates provided are estimates only. Standard delivery time can vary from 1-3 weeks from time of order, depending upon volume. Expedited transport can be arranged at extra cost.

5) Return Policy: Within 90 days of sale and following written approval by Evonik, products in their unopened containers, which by analysis meet the original specifications and are in the same condition as they were shipped, will be accepted for return at invoiced price, less a 25% handling charge and return freight paid by buyer. Products that are made to order or custom blended are non-returnable. Returned products that are not received back by Evonik in the same condition as they were shipped or that have been stored outside, may be subject to a higher restocking fees or no refund at all.

6) All sales are per Evonik's Terms and Conditions.

7) All disclaimers within the standard proposal/demand calculator attachments apply to any and all estimates.

PROPOSAL ATTACHMENTS

PRODUCT OVERVIEW

Klozur® KP is an environmental grade potassium persulfate which will persist for an extended period of time when dosed above its solubility limit. Like other Klozur® persulfates, Klozur® KP has been delivered safely and cost effectively to treat a wide variety of common contaminants of concern with an unmatched combination of power and control. With proper activation, Klozur® KP can generate oxidative, and reductive pathways delivering the power to destroy the most recalcitrant of contaminants.

For more information on activated Klozur® KP, please contact your Evonik representative or www.klozur.com.

SITE INFORMATION

Application Type **Injection PRB**

	Value	Unit	Note
Length (Perpendicular to GW Flow)	60	ft	customer supplied
Width (Parallel to GW Flow)	15	ft	customer supplied
Area of Treatment	900	ft2	customer supplied
Top of Target Interval	5	ft bgs	
Bottom of Target Interval	20	ft bgs	
Treatment Zone Thickness	15	ft	customer supplied
Treatment Volume	13,500	ft3	calculated value
Porosity	30	%	customer supplied
Effective Porosity	20	%	customer supplied
Ground Water Volume	30,292	USG	calculated value
Aquifer Temperature	15	◦C	customer supplied
Linear groundwater flow velocity	37	ft/year	calculated value
Groundwater Flowrate	6,734	ft3/year	calculated value
Soil Oxidant Demand	13.3	g Klozur / kg soil	estimated value, it is recommend that this be analytically determined
Soil Base Buffering Capacity (Alkaline Activation only)	5	g 25 percent NaOH / kg soil	estimated value, it is recommend that this be analytically determined
GW Base Buffering Capacity (Alkaline Activation only)	0.1	g 25 percent NaOH / L Groundwater	estimated value, it is recommend that this be analytically determined

Disclaimer:

The estimated dosage and recommended application methodology described in this document are based on the site information provided to Evonik, but are not meant to constitute a guaranty of performance or a predictor of the speed at which a given site is remediated. Klozur® persulfate and activator demand calculations do not take into account the kinetics, speed of the reaction, or ability to establish contact between the reagents and contamination in the subsurface. These calculations represent the minimum anticipated amount needed to treat the contaminants of concern (COCs). As a result, these calculations should be used as a general approximation for purposes of an initial economic assessment. Evonik recommends that oxidant demand and treatability testing be performed to verify the quantities of oxidant needed.

CONTAMINANTS OF CONCERN* (COCs)

Concentrations:

The following are estimates of the contaminant concentration in groundwater within the target area. The total COC mass was calculated including estimated COC mass in groundwater, soil and NAPL, if present, within the targeted area.

Contaminant	GW (mg/L)	Soil (mg/kg)	NAPL (lb)	Total COC Mass** (lb)
TCA	2.4	0.2	0.0	0.9
1,1-DCA	16	0.3	0.0	4.5
DCE	0.18	0.1	0.0	0.1
1,2-DCA	0.94	0.1	0.0	0.4
CA	24	9.6	0.0	19.0
acetone	0.38	0.0	0.0	0.1

Remedial Goals and Target Mass Reductions:

The target demand is determined by also accounting for remedial goals for each contaminant and represents the estimated mass reductions targeted for each contaminant.

Contaminant	GW (mg/L)	Soil (mg/kg)	NAPL (mg/L)	Total COC Mass (lb)
TCA	0	0.0	0.0	0.9
1,1-DCA	0	0.0	0.0	4.5
DCE	0	0.0	0.0	0.1
1,2-DCA	0	0.0	0.0	0.4
CA	0	0.0	0.0	19.0
acetone	0	0.0	0.0	0.1

*Unless provided, sorbed concentrations were roughly estimated based on expected groundwater concentrations, foc and Koc values. For a more refined estimate, it is recommended that actual values be verified via direct sampling of the targeted treatment interval.

** Includes estimated contaminant mass in soil, groundwater, and NAPL (if provided) at the site.

*** Includes estimated contaminant mass in soil, groundwater, and NAPL (if provided) at the site with the remedial goals subtracted from the total mass onsite.

Contaminant	GW (mg/L)	Contaminant Flux (lbs/yr)	Total COC Mass* (lbs)
TCA	2.4	1.01	1.01
1,1-DCA	16.0	6.72	6.72
DCE	0.18	0.08	0.08
1,2-DCA	0.94	0.39	0.39
CA	24	10.08	10.08
acetone	0.38	0.16	0.16

*Estimated mass flux of contaminants into Permeable Reactive Barrier over potential life of barrier.

GEOCHEMICAL DATA

Influent Oxidant Demand	GW (mg/L)		GW (kg/yr)	Total COC (kgs)	
Chemical Oxidant Demand	25		1.4	0.7	customer provided
ORP (mV)	-50	**mV**			
pH	6.82				

KLOZUR® PERSULFATE DEMAND

The estimated mass of Klozur® KP accounts for target demand with the COCs, non-target demand associated with influent groundwater, maintaining the theoretical solubility of Klozur® KP in the influent groundwater and a safety factor applied to each. The safety factor is intended to account for potential variability and any other uncertainties associated with the application or site.

The demand from COCs was estimated using: **Degradation Ratio** The degradation ratio should be determined/verified in a bench or field test

	Total Klozur KP
Klozur® KP Demand	**19,340 lb**

	Total Klozur SP
Klozur® SP Demand	**12,232 lb**

KLOZUR® PERSULFATE PACKAGING OPTIONS AND PRICING

Klozur® KP can be delivered to your site in in bags or super sacks for your handling convenience. Pricing below is exclusive of shipping and any applicable taxes.

Klozur® KP

Packaging Type	Packages / pallet	Number of Pallets	Number of Packages
55.1 lb bags	40	8	320
55.1 lb bags	Partial Pallet		31

Available Packaging Types	Unit Rate ($USD / lb)	Quantity (lbs)	Cost in USD (FOB Origin)
55.1 lb bags	2.15	17,632	$37,909
55.1 lb bags	2.15	1,708	$3,672
		Total	**$41,581**

Klozur® SP

Packaging Type	Packages / pallet	Number of Pallets	Number of Packages
55.1 lb bags	40	5	200
55.1 lb bags	Partial Pallet		22

Available Packaging Types	Unit Rate ($USD / lb)	Quantity (lbs)	Cost in USD (FOB Origin)
55.1 lb bags	1.58	11,020	$17,412
55.1 lb bags	1.58	1,212	$1,915

KLOZUR® ACTIVATION CHEMISTRIES

Klozur® activation chemistries are used to convert Klozur® KP into the highly reactive radicals. Choosing the right activator chemistry for your contaminants of concern is important in obtaining a successful site remediation. The choice of activator will be dependent upon the target contaminants, site lithology and hydrogeology, and other site conditions. While activator demand quantities for all methods are given, not all activation methods are recommended for your given contaminant or site conditions. Please consult with an Evonik technical representative for proper selection of activation chemistry.

Note: Only one type of activator is typically needed.

***Evonik Industries, AG is the owner or licensee under various patent applications relating to the use of activation chemistries**

Hydrated Lime [$Ca(OH)_2$]

Hydrated lime can be used to create alkaline conditions used to activate Klozur KP. The calculations assume a 1:1 molar ratio of hydrated lime to Klozur® KP plus influent groundwater base buffer capacity.

Mass of $Ca(OH)_2$ to Activate Klozur® KP:	7,500	**lb**

PermeOx® Ultra

PermeOx® Ultra is an engineered extended release calcium peroxide that can be used to activate Klozur® KP.

Mass of PermeOx® Ultra to Activate Klozur® KP:	12,635	**lb**

Sodium Hydroxide (NaOH)

Sodium Hydroxide (NaOH) is a highly soluble reagent used to create alkaline activated persulfate. NaOH is typically used activate high solubility Klozur® SP and hydrated lime to create alkaline conditions to activate Klozur® KP. If Klozur® SP is a relatively minor portion or if Klozur® SP is not expected to migrate, hydrated lime can be used to activate both Klozur® SP or Klozur® KP.

Mass of NaOH Solution to Activate Klozur® SP:	4,200	**lb**
NaOH Solution Concentration:	25	**% w/w**

Zero Valent Iron

Zero valent iron (ZVI) can be used to activate Klozur® KP. ZVI and Klozur® KP should not be mixed above ground or installed in the same trench. Rather, Klozur® KP should be installed in an upgradient trench or injection row. The persulfate anion will dissolve and flow into the ZVI installed in the downgradient trench or injection row.

Mass of ZVI to Activate Klozur® KP:	7,700	**lb**

INSTALLATION VIA INJECTION

Klozur® KP will be delivered as a dry powder, packaged in 55.1 lb (25 Kg) bags or 2,204 lb (1,000 Kg) supersacks and in 1,102 lb (500 Kg) supersacks by special order. Klozur® KP has a limited soluble in water ranging from 17 g/L (0°C) to 47 g/L (20°C). When applied at greater than its theoretical solubility, Klozur® KP solid will persist and slowly dissolve maintaining the theortical solubility in solution. Klozur® KP is typically applied as a solid/slurry via direct push points or soil mixing. Klozur® KP is often applied as a dense solid state slurry, typically between 40 and 50 percent solids by weight although some have applied at even higher concentrations.

Klozur® KP is typically applied as a solid slurry. It can be injected combined with Klozur® SP. Klozur® pesulfates are activated. Extended release Klozur® KP is usually combined with extended release alkaline source hydrated lime. Although other activators can be used. Specific activators such as hydrated lime and PermeOx® Ultra can be combined with Klozur® KP and injected as a single slurry. However, other activators, such as zero valent iron, must be applied in a separate slurry.

Injected Reagents

Solid Reagents			Highly Soluble Reagents		
Klozur® KP	lb	19,340	Klozur® SP	lb	12,232
Hydrated Lime	lb	7,500	NaOH Solution	lb	17,500
		26,840			29,732

Oxidants and Activators Injected in: Single Slurry

Slurry Preparation

	Units	Klozur® KP Slurry
Total Solid Reagents	lb	26,840
Total Dissolvable Reagents	lb	12,232
Solids/Slurry Concentration	%	**50**
Added Water Weight	lb	14,608
Volume of Water to be added	gal	1,754
Estimated Total Injection Volume	gal	3,641

Conventional Slurry Emplacement (DPT or Similar)

	Units	Klozur® KP Slurry
Solid Mass per unit length	lbs per linear ft	179
Number of Injection Points		10
Injection Point Spacing	ft	9.7
Injection Volume per point	gal	364
Injection Volume per unit length	gal/ft	24
Mass Per Injection Point	lbs	5,657
Klozur® KP	lbs	1,934
Klozur® SP	lbs	1,223
Hydrated Lime	lbs	750
NaOH Solution	lbs	1,750

Appendix B – Safety Data Sheets

SAFETY DATA SHEET

Classified in accordance 29 CFR 1910.1200

1. Identification

Product identifier: KLOZUR® SP

Other means of identification
None.

Recommended restrictions

Recommended use: Remediation of contaminated soil and groundwater.
Restrictions on use: Not known.

Manufacturer/Importer/Distributor Information

Company Name	:	Evonik Corporation 299 Jefferson Road Parsippany, NJ 07054 USA
Telephone	:	+1 973 929 8000
Fax	:	+1 973 929 8040
E-mail	:	product-regulatory-services@evonik.com

Emergency telephone number:

24-Hour Health Emergency	:	+1 800 424 9300 (CHEMTREC - US & CANADA) 800 681 9531 (CHEMTREC MEXICO) +1 703 527 3887 (CHEMTREC WORLD)

2. Hazard(s) identification

Hazard Classification

Physical Hazards

Oxidizing solids	Category 3

Health Hazards

Acute toxicity (Oral)	Category 4
Skin Corrosion/Irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2A
Respiratory sensitizer	Category 1
Skin sensitizer	Category 1
Specific Target Organ Toxicity - Single Exposure	Category 3 (Respiratory tract irritation.)

Label Elements

Hazard Symbol:

Signal Word: Danger

Hazard Statement:

May intensify fire; oxidizer.
Harmful if swallowed.
Causes skin irritation.
Causes serious eye irritation.
May cause allergy or asthma symptoms or breathing difficulties if inhaled.
May cause an allergic skin reaction.
May cause respiratory irritation.

Precautionary Statements

Prevention: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Keep away from clothing, strong acids, bases, heavy metal salts and other reducing substances, and combustible materials. Take any precaution to avoid mixing with combustibles. Avoid breathing dust/fume/gas/mist/vapors/spray. Wash face, hands and any exposed skin thoroughly after handling. Do not eat, drink or smoke when using this product. Use only outdoors or in a well-ventilated area. Contaminated work clothing should not be allowed out of the workplace. Wear protective gloves/protective clothing/eye protection/face protection. [In case of inadequate ventilation] wear respiratory protection.

Response: IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth. IF ON SKIN: Wash with plenty of soap and water. Wash contaminated clothing before reuse. If skin irritation or rash occurs: Get medical advice/attention. Take off contaminated clothing. Specific treatment (see supplemental first aid instructions on this label). IF INHALED: Remove person to fresh air and keep comfortable for breathing. If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention. In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.

Storage: Store in a well-ventilated place. Keep container tightly closed. Store locked up.

Disposal: Dispose of contents/ container to an approved facility in accordance with local, regional, national and international regulations.

Hazard(s) not otherwise classified (HNOC): None.

3. Composition/information on ingredients

Substances

Chemical Identity	Common name and synonyms	CAS number	Content in percent (%)*
Disodium peroxodisulphate		7775-27-1	>99%
Sodium Sulfate		7757-82-6	<1%

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

The exact concentration has been withheld as a trade secret.

4. First-aid measures

Description of necessary first-aid measures

General information: Remove from exposure, lie down. Show this safety data sheet to the doctor in attendance.

Inhalation: Remove from contaminated area. Apply artificial respiration if not breathing. Get medical attention immediately.

Skin Contact: Wash skin thoroughly with soap and water.

Eye contact: If in eyes, hold eyes open, flood with water for at least 15 minutes and see a doctor. Get medical attention.

Ingestion: Never give anything by mouth to an unconscious person. Rinse mouth thoroughly with water. Seek medical attention.

Personal Protection for First-aid Responders: No data available.

Most important symptoms and effects, both acute and delayed

Symptoms: No data available.

Hazards: No data available.

Indication of immediate medical attention and special treatment needed

Treatment: No data available.

5. Fire-fighting measures

General Fire Hazards: Release of oxygen may support combustion. Release of oxygen may support combustion.

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media: Dry powder. Dry sand. Water.

Unsuitable extinguishing media: Carbon dioxide High pressure inert gas, e.g. carbon dioxide jet.

Special hazards arising from the substance or mixture: No data available.

Special protective equipment and precautions for fire-fighters

Special fire-fighting procedures: No data available.

Special protective equipment for fire-fighters: Self-contained breathing apparatus.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures: Avoid contact with eyes, skin, and clothing. Avoid breathing dust. Use personal protective equipment.

Accidental release measures: Avoid spreading dust or contaminated materials. Prevent runoff from entering drains, sewers, or streams.

Methods and material for containment and cleaning up: Pick up with vacuum or absorbent solid, store in closed container for disposal. Avoid dust formation.

Environmental Precautions: No data available.

7. Handling and storage

Handling

Technical measures (e.g. Local and general ventilation): Use only in well-ventilated areas. Minimize dust generation and accumulation.

Safe handling advice: Wear appropriate personal protective equipment. Avoid breathing dust. Avoid contact with eyes, skin, and clothing. Provide adequate ventilation if fumes or vapors are generated. Handle under inert gas atmosphere in dry equipment.

Contact avoidance measures: No data available.

Storage

Safe storage conditions: Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat, sparks and open flame. Do not store near combustible materials. Avoid contamination. Keep away from food, drink and animal feeding stuffs. Avoid formation of dust.

Safe packaging materials: No data available.

8. Exposure controls/personal protection

Control Parameters

Occupational Exposure Limits

Chemical Identity	Type	Exposure Limit Values	Source
Disodium peroxodisulphate - as persulfate	TWA	0.1 mg/m3	US. ACGIH Threshold Limit Values, as amended (03 2016)

Please refer to the latest edition of the appropriate source text and consult an industrial hygienist or similar professional, or local agencies, for further information.

Biological Limit Values
No biological exposure limits noted for the ingredient(s).

Appropriate Engineering Controls Use only in well-ventilated areas. Minimize dust generation and accumulation.

Individual protection measures, such as personal protective equipment

Eye/face protection: Safety goggles

Skin Protection
Hand Protection: Material: Rubber (natural, latex).Material: Neoprene.Material: Polyvinyl chloride (PVC).

Skin and Body Protection: Long sleeved clothing

Respiratory Protection: Respirator must be worn if exposed to dust. Wear suitable respiratory protection.

Hygiene measures: Wash promptly if skin becomes contaminated. Provide eyewash station and safety shower.

9. Physical and chemical properties

Information on basic physical and chemical properties

Appearance	
Physical state:	solid
Form:	Crystalline
Color:	White
Odor:	Odorless
Odor Threshold:	No data available.
Melting Point:	356 °F/180 °C
Boiling Point:	No data available.
Flammability:	No data available.
Upper/lower limit on flammability or explosive limits	
Explosive limit - upper:	No data available.
Explosive limit - lower:	No data available.
Flash Point:	No data available.
Self Ignition Temperature:	No data available.
Decomposition Temperature:	No data available.
pH:	6 (1 g/l,)
Viscosity	
Dynamic viscosity:	No data available.
Kinematic viscosity:	No data available.
Flow Time:	No data available.
Solubility(ies)	
Solubility in Water:	42 g/l

Solubility (other):	No data available.
Partition coefficient (n-octanol/water):	No data available.
Vapor pressure:	No data available.
Relative density:	No data available.
Density:	2.59 g/cm3
Bulk density:	No data available.
Vapor density (air=1):	No data available.
Particle characteristics	
Particle Size:	< 420 mm
Particle Size Distribution:	No data available.
Specific surface area:	No data available.
Surface charge/Zeta potential:	No data available.
Shape:	No data available.
Crystallinity:	No data available.
Surface treatment:	No data available.

Other information

Oxidizing properties: The substance or mixture is classified as oxidizing with the category 3.

10. Stability and reactivity

Reactivity: No data available.

Chemical Stability: Stable under usual application conditions.

Possibility of hazardous reactions: Breaks down and releases toxic and spontaneously combustible gases when wet

Conditions to avoid: Heat. Moisture.

Incompatible Materials: Bases. Halogens and halogenated compounds. Oxidizing agents. Strong reducing agents. Combustible material

Hazardous Decomposition Products: No data available.

11. Toxicological information

Information on toxicological effects

Information on likely routes of exposure

Inhalation: No data available.

Skin Contact: No data available.

Eye contact: No data available.

Ingestion: No data available.

Acute toxicity (list all possible routes of exposure)

Oral

Product: ATEmix: 929.29 mg/kg

Dermal
Product: Not classified for acute toxicity based on available data.

Inhalation
Product: Not classified for acute toxicity based on available data.

Repeated dose toxicity
Product: No data available.

Skin Corrosion/Irritation
Product: No data available.
Components:

Disodium peroxodisulphate	Irritating.
Sodium Sulfate	OECD 404 (Rabbit): Not irritating

Serious Eye Damage/Eye Irritation
Product: No data available.
Components:

Disodium peroxodisulphate	Irritating.
Sodium Sulfate	Not irritating OECD 405 Rabbit:

Respiratory or Skin Sensitization
Product: No data available.
Components:

Disodium peroxodisulphate	May cause sensitization by skin contact. May cause sensitization by inhalation.
Sodium Sulfate	Maximization Test, OECD 406 (Guinea Pig): Not a skin sensitizer.

Carcinogenicity
Product: No data available.

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:
No carcinogens present or none present in regulated quantities

ACGIH: US.ACGIH Threshold Limit Values:
No carcinogens present or none present in regulated quantities

US. National Toxicology Program (NTP) Report on Carcinogens:
No carcinogens present or none present in regulated quantities

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050), as amended:
No carcinogens present or none present in regulated quantities

Germ Cell Mutagenicity

In vitro
Product: No data available.
Components:

Sodium Sulfate	Ames test (OECD 471): negative gene mutation test (OECD 476): negative Chromosomal aberration (OECD 473): negative

In vivo
Product: No data available.
Components:

Sodium Sulfate	Chromosomal aberration Intraperitoneal (Mouse, Female, Male): negative

Reproductive toxicity
Product: No data available.

Specific Target Organ Toxicity - Single Exposure

Product:	No data available.
Components:	
Disodium peroxodisulphate	Category 3 with respiratory tract irritation.

Specific Target Organ Toxicity - Repeated Exposure

Product:	No data available.

Aspiration Hazard

Product:	No data available.
Components:	
Sodium Sulfate	Not applicable

Information on health hazards

Other hazards

Product:	No data available.

12. Ecological information

Ecotoxicity:

Acute hazards to the aquatic environment:

Fish

Product:	No data available.
Components:	
Sodium Sulfate	LC 50 (Pimephales promelas, 96 h): 7,960 mg/l

Aquatic Invertebrates

Product:	No data available.
Components:	
Sodium Sulfate	EC 50 (Daphnia magna, 48 h): 1,776 mg/l

Toxicity to Aquatic Plants

Product:	No data available.
Components:	
Sodium Sulfate	EC 50 (Nitscheria linearis, 120 h): 1,900 mg/l (US-EPA-method)

Toxicity to microorganisms

Product:	No data available.

Chronic hazards to the aquatic environment:

Fish

Product:	No data available.

Aquatic Invertebrates

Product:	No data available.
Components:	
Sodium Sulfate	Lowest Observed Effect Concentration (Ceriodaphnia dubia, 7 d): 1,329 mg/l EC 50 (Ceriodaphnia dubia, 7 d): 1,698 mg/l

Toxicity to Aquatic Plants

Product:	No data available.

Toxicity to microorganisms

Product:	No data available.

Persistence and Degradability

Biodegradation
Product: No data available.

BOD/COD Ratio
Product: No data available.

Bioaccumulative potential

Bioconcentration Factor (BCF)
Product: No data available.

Partition Coefficient n-octanol / water (log Kow)
Product: No data available.
Components:
Sodium Sulfate Log Kow: 3.0

Mobility in soil:

Product No data available.

Results of PBT and vPvB assessment:

Product No data available.

Other adverse effects:

Other hazards
Product: No data available.

13. Disposal considerations

Disposal methods: Waste must be disposed of in accordance with federal, state, provincial and local regulations.

Contaminated Packaging: No data available.

14. Transport information

Domestic regulation

49 CFR
UN/ID/NA number : UN 1505
Proper shipping name : Sodium persulfate

Class : 5.1
Packing group : III
Labels : 5.1
ERG Code : 140
Marine pollutant : no

International Regulations

IATA-DGR
UN/ID No. : UN 1505
Proper shipping name : Sodium persulphate
Class : 5.1

Packing group	:	III
Labels	:	5.1
Packing instruction (cargo aircraft)	:	563
Packing instruction (passenger aircraft)	:	559

IMDG-Code

UN number or ID number	:	UN 1505
Proper shipping name	:	SODIUM PERSULPHATE
Class	:	5.1
Packing group	:	III
Labels	:	5.1
EmS Code	:	F-A, S-Q
Marine pollutant	:	no

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

Special precautions for user

The transport classification(s) provided herein are for informational purposes only, and solely based upon the properties of the unpackaged material as it is described within this Safety Data Sheet. Transportation classifications may vary by mode of transportation, package sizes, and variations in regional or country regulations.

15. Regulatory information

US Federal Regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)
None present or none present in regulated quantities.

US. Toxic Substances Control Act (TSCA) Section 5(a)(2) Final Significant New Use Rules (SNURs) (40 CFR 721, Subpt E)
None present or none present in regulated quantities.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050), as amended
None present or none present in regulated quantities.

CERCLA Hazardous Substance List (40 CFR 302.4):
None present or none present in regulated quantities.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

Oxidizer (liquid, solid or gas), Acute toxicity (any route of exposure), Skin Corrosion or Irritation, Serious eye damage or eye irritation, Respiratory or Skin Sensitization, Specific target organ toxicity (single or repeated exposure)

US. EPCRA (SARA Title III) Section 304 Extremely Hazardous Substances Reporting Quantities and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Hazardous Substances

None present or none present in regulated quantities.

US. EPCRA (SARA Title III Section 313 Toxic Chemical Release Inventory (TRI) Reporting

None present or none present in regulated quantities.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):
None present or none present in regulated quantities.

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)
None present or none present in regulated quantities.

US State Regulations

US. California Proposition 65
No ingredient requiring a warning under CA Prop 65.

16.Other information, including date of preparation or last revision

Issue Date:	09/06/2022
Version #:	1.0
Further Information:	No data available.
Revision Information	Changes since the last version are highlighted in the margin. This version replaces all previous versions.
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SAFETY DATA SHEET

Classified in accordance 29 CFR 1910.1200

1. Identification

Product identifier: KLOZUR® KP

Other means of identification
None.

Recommended restrictions

Recommended use: Remediation of contaminated soil and groundwater.
Restrictions on use: Not known.

Manufacturer/Importer/Distributor Information

Company Name	:	Evonik Corporation 299 Jefferson Road Parsippany, NJ 07054 USA
Telephone	:	+1 973 929 8000
Fax	:	+1 973 929 8040
E-mail	:	product-regulatory-services@evonik.com

Emergency telephone number:

24-Hour Health Emergency	:	+1 800 424 9300 (CHEMTREC - US & CANADA) 800 681 9531 (CHEMTREC MEXICO) +1 703 527 3887 (CHEMTREC WORLD)

2. Hazard(s) identification

Hazard Classification

Physical Hazards

Oxidizing solids	Category 3

Health Hazards

Acute toxicity (Oral)	Category 4
Skin Corrosion/Irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2A
Respiratory sensitizer	Category 1
Skin sensitizer	Category 1
Specific Target Organ Toxicity - Single Exposure	Category 3 (Respiratory tract irritation.)

Label Elements

Hazard Symbol:

Signal Word: Danger

Hazard Statement:

May intensify fire; oxidizer.
Harmful if swallowed.
Causes skin irritation.
Causes serious eye irritation.
May cause allergy or asthma symptoms or breathing difficulties if inhaled.
May cause an allergic skin reaction.
May cause respiratory irritation.

Precautionary Statements

Prevention: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Keep away from clothing, strong acids, bases, heavy metal salts and other reducing substances, and combustible materials. Take any precaution to avoid mixing with combustibles. Avoid breathing dust/fume/gas/mist/vapors/spray. Wash face, hands and any exposed skin thoroughly after handling. Do not eat, drink or smoke when using this product. Use only outdoors or in a well-ventilated area. Contaminated work clothing should not be allowed out of the workplace. Wear protective gloves/protective clothing/eye protection/face protection. [In case of inadequate ventilation] wear respiratory protection.

Response: IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth. IF ON SKIN: Wash with plenty of soap and water. Wash contaminated clothing before reuse. If skin irritation or rash occurs: Get medical advice/attention. Take off contaminated clothing. Specific treatment (see supplemental first aid instructions on this label). IF INHALED: Remove person to fresh air and keep comfortable for breathing. If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention. In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.

Storage: Store in a well-ventilated place. Keep container tightly closed. Store locked up.

Disposal: Dispose of contents/ container to an approved facility in accordance with local, regional, national and international regulations.

Hazard(s) not otherwise classified (HNOC): None.

3. Composition/information on ingredients

Substances

Chemical Identity	Common name and synonyms	CAS number	Content in percent (%)*
potassium peroxodisulphate		7727-21-1	>98%
Potassium sulphate		7778-80-5	<2%

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

The exact concentration has been withheld as a trade secret.

4. First-aid measures

Description of necessary first-aid measures

General information: Remove from exposure, lie down. Show this safety data sheet to the doctor in attendance.

Inhalation: Remove from contaminated area. Apply artificial respiration if not breathing. Get medical attention immediately.

Skin Contact: Wash skin thoroughly with soap and water.

Eye contact: If in eyes, hold eyes open, flood with water for at least 15 minutes and see a doctor. Get medical attention.

Ingestion: Never give anything by mouth to an unconscious person. Rinse mouth thoroughly with water. Seek medical attention.

Personal Protection for First-aid Responders: No data available.

Most important symptoms and effects, both acute and delayed

Symptoms: No data available.

Hazards: No data available.

Indication of immediate medical attention and special treatment needed

Treatment: No data available.

5. Fire-fighting measures

General Fire Hazards: Release of oxygen may support combustion.

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media: Dry powder. Dry sand. Water.

Unsuitable extinguishing media: Carbon dioxide High pressure inert gas, e.g. carbon dioxide jet.

Special hazards arising from the substance or mixture: No data available.

Special protective equipment and precautions for fire-fighters

Special fire-fighting procedures: No data available.

Special protective equipment for fire-fighters: Self-contained breathing apparatus.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures: Avoid contact with eyes, skin, and clothing. Avoid breathing dust. Use personal protective equipment.

Accidental release measures: Avoid spreading dust or contaminated materials. Prevent runoff from entering drains, sewers, or streams.

Methods and material for containment and cleaning up: Pick up with vacuum or absorbent solid, store in closed container for disposal. Avoid dust formation.

Environmental Precautions: No data available.

7. Handling and storage

Handling

Technical measures (e.g. Local and general ventilation): Use only in well-ventilated areas. Minimize dust generation and accumulation.

Safe handling advice: Wear appropriate personal protective equipment. Avoid breathing dust. Avoid contact with eyes, skin, and clothing. Provide adequate ventilation if fumes or vapors are generated. Handle under inert gas atmosphere in dry equipment.

Contact avoidance measures: No data available.

Storage

Safe storage conditions: Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat, sparks and open flame. Do not store near combustible materials. Avoid contamination. Keep away from food, drink and animal feeding stuffs. Avoid formation of dust.

Safe packaging materials: No data available.

8. Exposure controls/personal protection

Control Parameters

Occupational Exposure Limits

Chemical Identity	Type	Exposure Limit Values	Source
potassium peroxodisulphate - as persulfate	TWA	0.1 mg/m3	US. ACGIH Threshold Limit Values, as amended (03 2016)

Please refer to the latest edition of the appropriate source text and consult an industrial hygienist or similar professional, or local agencies, for further information.

Biological Limit Values
No biological exposure limits noted for the ingredient(s).

Appropriate Engineering Controls Use only in well-ventilated areas. Minimize dust generation and accumulation.

Individual protection measures, such as personal protective equipment

Eye/face protection: Safety goggles

Skin Protection
Hand Protection: Material: Rubber (natural, latex).Material: Neoprene.

Skin and Body Protection: Long sleeved clothing

Respiratory Protection: Respirator must be worn if exposed to dust. Wear suitable respiratory protection.

Hygiene measures: Wash promptly if skin becomes contaminated. Provide eyewash station and safety shower.

9. Physical and chemical properties

Information on basic physical and chemical properties

Appearance	
Physical state:	solid
Form:	Crystalline
Color:	White
Odor:	Odorless
Odor Threshold:	No data available.
Melting Point:	> 212 °F/> 100 °C
Boiling Point:	No data available.
Flammability:	No data available.
Upper/lower limit on flammability or explosive limits	
Explosive limit - upper:	No data available.
Explosive limit - lower:	No data available.
Flash Point:	Not applicable
Self Ignition Temperature:	No data available.
Decomposition Temperature:	No data available.
SADT:	> 100 °C ,
pH:	6.4 1% solution
Viscosity	
Dynamic viscosity:	No data available.
Kinematic viscosity:	No data available.
Flow Time:	No data available.
Solubility(ies)	
Solubility in Water:	5.6 g/l (77 °F/25 °C)
Solubility (other):	No data available.

Partition coefficient (n-octanol/water):	No data available.
Vapor pressure:	No data available.
Relative density:	No data available.
Density:	2.48 g/cm3
Bulk density:	No data available.
Vapor density (air=1):	No data available.

Other information

Oxidizing properties:	The substance or mixture is classified as oxidizing with the category 3.
Molecular weight:	270.31 g/mol

10. Stability and reactivity

Reactivity:	No data available.
Chemical Stability:	Stable under usual application conditions.
Possibility of hazardous reactions:	Breaks down and releases toxic and spontaneously combustible gases when wet
Conditions to avoid:	Heat. Moisture.
Incompatible Materials:	Bases. Halogens and halogenated compounds. Oxidizing agents. Strong reducing agents. Combustible material Strong acids
Hazardous Decomposition Products:	No data available.

11. Toxicological information

Information on toxicological effects

Information on likely routes of exposure

Inhalation:	No data available.
Skin Contact:	No data available.
Eye contact:	No data available.
Ingestion:	No data available.

Acute toxicity (list all possible routes of exposure)

Oral
Product: ATEmix: 306.12 mg/kg

Dermal
Product: ATEmix: 2,040.82 mg/kg

Inhalation
Product: Not classified for acute toxicity based on available data.

Repeated dose toxicity

Product:	No data available.
Components:	
Potassium sulphate	NOAEL (Rat(Female, Male), Oral, daily): 1,500 mg/kg LOAEL (Rat(Female, Male), Oral, daily): 1,500 mg/kg Literature

Skin Corrosion/Irritation

Product:	No data available.
Components:	
potassium peroxodisulphate	Irritating.
Potassium sulphate	EU method B.46 (In Vitro Skin Irritation: Reconstructed Human Epidermis Model Test) (Human, reconstructed epidermis (RhE) model): Not irritating

Serious Eye Damage/Eye Irritation

Product:	Strongly irritating.

Respiratory or Skin Sensitization

Product:	No data available.
Components:	
potassium peroxodisulphate	May cause sensitization by skin contact. May cause sensitization by inhalation.
Potassium sulphate	Local Lymph Node Assay (LLNA), OECD 429 (Mouse): Not a skin sensitizer.

Carcinogenicity

Product:	No data available.
Components:	
Potassium sulphate	Oral

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:
No carcinogens present or none present in regulated quantities

ACGIH: US.ACGIH Threshold Limit Values:
No carcinogens present or none present in regulated quantities

US. National Toxicology Program (NTP) Report on Carcinogens:
No carcinogens present or none present in regulated quantities

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050), as amended:
No carcinogens present or none present in regulated quantities

Germ Cell Mutagenicity

In vitro

Product:	No data available.
Components:	
Potassium sulphate	Mutagenicity (reverse mutation assay) (OECD 471): negative Mutagenicity (reverse mutation assay) (OECD 471): negative

In vivo

Product:	No data available.

Reproductive toxicity

Product:	No data available.

Specific Target Organ Toxicity - Single Exposure

Product:	No data available.
Components:	
potassium peroxodisulphate	Inhalation: Respiratory system - Category 3 with respiratory tract irritation.

Specific Target Organ Toxicity - Repeated Exposure

Product:	No data available.

Aspiration Hazard

Product:	No data available.
Components:	
potassium peroxodisulphate	Not applicable
Potassium sulphate	Not applicable

Information on health hazards

Other hazards

Product:	No data available.

12. Ecological information

Ecotoxicity:

Acute hazards to the aquatic environment:

Fish

Product:	No data available.
Components:	
Potassium sulphate	LC 50 (Pimephales promelas, 96 h): 680 mg/l Literature

Aquatic Invertebrates

Product:	No data available.
Components:	
Potassium sulphate	LC 50 (Daphnia magna, 48 h): 720 mg/l

Toxicity to Aquatic Plants

Product:	No data available.
Components:	
Potassium sulphate	EC 50 (Chlorella vulgaris (Fresh water algae), 18 d): 2,700 mg/l

Toxicity to microorganisms

Product:	No data available.

Chronic hazards to the aquatic environment:

Fish

Product:	No data available.

Aquatic Invertebrates

Product:	No data available.

Toxicity to Aquatic Plants

Product:	No data available.

Toxicity to microorganisms

Product:	No data available.

Persistence and Degradability

Biodegradation

Product:	No data available.
Components:	
Potassium sulphate	The methods for determining the biological degradability are not applicable to inorganic substances.

BOD/COD Ratio

Product: No data available.

Bioaccumulative potential

Bioconcentration Factor (BCF)
Product: No data available.

Partition Coefficient n-octanol / water (log Kow)
Product: No data available.
Components:
potassium peroxodisulphate: Log Kow: -1 20 °C

Mobility in soil:

Product No data available.

Results of PBT and vPvB assessment:

Product No data available.

Other adverse effects:

Other hazards
Product: No data available.

13. Disposal considerations

Disposal methods: Waste must be disposed of in accordance with federal, state, provincial and local regulations.

Contaminated Packaging: No data available.

14. Transport information

Domestic regulation

49 CFR

UN/ID/NA number	:	UN 1492
Proper shipping name	:	Potassium persulfate
Class	:	5.1
Packing group	:	III
Labels	:	5.1
ERG Code	:	140
Marine pollutant	:	no

International Regulations

IATA-DGR

UN/ID No.	:	UN 1492
Proper shipping name	:	Potassium persulphate
Class	:	5.1
Packing group	:	III
Labels	:	5.1
Packing instruction (cargo aircraft)	:	563
Packing instruction (passenger aircraft)	:	559

IMDG-Code

UN number or ID number	:	UN 1492
Proper shipping name	:	POTASSIUM PERSULPHATE
Class	:	5.1
Packing group	:	III
Labels	:	5.1
EmS Code	:	F-A, S-Q
Marine pollutant	:	no

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

Special precautions for user

The transport classification(s) provided herein are for informational purposes only, and solely based upon the properties of the unpackaged material as it is described within this Safety Data Sheet. Transportation classifications may vary by mode of transportation, package sizes, and variations in regional or country regulations.

15. Regulatory information

US Federal Regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)
None present or none present in regulated quantities.

US. Toxic Substances Control Act (TSCA) Section 5(a)(2) Final Significant New Use Rules (SNURs) (40 CFR 721, Subpt E)
None present or none present in regulated quantities.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050), as amended
None present or none present in regulated quantities.

CERCLA Hazardous Substance List (40 CFR 302.4):
None present or none present in regulated quantities.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

Oxidizer (liquid, solid or gas), Acute toxicity (any route of exposure), Skin Corrosion or Irritation, Serious eye damage or eye irritation, Respiratory or Skin Sensitization, Specific target organ toxicity (single or repeated exposure)

US. EPCRA (SARA Title III) Section 304 Extremely Hazardous Substances Reporting Quantities and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Hazardous Substances

None present or none present in regulated quantities.

US. EPCRA (SARA Title III Section 313 Toxic Chemical Release Inventory (TRI) Reporting

None present or none present in regulated quantities.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):
None present or none present in regulated quantities.

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)
None present or none present in regulated quantities.

US State Regulations

US. California Proposition 65

No ingredient requiring a warning under CA Prop 65.

Inventory Status:

US TSCA Inventory:	Included on Inventory.	

16.Other information, including date of preparation or last revision

Issue Date: 09/07/2022

Version #: 1.0

Further Information: No data available.

Revision Information Changes since the last version are highlighted in the margin. This version replaces all previous versions.

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SAFETY DATA SHEET

Classified in accordance 29 CFR 1910.1200

1. Identification

Product identifier: KLOZUR® CAUSTIC

Other means of identification
None.

Recommended restrictions

Recommended use: Remediation of contaminated soil and groundwater.
Restrictions on use: Not known.

Manufacturer/Importer/Distributor Information

Company Name	:	Evonik Corporation 299 Jefferson Road Parsippany, NJ 07054 USA
Telephone	:	+1 973 929 8000
Fax	:	+1 973 929 8040
E-mail	:	product-regulatory-services@evonik.com

Emergency telephone number:

24-Hour Health Emergency	:	+1 800 424 9300 (CHEMTREC - US & CANADA) 800 681 9531 (CHEMTREC MEXICO) +1 703 527 3887 (CHEMTREC WORLD)

2. Hazard(s) identification

Hazard Classification

Physical Hazards

Corrosive to metal	Category 1

Health Hazards

Skin Corrosion/Irritation	Category 1A
Serious Eye Damage/Eye Irritation	Category 1

Label Elements

Hazard Symbol:

Signal Word: Danger

Hazard Statement:

May be corrosive to metals.
Causes severe skin burns and eye damage.

Precautionary Statements

Prevention: Keep only in original packaging. Do not breathe dust/fume/gas/mist/vapors/spray. Wash face, hands and any exposed skin thoroughly after handling. Wear protective gloves/protective clothing/eye protection/face protection.

Response: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower]. Wash contaminated clothing before reuse. Specific treatment (see supplemental first aid instructions on this label). IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER/doctor. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Absorb spillage to prevent material damage.

Storage: Store locked up. Store in corrosive resistant stainless steel container with a resistant inner liner.

Disposal: Dispose of contents/ container to an approved facility in accordance with local, regional, national and international regulations.

Hazard(s) not otherwise classified (HNOC): None.

3. Composition/information on ingredients

Mixtures

Chemical Identity	Common name and synonyms	CAS number	Content in percent (%)*
sodium hydroxide		1310-73-2	25%

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

The exact concentration has been withheld as a trade secret.

4. First-aid measures

Description of necessary first-aid measures

General information: Pay attention to self-protection. Remove victims from hazardous area. Immediately remove soiled or soaked clothing and remove it to a safe distance. Keep victim warm, in a stabilized position and covered. Do not leave the victim unattended. Place patients who are unconscious but breathing in the stabilized lateral position.

Inhalation:	Potential for exposure by inhalation if aerosols or mists are generated. After inhalation move subject to fresh air. With labored breathing: Provide with oxygen. Consult a doctor immediately. If the casualty is not breathing: Perform mouth-to-mouth resuscitation, notify emergency physician immediately.
Skin Contact:	Wash off affected area immediately with plenty of water for at least 15 minutes. Get medical attention if any discomfort continues.
Eye contact:	With eye held open, thoroughly rinse immediately with plenty of water for at least 10 minutes. Notify emergency physician immediately (key words: burns in eye).
Ingestion:	Rinse mouth. Immediately give large quantities of water to drink. Notify the emergency physician immediately.
Personal Protection for First-aid Responders:	No data available.

Most important symptoms and effects, both acute and delayed

Symptoms:	Corrosive
Hazards:	Strongly irritating to corrosive.

Indication of immediate medical attention and special treatment needed

Treatment:	The initial focus is only on the local action, characterized by quickly progressing deep tissue damage. Coughing is a symptom of a respiratory tract irritation after inhalation of aerosols or mists from caustic liquids. In the eye, caustic liquids cause, depending on the intensity of exposure, severe irritation, destruction, and ablation of the epithelium of the conjunctiva and cornea, corneal clouding, edema and ulcerations. Danger! Possible loss of eyesight! Superficial irritations and damage up to ulcerations and scarring develop on the skin.

5. Fire-fighting measures

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media:	The product is non-combustible. In case of fire in the surroundings: Water spray, foam, CO2, dry powder.
Unsuitable extinguishing media:	High volume water jet.
Special hazards arising from the substance or mixture:	In case of fire-fighting with water or foam be aware of dangers of corrosion and of slipping.

Special protective equipment and precautions for fire-fighters

Special fire-fighting procedures:	Cool containers/tanks with water spray.
Special protective equipment for fire-fighters:	In case of fire use self-contained breathing apparatus if necessary.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures:	For personal protection see section 8.
Accidental release measures:	No data available.
Methods and material for containment and cleaning up:	Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). After cleaning, flush away traces with water. Fill into marked, sealable containers. To be disposed of in compliance with existing regulations.
Environmental Precautions:	Prevent product from entering drains. Do not allow to reach the sewage system, the ground or natural water bodies.

7. Handling and storage

Handling

Technical measures (e.g. Local and general ventilation):	Provide natural or explosion-proof ventilation adequate to ensure concentrations are kept below exposure limits.Provide readily accessible eye wash stations and safety showers.
Safe handling advice:	Avoid residues of the product on the containers. For personal protection see section 8.Handle in accordance with good industrial hygiene and safety practice.
Contact avoidance measures:	No data available.

Storage

Safe storage conditions:	In order to ensure due transportation, make certain that stacks are of the correct height, containers are securely fastened so as not to fall off, and labelled according to the regulations.Store in the original receptable, keeping this tightly sealed, under cool and dry conditions. Minimum storage temperature: 15 °C. Suitable materials are: Stainless steel. rubber-lined steel polyolefins Inadequate materials are: aluminium zinc enamel
Safe packaging materials:	No data available.

8. Exposure controls/personal protection

Control Parameters

Occupational Exposure Limits

Chemical Identity	Type	Exposure Limit Values	Source
sodium hydroxide	Ceiling	2 mg/m3	US. ACGIH Threshold Limit Values, as amended (03 2016)
	Ceil_Time	2 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards, as amended (2010)
	PEL	2 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000), as amended (03 2016)

Please refer to the latest edition of the appropriate source text and consult an industrial hygienist or similar professional, or local agencies, for further information.

Biological Limit Values
No biological exposure limits noted for the ingredient(s).

Appropriate Engineering Controls Provide natural or explosion-proof ventilation adequate to ensure concentrations are kept below exposure limits. Provide readily accessible eye wash stations and safety showers.

Individual protection measures, such as personal protective equipment

Eye/face protection: close-fitting protective goggles (e.g. closed goggles)

Skin Protection

Hand Protection: Material: Kächele-Cama Latex GmbH (KCL), Germany
Guideline: DIN EN 374
Additional Information: Applies to handling for longer periods or of large amountsMaterial: Kächele-Cama Latex GmbH (KCL), Germany
Guideline: DIN EN 374
Additional Information: Applies to handling for brief periods or of small amounts

Skin and Body Protection: Anti-static suit. acid-resistant protective clothing Alkali-resistant protective clothing

Respiratory Protection: in case vapors or aerosols appear use respiratory equipment with suitable filter or wear a self contained respiratory apparatus Suitable filter: A, code colour brown Note time limit for wearing respiratory protective equipment.

Hygiene measures: Avoid contact with skin and eyes. Wash contact areas after handling. Do not eat, drink, smoke, or sniff while at work. Wash your hands and/or face before breaks and before termination of work. Take off clothing and shoes contaminated with product. Clean before reuse.

9. Physical and chemical properties

Information on basic physical and chemical properties

Appearance

Physical state:	liquid
Form:	liquid
Color:	colorless
Odor:	Odorless
Odor Threshold:	No data available.
Freezing point:	3 °F/-16 °C
Boiling Point:	241 °F/116 °C
Flammability:	No data available.

Upper/lower limit on flammability or explosive limits

Explosive limit - upper:	Not applicable
Explosive limit - lower:	Not applicable
Flash Point:	Not applicable
Self Ignition Temperature:	Not expected during handling from practical experience.
Decomposition Temperature:	Not expected during handling from practical experience.
pH:	14 (20 °C)
Viscosity	
Dynamic viscosity:	6.4 mPa.s (77 °F/25 °C)
Kinematic viscosity:	5.20 mm2/s (86 °F/30 °C)
Flow Time:	No data available.
Solubility(ies)	
Solubility in Water:	> 10 g/l Soluble
Solubility (other):	Soluble
Partition coefficient (n-octanol/water):	No data available.
Vapor pressure:	10 - 18 hPa (86 °F/30 °C)
Relative density:	No data available.
Density:	1.273 g/cm3 (68 °F/20 °C)
Bulk density:	No data available.
Relative vapor density:	No data available.

Other information

Explosive properties:	Not expected during handling from practical experience.
Oxidizing properties:	Not expected during handling from practical experience.
Minimum ignition temperature:	Not applicable
Formation of Flammable Gases:	Not expected during handling from practical experience.
Peroxides:	Not expected during handling from practical experience.
Metal Corrosion:	Corrosive to metal
Evaporation Rate:	No data available.
Molecular weight:	40 g/mol

10. Stability and reactivity

Reactivity:	No data available.
Chemical Stability:	No data available.
Possibility of hazardous reactions:	Evolution of hydrogen with: various metals e.g.: aluminium, magnesium, zinc (Formation of detonating gas with atmospheric oxygen). Exothermic reaction with: acids
Conditions to avoid:	No further information available
Incompatible Materials:	aluminium Magnesium zinc acids
Hazardous Decomposition Products:	No hazardous decomposition products are known.

11. Toxicological information

Information on toxicological effects

Information on likely routes of exposure

Inhalation:	No data available.
Skin Contact:	Relevant route of exposure. Information on effects are given below.
Eye contact:	Relevant route of exposure. Information on effects are given below.
Ingestion:	If handled correctly, not a relevant route of exposure. Information on effects are given below.

Symptoms related to the physical, chemical and toxicological characteristics

Inhalation:	No data available.
Skin Contact:	Relevant route of exposure. Information on effects are given below.
Eye contact:	Relevant route of exposure. Information on effects are given below.
Ingestion:	If handled correctly, not a relevant route of exposure. Information on effects are given below.

Acute toxicity (list all possible routes of exposure)

Oral
Product: Not classified for acute toxicity based on available data.

Dermal
Product: Not classified for acute toxicity based on available data.

Inhalation
Product: No data available.
Not classified for acute toxicity based on available data.

Repeated dose toxicity
Product: No data available.

Skin Corrosion/Irritation
Product: Corrosive. (Rabbit): Corrosive.; Literature

Serious Eye Damage/Eye Irritation
Product: No data available.
Components:
sodium hydroxide — Risk of serious damage to eyes. OECD 405 Rabbit:

Respiratory or Skin Sensitization
Product: No data available.
Components:
sodium hydroxide — Sensitization test (man): Not a skin sensitizer.

Carcinogenicity
Product: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP, IARC, or OSHA.

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:
No carcinogens present or none present in regulated quantities

ACGIH: US.ACGIH Threshold Limit Values:
No carcinogens present or none present in regulated quantities

US. National Toxicology Program (NTP) Report on Carcinogens:
No carcinogens present or none present in regulated quantities

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050), as amended:
No carcinogens present or none present in regulated quantities

Germ Cell Mutagenicity

In vitro

Product:	No data available.
Components:	
sodium hydroxide	Ames test (OECD 471): negative gene mutation test (analogous OECD method): positive

In vivo

Product:	No data available.
Components:	
sodium hydroxide	Micronucleus test (analogous OECD method) Intraperitoneal (Mouse, Female, Male): negative

Reproductive toxicity
Product: No data available.

Specific Target Organ Toxicity - Single Exposure
Product: No data available.

Specific Target Organ Toxicity - Repeated Exposure
Product: No data available.

Aspiration Hazard

Product:	No data available.
Components:	
sodium hydroxide	Not applicable

Information on health hazards

Other hazards
Product: No data available.

12. Ecological information

Ecotoxicity:
Acute hazards to the aquatic environment:

Fish
Product: No data available.

Aquatic Invertebrates

Product:	No data available.
Components:	
sodium hydroxide	EC 50 (Ceriodaphnia, 48 h): 40.4 mg/l Literature

Toxicity to Aquatic Plants
Product: No data available.

Toxicity to microorganisms
Product: No data available.

Chronic hazards to the aquatic environment:

Fish
Product: No data available.

Aquatic Invertebrates
Product: No data available.

Toxicity to Aquatic Plants
Product: No data available.

Toxicity to microorganisms
Product: No data available.

Persistence and Degradability

Biodegradation
Product: No data available.

BOD/COD Ratio
Product: No data available.

Bioaccumulative potential

Bioconcentration Factor (BCF)
Product: No data available.

Partition Coefficient n-octanol / water (log Kow)
Product: Log Kow: No data available.

Mobility in soil:

Product No data available.

Results of PBT and vPvB assessment:

Product Not a PBT, vPvB substance as per the criteria of the REACH Regulation.

Other adverse effects:

Other hazards
Product: No further information available

Additional Information: no ecotoxicological studies with the product available.

13. Disposal considerations

Disposal methods: Discharge, treatment, or disposal may be subject to national, state, or local laws.

Contaminated Packaging: Dispose of container and unused contents in accordance with federal, state, and local requirements.

14. Transport information

Domestic regulation

49 CFR
UN/ID/NA number : UN 1824
Proper shipping name : Sodium hydroxide solution

Class	:	8
Packing group	:	II
Labels	:	8
ERG Code	:	154
Marine pollutant	:	no
Remarks	:	FOR USA ONLY: When shipping in, by or via USA note of the Reportable Quantity-Regulation!

International Regulations

IATA-DGR

UN/ID No.	:	UN 1824
Proper shipping name	:	Sodium hydroxide solution
Class	:	8
Packing group	:	II
Labels	:	8
Packing instruction (cargo aircraft)	:	855
Packing instruction (passenger aircraft)	:	851
Remarks	:	FOR USA ONLY: When shipping in, by or via USA note of the Reportable Quantity-Regulation!

IMDG-Code

UN number or ID number	:	UN 1824
Proper shipping name	:	SODIUM HYDROXIDE SOLUTION
Class	:	8
Packing group	:	II
Labels	:	8
EmS Code	:	F-A, S-B
Marine pollutant	:	no
Remarks	:	Keep separate from acids., FOR USA ONLY: When shipping in, by or via USA note of the Reportable Quantity-Regulation!

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

Special precautions for user

The transport classification(s) provided herein are for informational purposes only, and solely based upon the properties of the unpackaged material as it is described within this Safety Data Sheet. Transportation classifications may vary by mode of transportation, package sizes, and variations in regional or country regulations.

15. Regulatory information

US Federal Regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)
None present or none present in regulated quantities.

US. Toxic Substances Control Act (TSCA) Section 5(a)(2) Final Significant New Use Rules (SNURs) (40 CFR 721, Subpt E)
None present or none present in regulated quantities.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050), as amended
None present or none present in regulated quantities.

CERCLA Hazardous Substance List (40 CFR 302.4):

Chemical Identity
SODIUM HYDROXIDE

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

Corrosive to metal, Skin Corrosion or Irritation, Serious eye damage or eye irritation

US. EPCRA (SARA Title III) Section 304 Extremely Hazardous Substances Reporting Quantities and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Hazardous Substances

None present or none present in regulated quantities.

US. EPCRA (SARA Title III Section 313 Toxic Chemical Release Inventory (TRI) Reporting

None present or none present in regulated quantities.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):
None present or none present in regulated quantities.

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)

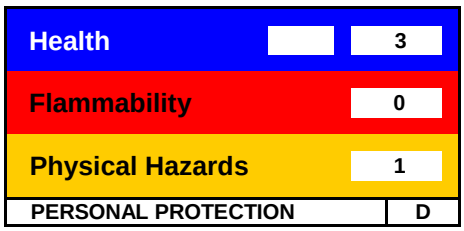
Chemical Identity
SODIUM HYDROXIDE

US State Regulations

US. California Proposition 65
No ingredient requiring a warning under CA Prop 65.

16.Other information, including date of preparation or last revision

HMIS Hazard ID



D - Face Shield, Gloves & Apron

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe; RNP - Rating not possible; *Chronic health effect

Issue Date:	09/08/2022
Version #:	1.0
Further Information:	No data available.
Revision Information	Changes since the last version are highlighted in the margin. This version replaces all previous versions.

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Safety Data Sheet

Hydrated Lime

Revision date:
July 11, 2019

1. Identification

Product Name: Hydrated Lime

Synonyms:
Chemical Hydrate
Commercial Hydrate
Hyd Chem SS,
Hyd Lime Chem,
Hydrate Tailings,
Hydrated Lime Kiln Dust,
Industrial Hydrate,
Pink Hydrate,

Recommended Uses: Water treatment, steel flux, caustic agent, pH adjustment, acid gas absorption, construction

Manufacturer: Carmeuse Americas

US Office
11 Stanwix Street, 21st Floor
Pittsburgh, PA 15222
Phone: (412) 995-5500
Fax: (412) 995-5594

Canadian Office
PO Box 190
Ingersoll, ON N5C 3K5
Phone: (519) 423-6283
Fax: (519) 423-6545

Emergency Contact: Infotrac: (800) 535-5053 (24 hrs a day, 7 days a week)

2. Hazards Identification

GHS classification

Physical Hazards

None

Health Hazards

Skin Irritation	Category 2
Eye Damage	Category 1
Carcinogenicity	Category 1A
Specific Target Organ Toxicity – Single Exposure	Category 3

GHS Label Elements:

Signal Word: Danger

Hazard Statements:
Causes skin irritation.
Causes serious eye damage.
May cause respiratory irritation.
May cause cancer through inhalation

Precautionary Statements:
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Keep container tightly closed
Do not breathe dust.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.
Use only outdoors or in well-ventilated area
Wear protective gloves, clothing and eye protection

Pictograms:

3. Composition

Chemical name	% by weight	CAS#
Calcium hydroxide	> 85	1305-62-0
Silica-crystalline quartz	< 1	14808-60-7

4. First Aid Measures

Eyes: Immediately flush eyes with generous amounts of water for at least 15 minutes. Pull back the eyelid to ensure that all lime dust has been washed out. Seek medical attention immediately. Do not rub eyes.

Skin: Wash exposed area with large amounts of water. Seek medical attention immediately.

Ingestion: Do not induce vomiting. Seek medical attention immediately. Never give anything by mouth unless instructed to do so by medical personnel.

Inhalation: Move victim to fresh air. Seek medical attention if necessary. If breathing has stopped, give artificial respiration

Most Important Symptoms: Irritation of skin, eyes, gastrointestinal tract or respiratory tract.

Immediate medical attention / special treatment? See first aid information above. Note to Physicians: Provide general supportive measures and treat symptomatically.

5. Fire Fighting Measures

Suitable (and unsuitable) fire extinguishing media: Use dry chemical fire extinguisher. Do not use water or halogenated compounds, except that large amounts of water may be used to deluge small quantities of this product.

Specific hazards arising from the product	Inhalation, skin or eye contact, can result in serious injury. This product is not combustible or flammable. This product is not considered to be an explosion hazard, although reaction with water or other incompatible materials may rupture containers. When this product is wet, it can be very slippery and can result in a slip hazard. Hazardous Combustion Products: None.
Special protective equipment and precautions for fire fighters	Wear full fire-fighting turn-out gear (full Bunker gear), and respiratory protection (SCBA) to prevent inhalation, skin or eye contact.

6. Accidental Release Measures

Personal precautions, protective equipment, emergency procedures:

Avoid inhalation, eye and skin contact. Avoid generating airborne dust. Wear appropriate protective clothing as described in section 8.

Methods and materials for containment and clean up:

Utilize cleanup methods that minimize generating dust: vacuum. Avoid dry sweeping. Residue on surfaces may be removed with copious amount of water or vinegar.

7. Handling & Storage

Safe Handling: Avoid inhalation, skin and eye contact. Avoid generating airborne dust. An eye wash station should be readily available when this product is handled.

Safe Storage: Keep in tightly closed containers. Protect containers from physical damage. Store in a cool, dry, and well-ventilated location. Do not store near incompatible materials (see Section 10 below). Keep away from moisture. Long-term storage in aluminum containers is not recommended, as calcium oxide may corrode aluminum over long periods of time

8. Exposure Controls/Personal Protection

Occupational Exposure Limits

	OSHA PEL (mg/m^3)	ACGIH TLV (mg/m^3)	Ont. Reg. 833 TWAEV (mg/m^3)
Calcium hydroxide	15 (total) 5 (respirable)	5	5
Silica, *crystalline quartz, cristobalite and tridymite*	0.05 (respirable)	0.025 (respirable)	0.1

Engineering Controls: Use with adequate general or local exhaust ventilation and to maintain exposure below occupational exposure limits.

Individual Protection Measures (Personal Protective Equipment):

Specific Eye / Face Protection:	Safety glasses with side shields. In windy conditions, or if work activity generates elevated airborne dust levels, dust proof or chemical goggles are recommended. Contact lenses should not be worn.
Specific Skin Protection:	When there is a risk of skin contact, wear appropriate clothing and gloves to prevent contact.
Specific Respiratory Protection:	If exposure limits are exceeded, an approved particulate respirator, or supplied air respirator, appropriate for the airborne concentrations, should be used. Selection and use of the respiratory protective equipment must be in accordance with applicable regulations and good industrial hygiene practices.
Other:	An emergency eye wash fountain and shower are recommended.

9. Physical & Chemical Properties

Appearance:	White powder
Odor:	Odorless
Odor threshold:	Not Applicable
pH at 25 degrees C:	12.45
Melting Point:	1076 °F (580 °C)
Boiling Point and range:	5162 °F (2850 °C)
Flash Point:	Not Applicable
Evaporation Rate:	Not Applicable
Flammability:	Not Applicable
Upper/lower flammability or explosive limits	Not Applicable
Vapor pressure/density:	Non Volatile
Relative density:	2.24
Solubility:	Slightly soluble in water: 0.2% @ 0 °C. Soluble in acids, glycerin, and sugar solutions
Partition coefficient: n-octanol/water	Not applicable
Auto-ignition temperature:	Not Available
Decomposition temperature:	Not available
Viscosity:	Not Applicable

10. Stability & Reactivity

Reactivity: Reacts with acids to form calcium salts, releasing heat. Reacts with carbon dioxide in air to form calcium carbonate. See also Incompatibility below.

Chemical stability: Stable under normal storage and handling conditions.

Possibility of Hazardous Reactions: See "reactivity" above.

Conditions to avoid: Vicinity of incompatible materials.

Incompatibility: This product should not be mixed or stored with the following materials, due to the potential for violent reaction and release of heat:

- acids
- reactive fluoridated compounds
- reactive brominated compounds
- reactive powdered metals
- reactive phosphorous compounds
- aluminum powder
- organic acid anhydrides
- nitro-organic compounds
- interhalogenated compounds

Hazardous decomposition products: None

11. Toxicological Information

Likely routes of exposure & symptoms:

Eyes: Contact can cause severe irritation or burning of eyes, including permanent damage.

Skin: Contact can cause severe irritation or burning of skin, especially in the presence of moisture.

Ingestion: This product can cause severe irritation or burning of gastrointestinal tract if swallowed.

Inhalation: This product can cause severe irritation of the respiratory system.

Chronic health effects: This product contains trace amounts of crystalline silica. Prolonged or repeated inhalation of respirable crystalline silica can cause silicosis, as serious lung disease.

Respiratory or skin sensitization: This material is not known to cause sensitization

Germ cell mutagenicity: No data available.

Carcinogenicity:	This product is not listed as carcinogenic by OSHA, IARC, NTP, ACGIH, or the EU Directives. This product may contain trace amounts of crystalline silica quartz which is listed by IARC as “Carcinogenic to Humans” (Group 1) and “Known to be a Human Carcinogen" by NTP (National Toxicology Program).
Reproductive toxicity:	No Data Available.
Numerical Measures of Toxicity	Crystalline Silica: Oral Rat LD_{50} > 22,500 mg/kg Calcium Hydroxide: Oral (rat) LD_{50}: 7340 mg/kg

12. Ecological Information

Because of the elevated pH of this product, it might be expected to produce some ecotoxicity upon exposure to certain aquatic organisms and aquatic systems in high concentrations
This material shows no bioaccumulation effect or food chain concentration toxicity.

13. Disposal Considerations

Dispose of contents in accordance with federal, state, provincial and local regulations.

14. Transport Information

Not regulated by Department of Transportation, Transport of Dangerous Goods

15. Regulatory Information

CERCLA Hazardous Substances	Not listed
SARA Toxic Chemical (40 CFR 372.65)	Not listed
SARA Section 302 Extremely Hazardous Substances (40 CFR 355)	Not listed
SARA 311/312	Not listed
SARA Section 313 Toxic Chemicals reporting requirements	None
Threshold planning quantity (TPQ)	Not listed
RCRA Hazardous Waste Classification (40 CFR 261)	Not Classified
EPA Toxic Substances Control Act (TSCA) Status	The components of this product are each listed on the TSCA Inventory List in the “active” status.
California Proposition 65	Airborne crystalline silica particulates of respirable size are known to the State of California to cause cancer.
NFPA ratings	Health: 3 Fire: 0 Reactivity: 0
HMIS Ratings	Health: 3 Fire: 0 Reactivity: 0 Personal protection: E
OSHA Specifically regulated substance (29 CFR 1910)	Not listed
OSHA Air contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)	Listed
MSHA	Not listed
Canada DSL	Listed

Canadian WHMIS Classification	D2A, Materials Causing other toxic effects. E, Corrosive Material

Canada CPR This product has been classified in accordance with the hazard criteria of the Controlled Products Regulation of a Canada and this SDS contains all the required information.

16. Other Information

List of GHS Hazard Statements:	H315: Causes skin irritation H318: Causes serious eye damage H335: May cause respiratory irritation. H350: May cause cancer through inhalation
List of GHS Precautionary Statements:	P201: Obtain special instructions before use. P202: Do not handle until all safety precautions have been read and understood. P233: Keep container tightly closed P260: Do not breathe dust. P264: Wash thoroughly after handling. P270: Do not eat, drink or smoke when using this product. P271: Use only outdoors or in well-ventilated area P280: Wear protective gloves, clothing and eye protection

Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation and Liability Act	RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act	IARC	International Agency for Research on Cancer
NTP	National Toxicology Program		

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Appendix C – Cost Estimate

FORMER DUSO CHEMICAL SITE ISCO PILOT TEST WORK PLAN
Site #:314103
ISCO Pilot Injection

Callout
Construction Cost Estimate

FORMER DUSO CHEMICAL SITE ISCO PILOT TEST WORK PLAN

Site #:314103

ISCO Pilot Injection

Unit Pricing

By:	MJZ	Cked By:	JM/LM
Date:	12/15/2022	Date:	12/23/2022

Bid Item	Description of Bid Item	Unit of Measure
UC-1	Monitoring Well and Piezometer Installation, Soil Borings	LF

2 shallow monitoring wells will be installed at 15 ft. deep each (30 ft.)	$	20.00
2 deep monitoring wells will be installed at 25 ft. deep each (50 ft.)	$	20.00
3 piezometers will be installed at 15 ft. deep each (45 ft.)	$	20.00
125 Total Feet		
Total Cost		**$60.00**

A Geoprobe DPT rig will be required onsite for the duration of the monitoring well/piezometer installation events.

$2,500/day x 5 days: **$ 12,500.00**

$400.00 per mobilization/demobilization **$ 400.00**

Geoprobe Cost: **$ 12,900.00**

A Geoprobe DPT rig will be required onsite to install 2 soil borings at 25 ft. deep each (50 ft.) (6 months post-injection monitoring) (Assume baseline soil samples will be collected from PMW-1S/D and PMW-2S/D during installation)

$2,500/day x 1 day: **$ 2,500.00**

$400.00 per mobilization/demobilization **$ 400.00**

Geoprobe Cost: **$ 2,900.00**

Est. $ 23,300.00

FORMER DUSO CHEMICAL SITE ISCO PILOT TEST WORK PLAN

Site #:314103

ISCO Pilot Injection

Unit Pricing

By:	JM	Cked By:	MZ/LM
Date:	12/14/2022	Date:	4/17/2023

Bid Item	**Description of Bid Item**	**Unit of Measure**
UC-2	ISCO Pilot Test Injection	Lump Sum

Total Cost of Klozur KP	$88,706
Total Cost of Klozur SP	$41,230
Soil SOD and VOC Analysis	$4,000
Total Cost of Hydrated Lime	$7,200
Total Cost of NaOH Solution	$20,533
Total Cost of ISCO Injection Materials	$161,669
Add 12% for Taxes and Shipping	$19,400
Total Cost	**$181,069**

Pilot Test will require 15 total days to complete.

A Geoprobe DPT rig will be required onsite for the duration of the injection events.
The rig will be mobilized and demobilized once during the event.
$2,500/day x 15 days: **$ 37,500.00**
$400.00 per mobilization/demobilization **$ 400.00**
Geoprobe Cost: **$ 37,900.00**

Project Manager = 15 days x 2 hours per day x $60.00 per hour:	**$ 1,800.00**
Geologist = 15 days x 8 hours per day x $44.00 per hour:	**$ 5,280.00**
Utility Truck = 15 days x 8 hours per day x $23.10 per hour:	**$ 2,772.00**
Skid Steer Loader = 15 days x 8 hours per day x $49.50 per hour:	**$ 5,940.00**
Miscellaneous Mechanical = 15 days x $250 per day:	**$ 3,750.00**
Generator = 15 days x 8 hrs per day x $11 per hour	**$ 1,320.00**
Trash pump = 15 days x 8 hrs per day x $6 per hour	**$ 720.00**
Water level meter and multiparameter probe = 15 days x $55/day	**$ 825.00**
Drainage Swale bypass (4" pipe and sandbags) = 150 lf x $5 per lf	**$ 750.00**

Total Cost = **$242,126.28**

16	injection points
20	intervals per point
320	injection intervals
24.3	gal slurry per interval
5.0	gpm slurry (from EISB Pilot Test report ERH boring logs)
4.9	min per interval
11.0	gal NaOH solution
1.0	gpm NaOH solution (from EISB Pilot Report)
11.0	min
15.9	injection time per interval
5	min for setup at each interval
20.9	total injection time per interval
111	total injection time in hrs (all 16 points)
2	number of simultaneous injection points (manifolded, one geoprobe rig)
56	total injection time (hrs)
9.3	assumes 8 hr days onsite, 1 hr for setup, 1 hr for cleanup = 6 injection hrs
10	total number of injection days with 6 injection hrs per day
2	added contingency days
3	added days for site setup, equipment/reagent delivery, stormwater protection setup, hand auger to 5-ft, demob.
15	**ISCO Pilot Field Duration**

Notes:
- Assumes "sandwich method" of NaOH/slurry/NaOH does not add significant time per injection interval

FORMER DUSO CHEMICAL SITE ISCO PILOT TEST WORK PLAN
Site #:314103
ISCO Pilot Injection
Unit Pricing

	By: JM	Cked By:
	Date: 12/16/2022	Date:

Bid Item	Description of Bid Item	Unit of Measure
UC-3	Health and Safety	Day

Health and Safety: $1,500/day (Includes Labor, PPE, CAMP, and Daily Reporting)

Est. $1,500/day

Well Installation: 5 days
(Health and Safety and Community Air Monitoring Required)

Sodium Persulfate: 15 days
(Health and Safety Required)

Est. $1,500/day

[1]See "Cold Spring Bid Tabulation" in Estimate Backup.

FORMER DUSO CHEMICAL SITE ISCO PILOT TEST WORK PLAN
Site #:314103
ISCO Pilot Injection
Unit Pricing

By:	JM	Cked By:	MG
Date:	12/6/2022	Date:	7/27/2022

Bid Item	Description of Bid Item	Unit of Measure
LS-1	Mob/Demob & Site Prep	Lump Sum

Assumed to be 10% of bid amount, not including LS-1 or LS-2

Est. $33,748

FORMER DUSO CHEMICAL SITE ISCO PILOT TEST WORK PLAN
Site #:314103
ISCO Pilot Injection
Unit Pricing

	By:	JM	Cked By:
	Date:	12/6/2022	Date:

Bid Item	Description of Bid Item	Unit of Measure
LS-2	Site Services	Day

Assumed to be 10% of bid amount, not including LS-1 or LS-2

Est. $33,748

FORMER DUSO CHEMICAL SITE ISCO PILOT TEST WORK PLAN

Site #:314103

ISCO Pilot Injection

Unit Pricing

By:	MZ	Cked By:	JM/LM
Date:	12/16/2022	Date:	12/16/2022

Bid Item	Description of Bid Item	Unit of Measure
LS-3	Site Survey	Lump Sum

Services include the following:

1. Establish survey control
2. Pre-stakeout of 5 proposed wells and 16 proposed injection points
3. Survey surficial features
4. Survey public right-of-ways
5. Survey as-built x-y-z of constructed wells
6. Base map preparation
7. Construction coordination with Prime Contractor, Engineer, and Municipalities
8. Submittals including: electronic files, field notes, and as-built survey

Est. **$10,000**

FORMER DUSO CHEMICAL SITE ISCO PILOT TEST WORK PLAN
Site #:314103
ISCO Pilot Injection
Unit Pricing

		By: JM	Cked By:
		Date: 12/16/2022	Date:

Bid Item	**Description of Bid Item**	**Unit of Measure**
LS-4	Performance Monitoring	Lump Sum

5 total performance monitoring events x 2 total days per performance monitoring event:
AECOM to perform **10** days

Laboratory analysis of VOCs and Sulfate for 5 events from 10 wells plus one VOC dup and one MS/MSD
Laboratory analysis of TOC, TPH, iron, and alkalinity for 2 events from 10 wells

	Unit Cost	Qty	Total	
VOCs	$ 42	60	$ 2,520	
Sulfate	$ 14	50	$ 700	
TOC	$ 18	20	$ 360	
TPH	$ 40	20	$ 800	
Iron	$ 4	20	$ 80	
Alkalinity	$ 42	20	$ 840	*No unit price in NYSDEC guidance, estimated*

Total: **$ 5,300.00**

Price per event (lab and labor): **$ 1,060**

Est.: $ 1,060.00 /event

FORMER DUSO CHEMICAL SITE ISCO PILOT TEST WORK PLAN
Site #:314103
ISCO Pilot Injection
Unit Pricing

		By: JM	Cked By: LM
		Date: 12/16/2022	Date: 12/23/2022

Bid Item	Description of Bid Item	Unit of Measure
LS-5	Investigation Derived Waste	Lump Sum

Monitoring Well Installation:
5 drums to be disposed of.
$200/drum for disposal
Cost: $ 1,000.00
Pick-up from Site and Transportation to Disposal Facility
Cost: $ 700.00

Total Cost: $ 1,700.00

Est. $ 1,700

FORMER DUSO CHEMICAL SITE ISCO PILOT TEST WORK PLAN
Site #:314103
ISCO Pilot Injection
Unit Pricing

	By:	JM	Cked By:
	Date:	12/16/2022	Date:

Bid Item	Description of Bid Item	Unit of Measure
LS-6	Onsite Transport	Day

One Equipment Operator - CDL will be required for 10 hours per day in order to transport the reagent from the staging area onsite to the injection locations.

The Equipment Operator - CDL will operate a tanker truck > 2,000 gal. during this time.

Equipment Operator - CDL - $83.00/hour x 10 hours/day = $830/day
Tanker Truck > 2,000 gal. - $84.00/hour x 10 hours/day = $840/day

Est. $1,670 per day

CONSTRUCTION COST ESTIMATE FOR ISCO PILOT INJECTION

		ISCO Pilot Test Injection and Performance Monitoring			
ITEM NO.	**DESCRIPTION**	**UNIT**	**UNIT PRICE**	**EST QTY**	**TOTAL PRICE**
UC-1	Monitoring Well and Piezometer Installation, Soil Borings	Lump Sum	$23,300	1	**$ 23,300**
UC-2	Sodium Persulfate Injection	Lump Sum	$242,126	1	**$ 242,126**
UC-3	Health and Safety	Day	$1,500	20	**$ 30,000**
LS-1	Mob/Demob & Site Prep	Lump Sum	$33,748	1	**$ 33,748**
LS-2	Site Services	Lump Sum	$33,748	1	**$ 33,748**
LS-3	Site Survey	Lump Sum	$10,000	1	**$ 10,000**
LS-4	Performance Monitoring	Lump Sum	$5,300	1	**$ 5,300**
UC-1, UC-2, UC-3, LS-1, LS-2, LS-3, LS-4 SUBTOTAL					**$ 378,222**
CONTINGENCY (10% of Subtotal)					**$ 37,822**
UC-1, UC-2, UC-3, LS-1, LS-2, LS-3, LS-4 GRAND TOTAL					**$ 416,044**
LS-5	Investigation Derived Waste	Lump Sum	$1,700	1	**$ 1,700**
LS-6	Onsite Transport	Day	$1,670	15	**$ 25,050**
LS-5 AND LS-6 SUBTOTAL					**$ 26,750**
CONTINGENCY (10% of Subtotal)					**$ 2,675**
LS-5 AND LS-6 GRAND TOTAL					**$ 29,425**
OVERALL GRAND TOTAL					**$ 445,469**

Highlighted item = 10% of total of all non-highlighted items (UC-1, UC-2, UC-3, LS-3, LS-4, LS-5, LS-6)