NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Remediation, Region 7
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September 26, 2019

Robert Bleazard
TRW Automotive U.S., LLC
12025 Tech Center Drive
Livonia, MI 48150

Re: Former TRW Union Springs Facility, Site ID No. C706019
Village of Union Springs, Town of Springport, Cayuga County
Bioremediation Pilot Test Work Plan

Dear Mr. Bleazard:

The New York State Department of Environmental Conservation (Department) has reviewed the letter dated September 20, 2019 in response to the Department's letter dated August 21, 2019 regarding the Bioremediation Pilot Test Work Plan (work plan) dated July 25, 2019 for the Former TRW Union Springs Facility (site). The letter dated September 20, 2019 and the work plan were prepared by ERM Consulting & Engineering, Inc. (ERM) on behalf of TRW Automotive U.S., LLC (the Volunteer). With the following modifications, the work plan is approved.

- ERM's letter dated September 20, 2019 is included as part of the work plan.

- Section 3.8 – The Department considers the trichloroethene contamination to be present due to a listed waste. Contact Henry Wilkie at henry.wilkie@dec.ny.gov to obtain a contained-in determination and to establish sampling and handling requirements.

Pursuant to 6 NYCRR 375-1.6(d)(3), the Volunteer must respond in writing within 15 days as to whether the modifications will be accepted. If accepted, the Volunteer's acceptance letter, this letter, and ERM's letter dated September 20, 2019 must be attached to the front of all copies of the work plan.

Approval of the pilot test work plan does not necessarily imply that the Department feels this technology is the most appropriate remedial technology for this area/site. A determination of the appropriate remedial technology for the area/site must be based on a full engineering analysis documented in an Alternatives Analysis.

Please send the approved work plan, along with the modification letters, to the document repository, and instruct the repository to replace any drafts with the approved plan.

If you have any questions, please do not hesitate to contact me at 315-426-7411 or joshua.cook@dec.ny.gov.

Sincerely,

Joshua P. Cook, P.E.
Professional Engineer 1

ec: Harry Warner (NYSDEC)
Joshua Cook (NYSDEC)
Henry Wilkie (NYSDEC)
Maureen Schuck (NYSDOH)
Jacquelyn Nealon (NYSDOH)
Robert Bleazard (TRW)
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20 September 2019

Mr. Josh Cook, P.E.
Environmental Engineer 2
New York State Department of Environmental Conservation
Region 7 - Division of Environmental Remediation
615 Erie Blvd West
Syracuse, New York 13204-2400

RE: Former TRW Union Springs Facility
Site ID No. C706019
Village of Union Springs, Town of Springport, New York
Bioremediation Pilot Test Work Plan
Response to Comments

Dear Mr. Cook:

TRW Automotive U.S. LLC (TRW; the Volunteer) received correspondence from the New York State Department of Environmental Conservation (NYSDEC) and New York State Department of Health (NYSDOH) dated 21 August 2019, providing comments and requesting modifications to the Bioremediation Pilot Test Work Plan. On behalf of the Volunteer, ERM Consulting & Engineering, Inc. (ERM) prepared the following responses to the state's comments, which are presented below.

For clarity of review, NYSDEC's and NYSDOH's comments are repeated below in italic font followed by ERM's response in plain font.

1. *Section 1.2.2 – It is noted that certain borings in the vicinity exhibited elevated readings deeper than 18 feet below grade; however, it does appear that the bulk of the contamination in the vicinity of the pilot test is probably shallower than 18 feet below grade. See MIP-02, MIP-12 and MIP-15.*

This comment references data generated using a membrane interface probe (MIP), which is a screening tool that was used to define the three-dimensional distribution of volatile organic compounds (VOCs) in soil and groundwater at the site. The MIP is an effective screening tool, but is known to experience carryover issues (i.e., false positive readings) after advancing through zones containing elevated VOC concentrations. Because of this known issue, ERM reviewed the MIP data and designed a soil boring program to collect correlation soil samples to validate the MIP screening data. Two soil borings, C-09 and C-13, were advanced within the area in question. The highest photoionization detector (PID) field-screening readings (27 to 181 parts per million (ppm)) were measured at depths of 10 to 16 feet below ground surface (ft bgs), which consists of sandy silt and clayey silt. PID readings were less than 3 ppm in both of these correlation borings at depths greater than 16 ft bgs. Laboratory analytical results for soil samples collected from these borings indicated that elevated VOC concentrations were detected at 15.5 ft bgs in boring C-09 (the deepest soil sample collected), but that only 15 micrograms per kilogram (µg/kg) of total VOCs were detected at 18 ft bgs in boring C-13. These data indicate that the elevated MIP

readings from 16 to 18 ft bgs in the referenced borings likely represented carryover issues and not actual contamination.

A variety of site characterization tools were used and the collective dataset was interpreted and used to define the target treatment depth for the bioremediation pilot test.

2. *Section 1.2.3 – Review how HGU-1 was defined. Many of the borings in the vicinity seem to indicate the sandier zone extends deeper than 18 feet in the vicinity of the pilot test. See boring C-09, MIP-03, MIP-12, MIP-15 and others.*

As discussed in the response to comment 1, a variety of characterization tools and data were used at the site. Of these, the Waterloo^{APS} generates a continuous log of permeability, which was used in conjunction with detailed soil boring logs to define geologic stratigraphy. The MIP generates a continuous log of electrical conductivity that can be used to evaluate geologic conditions; however, because it measures electrical and not hydraulic properties, it is not as reliable as the Waterloo^{APS} for defining hydrostratigraphy. Hydrogeologic units (HGUs) were defined at the site using a combination of stratigraphic data generated using the Waterloo^{APS} and soil borings, and groundwater elevation data measured in monitoring wells. ERM is confident in our definition of HGU boundaries at the site.

3. *Section 3.2 – Specify the criterion/criteria that will be considered to determine if injection of a supplemental carbon source/electron donor is necessary.*

Total organic carbon concentration data in groundwater collected from nearby monitoring wells will be used to determine when additional substrate must be added to the PRB.

4. *Section 3.3, 2nd Paragraph, 3rd Sentence – Once the sewer line is exposed would it be possible/helpful to construct a collar using concrete or grout or other material around the sewer line, or partially around the sewer line, adjacent to the permeable reactive barrier (PRB), through the zone of permeable backfill present/likely present around the sewer line, so as to cutoff/limit the preferential flow path through that fill material?*

ERM will be installing the permeable reactive barrier (PRB) with two off-set rows of large diameter bioremediation borings. These borings will be installed with a caisson drilling rig. Based on the subcontractor experience with drilling in close proximity to aging sanitary sewer pipes and due to ERM's subsurface clearance policies, we will not be exposing the sanitary sewer pipe to install the PRB due to the potential liability that would occur if the pipe was damaged during the process. The PRB will be installed 10 feet away from the sanitary sewer pipe to minimize the potential of damaging this utility.

5. *Section 3.4 – How was the length of 40 feet determined? Is that long enough to avoid any reduction in performance that may be experienced at the ends of the wall due to influence from groundwater that is not passing through the wall?*

The length of the PRB for this pilot test focuses on the area were the highest concentrations of VOCs and mass discharge were observed in the South Field AOC. The placement and length of the PRB were selected to be between correlation soil boring C-09 and monitoring well MW-1. Soil directly south of MW-1 exhibits low permeability based on the attempts to collects groundwater

samples using the Waterloo^{APS}. In addition groundwater flow south of the PRB is generally toward the southwest (based on static groundwater contouring and fluorescent dye studies) and away from the proposed monitoring area hydraulically downgradient of the proposed PRB.

6. *Section 3.4 – Refer to items 1 and 2 of this letter regarding the depth of contamination and HGU-1 and review the proposed depth of the biowall. Consider if the proposed depth of the PRB is expected to achieve its objectives and if the biowall could be extended deeper or augmented with injection wells for deeper portions of the contamination/plume*

Based on our review of the data, the proposed depth and length are expected to achieve the objectives of the pilot test outlined in Section 2.1.

7. *Section 3.5 – An inspector must be on-site during all remedial activities. The inspector must be a professional engineer (PE) or under the supervision or responsible charge of a PE.*

An ERM representatives will be on site during all aspects of the remedial activities and will be under the supervision or responsible charge of a professional engineer.

8. *Section 3.5.2 – It is the Department's understanding that aspects of the project that will rely on previously approved work plans will be conducted by ERM, not the contractor. That is acceptable and must be specified in the work plan. If the contractor becomes responsible for any aspects of this work (e.g. community air monitoring, soil sampling, waste profiling, etc.), the affected work plan section (e.g., Quality Assurance Project Plan) must be submitted for Department review prior to issuing to the contractor. There have been modifications to several of the work plan sections since they were submitted initially, and it would be best if the contractor is provided one succinct, complete document if they are to be carrying out those tasks.*

ERM will be responsible for the tasks outlined in this comment.

9. *Section 3.5.4 – Silt fencing must be installed, maintained and removed in accordance with New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016 (Blue Book).*

Erosion and sediment controls (ESC) will be installed following New York State Standards and Specifications.

10. *Section 3.5.4, Final Sentence – The erosion and sediment control (ESC) for the storm water catch basin must be installed, maintained and removed in accordance with Blue Book, Standard and Specifications for Storm Drain Inlet Protection or equivalent. A stabilized construction entrance must be installed, maintained and removed in accordance with the Blue Book.*

ESC will be installed following New York State Standards and Specifications.

11. *Section 3.5.4 – Other ESCs required for the work include an excavated soil stockpile containment pad and an equipment decontamination pad. The soil stockpile pad must be lined and bermed and should include a sump. Inactive areas of the stockpile must be covered, and*

the active face must be covered at the end of each workday. The equipment decontamination pad should have similar construction.

Lined soil stock piling areas will be constructed as outlined above.

12. *Section 3.5.5 – Documentation samples must be collected from the bottom of the excavation at a frequency of one sample per 900 square feet of excavation area, and at least one sidewall sample for every 30 linear feet of excavation sidewall. If multiple layers of contamination are identified, then a sidewall sample must also be collected from the horizon in which contamination was identified at the same frequency.*

    For samples of volatile organic compounds (VOCs), if samples are collected within 24 hours of excavation of the sample location, they should be taken from the zero to six-inch interval of the excavation floor; or after 24 hours, the samples should be taken at six to twelve inches.

We plan to install the PRB with large diameter soil borings using a caisson drilling rig. There will be no safe way to collect these confirmation samples during installation. As soon as each boring is complete, it will be immediately backfilled. The goal of the excavation is to enable installation of amended media in the subsurface. In addition, there is the added benefit that contaminated soil will be removed from the excavation. Significant soil data has been collected from across the South Field and Berm AOCs, so there would be minimal added benefit gained from collecting additional data in this area.

13. *Section 3.5.5 – Confirmation sampling must be conducted around the northern end of the trench to confirm the shallow VOC contamination identified in sampling location C-09 was adequately addressed by the excavation. Sampling must be conducted at 0-2 inches below grade and at 2-12 inches below grade for VOCs at locations surrounding C-09 for each direction which was not excavated (presumably north, east and west), unless any of those directions are addressed by the interim remedial measure which is being planned.*

This sampling will be completed along with the sampling request in Area 5 of the proposed IRMs.

14. *Section 3.5.5, 3rd Paragraph – All transport of waste materials must be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers must be appropriately licensed and trucks properly placarded. A copy of the haulers current Part 364 permit must be provided to ERM and the Department at least 24 hours prior to the start of hauling.*

    All wastes must be removed no later than 90 days after completion of excavation activities.

    ERM/the inspector must maintain a log of trucks hauling waste, which will include information identifying the vehicle (e.g., hauler, license plate number, etc.) and time leaving the site. Each load must be accompanied by a manifest or similar document. Documentation showing each load was disposed at an approved facility must be maintained and submitted with the Construction Completion Report.

    Material transported by trucks exiting the site must be secured with tight-fitting covers. Loose-fitting canvas-type truck covers must be prohibited. If loads contain wet material capable of producing free liquid, truck liners must be used. Loaded vehicles leaving the site must be

appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and all other applicable transportation requirements).

All material excavated and removed from the site must be treated as contaminated and regulated material and must be transported and disposed in accordance with all local, State (including 6 NYCRR Part 360) and Federal regulations.

A truck wash should be operated on-site, as appropriate. ERM/the inspector will be responsible for ensuring that all egress points for truck and equipment transport from the site are clean of dirt and other materials derived from the site during intrusive activities. Any truck wash waters must be collected and disposed of in an appropriate manner.

Locations where vehicles enter or exit the site must be inspected regularly, and at least daily, for evidence of off-site soil tracking. Cleaning of the adjacent streets must be performed as needed to maintain a clean condition with respect to site-derived materials.

Waste will be managed in accordance with local, state, and federal regulations. ERM will document all waste management activities. Trucks will be inspected and steps will be taken to make sure materials derived from the site are not tracked off site.

15. *Section 3.5.6 – The wood mulch might need to be sampled as a backfill material in accordance with Department's guidance document DER-10: Technical Guidance for Site Investigation and Remediation dated May 2010, as updated by its Errata Sheet (DER-10) and the Department's recent directive regarding imported fill and emerging contaminants. Please contact the Department to discuss.*

Per our telephone conversation on September 12, 2019, ERM has provided documentation on the source of the wood mulch/ wood chips for NYSDEC approval.

16. *Section 3.5.6 – Documentation showing each load came from an approved source must be maintained and submitted with a report documenting the activities. ERM/the inspector must maintain a log of loads of backfill imported to the site with similar information as for loads of waste leaving the site.*

Documentation will be maintained and provided to NYSDEC demonstrating that each load of imported fill came from an approved source.

17. *Section 3.5.8, 2nd Paragraph, 1st Sentence – Delete "using dry decontamination methods."*

ERM acknowledges this change to the Work Plan.

18. *Section 3.8 – Characterization must include sampling and analysis to determine if the waste contains a listed hazardous waste. If trichloroethene (TCE) is present in soil/solid materials at concentrations greater than 58 parts per million (ppm), then the soil would need to be managed as a hazardous waste.*

The following list of analyses will be run as required by the permitted receiving facility.

- Toxicity characteristic leaching procedure (TCLP) RCRA 8 metals
- TCLP VOCs
- TCLP Semivolatile organic compounds
- TCLP Herbicides/ pesticides
- Reactive sulfide
- Reactive cyanide
- Total Polychlorinated biphenyls
- Free liquid (paint filter)
- Corrosively by pH, and
- Ignitability/ Flashpoint

Waste determinations and profiles will be prepared based on the resulting concentrations and Environmental Protection Agency (EPA) guidance for defining hazardous waste.

19. *Section 4 – Complete a baseline groundwater sampling event prior to construction and include analysis of: sulfate; ferric and ferrous iron; nitrate and nitrite; target analyte list metals; and organic carbon (total or dissolved).*

This will be completed prior to construction.

20. *Section 4.1 – Include the above listed parameters for the periodic sampling. If desired these parameters could be analyzed less frequently than VOCs.*

The parameters listed in comment 19, will be included in the baseline sampling, and third and sixth quarterly sampling events.

21. *Section 4.3 – The report must be developed in general conformance with DER-10, must be certified by a PE with certification language consistent with a construction completion report per section 1.5 of DER-10, and must include the following:*

- *tabulated analytical data;*
- *disposal summary tables (waste type, volume, loads, disposal facility, etc.);*
- *backfill summary tables (fill type, volumes, loads, origin, etc.)*
- *figures and as-built drawings;*
- *copies of any permits/approvals;*
- *engineer's daily inspection reports;*
- *community air monitoring data;*
- *analytical data reports;*

- *data validation reports;*
- *waste profiles to include waste characterization results, waste profile submitted to disposal facility, and disposal facility acceptance letter;*
- *disposal tickets/manifests;*
- *engineer's log of loads of waste leaving the site;*
- *imported fill tickets/bills-of-lading or similar; and*
- *engineer's log of loads of backfill imported to the site.*

22. *Section 5 – The final report must be submitted within 90 days of the final monitoring event.*

The report will be completed in this time frame.

23. *If the Volunteer intends to inject fluids to supplement the mulch, either during the placement of the mulch or after, the Volunteer must notify the Department and must obtain and comply with all necessary permits/approvals/etc., including but not necessarily limited to an Underground Injection Control (UIC) permit application/notification to the United States Environmental Protection Agency. Please copy the Department on any UIC notifications.*

Notification and approvals will be obtained from the NYSDEC and EPA during the planning process.

Thank you for your assistance. Please contact me at 315-233-3038 or Rob.Sents@erm.com if you have any questions or comments.

Sincerely,

Robert Sents
Project Manager

Cc: Harry Warner (NYSDEC)
Maureen Schuck (NYSDOH)
Jacquelyn Nealon (NYSDOH)
Robert Bleazard (TRW)
Scott Blackhurst (TRW)
Craig Slater (Slater Law Firm PLLC)
Joe Fiacco (ERM)
Wendell Barner (Barner Consulting LLC)
Peter Marshall (LPW Development, LLC)

Bioremediation Pilot Test Work Plan

TRW Automotive U.S. LLC

Former TRW Union Springs Facility

25 July 2019

Project No.: 0496229

The business of sustainability

ERM

Bioremediation Pilot Test Work Plan

Former TRW Union Springs Facility

I, James Ryan, P.E. certify that I am currently a NYS registered professional engineer and that this Report Bioremediation Pilot Test Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10).

James Ryan, P.E.
Project Engineer
ERM Consulting & Engineering, Inc.
Date: 25 July 2019

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LIST OF FIGURES

LIST OF IN-TEXT TABLES

ACRONYMS AND ABBREVIATIONS

Name	Description
µg/kg	Micrograms per kilogram
AOC	Area of Concern
BPTWP	Bioremediation Pilot Test Work Plan
cDCE	cis-1,2-Dichloroethene
COC	Constitutes of concern
CVOC	Chlorinated Volatile Organic Compound
DER	Division of Environmental Remediation
ECD	Electron Capture Detector
ERM	ERM Consulting & Engineering, Inc.
ft bgs	feet below ground surface
HGU	Hydrogeologic Units
IDW	investigation derived waste
MIP	Membrane Interface Probe
LPW	LPW Development, LLC
NYSDEC	New York State Department of Environmental Conservation
PRB	permeable reactive barrier
QA/QC	Quality assurance and quality control
RI	Remedial Investigation
TCE	Trichloroethene
tDCE	trans-1,2-Dichloroethene
TOGS	Technical and Operational Guidance Series
TRW	TRW Automotive U.S. LLC
USEPA	United States Environmental Protection Agency
VC	Vinyl Chloride
VOC	Volatile Organic Compound

1. INTRODUCTION

ERM Consulting & Engineering, Inc. (ERM) prepared this Bioremediation Pilot Test Work Plan (BPTWP) on behalf of TRW Automotive U.S. LLC (TRW) Union Springs Facility, located at 107 Salem Street, Union Springs, New York (Figure 1; hereafter called the "Site"). TRW entered into a Brownfield Cleanup Agreement with the New York State Department of Environmental Conservation (NYSDEC) on 7 January 2016 as a Volunteer. The portion of the properties currently regulated under the Brownfield Cleanup Agreement has been assigned Brownfield Cleanup Program Site Number C706019 by the NYSDEC.

From December 2015 to September 2017, ERM conducted a remedial investigation (RI) to satisfy the requirements of the NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10; NYSDEC 2010). A draft summary report of the RI findings and a remedial alternatives analysis was prepared and submitted to the NYSDEC and New York State Department of Health (collectively, Regulators) for review on 13 April 2018 (hereafter called the "Report"; ERM 2018). The Regulators provided a comment letter to the Report on 17 September 2018. ERM is preparing a response and revising the Report based on comments, follow-up discussions, and correspondence with the NYSDEC. Revisions will include addressing specific comments and removing the remedial alternatives analysis section of the Report. TRW intends to manage portions of the Site with interim remedial measures to expedite Site remediation in some areas of concern (AOCs) and to pilot test remedial technologies to support evaluation of proposed remedial strategies for the remaining AOCs identified in the Report.

The purpose of this BPTWP is to document the proposed activities and methods for implementing and evaluating a permeable reactive barrier (PRB) pilot test within a portion of the South Field AOC (Figure 2) where chlorinated volatile organic compounds (CVOCs) were identified at elevated concentrations in soil and groundwater west of the Mill Pond's western berm. The proposed PRB is designed to place carbon-amended substrate within the targeted study area to support a biological treatment zone. This BPTWP presents the remedial goals, pilot test design, and performance monitoring plan.

1.1 Site Operational History

The Site was developed in approximately 1790 and has a long industrial history. The oldest building on the Site is the former mill building, which was constructed in the 1830s. Beginning in 1932, the Site was used by several companies for manufacturing electrical components for the automotive industry, with TRW operating the facility from 1990 through 1997. LPW Development, LLC (LPW) acquired the facility and associated properties from TRW in 1997. Since acquiring the property, LPW has been leasing the facility to various manufacturing and commercial tenants.

1.2 Nature and Extent of Contamination

A detailed account of the nature and extent of contamination at the Site is presented in the Report and in the Comprehensive Report: Site Characterization and Remedial Investigation, dated July 2015 (ERM 2015a). For the purposes of this BPTWP, a brief summary of the constituents of concern (COCs) proximal to the proposed bioremediation pilot test area is presented below.

1.2.1 Constituents of Concern

The primary COCs identified in overburden soil and groundwater within the target treatment zone (i.e., proximal to the proposed bioremediation pilot test area shown on Figure 2 to a depth of about 20 feet below ground surface [ft bgs]) are trichloroethene (TCE); cis-1,2-dichloroethene (cDCE); trans-1,2-dichloroethene (tDCE); and vinyl chloride (VC). These compounds are collectively referred to as CVOCs.

Although a quantity of contaminated soil will be removed by excavation as a result of the implementation of the PRB, the targeted media of this pilot test is shallow groundwater.

1.2.2 Soil

Soil within the proposed pilot test area consist of primarily sandy silt and fine-grained sand. CVOCs were detected in soil samples at depths ranging from 1.5 to 18 ft bgs at concentrations exceeding the Restricted-Commercial Soil Cleanup Objectives, as summarized in Table 1.

Table 1: Summary of Soil Impacts in the Proposed Bioremediation Pilot Test Area

Compound	Maximum Concentration (µg/Kg)	Restricted-Commercial Soil Cleanup Objectives (µg/Kg)
cDCE	550,000	500,000
TCE	930,000	200,000
tDCE	2,000	500,000
VC	5,100	13,000

Soil Cleanup Objectives are derived from 6 NYCRR Part 375-6.8(b)
µg/Kg: micrograms per kilogram

A full summary of the soil analytical data and the geological conditions in the South Field AOC are included in Comprehensive Report: Site Characterization and Remedial Investigation (ERM 2015a).

1.2.3 Groundwater

The Bioremediation Pilot Test is focused on evaluating the implementation and treatment of CVOCs within hydrogeologic unit (HGU) 1, where the majority of CVOC mass and potential for mobility has been identified (i.e., groundwater to a depth of approximately 18 ft bgs; Figure 3). HGUs are defined as vertical zones exhibiting similar groundwater flow characteristics. Groundwater flow within HGU-1 in the vicinity of the pilot test area occurs primarily within relatively high-permeability groundwater transport zones, primarily in the horizontal direction. The underlying HGU-2 is a relatively low-permeability zone that inhibits both horizontal and vertical groundwater flow. Comparison of groundwater elevations measured in adjacent monitoring wells screened in the various HGUs indicates that there are significant upward vertical hydraulic gradients. These gradients exist because there are two relatively low-permeability HGUs that inhibit upward groundwater flow and do not allow the groundwater elevations to equilibrate. The presence of upward vertical hydraulic gradients and underlying relatively low-permeability HGUs minimizes downward groundwater migration at the Site. With the focus of the pilot test on HGU-1, there will be no further discussion of deeper HGUs in the BPTWP.

Figure 4 depicts groundwater potentiometric contours in the area of the proposed PRB. The hydraulic gradient suggests that groundwater generally migrates in a southerly-to-southwesterly direction toward the buried and open portions of the former canal. Within this area, a zone of relatively high hydraulic conductivity acts as a preferential groundwater migration pathway with migration from the proposed pilot testing area, primarily in a westerly direction toward the open portion of the former canal. This preferential groundwater flow zone was confirmed with fluorescent dye tracer studies. The resulting flow directions and seepage velocities from the dye tracer studies are summarized on Figure 4. The PRB orientation was chosen to most effectively account for these multiple flow components.

Table 2 summarizes the most recent groundwater results from monitoring wells screened in HGU 1 in the vicinity of the proposed pilot test area. The CVOC concentrations summarized in Table 2 exceed the NYSDEC Division of Water Technical and Operational Guidance Series (TOGS 1.1.1; NYSDEC 1998) ambient groundwater quality standards in one or more of these referenced locations.

Table 2: Summary of CVOC Impacts to Shallow Groundwater Proximal to the Proposed Pilot Test Area

Compound	Maximum Concentration (µg/L)	TOGS 1.1.1. Ambient Water Quality Standard (µg/L)
CVOCs detected in shallow groundwater within the proposed Bioremediation pilot test area		
cDCE	14,000	5
tDCE	120	5
TCE	19,000	5
VC	10	2

µg/L: micrograms per liter

TOGS 1.1.1: Technical & Operational Guidance Series (TOGS) Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations

A full summary of the groundwater analytical data and characterization of the hydrogeologic conditions in the South Field AOC are included in Comprehensive Report: Site Characterization and Remedial Investigation (ERM 2015a).

2. SUMMARY OF ENGINEERED BIOREMEDIATION PILOT TEST STRATEGY

2.1 Pilot Test Goals and Objectives

The primary goal of the pilot testing is to confirm that installation of a PRB in the South Field AOC is effective at minimizing further CVOC migration in groundwater emanating from the area west of the mill pond berm. Objectives to achieve the goal of this Pilot Test are to:

- Create geochemically reducing conditions within and downgradient of the PRB footprint, which are conducive to stimulating microbial anaerobic reductive dechlorination of CVOCs in groundwater;
- Reduce CVOC concentrations in groundwater over time within and downgradient of the PRB;
- Determine the effective treatment zone size and shape resulting from the PRB;
- Determine the effectiveness of mulch as the carbon and electron donor amendment to generate the necessary biogeochemical conditions for microbial anaerobic reductive dechlorination; and
- Determine the effectiveness of the PRB to complete the anaerobic reductive dechlorination of the CVOCs to harmless byproducts.

The pilot test area was selected where:

- CVOC concentrations in groundwater exceed ambient groundwater quality standards;
- CVOCs were identified in soil within the top 2 feet of the surface (i.e., soil boring C09/ MIP-15) and will be excavated as part of PRB installation;
- The structural integrity of the earthen berm, located to the east of the pilot testing area, would not be affected during installation of the PRB; and
- CVOC-impacted groundwater migrating from the earthen berm toward the preferential groundwater migration pathway in the South Field AOC would be treated.

The bioremediation remedy is expected to achieve its primary goal through *in situ* microbial anaerobic reductive dechlorination within and hydraulically downgradient of the PRB. Data collected during the pilot test will be used to evaluate the viability of this remedial technology in this portion of the Site and will be used to design the final remedy, if appropriate.

2.2 Technology—Permeable Reactive Barrier

PRBs are installations that include reactive materials or amendments placed within a specific groundwater flux zone. The flux zone is designed to affect treatment as contaminated groundwater passes through them; in some cases, additional remediation occurs downgradient of the PRB due to migration of remedial amendments and generation of a treatment zone out of the PRB. PRBs are passive systems that take advantage of the groundwater flow within the treatment zone. PRBs are designed to be high transmissivity zones that cause groundwater to preferentially flow into and through the PRB. PRBs are designed to intercept a contaminant plume as it migrates with groundwater flow. For this Site, the treatment zone is narrow and at a shallow depth (less than 20 ft bgs; HGU-1, which is vertically confined by a low permeability clay unit [HGU-2]). This is an ideal set of conditions for application of a PRB because installation can be completed using cost effective traditional construction methods (e.g., trench excavation, large diameter auger/ borings, or a one-pass trencher, etc.).

There are various types of PRBs. This BPTWP proposes the implementation of a bioreactive PRB that uses wood mulch (composted cellulose) to induce microbial anaerobic reductive dechlorination. Microbial anaerobic reductive dechlorination was selected for pilot testing as a cost effective, readily implementable, and proven remedial alternative to treat CVOC-impacted groundwater. This technology

degrades contaminant mass by creating biogeochemical (specifically anaerobic reducing) conditions that stimulates the growth and activity of indigenous microbes capable of degrading CVOCs. These reactions result in a series of degradation byproducts and ultimately reduce CVOCs to a harmless byproduct, such as ethene and ethane. To facilitate microbial anaerobic reductive dechlorination, one or more electron donor is required. For this application, we are proposing the use of wood mulch as the electron donor amendment and carbon source. Wood mulch has the benefit of generating anaerobic reducing geochemical conditions while providing a long-term (several years) electron donor and carbon supply. The PRB will include an injection pipe and/or wells to be used to inoculate the treatment zone with a microbial consortium that includes *dehaloccocoides (Dhc) sp.*, a bacteria strain that is capable of completely dechlorinating chlorinated ethenes to ethene. The injection pipe(s) can also be used to add supplemental liquid electron donor amendment in the future, if necessary.

3. PILOT TEST ENGINEERING DESIGN AND INSTALLATION

3.1 Pilot Testing Design Summary

The proposed PRB will be located on the east end and hydraulically upgradient portion of the South Field AOC, where CVOC concentrations were identified in groundwater exceeding the ambient groundwater quality standards. The proposed PRB will be installed at the head of the area where preferential flow paths were identified in HGU-1 that result in relatively fast seepage velocities as compared with the surrounding areas. The placement of the PRB will allow for the evaluation of changes in geochemical conditions through the South Field AOC. In addition, the PRB will be located hydraulically downgradient of the Berm AOC and will create an anaerobic reducing treatment zone for CVOC-impacted groundwater emanating from this AOC (Figure 5).

3.2 PRB Electron Donor

Wood mulch is a proven effective source of organic carbon and electron donor needed to support microbial anaerobic reductive dechlorination. Wood mulch emplaced in a PRB releases soluble organic carbon compounds such as tannic, humic and carbonic acids that feed the indigenous microbes, causing the consumption of available dissolved oxygen. The resulting downgradient groundwater geochemical conditions become anaerobic and reducing, which are necessary to support microbial reductive dechlorination by *Dhc* and other bacteria. Wood mulch will be blended at approximately 50 percent by volume ratio with rock aggregate. The rock aggregate provides structural stability for the PRB, as well as maintaining a high-permeability zone for groundwater flux through the PRB. The rock aggregate will include limestone that will provide a pH buffer as the anaerobic reduction of the amendments generate acidic conditions that are not conducive to the microbial reduction of the CVOCs. Wood mulch provides a long-term sustained organic carbon and electron donor source. Since wood mulch is a slow-release carbon source, the PRB will be constructed to accommodate the direct injection of supplemental carbon/electron donor amendment, if determined necessary. Supplemental electron donor carbon, if used, will be in a liquid form (either insoluble microsuspension or dissolved form) so that the electron donor can readily migrate downgradient of the PRB.

3.3 PRB Location and Sizing

Figure 5 shows the proposed location of the PRB. This location was chosen based on the hydrogeological conditions of the South Field AOC, as discussed in Section 1.2.3. The area where Membrane Interface Probe (MIP) electron capture detector (ECD) data indicated the presence of significant CVOC mass (i.e., ECD values greater than 15 volts at thicknesses greater than 1 foot) is shown in yellow on Figure 5.

The PRB is oriented generally perpendicular to the groundwater flow direction, as determined through the dye tracer studies, which maximizes the effective width of the treatment zone. Additionally, the PRB will be constructed as near to the existing sanitary sewer as ERM's subsurface utility program safely allows. Buried utilities and associated bedding materials (e.g., sand or pea-gravel) generally exhibit higher permeability than the surrounding soils. Therefore, the existing sanitary sewer may represent a preferential pathway for CVOC-impacted groundwater in the South Field AOC. Locating the PRB in close proximity to the sanitary sewer will enable treatment of CVOC-impacted groundwater migrating along this portion of the sanitary sewer and potentially convey electron-donor-amended groundwater along this potential preferential pathway, further enhancing the effectiveness of the PRB.

3.4 PRB Construction

The proposed PRB will be installed to target depth of 18 feet. The PRB length (perpendicular to groundwater flow) will be approximately 40 feet. The portion of the PRB located within the saturated zone will be filled with a 50:50 by volume mix of mulch and aggregate. The proposed width (parallel to groundwater flow) of the PRB will depend on the means of installation, but will be at least 2 feet wide. The method used to install the PRB is still under review and the NYSDEC will be notified in writing on the installation method prior to mobilization. The general specifications for the construction of the PRB are included as Appendix A.

3.5 Engineered Bioremediation Installation

3.5.1 Site Access

ERM met with LPW on 17 June 2019 and reviewed the location and nature of the engineered bioremediation PRB pilot test documented in this BPTWP. LPW has signed an acknowledgment and approval for TRW to proceed with the pilot test as outlined in this BPTWP (Appendix B).

3.5.2 Supporting Documents

The work will be performed in conformance with the approved supporting documents from the RI Work Plan, such as the Quality Assurance Project Plan and the Community Air Monitoring Plan (ERM 2015b). The approved RI Health and Safety Plan will be revised to address potential risks associated with the tasks outlined in this BPTWP. The revised Health and Safety Plan will be reviewed and approved by ERM's senior health and safety team prior to mobilization to the Site.

3.5.3 Site Preparation

The pilot test area is generally grass covered and relatively flat, with a steep slope toward the unnamed stream to the northeast. No clearing activities are anticipated to be required.

3.5.4 Erosion and Sediment Control

During construction activities, erosion and sediment controls will be used to minimize storm water contacting disturbed areas and to control runoff. Silt fences will be installed to the north of the pilot test area, between the construction area and the abutting unnamed stream. In addition, sediment controls will be put in place on the storm water catch basin located north of the mill building.

3.5.5 PRB Excavation

Planning, care, and consideration will be given to a 10-inch-diameter existing sanitary sewer that runs southwest through the South Field AOC. The location and orientation of the excavation activities are not expected to interfere with the existing sanitary sewer. However, it is desirable to locate the PRB near to the sanitary sewer, and it may be necessary to temporarily expose a small portion of the sanitary sewer during the PRB installation as a safety measure to mitigate contact with the sanitary sewer as described in Section 3.3.

A subsurface clearance program will be implemented by notifying the New York State One-Call system and obtaining a valid dig ticket throughout the project. An independent utility location firm will be utilized, as needed, to locate the sanitary sewer proximal to the pilot testing area.

The excavated soils will be staged, characterized with analytical data, and profiled according to the results. Soil will be transported to a permitted off-Site disposal facility. Storm water and erosion control will

be managed by installing the appropriate dewatering and storm water management infrastructure in accordance with the selected excavation method.

The impacted soil areas will be excavated/removed with standard excavation equipment such as dozers, loaders, backhoes, excavators, caisson drill rig, and/or sonic drill rig to allow an efficient and safe removal of soil and accurate placement of amended backfill. Vacuum excavation or hand digging techniques will be employed within 10 feet of any identified underground utilities to allow field location of the underground utilities (such as the sanitary sewer line running adjacent to the proposed area of excavation). Dust control methods (spray water, gravel on haul roads, etc.) will be instituted, as needed, to limit fugitive dust emissions. The Community Air Monitoring Plan will be followed during intrusive activities. Excavation areas will be barricaded during working hours, as practical, and at the end of each work day during Pilot Test construction. Barricades can include construction tape on stakes, temporary construction fencing, or other physical barriers.

3.5.6 PRB Construction and Backfill

The saturated zone of the PRB will be backfilled with a mix of 50:50 mulch/aggregate. The source of the aggregate will be a virgin source and will contain less than 10 percent fines (e.g., washed pea gravel, screened limestone, etc.). The mulch material will be from a local source, preferably hardwoods and will have been composted for at least 4 weeks. The remaining imported backfill will be from a source that has been pre-approved by the NYSDEC following the guidelines outlined in DER-10. A PVC pipe will be installed within the mulch/aggregate mix to provide an injection point for supplemental electron donor amendment and/or inoculant, if needed.

Amendment material and backfill will be placed in shallow lifts and tamped with excavation equipment (e.g., excavator bucket if that is the chosen installation method) to minimize the occurrence of surface settling. Given the nature of the amendment material, minor surface settlement is anticipated over time. Surface grade will be monitored during the operation of the pilot study and corrective action (i.e., additional surface restoration/grading) will be considered, depending on the degree of settling.

3.5.7 Revegetation

Following final backfill and grading in the pilot test area, disturbed areas will be prepared for restoration with grass to facilitate stabilization of soil in the excavation area and for ease of maintenance by the property owner.

3.5.8 Site Cleanup and Demobilization

At the conclusion of PRB construction and Site restoration activities, demobilization will occur. Temporary improvements installed at the Site as part of construction activities, including but not limited to soil stockpile areas, and construction barricades will be removed. All general construction trash and associated containers will be removed and disposed of properly.

All construction equipment and materials scheduled for demobilization will be decontaminated using dry decontamination methods. The decontamination materials will be collected and disposed of appropriately.

3.6 Performance Monitoring Well Installation

A total of five new monitoring wells will be installed. Four new monitoring wells will be installed at distances of 10, 20, and 30 feet downgradient of the mulch PRB, and one new monitoring well will be installed upgradient of the mulch PRB (Figure 6). These newly installed monitoring wells, and the existing shallow monitoring well network, listed in Table 3 below will be used to monitor and evaluate the pilot test

performance. The new monitoring wells will be constructed using industry-standard techniques as outlined in the RI Work Plan (ERM 2015b).

3.7 Survey

Following the installation of the PRB and proposed monitoring wells, newly installed features will be surveyed for horizontal location and elevations by a surveyor licensed by the state of New York. The data will be used for subsequent construction-completion and performance reporting.

3.8 Investigation Derived Waste

Solid and potentially liquid investigation derived waste (IDW) will be generated by the installation of the PRB and during monitoring well installation. Materials that may become IDW and require proper management include:

- Excavated soil;
- Excavation dewatering liquid;
- Soil cuttings from monitoring well drilling;
- Well development water;
- Decontamination fluids, such as wash water;
- Personnel protective equipment; and
- Disposable sampling equipment.

IDW will be segregated according to waste type. IDW generated during assessment activities will be placed in Department of Transportation-approved 55-gallon drums, and/or in one or more lined roll-off dumpster, properly labeled with contents, and stored on Site in a secure area. Characterization, transportation, and disposal of IDW will be conducted by ERM in accordance with the NYSDEC guidelines.

4. PILOT TEST PERFORMANCE MONTORING AND REPORTING

The primary objective of the proposed monitoring program is to demonstrate the effectiveness of the bioremediation pilot test. The goal of this pilot test is to create an effective anaerobic reducing treatment zone to reduce CVOC concentrations in groundwater downgradient of the PRB via complete microbial anaerobic reductive dechlorination to ethene and ethane. This objective can be achieved by monitoring CVOC concentrations and dissolved gases (i.e., methane, ethane and ethene) and competing electron acceptors (CEAs) oxygen, iron sulfate and manganese. Additional bioremediation parameters may be monitored to support evaluation of various aspects of the bioremediation process (e.g., total and dissolved organic carbon content, and bacterial populations [e.g., *Dhc*]). The table below summarizes the performance-monitoring well network. The locations of the wells are shown on Figure 6.

A monitoring period of 18 months is proposed for the bioremediation pilot test. Groundwater monitoring events will include baseline monitoring conducted prior to PRB installation and six quarterly monitoring events following installation of the PRB.

Table 3: Summary of Proposed Performance Monitoring Well Network

Existing Wells	Proposed Wells
MW-1 MW-101 MW-103 MW-107 MW-400 E-18A C-13	MW-504 MW-505 MW-506 MW-507 MW-508

4.1 Groundwater Gauging and Sampling

Groundwater elevation gauging will be conducted concurrent with sampling events. Depth-to-groundwater will be measured using an electronic water level instrument in each shallow monitoring well listed in Table 3.

Groundwater monitoring will be conducted to evaluate the temporal changes in CVOC concentrations and speciation in groundwater in the vicinity of the PRB pilot test area. The 12 wells listed above (existing and proposed wells) will be included in each of the performance-monitoring events. For all monitoring events, groundwater samples will be collected and field parameters (pH, oxidation reduction potential, conductivity, and dissolved oxygen) will be measured. Sampling logs will be completed for each monitoring well for each sampling event to document the measured field parameters. Groundwater samples will be analyzed for CVOCs by United States Environmental Protection Agency (USEPA) Method 8260B and dissolved gases by USEPA Method RSK-175. As noted above, additional parameters may be analyzed on an as-needed basis to support evaluation of the PRB. Each event will include the following quality assurance and quality control (QA/QC) samples: duplicate, matrix spike and matrix spike duplicate, trip blank, and equipment rinsate blank. QA/QC samples will be submitted for VOC analysis by USEPA Method 8260B only.

The frequency of monitoring events, duration of the performance monitoring period, and analysis parameters will be reviewed and potentially revised, based on interpretation of the results.

4.2 Supplemental Amendments

Based on the results of the performance monitoring, it may be determined that additional electron donor amendment is needed to supplement the mulch. The exact composition of the electron donor will be determined based on the results of the post-installation monitoring activities. If the addition of a supplemental electron donor is found to be necessary, a supplemental amendment such as an emulsified vegetable oil, or equivalent will be selected and added to the PRB through the proposed injection piping/wells. Additionally, inoculation with *Dhc* microbial consortium may be warranted and can be added to the PRB via the injection piping/ wells.

4.3 Reporting

Data collected during the monitoring events will be included in the monthly progress reports as required by the Brownfield Cleanup Agreement. The results of the PRB pilot testing will be included in a Focused Feasibility Study Report that will be prepared following completion of the proposed pilot testing and interim remedial measures (to be presented in separate work plans).

5. SCHEDULE

Table 4 presents a general schedule of anticipated PRB-related activities for the duration of the pilot test period. The schedule may be modified based on conditions such as adverse weather, other Site activities, and contractor/equipment availability. The NYSDEC will be notified approximately 5 days in advance of any subsurface field or monitoring activities at the Site.

Table 4: Schedule of Anticipated Events

Task	Target Month and Year of Completion
Installation of PRB and monitoring wells	October 2019
Baseline Monitoring (Event 1)	September 2019
Monitoring Event 2	December 2019
Monitoring Event 3	March 2020
Monitoring Event 4	June 2020
Monitoring Event 5	September 2020
Monitoring Event 6	December 2020
Monitoring Event 7	March 2021

6. REFERENCES

ERM (Environmental Resources Management). 2015a. *Comprehensive Report: Site Characterization and Remedial Investigation, 107 Salem Street, Union Springs, New York*. ERM Project Number 0096370. July 2015.

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_____. 2018. *Draft Remedial Investigation and Alternatives Analysis Report, 107 Salem Street, Union Springs, New York*. ERM Project Number 0331722. April 2018.

Freeze, R.A., and Cherry, J.A., 1979, Groundwater: Englewood Cliffs, NJ, Prentice-Hall, 604 p.

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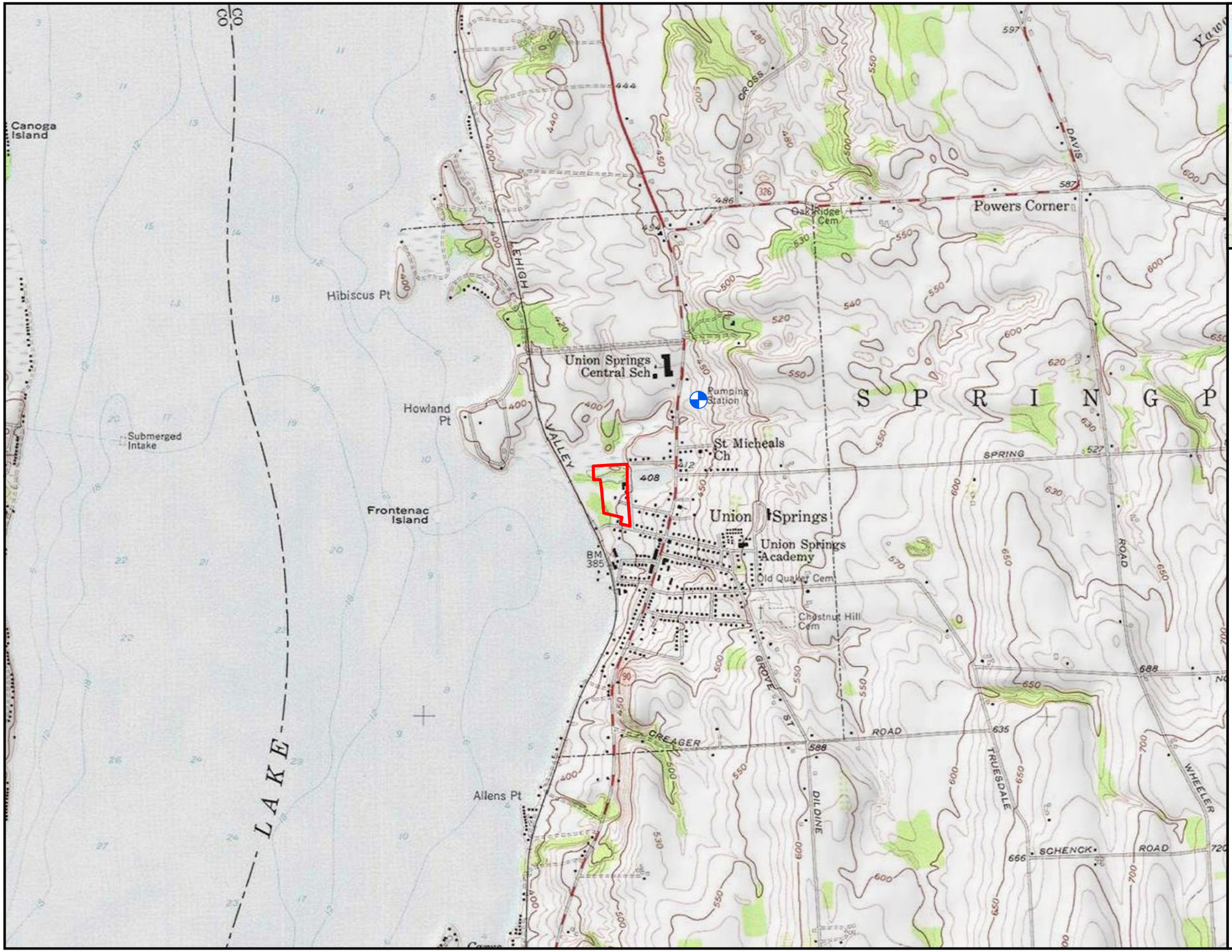
FIGURES



Legend

- Village of Union Springs Water Supply
- Approximate Site Boundary

NOTES:

- Location of Former TRW Union Springs Facility was digitized using aerial photography. Locations are approximate.

N

0 1,000 2,000 3,000 4,000

Feet

Figure 1: Site Location Map
Former TRW Union Springs Facility
Union Springs, New York

ERM

Q:\team\DMM\Clients_Q_O\TRW\Union_Springs\MXD\Misc\Figure1_SiteLocation_20190625.mxd - Dana.Heusinkveld - 6/25/2019

Unnamed Stream 2
Culvert
Unnamed Stream 1
Spillway / Culvert
Howland Street
Earthen Berm
Former Canal
Mill Pond
Shipping and Receiving Area
Former Mill Building
Union Springs Wastewater Treatment Facility
Former TRW Union Springs Facility
Frontenac Park
Cayuga Lake
Green Street
Salem Street
Creamery Road
Chapel Street

Legend

- Building Outline (Approximate)
- Surface Contour - 10 feet
- Surface Contour - 2 feet
- Stream
- Surface Water
- ERM Delineated Wetland
- Approximate Site Boundary
- **Buried Portion of Former Canal**

National Wetlands Inventory (NWI) Wetland Type

- Freshwater Emergent Wetland
- Riverine
- Lake

Subsurface Utilities

- Culvert
- Electric Line
- Gas Line
- Groundwater Interceptor Trench
- Sanitary Sewer Line
- Sanitary Sewer Line, Approximate*
- Storm Water Line
- Storm Water Line, Approximate
- Stormwater Line from Former TRW Facility
- Water Main

NOTES:

- National Wetlands Inventory data provided by the U.S. Fish and Wildlife Service. Data is collected at larger scale and may not match with aerial imagery.
- * Inferred based on information provided by the Village of Union Springs and manhole locations.
- Location of Former TRW Union Springs Facility was digitized using aerial photography. Locations are approximate.
- The buried portion of the former canal was digitized based on historical maps and photographs. Location is approximate.
- Approximate boundary of former canal based on normal high water conditions.
- Aerial imagery captured in 2015 from New York State.

N

0 25 50 100 150 200
Feet

Figure 2: Site Layout, Topography and Utilities
Former TRW Union Springs Facility
Union Springs, New York

ERM

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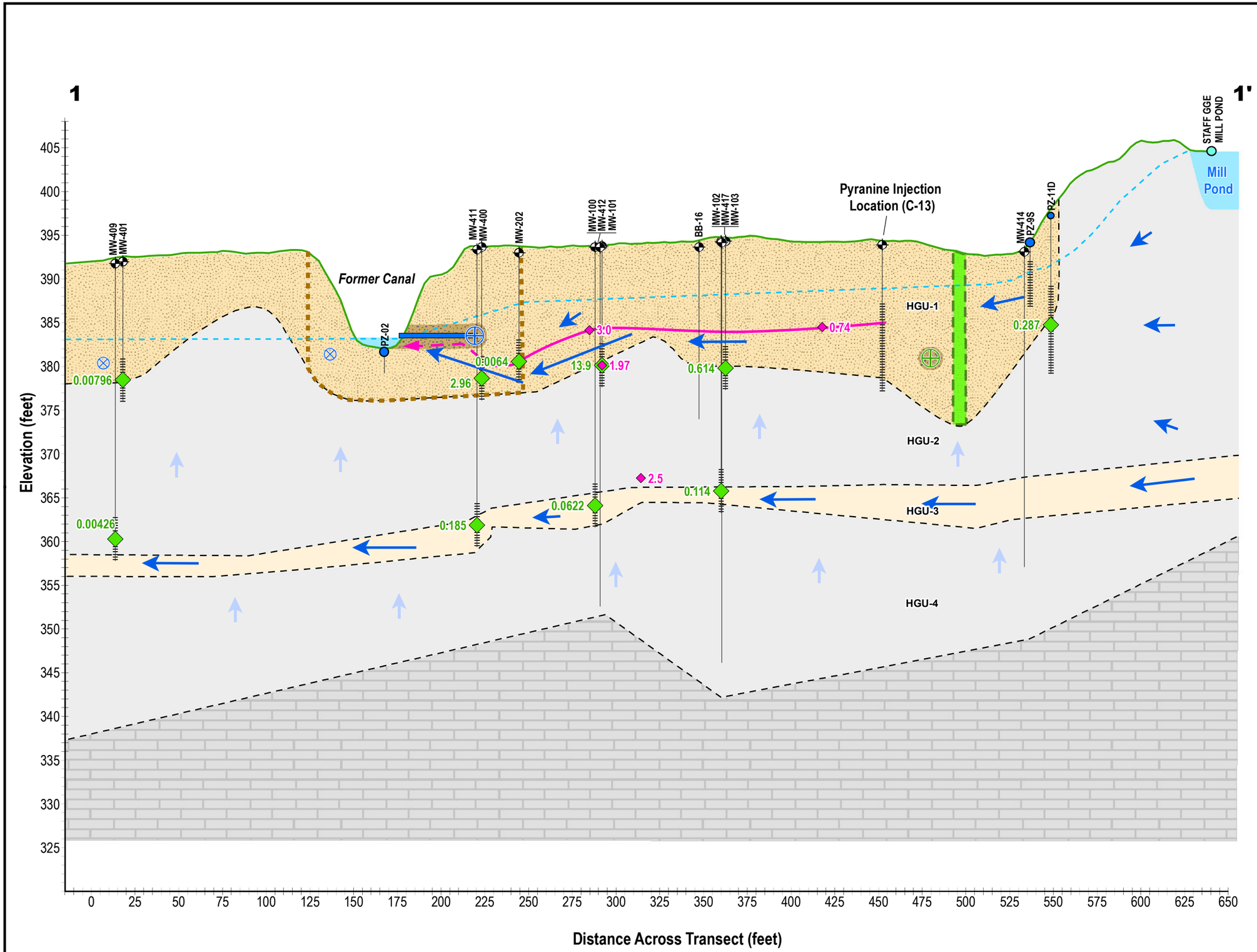

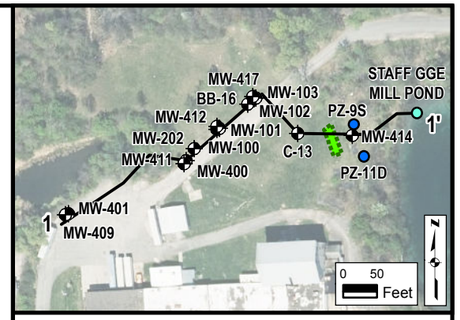

Legend

- Boring or Well
- Piezometer
- Staff Gauge
- Dye Seepage Velocity (feet/day)
- Hydraulic Conductivity
- Pyranine Dye Flow Path (Dashed where inferred)
- Approximate Water Table
- Hydrogeologic Unit (HGU) Boundary
- Monitoring Well Screen
- Buried Portion of Former Canal
- Ground Surface
- Bioremediation Pilot Test Area

Groundwater Flow Velocity

- Flow perpendicular to transect (flows into page)
- Upward Hydraulic Gradient
- < 0.1 ft/day
- 0.1 to 1.0 ft/day
- 1.0 to 10 ft/day
- >10 ft/day

Underground Utility

- Sanitary Sewer Line (perpendicular to transect)
- Stormwater Line from Former TRW Facility (perpendicular to transect)
- Stormwater Line from Former TRW Facility (parallel to transect)

Geology Type

- Heterogeneous Fill Material, Silty Sand
- Gravel
- Low Hydraulic Conductivity Silt, Clay, Diamict, Fill
- High Hydraulic Conductivity Silty Sand, Sand, Fill
- Bedrock

NOTES:

- Vertical Exaggeration = 5X
- Aerial imagery captured in 2015 from New York State.

Figure 3: Cross Section 1-1'
Geology and Hydrogeology
Former TRW Union Springs Facility
Union Springs, New York

ERM

PZ-01
388.43
MW-301
388.47
MW-302
389.15
HH-13
393.76
JJ-12
394.98
MW-9
384.24
JJ-17
392.94
MW-105
392.5
NN-25
392.13
0.07
0.10
Howland Street
Unnamed Stream 1
390
MW-103
390.9
BB-16
389.34
MW-110
389.39
FF-21
389.3
386
GG-27
387.52
APS-03
APS-24
MW-101
386.99
2.50
0.74
DD-23
387.1
1.97
C-13
389.41
MW-109
387.96
APS-02
3.00
0.83
MW-202
386.66
APS-16
E-18A
386.33
PZ-02
382.98
MW-400
385.92
3.59
4.00
382.51
MW-108
386.41
MW-107
387.13
MW-7
385.41
MW-201
385.97
Former Canal
384
MW-401
383.04
386
MW-200
385.16
PZ-3D
383
PZ-7D
385.94
RW-4
384.15
MW-8
389.94
MW-402
386.82
Former Mill
Building
MW-3
383.42
Former TRW Union
Springs Facility
MW-408
392.6
404.59
PZ-9D
387.45
PZ-10D
389.69
Earthen Berm
400
402
PZ-5D
390.65
PZ-11D
389.56
MW-1
387.56
PZ-2D
386.3
PZ-8D
387.44
PZ-6D
386.15
0.66
0.65
MW-A
387.81
0.31
PZ-1D
385.78
388
390
392
394
396
400
Mill Pond

Legend

- Groundwater Gauging Location
- 382.34 Groundwater Elevation (ft)
- Staff Gauge
- Waterloo APS
- Catch Basin
- Shallow Groundwater Contour (Inferred) - 10 feet
- Shallow Groundwater Contour - 10 feet
- Shallow Groundwater Contour (Inferred) - 2 feet
- Shallow Groundwater Contour - 2 feet
- Groundwater Interceptor Trench
- Generalized Groundwater Flow Direction
- Bioremediation Pilot Test Area
- Areas With High Permeability Interval (>0.1 ft/day) Derived from Slug Tests
- Approximate Site Boundary
- Buried Portion of Former Canal
- Stream
- Surface Water

Dye Injection Paths With Seepage Velocity (feet/day)

- Pyranine; Pyrinine - Approximate
- Pyranine - Inferred
- Sulfordamine B - Inferred
- Sulphordamine - Approximate
- Uranine - Approximate

NOTES:

- T = thickness in feet.
- Ik = index of hydraulic conductivity.
- Hydraulic conductivity calculated by analyzing slug test data using Bauer-Rice method with no correction factor applied (feet/day).
- Waterloo APS estimated conductivity was modeled using IK data where IK is > 2.0 and interpolated using topo-to-traster methods in ArcGIS 10.4.
- * denotes anomalous data that was not used in groundwater elevation interpretaions.
- Shallow groundwater elevations from wells screened less than 20 feet below surface.
- Groundwater elevations were obtained from the 10 April 2017 gauging event.
- Elevation is reported as feet above mean sea level.
- The buried portion of the former canal was digitized based on historical maps and photographs. Location is approximate.
- Aerial imagery captured in 2015 from New York State.

0 12.5 25 50 75 100
Feet

Figure 4: Shallow Overburden Groundwater Elevation with Contours and Dye Trace Seepage Velocities
Former TRW Union Springs Facility
Union Springs, New York

ERM

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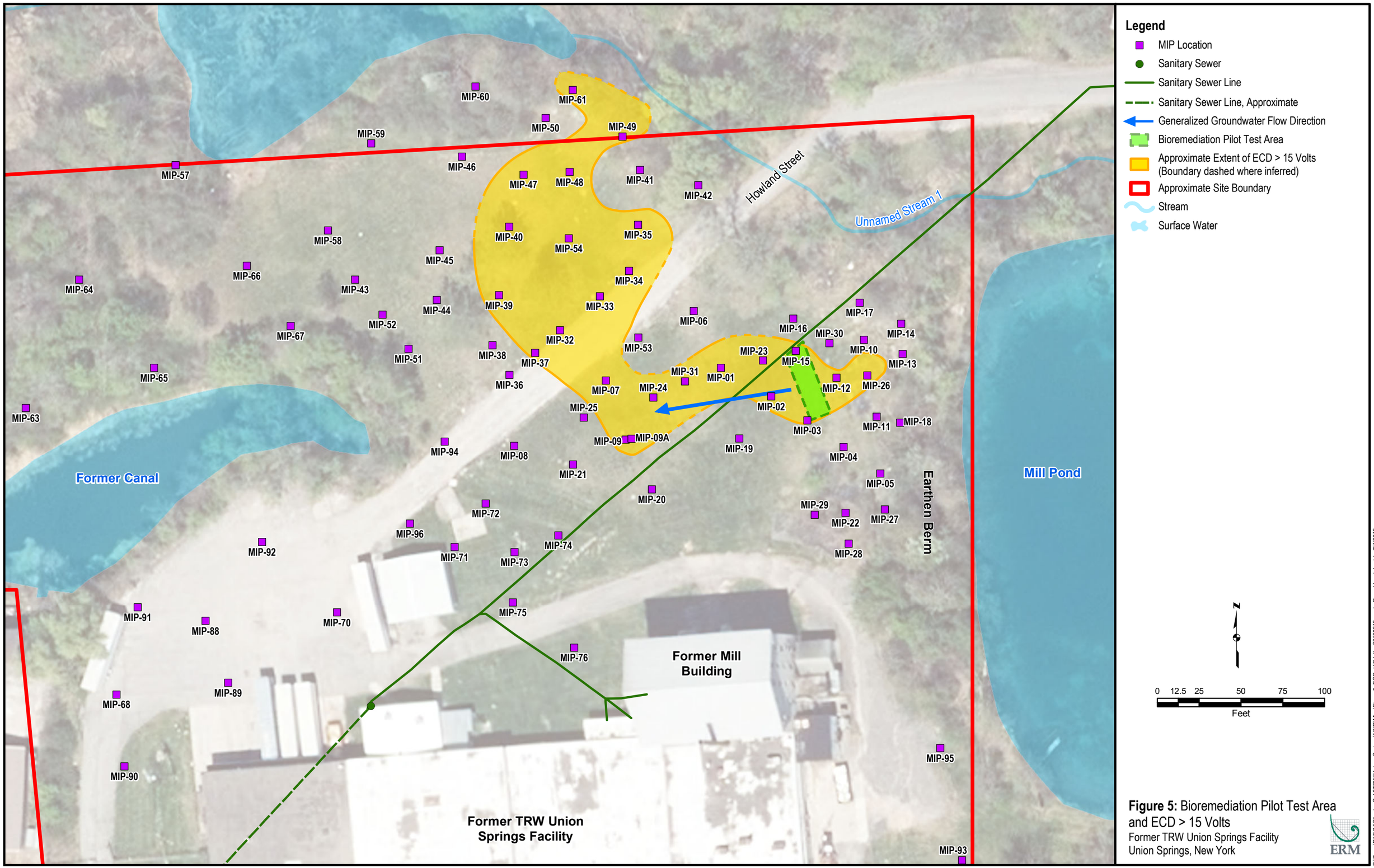

Figure 5: Bioremediation Pilot Test Area and ECD > 15 Volts
Former TRW Union Springs Facility
Union Springs, New York

ERM

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PZ-01
MW-301
MW-302
JJ-12
HH-13
MW-105
MW-9
JJ-17
NN-25
Howland Street
Unnamed Stream 1
MW-103
BB-16
FF-21
MW-110
APS-03
APS-24
DD-23
GG-27
APS-02
MW-101
C-13
MW-506
MW-504
PZ-9D
PZ-10D
MW-109
APS-16
MW-202
MW-505
MW-508
PZ-5D
PZ-11D
PZ-02
E-18A
MW-400
MW-108
MW-1
MW-507
MW-107
PZ-2D
PZ-8D
Earthen Berm
PZ-6D
MW-201
Former Canal
Mill Pond
MW-7
PZ-3D
PZ-7D
MW-A
MW-401
MW-200
PZ-1D
RW-4
MW-8
Former Mill Building
MW-402
MW-3
Former TRW Union Springs Facility
MW-408

Legend

- Proposed Bioremediation Monitoring Well
- Groundwater Gauging Location
- Groundwater Gauging Location used in Pilot Monitoring Program
- Staff Gauge
- Waterloo APS
- Sanitary Sewer
- Catch Basin
- Sanitary Sewer Line
- Sanitary Sewer Line, Approximate
- Groundwater Interceptor Trench
- Generalized Groundwater Flow Direction
- Bioremediation Pilot Test Area
- Areas With High Permeability Interval (>0.1 ft/day) Derived from Slug Tests
- Approximate Site Boundary
- Buried Portion of Former Canal
- Stream
- Surface Water

NOTES:

- The buried portion of the former canal was digitized based on historical maps and photographs. Location is approximate.
- Aerial imagery captured in 2015 from New York State.

N

0 12.5 25 50 75 100

Feet

Figure 6: Proposed Bioremediation Monitoring Wells

Former TRW Union Springs Facility
Union Springs, New York

ERM

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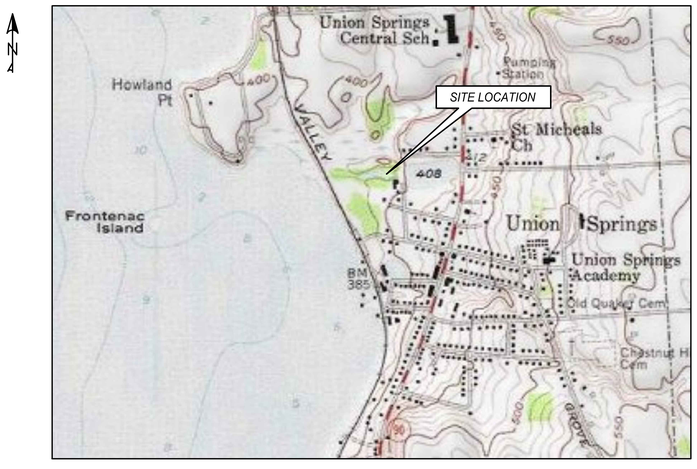
APPENDIX A BIOREMEDIATION PRB TEST DESIGN DRAWINGS

BIOREMEDIATION PILOT TEST

FORMER TRW UNION SPRINGS
UNION SPRINGS, NEW YORK

SITE VICINITY MAP

SITE LOCATION MAP



ISSUED FOR REVIEW

JULY 2019

PREPARED FOR
TRW AUTOMOTIVE U.S. LLC

DRAWING INDEX

PREPARED BY

ERM

Environmental Resources Management

Syracuse Office 315-445-2554

Rev.	Date	Description	By	Chk
DRAWN BY AR/CAK	CADD Review MB	CHECKED BY JR		

Environmental Resources Management

ERM.

TRW AUTOMOTIVE U.S. LLC
BIOREMEDIATION PILOT TEST

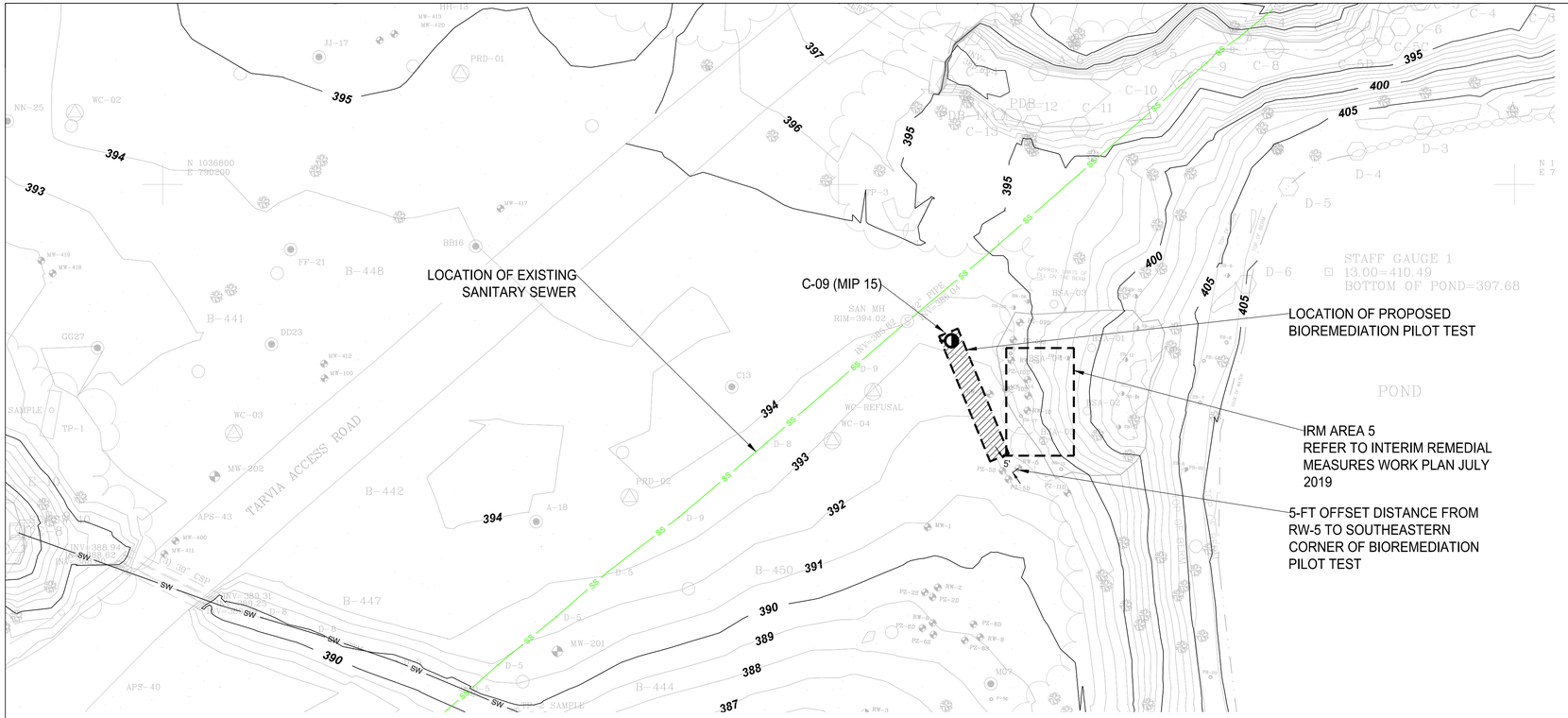
FORMER TRW UNION SPRINGS
UNION SPRINGS, NEW YORK

EXISTING CONDITIONS PLAN

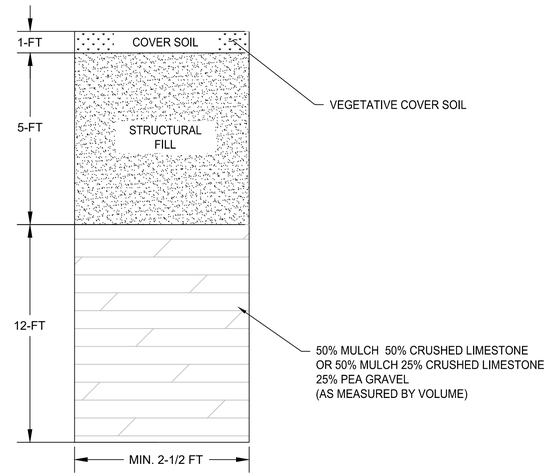
SCALE	PROJECT NUMBER	DRAWING	REV.
AS SHOWN	0496229	SHEET 02	A
DATE DRAWN 17 JUNE 2019			

T:\DWG\AutoCAD\dwg\0496229\02_Existing Conditions.dwg

REVISIONS TO BE MADE ON THE CADD FILE ONLY



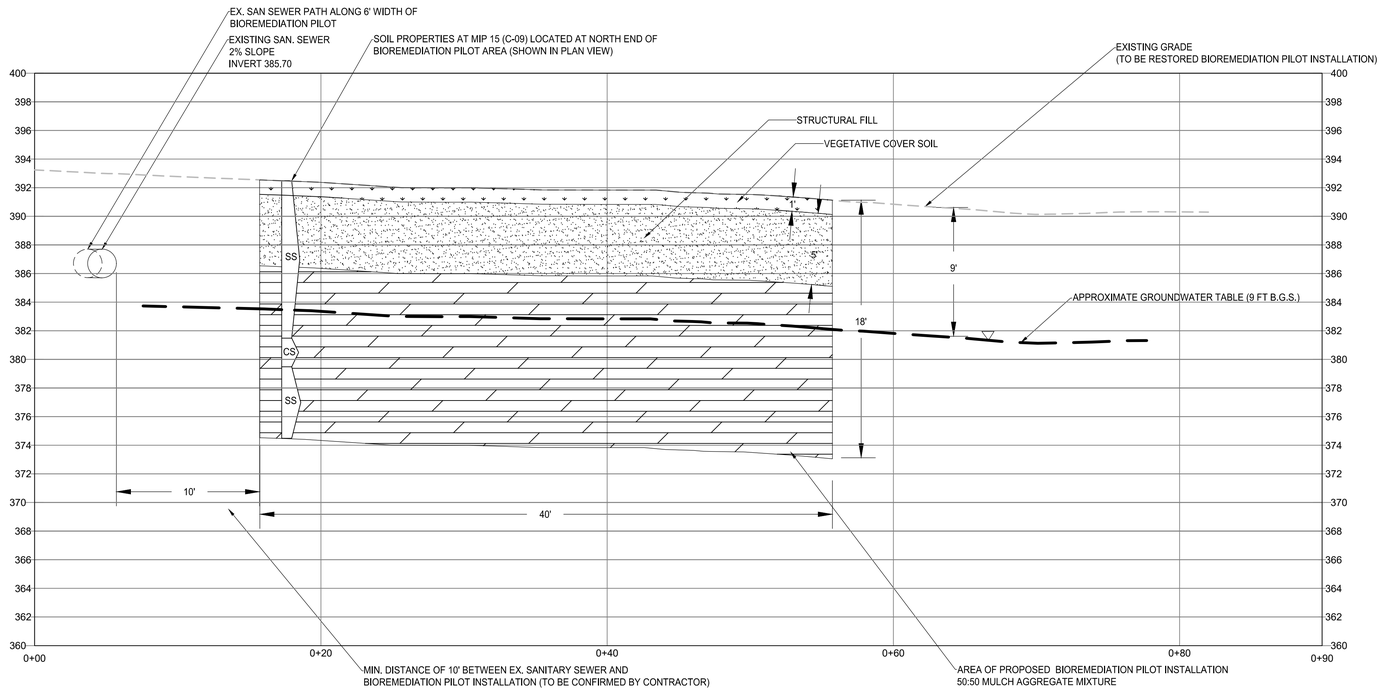
BIOREMEDIATION PILOT STUDY AREA
SCALE: 1" = 20'



BIOREMEDIATION PILOT PROFILE
SCALE: N.T.S.

STRUCTURAL FILL COMPOSITION

Gradation	ASTM D-422	Percent Passing	Sieve Size
		100%	2 in.
		52-100%	3/4 in.
		36-70%	3/8 in.
		24-50%	No. 4
		10-30%	No. 16
		0-10%	No. 200



BIOREMEDIATION PILOT PROFILE
SCALE: 1" = 5'

NOTE:

INSTALLATION METHOD HAS NOT YET BEEN SELECTED. ALTHOUGH DETAIL DEPICTS THE PILOT AREA AS A CONTINUOUS BOX OR WALL SHAPE, INSTALLATION METHODS MAY RESULT IN VARIATIONS SUCH AS WIDTH GREATER THAN 2.5 ft, LARGE DIAMETER VERTICAL BORINGS CLOSELY SPACED/STAGGERED, OR OTHER VARIATIONS.

SOIL MATERIAL PROPERTIES TABLE	
MATERIAL TYPE	C-09 DEPTH
SS = SILTY SAND, SANDY SILT	0 -11 FT B.G.S.; 13 -18 FT B.G.S
CS = CLAYEY SILT	11 - 13 FT B.G.S.

TOPSOIL SPECIFICATION

A. THE UPPER SIX INCHES SHALL CONSIST OF AN ORGANIC-RICH SOIL CAPABLE OF PROVIDING A SOIL LAYER THAT CAN PRODUCE AND SUSTAIN HEAVY GROWTHS OF THE VEGETATION. SOIL MAY EITHER BE TOPSOIL OR AMENDED COVER SOIL.

B. TOPSOIL AND AMENDED COVER SOIL SHALL CONTAIN FROM 3 TO 10 PERCENT ORGANIC MATTER AS DETERMINED BY LOSS ON IGNITION IN ACCORDANCE WITH ASTM D 2974. IF THE ORGANIC MATTER IS NOT WITHIN THE RANGE, THE CONTRACTOR SHALL ADD SUFFICIENT ORGANIC AMENDMENTS (I.E. PEAT MOSS, MANURE, COMPOST OR OTHER APPROVED AMENDMENT) TO ACHIEVE THE REQUIRED ORGANIC CONTENT. TOPSOIL AND AMENDED COVER SOIL SHALL ALSO BE REASONABLY FREE FROM UNDERLYING SUBSOIL, CLAY LUMPS, OBJECTIONABLE WEEDS, LARGE ROCKS, LITTER, BRUSH, MATTED ROOTS, TOXIC SUBSTANCES OR ANY MATERIAL THAT MIGHT BE HARMFUL TO PLANT GROWTH OR BE A HINDRANCE TO GRADING, PLANTING OR MAINTENANCE OPERATIONS. SOILS FROM DITCH BOTTOMS, DRAINED PONDS, OR ERODED AREAS, HANDLED WHEN TOO WET OR SOGGY ARE NOT ACCEPTABLE.

C. TOPSOIL AND AMENDED COVER SOIL SHALL HAVE A FINAL PH VALUE OF BETWEEN 6.0 TO 7.5, OR WITHIN THE OPTIMAL RANGE FOR THE GRASS SEED USED AND AS APPROVED BY THE OWNER'S REPRESENTATIVE. IF THE PH IS NOT WITHIN THE 6.0 TO 7.5 RANGE THE CONTRACTOR SHALL ADD OWNER-APPROVED AMENDMENTS TO ACHIEVE SUITABLE PH.

Rev.	Date	Description	By	Chk

DRAWN BY: AR | CADD Review: MB | CHECKED BY: JR

Environmental Resources Management

TRW AUTOMOTIVE U.S. LLC
BIOREMEDIATION PILOT TEST

FORMER TRW UNION SPRINGS
UNION SPRINGS, NEW YORK

PLAN AND PROFILE

SCALE	PROJECT NUMBER	DRAWING	REV.
AS SHOWN	0496229	SHEET 03	A

DATE DRAWN: JULY 2019

REVISIONS TO BE MADE ON THE CADD FILE ONLY

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APPENDIX B LPW DEVELOPMENT LLC ACKNOWLEDGMENT AND APPROVAL

ERM

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ERM

18 July 2019

Mr. Marshall
LPW Development LLC,
15 Garfield Street
Auburn, New York 13021-009

Subject: Proposed Bioremediation Pilot Study Approval – Former TRW Automotive Facility, 107 Salem St, Village of Union Springs, NY.

Dear Mr. Marshall

ERM Consulting & Engineering, Inc. (ERM), on behalf of TRW Automotive U.S. LLC (TRW) is planning to implement the proposed Bioremediation Pilot Study (Project) on the referenced property as discussed in detail during our meeting with you on 17 June 2019. During the meeting, the details of the Project were discussed as outlined below:

- ERM is proposing to install a permeable reactive barrier (PRB) south of the Howland Street access road to assess the potential treatability of groundwater through bioremediation. The pilot testing area is shown on the attached figure. Soil will be removed from the proposed pilot test area and backfilled with amended imported fill that has been preapproved for use on the property by the New York State Department of Environmental Conservation. Disturbed soil around the PRB will be graded and grass will be planted for ease of maintenance.
- Several flush-mounted monitoring wells and/ or piezometers already exist or will be installed in and around the proposed pilot testing area for monitoring of subsurface conditions.
- The proposed pilot test is a long-term remedial approach. The PRB is anticipated to remain in place and will be maintained to be flush to the current surface grade.

This signed letter serves as documentation of the 17 June meeting and LPW's acknowledgement and approval for the Project.

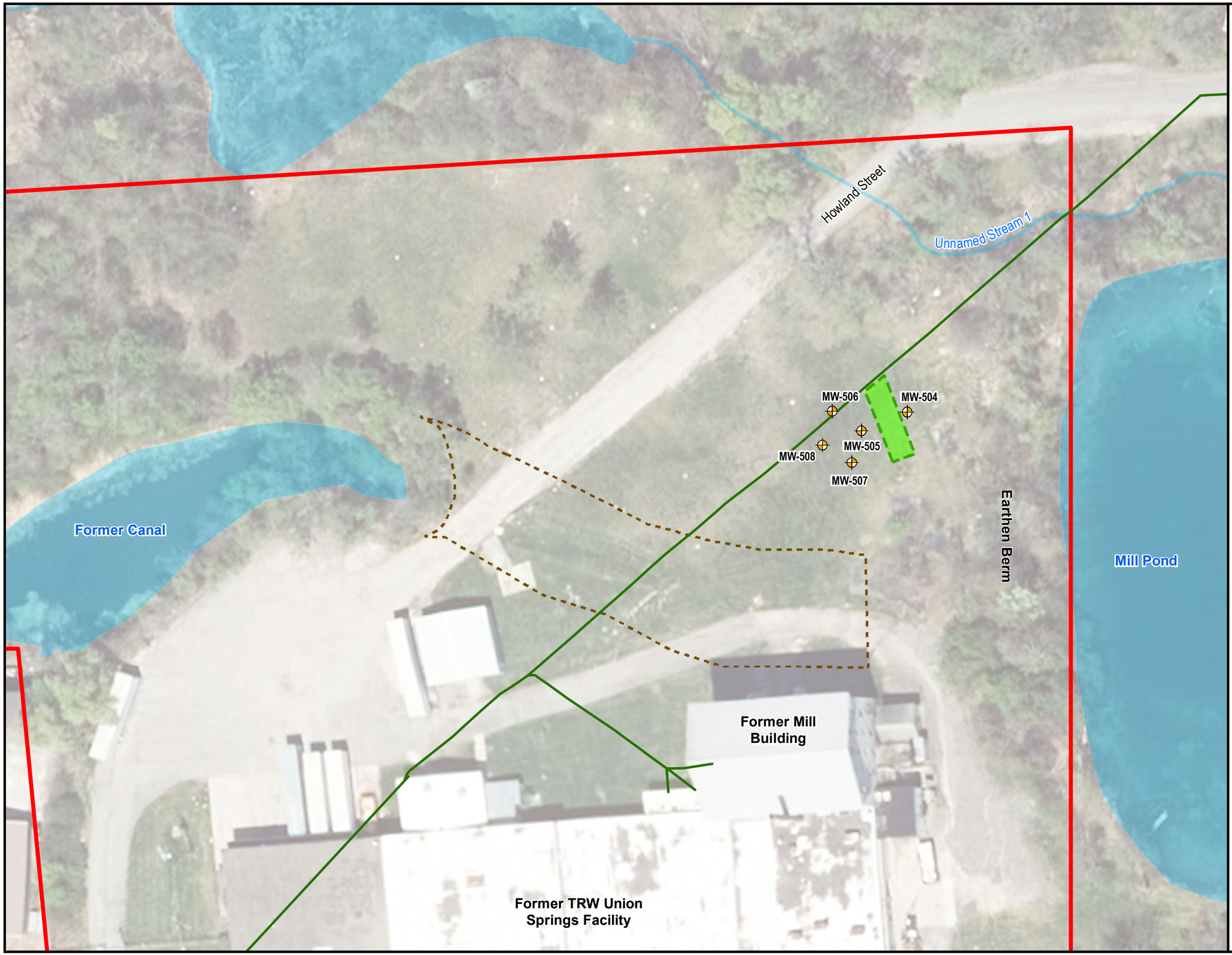
Yours sincerely

Rob Sents
ERM Project Manager

Name: [signature]

Title: Member

Date: 7-25-19



Legend

- Proposed Bioremediation Monitoring Well
- Sanitary Sewer Line
- Bioremediation Pilot Test Area
- Approximate Site Boundary
- Buried Portion of Former Canal
- Stream
- Surface Water

NOTES:

- The buried portion of the former canal was digitized based on historical maps and photographs. Location is approximate.
- Aerial imagery captured in 2015 from New York State.

N

0 12.5 25 50 75 100

Feet

Figure: Proposed Bioremediation Pilot Test

Former TRW Union Springs Facility
Union Springs, New York

ERM

Q:\Team\DMM\Clients_Q_U\TRW\Union_Springs\MXD\Misc\Figure_ProposedBioRemPilotTest_20190718.mxd - Dana.Heusinkveld - 7/18/2019