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JUNE 2017 – JUNE 2018 ANNUAL SITE MANAGEMENT-PERIODIC REVIEW REPORT

D.C. Rollforms Site
Jamestown, New York
NYSDEC Site No. 907019

July 2018

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ACRONYMS AND ABBREVIATIONS

AC	air compressor
acfm	actual cubic feet per minute
AGC	Annual Guidance Concentration
AS	air stripper
B	blower
BPU	Board of Public Utilities
CAMP	Community Air Monitoring Plan
CF	cartridge filters
COC	Constituents of Concern
DCE	Dichloroethene
DNAPL	Dense Non-Aqueous Phase Liquid
DRO	Diesel Range Organics
FSP	Field Sampling Plan
gpm	gallons per minute
GRO	Gasoline Range Organics
In W.C.	Inches of Water Column
ISCO	In-Situ Chemical Oxidation
kg	kilograms
lbs	pounds
LPGOC	Liquid Phase Granular Organically Modified Clay
MW	monitoring well
NAPL	Non-Aqueous Phase Liquid
ND	non-detect
NYSDEC	New York State Department of Environmental Conservation
O&G	Oil and Grease
O&M	Operation and Maintenance
OM&M	Operation, Maintenance and Monitoring
OW	observation well
OWS	oil/water separator

PCBs	polychlorinated Biphenyls
PLC	programmable logic controller
POTW	Publicly Owned Treatment Works
SMP	Site Management Plan
SP	sample port
SVE	soil vapor extraction
TCE	Trichloroethene
TP	transfer pump
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
µg/L	micrograms per liter
mg/L	milligrams per liter
USEPA	United States Environmental Protection Agency
VC	Vinyl Chloride
VEP	Vacuum Enhanced Pumping
VOCs	Volatile Organic Compounds
VPGAC	vapor phase granular activated carbon

1 EXECUTIVE SUMMARY

Arcadis of New York, Inc. (Arcadis), on behalf of Ingersoll Rand, has prepared this Annual Site Management Periodic Review Report (PRR) for the former D.C. Rollforms (NYSDEC Site Code 907019) Site (referred to hereafter as the Site) located in Jamestown, Chautauqua County, New York (Figure 1). This PRR covers the reporting period from June 2017 through June 2018. This PRR summarizes the operational and performance monitoring data generated during June 2017 – June 2018 reporting period for the remedial program at the Site. The basis of this report is to satisfy the requirements set forth in the Site Management PRR, as requested by NYSDEC in a letter date May 2, 2018.

A groundwater and soil vapor extraction treatment system (referred to herein as the 'system') was installed at the site in 2007. The system has been operational since 2008 (10 years) and consists of a vacuum enhanced pumping (VEP) system which recovers and treats site constituents of concern (COCs), which mainly consist of chlorinated volatile organic compounds (VOCs) trichloroethene (TCE), dichloroethene (DCE), and vinyl chloride (VC).

Overall, the current remedial program has been effective in achieving the remedial goals at the site by containing and eliminating off site migration of contaminated soils and groundwater. And reducing the COC concentrations in soil and groundwater. During the June 2017 – June 2018 period, the system recovered 2,183,820 gallons of impacted groundwater. Total COC mass removal included 15 kg in the dissolved phase, 3.5 kg in the vapor phase, and 4.25 gallons of dense non-aqueous phase liquid (DNAPL).

All the elements defined in the Operation, Maintenance & Monitoring (OM&M) Plan (ARCADIS 2008) and Site Management Plan (SMP) (ARCADIS 2009) were in compliance during the reporting period. The remedial system was operated continuously during the reporting period, except for noted routine and/or non-routine maintenance activities. No substantial changes were made regarding site management and remedial system operation during the specified reporting period.

The Site conceptual model is well defined and is based on soil and groundwater data collected during previous investigations, which included the groundwater and remedial system analytical data that have been collected since 2008. Based on the trends in Site COC concentrations in groundwater a pilot-scale in-situ chemical oxidation (ISCO) injection approach was conducted to enhance remediation of the residual groundwater plume at the site. The pilot study took place October 2016 through November 2017 in the area near monitoring wells MW-8S, MW-12, and MW-13, and MW-14, which historically have had the highest concentration of VOCs in groundwater. Overall, the one-year post-pilot study results were very promising. A reduction of 85 to 99% of the VOC mass was achieved, and maintained within the groundwater monitoring well network, except for MW-14, where some rebound in concentrations occurred between 6 months and 12 months following the injections. Based on the overall pilot study results and current groundwater data, an additional ISCO injection event will be performed. The full-scale ISCO injection work plan is discussed in further detail in Section 10.

The PRR is organized as follows:

- Section 2 provides a brief overview of the Site location and physical description, Site Geology/Hydrogeology, extent of contamination, summary of remedial actions.

- Section 3 summarizes the system O&M and Site inspections.
- Section 4 discusses the system performance.
- Section 5 provides an evaluation of the system performance.
- Section 6 summarizes the system groundwater monitoring.
- Section 7 provides a detailed summary of the ISCO pilot study program.
- Section 8 provides conclusions by summarizing the system performance and groundwater monitoring results.
- Section 9 discusses the institutional and engineering controls.
- Section 10 discusses the future goals and recommendations for the site.
- Section provides a list of references.

2 SITE OVERVIEW

2.1 Site Location and Description

The Site is located at 583 Allen Street in Jamestown, Chautauqua County, New York (Figure 1). The Site is approximately 2.38 acres in size and is a vacant parcel. The vacant parcel is owned by All Metal Press and Fabrication, Inc., which acquired the property from the Jamestown Allen Co. in 2016, and is bounded by Allen Street on the east, the Weber Knapp and Jamestown Urban Renewal Agency properties on the south, and the Chadakoin River on the west and northwest. The adjacent north parcel is owned by All Metal Press and Fabrication, Inc. This parcel contains a two-story building and parking lot (Figure 2). The Site is located in a mixed residential and commercial area, which is served by a public water supply and sanitary sewer.

2.2 Summary of Site Geology and Hydrogeology

The subsurface geologic conditions at the site consist mainly of two overburden units; a surficial layer of fill material and an underlying dense till. Along the western side of the site and adjacent to the Chadakoin River, an approximate 2 to 4-foot thick layer of native deposits consisting of sand, silt, and gravel, occurs between the fill and till layers. The fill layer consists of sand, gravel, cinders, bricks, concrete, and slag and varies in thickness from 7 to 15 feet. The thickness of till varies from less than one foot to over 15 feet. The till is underlain by shale bedrock. The on-site surface water and groundwater flow in a west-northwesterly direction towards the Chadakoin River.

The horizontal hydraulic conductivity of the surficial fill material, based on slug tests in monitoring wells, is in the range of 10^{-3} to 10^{-4} centimeters per second (cm/s). The underlying till is generally dense silt and clay-rich soil with a horizontal hydraulic conductivity, based on slug tests, on the order of 10^{-6} cm/s.

2.3 Nature and Extent of Contamination

The following sections describe the historical nature and extent of the contamination onsite identified during the initial and previous remedial investigations (RI). Previous investigations at the site include Phase I and Phase II Environmental Site Assessments (ESAs) and a supplemental environmental investigation. Empire Soils Investigations performed these investigations for Dowcraft Corporation in 1990 and 1991 (Empire Soils Investigations, 1990a, 1990b, 1991b). The Phase II ESA consisted of a sub-surface soil and groundwater investigation. Eight test pits were excavated, and subsurface soil samples were collected from several of these test pits for analysis. Seven monitoring wells were installed, and groundwater samples were analyzed. To determine the nature and extent of contamination, a Remedial Investigation (RI) was conducted. The RI was completed by ARCADIS G&M was conducted in two phases; the first phase was completed in April 1998 and the second in February 1999. A summary of the RI results is summarized in the following sections.

2.3.1 Surface Soil

During the initial RI surface soil samples were collected at fifteen locations throughout the site. VOCs were not detected in any of the surface soil samples. Analysis of semi-volatile organic compounds (SVOCs) indicated total SVOC concentrations ranging from 2.8 milligrams per kilogram (mg/kg) to 89 mg/kg. The surface soils from select areas onsite were removed during the construction of the remedial construction (2007). All other remaining site surface areas were covered with one foot of clean fill.

2.3.2 Subsurface Soil

During the initial 1991 investigation, eight test pits were excavated, and subsurface soil samples were collected from six locations where visual contamination was present. Analytical results indicated contamination of metals above the regulatory guidance (Technical Administrative Guidance Memorandum [TAGM-4046]), at that time, levels for arsenic, cadmium, chromium, copper, mercury, nickel, and zinc. No VOCs were detected in unsaturated sub-surface soil samples. Oil and grease varied from 0.21% to 7.1% while cyanide ranged from non-detect (ND) to 15.4 mg/kg.

During the first phase of the remedial investigation, a sub-surface soil sample collected from location GP-13 in the delisted northern parcel indicated metal contamination, primarily due to lead (86,900 mg/kg). In February 2000, 19 additional test pits were excavated to determine the extent of lead contamination in the northern parcel. Samples collected from the test pits indicate total lead levels ranged from 20 to 33,100 mg/kg. The results of TCLP lead analysis determined that soils were not a hazardous waste as the TCLP levels for lead were below the regulatory limit of 5 milligrams per liter (mg/L).

Eighteen test pits were excavated in 2000. Total VOCs ranged from 0.024 to 66 mg/kg as compared to the regulatory cleanup guidance value at the time (TAGM) of 10 mg/kg. Total VOCs in excess of 10 mg/kg were identified in TP-11, TP-12, and TP-15. SVOCs concentrations ranged from ND to 79 mg/kg.

2.3.3 Groundwater

Fifteen groundwater monitoring wells and 27 Geoprobe were installed and sampled during the remedial investigation between 1997 and 2000. VOCs including TCE, DCE, VC were reported in several

groundwater samples. The highest level of chlorinated solvents was reported in monitoring wells MW-8 S/D and Geoprobe GP-5 located in the former TCE, paint and thinner storage area. At GP-5, concentrations of TCE and DCE were 830 mg/L and 34 mg/L, respectively. At MW-8S/D, levels of TCE, DCE, and VC varied from 0.096 to 920 mg/L, 7.1 to 18 mg/L and ND to 1.6 mg/L, respectively. Tetrachloroethene (PCE) was also found in MW-8D at a concentration of 1.1 mg/L. In October 1999, 5 additional Geoprobe were installed and were sampled during the investigation to determine the extent of total VOCs. Samples collected from these Geoprobe samples indicated elevated levels of VOCs. The highest levels were found in Geoprobe GP-30 with VC, DCE, and TCE ranging 17 mg/L, 40 mg/L, and ND, respectively.

Total SVOCs, consisting primarily of polycyclic aromatic hydrocarbons (PAHs), were present in most of the groundwater samples. Due to high detection limits, the comparison of individual SVOC contaminant levels to groundwater standards is not, however, feasible. The highest concentrations of PAHs were in Geoprobe GP-5 (61 mg/L) and in GP-6 (249 mg/L). The concentrations of SVOCs in the remaining wells varied from ND to 3.6 mg/L.

Non-Aqueous Phase Liquid (NAPL) consisting primarily of total petroleum hydrocarbons (TPHs) was observed in ESI-3, ESI-4, and MW-8S. The highest concentrations of TPHs were recorded in GP-6 (2,406 mg/L, ESI-3 (421 mg/L), and GP-5 (333 mg/L).

2.3.4 Soil Vapor

Off-site soil vapor intrusion was raised as a concern by the New York State Department of Health (NYSDOH) in a letter dated May 5, 2014, citing the possibility of a preferential pathway for vapor movement via the onsite treatment systems discharge pipeline bedding material. A soil vapor investigation (SVI) was completed in accordance with the Soil Vapor Investigation Work Plan (Arcadis 2014) and the Response to Comments of the Soil Vapor Investigation Work Plan (Arcadis 2014) which were approved by the NYSDEC in an email received August 11, 2015.

Of the three site related chemicals (e.g., cis-DCE, TCE and VC), only TCE was detected in soil vapor. Cis-1,2-dichloroethene and vinyl chloride were not detected in any soil vapor sample. Although TCE was detected in soil vapor samples, all concentrations were below the soil vapor screening values calculated using the NYSDOH Air Guideline Value for TCE.

2.4 Summary of Remedial Actions

2.4.1 Summary of Interim Remedial Measures

The interim remedial measures (IRM) conducted onsite are listed and briefly summarized below. Further details for each IRM can be found in the referenced historically documents.

- Manual free product recovery activities were initiated in September 1998 to collect light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL) in wells ESI-3, and ESI-4. In addition, manual bailing of periodic trace DNAPL detected in well MW-8D was initiated in February 1999 (ARCADIS G&M 1999).
- Lead impacted soil removal in the area of Geoprobe GP-13 (located on the delisted parcel north of the building) was completed in October 1999, approximately 18 tons of soil were removed. Following an

additional investigation in January 2000, to further delineate the lead impacts, approximately 929 tons of lead impacted soils were removed and disposed offsite in May 2000.

- Polychlorinated biphenyls (PCBs) impacted soils were identified/delineated near surface sample locations SS-1 and SS-1A (located near monitoring wells ESI-1, ESI-2, and ESI-7), and subsequently excavated and disposed offsite in August 2000.
- Enhanced Reductive Dechlorination (ERD) pilot test was selected and implemented in 1998 in the area of monitoring wells MW-7 and MW-8S to address the total VOC impacts in groundwater. Following the initial pilot test period, the reagent injections were continued through 2004. The injection program was discontinued following the October 2004 injection event in anticipation of the design and implementation of the remedy (ARCADIS G&M 2005).

2.4.2 Summary of Full-Scale Remedy

The approved remedy for the Site was document the NYSDEC approved 100% Remedial Design Work Plan (ARCADIS, 2006). The final remedy for this Site was documented in the Engineering Construction Completion Report (ARCADIS, 2009), which documented the remedial construction activities which were initiated in September 2006 and completed in June 2008. The SMP was finalized and approved by NYSDEC in 2009. The final remedy implemented for the D.C. Rollforms Site includes the following elements:

- Installation of a steel interlocking sheet-pile wall (i.e., vertical barrier wall) at the top of the riverbank between the Chadakoin River and the Site;
- Vacuum Enhanced Pumping technology utilizing submersible pneumatic pumps and a regenerative blower to remediate NAPL and VOCs in groundwater and soil;
- Groundwater and soil vapor treatment system comprised an oil/water separator, solids filtration units, carbon filtration, and air stripping technologies;
- Excavation of the soil between the vertical barrier wall and Chadakoin River;
- Removal of abandoned Site storm water outfalls;
- Riverbank reconstruction/stabilization and restoration including live plantings;
- Covering and reseeding disturbed areas with 12-inches of clean soil;
- The removal of sediment from the Chadakoin River; and
- Fish habitat construction (e.g., wingwall structure) in the Chadakoin River.

The remedial system layout is shown on the site plan in Figure 2. The groundwater collection system is designed to extract groundwater impacted by NAPL and VOCs consisting primarily of TCE, total DCE, and VC. The extracted groundwater is treated via an oil/water separator (OWS), filtration, and air stripping prior to discharge to the publically owned treatment works (POTW) sanitary sewer under an Industrial Waste Water Discharge permit with the Jamestown Board of Public Utilities (BPU).

2.4.3 Engineering Controls

As part of the remedy, engineering controls implemented and maintained at the D.C. Rollforms Site include:

- Installation of a steel interlocking sheet-pile wall (i.e., vertical barrier wall) at the top of the riverbank between the Chadakoin River and the Site;

- Vacuum Enhanced Pumping technology utilizing submersible pneumatic pumps and a regenerative blower to remediate NAPL and VOCs in groundwater and soil; and
- Groundwater and soil vapor treatment system comprised an oil/water separator, solids filtration units, carbon filtration, and air stripping technologies.

2.4.4 Institutional Controls

Institutional controls have been implemented as part of the Remedial Action. The Declaration of Covenants and Restrictions dated June 2005 addresses prohibitions on the property. The prohibitions set forth in the declaration are summarized as follows:

- The property is prohibited from ever being used for purposes other than commercial or industrial;
- The use of groundwater underlying the property is prohibited without rendering it safe for drinking water or industrial/commercial purposes; and
- The owner of the property shall continue to not interfere with any institutional and engineering controls the NYSDEC required Ingersoll Rand to put into place and maintain.

The covenants and restrictions run with the land and are binding upon all future owners of the property.

2.4.5 Remedial Enhancements

In 2016, Arcadis implemented an ISCO pilot study in order enhance remediation of the residual groundwater plume at the site. The pilot study took place October 2016 through November 2017 in the area near targeted monitoring wells MW-8S, MW-12, and MW-13, and MW-14, which historically have had the highest concentration of VOCs in groundwater. Three injection wells were installed upgradient of the targeted monitoring wells and were screened from approximately 11 to 15 feet below ground surface (ft bgs). Overall, the pilot study results were very promising. A reduction of 85 to 99% of the VOC mass was achieved within three of the four groundwater monitoring wells. These results are discussed in further detail below in Section 7.

3 SITE OPERATION AND MAINTENANCE SUMMARY

The system is operated as documented in the Operation, Maintenance, and Monitoring Plan (OM&M Plan; ARCADIS 2008). The following sections summarize the remedial system O&M program. The remedial system was operated from June 2017 through June 2018 reporting period with brief periods of shutdown due to scheduled operation and maintenance (O&M), and/or alarm conditions, as well as repairs and non-routine maintenance activities.

Monthly O&M site visits consisted of system inspection, recording of operating parameters, influent and effluent system sampling, and investigation/troubleshooting of any alarm conditions. System alarm verification was performed remotely via desktop software. The O&M data generated during each monthly visit are documented in field notes. O&M related to each of the major system components (collection system, liquid and vapor treatment) are discussed below.

3.1 Collection and Treatment System O&M

The following O&M tasks were performed monthly on the remedial system (pneumatic pumps, air compressor, regenerative blower, transfer pump, and related equipment).

3.1.1 Liquid Phase Treatment

The following OM&M tasks were performed monthly and/or quarterly with regards to the liquid phase extraction and treatment portion of the system:

- Inspection of all pipes and fittings for potential leaks;
- Checking air compressor (AC-600) oil level and pressure to assure proper operation;
- Inspection of pneumatic recovery pumps for proper operation and repair/cleaning, as needed;
- Inspection and cleaning of air stripper (AS-700), as needed;
- Inspection of flow meter (FQI-700) to assure proper operation;
- Monitor and record the system field gauge readings to determine if the system is operating within the designed operational ranges;
- Check and record pressure readings at inlet and outlet of cartridge filters (CF-400 and 401) to assure proper operation;
- Change-out cartridge filters (CF-400 and 401), as needed;
- Record total volume of groundwater recovered and average recovery flow rates;
- Maintain sequestering agent dosing rate and change-out drum as needed;
- Collect system influent liquid phase samples and submit for laboratory analysis of site-specific COCs. These results are summarized in Section 4.3; and
- Collect system effluent liquid phase samples and submit for laboratory analysis as per the Industrial Wastewater Discharge permit, as set forth by the Jamestown BPU. These results are summarized in Section 4.4.

3.1.2 Vapor Phase Treatment

The following OM&M tasks were performed monthly and/or quarterly with regards to the vapor extraction and treatment portion of the system.

- Inspection of all pipes and fittings for potential leaks;
- Recording of the blower outlet temperature (TI-901 and TI-902);
- Record extracted air flow rate (FIT-501);
- Check and record pressure readings at inlet and outlet of the heat exchanger and vapor phase activated carbon vessels (ASC-501 and ASC-502) to assure proper operation;
- Monitor the regenerative blower (B-900) for proper operation pressures and temperatures;

- Influent vapor samples are collected and submitted for laboratory analysis of site-specific COCs. These results are summarized in Section 4.5; and
- Effluent vapor samples are collected and submitted for laboratory analysis to monitor the system VOC emissions. These results are summarized in Section 4.6.

3.1.3 Recovery Well Inspections

The following O&M tasks were performed quarterly or as needed with regards to the system recovery wells.

- Record applied vacuum readings at individual VEP wells;
- Observe pump operation at each recovery well; and
- Recovery well integrity surveys are conducted to observe the surface conditions around each well, the condition of the concrete surface seal and presence of a secure bolt down road box.

3.1.4 Performance Monitoring Well Monitoring

- Record induced vacuum readings at select monitoring wells; and
- Record DTW/drawdown at site monitoring wells.

3.1.5 Recordkeeping and Reporting

Monitoring data were recorded on OM&M checklists. Influent and effluent liquid and vapor samples were submitted quarterly for laboratory analysis. The analytical results are used to evaluate system performance and to estimate the contaminant mass removal.

3.2 Non-Routine O&M

During the June 2017 – June 2018 reporting period, the following system non-routine O&M activities were performed:

- Several non-fatal low flow alarms were received for the sequestering agent dosing pump. Each of these alarms were cleared by re-priming the dosing pump and/or by changing out the sequestering agent drum;
- On December 6, 2017, the AC intercooler and manifold filter regulator were replaced; additionally, vibration foot pads were installed underneath the AC;
- On December 7, 2017, the programmable logic controller (PLC) autodialer was repaired;
- On February 22, 2018, the following maintenance activities were completed:
    - AC manifold filter regulator was replaced
    - Ahlstrom Schaeffer was onsite to replace the 480 VAC surge logic module
    - Several leaking fittings on the liquid phase influent manifold were replaced.
- On February 23, 2018, the pneumatic pump in VEP-10 was removed and replaced with a new QED AP4+ pump. Additional the thermostat for building heater UH-1 was replaced;

- The AC circuit breaker was found tripped on April 30, 2018. The AC motor amperage and voltages were inspected by Ahlstrom Schaeffer Electric and confirmed to operating within the normal range. Two fuses were also found blown and were replaced.

No system process modifications were made during the reporting period, except for the shutdown of recovery wells VEP-1 through VEP-4 during the ISCO pilot study. It should be noted that VEP-5 and VEP-7 were taken offline in November 2017 following the pilot study.

3.3 Riverbank and Cover System Inspections

As outlined in the SMP, the following remedial design elements were constructed at the Site.

- 12 inches of clean soil cover/grass seed in areas disturbed during construction
- Riverbank reconstruction including stabilization/erosion controls
- Wingwall structure
- Riverbank plantings.

Each of these areas is inspected quarterly to certify that the engineering controls are in place and functioning as designed.

The cover system, riverbank, and wingwall structure were inspected for erosion, sloughing, settlement or other indication of loss of integrity. The riverbank plantings were observed for any signs of distress or lack of growth.

During the 2017 - 2018 reporting period the Site cover material and riverbank were inspected on quarterly basis and recorded on inspection checklists which have been provided as Appendix A.

3.3.1 Site Cover

No erosion of the Site cover was observed during the reporting period. The vegetation growth across the Site was observed to be in good condition.

3.3.2 Riverbank Inspections

The riverbank plantings were inspected quarterly and during the 2016 - 2017 reporting period the plants continue to indicate growth and the previous measures taken to deter wildlife have appeared to be successful. Based on the site inspections and observations the rip-rap stone and wingwall deflector appeared to be in place, and functional.

4 REMEDIAL SYSTEM PERFORMANCE SUMMARY

The operational data collected during the monthly inspections of the system operation are summarized in the following sections. System O&M data have been provided in Table 1, and system liquid phase influent and vapor phase sample results have been submitted to NYSDEC's EIMS Administrator in the required EQuIS Electronic Data Deliverable (EDD) format. System liquid phase effluent analytical results have

been provided with the Industrial Wastewater Discharge Monitoring Reports, which are submitted monthly to the Jamestown BPU.

4.1 Objectives of Monitoring

During operation of the system, various data were collected and analyzed to evaluate the overall performance and effectiveness of the system. This performance monitoring is intended to achieve the following objectives:

- Evaluate total dissolved and vapor phase VOC and TPH, as well as NAPL recovered during the operational period
- Evaluate performance of the remedial system
- Determine if any modifications to the system are required to enhance the system performance
- Ultimately determine when remedial milestones or endpoints have been achieved.

The performance monitoring results for June 2017 – June 2018 reporting period are summarized below.

4.2 System Performance Data

The system operational data for 2017 through 2018 is summarized in Table 1. These data include the average and cumulative recovered groundwater and soil vapor flows, average applied vacuums to the recovery well network, and recovery well statuses.

4.2.1 Groundwater Recovery/Extracted Liquid Data

4.2.1.1 Liquid Flows

Total extracted groundwater flow readings were collected from the totalizing flowmeter (FQI-700). The average monthly system groundwater extraction flow rates are included in Table 1. A cumulative total of 17,717,520 gallons of groundwater has been recovered by the system from startup (January 2008) through May 2018 (Table 1). The total flow recovered between April 2017 and May 2018 was 2,183,820 gallons, this total flow corresponds to an average recovery rate of approximately 3.6 gallons per minute (gpm).

4.2.1.2 System Influent Liquid Phase Analytical Results

The liquid phase monthly influent concentrations of TCE, total DCE, VC, TPH GRO/DRO, and PCBs in groundwater are provided in Table 2 and are illustrated graphically on Figure 3. Recovery well statuses during influent liquid phase sampling events have been included in Table 2.

Liquid phase influent concentrations during June 2017 – May 2018 ranged from 2.2 to 19.2 micrograms per liter (μg/L) for TCE, 25.7 to 67.1 μg/L for total DCE, and 8.2 to 33.5 μg/L for VC. Influent concentrations of TPH DRO ranged from 1.28 mg/L to 2.53 mg/L.

4.2.1.2 System Effluent Treated Liquid Phase Analytical Results

Pursuant to the effluent standards set by the Jamestown BPU Industrial Wastewater Discharge Permit (Permit No. 037), sampling consists of the monthly collection of four grab samples over an 8-hour period during a typical operational day. These samples are analyzed for VOCs using USEPA Method 624, oil and grease (O&G) using USEPA Method 1664A, total suspended solids (TSS) using USEPA Method 2540D, and PCBs using USEPA Method 608. All samples were submitted to SGS Laboratory in Dayton, New Jersey. Prior to final discharge to local sanitary sewer manhole 3T6, the system effluent sample is collected from sample port SP-702 located post air stripper (AS-700).

During June 2017 – June 2018 reporting period, the effluent discharge monitoring parameters were non-detect or reported at quantities below the permitted effluent limits. The effluent sample results are provided in Table 3. It should be noted that the Jamestown BPU renewed the Site Industrial Discharge Permit during the reporting period on September 4, 2017, with a new expiration date of September 3, 2022. A copy of the renewed permit has been provided as Appendix B.

4.2.2 Soil Vapor Extraction Data

4.2.2.1 Vapor Flows

The soil vapor extraction (SVE) (i.e., vapor phase) system was operational during the June 2017 – June 2018 period except for isolated shutdowns and/or temporary recovery well configuration changes due to routine O&M activities, as well as non-routine O&M activities discussed in Section 3.1 and 3.2, respectively.

Total (i.e., extracted soil vapor and fresh air dilution) vapor flow rate readings were collected from the flowmeter (FIT-501) located in the vapor treatment system exhaust post the VPGAC vessel ASC-502 (i.e., post-blower/fresh air dilution valve) and ranged from 80 to 252 actual cubic feet per minute (acfm) during the operational months for the vapor phase extraction system during the June 2017 – June 2018 reporting period (Table 1). These flow ranges correspond to an average recovery rate of approximately 156 acfm over the operational period for the vapor phase extraction system during June 2017 – June 2018.

4.2.2.2 Applied and Induced Vacuum

The applied vacuum at the system knockout tank generated by regenerative blower B-900 generally ranged from 35 to 80 inches of water column (in.W.C.). The applied vacuum to the VEP wellheads was adjusted based on several factors which included observed vacuum at the wellhead, induced vacuum at select monitoring points, and seasonal groundwater elevations. The average monthly VEP applied wellhead vacuums are included in Table 1.

Induced vacuum measurements were recorded periodically throughout the reporting period at select monitoring wells.

4.2.2.3 System Vapor Influent Sampling & Analytical Results

The influent vapor concentrations of TCE, total DCE, VC, and TPH GRO are presented in Table 4, and are illustrated graphically on Figure 4. The two predominant compounds detected in the influent vapor

samples have been TCE and DCE. TCE was detected in influent vapor samples with concentrations ranging from 64 to 172 micrograms per cubic meter (μg/m^3). Influent DCE vapor concentrations were non-detect, except for the May 2018 sample, which was detected at a concentration of 3,874 μg/m^3. Influent TPH GRO vapor concentrations were non-detect, except for the February 2018 sample, which was detected at a concentration of 115 μg/m^3 . Influent VC vapor samples were below the method detection limit for each influent vapor sampling event. All samples were submitted to Pace Analytical Laboratories in Pittsburgh Pennsylvania.

4.2.2.4 System Vapor Effluent Sampling & Analytical Results

The purpose of the effluent sample collection is to ensure that the permit equivalent standards/guidance values are met as an air permit is not required for the Site. During the June 2017 – June 2018 reporting period, regulatory guidance values were not exceeded. The effluent vapor concentrations of TCE, total DCE, VC, and TPH GRO are presented in Table 4.

4.2.3 Non-Aqueous Phase Liquid Recovery

During the June 2017 – June 2018 reporting period, approximately 4.3 gallons of DNAPL was recovered by the VEP recovery well network, primarily from recovery wells VEP-11, VEP,12, VEP-13, and VEP-14. Measurable LNAPL was not observed within any of the VEP wells, or oil water separator during the reporting period. Since starting the system in January 2008, an estimated cumulative total of 355.5 gallons of DNAPL have been recovered. A summary of annual DNAPL removal is provided in Table 7.

5 SYSTEM EVALUATION

The following sections summarize the remedial system performance monitoring data from June 2017 through June 2018.

5.1 Mass Recovery

The estimated total mass recovered was calculated using the system influent dissolved and vapor phase analytical sampling results with the corresponding extraction flow rates and the NAPL volumes collected.

5.1.1 Dissolved Phase

Influent groundwater laboratory analytical data were used to estimate dissolved phase VOC and TPH GRO/DRO mass recovery rates. As shown in Table 5, influent VOC and TPH GRO/DRO levels and groundwater recovery rates were used to calculate the overall mass of VOCs recovered in the dissolved phase. As indicated in Table 5, a total estimated mass of approximately 15 kilograms (kg) of VOCs and TPH DRO were recovered in the dissolved phase during the reporting period.

As the data presented in Table 5 indicate, total dissolved phase mass recovery rate estimates ranged from 9 to 64 grams per day. The fluctuation in dissolved phase mass recovery rate is related to variability in influent mass concentrations in the extracted groundwater due to VEP well configurations, extraction rate, and precipitation recharge to the groundwater system. The annual dissolved phase mass recovery of VOCs, and TPH [GRO & DRO] are shown on Figure 3.

5.1.2 Vapor Phase

Influent vapor sampling results, molecular weights, and total vapor extraction flow rates were utilized to estimate the vapor phase VOC and TPH/GRO mass recovery rate for the reporting period. As the data presented in Table 6 indicate, the vapor phase mass recovery rate ranged from 1 to 21 grams per day during the operational period for the vapor extraction system. As mentioned in the discussion of dissolved phase mass recovery rates, the fluctuation in vapor phase mass recovery rate is related to the VEP well configuration and groundwater elevations. As Table 6 shows, a total estimated mass of 3.5 kg of VOCs were removed in the vapor phase during April 2017 – May 2018. As expected, the mass transfer of VOCs from soil to vapor is predominantly limited to desorption and diffusion processes. Therefore, mass removal rates in the vapor phase are declining over time as the Site is remediated. No detectable concentrations of TPH GRO were detected in the system influent, which indicates that the lighter fraction VOCs that were historically present have been remediated from the subsurface. The annual vapor phase mass recovered for VOCs and TPH [GRO] is shown on Figure 4.

5.1.3 Non-Aqueous Phase Liquid

As noted in Section 4.2.3, approximately 4.3 gallons of DNAPL was recovered during the reporting period.

5.1.4 Total Mass Removal Trend

The VEP system has recovered a cumulative total of approximately 414.5 kg (912 lbs) and 182 kg (400.4 lbs) of dissolved and vapor phase VOCs, respectively, during the period of operation from startup in 2008 through May 2018 (Table 7). The mass removal rate had fluctuated for the liquid phase mass removed during each year of the operation from 2008 through 2012. However, in 2014 the liquid phase VOC/TPH mass removal rates dropped an order of magnitude and continued to decrease through 2017, then slightly increased in 2018 as a result of increased pumping/extraction rates. The variation and overall decreasing trend in mass removal rates are largely attributable to the decrease in TPH DRO in the system influent water samples. As indicated in previous reports, the rate of recovery is expected to decrease as the mass removal becomes more dependent on desorption and diffusion processes rather advective movement and capture of VOCs.

The mass removal rate for the vapor phase VOC/TPH had generally dropped off after the first year of operation in 2008 and plateaued during each year of the operation from 2010 through 2012 and has subsequently continued to drop through 2017, with a slight increase in 2018. The variation and overall decreasing trend in mass removal rates are mostly attributable to the decrease in TPH GRO in the system influent vapor samples, as well as lighter fraction VOC concentrations. As indicated in previous reports, the rate of recovery has, and is expected to decrease as the mass removal becomes more dependent on desorption and diffusion processes rather advective movement and capture of VOCs, particularly for any lighter fraction VOCs and GRO compounds.

As presented in Table 7, the dissolved and vapor phase mass recovered during April 2017 – May 2018 is estimated at 15.0 and 3.5 kg, respectively. Figure 5 also depicts annual mass recovery through December 2017 for both the dissolved and vapor phases, and DNAPL.

6 GROUNDWATER MONITORING

Groundwater monitoring activities were conducted on June 2017 and November 2017. Groundwater monitoring consisted of the collection of groundwater samples from monitoring wells and the measurement of water levels in monitoring wells to evaluate the hydraulic influence of the system.

Sampling was conducted at thirteen monitoring wells to evaluate VOC concentration trends at the Site and overall remedial progress.

Collection of groundwater samples was performed in accordance with the Field Sampling Plan and consisted of purging three volumes of water from each well or purging until the well was dry. Samples were then collected using low flow sampling techniques where feasible, and select wells were sampled using disposable bailer's due to lack of water. It should be noted that all groundwater sampling was conducted with the VEP system offline (i.e., static conditions). All samples were submitted to SGS Laboratories in Dayton, New Jersey for analysis of VOCs using USEPA Method 8260. Groundwater analytical results are discussed in Section 6.2.2.

6.1 Well Inspections

Recovery well and monitoring well integrity inspections are conducted quarterly to observe the surface conditions around each well, the condition of the concrete surface seal and presence of a secure locking cap and/or bolt down road box. Periodically, the depth to bottom in all the wells is measured and compared to the original constructed well depth. All stickup monitoring wells were in good to condition and secured with padlocks. Each VEP well was also is good working condition, each manhole cover was securely bolted down in place.

6.2 Groundwater Monitoring Results

The results of the groundwater monitoring program are summarized in the following sections. The groundwater monitoring program was performed in accordance with the Groundwater Collection and Treatment System OM&M Plan (ARCADIS 2008) and as approved by NYSDEC.

6.2.1 Groundwater Elevation Data

Water level data collected from the Site monitoring wells for 2017 are summarized in Table 8. The groundwater elevations reflect the position of the water table within the fill material layer at the Site under pumping conditions for each sampling event in June and November 2017. Overall, the water level data indicated that the system influences water levels near the VEP recovery wells, with drawdown typically in the range consistent with design estimates of 1 to 5 feet in adjacent monitoring wells.

6.2.2 Groundwater Analytical Results

During the reporting period, groundwater samples were collected from thirteen (13) monitoring wells to monitor groundwater quality and evaluate the performance of the system. A summary of the groundwater monitoring analytical results, along with historical data, is shown in Table 9. Historical TCE, DCE (total),

and VC concentration trends in groundwater for monitoring wells are depicted on Figures 6A, 6B, 6C and 6D.

The following selected observations were made with respect to the groundwater analytical data:

Furthest Upgradient and Downgradient Site Monitoring Wells:

- Consistent with the historical Site results since the startup of the remedial system, TCE and total DCE remain below the NYSDEC Class GA groundwater standards in upgradient monitoring well ESI-6, however a slight increase in VC concentrations was noted during in November 2017.
- Consistent with the historical Site results since the startup of the remedial system, TCE, total DCE, and VC have remained below the NYSDEC Class GA groundwater standards in monitoring well MW-9, which is located at the northwest (furthest downgradient) corner of the Site near the Chadakoin River.

Central/Upgradient Located Site Monitoring Wells:

- Consistent with the historical results for the Site, the primary VOCs detected in groundwater are TCE, total DCE and VC, with the highest dissolved phase concentrations detected at monitoring wells OW-5, OW-6 and MW-14.
- TCE, DCE, and VC concentrations at MW-8S, MW-12, and MW-13 have continued to show significant decrease in total chlorinated VOC concentrations ranging from 89% to 99%, as compared to baseline/pre-ISCO values in 2016.
- TCE concentrations at monitoring well OW-5 continue to remain below NYSDEC Class GA groundwater standards. DCE and VC concentrations have decreased since the startup of the system in 2008, however the concentrations continue to fluctuate from one to three orders of magnitude above the NYSDEC Class GA groundwater standards.
- TCE, DCE, and VC concentrations at monitoring well OW-6 continue to fluctuate within ranges established since the recovery system startup in 2008.

Adjacent Riverbank/Hydraulic Barrier Monitoring Wells:

- Concentrations of TCE, total DCE and VC at monitoring well ESI-1 and ESI-2 which are located adjacent to the Chadakoin River and upgradient from the vertical barrier wall, continues to remain below the NYSDEC Class GA groundwater standards since starting up the remedial system.
- VOC concentrations at well MW-10R concentrations at monitoring well MW-10R continue to fluctuate within ranges established since being installed in 2010. TCE concentrations ranged from 11 to 56.7 μg/L, and DCE concentrations ranged from 83.8 to 143 μg/L during the reporting period.
- VOC concentrations at monitoring well ESI-4R continue to fluctuate within ranges established since being installed in 2010. TCE concentrations ranged from 53.7 to 96.6 μg/L, and DCE concentrations ranged from 39.9 to 91.9 μg/L during the reporting period.
- Concentrations of TCE and VC at monitoring well ESI-7 continues to remain below NYSDEC Class GA groundwater standards. Cis, 1,2-DCE was detected at a concentration of 4.1 μg/L in the June 2018 sample, and 7.3 μg/L in the November 2017 sample.

7 ISCO PILOT STUDY SUMMARY

The following sections summarize the ISCO pilot study, which was conducted on-site from October 2016 through November 2017. The ISCO Pilot Study area and injection well layout is shown on the Figure 7. The overall objective of the ISCO pilot study was to evaluate a remedial alternative to existing VEP system to reduce remedial timeframe. The specific design information was obtained during the pilot-scale ISCO study:

- Injection design parameters, including achievable injection flow rates and safe injection pressures
- Distribution and longevity of the injected persulfate/activator in the targeted injection zones
- Hydraulic properties of the subsurface in the vicinity of the injection area (e.g., migratory porosity, which can be estimated based on the hydraulic responses to injection)
- Efficacy of ISCO technology and designed dosing of persulfate/activator on the treatment of groundwater COCs at the site
- Recommendations for any contingent actions (e.g., additional injection wells or injection events), additional monitoring, and the potential effect of ISCO activities on ongoing vacuum enhanced pumping system.

The ISCO pilot study performance monitoring was performed on month-1, month-3, month-6, and approximately one-year following the injection event. Field parameters, depth to water, and sodium persulfate concentration data were collected from select monitoring wells at or downgradient of the target injection area. Additionally, groundwater samples were collected from four monitoring wells (MW-8S, MW-12, MW-13, and MW-24) located at the target injection area (dose response wells) for total sodium VOC analyses.

Compared to the baseline concentrations, the month-1 post ISCO monitoring data showed significant decrease in total chlorinated VOC concentrations (TCE, DEC [total], and VC combined) in all four dose-response wells with approximately 45% (MW-13) to 99% (MW-8S) decrease. The month-3 and month-6 data showed even further degradation of total chlorinated VOCs and based on the month-6 data the degradations were over 99% in MW-8S, approximately 93% in MW-12, 99% in MW-13, and 90% in MW-14. The one-year data showed similar degradation of total chlorinated VOCs as compared to the month-6 data, the degradations remained over 99% in MW-8S, approximately 85% in MW-12, and 99% in MW-13. However, total chlorinated VOC concentrations did rebound approximately 79% of the baseline value in MW-14 after one year. It should be noted that during the injection event the reagent dose-response was the highest in MW-8S and MW-12. Although dose-response wells MW-13 and MW-14 did not show the instantaneous arrival of reagents during the injection event, the concentrations of total chlorinated VOCs decreased significantly following the injection event. The decrease in total chlorinated VOCs suggests delayed arrival of reagents at these two wells, immediately upgradient. In these wells, detection of high concentrations of sodium (decomposition product of sodium persulfate) supports this observation. Persulfate concentrations in these wells were minimal (in low mg/L range) and pH values were circumneutral or slightly basic (9.2 s.u. in MW-8S during the month-6 monitoring).

8 CONCLUSIONS

The following sections summarize the conclusion of the system operation and groundwater data during the reporting period.

8.1 System Performance Summary

Data from the June 2017 – June 2018 reporting period indicate that the VEP system has been effective at recovering dissolved and vapor phase VOC mass and NAPL from the subsurface at the Site.

The performance effectiveness of the remedial system is summarized through the following metrics:

- Sustained average groundwater extraction rate of 3.6 gpm from the VEP well network.
- Averaged a soil vapor extraction rate of 156 acfm from the VEP well network. It should be noted that this extracting rate includes fresh air dilution (i.e., makeup air).
- The groundwater elevation data indicate that the VEP well network is effective at dewatering the fill material near the recover wells thus making more adsorbed phase mass available via vacuum extraction through in-situ stripping and bio-venting processes.
- As indicated by the ND, or near detection limits, extraction soil vapor concentrations, the induced lateral air flows in the sub-surface have remediated the VOCs and lighter fraction petroleum compounds (e.g., TPH GRO).
- Approximately 4.3 gallons of DNAPL were recovered by the remedial system. Since startup the system has recovered approximately 355.5 gallons of DNAPL
- An estimated total mass of 15 kg and 3.5 kg were recovered in the dissolved and vapor phase in April 2017 – May 2018, respectively. Since system startup in January 2008 an estimated cumulative total mass of approximately 415 kg and 182 kg have been recovered in the dissolved and vapor phases, respectively.

8.2 Groundwater Data Summary

The analytical results continue to show improvement in groundwater quality in several of the monitoring wells. VOC concentrations continue to remain below the NYSDEC Class GA groundwater standards in the up- and down-gradient monitoring wells. The following highlights the groundwater analytical data for specific monitoring wells at the site:

- VOC concentrations in upgradient and downgradient monitoring wells ESI-1, ESI-2, ESI-6, and MW-9 continue to remain below, or near NYSDEC Class GA Groundwater Standards.
- Monitoring wells MW-8S, MW-12, and MW-13 responded favorably to the ISCO pilot study and have continued to show significant decrease in total chlorinated VOC concentrations ranging from 89% to 99%.
- VOC concentrations in monitoring well OW-5 and OW-6 during the 2017 sampling events were within the normal variable historical ranges.

9 INSTITUTIONAL AND ENGINEERING CONTROLS COMPLIANCE

As part of the annual certification under the Site Management and OM&M Plans the Site engineering controls have been maintained and remain in place functioning as designed except for noted shutdowns due to non-routine system maintenance. The engineering controls include the following:

- Soil cover and vegetative growth across the Site
- Riverbank and stabilization erosion controls
- Wingwall deflector
- Vertical hydraulic barrier wall
- Groundwater recovery and soil vapor extraction via VEP (i.e., recovery) wells
- Remedial system operation and maintenance.

No changes in site use were observed during the reporting period, as per the SMP, which includes land and groundwater use restrictions. A copy of the signed Institutional and Engineering Controls Certification Forms have been included as Appendix C.

10 2018-2019 GOALS AND RECOMMENDATIONS

The information presented in this section indicates that the system will continue to operate as designed and outlined within the NYSDEC approved Groundwater Collection and Treatment System Operational, Maintenance, and Monitoring Plan (ARCADIS 2008), with the exception of reduced VEP well operations near the ISCO treatment area. The recommendations and action items planned for during the 2018 - 2019 reporting period are described in the sections below.

10.1 Goals

System operation goals and performance monitoring will continue to focus on optimizing mass removal rates through the operation of VEP well network, evaluating individual recovery well mass removal rates, and continued operation and maintenance of the remedial system process equipment and components.

The goals for system operational activities during 2018 - 2019, as well as activities already conducted in the first half of 2018, are as follows:

- Conduct water level measurements at all monitoring wells to monitor hydraulic influence of the system.
- Collect groundwater samples on a semi-annual basis from monitoring wells ESI-1, ESI-2, ESI-4R, ESI- 6, ESI-7, MW-8S, MW-9, MW-10R, MW-12, MW-13, MW-14, OW-5 and OW-6.
- Continue to monitor the treatment system for mass removal efficiency and VOC breakthrough based on field screening and/or laboratory analysis of samples collected from the system influent and effluent sample points.

- Collect system effluent samples as required by the Jamestown BPU Industrial Wastewater Discharge Permit.
- Continue DNAPL recovery efforts.
- Perform O&M activities (e.g., liquid phase cartridge filter change-outs, pneumatic pump cleaning as needed, sequestering agent drum replacement, air stripper cleaning, etc.).

10.2 Remedial Enhancements

As noted above in the executive summary section, and previous reports, Arcadis evaluated ISCO technology to enhance the current remedial program at the site. As a result of the successful ISCO pilot study, a second ISCO injection event is being performed. The ISOC Work Plan is attached as Appendix D. A summary of the ISCO work plan is provided below.

In order to enhance remediation of the residual groundwater plume at the site, a pilot-scale ISCO injection approach, utilizing alkaline activated sodium persulfate as the oxidant, was implemented at the site in October 2016. Since then, the site groundwater is being monitored routinely. The groundwater data shows significant decrease of COCs concentrations at the pilot test area monitoring wells. Based on the overall success of the pilot program, Arcadis is planning a full-scale application near the pilot study area, and the area of monitoring wells OW-5 and OW-6 where chlorinated volatile organic compound (CVOC) concentrations have remained elevated several orders of magnitude above the New York State Class GA Groundwater Standards.

The full scale ISCO remedy for the pilot study area and monitoring wells OW-5 and OW-6 areas will be implemented in July 2018. The methodology, implementation, performance monitoring of the ISCO injection to be conducted at the site and the health and safety requirements related to ISCO injection will be similar to the previous injection event. The ISCO remedy will focus on the treatment of silty sands and gravels in the lower saturated overburden zones, where the bulk of the CVOC mass is located, and which is the primary source for the TCE, DCE, and VC dissolved phase mass flux down-gradient. The injection strategy and design parameters were based on data collected from the bench testing and pilot test injection field parameters (Arcadis 2016).

To optimize the existing injection well network and increase the distribution of oxidant reagents to MW-13, MW-14, OW-5 and OW-6, seven additional injection wells (designated IW-9 through IW-15) were installed in June 2018. The new injection well locations are provided on Figure 8.

It should be noted that in accordance with the Site-Specific Health and Safety Plan (HASP), a Community Air Monitoring Plan (CAMP) was implemented during the intrusive drilling activities at the Site. Real-time, continuous fugitive dust monitoring was performed using a PDR Mini-ram particulate meter during all drilling and drill cutting/soil handling activities. The action level of 100 mg/m^3 above background levels, integrated over a 15-minute averaging period, were never exceeded during site activities. Real-time, continuous monitoring for VOCs was also performed using a portable PID during all activities. The PID was set to alarm in the event that action levels as prescribed within the HASP and CAMP were exceeded. The action level for VOCs, 5 ppmv, integrated over a 15-minute averaging period, in the work zone or downwind perimeter area, were never exceeded during site activities. Air monitoring and well construction logs maintained during the drilling activities are included in ISCO Work Plan appendices.

The design for the full-scale injection optimized the initial pilot approaches by injecting a larger volume of persulfate solution to improve oxidant distribution. The concentrations of chemicals in the injection solution will be consistent with pilot test, i.e. 40 grams per liter (g/L) of persulfate activated with 3 to 1 molar ratio of sodium hydroxide to sodium persulfate will be used for preparing the injection solution. The injection solution will be prepared in small batches by mixing sodium persulfate and sodium hydroxide with water. To achieve a radius of influence (ROI) of 10 feet, approximately 1,200 gallons of injection solution is estimated to be required per injection well. This estimated volume is based on the pilot test data. Based on the total injection volume of 12,000 gallons and 40 g/L of sodium persulfate activated with 3 to 1 molar ratio of sodium hydroxide to sodium persulfate in the injection solution, an approximate 4,000 pounds of sodium persulfate and approximately 2,000 pounds of sodium hydroxide (dry basis) will be needed. The actual injection volume required to achieve adequate distribution of reagents is contingent upon field observations.

Baseline groundwater monitoring was conducted in late June 2018, and additionally baseline sampling is planned for in early July 2018. Post-injection monitoring will commence in August 2018 and will continue for a minimum period of 6-months. The ISCO full scale remedy performance monitoring results will be discussed in a future report.

11 REFERENCES

Arcadis 2016, Response to Comments – Soil Vapor Investigation Report, DC Rollforms Site, Jamestown, New York (Site No. 907019), July 2016

Arcadis 2016, Site Management Periodic Review Report and ICEC Certification, DC Rollforms Site, Jamestown, New York (Site No. 907019), July 2016.

Arcadis 2016, Soil Vapor Investigation, DC Rollforms Site, Jamestown, New York (Site No. 907019), March 2016.

ARCADIS 2008, Engineering Construction Completion Report, D.C. Rollforms, Ingersoll Rand Site, Jamestown, New York, Site Code 907019, December 7, 2008.

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ARCADIS 2008, Groundwater Collection and Treatment System Operation, Maintenance, and Monitoring Plan, D.C. Rollforms, Ingersoll Rand Site, Jamestown, New York, Site Code 907019, December 2, 2008.

Administration Order on Consent Index #B9-0446-94-01A, D.C. Rollforms site, Site #907019, Ingersoll Rand Company, Jamestown, New York, September 21, 2004.

Record of Decision, D.C. (Dow Craft) Rollforms Inactive Hazardous Waste Site, Jamestown, Chautauqua County, New York, Site No. 9-07-019, March 31, 2003.

TABLES

Table 1.
System Operational Data, 2017-2018
DC Rollforms Site
Jamestown, New York

System Parameters			Date											
			4/10/17	6/30/17	7/26/17	8/22/17	9/14/17	10/12/17	11/16/17	12/18/17	1/18/18	2/23/18	3/16/18	4/30/18	5/17/18
SVE Blower Applied Vacuum (in. W.C.)			51	50	51	51	52	48	48	57	55	35	72	80	82
Vapor Extraction Flowrate (acfm)			80	155	225	225	211	232	252	213	215	250	191	160	138
Cumulative Groundwater Recovered and Treated			15,607,990	15,931,540	16,059,070	16,115,700	16,169,000	16,246,650	16,380,680	16,560,450	16,746,580	17,006,105	17,422,690	17,614,280	17,717,520
Monthly System Flow (gallons)			74,290		127,530	56,630	53,300	77,650	134,030	179,770	186,130	259,525	416,585	191,590	103,240
Monthly System Influent (gpm)			2.6		3.4	1.5	1.6	1.9	2.7	3.9	4.2	5.0	13.8	3.0	4.2
Recovery Well Statuses[1]															
Vacuum Enhanced Pumping (VEP) Wells	VEP-1	Liquid Phase On (Y/N)	N	N	Y	N	N	N	N	N	N	N	N	N	N
		Vapor Phase On (Y/N)	N	N	N	N	N	N	N	N	N	N	N	N	N
	VEP-2	Liquid Phase On (Y/N)	N	N	Y	Y	N	N	N	N	N	N	N	N	N
		Vapor Phase On (Y/N)	N	N	N	N	N	Y	Y	Y	N	N	N	N	N
	VEP-3	Liquid Phase On (Y/N)	N	N	Y	Y	Y	Y	Y	Y	N	N	N	N	N
		Vapor Phase On (Y/N)	N	N	N	N	N	Y	Y	Y	N	N	N	N	N
	VEP-4	Liquid Phase On (Y/N)	N	N	N	N	N	N	N	N	N	N	N	N	N
		Vapor Phase On (Y/N)	N	N	N	N	N	N	N	N	N	N	N	N	N
	VEP-5	Liquid Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N
		Vapor Phase On (Y/N)	Y	Y	N	N	N	Y	Y	Y	N	N	N	N	N
	VEP-6	Liquid Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
		Vapor Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
	VEP-7	Liquid Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
		Vapor Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
	VEP-8	Liquid Phase On (Y/N)	Y	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
		Vapor Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	VEP-9	Liquid Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
		Vapor Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
	VEP-10	Liquid Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
		Vapor Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
	VEP-11	Liquid Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
		Vapor Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
	VEP-12	Liquid Phase On (Y/N)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
		Vapor Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
	VEP-13	Liquid Phase On (Y/N)	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y
		Vapor Phase On (Y/N)	Y	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y
	VEP-14	Liquid Phase On (Y/N)	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
		Vapor Phase On (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y

Notes:
1. Recovery wells for which total fluids pneumatic considered to have liquid phases on in this table.

Definitions:
acfm - actual cubic feet per minute
gpm - gallons per minute
in.W.C. - Inches of Water Column
N - No
Y - Yes
SVE - Soil Vapor Extraction
VEP - Vacuum Enhanced Pumping

Table 2.
TCE, DCE (total), VC, and TPH in System Influent Water Samples, 2017-2018
DC Rollforms Site
Jamestown, New York

Date	VOCs (µg/L)[1]			DRO (mg/L)	VEP Wells Online During Monthly System Influent Sampling Event
	TCE	DCE (total)[2]	VC		
6/30/17	2.2	44.7	8.2	1.28	VEP-5 through VEP-7, VEP-9 through VEP-11, VEP-13
9/14/17	2.4	25.7	33.5	2.53	VEP-3, VEP-5 through VEP-14
11/16/17	16.2	67.1	14.5	1.77	VEP-5 through VEP-12, VEP-14
2/23/18	14.9	40.3	9.1	1.72	VEP-6 through VEP-14
5/17/18	19.2	117	30.4	2.02	VEP-6 through VEP-14

Notes:

1. Samples analyzed for VOCs using US EPA Method 624. Samples analyzed for TPH [GRO] and TPH[DRO] using US EPA Method 8015 B. Samples analyzed for PCB using US EPA Method 608.
2. DCE (total) includes the sum of 1,1-Dichloroethene, cis-1,2-Dichloroethene, and trans-1,2-Dichloroethene.

Definitions:

D - Identifies an analysis that used a secondary dilution factor
DCE - Dichloroethene
DRO - Diesel Range Organics
E - Sample concentration exceeded calibration range
GRO - Gasoline Range Organics
mg/L - milligrams per liter
ND - Non-Detect
NS - Not Sampled for
PCB - Polychlorinated Biphenyls
TCE - Trichloroethene
TPH - Total Petroleum Hydrocarbons
µg/L - micrograms per liter
VC - Vinyl Chloride
VOCs - Volatile Organic Compounds

Table 3.
TCE, DCE (total), VC, PCBs, TSS, Oil Grease and pH in System Effluent Water Samples, 2017-2018
DC Rollforms Site
Jamestown, NY

Date	Analyte[1]						
	Total VOCs (µg/L)	PCB (µg/L)	TSS (mg/L)	Oil & Grease (mg/L)		pH (s.u.)	
	Local Discharge Limit						
	2130	ND	350	100		5.5 - 10	
5/25/2017	55.2	<0.0001	< 4	< 5.1	< 5.1	7.8	7.9
				< 5.1	< 5.1	7.8	8.0
6/30/2017	4.0 J	NS	< 4	< 5.1	< 5.2	7.3	7.3
				< 5.1	< 5.1	7.5	7.6
7/26/2017	< 5.0	<0.0001	< 4	< 5.1	< 5.0	7.5	7.6
				< 5.1	< 5.1	7.6	8.0
8/22/2017	< 5.0	<0.0001	9.0	<5.0	< 5.0	8.2	8.1
				< 5.0	<8.6	8.1	8.1
9/12/2016	0.87 J	<0.0001	< 4	< 5.0	< 5.0	8.0	8.0
				< 5.0	<5.1	8.2	8.2
10/12/2017	< 5.0	<0.0001	< 4	< 5.1	< 5.1	8.1	8.0
				< 5.1	< 5.2	8.0	8.2
11/16/2017	1.4	<0.0001	< 4	< 5.0	< 5.0	7.9	8.0
				< 5.0	< 5.1	8.1	8.2
12/18/2017	2.5	<0.0001	< 4	< 5.1	< 5.1	8.0	8.2
				< 5.1	< 5.1	8.2	8.3
1/18/2018	4.6	<0.0001	< 4	< 5.2	< 5.1	8.0	8.1
				< 5.1	< 5.1	8.1	7.0
2/23/2018	< 5.0	<0.0001	< 4	< 5.0	< 5.0	7.0	7.1
				< 5.0	< 5.0	7.0	7.0
3/16/2018	2.4	<0.0001	< 4	< 5.0	< 5.0	7.2	7.6
				< 5.0	< 5.0	7.6	7.4
4/30/2018	0.64 J	<0.0001	6.8	< 5.2	< 5.2	6.7	6.6
				< 5.2	< 5.2	6.8	7.0
5/17/2018	0.22	<0.0001	< 4	< 4.8	< 5.0	7.2	7.5
				< 5.1	< 4.9	7.6	7.5

Notes:

1. System effluent water samples collected via sample port SP-702 located after the air stripper. Samples analyzed for TCE, DCE (total), VC, PCB, and TSS consisted of four effluent samples collected during a typical operating day that were composited at the laboratory. Samples analyzed for Oil & Grease and pH were not composited. Samples analyzed for TCE, DCE (total), and VC using US EPA Method 624. Samples analyzed for PCB using US EPA Method 608. Samples analyzed for TSS using US EPA Method 160.2. Samples analyzed for Oil & Grease using US EPA Method 1664. pH measured in field.
2. DCE (total) includes the sum of 1,1-Dichloroethene, cis-1,2-Dichloroethene, and trans-1,2-

Definitions:

"--" - Indicates data not available
B - indicates a results > = MDL but < RL
DCE - Dichloroethene
J - Indicates an estimated value
mg/L - milligrams per liter
ND - Non-detect
NS - Not sampled
PCB - Polychlorinated Biphenyls
s.u. - standard units
TCE - Trichloroethene
TSS - Total Suspended Solids
µg/L - micrograms per liter
VC - Vinyl Chloride

Table 4.
TCE, DCE (total), VC and TPH in System Influent and Effluent Vapor Samples, 2017-2018
DC Rollforms Site
Jamestown, New York

Date	Sample Location	TCE		DCE (total)[2]		VC		TPH [GRO]		VEP Wells Online During Monthly System Influent Sampling Event
		ppmv	µg/m^3	ppmv	µg/m^3	ppmv	µg/m^3	ppmv	µg/m^3	
6/30/2017	Influent	0.025	134	< 0.02	< 79	<1.0	< 2,598	<0.7	< 1,280	VEP-5 through VEP-7, VEP-9 through VEP-11, and VEP-13
	Effluent	0.076	408	0.011	436	<1.0	< 2,598	<0.7	< 1,280	
9/14/2017	Influent	0.032	172	< 0.02	< 79	<1.0	< 2,598	<0.7	< 1,280	VEP-5 through VEP-14
	Effluent	0.086	462	0.081	321	<1.0	< 2,598	<0.7	< 1,280	
11/16/2017	Influent	0.013	70	< 0.02	< 79	<1.0	< 2,598	<0.7	< 1,280	VEP-5 through VEP-14
	Effluent	0.014	75	< 0.02	< 79	<1.0	< 2,598	<0.7	< 1,280	
2/23/2018[3]	Influent	0.018	97	< 0.02	< 79	<1.0	< 2,598	1.1	3.87	VEP-6 through VEP-14
	Effluent	0.014	75	< 0.02	< 79	<1.0	< 2,598	<0.7	< 1,280	
5/17/2018	Influent	0.012	64	0.029	115	<1.0	< 2,598	<0.7	< 1,280	VEP-6 through VEP-14
	Effluent	0.048	258	0.036	143	<1.0	< 2,598	<0.7	< 1,280	

Notes:
1. Influent vapor sample collected via sample port SP-900 located before the liquid knockout tank. Effluent vapor sample collected via sample port SP-503 located after VPGAC vessel ASC-502. Samples analyzed using Microseeps, Inc. Method AM 4.02.
2. DCE (total) includes the sum of 1,1-Dichloroethene, cis-1,2-Dichloroethene, and trans-1,2-Dichloroethene.

Definitions:
DCE - Dichloroethene
GRO - Gasoline Range Organics
J - Indicates an estimated value
NA - Not Available
ND - Non-detect
NS - Not Sampled
ppmv - parts per million by volume
SVE - Soil Vapor Extraction
TCE - Trichloroethene
TPH - Total Petroleum Hydrocarbons
µg/m^3 - micrograms per cubic meter
VC - Vinyl Chloride

Table 5.
Cumulative Dissolved Phase VOC and TPH Mass Recovery, 2017-2018
DC Rollforms Site
Jamestown, New York

Date	VOC and TPH [GRO & DRO] Mass Removed																
	Influent VOC and TPH [GRO & DRO] Concentrations				Total Cumulative Flow (gallons)[1]	Total Flow Per Reporting Period (L)	Estimated Mass Removed Per Reporting Period (kg)[3]				Estimated Cumulative Mass Removed (kg)				Estimated Cumulative Mass Removal (kg)	Cumulative Days Operating	Estimated Mass Removal Rate Per Reporting Period (kg/day)
	TCE (µg/L)	DCE (total) (µg/L)[2]	VC (µg/L)	TPH [DRO] (mg/L)			TCE	DCE (total)[2]	VC	TPH [DRO]	TCE	DCE (total)[2]	VC	TPH [DRO]			
3/21/17	12	156	15.7	1.00	15,533,700	-	-	-	-	-	-	-	-	-	-	-	-
6/30/17	2.2	44.7	8.2	1.28	15,959,410	1,611,487	0.011	0.162	0.019	1.837	0.011	0.162	0.019	1.837	2.030	0	-
9/14/17	2.4	25.7	33.5	2.53	16,173,200	809,283	0.002	0.028	0.017	1.542	0.013	0.190	0.036	3.379	3.618	177	0.009
11/16/17	16.2	67.1	14.5	1.77	16,381,360	787,971	0.007	0.037	0.019	1.694	0.021	0.227	0.055	5.073	5.375	240	0.028
2/23/18	14.9	40.3	9.1	1.72	17,006,105	2,364,916	0.037	0.127	0.028	4.127	0.057	0.354	0.083	9.200	9.694	339	0.044
5/17/18	19.2	117	30.4	2.02	17,717,520	2,692,997	0.046	0.212	0.053	5.036	0.103	0.566	0.136	14.236	15.041	422	0.064
Groundwater Recovered 2017-2018 (gal)					**2,183,820**					Total VOCs Recovered 2017-2018 (kg):					**15.041**		
Average Groundwater Recovery Rate (gpm)					**3.6**												

Notes:

1. Total cumulative flow is estimated based on the system flowmeter FQI-700.
2. DCE (total) is the sum of 1,1-Dichloroethene, cis-1,2-Dichloroethene, and trans-1,2-Dichloroethene.
3. Estimated mass removed per reporting period is calculated from influent mass concentration and volume of groundwater recovered. Influent mass concentrations used for calculations are the average of the concentrations from the previous and current monthly events.

Definitions:

DCE - Dichloroethene
DRO - Diesel Range Organics
GRO - Gasoline Range Organics
gal - gallons
gpm - gallons per minute
kg - kilograms
L - Liters
mg/L - milligrams per liter
ND - Non-detect
TCE - Trichloroethene
TPH - Total Petroleum Hydrocarbons
µg/L - micrograms per liter
VC - Vinyl Chloride
VOC - Volatile Organic Compounds

Table 6.
Cumulative Vapor Phase VOC and TPH Mass Recovery, 2017-2018
DC Rollforms Site
Jamestown, New York

Date	Influent VOC and TPH [GRO] Concentrations (ppmv)				Influent VOC and TPH [GRO] Concentrations (µg/m^3)[1]				Influent VOC and TPH [GRO] Concentrations (µg/L)				Vapor Extraction Flow Rate (acfm)	Reporting Period			Mass of Component Recovered[3] Per Reporting Period (kg)				Cumulative Mass Recovered (kg)				Estimated[2] Cumulative Mass Recovery (kg)	Cumulative Days Operating	Estimated[2] Mass Recovery Rate Per Reporting Period (kg/day)
														Period Duration		Volume Of Air Treated (L)[2]											
	TCE	DCE (total)[4]	VC	TPH [GRO]	TCE	DCE (total)[4]	VC	TPH [GRO]	TCE	DCE (total)[4]	VC	TPH[5] [GRO]		(days)	(min)		TCE	DCE (total)[4]	VC	TPH [GRO]	TCE	DCE (total)[4]	VC	TPH [GRO]			
3/21/17	0.100	0.020	<1	0.7	537	79	ND	ND	0.537	0.079	ND	ND	-	0	0	-	-	-	-	-	0.000	0.000	0.000	0.000	0.00	0	-
6/30/17	0.025	0.020	<1	<0.7	134	79	ND	ND	0.134	0.079	ND	ND	155	101	145,440	638,351,286	0.214	0.051	0.000	0.000	0.214	0.051	0.000	0.000	0.26	101	0.003
9/14/17	0.032	0.020	<1	<0.7	172	79	ND	ND	0.172	0.079	ND	ND	112	76	109,440	347,086,946	0.053	0.028	0.000	0.000	0.267	0.078	0.000	0.000	0.35	177	0.001
11/16/17	0.013	0.020	<1	<0.7	70	79	ND	ND	0.070	0.079	ND	ND	126	63	90,720	323,681,412	0.039	0.026	0.000	0.000	0.306	0.104	0.000	0.000	0.41	240	0.001
2/23/18	0.018	0.020	<1	1.1	97	79	ND	3,874	0.097	0.079	ND	3.874	250	99	142,560	1,009,210,752	0.084	0.080	0.000	1.955	0.390	0.184	0.000	1.955	2.53	339	0.021
5/17/18	0.012	0.029	<1	<0.7	64	115	ND	ND	0.064	0.115	ND	ND	138	83	119,520	467,050,503	0.038	0.045	0.000	0.905	0.428	0.229	0.000	2.860	3.52	422	0.012
								Average SVE Extraction Rate (cfm)					156							2017-2018 Cumulative Mass Recovery Rate (kg)				3.52		

Notes:

1. Vapor results were converted to mg/m3 and mg/L using Microseeps unit conversion factors, assuming a temperature of 25 C (+ 273.15 K), and gas constant, 0.08206 l*atm/(mol*K).
2. Volumes of air treated are estimated values.
3. Estimated mass recovery rate calculated from monthly influent mass concentration and estimated vapor extraction rate. Influent concentrations used are averages of those from the previous and current monthly events.
4. DCE (total) is the sum of 1,1-Dichloroethene, cis-1,2-Dichloroethene, and trans-1,2-Dichloroethene.
5. Conversion of TPH[GRO] from ppmv to µg/L assumes molecular weight approximately equal to hexane, temperature of 25ºC, and pressure of 1 atmosphere.
6. Laboratory detection limits used for March 2016 sample results for the reporting period average.

Definitions:

acfm - actual cubic feet per minute
DCE - Dichloroethene
GRO - Gasoline Range Organics
kg - kilograms
L - Liters
min - minutes
ND - Non-detect
NS - Not Sampled
ppmv - parts per million by volume
TCE - Trichloroethene
TPH - Total petroleum hydrocarbons
µg/L - micrograms per liter
VC - Vinyl Chloride
VOC - Volatile Organic Compounds

Table 7.
Annual and Cumulative Mass Recovery Summary
DC Rollforms Site
Jamestown, New York

Year	Estimated Annual Mass Recovery		
	Dissolved Phase (kg)	Vapor Phase (kg)	DNAPL (gallons)
2008	30.4	116.2	117
2009	90.7	27.5	135
2010	72.0	8.1	39
2011	133.2	8.8	18
2012	39.9	9.3	12.5
2013	8.6	3.4	2.5
December 2014	11.7	2.2	12.0
January 2015 - April 2016	8.1	0.6	13.0
March 2016 - March 2017	5.0	0.8	1.5
March 2017 - May 2018	15.0	3.5	4.3
Total	**414.5**	**180.4**	**354.8**

Notes:

1. Estimated cumulative mass recovery includes mass recovered since the system was brought online at the beginning of 2008.
2. Total volume of DNAPL recovered is based on volumes removed and containerized from oil/water separator (OWS-200) during the reporting period.
3. The vapor phase mass removal value for 2014 was corrected from 1.1 kg to 2.2 kg.

Definitions:

DNAPL - Dense Non-Aqueous Phase Liquid
kg - kilograms

Table 8.
Summary of Groundwater Elevation Data
DC Rollforms Site
Jamestown, New York

Well ID	Measuring [1] Point Elevation (ft amsl)	Operational Conditions 11/8/2016		Operational Conditions 6/28/2017		Operational Conditions 11/15/2017	
		Depth to [2] Water	Water-Level Elevation [3]	Depth to [2] Water	Water-Level Elevation [3]	Depth to [2] Water	Water-Level Elevation [3]
ESI-1	1296.37	7.25	1289.12	11.28	1285.09	7.64	1288.73
ESI-2	1295.08	7.1	1287.98	11.26	1283.82	9.16	1285.92
ESI-3[4]	1295.75	6.25	1289.50	7.13	1288.62	6.98	1288.77
ESI-4R	1294.96	10.30	1284.66	12.10	1282.86	8.44	1286.52
ESI-5	1293.08	4.05	1289.03	5.21	1287.87	4.37	1288.71
ESI-6	1295.24	5.86	1289.38	8.20	1287.04	6.21	1289.03
ESI-7	1295.12	6.74	1288.38	10.90	1284.22	9.09	1286.03
MW-4S	1295.75	10.28	1285.47	12.94	1282.81	8.36	1287.39
MW-7D	1295.37	6.77	1288.60	9.73	1285.64	8.29	1287.08
MW-8S	1295.21	6.15	1289.06	7.00	1288.21	6.54	1288.67
MW-8D	1295.48	5.88	1289.60	6.11	1289.37	6.04	1289.44
MW-9	1291.95	6.41	1285.54	6.72	1285.23	6.78	1285.17
MW-10R	1295.11	8.09	1287.02	11.84	1283.27	8.29	1286.82
MW-12	1294.91	5.57	1289.34	6.30	1288.61	6.02	1288.89
MW-13	1294.20	4.77	1289.43	5.70	1288.50	5.16	1289.04
MW-14	1294.59	5.44	1289.15	6.50	1288.09	5.58	1289.01
OW-1	1292.59	7.61	1284.98	NA	NA	11.18	1281.41
OW-2	1293.96	8.99	1284.97	13.25	1280.71	10.39	1283.57
OW-3	1292.01	3.22	1288.79	4.51	1287.50	3.83	1288.18
OW-4	NM	7.30	NA	10.36	NA	8.09	NA
OW-5	1295.59	7.20	1288.39	10.31	1285.28	9.52	1286.07
OW-6	1295.67	7.25	1288.42	11.53	1284.14	9.52	1286.15
OW-7	NM	6.99	NA	11.03	NA	8.95	NA

Definitions:
NA - Not Available
NM - Not Measured

Table 9.
Summary of TCE, DCE, and VC in Groundwater Samples
DC Rollforms Site
Jamestown, New York

Well ID	MW-8S		
Date	Analyte (µg/L)[1]		
	TCE	DCE (total)[2]	VC
December 1998	< 5	8,500	1,100
January 1999	< 5	9,300	2,100
February 1999	3,000	2,500	< 10
March 1999	120	1,406	330
April 1999	130	4,416	480
May 1999	320	2,110 J	62 J
July 1999	35 J	1,600	290
September 1999	96 J	7,100	1,600
January 2000	9	50	72
July 2000	< 5	1,107 J	820
December 2001	85	11 J	1 J
March 2002	6	51 J	18
July 2002	< 5	4.6 J	5 J
October 2002	< 20	410	130
December 2002	3 J	37 J	23
August 2003	9	8.8	3
December 2003	< 5	50 J	49
June 2004	< 5	9.6 J	35
November 2004	< 20	400	93
July 2005	< 20	320	180
March 2008	150 D	758 DJ	60 DJ
June 2008	< 100	3,100 D	910
September 2008	46 J	6,029 DJ	1,800
December 2008	26	69 J	1.5
March 2009	23	92	< 1
June 2009	42	3,000	350
September 2009	57	7,800 D	870
December 2009	67	4,400	270
March 2010	< 25	4,700	580
June 2010	< 25	5,400 D	690
October 2010	58	1,811	57
December 2010	14	66	< 1
March 2011	25	145	3
June 2011	10	3,902 D	334 D
October 2011	12	2,744 D	115 D
December 2011	16	158	< 1
March 2012	29.5	399.5	24.2
October 2012	< 1	809	1270
March 2013	16.7	121	< 1
August 2013	1.6	3410.1	242
March 2014	16.5	134.1	< 1
August 2014	11	4,137	631
March 2015	9.3	34.9	<1
August 2015	2.3	1,440	0.32 J
May 2016	11.2	7,446	648
November 2016	< 1	40	< 1
January 2017	2.9	10	2.9
April 2017	2	10	2.2
June 2017	30.2	72	6.6

Well ID	MW-9		
Date	Analyte (µg/L)[1]		
	TCE	DCE (total)[2]	VC
March 2008	3.4 J	6.9 J	3.6 J
June 2008	10	< 5	< 5
September 2008	9.8 J	2.2 J	< 25
December 2008	6.8	0.52 J	< 1
March 2009	4.8	2.7	1.4
June 2009	7.2	< 1	< 1
September 2009	11	< 1	< 1
December 2009	4.1	< 1	< 1
March 2010	2.1	2.7	1.9
June 2010	5.3	< 1	< 1
October 2010	8.4	< 1	< 1
December 2010	4.7	< 1	< 1
March 2011	4	4.2	1.5
June 2011	9	< 1	< 1
October 2011	8.6	< 1	< 1
December 2011	6.7	< 1	< 1
March 2012	4.4	1.4	< 1
October 2012	3.4	3.0	4.4
March 2013	3	< 1	< 1
August 2013	4	2.4	< 1
March 2014	1.9	< 1	< 1
August 2014	3.9	< 1	< 1
March 2015	1.9	< 1	< 1
August 2015	2.3	3.5	0.75 J
May 2016	2.2	1.0	< 1
November 2016	3.9	< 1	< 1
June 2017	4.5	< 1	< 1
November 2017	3.2	< 1	< 1

Well ID	MW-10R[4]		
Date	Analyte (µg/L)[1]		
	TCE	DCE (total)[2]	VC
June 2010	3.9	12	< 2
October 2010	56	260	< 2
December 2010	22	9.4	< 1
March 2011	76	17	< 1
June 2011	9.3	273	1.8
October 2011	86	143	< 1
December 2011	11	31	< 1
March 2012	17	111	< 1
May 2012	13.2	157	< 1
October 2012	< 1	1.7	< 1
December 2012	1.1	41	< 1
March 2013	79.3	38.6	< 1
June 2013	9.6	19.4	< 1
August 2013	< 1	23	< 1
November 2013	1.5	2.1	< 1
March 2014	31.4	25.8	< 1
May 2014	53.4	26.7	< 1
August 2014	13.2	41.9	1.1
December 2014	13	16.2	< 1
March 2015	19.3	7.1	< 1
May 2015	22.4	96	< 1
August 2015	< 1	12	< 1
May 2016	2.6	89.9 J	3.7
November 2016	109	54.6	< 1
June 2017	53.7	91.9	< 1
November 2017	96.6	39.9	< 1

Well ID	MW-12		
Date	Analyte (µg/L)[1]		
	TCE	DCE (total)[2]	VC
December 1998	81	524 J	260
January 1999	60	460	120
February 1999	4,400 B	9,800	< 10
March 1999	66 J	4,516	380
April 1999	510	9,200	710 J
May 1999	300	7,438 J	360 J
July 1999	6	29 J	83
September 1999	56	1,000	120
January 2000	12 J	1,100	920
July 2000	< 5	< 5	< 10
December 2001	< 5	15 J	< 10
March 2002	7	172 J	120
July 2002	< 5	35	24
October 2002	10	48 J	37
December 2002	64	301 J	130
August 2003	42	40	100
December 2003	22	140	220
June 2004	< 5	11	26
November 2004	32	140	140
July 2005	0.76	51	86
March 2008	44	1,808 DJ	400
June 2008	< 100	1900	470
September 2008	< 50	810	410
December 2008	1,600 D	1,808 D	30
March 2009	540	760	14
June 2009	280	2300	140
September 2009	< 20	5,800 D	230
December 2009	470	3,500	59
March 2010	510	3800	140
June 2010	110	4,800	440
October 2010	36	970	310
December 2010	230	1,200	< 10
March 2011	127	620.4	9.4
June 2011	194	3,843 D	364 D
October 2011	1,750 D	1,942 D	15
December 2011	828 D	2,032 D	25
March 2012	188	1,580	25.3
May 2012	5870	9,958	106
October 2012	< 1	2,685	3860
December 2012	692	1,244	5.8
March 2013	130	745	< 1
June 2013	393	2,092	76.7
August 2013	198	1,016	460
November 2013	1010	1,810	58.4
March 2014	202	809	< 5
May 2014	140	998.9	< 5
August 2014	< 5	1,387.3	1200
December 2014	262	1,064.9	14.3
March 2015	92.1	629.2	< 5
May 2015	390	2,272	176
August 2015	38.7	1541.8	389
May 2016	149	1857.5	230
November 2016	58.6	510.3	64
January 2017	26.2	163	15.2
April 2017	14.4	125	19.9
June 2017	8.2	245.4	81.1

Definitions:

B - indicates a results > = MDL but < RL
D - Identifies an analysis that used a secondary dilution factor
DCE - Dichloroethene
J - Indicates an estimated value
TCE - Trichloroethene
µg/L - micrograms per liter
VC - Vinyl Chloride

Table 9.
Summary of TCE, DCE, and VC in Groundwater Samples
DC Rollforms Site
Jamestown, New York

Well ID	MW-13			Well ID	MW-14			Well ID	ESI-1			Well ID	ESI-2		
Date	Analyte (µg/L)[1]			Date	Analyte (µg/L)[1]			Date	Analyte (µg/L)[1]			Date	Analyte (µg/L)[1]		
	TCE	DCE (total)[2]	VC		TCE	DCE (total)[2]	VC		TCE	DCE (total)[2]	VC		TCE	DCE (total)[2]	VC
July 2000	< 5	6	4 J	July 2000	13 J	4,700	1,400	July 2002	< 100	210	2,300	July 2002	< 20	21	390
December 2001	24	< 5	< 5	December 2001	< 5	3,000	610	October 2002	< 20	21	460	October 2002	< 10	< 10	52
July 2002	0.9 J	< 5	< 5	March 2002	< 5	6,600	1,100	August 2003	< 20	16	420	August 2003	< 5	< 5	36
October 2002	< 5	< 5	< 5	July 2002	NA	14,000	3,800	December 2003	< 5	1 J	1 J	December 2003	< 20	230	500
December 2002	51	3 J	< 5	October 2002	< 500	8,400	2,000	June 2004	< 500	92 J	1,300	June 2004	< 5	5 J	190
August 2003	3	< 5	< 5	December 2002	< 250	6,816 J	1,400	December 2004	< 5	< 5	< 5	December 2004	< 5	< 5	12
December 2003	< 5	< 5	< 5	August 2003	< 1,200	20,000	1,900	July 2005	< 50	70	1,200	July 2005	< 5	< 5	75
June 2004	< 5	< 5	< 5	December 2003	< 500	16,000	2,200	March 2008	< 50	< 50	< 50	March 2008	< 25	< 25	< 25
November 2004	< 5	< 5	< 5	June 2004	< 1,000	19,000	2,500	June 2008	< 50	< 50	< 50	December 2008	< 1	< 1	< 1
July 2005	< 5	< 5	< 5	December 2004	< 500	16,000	2,300	September 2008	< 50	< 50	< 50	March 2009	< 1	< 1	< 1
March 2008	2.7 J	48 J	24	March 2008	1.7 J	1,009 DJ	340	December 2008	< 1	< 1	< 1	March 2010	< 1	< 1	< 1
June 2008	6.7	1,306 DJ	85	June 2008	< 100	1,800	550	March 2009	< 1	< 1	< 1	June 2010	< 1	< 1	< 1
September 2008	< 100	1,700 D	890	September 2008	< 100	1,814 J	3,900 D	June 2009	< 1	< 1	< 1	October 2010	< 1	< 1	< 1
December 2008	61	523 DJ	200 D	December 2008	3.7	975 DJ	390 D	September 2009	< 1	3.2	< 1	December 2010	< 1	< 1	< 1
March 2009	41	1,700	630	March 2009	< 5	620	150	December 2009	< 1	< 1	< 1	March 2011	< 1	< 1	< 1
June 2009	< 50	6,200	1,700	June 2009	< 10	1,100	450	March 2010	< 1	3.6	< 1	June 2011	4.1	< 1	1.1
September 2009	< 25	2,600	170	September 2009	< 2.5	190	300	June 2010	< 1	< 1	< 1	October 2011	< 1	< 1	< 1
December 2009	< 5	900	400	December 2009	< 2.5	710 D	310	October 2010	< 1	< 1	< 1	December 2011	< 1	< 1	< 1
March 2010	< 5	510	170	March 2010	< 5	1,307 D	510	December 2010	< 1	< 1	< 1	March 2012	< 1	< 1	< 1
June 2010	< 5	1,400 D	530	June 2010	< 2	220	280	March 2011	< 1	< 1	< 1	October 2012	< 1	< 1	< 1
October 2010	< 10	5,157 D	4,500 D	October 2010	< 1	85	170	June 2011	< 1	< 1	< 1	March 2013	< 1	< 1	< 1
December 2010	< 25	4,500 D	4,300	December 2010	3.4	1,607 D	390 D	October 2011	< 1	< 1	< 1	August 2013	< 1	< 1	< 1
March 2011	5.8	363	612	March 2011	66	1,809	451	December 2011	< 1	< 1	< 1	March 2014	< 1	< 1	< 1
June 2011	5.7	325	377	June 2011	< 1	1,419 D	544	March 2012	< 1	< 1	< 1	August 2014	0.54 J	< 1	0.89 J
October 2011	85	1,538 D	1,310 D	October 2011	3.4	2,230 D	476 D	October 2012	< 1	10.9	11.8	March 2015	0.47 J	< 1	< 1
December 2011	79	916 D	494 D	December 2011	3.1	1,282 D	353	March 2013	< 1	< 1	< 1	August 2015	< 1	2.8	1.4
March 2012	36.7	392	243	March 2012	< 1	3401.3	1260	August 2013	< 1	< 1	< 1	May 2016	< 1	0.76 J	1.2
May 2012	495	3,116	682	May 2012	< 1	568	209	March 2014	< 1	< 1	< 1	November 2016	3.7	< 1	< 1
October 2012	< 1	2,554	3,100	October 2012	< 1	24.9	65	August 2014	< 1	< 1	< 1	June 2017	<1	2.3	1.3
December 2012	72.2	316	15	December 2012	2.9	1828.7	194	March 2015	< 1	< 1	< 1	November 2017	<1	<1	<1
March 2013	52.8	350	27.7	March 2013	< 1	801	158	August 2015	< 1	< 1	< 1				
June 2013	40.9	971.3	60.2	June 2013	< 1	2512.5	611	May 2016	< 1	< 1	< 1				
August 2013	< 1	1,564	1,000	August 2013	< 1	888.2	526	November 2016	< 1	< 1	< 1				
November 2013	29.5	125	8.2	November 2013	< 1	2310	1190	June 2017	< 1	< 1	< 1				
March 2014	25.6	277.6	180	March 2014	< 4	1044.9	590	November 2017	< 1	< 1	< 1				
May 2014	46.5	321.6	18.1	May 2014	< 10	1640.2	1030								
August 2014	46	2,395	236	August 2014	912	4016 J	204								
December 2014	11.2	198	350	December 2014	< 5	1494.2	1970								
March 2015	12.1	175.3	27	March 2015	< 5	1236	954								
May 2015	1.9	2.2	326	May 2015	1.6	427	523								
August 2015	< 1	10,009	5,910	August 2015	< 5	285	453								
May 2016	< 1	145	181	May 2016	< 5	788.1	871								
November 2016	25	121	48	November 2016	1.7	194.7	303								
January 2017	< 2	7	9.3	January 2017	0.6	105	150								
April 2017	<1	2	2.4	April 2017	0.5	59	98.5								
June 2017	<2	1.4	1.4	June 2017	<1	413	766								

Definitions:

B - indicates a results > = MDL but < RL
D - Identifies an analysis that used a secondary dilution factor
DCE - Dichloroethene
J - Indicates an estimated value
TCE - Trichloroethene
µg/L - micrograms per liter
VC - Vinyl Chloride

Table 9.
Summary of TCE, DCE, and VC in Groundwater Samples
DC Rollforms Site
Jamestown, New York

Well ID	ESI-4R[3]		
Date	Analyte (µg/L)[1]		
	TCE	DCE (total)[2]	VC
October 2010	150	186	38
December 2010	12	410	39
March 2011	134	410	52
June 2011	15	1,165 D	248 D
October 2011	4.2	391	102
December 2011	2.5	480 D	101
March 2012	3.5	2,070	825
August 2013	< 1	98	9.2
March 2014	1.2	315	51.9
August 2014	1.1	253.5	33.6
March 2015	10.1	230.8	86
August 2015	2.1	180	29.1
May 2016	2.1	194	39.5
November 2016	< 1	330	431.0
June 2017	11	143	35.7
November 2017	56.7	83.4	7.7

Well ID	ESI-6		
Date	Analyte (µg/L)[1]		
	TCE	DCE (total)[2]	VC
December 1998	2 J	19	13
January 1999	< 5	30	34
February 1999	360	22	< 10
March 1999	390	82	50
April 1999	520	75	45 J
May 1999	280	39	42
July 1999	120	12	11
September 1999	610	8 J	< 10
January 2000	130	46	24
July 2000	< 5	< 5	< 10
December 2001	3	14	5
March 2002	< 5	49	26
July 2002	1 J	4 J	2 J
October 2002	< 5	1 J	< 5
December 2002	< 5	14	9
August 2003	< 5	2	< 5
December 2003	4 J	67	23
June 2004	< 5	6	12
November 2004	< 5	43	11
July 2005	< 5	14	6
March 2008	< 5	1.6 J	3.6 J
June 2008	< 5	< 5	1.5 J
September 2008	< 5	2.6 J	3.2 J
December 2008	< 1	2.2	1.1
March 2009	9.1	6.8	2.4
June 2009	1.4	1.1	< 1
September 2009	< 1	< 1	< 1
December 2009	< 1	2.1	< 1
March 2010	< 1	< 1	< 1
June 2010	< 1	< 1	< 1
October 2010	< 1	< 1	< 1
December 2010	< 1	1.6	< 1
March 2011	1.1	2.5	< 1
June 2011	< 1	< 1	< 1
October 2011	< 1	< 1	< 1
December 2011	< 1	1.5	< 1
March 2012	< 1	< 1	< 1
October 2012	< 1	< 1	< 1
March 2013	< 1	< 1	< 1
August 2013	< 1	1.3	< 1
March 2014	< 1	< 1	< 1
August 2014	< 1	< 1	< 1
March 2015	0.51 J	1.6	< 1
August 2015	< 1	0.87 J	0.21 J
May 2016	< 1	< 1	< 1
November 2016	< 1	1.5	< 1
June 2017	<1	<1	<1
November 2017	<1	4.6	26.8

Well ID	ESI-7		
Date	Analyte (µg/L)[1]		
	TCE	DCE (total)[2]	VC
December 1998	320	8	< 10
January 1999	< 5	3	< 10
February 1999	16	19	< 10
March 1999	100	40	2 J
April 1999	180	37	4 J
May 1999	77	83 J	88
July 1999	89	2.5 J	4 J
September 1999	190	4 J	< 10
January 2000	33	49.7 J	3 J
July 2000	4 J	14	< 10
December 2001	7	17 J	2 J
March 2002	65	261 J	2 J
July 2002	9	204 J	33
October 2002	1 J	7	2 J
December 2002	24	83 J	1 J
August 2003	10	93	5
December 2003	13	171 J	4 J
July 2004	< 5	17 J	11
November 2004	10	66	< 5
July 2005	< 5	19	18
March 2008	2.2 J	20	2.4 J
June 2008	< 5	< 5	< 5
September 2008	< 5	1.1 J	0.55 J
December 2008	0.79 J	3.2	< 1
March 2009	7.9	5.7	< 1
June 2009	< 1	< 1	< 1
September 2009	< 1	1.4	< 1
December 2009	< 1	1.8	1.4
March 2010	1.1	5.6	3.2
June 2010	< 1	1.1	1.2
October 2010	< 1	2.6	1.2
December 2010	7.3	13	< 1
March 2011	44	168	6.8
June 2011	< 1	1.3	1.6
October 2011	< 1	1.2	< 1
December 2011	1.2	9.1	< 1
March 2012	8.5	10.1	1.5
October 2012	< 1	2.1	4.4
March 2013	< 1	< 1	< 1
August 2013	< 1	< 1	< 1
March 2014	10.2	8.0	1.5
August 2014	< 1	1.3	0.79
March 2015	5.5	14.1	< 1
August 2015	< 1	3.6	0.51 J
May 2016	33.1	62.4	3.4
November 2016	1.9	4.8	< 1
June 2017	< 1	4.1	<1
November 2017	2.7	7.3	<1

Well ID	OW-5		
Date	Analyte (µg/L)[1]		
	TCE	DCE (total)[2]	VC
March 2008	< 5	< 5	< 5
June 2008	< 5	6,656 DJ	11,000 D
September 2008	< 25	7,213 DJ	11,000 D
December 2008	< 1	< 1	< 1
March 2009	< 1	< 1	< 1
June 2009	< 5	930	780
September 2009	< 5	3,200 D	5,400 D
December 2009	< 1	130	130
March 2010	< 1	1,709 D	1,400 D
June 2010	< 10	5,100 D	4,200 D
October 2010	< 2	46	110
December 2010	< 1	< 1	< 1
March 2011	< 1	< 1	< 1
June 2011	1	2,558 D	1650
October 2011	< 1	187	137 D
December 2011	< 1	< 1	< 1
March 2012	< 1	1207.5	1030
October 2012	< 1	2554.2	4060
March 2013	< 1	9.3	< 1
August 2013	< 1	1868.8	2,710
March 2014	< 1	22.9	25
August 2014	< 1	385.7 J	1000
March 2015	3.2	< 1	< 1
August 2015	0.56 J	98	262
May 2016	< 1	171	463
November 2016	< 1	< 1	< 1
June 2017	< 1	514	660
November 2017	< 1	57	84

Definitions:

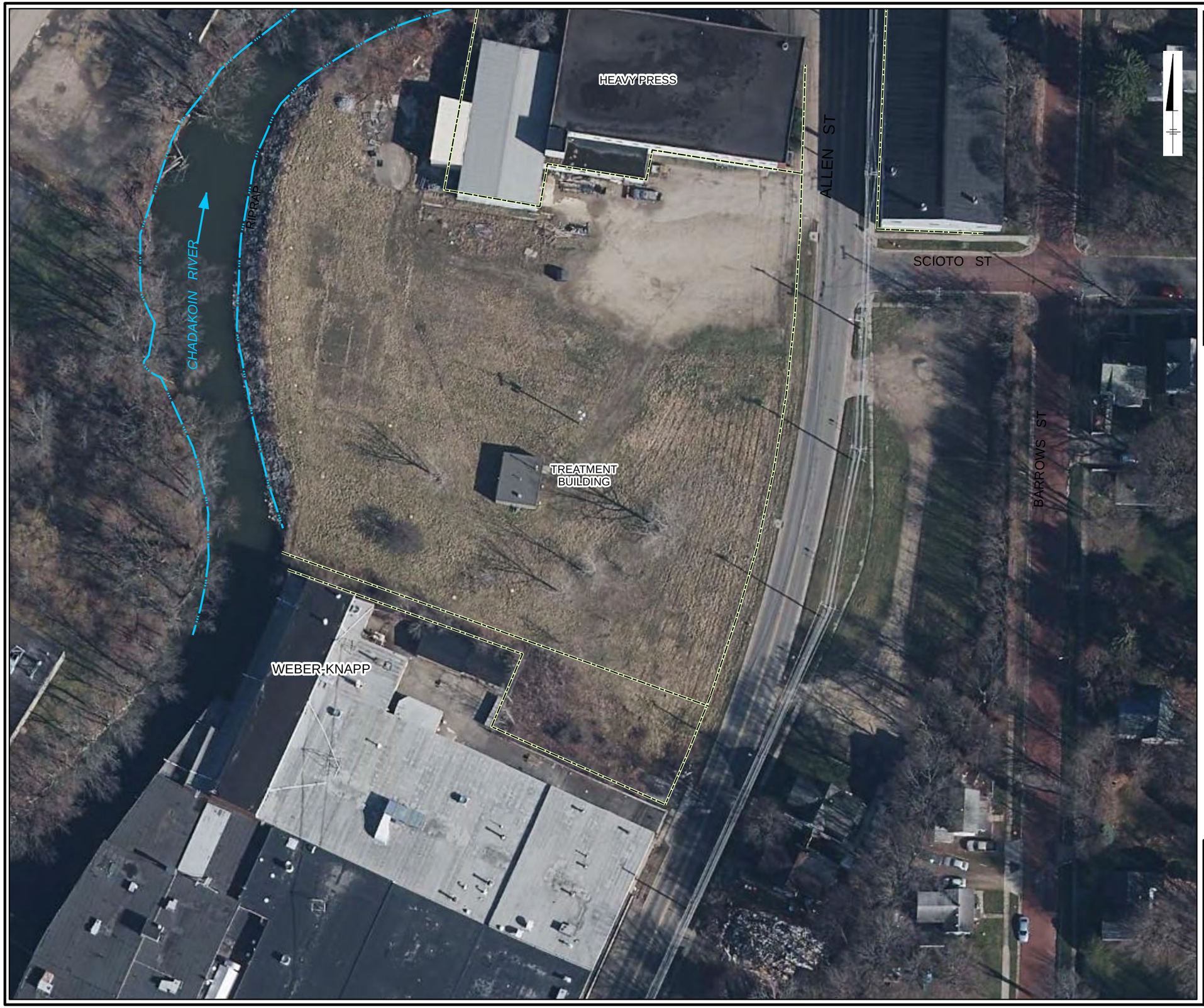
B - indicates a results > = MDL but < RL
D - Identifies an analysis that used a secondary dilution factor
DCE - Dichloroethene
J - Indicates an estimated value
TCE - Trichloroethene
µg/L - micrograms per liter
VC - Vinyl Chloride

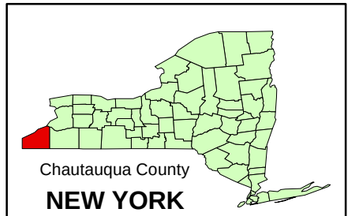
Table 9.
Summary of TCE, DCE, and VC in Groundwater Samples
DC Rollforms Site
Jamestown, New York

Well ID	OW-6		
Date	Analyte (µg/L)[1]		
	TCE	DCE (total)[2]	VC
March 2008	42	343 DJ	76
June 2008	11 J	100	310
September 2008	14 J	130	330
December 2008	230 D	98 D	0.8 J
March 2009	480	210	< 2.5
June 2009	94	290	40
September 2009	35	300	120
December 2009	200	640 D	9.8
March 2010	59	606	150
June 2010	20	420	120
October 2010	32	223	220
December 2010	190 D	180	1.4
March 2011	3.6	6.1	< 1
June 2011	15	249	17
October 2011	2.7	11.7	< 1
December 2011	610 D	362 D	< 1
March 2012	298	314	4.3
May 2012	66.8	414	57.5
October 2012	9.6	93.6	100
December 2012	13.8	85.5	57.6
March 2013	27.8	46	< 1
June 2013	35	157	87.5
August 2013	28.5	207.0	290
November 2013	1	2.1	1.6
March 2014	827	544	< 4
May 2014	672	358.1	1.8
August 2014	67	450.3	47.1
December 2014	17.1	48.2	0.46 J
March 2015	214	283	< 4
May 2015	197	5.6 J	176
August 2015	30.6	420.3	190
May 2016	68.1	600.2	108
November 2016	45.3	522	12
June 2017	16	479.9	405
November 2017	160	537.2	9

Definitions:
B - indicates a results > = MDL but < RL
D - Identifies an analysis that used a secondary dilution factor
DCE - Dichloroethene
J - Indicates an estimated value
TCE - Trichloroethene
µg/L - micrograms per liter
VC - Vinyl Chloride

FIGURES





LEGEND

- Property Line
- Riverbank
- Flow Direction

0 60 120

SCALE IN FEET

PROJECTION: NAD 1983 StatePlane New York West FIPS 3103 Feet

SOURCE: NYS Orthos Online (2016).

INGERSOLL RAND - DC ROLLFORMS SITE
NYSDEC SITE NO. 907019, JAMESTOWN, NEW YORK

2017-2018 PRR

Site Location Map

ARCADIS Design & Consultancy for natural and built assets

FIGURE **1**

CITY: (CITRIX) DIV/GROUP:(ENV/GIS) PIC:() PM:(M.SANFORD/M.WACKSMAN) TM:(T.CARIGNAN) BY: KIVES
PROJECT: AY000219.0024 PATH: Z:\GISPROJECTS_ENV\INGERSOLRAND\DC_ROLLOVER\MAPDOCS\2018SEMIANNUALREPORTVF1 DCR_GWMON REG SITE LOC.MXD SAVED: 2/20/2018

LEGEND

- Monitoring Well
- Recovery Well (passive)
- Injection Well (inactive)
- Observation Well
- Vacuum Enhanced Pumping Well
- VEP Valve Box
- Property Line
- Interlocking Sheet Pile/Hydraulic Barrier Wall
- High Water Mark
- Bundled Process Line
- Discharge Line
- Recovery Well Piping
- Vacuum Line
- Overhead Electrical/Telecom Line
- Sanitary Sewer Line
- Bollard Pipe
- Effluent Pipe Clean Out
- Fire Hydrant
- Sewer Manhole
- Utility Pole

NOTE: All locations are approximate.

0 40 80

SCALE IN FEET

PROJECTION: NAD 1983 StatePlane New York West FIPS 3103 Feet

SOURCE: NYS Orthos Online (2016).

INGERSOLL RAND - DC ROLLFORMS SITE
NYSDEC SITE NO. 907019, JAMESTOWN, NEW YORK

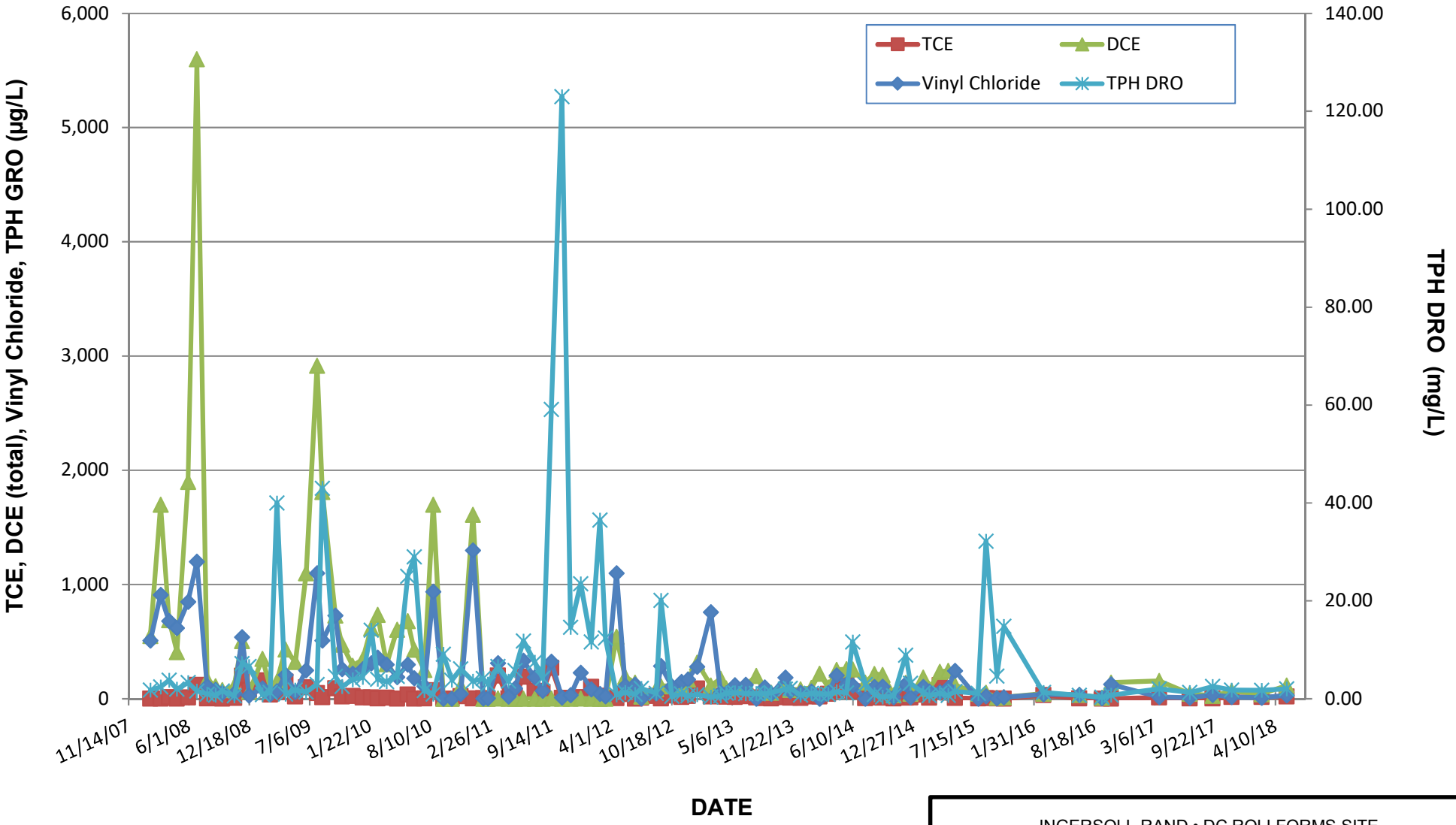
2017-2018 PRR

Site Plan/Remedial System Layout

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2

CITY: (KNOXVILLE) DIV/GROUP:(ENV/GIS) PIC:() PM:(M.SANFORD/M.WACKSMAN) TM:(T.CARIGNAN)
PROJECT: AY000219.0024 PATH: Z:\GISPROJECTS_ENV\INGERSOLRAND\DC_ROLLOVER\MAPDOCS\2018\SEMIANNUALREPORT\F2 DCR_GWMON SITE PLAN.MXD SAVED: 2/20/2018 BY: KIVES



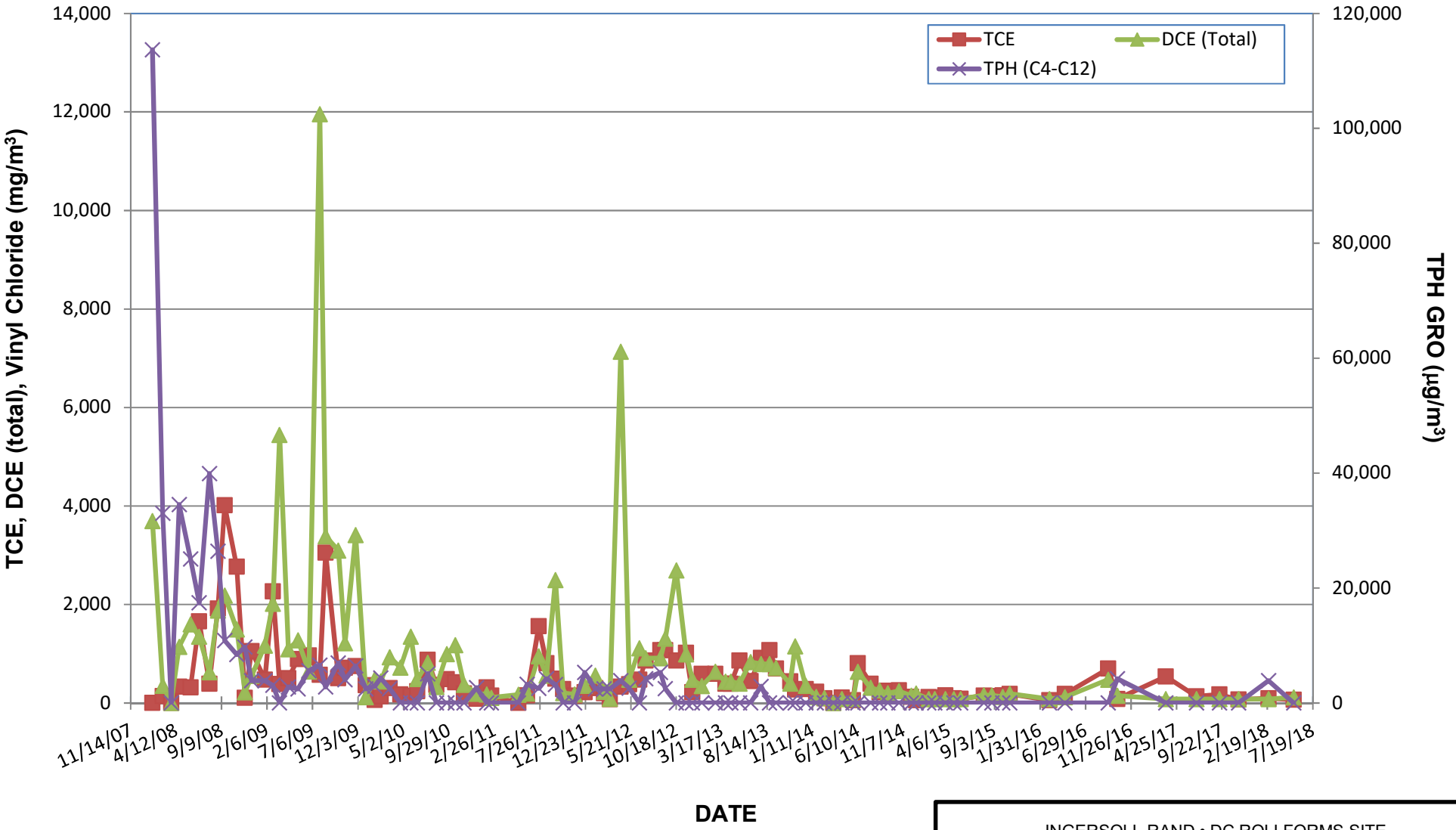
Definitions:
DCE – Dichloroethene
DRO – Diesel Range Organics
GRO – Gasoline Range Organics
mg/L – milligrams per liter
TCE – Trichloroethene
TPH – Total Petroleum Hydrocarbons
µg/L – micrograms per liter

INGERSOLL RAND • DC ROLLFORMS SITE
JAMESTOWN, NEW YORK
2017-2018 PRR

System Influent Dissolved Phase Concentrations

ARCADIS Design & Consultancy for natural and built assets

FIGURE
3



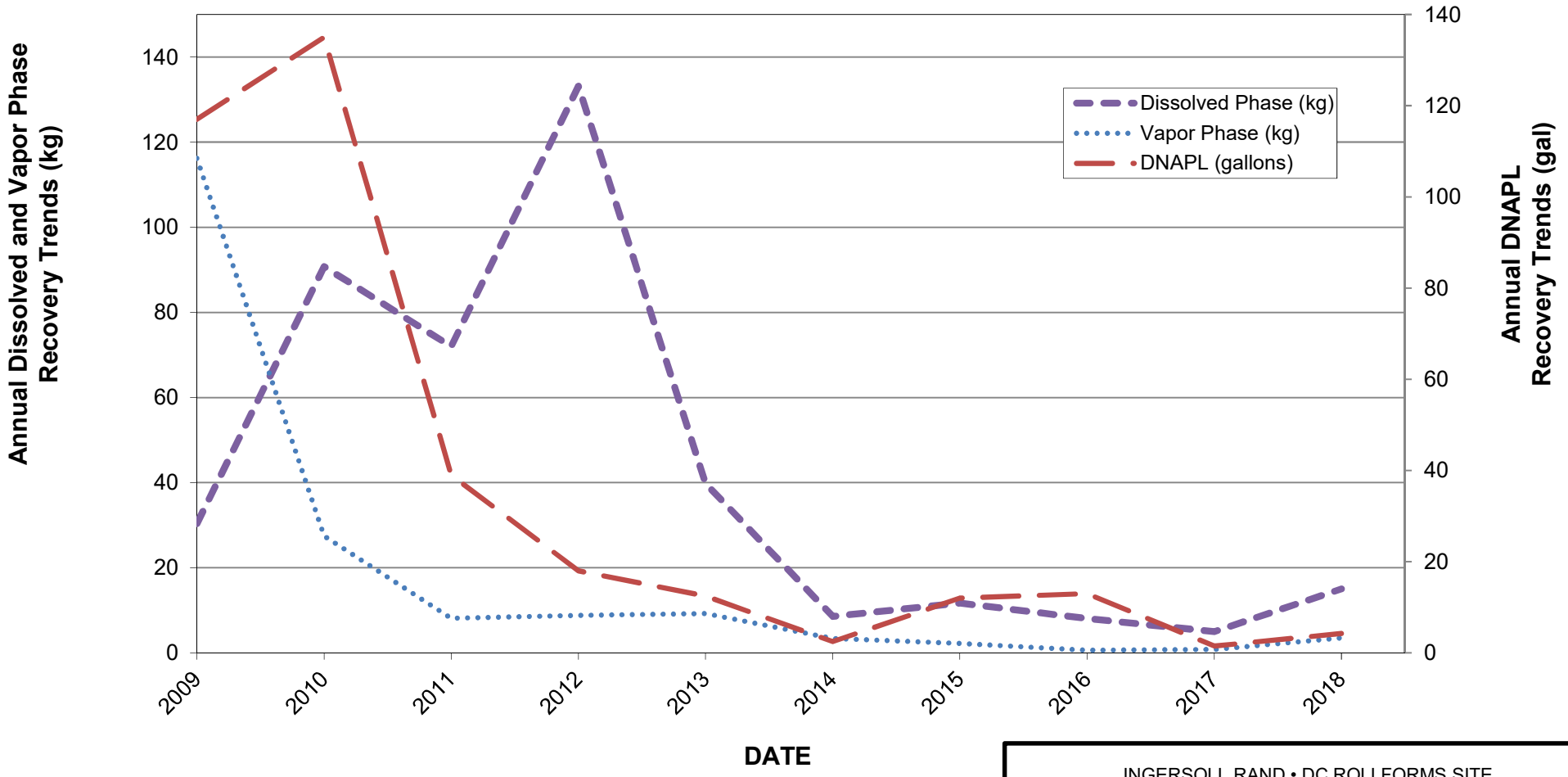
Definitions:
DCE – Dichloroethene
GRO – Gasoline Range Organics
mg/m^3 – milligram per cubic meters
TCE – Trichloroethene
TPH – Total Petroleum Hydrocarbons

INGERSOLL RAND • DC ROLLFORMS SITE
JAMESTOWN, NEW YORK
2017-2018 PRR

System Influent Vapor Phase Concentrations

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4

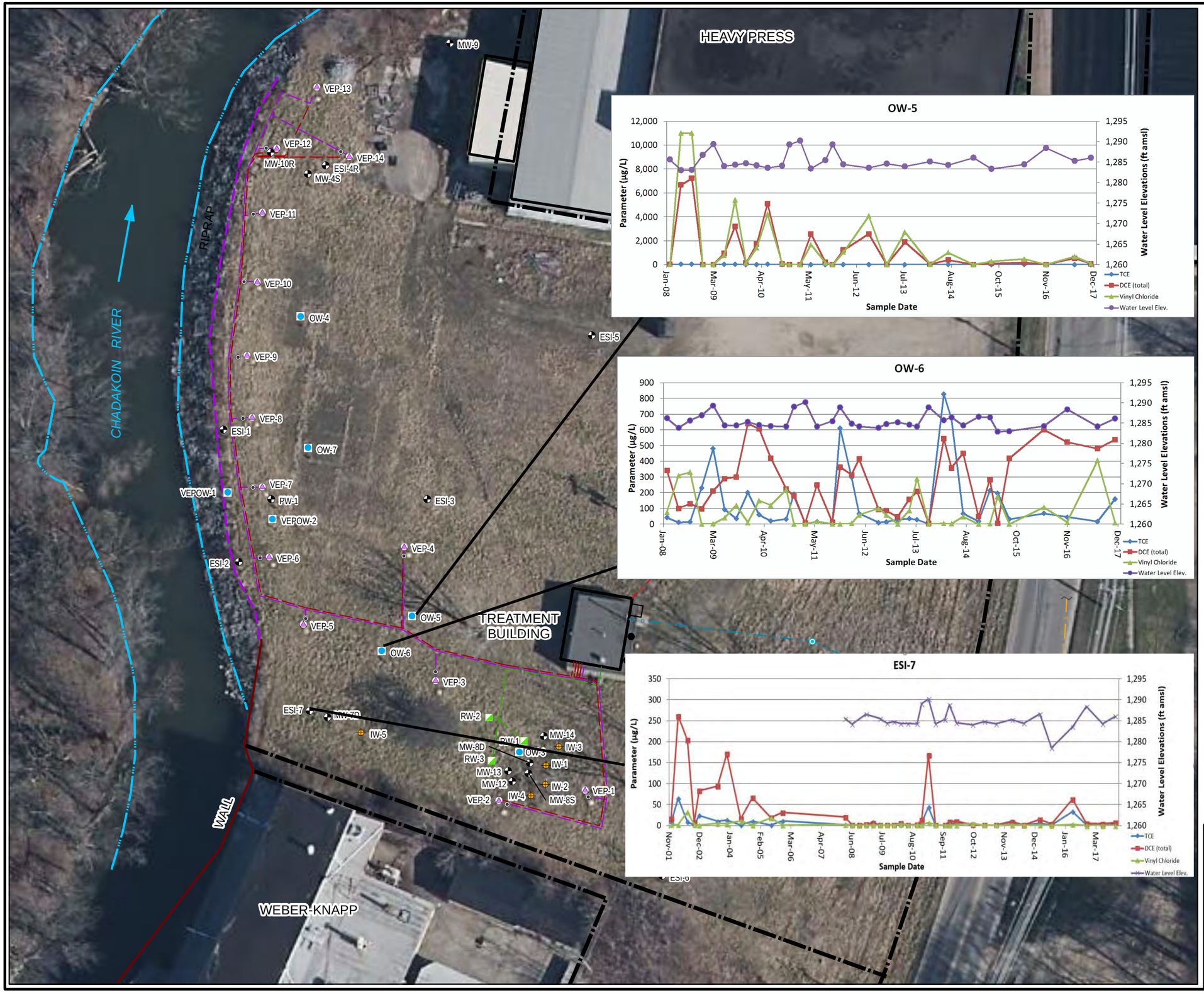


INGERSOLL RAND • DC ROLLFORMS SITE
JAMESTOWN, NEW YORK
2017-2018 PRR

Annual Mass Recovery Trends vs. Time

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5



LEGEND

- Monitoring Well
- Recovery Well (passive)
- Injection Well (inactive)
- Observation Well
- Vacuum Enhanced Pumping Well
- VEP Valve Box
- Property Line
- Interlocking Sheet Pile/Hydraulic Barrier Wall
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- Effluent Pipe Clean Out
- Fire Hydrant
- Sewer Manhole
- Utility Pole

NOTE: All locations are approximate.

0 40 80

SCALE IN FEET

PROJECTION: NAD 1983 StatePlane New York West FIPS 3103 Feet

SOURCE: NYS Orthos Online (2016).

INGERSOLL RAND - DC ROLLFORMS SITE
NYSDEC SITE NO. 907019, JAMESTOWN, NEW YORK

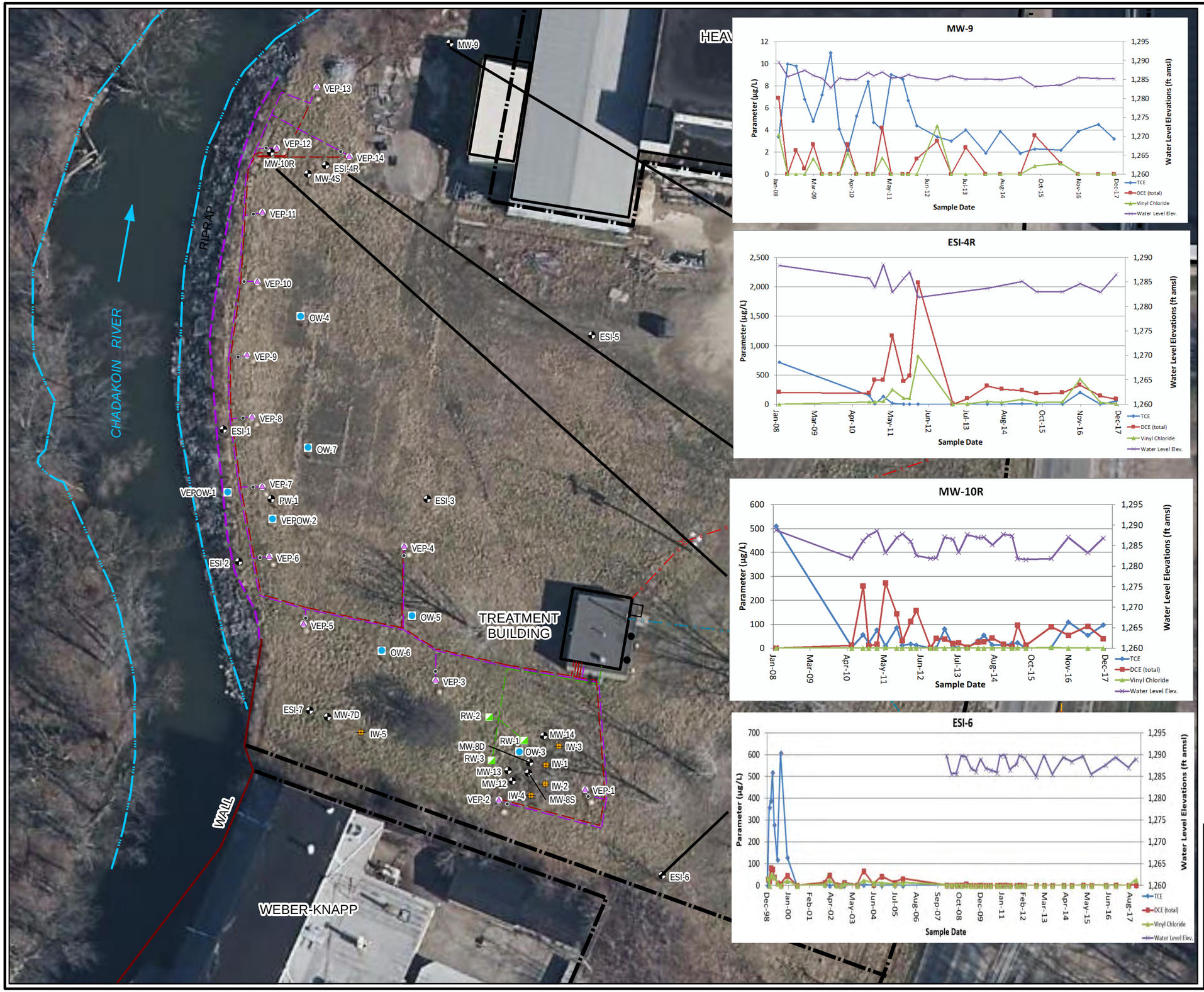
2017-2018 PRR

Summary of Groundwater Monitoring Analytical Results

ARCADIS Design & Consultancy for natural and built assets

FIGURE **6A**

CITY: (KNOXVILLE) DIV/GROUP:(ENV/GIS) PIC:() PM:(M.SANFORD/M.WACKSMAN) TM:(T.CARIGNAN) BY: KIVES
PROJECT: AY000219.0024 PATH: Z:\GIS\PROJECTS_ENV\INGERSOLRAND\DC_ROLLOVER\MAPDOCS\2018\SEMIANNUALREPORT\F2 DCR_GWMON SITE PLAN.MXD SAVED: 2/20/2018



LEGEND

- Monitoring Well
- Recovery Well (passive)
- Injection Well (inactive)
- Observation Well
- Vacuum Enhanced Pumping Well
- VEP Valve Box
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- Sanitary Sewer Line
- Bollard Pipe
- Effluent Pipe Clean Out
- Fire Hydrant
- Sewer Manhole
- Utility Pole

NOTE: All locations are approximate.

0 40 80

SCALE IN FEET

PROJECTION: NAD 1983 StatePlane New York West FIPS 3103 Feet

SOURCE: NYS Orthos Online (2016).

INGERSOLL RAND - DC ROLLFORMS SITE
NYSDEC SITE NO. 907019, JAMESTOWN, NEW YORK

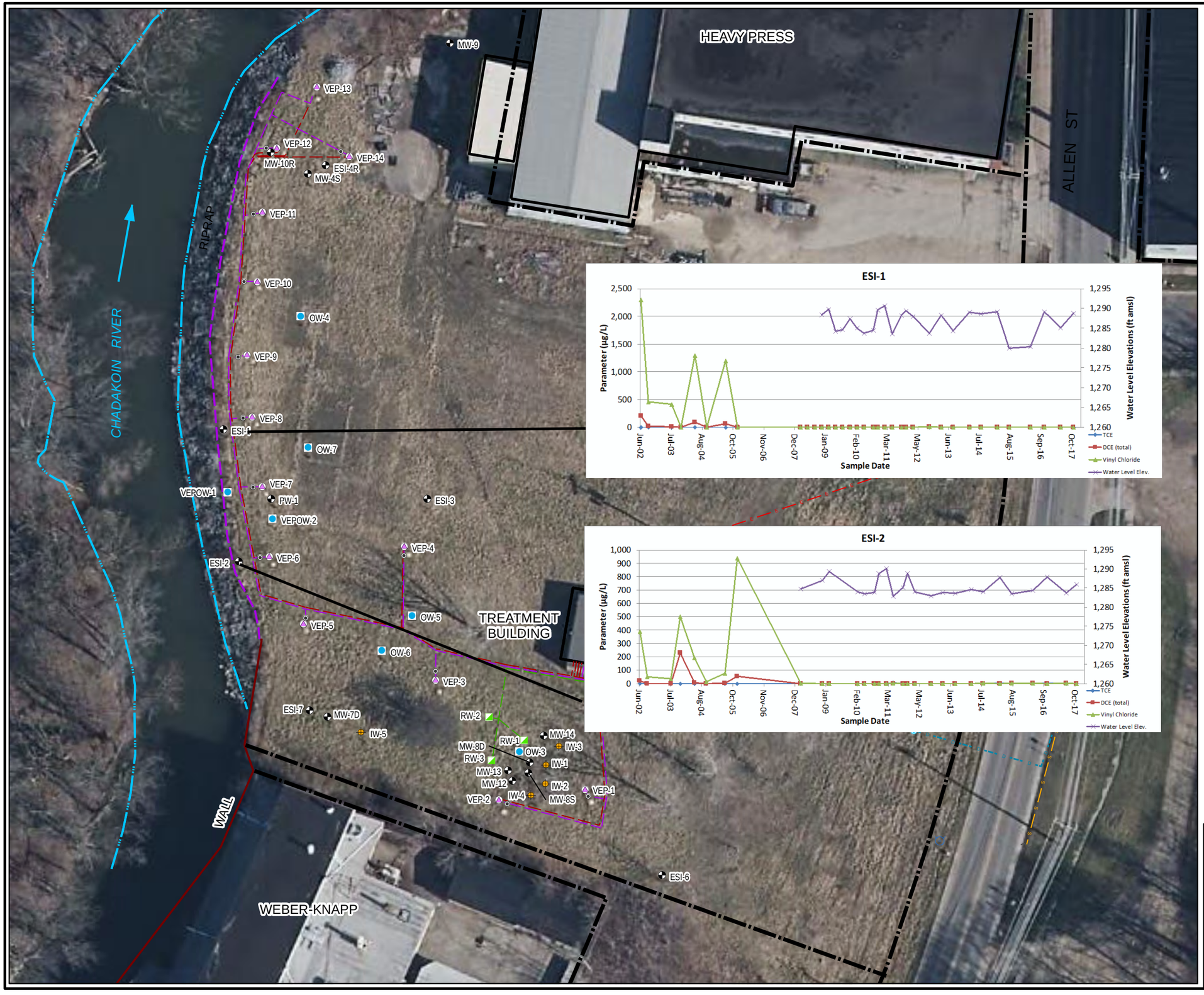
2017-2018 PRR

Summary of Groundwater Monitoring Analytical Results

ARCADIS Design & Consultancy for natural and built assets

FIGURE **6B**

CITY: (KNOXVILLE) DIV/GROUP:(ENV/GIS) PIC:() PM:(M.SANFORD/M.WACKSMAN) TM:(T.CARIGNAN) BY: KIVES
PROJECT: AY000219.0024 PATH: Z:\GISPROJECTS_ENV\INGERSOLRAND\DC_ROLLOVER\MAPDOCS\2018\SEMIANNUALREPORT\F2 DCR_GWMON SITE PLAN.MXD SAVED: 2/20/2018



LEGEND

- Monitoring Well
- Recovery Well (passive)
- Injection Well (inactive)
- Observation Well
- Vacuum Enhanced Pumping Well
- VEP Valve Box
- Property Line
- Interlocking Sheet Pile/Hydraulic Barrier Wall
- High Water Mark
- Bundled Process Line
- Discharge Line
- Recovery Well Piping
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- Overhead Electrical/Telecom Line
- Sanitary Sewer Line
- Bollard Pipe
- Effluent Pipe Clean Out
- Fire Hydrant
- Sewer Manhole
- Utility Pole

NOTE: All locations are approximate.

0 40 80

SCALE IN FEET

PROJECTION: NAD 1983 StatePlane New York West FIPS 3103 Feet

SOURCE: NYS Orthos Online (2016).

INGERSOLL RAND - DC ROLLFORMS SITE
NYSDEC SITE NO. 907019, JAMESTOWN, NEW YORK

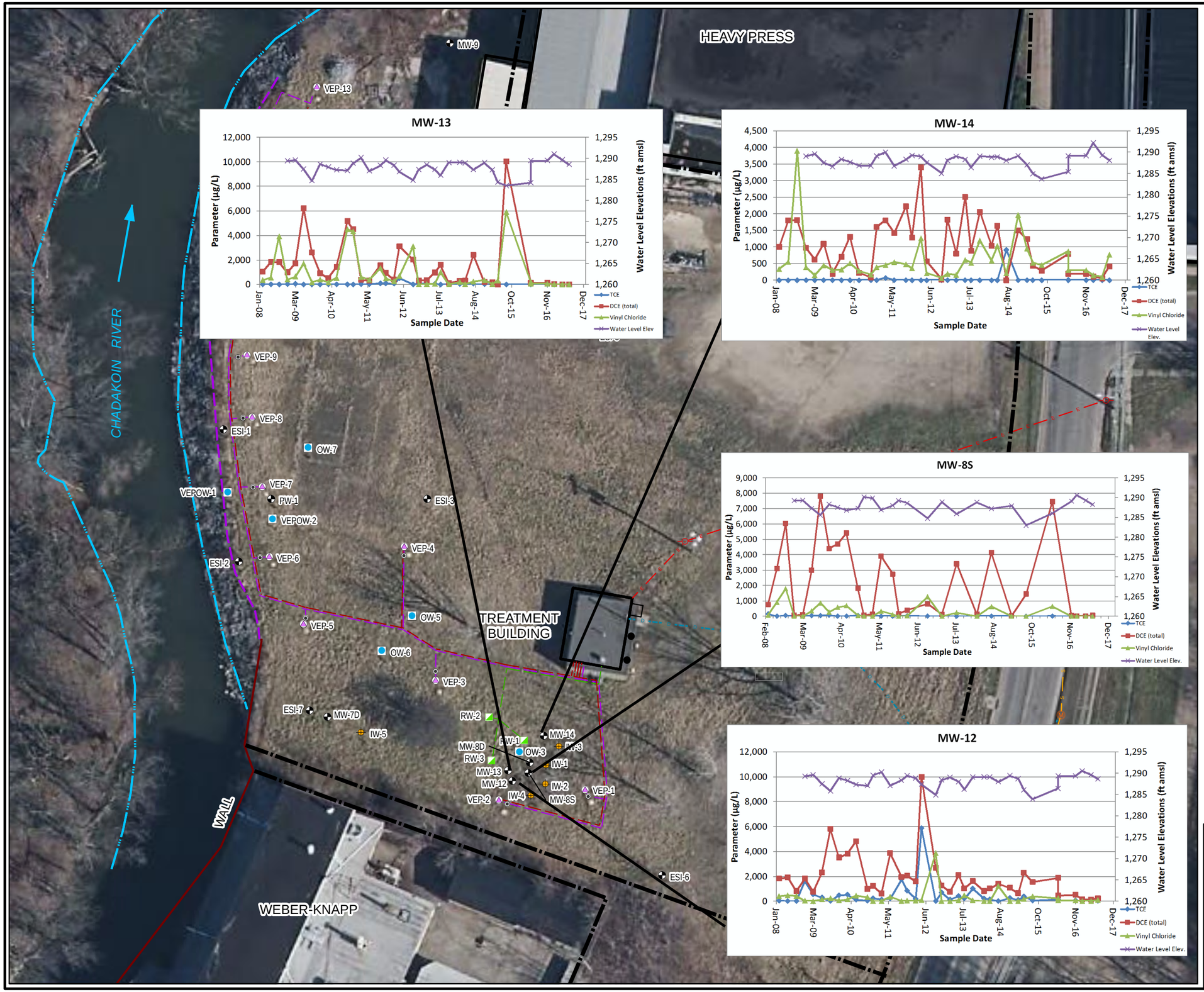
2017-2018 PRR

Summary of Groundwater Monitoring Analytical Results

ARCADIS Design & Consultancy for natural and built assets

FIGURE **6C**

CITY: (KNOXVILLE) DIV/GROUP:(ENV/GIS) PIC:(.) PM:(M.SANFORD/M.WACKSMAN) TM:(T.CARIGNAN) BY: KIVES
PROJECT: AY000219.0024 PATH: Z:\GISPROJECTS_ENV\INGERSOLRAND\DC_ROLLOVER\MAPDOCS\2018\SEMIANNUALREPORT\F2 DCR_GWMON SITE PLAN.MXD SAVED: 2/20/2018



LEGEND

- Monitoring Well
- Recovery Well (passive)
- Injection Well (inactive)
- Observation Well
- Vacuum Enhanced Pumping Well
- VEP Valve Box
- Property Line
- Interlocking Sheet Pile/Hydraulic Barrier Wall
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- Sanitary Sewer Line
- Bollard Pipe
- Effluent Pipe Clean Out
- Fire Hydrant
- Sewer Manhole
- Utility Pole

NOTE: All locations are approximate.

0 40 80

SCALE IN FEET

PROJECTION: NAD 1983 StatePlane New York West FIPS 3103 Feet

SOURCE: NYS Orthos Online (2016).

INGERSOLL RAND - DC ROLLFORMS SITE
NYSDEC SITE NO. 907019, JAMESTOWN, NEW YORK

2017-2018 PRR

Summary of Groundwater Monitoring Analytical Results

ARCADIS Design & Consultancy for natural and built assets

FIGURE **6D**

CITY: (KNOXVILLE) DIV/GROUP:(ENV/GIS) PIC:() PM:(M.SANFORD/M.WACKSMAN) TM:(T.CARIGNAN) BY: KIVES
PROJECT: AY000219.0024 PATH: Z:\GISPROJECTS_ENV\INGERSOLRAND\DC_ROLLOVER\MAPDOCS\2018\SEMIANNUALREPORT\F2 DCR_GWMON SITE PLAN.MXD SAVED: 2/20/2018

LEGEND

- Monitoring Well
- Recovery Well (passive)
- Injection Well (inactive)
- Observation Well
- Vacuum Enhanced Pumping Well
- VEP Valve Box
- Proposed Injection Well
- Property Line
- Interlocking Sheet Pile/Hydraulic Barrier Wall
- High Water Mark
- Bundled Process Line
- Discharge Line
- Recovery Well Piping
- Vacuum Line
- Overhead Electrical/Telecom Line
- Sanitary Sewer Line
- Bollard Pipe
- Effluent Pipe Clean Out
- Fire Hydrant
- Sewer Manhole
- Utility Pole

NOTE: All locations are approximate.

0 40 80

SCALE IN FEET

PROJECTION: NAD 1983 StatePlane New York West FIPS 3103 Feet

AERIAL SOURCE: ESRI Online Imagery (June 2013).

INGERSOLL RAND - DC ROLLFORMS SITE NYSDEC
SITE NO. 907019, JAMESTOWN, NEW YORK

2017-2018 PRR

ISCO Pilot Study Area/ Injection Well Layout

ARCADIS Design & Consultancy for natural and built assets

FIGURE 7

CITY: (KNOXVILLE) DIV/GROUP:(ENV/GIS) PIC:() PM:(M.SANFORD/M.WACKSMAN) TM:(M.AHMAD/T.CARIGNAN) BY: KIVES
PROJECT: AY000219.0020 PATH: Z:\GISPROJECTS_ENV\INGERSOLRAND\DC_ROLLOVER\MAPDOCS\2017\ISCO COST EST\F1 DCR_ISCO CE SITE PLAN.MXD SAVED: 5/17/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

- Monitoring Well
- Recovery Well (passive)
- Injection Well (inactive)
- Observation Well
- Vacuum Enhanced Pumping Well
- VEP Valve Box
- 2016 ISCO Injection Well
- Property Line
- Interlocking Sheet Pile/Hydraulic Barrier Wall
- High Water Mark
- Bundled Process Line
- Discharge Line
- Recovery Well Piping
- Vacuum Line
- Overhead Electrical/Telecom Line
- Sanitary Sewer Line
- Bollard Pipe
- Effluent Pipe Clean Out
- Fire Hydrant
- Sewer Manhole
- Utility Pole
- 2018 ISCO Injection Well

NOTE: All locations are approximate.

0 40 80

SCALE IN FEET

PROJECTION: NAD 1983 StatePlane New York West FIPS 3103 Feet

AERIAL SOURCE: ESRI Online Imagery (June 2013).

INGERSOLL RAND - DC ROLLFORMS SITE
NYSDEC SITE NO. 907019, JAMESTOWN, NEW YORK

ISCO WORK PLAN

2018 Injection Well Layout

ARCADIS Design & Consultancy for natural and built assets

FIGURE
8

CITY: (KNOXVILLE) DIV/GROUP:(ENV/GIS) PIC:() PM:(M.SANFORD/M.WACKSMAN) TM:(M.AHMAD/T.CARIGNAN) BY: KIVES
PROJECT: AY000219.0020 PATH: Z:\GISPROJECTS_ENV\INGERSOLRAND\DC_ROLLOVER\MAPDOCS\2017\ISCO COST EST\F1 DCR_ISCO CE SITE PLAN.MXD SAVED: 5/17/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

APPENDIX A

Site Inspection Forms

Site Cover and Riverbank Inspection Checklist

DC Rollforms Site, Jamestown, New York

Section 1: General Information

Figure Reference:	Weather:
Date / Time Monitoring Performed: 07/27/17	75° Cloudy

Cover material(s) ☐ Soil ☐ Vegetated Topsoil ☐ Rip Rap Stone

Section II. Observations

Observation	Yes	No	N/A	Provide Comments As Necessary (use additional space below if needed)
Erosion and Sedimentation Controls				
Are erosion and sedimentation (E&S) controls present? If yes:	X			
Are they functioning as intended?	X			
Are they still required (i.e., has a healthy stand of vegetation been established)?	X			
Vegetated Topsoil Isolation Cover				
Are there areas of scour?		N		
Is any geotextile fabric exposed?		N		
Is vegetation effectively covering the intended area? Provide percent growth for seeded areas.	Y			
Is there any sign of distressed vegetation?		N		
Do any areas require seeding?		N		
Photograph Numbers (if applicable)				
Rip Rap Stone Cover				
Are there areas of scour?		N		
Is any geotextile fabric exposed?		N		
Photograph Numbers (if applicable)				
Wing Wall Deflector				
Are there areas of scour?		N		
Is 30" dia. Rip Rap in place?	Y			
Photograph Numbers (if applicable)				
Riverbank Plantings				
Are the live stake cuttings thriving?	Y			
Photograph Numbers				
Chadakoin River (USGS)				
Discharge, Cubic Feet Per Second?	73			
Gage Height, Feet?	0.15			

Other Observations: Describe any other relevant observations noted during this monitoring period.

Performed by: J. Baker Signature: [signature] Date: 07/27/17

Site Cover and Riverbank Inspection Checklist

DC Rollforms Site, Jamestown, New York

Section 1: General Information

Figure Reference: Figure 2 PRR

Weather: 30°F Cloudy

Date / Time Monitoring Performed: 12/16/17 10:30

Cover material(s): X Soil; X Vegetated Topsoil; X Rip Rap Stone

Section II. Observations

Observation	Yes	No	N/A	Provide Comments As Necessary (use additional space below if needed)
Erosion and Sedimentation Controls				
Are erosion and sedimentation (E&S) controls present? If yes:	X			
Are they functioning as intended?	X			
Are they still required (i.e., has a healthy stand of vegetation been established)?			X	Winter/Dormant Condition
Vegetated Topsoil Isolation Cover				
Are there areas of scour?		X		
Is any geotextile fabric exposed?		X		
Is vegetation effectively covering the intended area? Provide percent growth for seeded areas.			X	Winter
Is there any sign of distressed vegetation?			X	
Do any areas require seeding?			X	
Photograph Numbers (if applicable)				
Rip Rap Stone Cover				
Are there areas of scour?		X		
Is any geotextile fabric exposed?		X		
Photograph Numbers (if applicable)	NO			
Wing Wall Deflector				
Are there areas of scour?		X		
Is 30" dia. Rip Rap in place?	X			
Photograph Numbers (if applicable)	NO			
Riverbank Plantings				
Are the live stake cuttings thriving?			X	Winter
Photograph Numbers	NO			
Chadakoin River (USGS)				
Discharge, Cubic Feet Per Second?	640			
Gage Height, Feet?	2.25			

Other Observations: Describe any other relevant observations noted during this monitoring period.

Performed by: Todd Carlgren | Signature: [signature] | Date: 12/16/17

Site Cover and Riverbank Inspection Checklist

DC Rollforms Site, Jamestown, New York

Section 1: General Information

Figure Reference: Fig 2. PRR

Weather: 50°F Cloudy / Light Rain

Date / Time Monitoring Performed: 2/23/18 12:00

Cover material(s): X Soil | X Vegetated Topsoil | X Rip Rap Stone

Section II. Observations

Observation	Yes	No	N/A	Provide Comments As Necessary (use additional space below if needed)
Erosion and Sedimentation Controls				
Are erosion and sedimentation (E&S) controls present? If yes:	X			
Are they functioning as intended?	X			
Are they still required (i.e., has a healthy stand of vegetation been established)?		X		Winter / Dormant Conditions
Vegetated Topsoil Isolation Cover				
Are there areas of scour?		X		
Is any geotextile fabric exposed?		X		
Is vegetation effectively covering the intended area? Provide percent growth for seeded areas.			X	Winter
Is there any sign of distressed vegetation?			X	
Do any areas require seeding?			X	
Photograph Numbers (if applicable)	No			
Rip Rap Stone Cover				
Are there areas of scour?		X		
Is any geotextile fabric exposed?		X		
Photograph Numbers (if applicable)	No			
Wing Wall Deflector				
Are there areas of scour?		X		
Is 30" dia. Rip Rap in place?	X			
Photograph Numbers (if applicable)	No			
Riverbank Plantings				
Are the live stake cuttings thriving?			X	Winter
Photograph Numbers				
Chadakoin River (USGS)				
Discharge, Cubic Feet Per Second?	1,100			
Gage Height, Feet?	2.0			

Other Observations: Describe any other relevant observations noted during this monitoring period.

Performed by: Todd Carignan | Signature: [signature] | Date: 2/25/18

Site Cover and Riverbank Inspection Checklist

DC Rollforms Site, Jamestown, New York

Section 1: General Information

Figure Reference:

Weather: 50° Cloudy

Date / Time Monitoring Performed: 06/06/18

Cover material(s): X Soil | X Vegetated Topsoil | X Rip Rap Stone

Section II. Observations

Observation	Yes	No	N/A	Provide Comments As Necessary (use additional space below if needed)
Erosion and Sedimentation Controls				
Are erosion and sedimentation (E&S) controls present? If yes:	X			
Are they functioning as intended?	X			
Are they still required (i.e., has a healthy stand of vegetation been established)?	X			
Vegetated Topsoil Isolation Cover				
Are there areas of scour?		X		
Is any geotextile fabric exposed?		X		
Is vegetation effectively covering the intended area? Provide percent growth for seeded areas.	X			100%
Is there any sign of distressed vegetation?		X		
Do any areas require seeding?		X		
Photograph Numbers (if applicable)	No			
Rip Rap Stone Cover				
Are there areas of scour?		X		
Is any geotextile fabric exposed?		X		
Photograph Numbers (if applicable)	No			
Wing Wall Deflector				
Are there areas of scour?		X		
Is 30" dia. Rip Rap in place?	X			
Photograph Numbers (if applicable)	No			
Riverbank Plantings				
Are the live stake cuttings thriving?	X			Dogwood, Willow J
Photograph Numbers				
Chadakoin River (USGS)				
Discharge, Cubic Feet Per Second?	110			
Gage Height, Feet?	0.74			

Other Observations: Describe any other relevant observations noted during this monitoring period.

Performed by: J. Baker | Signature: | Date:

APPENDIX B

Jamestown BPU Discharge Permit Renewal

JAMESTOWN BOARD OF PUBLIC UTILITIES

PO Box 700
Jamestown, NY 14702-0700
Phone (716) 661-1673
Fax (716) 661-1617

ELECTRIC
DISTRICT HEAT
WATER
WASTEWATER
SOLID WASTE

November 1, 2017

Michael Goldstein
Ingersoll Rand
800 Beaty St., Building E
Davidson, NC 28036

Dear Mr. Goldstein:

Please find enclosed a copy of your firm's renewed Industrial Waste Discharge Permit governing the wastewater discharge (s) from your facility to the Jamestown Publicly Owned Treatment Works (POTW). The effective dates of the permit are shown on the first page of the permit. This permit is subject to change should there be any additions and/or deletions made to the industrial pretreatment programs as established by the Environmental Protection Agency.

Please review your permit carefully as it may include changes from your previous permit. Should you have any questions or comments concerning your permit, please do not hesitate to contact this office.

Should you have any questions, please do not hesitate to contact this office.

Sincerely,

Michael V Saar, P.E.
DGM - Water Resources

CITY OF JAMESTOWN
BOARD OF PUBLIC UTILITIES
INDUSTRIAL WASTEWATER DISCHARGE PERMIT

Permit Number: 037 **SIC:** Groundwater Remediation

Date Issued: September 4, 2017 **Expiration Date:** September 3, 2022

Revision Date: N/A

Ingersoll Rand, as a Significant Industrial User (SIU) of the City of Jamestown Publicly Owned Treatment Works (POTW), is hereby issued an industrial wastewater discharge permit for it's ground water remediation site at 583 Allen St., pursuant to Chapter 24A of the Jamestown City Code (Jamestown Sewer Use Ordinance) and also with any applicable provisions of federal or state law(s) or regulations(s). Said permit shall be effective for a period of five (5) years from the date of issuance hereof.

This permit is granted in accordance with the application filed on August 22, 2007 and notice of process modifications submitted on N/A and in conformity with the plans, specifications, semi-annual self-monitoring reports, and other data submitted to the City in support of the above application, all of which are filed with and considered as part of this permit, together with the following named conditions and requirements:

Effective this 4th day of September, 20 17
To expire the 3rd day of September, 20 22

Deputy General Manager - Board of Public Utilities

RIGHT OF ENTRY

The permittee shall allow duly authorized employees or representatives of the City to enter the permittee's premises for the purpose of inspection, observation, measurement, sampling, and testing in accordance with Article VIII of the Jamestown Sewer Use Ordinance.

SAMPLING MANHOLE REQUIREMENTS

If, in the opinion of the General Manager, there are not adequate facilities for the acquisition of representative samples and accurate flow measurements, the General Manager may require that a sampling manhole with flow measuring device be installed by the permittee at his expense. This sampling manhole shall be approved by this office before installation. The permittee shall be responsible for all maintenance of the sampling manhole and calibration of the monitoring equipment.

BOARD OF PUBLIC UTILITES MONITORING

Compliance with the Jamestown Sewer Use Ordinance will be monitored via wastewater discharge monitoring. The City of Jamestown will monitor each SIU a minimum of one time per year. Results will be transmitted to each SIU.

SELF MONITORING

Each SIU must conduct self-monitoring and report results to the City in accordance with applicable federal and local regulations. **Self Monitoring reports are due the 28TH of each month for the operations of the previous month.** Self-monitoring for assessing continued compliance shall be conducted and reported in accordance with federal regulations (40 CFR 403.12(e)). All permit limits set forth in this permit are enforceable effluent limitations.

MONITORING LOCATION #1
NEW SOURCE

PARAMETER	SAMPLE	LOCAL	FEDERAL	FEDERAL
	Monthly	LIMIT	MAX	30 DAY AVE
		MG/L	MG/L	MG/L
FLOW	Report	-	-	-
PH (4 grabs)	X	5.5-10.0	-	-
Oil and Grease (4 Grabs)	X	100	-	-
TSS (comp)	X	350	-	-
Volatile Organics (comp)	X	2.13	-	-
PCB's (comp)	X	Non Detect	-	-

Notes :

1. Samples should be taken as **composites** of at least 4 grab samples collected during a typical production day except for pH and Oil & Grease. Four separate samples must be taken and **individually analyzed for pH and Oil & Grease.**
2. All analysis shall be preformed by a New York State Department of Health Certified Environmental Laboratory.
3. All analysis shall be performed in accordance with the latest edition of the following references:
   a. Standard Methods for the Examination of Water and Wastewater
   b. Method for Chemical Analysis of Water and Wastes, USEPA, technology Transfer, 1983

PROHIBITED DISCHARGES

The following should not be introduced into the City Sewer system:

(1) Pollutants which create a fire or explosion hazard in the POTW, including, but not limited to, wastestreams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21.
(2) Pollutants which will cause corrosive structural damage to the POTW, but in no case Discharges with pH lower than **5.5** or greater than **10.0**;
(3) Solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW resulting in Interference;
(4) Any pollutant, including oxygen demanding pollutants (BOD, etc.) released in a Discharge at a flow rate and/or pollutant concentration which will cause Interference with the POTW.
(5) Heat in amounts which will inhibit biological activity in the POTW resulting in Interference, but in no case heat in such quantities that the temperature at the POTW Treatment Plant exceeds 40 deg.C (104 deg.F) unless the Approval Authority, upon request of the POTW, approves alternate temperature limits.
(6) Petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through;
(7) Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems;
(8) Any trucked or hauled pollutants, except at discharge points designated by the POTW.
(9) The discharge of concentrated solutions without pretreatment is strictly prohibited. Any request to discharge such wastes must be submitted to this office and is subject to the approval of the General Manager on a case by case basis.
10) Any water or waste containing fats, wax, grease, oils, or oil products, whether emulsified or not, in excess of **100 mg/l.**

HAZARDOUS WASTE DISCHARGE NOTIFICATION

For discharges of listed and characteristic hazardous wastes which are not already reported in periodic self-monitoring reports and which exceed 15 kilograms per month, the regulations require that all industrial users notify USEPA, NYSDEC, and the City of Jamestown as to the constituents of these wastes and the anticipated discharge volume of such wastes on both a monthly and an annual basis.

CHANGE IN WASTEWATER DISCHARGE

All discharges authorized herein shall comply with the terms and conditions of this permit. Any industrial facility expansions, production increases, or process modifications which result in new, different, or increased discharges of pollutants must be reported by submission of a new industrial waste disposal questionnaire. This permit may be modified to specify and limit any pollutants not previously limited. The discharge of any pollutant more frequently than or at a level in excess of that specified and authorized by this permit shall constitute a violation of the terms and conditions of this permit.

RECORDKEEPING

The permittee shall retain all records of monitoring activities and results (whether or not required by this permit) for a minimum of 3 years. These records shall be made available for inspection and copying to duly authorized employees or representatives of the City. This period of retention shall be extended during any unresolved litigation.

PERMIT MODIFICATIONS

After sufficient notice to the permittee, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:

(a) Violation of any terms or conditions of this permit.
(b) A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.
(c) If an effluent standard is established under any state or federal law for a pollutant which is present in the discharge and such standard or prohibition s more stringent that any limitation for such pollutant in this permit.

PERMIT TRANSFER

Sewer Use Permits are issued to a specific User for a specific operation. A wastewater discharge permit shall not be reassigned or, transferred, or sold to a new owner, new User, different premise, or a new or changed operation without the approval of the City. Any succeeding Owner or User shall also comply with the terms and conditions of the existing permit.

NOTICE OF NON-COMPLIANCE

The permittee shall notify the operator of the Jamestown Wastewater Treatment Plant **immediately,** by telephone (665-3980), so that the operator can take the necessary steps to prevent damage to the wastewater treatment process and equipment in the event the permittee:

(1) Does not comply with or will be unable to comply with any daily maximum effluent limitation specified in this permit.
(2) Discharges or may discharge any wastewater which may cause a slug loading to the Jamestown Wastewater Treatment Plant. This includes wastewater which may cause pass through or interference with wastewater treatment plant operations.
(3) Discharges or may discharge any material or wastewater which is prohibited from discharge as described in the City of Jamestown Local Sewer Use Ordinance or this permit.

These non-complying discharges or possible discharges may be due to:

Breakdown of industrial wastewater pretreatment equipment;
Accidents caused by human error or negligence; or
Other causes, such as acts of nature.

The General Manager shall be notified by telephone within 24 hours, and in writing within five (5) days and said notification shall include the following pertinent information:

(1) A description of the non-complying discharge;
(2) Cause of non-compliance;
(3) Anticipated time the condition of non-compliance is expected to continue, or if such condition has been corrected, the duration of the period of non-compliance;
(4) Steps taken by the permittee to reduce and eliminate the non-complying discharge; and
(5) Steps to be taken by the permittee to prevent reoccurrence of the condition of non-compliance.

The permittee must also repeat sampling for all parameters exceeding discharge limitations and submit the results of the repeat analysis within thirty (30) days of the violation(s).

Nothing in this permit shall be construed to relieve the permittee from the penalties for non-compliance of this permit for any reason subject to Article (IX) (Penalties) of the Jamestown Sewer Ordinance.

SCHEDULE OF COMPLIANCE

The permittee shall comply with the following schedule if the present discharge does not conform to the effluent limitations described within this permit:

a. By _____ the permittee shall have a registered Professional Engineer contact this office.
b. By _____ the permittee shall complete an engineering report and submit it to this office.
c. By_____ the permittee shall complete final plans and specifications for pretreatment facilities and submit them to this office for review and approval.
d. By _____ the permittee shall start construction of its approved pretreatment facilities.
e. By _____ the permittee shall complete construction of the pretreatment facilities.
f. By _____ the permittee shall attain operational levels required to achieve the effluent limits specified within this permit.

CIVIL AND CRIMINAL PENALTIES

A permittee found violating applicable local, state or federal regulations may be subject to administrative penalties, civil action, and/or criminal prosecution. If administrative penalties are warranted, a fine in an amount not exceeding $1000.00 per day per violation may be assessed. If criminal penalties are assessed, a fine in an amount not exceeding $1,000.00 per violation per day may be assessed, imprisonment for not more than 6 months, or both. Any person violating applicable local, state or federal regulations that results in expense, loss or damage to the City and its property shall be liable for all costs.

APPENDIX C

Institutional and Engineering Controls Certification Forms

Enclosure 2

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Site Management Periodic Review Report Notice
Institutional and Engineering Controls Certification Form

Site Details **Box 1**

Site No. **907019**

Site Name D.C. (Dow Craft) Rollforms

Site Address: 583 Allen Street Zip Code: 14701
City/Town: Jamestown
County: Chautauqua
Site Acreage: 2.4

Reporting Period: June 15, 2017 to June 15, 2018

	YES	NO
1. Is the information above correct?	X	☐
If NO, include handwritten above or on a separate sheet.		
2. Has some or all of the site property been sold, subdivided, merged, or undergone a tax map amendment during this Reporting Period?	☐	X
3. Has there been any change of use at the site during this Reporting Period (see 6NYCRR 375-1.11(d))?	☐	X
4. Have any federal, state, and/or local permits (e.g., building, discharge) been issued for or at the property during this Reporting Period? Jamestown BPU renewed the Industrial Water Discharge Permit, see attached.	X	☐
If you answered YES to questions 2 thru 4, include documentation or evidence that documentation has been previously submitted with this certification form.		
5. Is the site currently undergoing development?	☐	X

Box 2

	YES	NO
6. Is the current site use consistent with the use(s) listed below? Commercial and Industrial	X	☐
7. Are all ICs/ECs in place and functioning as designed?	X	☐

IF THE ANSWER TO EITHER QUESTION 6 OR 7 IS NO, sign and date below and DO NOT COMPLETE THE REST OF THIS FORM. Otherwise continue.

A Corrective Measures Work Plan must be submitted along with this form to address these issues.

Signature of Owner, Remedial Party or Designated Representative Date

SITE NO. 907019 **Box 3**

Description of Institutional Controls

Parcel	Owner	Institutional Control
307-13-2.2	Jamestown Allenco, Inc.	Site Management Plan Landuse Restriction Ground Water Use Restriction Soil Management Plan

Deed Restrictions (7/19/2005) Recorded - 11/29/2005:
1. Property use: Commercial or Industrial
2. Prohibition of use of groundwater.

Site Management Plan:Soils Management Plan and Inspections of Cover System, Rip Rap, Plantings, and Erosion.

Groundwater Collection and Treatment System Operation, Maintenance, and Monitoring.

Box 4

Description of Engineering Controls

Parcel	Engineering Control
307-13-2.2	Groundwater Containment Subsurface Barriers Groundwater Treatment System

Periodic Review Report (PRR) Certification Statements

1. I certify by checking "YES" below that:

   a) the Periodic Review report and all attachments were prepared under the direction of, and reviewed by, the party making the certification;

   b) to the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the site remedial program, and generally accepted engineering practices; and the information presented is accurate and compete.

YES	NO
X	☐

2. If this site has an IC/EC Plan (or equivalent as required in the Decision Document), for each Institutional or Engineering control listed in Boxes 3 and/or 4, I certify by checking "YES" below that all of the following statements are true:

   (a) the Institutional Control and/or Engineering Control(s) employed at this site is unchanged since the date that the Control was put in-place, or was last approved by the Department;

   (b) nothing has occurred that would impair the ability of such Control, to protect public health and the environment;

   (c) access to the site will continue to be provided to the Department, to evaluate the remedy, including access to evaluate the continued maintenance of this Control;

   (d) nothing has occurred that would constitute a violation or failure to comply with the Site Management Plan for this Control; and

   (e) if a financial assurance mechanism is required by the oversight document for the site, the mechanism remains valid and sufficient for its intended purpose established in the document.

YES	NO
X	☐

IF THE ANSWER TO QUESTION 2 IS NO, sign and date below and DO NOT COMPLETE THE REST OF THIS FORM. Otherwise continue.

A Corrective Measures Work Plan must be submitted along with this form to address these issues.

Signature of Owner, Remedial Party or Designated Representative

Date

IC CERTIFICATIONS
SITE NO. 907019

Box 6

SITE OWNER OR DESIGNATED REPRESENTATIVE SIGNATURE

I certify that all information and statements in Boxes 1,2, and 3 are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

I Todd Carignan (print name) at 855 Route 146, Suite 210, Clifton Park, NY 12065 (print business address),

am certifying as Remedial Party (Owner or Remedial Party)

for the Site named in the Site Details Section of this form.

T. Carignan — 7/16/18

Signature of Owner, Remedial Party, or Designated Representative Rendering Certification — Date

IC/EC CERTIFICATIONS

Box 7

Professional Engineer Signature

I certify that all information in Boxes 4 and 5 are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

I Moh Mohiuddin (print name) at 50 Millstone Road, Suite 220, East Windsor, NJ 08520 (print business address),

am certifying as a Professional Engineer for the Remedial Party (Owner or Remedial Party)

Signature of Professional Engineer, for the Owner or Remedial Party, Rendering Certification

Stamp (Required for PE)

07/16/2018
Date

APPENDIX D

ISCO Work Plan

ARCADIS Design & Consultancy for natural and built assets

Ingersoll Rand Company

IN-SITU CHEMICAL OXIDATION WORK PLAN

D.C. Rollforms Site, Jamestown, New York

July 6, 2018

,

IN-SITU CHEMICAL OXIDATION WORK PLAN

D.C. Rollforms Site, Jamestown, New York

Prepared for:

Ingersoll Rand Company

Prepared by:

Arcadis of New York, Inc.

855 Route 146

Suite 210

Clifton Park

New York 12065

Tel 518 250 7300

Fax 518 250 7301

Our Ref.:

AY000219.0026

Date:

July 6, 2018

VERSION CONTROL, ARIAL 16PT

Issue	Revision No	Date Issued	Page No	Description	Reviewed by

CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

bgs	Below ground surface
CAMP	Community Air Monitoring Plan
COCs	Chemicals of concern
FS	Feasibility Study
g/L	Grams per liter
HASP	Health and Safety Plan
IRMs	Interim remedial measures
ISCO	In-situ chemical oxidation
NYSDEC	New York State Department of Environmental Conservation
PPE	Personal protective equipment
psi	Pounds per square inch
PVC	Polyvinyl chloride
RI	Remedial Investigation
ROD	Record of Decision
SDS	Safety Data Sheet
TPH	Total petroleum hydrocarbon
VOCs	Volatile organic compounds

1 INTRODUCTION

This In-Situ Chemical Oxidation (ISCO) work plan (work plan) has been prepared by Arcadis of New York on behalf of Ingersoll Rand Company for the D.C. Rollforms Site (herein referred to as the "site") located in in Jamestown, New York (Figure 1).

In order to enhance remediation of the residual groundwater plume at the site, a pilot-scale ISCO injection approach, utilizing alkaline activated sodium persulfate as the oxidant, was implemented at the site in October 2016. Since then, the site groundwater is being monitored routinely. The groundwater data shows significant decrease of chemical of concern (COC) concentrations at the pilot test area monitoring wells. Based on the overall success of the pilot program, Arcadis is proposing a full-scale application near the pilot test area, and the area of monitoring wells OW-5 and OW-6 where chlorinated volatile organic compound (CVOC) concentrations have remained elevated several orders of magnitude above the New York State Class GA Groundwater Standards.

This Work Plan presents the methodology, implementation, performance monitoring of the ISCO injection to be conducted at the site and the health and safety requirements related to ISCO injection.

1.1 Project Background

The D.C. Rollforms site is an inactive hazardous waste State Superfund site located in Jamestown, New York. Arcadis has completed the Remedial Investigation (RI) and Feasibility Study (FS) in accordance with the New York State Department of Environmental Conservation (NYSDEC) Consent Order for the RI/FS and has implemented several interim remedial measures (IRMs) as part of initiating cleanup of the site. The selected remedy for the site was finalized in the Record of Decision (ROD) during 2003. The ROD finalized the remedy and remedial goals for cleanup of chlorinated VOCs in groundwater, free product recovery, an oil seep along the Chadakoin River and focused removal of sediments. In 2007, Arcadis completed construction of the remedy and is currently operating the groundwater collection and treatment system.

1.2 Project Rationale and Objectives

The full-scale ISCO described in this report will be performed to evaluate a viable remedial alternative to the current pump and treat program to address the source areas onsite, and ultimately reduce the remedial life-cycle costs for the site. ISCO is a proven technology for degrading COCs present at the site. Data collected during the pilot test showed that the technology can be successfully implemented on a full-scale basis. The design data collected during the pilot test will be utilized to design the full-scale application.

The objective of the ISCO implementation is to destroy COCs mass in groundwater to the extent practicable. The post implementation data will be utilized to recommend any contingency actions (e.g., additional injection wells or injection events), additional monitoring, and the potential effect of ISCO activities on ongoing vacuum enhanced pumping (VEP) system and optimization of the VEP system operations.

1.3 Technology Overview

ISCO is an in-situ remedial technology that can be used to treat soil and groundwater impacted with a wide range of organic constituents. ISCO is achieved by delivering chemical oxidants to contaminated media, such that target constituents are transformed to less toxic compounds and ultimately into carbon dioxide and water, and specifically for oxidation of chlorinated compounds at the site, chloride.

ISCO involves injection of oxidant reagents, such as sodium persulfate (implemented at this site), permanganate, hydrogen peroxide, and ozone, into an aquifer to facilitate treatment. Persulfate is a relatively new (10 years) oxidant to the industry that has considerable longevity in the subsurface, ranging from weeks to months. This stability is due to slower reaction kinetics. When compared to the rapid kinetics of catalyzed hydrogen peroxide and ozone, the use of persulfate allows for a comparatively greater radius of influence when deployed via injections. Persulfate requires activation in order for sulfate and hydroxyl radicals to be produced and improve kinetics. Activators include chelated iron, a base compound, hydrogen peroxide, existing organics and metals at the site (ambient activation) or heat to increase reaction kinetic rates.

The selection of oxidant and activation method and optimal dosing are typically evaluated through a laboratory-based treatability test and verified in the field via pilot-scale injection tests. ISCO injection tests are typically conducted by slightly pressurized injection or by gravity feeding the persulfate solution and activator into the subsurface. Groundwater quality parameters (i.e., specific conductance, pH, and depth to water) and injected oxidant are normally monitored during injection for real-time determination of injection breakthrough in the field. Groundwater COCs and presence of oxidant are also monitored during and after the injection test to evaluate the effectiveness of the ISCO technology.

1.4 Implementation Methodology

The full-scale ISCO injection will be conducted to enhance remediation of the residual groundwater plume near the pilot test area (near MW-8S and MW-14), and the area of monitoring wells OW-5 and OW-6 (Figure 1). Alkaline activated sodium persulfate will be injected into up to 10 injection wells. Based on the results of the pilot-test, sodium hydroxide and sodium persulfate concentrations are determined. Injection will be conducted simultaneously into multiple injection wells through gravity feeding, or under slight pressures if practical injection flow rates cannot be achieved through gravity feeding. Three post injection performance monitoring events will be conducted following the injection to evaluate the efficacy of ISCO approach for addressing residual COCs in groundwater at the site.

1.5 Work Plan Organization

The Work Plan is organized in the following sections:

- Section 2 – Health and Safety – The health and safety procedures and personal protection equipment (PPE) requirement related to ISCO injection activities are discussed in this section.

- Section 3 – Well Network – This section describes the different aspects of the injection well installations, waste disposal and well network for injection and performance monitoring.

- Section 4 – ISCO Injection Implementation – This section details ISCO injection activities and injection monitoring.

- Section 5 – Performance Monitoring – This section describes the monitoring program for the evaluation of ISCO performance.

- Section 6 – Reporting – This section presents the report outline and other pertinent information that will be submitted as a deliverable.

- Section 7 – Project Schedule – Project milestones and their respective dates are presented in this section.

2 HEALTH AND SAFETY

The existing site specific Health and Safety Plan (HASP) has been updated to include health and safety requirements related to the ISCO injection activities to be conducted at the site. The Safety Data Sheets (SDS) for sodium persulfate and sodium hydroxide and the ISCO Injection Hazard Analysis Forms for injection of activated sodium persulfate have been added to the HASP. The SDS, and Hazard Analysis Forms have been included in this Work Plan as Appendices A and B, respectively. The updated HASP will be kept readily available during all on-site activities. During field activities, each day will begin with a health and safety tailgate briefing including all field staff and subcontractors. A summary of ISCO injection specific hazards prevention methods and a list of personal protective equipment (PPE) used for ISCO injection are as follows:

ISCO Hazard Prevention:

- Inhalation: wear full-face respirator while handling sodium persulfate powder during mixing
- Sodium persulfate and sodium hydroxide exposure:
    - wear proper PPE, notably nitrile gloves and a face shield to prevent splashing during mixing and handling
    - assure that all materials/piping/manifolds are chemically compatible with the corrosivity of persulfate (no carbon steel or brass)
- Chemical Test Kit reagent exposure: wear proper PPE
- Excessive heat generated during sodium hydroxide solution mixing: mix solution slowly, add concentrated sodium hydroxide solution into water and avoid adding water into concentrated sodium hydroxide solution
- Spills: utilize secondary containment, absorbent socks, dilution, neutralization
- Leaks: conduct clean (potable) water injection to test piping and connections for leaks prior to ISCO injection
- Fires: store chemicals away from heat, moisture, and combustible materials

- Pressure: use proper tools, fittings, and pressure gauges, wear proper PPE
- Splash: shower/eye wash station for personal decontamination, wear proper PPE.

It should be noted that in accordance with the Site-Specific HASP, a Community Air Monitoring Plan (CAMP) was implemented during the intrusive drilling activities at the Site. Real-time, continuous fugitive

dust monitoring was performed using a PDR Mini-ram particulate meter during all drilling and drill cutting/soil handling activities. The action level of 100 mg/m^3 above background levels, integrated over a 15-minute averaging period, were never exceeded during site activities. Real-time, continuous monitoring for VOCs was also performed using a portable PID during all activities. The CAMP has been provided as Appendix C.

3 WELL NETWORK

To target the residual groundwater COCs at the site, the full-scale ISCO injection will be performed simultaneously via manifolds at multiple injection wells (Figure 1). Applicable and available injection and monitoring wells construction summary is presented in Table 1. Groundwater monitoring, including baseline sampling, dose-response monitoring and post injection performance monitoring will be conducted in selected monitoring wells (Table 2). The injection and monitoring well network may be revised based on the field observations. The injection and monitoring well network is discussed in detail in this section.

3.1 Injection Well Network

Based on the historic groundwater elevation data, the direction of groundwater flow is in a west-northwesterly direction towards the Chadakoin River. To enhance reagent distribution in the target areas the existing injection well network has been expanded by installation of seven new injection wells (IW-9 through IW-15). The new injection wells and the three injection wells (IW-6, IW-7, and IW-8) used during the pilot-scale injection will be utilized in the full-scale ISCO implementation. The wells were screened above the dense till or bedrock approximately 6.0 to 12.5 feet below ground surface (bgs) upgradient of impacted monitoring wells located at the west-southwest side for the treatment building. The locations of the injection wells are shown on Figure 1.

3.1.1 Utility Clearance

Prior to well installation, Arcadis' Health and Safety protocols require that applicable municipal and private underground utilities will be identified. Existing underground utilities were identified utilizing the following processes:

- Dig Safely New York One-Call was notified
- Reviewed Site record drawings and remedial construction as-built drawings
- Site construction record photologs
- Performed visual site inspections.

3.1.2 Well Installation

Injection well boreholes were advanced using hollow-stem auger drilling techniques. Each injection well was constructed with 2-inch diameter schedule 40 PVC casing and 2-inch diameter stainless steel V-wire wrap well screen (0.010-inch slot). The screen intervals for each well varied and ranged from 5.9 to 13.9 feet bgs. The annular space around the well screen was backfilled with #2 Silica filter pack to 1-foot above top of screen, followed by 1-foot of #00N choker sand, and neat Portland cement to the surface. Wells

were completed with 12-inch diameter flush-mount well covers set inside a concrete pad and secured with a cam-lock fitting. Well construction logs are presented as Appendix D.

3.1.3 Well Development and Baseline Sampling

Following installation, the injection wells were developed the week of June 25, 2018 by surging and pumping to remove the fine sediments entrained during well installation and to consolidate the sand pack around the screened interval. A surge block and submersible pump was utilized to develop each well. During well development, grab groundwater sample(s) were collected and field-screened for total nephelometric turbidity units (NTUs). Well development was conducted for approximately two hours, or until turbidity is reduced to 50 NTUs, or less, as deemed practicable. During well development, sustained extraction rates (maximum extraction rate without drying out the well) were determined and recorded. The sustained extraction rates data will be utilized for estimating likely injection rates.

Following well development and required equilibration period with the surrounding aquifer, the injection wells will be sampled for VOCs in accordance with the site specific sampling protocol. During sampling field parameters (pH, specific conductance, dissolved oxygen, oxidation reduction potential, and temperature), depth to water, and background sodium persulfate concentrations (if any) will be recorded. The new injection well baseline data may be useful for defining extend of VOCs in the target location.

3.1.4 **Well Installation Derived Waste Disposal**

The soil cuttings from the injection well installation were containerized in labeled 55-gallon steel drums and staged onsite will be characterized for off-site disposal. The development water was containerized and treated onsite with the groundwater collection and treatment system.

3.2 Monitoring Well Network

Within the target treatment area, VOC-impact is persistent primarily near monitoring wells MW-8S, MW-12, MW-13, MW-14, OW-5, and OW-6 in the overburden matrix. The groundwater gradient is to the west-northwesterly direction. During and following ISCO solution injection monitoring wells MW-8S, MW-12, MW-13, MW-14, OW-5 and OW-6 will be monitored to evaluate the performance of the full-scale ISCO. To assess the extent of migration of ISCO solution monitoring wells ESI-7, RW-1, RW-2, RW-3, and VEP-1 through VEP-5 will be monitored. The monitoring plan is presented in Table 2.

4 ISCO INJECTION IMPLEMENTATION

The following sections describe the details of the injection program, including components of injection system, injection solution composition and volume, injection procedure, and monitoring during ISCO implementation. During ISCO injection event, applicable duel phase extraction wells (VEP-1 through VEP-5) located near ISCO injection area will be isolated from the existing treatment system to prevent the extraction of ISCO solution. If needed the treatment system operation may be stopped temporarily.

4.1 Injection Setup

An injection system piping and instrumentation diagram (P&ID) is presented on Figure 2 and summarized in this section. The injection system will consist of solution mixing tanks (for sodium persulfate and sodium hydroxide), pumps for solution mixing/injection, and water transferring from the storage tank to mixing tanks, manifold for solution distribution, flow totalizer, pressure indicator, flexible hose, and well head fittings. Injection solution will be distributed via aboveground hose to the injection wellheads. The well head fittings will consist of a pressure gauge and a vent port. The parts and components of equipment and supplies that will be in contact with injection solution will be made of materials chemically compatible with sodium persulfate and sodium hydroxide.

Secondary containment will be used to prevent potential minor leaks and spills of the injection solution from the tank and the manifold from getting to the ground surface. The solution mixing tanks, mixing and injection pumps, and solution distribution manifold with flow totalizers and flow control gate valves will be placed inside the secondary containment. The secondary containment will be required to have at least 110% of a volumetric capacity standard set by the USEPA. Unused sodium persulfate and sodium hydroxide will be stored separately on a poly sheeting near the injection system. Injection pumps are compressor driven diaphragm pumps. On site compressor will be utilized to run the diaphragm pumps. The air hose, and injection hose will be arranged appropriately to prevent potential tripping and electrical hazards.

4.2 Injection Reagent and Solution

Injection solution will be prepared using groundwater treated by existing onsite treatment system. If the treatment system is not in operation or volume of treated water is not sufficient for injection solution preparation, clean water from a local water vendor may be used. The clean water will be temporarily stored in a storage tank prior to being pumped to the injection solution mixing tanks. The injection solution will be prepared in 250-gallon tanks placed in the secondary containment.

The concentrations of chemicals in the injection solution will be consistent with pilot test, i.e. 40 grams per liter (g/L) of persulfate activated with 3 to 1 molar ratio of sodium hydroxide to sodium persulfate will be used for preparing the injection solution. The injection solution will be prepared in small batches by mixing sodium persulfate and sodium hydroxide with water. To achieve a radius of influence (ROI) of 10 feet, approximately 1,200 gallons of injection solution is estimated to be required per injection well. This estimated volume is based on the pilot test data. Based on the total injection volume of 12,000 gallons and 40 g/L of sodium persulfate activated with 3 to 1 molar ratio of sodium hydroxide to sodium persulfate in the injection solution, an approximate 4,000 pounds of sodium persulfate and approximately 2,000 pounds of sodium hydroxide (dry basis) will be needed. The actual injection volume required to achieve adequate distribution of reagents is contingent upon field observations.

4.3 Field Implementation

Prior to the injection of mixed solution, a clean (potable) water injection will be conducted to test the injection system for any potential leaks in the piping configuration. In the case of leaking occurs, the leaks will be fixed prior to the start of reagent injection.

Injection solutions of sodium persulfate and sodium hydroxide will be either gravity fed or pumped at low pressure (<2 pounds per square inch [psi]) into the injection wells. A recirculation line may be setup to direct solution back to the mixing tank to reduce the pressure applied to well heads. Upon alkaline activation, the mixture of concentrated sodium hydroxide and sodium persulfate may generate heat and/or gas. Though it is anticipated that mixed reagent will not be detrimental for injection process, Arcadis field crew will be vigilant about the injection process conditions (injection flow rate, injection pressure, and cumulative volume injected). The alkaline activated persulfate solution will be distributed to the injection wellhead of each injection well via aboveground manifold and hoses. Each injection leg of the manifold will be equipped with a flow totalizer to record volume injected at each injection well and a flow control valve to control the flow rate. A hazard analysis from for ISCO injection of alkaline activated sodium persulfate is included in Appendix B, which describes work steps, potential hazards, and critical actions for hazard prevention associated with each step.

Based on Arcadis' experience during the pilot test at this site, an injection flow rate of approximately 0.5 to 1 gallon per minute (gpm) is anticipated. If the injection rate is significantly less than 1 gpm, unmanned overnight injection may be performed under gravity flow to complete the injection event within the anticipated one week timeframe. Once the injection is completed approximately 5 to 10 gallons of water will be injection into each wells to rinse the injection components and then the injection system will be depressurized by opening the vent valves. The well head assembly will be disconnected from the well and placed over a 5-gallon bucket. The shut-off valve on the assembly will then be opened to drain the hose into the bucket. While one field staff is holding and securing the bucket, the other will walk slowly from the manifold toward the well head and lift the section of hoses while walking to move/push the residual solution in the hose into the bucket. The drained solution will be poured slowly into the injection wells.

5 PERFORMANCE MONITORING

This section describes the monitoring to be performed during injection activities (process monitoring), including monitoring of injection field parameters, dose response and hydraulic response, and post injection monitoring, including monitoring of field parameters, and sampling for VOCs, sodium, and persulfate from selected wells. The details of the injection monitoring program are provided in Table 2.

5.1 Process Monitoring During Injection

The injection solution flow rates, cumulative injected volumes, and wellhead pressures will be monitored and recorded in an injection log. When injection is conducted under pumping, wellhead pressures will be monitored closely and adjusted as necessary during injection. Injection flow rates and cumulative injected volumes at each individual well will be monitored with designated flow totalizers, and overall injection flow rates and total injected volume will be recorded and calculated based on the changes of volumes in solution tanks. In addition, mixed reagent quantities, pH, and specific conductance of sodium persulfate and sodium hydroxide solutions will be recorded for every batch. Persulfate concentration of the alkaline activated persulfate solution will be analyzed in selected batches using a field test kit. Solution pH, temperature and conductance will be monitored using an YSI600 or similar portable device.

5.2 Dose-Response Monitoring

Dose-response monitoring will be performed at up to six monitoring wells (MW-8S, MW-12, MW-13, MW-14, OW-5 and OW-6) during injection by monitoring of real-time field parameters, specifically specific conductance, pH, temperature, redox potential, and persulfate (using field test kit) at least once per day. Field parameters and persulfate data will be collected from RW-1, RW-2, RW-3, VEP-2, and VEP-3 once per day, and from ESI-7, VEP-1, VEP-4, and VEP-5 once the injection is completed.

Sodium persulfate and sodium hydroxide contain inorganic ions that are in correlation to solution salinity and conductance. The higher the concentrations of sodium persulfate and sodium hydroxide, the higher the corresponding conductance. These real-time data will be utilized to evaluate the arrival of injection solution at selected monitoring wells. Breakthrough at a specific well location will be determined when a sample exhibits an increase in persulfate concentration, and/or an increase in pH and specific conductance. The field parameters will be measured using hand held instruments every six hours or at a frequency sufficient to capture arrival of injection solution. Additionally, hydraulic response will be monitoring by manual gauging of water level at the dose-response monitoring wells.

5.3 Post-Injection Performance Monitoring

Post-injection groundwater monitoring will be performed at monitoring wells surrounding the injection wells to observe the timing and concentration of injected solution arrival and disappearance at each location. Monitoring will include three round of post-injection monitoring events. Monitoring will be performed using a combination of down-hole monitoring and grab sampling. Based on field observations, groundwater samples will be collected for the laboratory analyses of VOCs, and sodium on month-1, month-3 and month-6 following the injection event. Post injection monitoring data will be collected from injection wells IW-6 through IW-15, and monitoring wells ESI-7, OW-5, OW-6, MW-8S, MW-12, MW-13, MW-14, RW-1, RW-2, RW-3, VEP-1, VEP-2, VEP-3, VEP-4, and VEP-5. The details of the post-injection monitoring plan is presented in Table 2.

While the exact timing of the sampling events will be adjusted based on the field screening results, at the selected monitoring wells three rounds of sampling of groundwater will occur for laboratory analysis of VOCs and sodium. It should be noted that the sampling events will be supplemented with the ongoing monitoring program wherever appropriate. A detailed monitoring plan is presented in Table 2.

6 REPORTING

Data collected during and following the full-scale injection will be evaluated against the performance objectives and the results will be summarized in a Summary Report. The report will assess the effectiveness of ISCO, determine basis-of-design parameters for full-scale ISCO implementation, and the potential effect of ISCO activities on ongoing vacuum enhanced pumping system.

7 SCHEDULE

Arcadis anticipates the full-scale ISCO will be implemented in July 2018. Within 45 days of the availability of the post-injection performance monitoring data the ISCO Summary Report will be submitted to the Department for their review.

TABLES

Table 1. Well Construction Details
D.C. Rollforms, Ingersoll Rand, Jamestown, New York.

Well	Well Diameter	Slot Size	Material Type	Screen Depth Interval *	Geologic Unit
IW-6	2"	0.010"	PVC casing; SS screen	5.8-11.3	Fill/Till
IW-7	2"	0.010"	PVC casing; SS screen	5.8-13.3	Fill/Till
IW-8	2"	0.010"	PVC casing; SS screen	5.8-14.9	Fill/Till
IW-9	2"	0.010"	PVC casing; SS screen	5.9-13.9	Fill/Till
IW-10	2"	0.010"	PVC casing; SS screen	6.1-12.3	Fill/Till
IW-11	2"	0.010"	PVC casing; SS screen	6.5-12.5	Fill/Till
IW-12	2"	0.010"	PVC casing; SS screen	6.5-12.0	Fill/Till
IW-13	2"	0.010"	PVC casing; SS screen	6.5-12.5	Fill/Till
IW-14	2"	0.010"	PVC casing; SS screen	6.5-12.5	Fill/Till
IW-15	2"	0.010"	PVC casing; SS screen	6.5-12.5	Fill/Till
ESI-7	2"	0.020"	PVC	5-15	Fill/Till
MW-8S	4"	0.010"	PVC	4-9	Fill
MW-12	4"	0.010"	PVC	5-10	Fill
MW-13	2"	0.010"	PVC	5-10	Fill
MW-14	2"	0.010"	PVC	5-10	Fill
OW-5	2"	0.010"	PVC	3.5-10	Fill
OW-6	2"	0.010"	PVC	3.5-10	Fill
VEP-1	6"	0.020"	PVC	5.5-10.5	Fill
VEP-2	6"	0.020"	PVC	5.5-10.5	Fill
VEP-3	6"	0.020"	PVC	5.5-10.5	Fill
VEP-4	6"	0.020"	PVC	5.5-10.5	Fill
VEP-5	6"	0.020"	PVC	5.5-10.5	Fill

Notes:
proposed construction details of new injection wells

Table 2. Proposed Monitoring Program[1]
D.C. Rollforms, Ingersoll Rand, Jamestown, New York.

Well ID	Baseline Monitoring				Injection Performance Monitoring			Post-Injection Performance Monitoring[8]			
	VOCs[2]	Metals[3]	Persulfate[4]	Field Parameters[5] and DTW[6]	Persulfate[4]	Field Parameters[5] and DTW[6]	Injection Parameters[7]	VOCs[2]	Metals[3]	Persulfate[4]	Field Parameters[5] and DTW[6]
Injection Solution	--	--	--	--	Once per day	pH and conductivity only for every batch	--	--	--	--	--
IW-6	--	--	--	--	--	--	Every two hours during injction	Months 3, and 6 following completion of injection		Months 1, 3, and 6 following completion of injection	
IW-7	--	--	--	--	--	--	Every two hours during injction				
IW-8	--	--	--	--	--	--	Every two hours during injction				
IW-9	X	--	X	X	--	--	Every two hours during injction				
IW-10	X	--	X	X	--	--	Every two hours during injction				
IW-11	X	--	X	X	--	--	Every two hours during injction				
IW-12	X	--	X	X	--	--	Every two hours during injction				
IW-13	X	--	X	X	--	--	Every two hours during injction				
IW-14	X	--	X	X	--	--	Every two hours during injction				
IW-15	X	--	X	X	--	--	Every two hours during injction				
MW-8S	--	--	--	--	At least once per day		--	Months 1, 3, and 6 following completion of injection			
MW-12	--	--	--	--			--				
MW-13	--	--	--	--			--				
MW-14	--	--	--	--			--				
OW-5	--	--	--	--			--				
OW-6	--	--	--	--			--				
ESI-7	--	--	--	--	At the end of Injection		--	--	Months 3, and 6 following completion of injection		
RW-1	--	--	--	--	Once per day		--	--	--	Months 1, 3, and 6 following completion of injection	
RW-2	--	--	--	--			--	--	--		
RW-3	--	--	--	--			--	--	--		
VEP-2	--	--	--	--			--	--	--		
VEP-3	--	--	--	--			--	--	--		
VEP-1	--	--	--	--	At the end of Injection		--	--	--		
VEP-4	--	--	--	--			--	--	--		
VEP-5	--	--	--	--			--	--	--		

Notes:
1. Sampling and monitoring locations, parameters and schedule may be adjusted by the leading engineer in the field based on field observation
2. Site specific VOCs
3. Metals analysis will include total sodium analysis
4. Persulfate to be analyzed by commercially available field test kits.
5. Field Parameters include pH, specific conductivity, oxidation reduction potential(ORP), dissolved oxygen, and temperature
6. DTW - depth-to-water, manually gauged with water level meters
7. Injection Parameters include injection flowrate, cumulative injection volume, injection well head pressure
8. Sampling events will be supplemented with the ongoing monitoring program wherever appropriate
-- not applicable

FIGURES

LEGEND

- Monitoring Well
- Recovery Well (passive)
- Injection Well (inactive)
- Observation Well
- Vacuum Enhanced Pumping Well
- VEP Valve Box
- 2016 ISCO Injection Well
- Property Line
- Interlocking Sheet Pile/Hydraulic Barrier Wall
- High Water Mark
- Bundled Process Line
- Discharge Line
- Recovery Well Piping
- Vacuum Line
- Overhead Electrical/Telecom Line
- Sanitary Sewer Line
- Bollard Pipe
- Effluent Pipe Clean Out
- Fire Hydrant
- Sewer Manhole
- Utility Pole
- 2018 ISCO Injection Well

NOTE: All locations are approximate.

0 40 80

SCALE IN FEET

PROJECTION: NAD 1983 StatePlane New York West FIPS 3103 Feet

AERIAL SOURCE: ESRI Online Imagery (June 2013).

INGERSOLL RAND - DC ROLLFORMS SITE
NYSDEC SITE NO. 907019, JAMESTOWN, NEW YORK

ISCO WORK PLAN

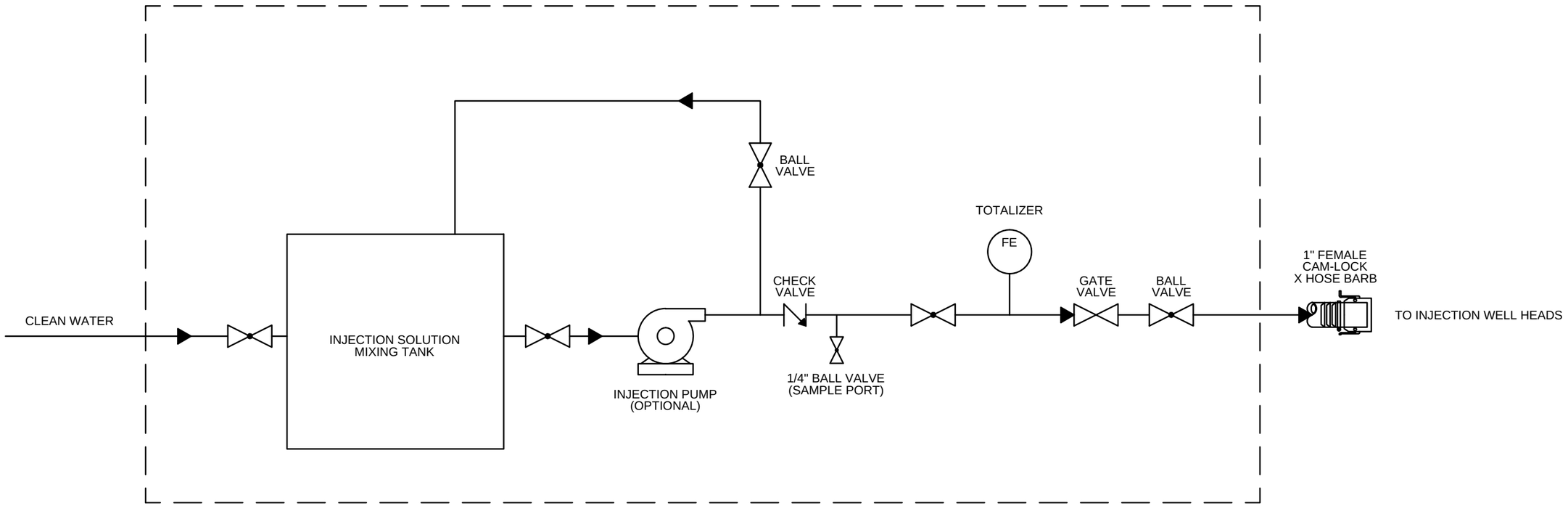
2018 Injection Well Layout

ARCADIS Design & Consultancy for natural and built assets

FIGURE
8

CITY: (KNOXVILLE) DIV/GROUP:(ENV/GIS) PIC:() PM:(M.SANFORD/M.WACKSMAN) TM:(M.AHMAD/T.CARIGNAN) BY: KIVES
PROJECT: AY000219.0020 PATH: Z:\GISPROJECTS_ENV\INGERSOLRAND\DC_ROLLOVER\MAPDOCS\2017\ISCO COST ESTIF1 DCR_ISCO CE SITE PLAN.MXD SAVED: 5/17/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



NOT TO SCALE

INGERSOLL RAND - DC ROLLFORMS SITE
NYSDEC SITE NO. 907019
JAMESTOWN, NEW YORK
ISCO WORK PLAN

PROPOSED INJECTION PIPING AND INSTRUMENTATION DIAGRAM

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2

APPENDIX A

Safety Data Sheets

SAFETY DATA SHEET
Klozur® SP

SDS # : 7775-27-1-12
Revision date: 2016-08-01
Format: NA
Version 1.03

1. PRODUCT AND COMPANY IDENTIFICATION

Product Identifier

Product Name Klozur® SP

Other means of identification

CAS-No 7775-27-1
Synonyms Sodium Persulfate; Sodium Peroxydisulfate; Disodium Peroxydisulfate; Peroxydisulfuric acid, disodium salt; Peroxydisulfuric acid, sodium salt.

Alternate Commercial Name Klozur® Persulfate

Recommended use of the chemical and restrictions on use

Recommended Use: In situ and ex situ chemical oxidation of contaminants and compounds of concern for environmental remediation applications

Restrictions on Use No uses to be advised against were identified.

Manufacturer/Supplier

PeroxyChem LLC
2005 Market Street
Suite 3200
Philadelphia, PA 19103
Phone: +1 267/ 422-2400 (General Information)
E-Mail: sdsinfo@peroxychem.com

Emergency telephone numbers

For leak, fire, spill or accident emergencies, call:
1 800 / 424 9300 (CHEMTREC - U.S.A.)
1 703 / 527 3887 (CHEMTREC - Collect - All Other Countries)
1 303/ 389-1409 (Medical - U.S. - Call Collect)

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status
This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200)

Acute toxicity - Oral	Category 4
Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 2B
Respiratory sensitization	Category 1
Skin sensitization	Category 1
Specific target organ toxicity (single exposure)	Category 3
Oxidizing Solids	Category 3

GHS Label elements, including precautionary statements

EMERGENCY OVERVIEW

Danger

Hazard Statements
H334 - May cause allergy or asthma symptoms or breathing difficulties if inhaled
H335 - May cause respiratory irritation
H320 - Causes eye irritation
H315 - Causes skin irritation
H317 - May cause an allergic skin reaction
H302 - Harmful if swallowed
H272 - May intensify fire; oxidizer

Precautionary Statements - Prevention
P261 - Avoid breathing dust.
P285 - In case of inadequate ventilation wear respiratory protection
P271 - Use only outdoors or in a well-ventilated area
P280 - Wear protective gloves/ protective clothing
P264 - Wash face, hands and any exposed skin thoroughly after handling
P210 - Keep away from heat/sparks/open flames/hot surfaces. - No smoking
P220 - Keep/Store away from clothing/combustible materials
P221 - Take any precaution to avoid mixing with combustibles

Precautionary Statements - Response
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P337 + P313 - If eye irritation persists: Get medical advice/ attention
P302 + P352 - IF ON SKIN: Wash with plenty of water.
P333 + P313 - If skin irritation or rash occurs: Get medical advice/ attention
P304 + P341 - IF INHALED: If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing
P342 + P311 - If experiencing respiratory symptoms: Call a POISON CENTER or doctor
P301 + P312 - IF SWALLOWED: Call a POISON CENTER or doctor if you feel unwell
P330 - Rinse mouth
P370 + P378 - In case of fire: Use water spray for extinction

Precautionary Statements - Storage
P403 + P233 - Store in a well-ventilated place. Keep container tightly closed

Hazards not otherwise classified (HNOC)
No hazards not otherwise classified were identified.

Other Information Risk of decomposition by heat or by contact with incompatible materials

Unknown acute toxicity
0% of the mixture consists of ingredient(s) of unknown toxicity

3. COMPOSITION/INFORMATION ON INGREDIENTS

Formula Na2O8S2

Chemical name	CAS-No	Weight %
Sodium Persulfate	7775-27-1	> 99

4. FIRST AID MEASURES

General Advice May produce an allergic reaction.

Eye Contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids intermittently. Consult a physician. If symptoms persist, call a physician.

Skin Contact Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get medical attention if irritation develops and persists.

Inhalation Remove from exposure, lie down. If breathing is irregular or stopped, administer artificial respiration. Call a physician immediately.

Ingestion Do NOT induce vomiting. Call a physician or poison control center immediately. Rinse mouth. Drink 1 or 2 glasses of water.

Most important symptoms and effects, both acute and delayed Itching; Redness; Coughing and/ or wheezing.

Indication of immediate medical attention and special treatment needed, if necessary Treat symptomatically

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media Water. Cool containers with flooding quantities of water until well after fire is out.

Unsuitable extinguishing media Do not use carbon dioxide or other gas filled fire extinguishers; they will have little effect on decomposing persulfate.

Specific Hazards Arising from the Chemical Decomposes under fire conditions to release oxygen that intensifies the fire.

Flammable properties Contact with combustible material may cause fire

Explosion data
Sensitivity to Mechanical Impact Not sensitive.
Sensitivity to Static Discharge Not sensitive.

Protective equipment and precautions for firefighters As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions Keep off any unprotected persons. Avoid contact with the skin and the eyes. Avoid breathing dust. Wear personal protective equipment.

Other Never add other substances or combustible waste to product residues.

Environmental Precautions Prevent material from entering into soil, ditches, sewers, waterways, and/or groundwater. See Section 12, Ecological Information for more detailed information.

Methods for Containment Vacuum, shovel or pump waste into a drum and label contents for disposal. Avoid dust formation. Store in closed container.

Methods for cleaning up Clean up spill area and treat as special waste. Dispose of waste as indicated in Section 13.

7. HANDLING AND STORAGE

Handling Wear personal protective equipment. Use only in area provided with appropriate exhaust ventilation. Avoid dust formation. Handle product only in closed system or provide appropriate exhaust ventilation at machinery. Avoid contact with skin and eyes. Avoid breathing dust. Remove and wash contaminated clothing before re-use. Reference to other sections.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat. Do not store near combustible materials. Avoid contamination of opened product. Keep away from food, drink and animal feedingstuffs. Avoid formation and deposition of dust.

Incompatible products Acids, Alkalis, Halides, Combustible materials, Organic material, Reducing agents. Acids, alkalis, halides (fluorides, chlorides, bromides), combustible materials, reducing agents and organic compounds.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines .

Chemical name	ACGIH TLV	OSHA PEL	NIOSH	Mexico
Sodium Persulfate 7775-27-1	TWA: 0.1 mg/m³	-	-	-
Chemical name	**British Columbia**	**Quebec**	**Ontario TWAEV**	**Alberta**
Sodium Persulfate 7775-27-1	TWA: 0.1 mg/m³	-	TWA: 0.1 mg/m³	TWA: 0.1 mg/m³

Appropriate engineering controls

Engineering measures Provide local exhaust or general ventilation adequate to maintain exposures below permissable exposure limits.

Individual protection measures, such as personal protective equipment

Eye/Face Protection Eye protection recommended. Chemical goggles consistent with EN 166 or equivalent.

Skin and Body Protection Wear long-sleeved shirt, long pants, socks, and shoes.

Hand Protection Protective gloves: Neoprene gloves, Polyvinylchloride, Natural Rubber.

Respiratory Protection If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn: particulate filtering facepiece respirators.

Hygiene measures Keep away from food, drink and animal feeding stuffs. Do not eat, drink or smoke when using this product. Wash hands before breaks and after shifts. Keep work clothes separate, remove contaminated clothing - launder after open handling of product.

General information Protective engineering solutions should be implemented and in use before personal protective equipment is considered.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance	Crystalline solid
Physical State	Solid
Color	White
Odor	odorless
Odor threshold	Not applicable
pH	6.0 (1% solution)
Melting point/freezing point	180 °C (Decomposes)
Boiling Point/Range	Decomposes upon heating
Flash point	Not flammable
Evaporation Rate	No information available
Flammability (solid, gas)	Not flammable
Flammability Limit in Air	Not applicable
Upper flammability limit:	No information available
Lower flammability limit:	No information available
Vapor pressure	6.07E-30 mm Hg at 25ºC
Vapor density	No information available
Density	2.59 g/cm³ (crystal density)
Specific gravity	No information available
Water solubility	42 % @ 25 °C
Solubility in other solvents	No information available
Partition coefficient	No information available (inorganic)
Autoignition temperature	No evidence of combustion up to 600°C No evidence of combustion up to 600 °C
Decomposition temperature	> 100 °C (assume)
Viscosity, kinematic	No information available (Solid)
Viscosity, dynamic	No information available
Explosive properties	Not explosive
Oxidizing properties	oxidizer
Molecular weight	238.1
VOC content (%)	Not applicable
Bulk density	1.12 g/cm³ (loose)

10. STABILITY AND REACTIVITY

Reactivity None under normal use condtions. Oxidizer. Contact with other material may cause fire

Chemical Stability Stable.

Possibility of Hazardous Reactions None under normal processing.

Hazardous polymerization Hazardous polymerization does not occur.

Conditions to avoid Heat. Moisture.

Incompatible materials Acids, alkalis, halides (fluorides, chlorides, bromides), combustible materials, reducing agents and organic compounds. . Acids, Alkalis, Halides, Combustible materials, Organic material, Reducing agents.

Hazardous Decomposition Products Oxygen which supports combustion

11. TOXICOLOGICAL INFORMATION

Product Information

Unknown acute toxicity 0% of the mixture consists of ingredient(s) of unknown toxicity

LD50 Oral	Sodium Persulfate: 895 mg/kg (rat)
LD50 Dermal	Sodium Persulfate: > 10 g/kg
LC50 Inhalation	Sodium Persulfate: >5.10 mg/L (4h) (rat)

Serious eye damage/eye irritation Irritating to eyes.
Skin corrosion/irritation Minimally irritating.

Sensitization Sodium Persulfate:. May cause sensitization by inhalation and skin contact.

Information on toxicological effects

Symptoms Symptoms of allergic reaction may include rash, itching, swelling and trouble breathing.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Irritating to eyes, respiratory system and skin.
corrosivity None.

Carcinogenicity Contains no ingredient listed as a carcinogen.

Mutagenicity Did not show mutagenic effects in animal experiments

Neurological effects Not neurotoxic

Reproductive toxicity This product is not recognized as reprotox by Research Agencies.
Developmental toxicity None known.
Teratogenicity Not teratogenic in animal studies.

STOT - single exposure May cause respiratory irritation.
STOT - repeated exposure Not classified.

Target organ effects Eyes, Lungs.

Aspiration hazard No information available.

12. ECOLOGICAL INFORMATION

Ecotoxicity

Ecotoxicity effects

Sodium Persulfate (7775-27-1)				
Active Ingredient(s)	Duration	Species	Value	Units
Sodium Persulfate	96 h LC50	Rainbow trout	163	mg/L
Sodium Persulfate	48 h LC50	Daphnia magna	133	mg/L
Sodium Persulfate	96 h LC50	Grass shrimp	519	mg/L
Sodium Persulfate	72 h EC50	Algae Selenastrum capricornutum	116	mg/L

Persistence and degradability Biodegradability does not pertain to inorganic substances.

Bioaccumulation Does not bioaccumulate.

Mobility Dissociates into ions.

Other Adverse Effects None known.

13. DISPOSAL CONSIDERATIONS

Waste disposal methods This material, as supplied, is a hazardous waste according to federal regulations (40 CFR 261). It must undergo special treatment, e.g. at suitable disposal site, to comply with local regulations.

Contaminated Packaging Empty remaining contents. Dispose of in accordance with local regulations.

14. TRANSPORT INFORMATION

DOT

UN/ID no	UN 1505
Proper Shipping Name	SODIUM PERSULFATE
Hazard class	5.1
Packing Group	III

TDG

UN/ID no	UN 1505
Proper Shipping Name	SODIUM PERSULFATE
Hazard class	5.1
Packing Group	III

MEX

UN/ID no	UN 1505
Proper Shipping Name	SODIUM PERSULFATE
Hazard class	5.1
Packing Group	III

ICAO

UN/ID no	UN 1505
Proper Shipping Name	SODIUM PERSULFATE
Hazard class	5.1
Packing Group	III

ICAO/IATA

UN/ID no	UN 1505
Proper Shipping Name	SODIUM PERSULFATE
Hazard class	5.1
Packing Group	III

IMDG/IMO

UN/ID no	UN 1505
Proper Shipping Name	SODIUM PERSULFATE
Hazard class	5.1
Packing Group	III

ADR/RID

UN/ID no	UN 1505
Proper Shipping Name	SODIUM PERSULFATE
Hazard class	5.1
Packing Group	III

ADN

Proper Shipping Name	SODIUM PERSULFATE
Hazard class	5.1
Packing Group	III

15. REGULATORY INFORMATION

U.S. Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

SARA 311/312 Hazard Categories
This product is not subject to reporting under the Emergency Planning and Community Right-to-Know rule.

Clean Water Act
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40

CFR 122.42)

CERCLA/EPCRA
This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material

US State Regulations

U.S. State Right-to-Know Regulations
This product contains the following substances regulated under state Right-to-Know laws:

Chemical name	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Sodium Persulfate		X			

California Proposition 65
This product does not contain any Proposition 65 chemicals

CANADA

Environmental Emergencies
This product contains no substances listed under Canada's Environmental Emergency regulations.

Canadian National Pollutant Release Inventory
This product contains no substances reportable under Canada's National Pollutant Release Inventory regulations.

International Inventories

Mexico

Mexico - Grade Slight risk, Grade 1

16. OTHER INFORMATION

NFPA	**Health Hazards** 1	**Flammability** 0	**Stability** 1	**Special Hazards** OX
HMIS	**Health Hazards** 1	**Flammability** 0	**Physical hazard** 1	**Special precautions** J

NFPA/HMIS Ratings Legend Special Hazards: OX = Oxidizer
Protection=J (Safety goggles, gloves, apron, combination dust and vapor respirator)

Revision date: 2016-08-01
Revision note Initial Release
Issuing Date: 2017-03-17

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Prepared By:

PeroxyChem

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End of Safety Data Sheet

Infosafe No™	1CH6F	Issue Date : September 2014	RE-ISSUED by CHEMSUPP

Product Name : **SODIUM HYDROXIDE**

Classified as hazardous

1. Identification

GHS Product Identifier: SODIUM HYDROXIDE

Company Name: CHEM-SUPPLY PTY LTD (ABN 19 008 264 211)

Address: 38 - 50 Bedford Street GILLMAN
SA 5013 Australia

Telephone/Fax Number: Tel: (08) 8440-2000
Fax: (08) 8440-2001

Recommended use of the chemical and restrictions on use: Acid neutralisation, chemical manufacture, rayon, cellophane, petroleum refining, pulp and paper, aluminium, detergents, soap, cellulose, textile processing, vegetable oil refining, plastics, explosives, dyestuffs, paint and paint remover, metal cleaning, etching and electroplating, reclaining rubber, regenerating ion exchange resins, organic fusions, peeling of fruits and vegetables in food industry, cleaning products, food additive and laboratory reagent.

Other Names

Name	Product Code
SODIUM HYDROXIDE Mini Pearl LR	SL000
SODIUM HYDROXIDE Pellet AR	SA178
SODIUM HYDROXIDE Mini Pearl AR	SA000
SODIUM HYDROXIDE Pellet LR	SL178
Caustic soda, Sodium hydrate, Lye	
SODIUM HYDROXIDE Mini Pearl TG	ST000

Other Information: EMERGENCY CONTACT NUMBER: +61 08 8440 2000
Business hours: 8:30am to 5:00pm, Monday to Friday.

Chem-Supply Pty Ltd does not warrant that this product is suitable for any use or purpose. The user must ascertain the suitability of the product before use or application intended purpose. Preliminary testing of the product before use or application is recommended. Any reliance or purported reliance upon Chem-Supply Pty Ltd with respect to any skill or judgement or advice in relation to the suitability of this product of any purpose is disclaimed. Except to the extent prohibited at law, any condition implied by any statute as to the merchantable quality of this product or fitness for any purpose is hereby excluded. This product is not sold by description. Where the provisions of Part V, Division 2 of the Trade Practices Act apply, the liability of Chem-Supply Pty Ltd is limited to the replacement of supply of equivalent goods or payment of the cost of replacing the goods or acquiring equivalent goods.

2. Hazard Identification

GHS classification of the substance/mixture: Corrosive to Metals: Category 1
Skin Corrosion/Irritation: Category 1A

Signal Word (s): DANGER

Hazard Statement (s): H290 May be corrosive to metals.
H314 Causes severe skin burns and eye damage.

Pictogram (s): Corrosion

Precautionary statement – Prevention: P234 Keep only in original container.
P261 Avoid breathing dust/fume/gas/mist/vapours/spray.
P264 Wash thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.

Precautionary statement – Response: P301+P330+P331 IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304+P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310 Immediately call a POISON CENTER or doctor/physician.

Classified as hazardous

Precautionary statement – Storage	P363 Wash contaminated clothing before reuse. Store locked up. Store in corrosive resistant/... container with a resistant inner liner.

3. Composition/information on ingredients

Chemical Characterization Solid

Ingredients

Name	CAS	Proportion	Hazard Symbol	Risk Phrase
Sodium hydroxide	1310-73-2	100 %	C	R35

4. First-aid measures

Ingestion	Rinse mouth thoroughly with water immediately. Give water to drink. DO NOT induce vomiting. If vomiting occurs, have victim lean forward to reduce risk of aspiration. If vomiting occurs give further water to achieve effective dilution. Seek immediate medical assistance.
Skin	Wash affected areas with copious quantities of water immediately. Remove contaminated clothing and wash before re-use. Seek urgent medical assistance. Cover skin with an emollient.
Eye contact	Immediately irrigate with copious quantity of water for at least 15 minutes. Eyelids to be held open. Seek immediate medical assistance. If available, a neutral saline solution may be used to flush the contaminated eye/s an additional 30 minutes.
First Aid Facilities	Maintain eyewash fountain and safety shower in work area.
Advice to Doctor	Treat symptomatically as for strong alkalis. Consult Poisons Information Centre. In severe cases, where excessive amounts of sodium hydroxide has been ingested, endoscopy should be performed to determine the severity of the oesophageal burns.
Other Information	For advice, contact the National Poisons Information Centre (Phone Australia 13 11 26; New Zealand 0800 764 766) or a doctor.

5. Fire-fighting measures

Hazards from Combustion Products	May librate toxic fumes in fire (sodium oxide).
Specific Methods	Use extinguishing media most appropriate for the surrounding fire. Small fire: Use dry chemical, CO2 or water spray. Large fire: Use water spray, fog or foam - Do NOT use water jets. If safe to do so, move undamaged containers from the fire area. Cool containers with flooding quantities of water until well after the fire is out. Avoid getting water inside the containers.
Specific hazards arising from the chemical	Material does not burn. Fire or heat will produce irritating, poisonous and/or corrosive gases.
Hazchem Code	2W
Precautions in connection with Fire	Wear SCBA and chemical splash suit. Fully encapsulating, gas-tight suits should be worn for maximum protection. Structural firefighter's uniform is NOT effective for these materials.

6. Accidental release measures

Personal Precautions	Do not allow hot material to contact water or other liquids. Avoid contact with skin. Avoid contact with eyes.
Personal Protection	Wear protective clothing specified for normal operations (see Section 8)
Clean-up Methods - Small Spillages	Sweep up (avoid generating dust) and remove to a suitable, clearly labelled container for disposal in accordance with local regulations.
Clean-up Methods - Large Spillages	Seek expert advice on handling and disposal.
Environmental Precautions	Avoid release to the environment.

7. Handling and storage

Precautions for Safe Handling	Avoid generation or accumulation of dusts. Contaminated clothing should be removed and washed before reuse. Application of skin-protective barrier cream is recommended. Wash hands and face thoroughly after working with material. Use in well ventilated areas away from all ignition sources. In case of insufficient ventilation, wear suitable respiratory equipment. When diluting or preparing solution,

	add caustic to water in small amounts to avoid boiling and splattering.
Conditions for safe storage, including any incompatabilities	Store in a cool,dry place. Store away from acids. Keep containers securely sealed and protected against physical damage.
Corrosiveness	Corrosive to aluminum, tin, zinc. Corrosive to steel at elevated temperatures.
Storage Regulations	Refer Australian Standard AS 3780 - 1994 'The Storage and Handling of Corrosive Substances'.
Other Information	Containers made of nickel alloys are preferred. Steel containers are acceptable if temperatures are not elevated.

8. Exposure controls/personal protection

Occupational exposure limit values

Name	STEL		TWA		
	mg/m3	ppm	mg/m3	ppm	Footnote
Sodium hydroxide			2		Peak limitation

Other Exposure Information	A time weighted average (TWA) has been established for Sodium hydroxide (Safe Work Australia) of 2 mg/m3. The corresponding STEL level is 2 mg/m3 - Peak Limitation - a ceiling concentration which should not be exceeded over a measurement period which should be as short as possible but not exceeding 15 minutes. The exposure value at the TWA is the average airborne concentration of a particular substance when calculated over a normal 8 hour working day for a 5 day working week.
Appropriate engineering controls	In industrial situations maintain the concentrations values below the TWA. This may be achieved by process modification, use of local exhaust ventilation, capturing substances at the source, or other methods.
Respiratory Protection	Where ventilation is not adequate, respiratory protection may be required. Avoid breathing dust, vapours or mists. Respiratory protection should comply with AS 1716 - Respiratory Protective Devices and be selected in accordance with AS 1715 - Selection, Use and Maintenance of Respiratory Protective Devices. Filter capacity and respirator type depends on exposure levels. In event of emergency or planned entry into unknown concentrations a positive pressure, full-facepiece SCBA should be used. If respiratory protection is required, institute a complete respiratory protection program including selection, fit testing, training, maintenance and inspection.
Eye Protection	The use of a face shield, chemical goggles or safety glasses with side shield protection as appropriate. Must comply with Australian Standards AS 1337 and be selected and used in accordance with AS 1336.
Hand Protection	Avoid skin contact when removing gloves from hands, do not touch the gloves outer surface. Dispose of gloves as hazardous waste. Hand protection should comply with AS 2161, Occupational protective gloves - Selection, use and maintenance. Recommendation: Rubber or plastic gloves.
Personal Protective Equipment	Final choice of personal protective equipment will depend on individual circumstances and/or according to risk assessments undertaken.
Footwear	Safety boots in industrial situations is advisory, foot protection should comply with AS 2210, Occupational protective footwear - Guide to selection, care and use.
Body Protection	Clean clothing or protective clothing should be worn, preferably with and apron. Clothing for protection against chemicals should comply with AS 3765 Clothing for Protection Against Hazardous Chemicals.
Hygiene Measures	Do not eat, drink or smoke in work areas. Wash hands thoroughly after handling this material. Maintain good housekeeping.

9. Physical and chemical properties

Form	Solid
Appearance	White, deliquescent flakes, pellets or minipeal.
Odour	Odourless.
Melting Point	318 - 323 °C
Boiling Point	1390 °C @ 760 mm Hg
Solubility in Water	Soluble.
Solubility in Organic Solvents	Soluble in alcohol and glycerol. Insoluble in acetone and ether.

Specific Gravity	2.130 @ 20 °C
pH	12 (0.05% soln); 13 (1% soln); 14 (5% soln)
Odour Threshold	Odourless.
Flammability	Non-combustible.
Molecular Weight	40.01
Other Information	Absorbs water and carbon dioxide from the air.

10. Stability and reactivity

Chemical Stability	Stable under normal use conditons. Hygroscopic Slowly absorbs moisture from air, reacting with carbon dioxide and forming sodium carbonate.
Conditions to Avoid	Exposure to moisture. Exposure to air. Dust generation. Incompatibles.
Incompatible Materials	Strong acids, ally alcohol, ally chloride, phophorous, metals (aluminium, magnesium, tin, zinc), nitro compounds (nitroethane, nitromethane, nitroparaggins, nitropropane) and chloro organic compounds, organic halogen compounds (trichloroethylene), water.
Hazardous Decomposition Products	Sodium oxide.
Possibility of hazardous reactions	May react violently with strong acids. In contact with water, reaction may generate enough heat to ignite combustible materials. In contact with metals, reaction may produce flammable and explosive hydrogen gas. May react with organohalogen compounds to form spontaneously combustible compounds. May react explosively in contact with nitro and chloro organic compounds. May form expolosive products with ammonia plus silver nitrate, benzene and benzene sulfonyl chloride, tetrahydrofuran, sodium tetrahydroborate, and trichlorophenol sodium salt plus methyl alcohol plus tichlorobenzene plus heat.
Hazardous Polymerization	Will not occur.

11. Toxicological Information

Ingestion	Corrosive. Swallowing may cause severe burns of mouth, throat, and stomach. Severe scarring of tissue and death may result. Similar symptoms may be experienced as for inhalation with, severe pain, severe scarring of tissue, diarrhea, bleeding, vomiting, fall in blood pressure, collapse and death. Damage may appear days after exposure. Risk of perforation in the oesophagus and stomach.
Inhalation	Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage or burns of the mucous membranes of the upper respiratory tract, depending on severity of exposure. Symptoms may include coughing, wheezing, laryngitis, shortness of breath, nausea, vomiging, sneezing, sore throat or runny nose. Severe chemical pneumonitis and pulmonary edema may occur.
Skin	Corrosive. Contact with skin causes severe burns and scarring. Can penetrate deeply. Burns are not immediately painful, onset of pain and irritation may be minutes to hours.
Eye	Corrosive. Causes severe burns. Can penetrate deeply. In severe cases, ulceration, permanent impairment of vision and permanent blindness may occur.
Carcinogenicity	Not listed in the IARC Monographs.
Chronic Effects	Prolongecd contact with dilute solution or dust has destructive effects upon tissue.
Mutagenicity	No evidence of mutagenic properties.

12. Ecological information

Ecotoxicity	Toxic for aquatic organisms. Harmful effect due to pH shift.
Persistence and degradability	Methods for the determination of biodegradability are not applicable to inorganic substances.
Acute Toxicity - Fish	LC50 Gambusia affins (mosquito fish) - 125mg/L - 96 h.
Acute Toxicity - Daphnia	EC50 (Daphina magna): 76 mg/l/24h.

13. Disposal considerations

Disposal Considerations	Whatever cannot be saved for recovery or recycling should be disposed of according to relevant local, state and federal government regulations.

14. Transport information

Classified as hazardous

Transport Information	Dangerous goods of Class 8 (Corrosive) are incompatible in a placard load with any of the following: Class 1, Class 4.3, Class 5, Class 6, if the Class 6 dangerous goods are cyanides and the Class 8 dangerous goods are acids, Class 7; and are incompatible with food and food packaging in any quantity. Not to be loaded on the same vehicle with strong acids.
U.N. Number	1823
UN proper shipping name	SODIUM HYDROXIDE, SOLID
Transport hazard class(es)	8
Hazchem Code	2W
Packaging Method	3.8.8
Packing Group	II
EPG Number	8A1
IERG Number	37

15. Regulatory information

Regulatory Information	Listed in the Australian Inventory of Chemical Substances (AICS).
Poisons Schedule	S6

16. Other Information

Date of preparation or last revision of SDS	September 2009.
Literature References	'Standard for the Uniform Scheduling of Medicines and Poisons No. 4', Commonwealth of Australia, June 2013. Lewis, Richard J. Sr. 'Hawley's Condensed Chemical Dictionary 13th. Ed.', Rev., John Wiley and Sons, Inc., NY, 1997. National Road Transport Commission, 'Australian Code for the Transport of Dangerous Goods by Road and Rail 7th. Ed.', 2007. 'Labelling of Hazardous Workplace Chemicals, Code of Proctice' Safe Work Australia. Standards Australia, 'SAA/SNZ HB 76:2010 Dangerous Goods - Initial Emergency Response Guide', Standards Australia/Standards New Zealand, 2010. Safe Work Australia, 'Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(2004)]'. Safe Work Australia, 'Hazardous Substances Information System, 2005'. Safe Work Australia, 'National Code of Practice for the Labelling of Safe Work Hazardous Substances (2011)'. Safe Work Australia, 'National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC:1003(1995)]'.
Contact Person/Point	Paul McCarthy Ph. (08) 8440 2000 DISCLAIMER STATEMENT: All information provided in this data sheet or by our technical representatives is compiled from the best knowledge available to us. However, since data, safety standards and government regulations are subject to change and the conditions of handling and use, or misuse, are beyond our control, we make no warranty either expressed or implied, with respect to the completeness or accuracy to the information contained herein. Chem-Supply accepts no responsibility whatsoever for its accuracy or for any results that may be obtained by customers from using the data and disclaims all liability for reliance on information provided in this data sheet or by our technical representatives.
Empirical Formula & Structural Formula	NaOH

...End Of MSDS...

APPENDIX B

Hazard Analysis Form

ACTIVITY HAZARDS ANALYSIS

Overall Risk Assessment Code (RAC) (Use highest code): L

Date: 06/01/16 Project: D.C. Rollforms Site

Activity: Sodium Persulfate and Sodium Hydroxide Injection, Handling, and Treatment

Activity Location: Jamestown, NY

Prepared By: Mushtaque Ahmad

Risk Assessment Code Matrix

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Add Identified Hazards

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
X	Site reconnaissance and walk-around	Slips/trips/falls can occur from uneven ground surface, slippery walkways or from tripping over equipment	Survey the site upon arrival. Note any site conditions that may pose a potential hazard, and make note of any changes since the last injection event.	L
X		Personnel could be struck by vehicle	• Secure work area with cones. • Position vehicle to serve as a barrier between personnel and site traffic. • Unload equipment as close to the work area as possible. • Plan the location where the trailer carrying injection equipment will be set up making sure to not block any ingress/egress to the site.	L
X	Setting up of injection equipment	Pinch points can cause hand injury- • Pinch points and sharp edges/burrs can be present on the metal clamps, cam-lock, and other injection equipment.	• Wear work leather gloves.	L
X		Heavy equipment can fall and strike personnel	• Make sure that the wheels of the vehicles have been chocked prior to operation and unloading. • Use proper lifting technique	L
X		Truck and/or trailer becomes stuck on soft or uneven ground causing potential property damage and impact injury to workers during extraction	Plan setup and factor weight of full tanks when accessing and egressing from injection areas, ensure adequate hose lengths are available to pump solutions to wells in soft ground areas from stable road surface other firm surface.	L
X	Load, unload and set up of required PPE, equipment including waterline hoses, injection hoses, flow meters and supplies in/out of vehicle or storage area	Ergonomic strain from improper lifting techniques or awkward body positions/twisting	• Follow proper lifting technique, bending with the knees and not with the back. Avoid twisting at the waist when lifting. • Ask a buddy for help when lifting objects weighing over 55 lbs. (as a general guide; may vary on specific circumstances)	L
X		Slips/trips/falls can occur from walking over dragging and unsecured hoses	• Keep coiled hoses ends secured to coil when loading and unloading, stop and pick up dangling hoses that could be a trip hazard when carrying.	L

ACTIVITY HAZARDS ANALYSIS

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
X	Connecting the water supply to the injection trailer	Lifting hoses resulting in a back injury	• Do not lift more than your personal limits. • Use a second person if needed or when lifting hoses >55 lbs. • Lift with your knees and not your back.	L
X		Possible pressure build up can result in equipment failure or flying objects that can cause personal injury	• Check equipment and valves before making connections. • Check the water valves are in the off position. • Make the hose connections and secure the cam locks with counter pins. • Open supply valves slowly to avoid damage to hoses or personnel. • Check supply lines and valves for leaking after water/sodium persulfate and sodium hydroxide supply is on. • Tether hose connections if securing devices are not present. . Depressurize before disconnecting any system component.	L
X	Connect the injection trailer to a power supply	Electrocution or power surge resulting in equipment damage, injury or loss of life	• Inspect power cords for evidence of damage to the wire or connector. If damage is present, do not use power cord. • Inspect connection of power supply for evidence of damage. Use GFCI 'pigtail'.	L
X		Misuse of generator can cause electrocution, fire or equipment failure	• If using generator on injection trailer inspect components for damage. • Check oil/fuel levels and fill if necessary. • Inspect injection trailer control panel for evidence of damage to switches, circuits or breakers before connecting power. • Connect power cord then power supply. Watch for wet or other conductive surfaces.	L
X	Connecting the injection well head to the injection wells	Pressure build up in wells can cause well caps to fly off causing head or bodily injury	• When opening injection wells, be sure your body is not over the well when opening. • Be sure that safety glasses are worn and your head is facing away from the well when opening.	L
X	Mixing of sodium persulfate and water	Breathing or contact with sodium persulfate can irritate nose, throat and lungs causing coughing, wheezing and/or shortness or breath. Contact may cause skin allergy resulting in itching and skin rash	• Use full-face respirator with P100 cartridges as needed. • Wear chemical protective clothing; splash shield (as needed) and gloves to minimize contact with skin/eyes/face when handling solid or solution.	L
X		Lifting/handling bags of sodium persulfate can result in muscle strain	• Do not lift more than your personal limits. • Use a second person if needed or when lifting >55 lbs. • Lift with your knees and not your back.	M
X	Mixing of sodium hydroxide and water	Breathing or contact with sodium persulfate can irritate nose, throat and lungs causing coughing, wheezing and/or shortness or breath. Contact may cause skin allergy resulting in itching and skin rash	• Use full-face respirator with P100 cartridges as needed. • Wear chemical protective clothing; splash shield (as needed) and gloves to minimize contact with skin/eyes/face when handling solid or solution.	M
X		Lifting/handling of bags of solids can result in muscle strain	• Do not lift more than your personal limits. • Use a second person if needed or when lifting >55 lbs. • Lift with your knees and not your back.	L

ACTIVITY HAZARDS ANALYSIS

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
X	Pump solution into wells and read pressure and flow gauges	Pressure can build up resulting in hose or flow meter failure leading to possible injury	• Start injections at low flow rate and adjust as needed. Secure cam locks to hoses or flow meters with counter pins/locking device/zipties. • Never place any body part directly over well head. • Monitor pressures and stress points of the system during injection (connections, valves, threaded fitting, etc.) • When injection is complete, ensure there is no pressure prior to disassembly. • Shut down injection and let formation de-pressurize itself before disconnection hoses.	L
X		Cold/wet conditions can cause improper well-head adapted connections, i.e. PVC glue/ cement may not cure properly	• Connect during a warmer day and for a cold weather injection event do any PVC glue related work a few days ahead of the injection event.	L
X		Slips/trips/falls can occur due to hoses laying on the ground resulting in injury	• Practice good housekeeping techniques. • For hoses used during introductions, avoid walking over hoses as much as practicable. • Use high visibility marking and warning devices and secure hose if traveling across a designated facility walking area.	L
X	Clean Equipment	Slips/trips/falls can occur from water and soap causing slippery surfaces. Tripping can occur from equipment being laid out for cleaning	• Be aware of surroundings when cleaning equipment. • Maintain good footing and walk slowly on wet/slippery surfaces.	L
X		Heavy lifting of equipment can cause muscle strain	• Use proper lifting techniques. Request assistance when lifting heavy equipment.	L
X	Site restoration/loading of equipment	Tripping on equipment laying on the ground	• Secure all equipment after use. • Leave the site clean and free from any trash or debris. • Secure all wells, gates and entrances to the site.	L
X		Heavy lifting can cause muscle strain	• Use proper lifting techniques when loading equipment.	L
X	Inspect injection trailer and demobilize from site	Improperly loading the trailer can cause flying debris on the roadway. Improper trailer connections can cause the trailer to detach during demobilization.	• Be sure all line items on the check list are satisfactory before departing from the site.	L

Add Items

	EQUIPMENT	TRAINING	INSPECTION
X	Vehicles/Trailer	40 hr. Hazwoper	Perform inspection of vehicle at the start and end of each day and prior to each use.
X	PPE		Before each use.
X			

ACTIVITY HAZARDS ANALYSIS

Involved Personnel:

Acceptance Authority (digital signature): _____

APPENDIX C

Community Air Monitoring Plan

COMMUNITY AIR MONITORING PLAN
FORMER DC ROLLFORMS SITE
583 ALLEN ST, JAMESTOWN, NEW YORK

Any work conducted pursuant to the Excavation Work Plan, or intrusive activities (e.g., drilling), must also be conducted in accordance with the procedures defined in a Health and Safety Plan (HASP) prepared for the Site and this Community Air Monitoring Plan (CAMP).

This CAMP is to provide a measure of protection for any potential downwind receptors, and to confirm that work activities do not generate airborne contaminants, a designated qualified party will conduct continuous monitoring for volatile organic compounds (VOCs) and particulate matter (dust) during all ground intrusive activities at the site. Monitoring will be conducted at the downwind perimeter of each work area.

VOC Monitoring, Response and Actions

Volatile organic compounds (VOCs) will be monitored on a continuous basis during all excavation and drilling activities. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. Sampling station locations will be adjusted on a daily or more frequent basis based on actual wind directions to provide an upwind and at least two downwind monitoring stations.

VOC monitoring will be conducted using a MiniRae 2000 photoionization detector (PID). The PID will be calibrated at least once daily using the span calibration gas recommended by the manufacturer. The PID will calculate 15-minute running average concentrations. These averages will be compared to the action levels specified below.

Action Levels

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, all work activities will be stopped.

All 15-minute average readings will be recorded and be available for review by the New York State Department of Environmental Conservation (NYSDEC) or the NYS Department of Health (DOH). Instantaneous readings, if any, used for decision purposes will also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously at the downwind perimeter of each work area during all ground intrusive activities. Real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) will be used for the particulate monitoring. The equipment will be equipped with an audible alarm to indicate exceedance of the action levels summarized below. Any fugitive dust migration will also be visually assessed during all work activities.

Action Levels

- If the downwind PM-10 particulate level is 0.1 milligrams per cubic meter (mg/m3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 0.15 mg/m3 above the upwind level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 0.15 mg/m^3 above the upwind level, work will be stopped, and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 0.15 mg/m^3 of the upwind level and in preventing visible dust migration.

All air monitoring measurements readings will be recorded on field forms and made available for NYSDEC and NYSDOH review.

ARCADIS Design & Consultancy for natural and built assets

AIR MONITORING LOG

Project: DC Rollforms | Site Location: Jamestown NY

Project Number: AY000219.0026

Prepared by: J. Brayer | Date: 6/18/18

TIME	Wind Direction	Background PID (ppm)	Background PDR (ug/m3)	Work Zone PID (ppm)	Downwind Perimeter PID (ppm)	Downwind Perimeter PDR (ug/m3)	Notes
14:30	N	0.0	0.000	0.3	0.0	0.000	Downwind
14:45	N	0.0	0.000	0.2	0.0	0.001	toward
15:00	N	0.0	0.000	0.5	0.1	0.010	All Metal Press
15:20	N	0.0	0.000	0.5	0.2	0.000	
15:45	N	0.0	0.000	0.5	0.2	0.000	
16:00	NW	0.1	0.000	0.5	0.2	0.000	
16:15	NW	0.1	0.003	0.5	0.2	0.000	
16:35	NW	0.1	0.001	0.6	0.1	0.000	

COMMENTS: Set up on drilling IW-10

C:\Users\bbingham\Desktop\air monitoring log - sheet1

ARCADIS Design & Consultancy for natural and built assets

AIR MONITORING LOG

Project: DC Rollforms Site Location: Jamestown NY

Project Number: AY000219.0026

Prepared by: J. Breyer Date: 6/19/18

TIME	Wind Direction	Background PID (ppm)	Background PDR (mg/m3)	Work Zone PID (ppm)	Downwind Perimeter PID (ppm)	Downwind Perimeter PDR (mg/m3)	Notes
09:00	N	0.0	0.000	0.0	0.0	0.000	Downwind
09:15	N	0.0	0.000	0.0	0.0	0.000	toward All Metal
09:30	N	0.0	0.005	0.0	0.0	0.000	Press
09:45	N	0.0	0.000	0.0	0.0	0.000	
10:00	N	0.0	0.000	0.0	0.0	0.000	
10:15	NE	0.0	0.00	0.0	0.0	0.000	
10:30	N	0.0	0.005	0.0	0.0	0.000	
10:45	NE	0.0	0.040	0.5	0.0	0.018	
11:00	NE	0.0	0.035	0.0	0.0	0.035	
12:45	N	0.0	0.030	0.0	0.0	0.039	
12:55	N	0.0	0.031	0.0	0.0	0.035	
13:15	N	0.0	0.025	0.0	0.0	0.029	
13:45	NW	0.0	0.009	0.0	0.0	0.015	
14:15	NW	0.0	0.010	0.0	0.0	0.010	
14:30	NW	0.0	0.045	0.0	0.1	0.040	
15:00	N	0.0	0.055	0.0	0.1	0.055	
15:15	N	0.0	0.050	0.0	0.1	0.052	
15:30	NW	0.0	0.038	0.0	0.1	0.045	
15:50	NW	0.0	0.040	0.0	0.1	0.040	
COMMENTS	Continue drilling IW-10. Setup and drill IW-9, IW-11 and IW-12. Start drilling IW-B						
16:15	NW	0.0	0.040	0.0	0.1	0.040	
16:30	NW	0.0	0.040	0.0	0.1	0.040	

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ARCADIS Design & Consultancy for natural and built assets

AIR MONITORING LOG

Project DC Rollforms **Site Location** Jamestown NY

Project Number AY002219.0026

Prepared by J. Breyer **Date** 6/20/18

TIME	Wind Direction	Background PID (ppm)	Background PDR (ug/m3)	Work Zone PID (ppm)	Downwind Perimeter PID (ppm)	Downwind Perimeter PDR (ug/m3)	Notes
07:30	N	0.0	0.000	0.0	0.0	0.000	Downwind towards All Metal Press
07:45	N	0.0	0.030	0.0	0.0	0.030	
08:00	N	0.0	0.015	0.0	0.1	0.015	
08:15	N	0.0	0.025	0.0	0.2	0.025	
08:30	N	0.0	0.010	0.0	0.2	0.015	
09:15	N	0.0	0.000	0.0	0.2	0.000	
09:30	N	0.0	0.000	0.0	0.1	0.000	
09:45	N	0.0	0.000	0.0	0.0	0.000	
10:00	N	0.1	0.001	0.3	0.3	0.001	
10:30	NE	0.1	0.002	0.3	0.3	0.000	
10:45	NE	0.1	0.000	0.3	0.3	0.000	
11:00	NE	0.1	0.035	0.2	0.2	0.030	
11:30	NE	0.1	0.040	10.1	0.9	0.015	IW-15
12:45	NE	0.2	0.010	0.8	0.7	0.010	
13:00	NE	0.2	0.015	0.9	0.5	0.016	
13:15	NE	0.1	0.015	0.3	0.3	0.015	
13:30	NE	0.1	0.052	0.3	0.3	0.030	
13:45	NE	0.1	0.030	0.2	0.2	0.025	
14:00	NE	0.1	0.015	0.4	0.4	0.015	

COMMENTS Continue drilling IW-13. Setup and drill IW-14 and IW-15.

ARCADIS Design & Consultancy for natural and built assets

AIR MONITORING LOG

Project: DC Rollforms Site Location: Jamestown NY

Project Number: AY000219.0026

Prepared by: J. Brayer Date: 6/20/18

TIME	Wind Direction	Background PID (ppm)	Background PDR (ug/m3)	Work Zone PID (ppm)	Downwind Perimeter PID (ppm)	Downwind Perimeter PDR (ug/m3)	Notes
14:15	NE	0.1	0.005	0.3	0.3	0.005	
14:30	NE	0.1	0.010	0.4	0.1	0.015	
14:45	NE	0.1	0.015	0.5	0.1	0.015	
15:15	NE	0.1	0.000	0.1	0.1	0.000	
15:40	NE	0.1	0.000	0.2	0.1	0.000	
16:00	NE	0.1	0.000	0.1	0.1	0.000	
16:15	NE	0.1	0.055	0.2	0.1	0.055	
16:30	NE	0.1	0.003	0.2	0.1	0.005	

COMMENTS: Drilling completed on 6/20/18. Install wellhead protective casings on 6/21/18

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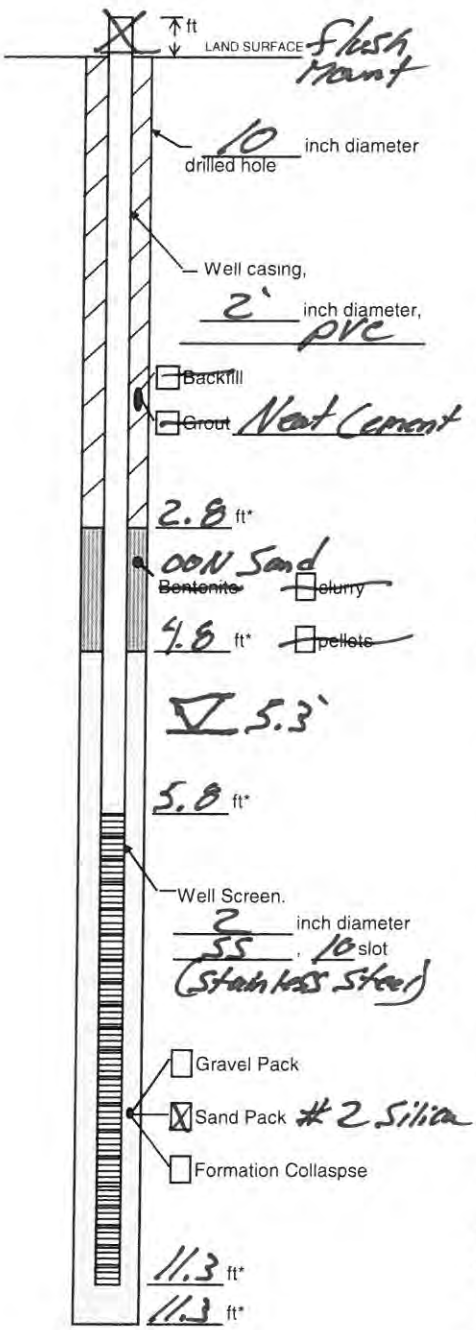
APPENDIX D

Well Construction Logs

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project DC Roll forms Well IW-6

Town/City Jamestown

County Chautauqua State NY

Permit No. N/A

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 06/22/16

Drilling Method 6 3/4 Hollow Stem Auger (HSA)

Drilling Contractor Nothnagle Drilling

Drilling Fluid None

Development Technique(s) and Date(s)

6 1/4 HSA

Fluid Loss During Drilling N/A gallons

Water Removed During Development _____ gallons

Static Depth to Water 5.23 feet below M.P. (Surface)

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose Injection well

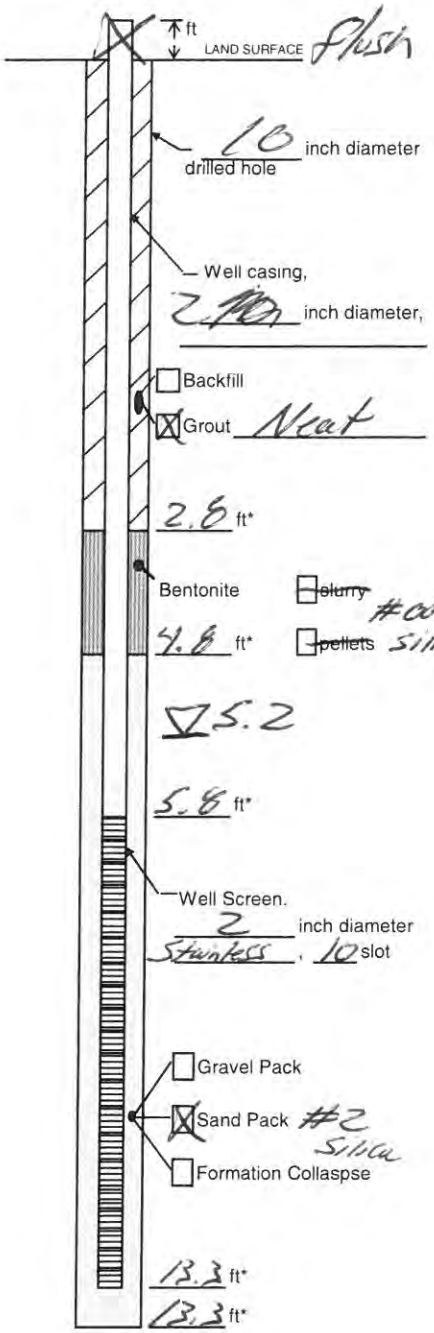
Remarks 55 Screen cut (Custom) in field to just below Water table 5.5' 55 Screen. 5.8' PVC Riser - Cam Lock fitting on top

Prepared by J. Baxter

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project DC Rollforms Well TW-7

Town/City Jamestown

County Chautauqua State NY

Permit No. N/A

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 06/23/16

Drilling Method 6 1/4 10"

Drilling Contractor Nothnagle Drilling

Drilling Fluid None

Development Technique(s) and Date(s)

6 1/4 HSA

Fluid Loss During Drilling N/A gallons

Water Removed During Development _____ gallons

Static Depth to Water 5.25 feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose Injection Well

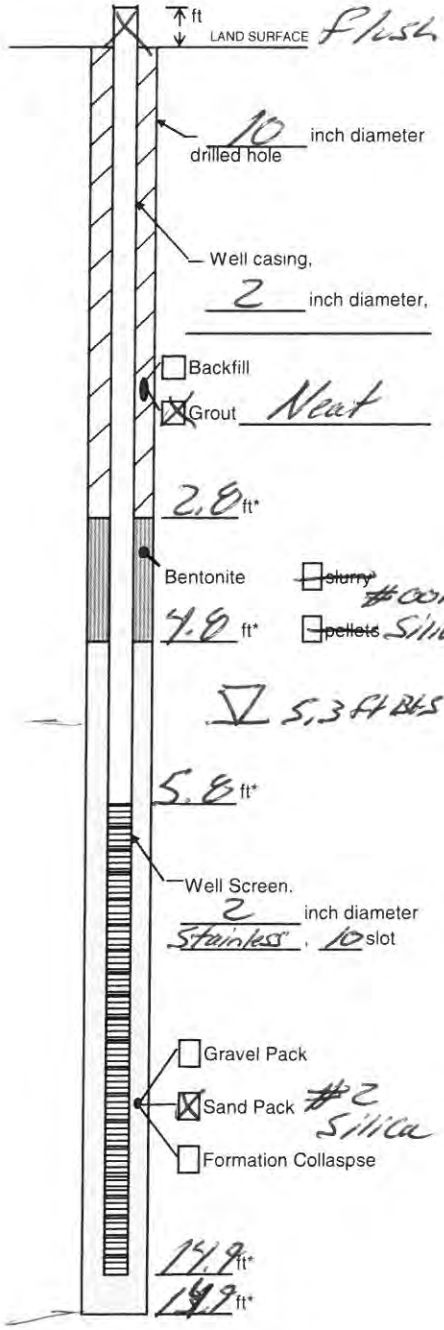
Remarks 5S Screen Custom Cut to length 0.5' below water table 7.5' Screen 5.8' PVC Riser CamLock fitting at Surface

Prepared by J. Baxter

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project DC Rolloms Well IW-8

Town/City Jamestown

County Chautauqua State NY

Permit No. N/A

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6/23/16

Drilling Method 6 1/4 10"

Drilling Contractor Northeastern Drilling

Drilling Fluid None

Development Technique(s) and Date(s)

6 1/4 HSA

Fluid Loss During Drilling N/A gallons

Water Removed During Development _____ gallons

Static Depth to Water 5.3 feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose Injection well

~~SS Screen Custom Cut~~

~~to~~

Remarks SS Screen Custom Cut to length

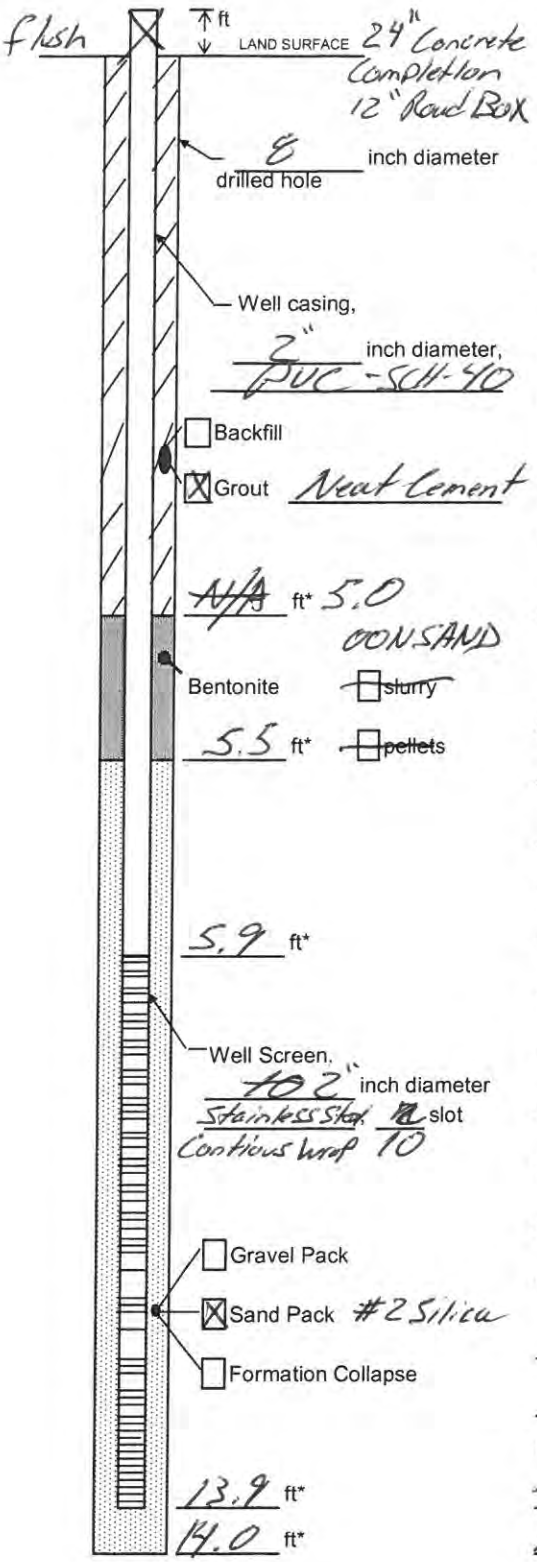
0.3' of Screen is Threads. This was taken into account in Setting 9.1' of Screen

Prepared by J. Baker

ARCADIS Design & Consultancy for natural and built assets

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project DC Rollforms - ISCO Well IW-9

Town/City Jamestown, NY

County Chautauqua State NY

Permit No. _____

Land-Surface Elevation and Datum:

Not Surveyed feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6-19-18

Drilling Method 4 1/4 HSA

Drilling Contractor ARCADIS

Drilling Fluid Water - To Maintain Head

Development Technique(s) and Date(s)

Air lift and Waterra Hydrolift w/ Surge block

Fluid Loss During Drilling 5 gallons

Water Removed During Development _____ gallons

Static Depth to Water _____ feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose ISCO Injection

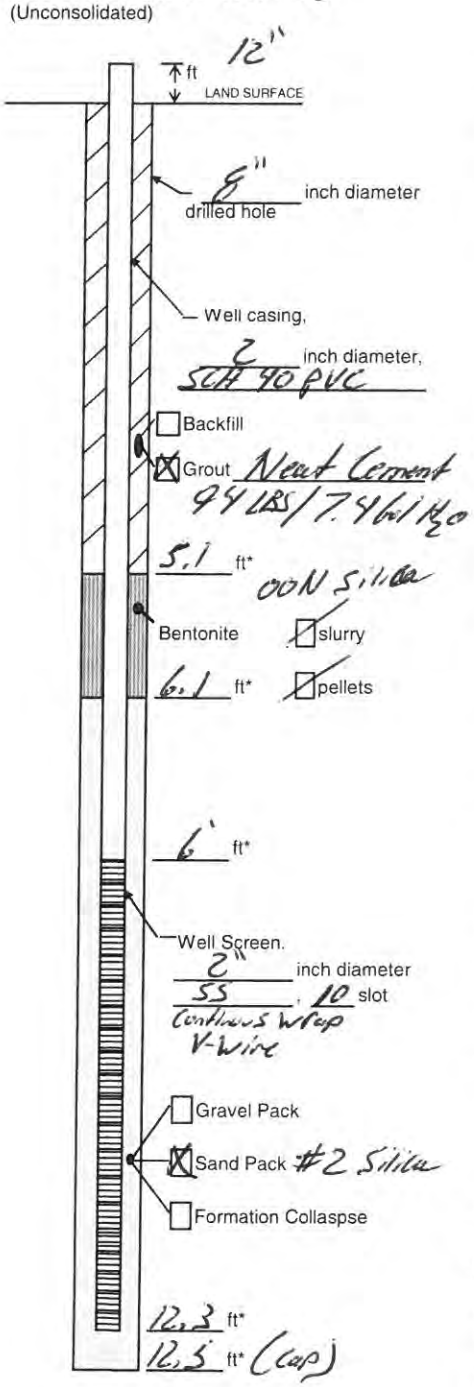
Remarks 3" Sump at base of well - SS Screen was cut and welded to length - Max length of Screen used w/ 5' Overburden maintained

Prepared by T. Brayer

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project DC Rollforms Well IW-10

Town/City Jamestown

County Chautauqua State NY

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6-18/6-19-16

Drilling Method 4 1/4 HSA

Drilling Contractor ARCADIS - Dan Richmond

Drilling Fluid Water for Head overnight

Development Technique(s) and Date(s)

Fluid Loss During Drilling _____ gallons

Water Removed During Development _____ gallons

Static Depth to Water _____ feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose ISCO Injection Well (Second Round

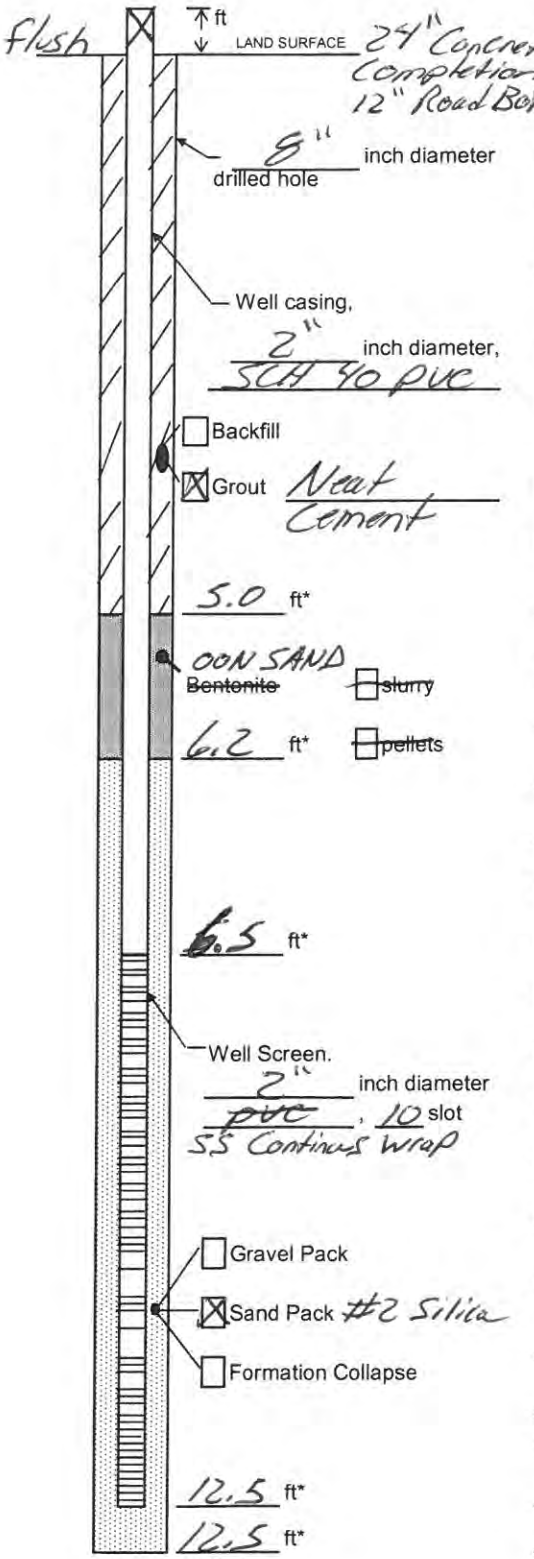
Remarks SS Custom cut Screen to match max GW level but maintain min. 5' overburden

Prepared by J. Braxton

ARCADIS Design & Consultancy for natural and built assets

Well Construction Log

(Unconsolidated)



Project DC Rollforms Well IW-11

Town/City Jamestown

County Chautauqua State NY

Permit No. _____

Land-Surface Elevation and Datum:

N/A feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6-19-18

Drilling Method 4 1/4 HSA

Drilling Contractor ARCADIS

Drilling Fluid N/A

Development Technique(s) and Date(s)

Air lift and Waterra Hydro Lift II w/ Surge Block

Fluid Loss During Drilling _____ gallons

Water Removed During Development _____ gallons

Static Depth to Water _____ feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose ISCO Injections

Remarks _____

Measuring Point is Top of Well Casing Unless Otherwise Noted.

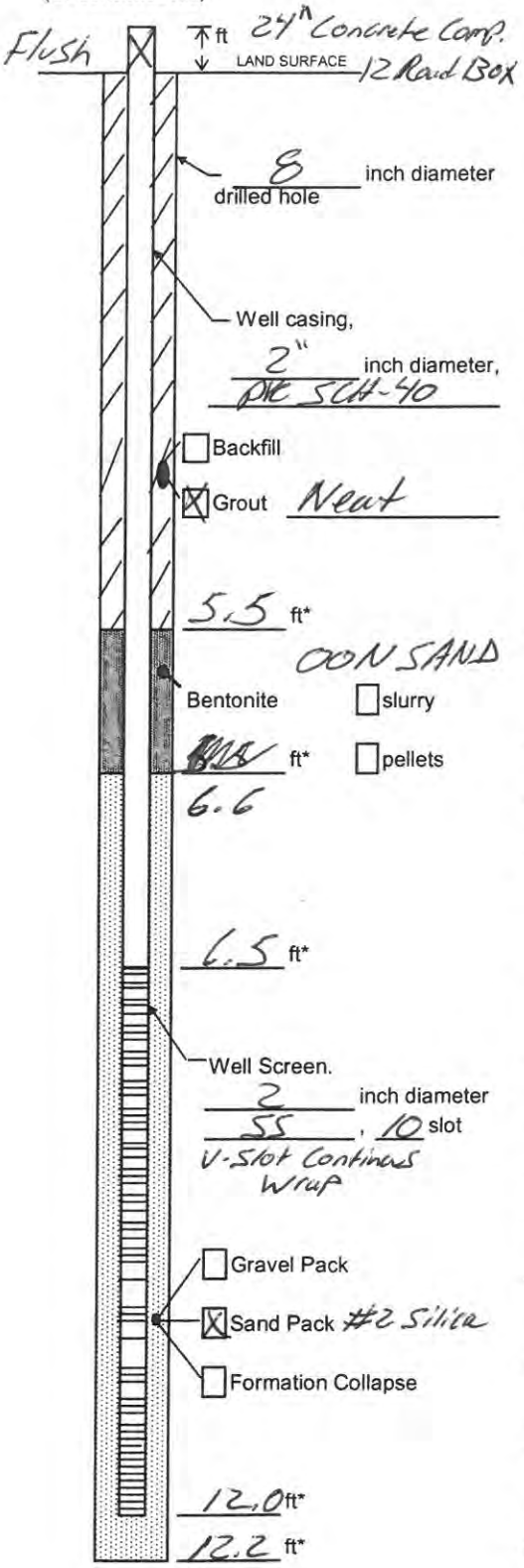
* Depth Below Land Surface

Prepared by J. Brakes

ARCADIS Design & Consultancy for natural and built assets

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project DC Roll Forms Well IW-12

Town/City Jamestown

County Chautauqua State NY

Permit No.

Land-Surface Elevation and Datum:

N/A feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6-19-18

Drilling Method 4 1/4 HSA

Drilling Contractor ARCADIS - PowerProbe 9520 VTR

Drilling Fluid N/A

Development Technique(s) and Date(s)

Fluid Loss During Drilling _____ gallons

Water Removed During Development _____ gallons

Static Depth to Water _____ feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose ISCO Injections

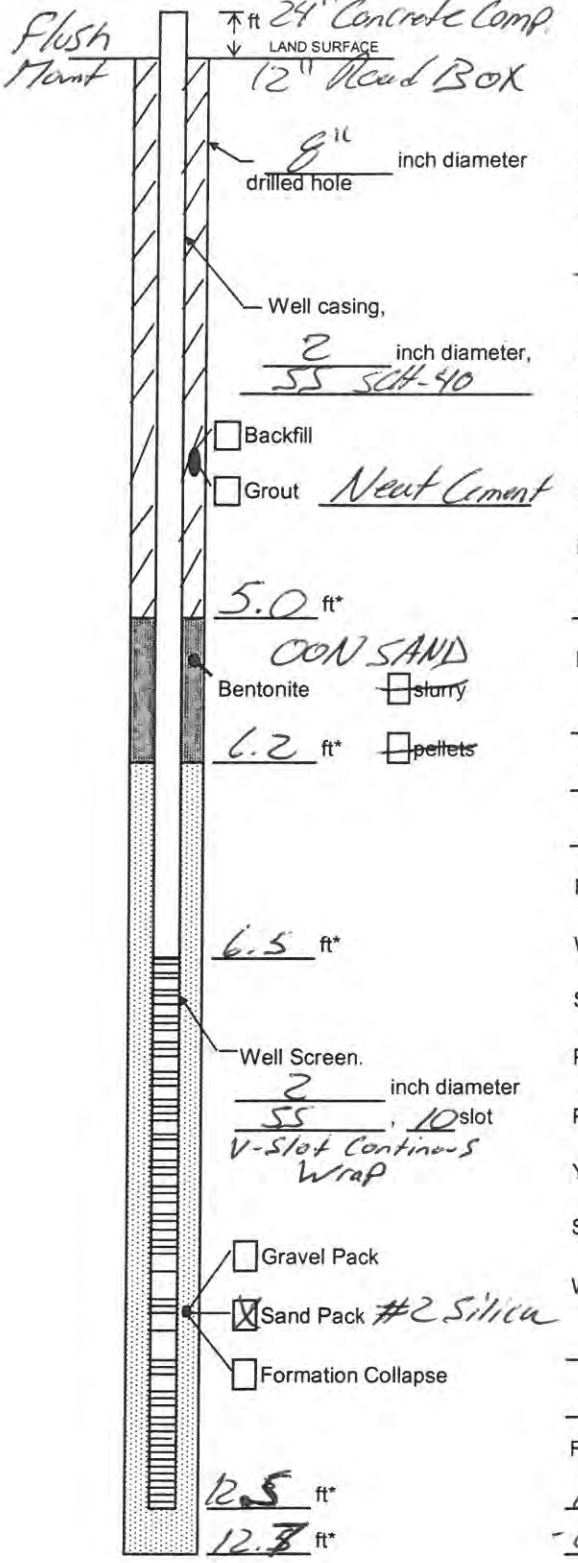
Remarks Screen Custom Cut to be below Water Table. Was decided On Next well to maximize Screen length up to 5' overburden based on historical WLs and analytical

Prepared by J. Bialer

ARCADIS Design & Consultancy for natural and built assets

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project DC Rollforms Well TW-13

Town/City Jamestown

County Chautauqua State NY

Permit No. _____

Land-Surface Elevation and Datum:

N/A feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6-19-18 / 6-20-18

Drilling Method 4 1/4 HSA

Drilling Contractor ARCADIS - Powerprobe 9620 VTR

Drilling Fluid None

Development Technique(s) and Date(s)

Air lift and Waterra Hydro lift II W/ Surge Block

Fluid Loss During Drilling _____ gallons

Water Removed During Development _____ gallons

Static Depth to Water _____ feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose Injection Well - ISCO

Remarks

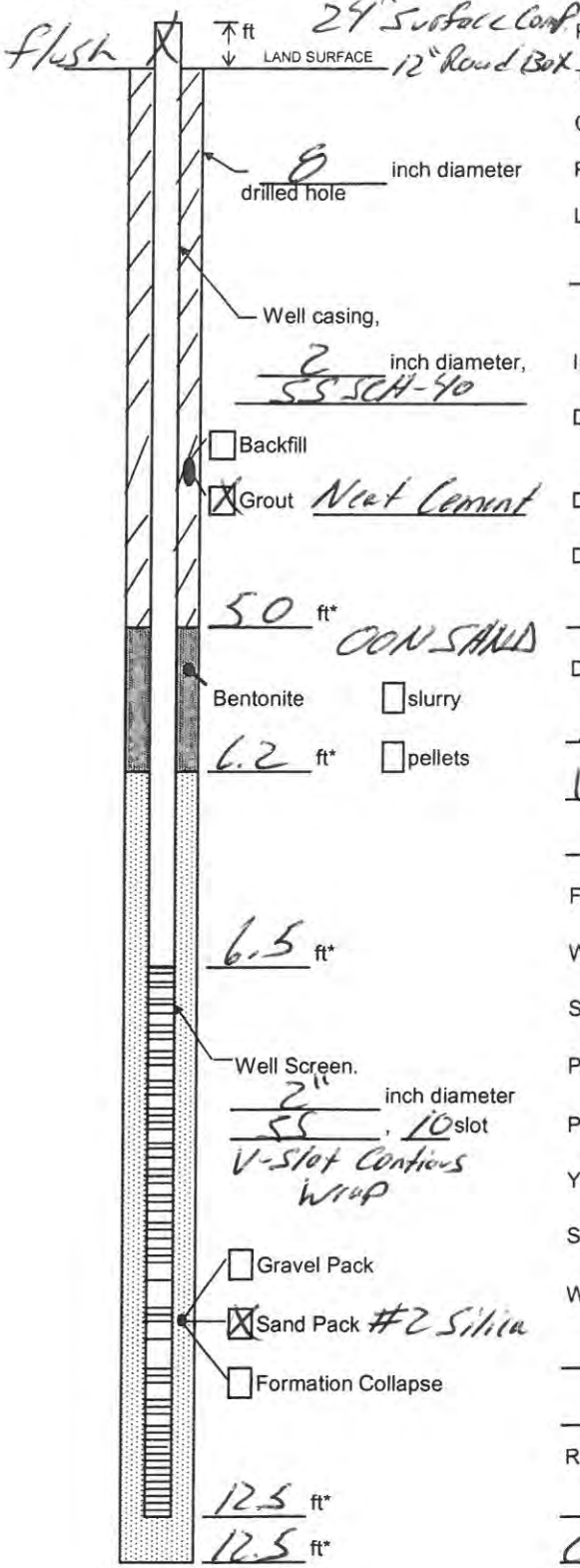
6' SS Custom Cut #10 slot screen - Cut to maximize contact and min. 5' overburden and grout seal

Prepared by T. Baker

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project DC Rollforms Well IW-14

Town/City Jamestown, NY

County Chautauqua State NY

Permit No. _____

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6-20-18

Drilling Method 4¼ HSA

Drilling Contractor ARCADIS - Powerprobe 9520 VTR

Drilling Fluid None

Development Technique(s) and Date(s)

Air lift and Waterra Hydro Lift II w/ Surge Block

Fluid Loss During Drilling _____ gallons

Water Removed During Development _____ gallons

Static Depth to Water _____ feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose

Injection Well - ISCO

Remarks

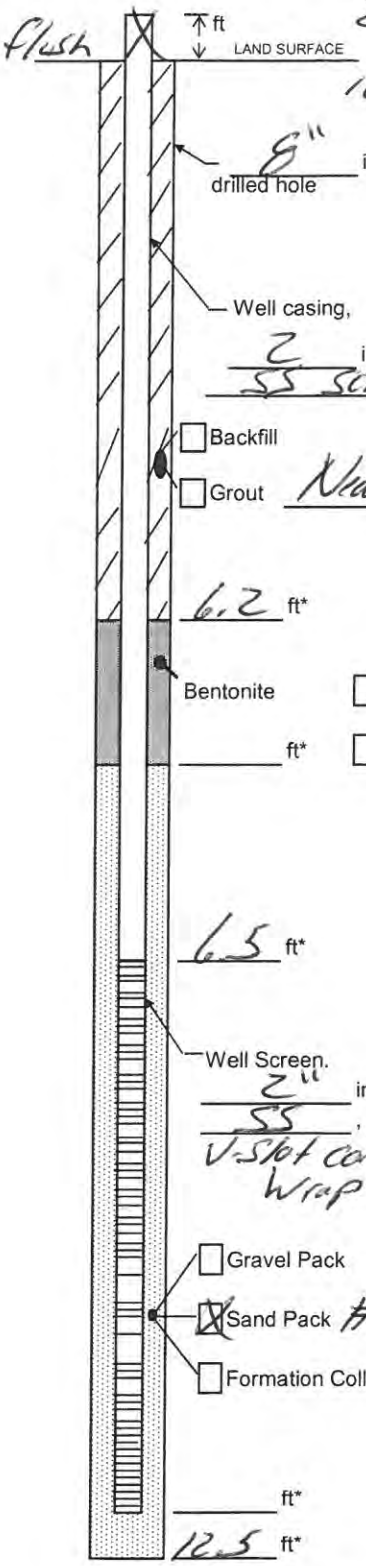
6' SS Custom Cut #10 Slot Screen Cut to maximize Contact while maintaining 5' Cement Qby + Overburden

Prepared by J. Braxton

ARCADIS Design & Consultancy for natural and built assets

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project DC Rollforms Well IW-15

Town/City Jamestown, NY

County Chautauqua State NY

Permit No. _____

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6-20-18

Drilling Method 4 1/4 HSA

Drilling Contractor ARCADIS- Power Probe 9520 VTR

Drilling Fluid None

Development Technique(s) and Date(s)

Air lift and Waterra Hydro lift II w/ Surge Block

Fluid Loss During Drilling _____ gallons

Water Removed During Development _____ gallons

Static Depth to Water _____ feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose

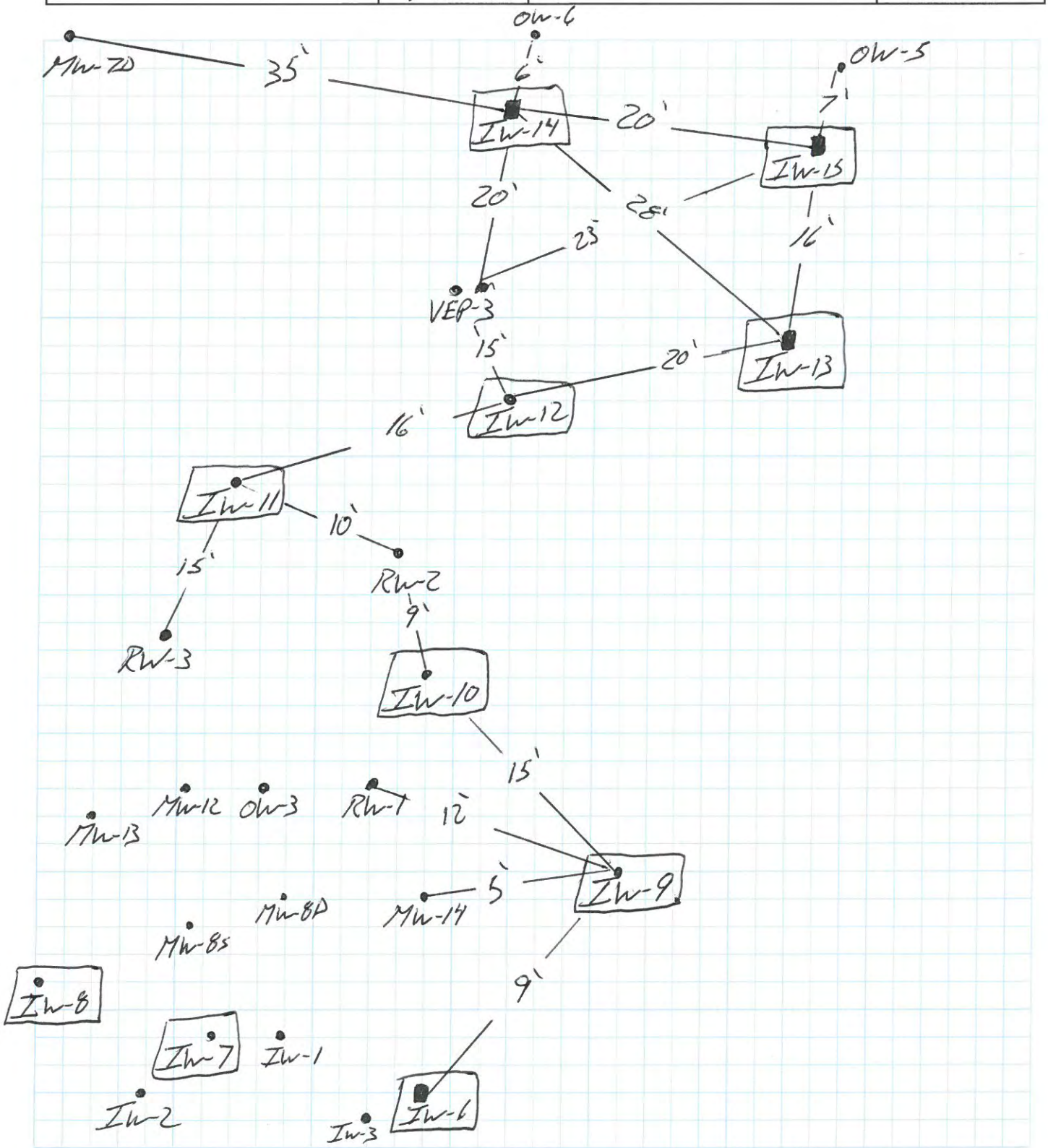
Injection Well TSCO

Remarks

Prepared by _____

ARCADIS Design & Consultancy for natural and built assets

Subject	DC Rollforms - ISCO wells		
Project No.		Sheet	
Calculations By	Date 7-3-18	Checked By	Date



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