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Ashland LLC

MULCH PERMEABLE REACTIVE BARRIER INSTALLATION WORK PLAN

Former Ashland LLC Facility
130 South Street
Rensselaer, New York

August 25, 2020

Cullen Flanders

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MULCH PERMEABLE REACTIVE BARRIER INSTALLATION WORK PLAN

Former Ashland LLC Facility
130 South Street
Rensselaer, New York

Prepared for:

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WARNING: These plans, specifications, and documents are each part of an integrated design system. Any modification, alteration, change, deletion, addition, or substitution of or to any specification(s) could result in property damage, injury, or even death, and requires a full review of the entire system by a professional engineer. Any unauthorized modification of this document may constitute unlicensed practice as a Professional Engineer and may constitute a felony (NY Education Law § 6512.1).

Certification Statement

I, Cullen M. Flanders, P.E. certify that I am currently a NYS registered professional engineer and that this *Mulch Permeable Reactive Barrier Installation Work Plan* was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the *Technical Guidance for Site Investigation and Remediation* (DER-10).

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ACRONYMS AND ABBREVIATIONS

AFCEE	Air Force Center for Engineering and the Environment
Arcadis	Arcadis U.S., Inc.
Ashland	Ashland LLC
bgs	below ground surface
CVOC	chlorinated volatile organic compound
CY	cubic yard
DPT	direct-push technology
ERD	enhanced reductive dechlorination
EVO	emulsified vegetable oil
HASP	Health and Safety Plan
IRZ	in-situ remediation zone
ITRC	Interstate Technology & Regulatory Council
NYSDEC	New York State Department of Environmental Conservation
PPE	personal protective equipment
PRB	permeable reactive barrier
PVC	polyvinyl chloride
ROI	radius of influence
site	former Ashland LLC facility located at 130 South Street in Rensselaer, New York
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
Work Plan	Mulch Permeable Reactive Barrier Installation Work Plan

1 INTRODUCTION

Corrective measures at the former Ashland LLC (Ashland) facility located at 130 South Street in Rensselaer, New York (site; Figure 1) currently includes enhanced reductive dechlorination (ERD) of chlorinated volatile organic compounds (CVOCs) in groundwater. The ERD system, which has operated since 2010, was expanded in 2018 by installing 17 additional injection wells targeting source mass and CVOC flux pathways generally deeper than historical ERD operations, which focused on shallow groundwater. This Mulch Permeable Reactive Barrier Installation Work Plan (Work Plan) presents a proposed scope of work to resume carbon substrate addition into shallow groundwater through the installation of a mulch permeable reactive barrier (PRB) at the downgradient site boundary. The mulch PRB is expected to provide long-term carbon delivery to the shallow subsurface to continue ERD of CVOCs. The scope proposed in this Work Plan also includes ERD injections into existing site infrastructure consistent with the 2018 ERD injection event completed under the ERD System Optimization Work Plan (Arcadis 2018), and a one-time ERD injection using direct-push technology (DPT) into targeted CVOC source zones to improve carbon substrate distribution and further facilitate source mass reduction. On behalf of Ashland, Arcadis U.S., Inc. (Arcadis) requests approval of this Work Plan from the New York State Department of Environmental Conservation (NYSDEC) prior to implementation.

2 BACKGROUND AND PREVIOUS INVESTIGATIONS

The Corrective Measures Implementation Work Plan (Arcadis 2010) for the site was approved by the United States Environmental Protection Agency (USEPA) in a letter dated March 16, 2010 (USEPA 2010). Groundwater remediation activities commenced in 2010 by implementing an ERD program along the downgradient portion of the site to address potential off-site migration of CVOCs in shallow groundwater, including six ERD injection events. Multiple supplemental investigations were completed in 2017 to update the project conceptual site model and provide data to optimize the ERD program. Based on this data, the ERD program was optimized in 2018 by expanding the existing ERD system infrastructure into deeper CVOC source zones and mass flux pathways than were previously targeted. Following the system expansion, an injection event was completed in 2018 to deliver carbon substrate and stimulate ERD in these newly targeted deeper zones. At that time, shallow injections were not deemed necessary in 2018 based on available data. These 2018 remedial activities are further detailed in the ERD System Optimization Work Plan (Arcadis 2018), ERD System Optimization Well Installation Summary (Arcadis 2019), and 2019 Corrective Measure Implementation Annual Progress Report (Arcadis 2020).

Based on performance monitoring data collected since the 2018 ERD system optimization, the following observations have been made:

- Deeper injection events targeting areas identified during site characterization events yielded successful treatment; however, a combination of continued deep injections and carbon substrate delivery to the shallow subsurface consistent with injections from 2010 to 2016 is necessary to meet project objectives.
- Recent data indicate that carbon substrate is nearing depletion in areas targeted during the 2018 injection event and that these areas would benefit from additional injections.

- Targeted source area treatment is effective; therefore, supplemental targeted treatment is necessary to continue ERD of on-site source CVOC mass that is leading to downgradient impacts.

Based on these observations, Arcadis developed a scope of work to facilitate carbon distribution into shallow groundwater at the site concurrent with additional deeper carbon injections.

3 OBJECTIVES

The objectives of the scope of work presented in this Work Plan are as follows:

- Replenish carbon substrate through emulsified vegetable oil (EVO) injections into in the same ERD injection infrastructure utilized in 2018 to continue promoting in-situ remediation zones (IRZs) to treat CVOC source mass and mass flux zones.
- Supplement the 2018 ERD system expansion with a one-time injection event into CVOC source zones using temporary DPT injection points to deliver EVO and similarly promote CVOC treatment by establishing IRZs in these areas.
- Install a mulch PRB in the shallow mass flux zone along the site boundary to provide long-term carbon delivery to the shallow subsurface to promote IRZs to treat CVOCs.

4 ENHANCED REDUCTIVE DECHLORINATION INJECTION METHODOLOGY

The injection points for the proposed EVO addition are showing on Figure 2. EVO will be delivered to target areas by injecting in the existing infrastructure and temporary DPT points. The methods for these injections are summarized in the following sections.

4.1 Existing Infrastructure Injections

The ERD system optimization injection wells shown on Figure 2 will be used to repeat the 2018 ERD injections, except at well IW-A10 which was damaged during installation or development and is currently inoperable. Well construction details (e.g., screened interval, diameter) for each well are presented in the ERD System Optimization Well Installation Summary (Arcadis 2019) and the Injection Work Plan (Arcadis 2017). Prior to injection, Arcadis field staff will complete brief falling head tests using potable water to confirm that injection wells have not fouled; if fouling is observed to the point that injection is not feasible, well redevelopment may be completed.

The injection will be completed using a mobile injection trailer and/or dedicated injection manifolds and tanks. Injection equipment will consist of the following:

- Injection solution mixing tank(s)
- Injection pump(s) as needed
- Solution delivery piping or hoses
- Wellhead assemblies

- Instruments necessary to monitor injection progress (e.g., flow totalizers, pressure gauges)

Injection solution will be prepared on site using potable water and EVO at approximately 2% by volume. It is estimated that approximately 3,300 and 4,900 gallons of injection solution will be injected per well with 10- and 15-foot screens, respectively, for a total of up to 68,900 gallons. The actual injection solution volume may be adjusted based on injection progress and monitoring during implementation.

4.2 Direct-Push Injections

Supplemental injections will be completed as shown on Figure 2 to target additional CVOC source mass between existing ERD injection well transects. Final DPT locations may be adjusted during utility location and clearance, which will provide a line of evidence for subsurface utilities in advance of drilling activities and to locate potential buried pipelines, utilities (i.e., water supply, sewer, and storm), tanks, and drums. Electromagnetic, ground-penetrating radar, and radio frequency detection geophysical techniques, at a minimum, will be used. Each proposed DPT injection location will also be hand cleared to a depth of 5 feet below ground surface (bgs) with a vacuum truck or hand augur prior to drilling.

DPT injections will be completed with typical tooling dependent on subcontractor availability (e.g., retractable slotted screen). At each location, injections will be completed in multiple 4-foot intervals. After the injections are completed, the injection points will be abandoned and properly sealed. The DPT injection locations will be flagged and labeled following abandonment and recorded using a Trimble® R1 GNSS receiver connected to a mobile device (or equivalent).

The target radius of influence (ROI) for DPT injections is 10 feet. Confirmation of the injection ROI will be completed with daily field observations at up to two existing monitoring wells near DPT injection points (MW-23 and MW-24). Field observations indicating injection solution arrival may include changing water quality parameters (i.e., turbidity increase) and visual observation of oil droplets. Based on visual observations, the injection approach may be adjusted to provide coverage over the same area by injecting a higher volume (i.e., achieving target ROI), or increasing injection point density (i.e., accounting for a smaller achievable ROI).

Injection solution will be prepared on site using potable water and EVO at approximately 2% by volume. Up to approximately 588 gallons of injection solution will be injected per 4-foot interval; however, the target volume for each interval is subject to change pending field observations and subcontractor equipment availability. Injections are planned from two to five intervals at 12 injection points for a total of up to approximately 20,600 gallons. The actual injection solution volume may be adjusted based on injection progress and monitoring during field implementation. Injection will occur simultaneously into groupings of up to six injection points at a time, resulting in multiple injection batches. The injections will be completed using subcontractor equipment (e.g., mobile injection trailer, dedicated injection manifolds and tanks).

4.3 Injection Monitoring

Field staff will periodically measure injection flow rates, wellhead pressures, and cumulative injection volumes during injection at all wells and injection points. Injection solution samples will be collected periodically from solution mixing tanks for total organic carbon analysis to verify injection solution reagent strength. Additionally, a calibrated multimeter will be used to measure the injection solution for dissolved oxygen, oxidation-reduction potential, specific conductivity, temperature, turbidity, and pH. During injection, monitoring wells near injection wells will be visually inspected for EVO presence.

4.4 Post-Injection Monitoring

Post-injection performance monitoring will be accomplished through continued routine groundwater monitoring events completed as part of the current remedy. Results will be presented in Annual Corrective Measure Implementation Reports for the site.

5 PRELIMINARY MULCH PERMEABLE REACTIVE BARRIER DESIGN

A mulch PRB will be installed along the site boundary as shown on Figure 3 by excavating soil and backfilling the resulting trench with wood mulch (i.e., composted cellulose) mixed with sand and/or gravel to induce microbial anaerobic reductive dechlorination. Mulch provides a long-term source of available carbon, while sand and gravel help maintain permeability, prevent compaction, and aid in emplacement of the mulch PRB (Air Force Center for Engineering and the Environment [AFCEE] 2008). The mulch PRB is intended to replace and expand upon shallow injection wells at the site boundary, which have shown to be inefficient at carbon substrate delivery due to low-permeability geology in the shallow subsurface. During the installation of the mulch PRB, many of the existing shallow injection wells may be removed or destroyed. The mulch PRB will include injection conveyance risers to deliver carbon substrate as needed to supplement and enhance the microbial anaerobic dechlorination groundwater treatment process.

Design considerations include substrate, optimal location and depth, groundwater residence time, and injection infrastructure configuration. Recommendations for these design considerations are summarized in this section.

5.1 Substrate

Mulch PRBs typically comprise a mulch, sand, and/or gravel mix. The matrix for the proposed mulch PRB will consist of approximately 60% wood mulch and 40% sand and gravel. Wood mulch was selected as the reactive media because it generates anaerobic reducing geochemical conditions while providing a long-term electron donor and carbon supply, consistent with the current ERD remedy. This mulch matrix composition was chosen to provide a high mulch percentage while retaining enough variety in grain size to minimize preferential flow path development. The prepared mulch matrix may also be sprayed with EVO to promote additional sustained release of dissolved organic carbon to facilitate microbial activity and IRZ establishment.

5.2 Location

The proposed mulch PRB is approximately 480 feet long and will be located parallel to the adjacent railroad track along the western site boundary as shown on Figure 3. The target location and orientation of the mulch PRB was selected to intersect groundwater flow from upgradient source areas and intercept any CVOCs travelling in shallow mass flux pathways. The location is intended to mimic the location of historical shallow injection well transects, while also expanding treatment areas laterally to encompass additional potential mass flux along the site boundary. The location of mulch PRB is subject to change based on site constraints.

5.3 Depth

The mulch PRB will extend to approximately 8 feet bgs in the southern section of the site and 10 feet bgs in the northern section. The target design depth is based on the 2017 site characterization results and accounts for CVOC concentrations and site lithology. The mulch matrix will extend upward from the bottom of the trench to approximately 2 feet bgs. The mulch will be covered with geotextile fabric prior to backfilling the remaining feet of trench with clean fill or gravel. Clean fill or gravel will also be used to create an approximate 6-inch mound above ground surface to compensate for subsidence as PRB materials settle. The depth of the mulch PRB is subject to change based on site constraints.

5.4 Width

The target design width of the mulch PRB is primarily determined by the following:

- *Groundwater residence time*. This is determined using CVOC concentrations entering the upgradient side of the PRB and groundwater seepage velocity through the PRB.
- *Site constraints*. The proposed location is along the site boundary, where access restrictions limit the mulch PRB width to a maximum of approximately 4 feet.

The CVOC concentration entering the mulch PRB was conservatively assumed to be 1,800 micrograms per liter (µg/L) of cis-1,2-dichloroethene, consistent with the highest observed CVOC concentration at a monitoring well near the proposed mulch PRB location (MW-19 in May 2014). Based on this and other conservative assumptions of hydraulic properties for site lithology and the mulch PRB matrix (e.g., hydraulic gradient, effective porosity), the maximum allowable 4-foot width is expected to result in sufficient residence time to significantly reduce CVOC concentrations within the mulch PRB. Additionally, soluble carbon substrate is expected to migrate from the PRB, allowing for an established downgradient treatment zone that would further reduce CVOC concentrations through reductive dechlorination as groundwater continues downgradient (Interstate Technology & Regulatory Council [ITRC] 2011). As a result, the site-constrained target width of 4 feet is expected to meet project objectives. The width of the mulch PRB is subject to change based on site constraints.

5.5 Injection Infrastructure

The mulch PRB will include 4-inch-diameter polyvinyl chloride (PVC) pipe with 10-slot sized screened intervals installed vertically every 20 feet along the mulch PRB to facilitate future carbon substrate replenishment. The risers will be screened from 2 feet bgs to approximately 0.5 feet above the bottom of the PRB at roughly 7.5 and 9.5 feet bgs in the southern and northern sections, respectively. The pipe will not initially be used for carbon delivery but will be accessible for future use if needed, as described in Section 6.8.2.

5.6 Erosion Control

A Storm Water Pollution Prevention Plan (SWPPP) was deemed not necessary for mulch PRB construction activities because the total disturbed area is less than 1 acre. The disturbed area impacted by mulch PRB construction is calculated to be 0.4 acres, within the total site area of 3.9 acres. However, best management practices addressing erosion and sediment control will be implemented as needed to address stormwater runoff from mulch PRB installation activities.

6 FIELD ACTIVITIES

The following sections detail field activities planned to complete the ERD injections and mulch PRB installation described in Sections 4 and 5.

6.1 Health and Safety

Prior to performing field activities, Arcadis will revise the site-specific Health and Safety Plan (HASP) as needed to outline any additional anticipated hazards. A Community Air Monitoring Plan is not necessary because no significant odors are anticipated during the field events; however, air monitoring will be conducted in accordance with the HASP (available upon request), which facilitates community protection. Excavation areas will be monitored for head space and stop-work authority will be exercised if needed to allow for potential vapors to dissipate, upgrade PPE, and/or use a foam odor suppressant. Additionally, excavated soil stockpiles will be covered prior to off-site disposal.

6.2 Site Clearing and Grading

Trees, brush, vegetation, and historical building materials near the proposed mulch PRB and stockpile areas will be cleared as needed. Cleared vegetation will be removed from the site or processed into mulch using a grinder or chipper. If mulch is generated from the cleared material, it may be used as needed in the PRB mulch matrix or for site restoration activities described in Section 6.5.3.

6.3 Utility Location and Clearance

A minimum of three lines of evidence will be established to support utility location and clearance for subsurface utilities in advance of drilling and construction activities and to locate potential buried pipelines, utilities (i.e., water supply, sewer, and storm), tanks, and drums. Electromagnetic, ground-penetrating radar, and radio frequency detection geophysical techniques, at a minimum, will be used.

6.4 Staging and Mulch Matrix Preparation

The total volume of mulch matrix components delivered to the site will be approximately 500 cubic yards (CY). In addition to the mulch matrix backfill, approximately 180 CY of clean fill or gravel will be stockpiled for use in capping. The mulch matrix components (mulch, sand, and/or gravel) will be either mixed at the supplier’s facility or on site to meet the design specification described in Section 5.1. The staging methods that will be used for either on-site or supplier mixing are described below.

After the stockpiles have been mixed, staged, and passed any applicable testing criteria, the mulch matrix will remain undisturbed until placement into the trench box. However, the mulch matrix will be kept moist to maintain microbial activity and reduce its buoyancy and the likelihood of matrix separation during emplacement. In the event of a substantial rain event, the mulch stockpiles will be covered with polyethylene sheeting to keep the mulch matrix moist (not wet) and to maintain its buoyancy.

6.4.1 Mixing at Supplier Facility

If the mulch matrix is mixed at the supplier's facility, it will be stockpiled in designated locations following delivery. The mulch matrix will be visually inspected after it is delivered and as it is loaded into the trench.

6.4.2 On-Site Mixing

If the mulch matrix is mixed on site, individual components will be initially stored in adjacent designated storage areas. If the mulch appears to be drying out before mixing, it may be moistened with water. To prepare the mulch matrix, the components will be mixed between the adjacent piles using a pay loader and an excavator using known measurements of the heavy equipment's bucket to determine mixing percentages of the mulch matrix components.

Prior to mixing, field staff will create a mixture in a bucket representing the correct volumetric ratios of components for comparison of mulch matrix during emplacement. The simulated mixture will be settled in the bucket to determine its volume and weighed to determine bulk density, which is the target density for field-mixed mulch matrix. Two other simulated mixtures will be created: one with 10% less mulch and one with 10% more mulch. The density of these simulated mixtures will be similarly determined to bound the acceptable density variation among representative field-mixed samples. During emplacement, the bulk density will be assessed in the field using the protocol above at least once every 25 to 50 CY of material, or whenever the properties of the bulk mixture change upon visual inspection. This quality control will result in at least 10 assessments of mulch matrix. If field-mixed samples do not meet these density criteria, the mulch matrix will be supplemented with additional materials or further homogenized as necessary. The mulch matrix will also be visually inspected after mixing and as it is loaded into the trench.

6.5 Mulch Permeable Reactive Barrier Installation

6.5.1 Spoils Management and Waste Characterization Sampling

Soil samples will be collected at various locations along the proposed trench location before remedial trenching work for waste characterization purposes. Soil samples will be collected using a DPT rig throughout the entire target depth of the trench at each location and will be mixed and composited. It is estimated that three composite samples will be collected for waste characterization purposes based on the predicted 640 CY of spoils generated during trenching activities. Typical waste characterization analyses will include Toxicity Characteristic Leaching Procedure metals, volatile organic compounds (VOCs), semi-volatile organic compounds, total VOCs, pesticides/herbicides, total polychlorinated biphenyls, reactive sulfide/cyanide, and physical parameters as required by the disposal facility. Seven supplemental composite samples will also be collected and analyzed for total VOCs along the proposed trench location to assist with waste characterization. Analysis will be performed on a standard turnaround-time and a waste profile will be established at the disposal facility.

6.5.2 Trenching, Injection Infrastructure Installation, and Matrix Emplacement

Wooden stakes with high-visibility flagging tapes will be used to mark the mulch PRB alignment shown on Figure 3. Stakes will be placed at the corners of the wall ends and every 50 feet along the centerline of the length of the trench.

Trenching and mulch matrix placement will be performed by excavators, and a front-end loader will shuttle mixed mulch matrix from the nearest stockpile to the trench. Spoils will be loaded directly into tri-axle dump trucks for direct loadout and off-site disposal, placed in the front-end loader bucket, or temporarily staged adjacent to the east side of the trench for relocation to the designated stockpile areas. Spoils management methods will be confirmed with equipment operators prior to implementation and included in the HASP update. The slotted PVC pipe discussed in Section 5.5 will be installed after excavation and prior to mulch matrix placement. The bottom ends of the PVC pipe will be capped, and the top will extend to a stickup. Following emplacement of the PVC pipe, mulch matrix will be installed to 2 feet bgs and covered with a geotextile material. Access to trench that is temporarily left open during construction will be controlled by construction fences as needed.

Excavation equipment will be used to fill the top 2 feet with clean fill or gravel in 6-inch lifts. Following placement of each lift, a non-vibratory roller (e.g., sheep’s foot roller) will be used to compact the capping material to minimize future infiltration. No compaction testing will be performed. Capping with clean fill or gravel will bring the trench up to grade and form a mound that extends approximately 6 inches above grade. This is estimated to require a volume of 180 CY of material.

6.5.3 Site Restoration

The mulch PRB will be mounded slightly to allow for settlement and to allow for surface water drainage. Mulch that was processed during the site clearing activities described in Section 6.2 may be applied up to 3 inches thick to disturbed areas to assist with site stabilization and restoration.

6.6 Survey

A professional surveyor will survey the final location of the completed mulch PRB alignment. Prior to capping, the stakes marking the alignment will be moved, if necessary, to reflect the installed extent of the trench. These stakes will remain in place during backfilling and site restoration activities and will be used to survey the newly installed mulch PRB alignment horizontally and vertically at the ends, and every 50 feet along the centerline. Horizontal and vertical survey data will also be collected for the installed PVC risers.

6.7 Performance Monitoring

Post-construction performance monitoring will be accomplished through continued routine groundwater monitoring events completed as part of the current remedy. Results will be presented in Annual Corrective Measure Implementation Reports for the site.

6.8 Mulch Permeable Reactive Barrier Operations, Maintenance, and Monitoring

The mulch PRB monitoring and maintenance described in this section will be documented in Corrective Measure Implementation Annual Progress Reports.

6.8.1 Visual Inspections

Field staff will visually inspect the mulch PRB alignment to identify signs of subsidence annually for five years, at which point the need for continued monitoring will be evaluated. If minor subsidence is noted, additional fill may be added to the level of the ground surface. If major subsidence is noted, a contingency measure will be initiated to fill voids within the mulch PRB that may have developed from subsidence. This measure may include removing the overburden above the mulch PRB, supplementing the mulch matrix with additional matrix, and replacing the overburden.

6.8.2 Substrate Replenishment

Substrate may be injected into the mulch PRB to replenish soluble carbon substrate. The need for these injections will be identified through routine performance monitoring and will be documented in Corrective Measure Implementation Annual Progress Reports. An appropriate carbon substrate for remedial injections will be selected based on field conditions at the time of the injections but is anticipated to be a slow-release carbon substrate (e.g., EVO).

7 WASTE

Waste that will be generated from drilling, sampling, and mulch PRB installation activities and are discussed in this section.

7.1 Investigation-Derived Waste

Investigation-derived waste generated during field activities may include soil cuttings, decontamination fluids, purge water, personal protective equipment (PPE), and other disposable sampling materials. Soil cuttings derived from drilling, wastewater from decontamination procedures, and purge water from the collection of groundwater samples will be placed in properly labelled 55-gallon drums. PPE (e.g., nitrile gloves, disposable supplies, paper, plastic) will be treated as municipal waste. Containerized waste will be disposed of in accordance with waste hauler, waste handling facility, and state and federal requirements.

7.2 Mulch PRB Waste

Spoils generated during mulch PRB excavation activities will be characterized as discussed in Section 6.5.1 and disposed of in accordance with waste hauler, waste handling facility, and state and federal requirements at an Ashland approved facility.

8 SCHEDULE

Field activities are tentatively scheduled to start in mid- to late September 2020; however, the actual schedule is dependent on the weather and regulatory approval. Injections are expected to occur for approximately 9 weeks. Mulch PRB construction, including set up and break down, is expected to require approximately 6 weeks to complete, likely after the injections.

9 REPORTING

Arcadis will document injections and mulch PRB installation in a technical memorandum to be submitted as an appendix to the Annual Corrective Measure Implementation Report. Documentation will include:

- Figure with surveyed mulch PRB location
- Figure with DPT injection locations
- Table with volumes of injected solution
- Discussion of installation activities
- Discussion of any departures from approved work plan, as applicable

Subsequent monitoring data and analysis will be included in the Corrective Measure Implementation Annual Progress Report. At a minimum, the documentation will include the reporting of field sampling activities and summary of analytical results.

Once the proposed event is complete and adequate analytical data have been collected to determine the next steps for the site, Arcadis proposes a follow-up teleconference between all project stakeholders to discuss the outcome of this field event and path forward for the site.

10 REFERENCES

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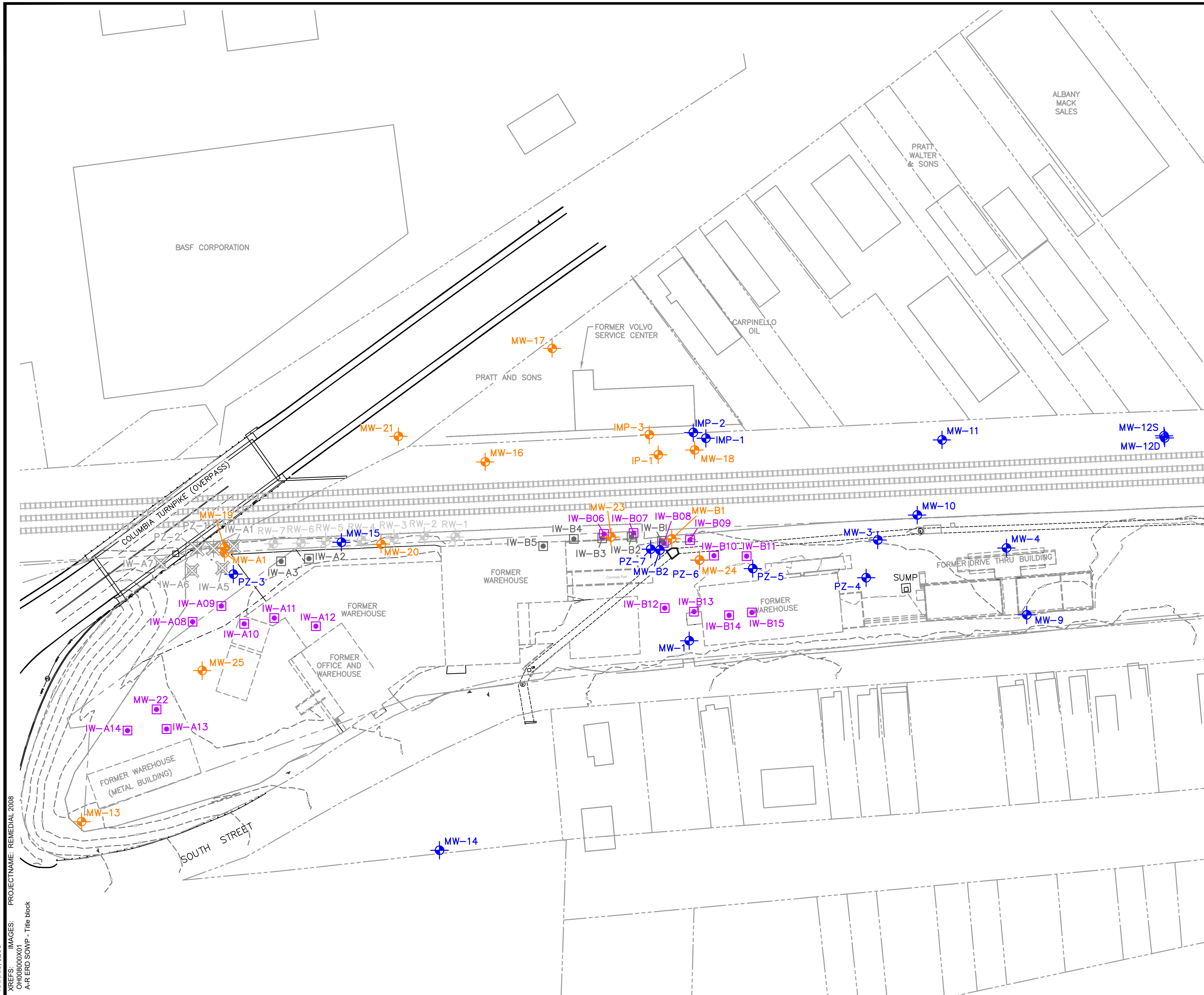
FIGURES



LEGEND:

IMP-1/MW-1/PZ-1	GROUNDWATER GAUGING WELL
IP-1/IMP-3/MW-16	PERFORMANCE MONITORING GROUNDWATER SAMPLING LOCATIONS
IW-A2	SHALLOW INJECTION WELL LOCATION (2010)
IW-A14	ERD SYSTEM OPTIMIZATION INJECTION WELL (2018)
	SURFACE CONTOUR
	RAILROAD TRACK
	CULVERTED STREAM PIPE
	PROPERTY LINE
	FORMER BUILDINGS AND STRUCTURES
	RECOVERY WELLS ABANDONED IN 2016
	INJECTION WELLS/PIEZOMETERS ABANDONED IN 2018

NOTES:

1. LOCATIONS AND TOPOGRAPHY EAST OF CSX RAILROAD PROPERTY AND WEST OF AND INCLUDING SOUTH STREET, SURVEYED BY THEW ASSOCIATES PE-LS, PLLC (OCTOBER 2008). TWO NEW MONITORING WELLS, MW-20 & MW-21, AND TEN NEW INJECTION WELLS, IW-A2 THROUGH IW-A7 & IW-B2 THROUGH IW-B5, WERE SURVEYED ON JULY 2, 2010 BY THEW ASSOCIATES. ONE NEW MONITORING WELL (MW-25) AND 17 NEW INJECTION WELLS (IW-A08 THROUGH IW-A14; IW-B06 THROUGH IW-B15) WERE SURVEYED ON DECEMBER 5, 2018 BY THEW ASSOCIATES, ALONG WITH THREE DUAL-PURPOSE MONITORING AND INJECTION WELLS INSTALLED IN 2017 (MW-22 THROUGH MW-24).
2. REFERENCED HORIZONTALLY TO THE NORTH AMERICAN DATUM OF 1983 (NAD83) AND PROJECTED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM (EAST ZONE). VERTICAL REFERENCE TO NGVD 1929.
3. ASHLAND PROPERTY BOUNDARY ESTABLISHED BY THEW ASSOCIATES SURVEY AND DEED RESEARCH (OCTOBER 2008). OTHER PROPERTY LINES AND MAP FEATURES ARE FROM RENSSELAER COUNTY TAX MAPPING AND NEW YORK STATE CLEARING-HOUSE AERIAL PHOTOGRAPHY.
4. INJECTION WELL MW-22 WAS INSTALLED DURING THE 2017 LIMITED-SCALE INJECTION EVENT.

0 100' 200'

GRAPHIC SCALE

ASHLAND INC.
RENSSELAER, NEW YORK
MULCH PRB INSTALLATION WORK PLAN

SITE PLAN

ARCADIS Design & Consultancy for natural and built assets

FIGURE 1

DIV/GROUP: ENVCAD
C:\Users\jlharris\BIM 360\Arcadis\ANA - Ashland LLC\Project Files\Ashland-Rensselaer\2020\30054738\01-DWG\A-R ERD SOWP - Fig 1 - Site Plan.dwg LAYOUT: 1 SAVED: 2/11/2020 4:46 AM ACADVER: 23.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 6/29/2020 3:09 PM BY: HARRIS, JESS
XREFS: OH08000X01 A-R ERD SOWP - Title block IMAGES: PROJECTNAME: REMEDIAL 2008

LEGEND:

- IMP-1/MW-1/PZ-1 — GROUNDWATER GAUGING WELL
- IP-1/IMP-3/MW-16 — PERFORMANCE MONITORING GROUNDWATER SAMPLING LOCATIONS
- IW-B1 — SHALLOW INJECTION WELL LOCATION (2010)
- SURFACE CONTOUR
- RAILROAD TRACK
- CULVERTED STREAM PIPE
- PROPERTY LINE
- FORMER BUILDINGS AND STRUCTURES
- IW-A14 — ERD SYSTEM OPTIMIZATION INJECTION WELL (2018)
- MW-21 — REMEDIAL OPTIMIZATION MONITORING WELL
- IW-A5 — INJECTION WELLS/PIEZOMETERS ABANDONED IN 2018
- PROPOSED DPT INJECTION POINTS

NOTES:

1. LOCATIONS AND TOPOGRAPHY EAST OF CSX RAILROAD PROPERTY AND WEST OF AND INCLUDING SOUTH STREET, SURVEYED BY THEW ASSOCIATES PE-LS, PLLC (OCTOBER 2008). TWO NEW MONITORING WELLS, MW-20 & MW-21, AND TEN NEW INJECTION WELLS, IW-A2 THRU IW-A7 & IW-B2 THRU IW-B5, WERE SURVEYED ON JULY 2, 2010 BY THEW ASSOCIATES. ONE NEW MONITORING WELL (MW-25) AND 17 NEW INJECTION WELLS (IW-A08 THROUGH IW-A14; IW-B06 THROUGH IW-B15) WERE SURVEYED ON DECEMBER 5, 2018 BY THEW ASSOCIATES, ALONG WITH THREE DUAL-PURPOSE MONITORING AND INJECTION WELLS INSTALLED IN 2017 (MW-22 THROUGH MW-24).
2. REFERENCED HORIZONTALLY TO THE NORTH AMERICAN DATUM OF 1983 (NAD83) AND PROJECTED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM (EAST ZONE). VERTICAL REFERENCE TO NGVD 1929.
3. ASHLAND PROPERTY BOUNDARY ESTABLISHED BY THEW ASSOCIATES SURVEY AND DEED RESEARCH (OCTOBER 2008). OTHER PROPERTY LINES AND MAP FEATURES ARE FROM RENSSELAER COUNTY TAX MAPPING AND NEW YORK STATE CLEARING-HOUSE AERIAL PHOTOGRAPHY.
4. INJECTION WELL MW-22 WAS INSTALLED DURING THE 2017 LIMITED-SCALE INJECTION EVENT.

0 100' 200'

GRAPHIC SCALE

ASHLAND INC.
RENSSELAER, NEW YORK
MULCH PRB INSTALLATION WORK PLAN

PROPOSED INJECTION LOCATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE 2

DIV/GROUP: ENVCAD
C:\Users\jlharris\BIM 360\Arcadis\ANA - Ashland LLC\Project Files\Ashland-Rensselear\2020\30054738\01-DWG\A-R ERD SOWP - Fig 3 - Proposed PRB Layout.dwg LAYOUT: 3 SAVED: 6/29/2020 3:27 PM ACADVER: 23.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 6/29/2020 4:05 PM
BY: HARRIS, JESS
XREFS: IMAGES: PROJECTNAME: REMEDIAL 2008
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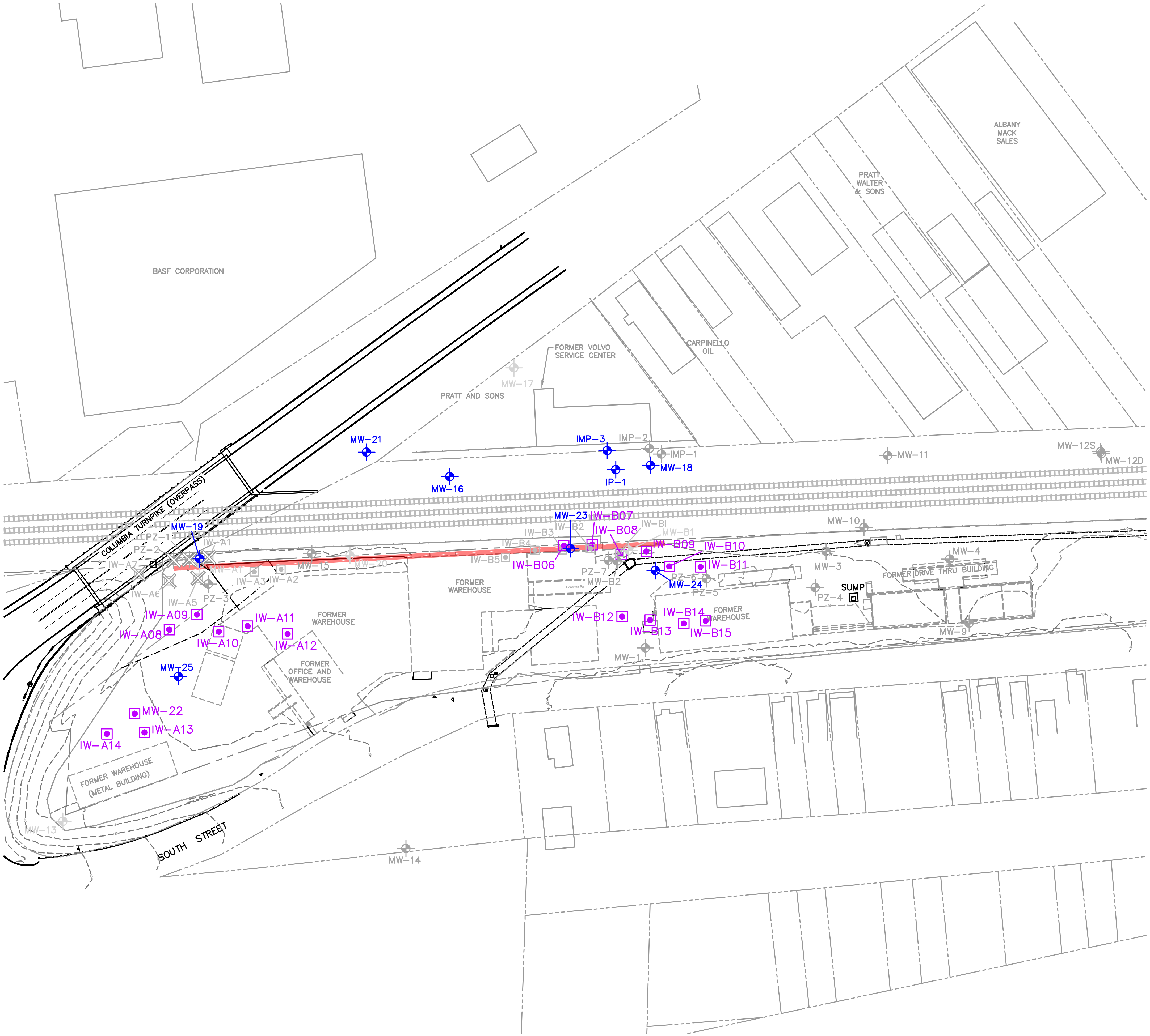
A-R ERD SOWP - Title block



LEGEND:

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	RAILROAD TRACK
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	FORMER BUILDINGS AND STRUCTURES
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MW-21	REMEDIAL OPTIMIZATION MONITORING WELL
IW-A5	INJECTION WELLS/PIEZOMETERS ABANDONED IN 2018
	PROPOSED PRB LOCATION

NOTES:

1. LOCATIONS AND TOPOGRAPHY EAST OF CSX RAILROAD PROPERTY AND WEST OF AND INCLUDING SOUTH STREET, SURVEYED BY THEW ASSOCIATES PE-LS, PLLC (OCTOBER 2008). TWO NEW MONITORING WELLS, MW-20 & MW-21, AND TEN NEW INJECTION WELLS, IW-A2 THRU IW-A7 & IW-B2 THRU IW-B5, WERE SURVEYED ON JULY 2, 2010 BY THEW ASSOCIATES. ONE NEW MONITORING WELL (MW-25) AND 17 NEW INJECTION WELLS (IW-A08 THROUGH IW-A14; IW-B06 THROUGH IW-B15) WERE SURVEYED ON DECEMBER 5, 2018 BY THEW ASSOCIATES, ALONG WITH THREE DUAL-PURPOSE MONITORING AND INJECTION WELLS INSTALLED IN 2017 (MW-22 THROUGH MW-24).
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0 100' 200'

GRAPHIC SCALE

ASHLAND INC.
RENSSELAER, NEW YORK
MULCH PRB INSTALLATION WORK PLAN

PROPOSED MULCH PRB LAYOUT

ARCADIS Design & Consultancy for natural and built assets

FIGURE
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