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Sent Via Electronic Email

September 30, 2021

Mr. George Jacob
U.S. Environmental Protection Agency, Region II
Emergency and Remedial Response Division
Central New York Remediation Section
290 Broadway, 20th Floor
New York, NY 10007-1866

Subject: **Conceptual Site Model Update and Work Plan for PlumeStop® Injection**
York Oil Superfund Site
Moira, New York

Dear Mr. Jacobs:

Attached for your review is the Conceptual Site Model Update and Work Plan for Plumestop® Injection prepared by HRS Water Consultants, Inc. on behalf of ***de maximis, inc*** and Arconic for the York Oil Superfund Site. Please let me know if you have any questions. We are exploring availability with drillers and hope to be able to implement the investigation work in late October / early November 2021.

Please contact me if you have any questions.

Sincerely,

Bruce Thompson

Enclosure

cc: Ms. Nicole Hinze, NYSDEC

Conceptual Site Model Update and Work Plan for PlumeStop® Injection

York Oil Superfund Site
Moira, NY

Prepared By:

HRS Water Consultants, Inc.
8885 West 14th Avenue
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Appendix A: Plumestop® Application Design Summary

1. INTRODUCTION

The York Oil facility is located in Moira, Franklin County, New York (Figure 1). The facility was constructed in the 1950s by the York Oil Company, which processed used oils collected from service stations, car dealers, and industrial facilities. The oils, some of which contained polychlorinated biphenyls (PCBs) and solvents, were processed to remove impurities and resold to other businesses. The oil recycling operation was discontinued in the mid-1960s. The property was then used by Pierce Brothers Oil Services, Inc., for used oil storage. The collected oils were stored or processed in eight aboveground storage tanks, three earthen-dammed settling lagoons, and at least one underground storage tank.

The Site was added to the National Priorities List (NPL) in September 1983 (Figure 2). For investigation and remediation purposes, the Site was divided into two operable units (OUs): the "Site Proper" and the "Contamination Pathways" (OU1 and OU2, respectively). In February 1988, EPA signed a Record of Decision (ROD) selecting a source control remedy for the “Site Proper”. The OU1 ROD required excavation, treatment, and on-site disposal of contaminated soils and sediments, installation of deep groundwater draw-down wells at the edges of the site to collect the sinking plume of phenol-contaminated groundwater; installation of shallow dewatering wells to collect contaminated groundwater and oil during excavation, and treating these liquids prior to discharging the treated groundwater in accordance with state environmental requirements; removing and transporting contaminated tank oils to an EPA-approved facility to be incinerated; cleaning and demolishing the empty storage tanks; and inspecting the site every five years to assure that human health and the environment continue to be protected.

The Contamination Pathways studies resulted in a ROD issued in September 1998. The OU2 ROD required excavation of lead- and PCB-contaminated sediments from the Western Wetland and Northwestern Wetland, followed by solidification/stabilization and on-site disposal; natural attenuation of the solvents in groundwater in the Southern Wetland; institutional controls (ICs) to prevent the installation and use of groundwater wells in the Southern Wetland; and long-term groundwater monitoring.

Operation of the OU1 groundwater treatment system (GWTS) started in December 2001. Phenol was not found in the influent; the target compounds were volatile organic compounds (VOCs), principally cis-1,2-dichloroethene (cDCE). Alternatives to continued operation of the GWTS were evaluated in 2009, resulting in shut down of the GWTS in favor of in situ treatment.

2.0 HISTORIC IN SITU TREATMENT METHODS

An investigation was conducted in spring 2009 of the former lagoon area immediately upgradient from the GWTS, which revealed ~2,000 cubic yards of subsurface soil containing total petroleum hydrocarbons (TPH). In addition to the TPH, some soil samples contained cDCE and tetrachloroethene (also called perchloroethene, or “PCE”). PCE degrades to cDCE through an intermediate product, trichloroethene (TCE). PCE and TCE have partitioned into the TPH, and were postulated to be dissolving into groundwater. TPH could potentially serve as an electron donor that facilitates biological degradation to cDCE. Previous analysis of monitored natural attenuation (MNA) data identified the lack of electron donor as a limiting factor for successful biological degradation of cDCE, so approaches to increase electron donor were utilized.

2.1 *In Situ* Chemical Reduction (ISCR)

An evaluation of feasible alternatives was performed, and EHC® was identified as a preferred *in situ* remedial option for OU-1 groundwater. EHC® is a patented combination of controlled-release carbon and zero valent iron (ZVI) particles used for stimulating *in situ* chemical reduction (ISCR) of otherwise persistent organic compounds in groundwater.

The EHC® process was proposed to USEPA at a meeting in February 2009, and a full-scale pilot study was proposed in July 2009 and approved by USEPA in August 2009. In September 2009, the groundwater extraction and treatment system was shut down and the system was drained for long-term inactivation.

Phase I of the *in situ* chemical reduction pilot study was completed in October 2009 with the installation of a 200-foot long EHC®-amended permeable reactive barrier (PRB) at a targeted depth of 6 to 35 ft. bgs. Quarterly groundwater sampling was initiated following EHC® injection. Post-injection groundwater level measurements near the PRB did not indicate any changes to the direction of groundwater flow. Groundwater sampling was reduced to semiannual during 2012.

As part of the *In Situ* Chemical Reduction Pilot Study, five new monitoring wells (YO-117S, YO-117D, YO-118, YO-119, and YO-120) were installed in October 2009.

2.2 ISCR – Phase II

In October 2011, in a letter to USEPA, on behalf of Alcoa, *de maximis* proposed a Phase II to the *in situ* chemical reduction pilot study, with the goal of enhancing the performance of the PRB through application of additional EHC®. The EHC® was to be injected using direct push technology (DPT), with locations spaced closer together as compared to Phase I to ensure creation of a continuous treatment zone. In addition, the barrier would extend further to the west to create a greater influence on the YO-12 well cluster area. The total length of the PRB would be approximately 240 ft. and extend to a depth of 6 to 43 ft. bgs. To address the recent detections of benzene, toluene, ethylbenzene and xylene (BTEX) compounds immediately downgradient of the prior EHC® injection area, *de maximis* recommended that an EHC® product containing a sulfate salt be used to further stimulate the degradation of BTEX by anaerobic oxidation via sulfate reduction.

From October 31 to November 1, 2011, Paragon Environmental Construction, Adventus, *de maximis* and CDM Smith were onsite to perform the Phase II EHC® injection via DPT. Numerous attempts were made to direct push to 43 ft. bgs that were ultimately unsuccessful due to subsurface conditions (cobble layer). One injection point was drilled to depth, but the EHC® could not be injected because the injection tip would not open. Once the injection tip was retrieved it was evident the cobble layer had damaged the injection tip, rendering the rod unusable.

After two field days of unsuccessful attempts, the Phase II EHC® injection was abandoned. Adventus, *de maximis*, Alcoa and CDM Smith decided to explore new avenues for possible EHC® injection in spring 2012. Meanwhile, the December 2011 groundwater sampling round indicated only one well where the OU-1 cleanup standards were exceeded. Based on the difficulties encountered during the October 2011 injection attempt and the subsequent improvements in groundwater quality, semi-annual groundwater monitoring was extended through 2014.

2.3 *In Situ* Bioremediation via Enhanced Reductive Dechlorination

On November 6th, 2015, on behalf of Alcoa, *de maximis* proposed a Work Plan to USEPA to inject LactOil® at the York Oil Superfund Site. The lack of an electron donor was targeted as a limiting factor for successful biodegradation of cDCE. From November through December 2015, five new wells were installed in OU-1. YO-121, YO-122, YO-123, and YO-124 are overburden wells used for injection of LactOil®. YO-125R, a bedrock well, is used for monitoring.

An environmental fracturing process was used to emplace enhanced permeability sand lenses out to a radius of approximately 15 to 20 ft. from the injection boreholes. The permeability enhancement injection process (environmental fracturing) caused a "tensile parting" of the soil to emplace a sand and guar mixture in a planar lens extending out from the injection borehole. Once the guar breaks down or is extracted during well development, the sand-filled lens remains to provide a high permeability injection pathway that can be used multiple times to inject electron donor to sustain a biological treatment zone between OU1 and OU2.

The use of injection wells means that instead of the solid / slurry EHC, a liquid reagent was used and approximately 1,400 gallons of a 5% solution of LactOil® was injected using hydraulic fracturing into the subsurface in the fall of 2015. This is equivalent to 5,000 pounds. Groundwater monitoring occurred in 2016 and 2017 to evaluate effectiveness of this treatment. The following conclusions were made based on these data:

- *In Situ* Bioremediation Treatment Pilot Study - Results indicate reducing conditions were achieved within the injection zone, and a reduction in cDCE has been observed in downgradient wells with the exception of YO-111D and YO-117D. With the change to more reducing conditions, it appears the environment continues to support enhanced biodegradation of cDCE and VC. In fact, ethene concentrations were at all-time highs in YO-117D in 2017.
- As of the end of 2017, the added electron donor was still providing TOC thereby providing the desired reducing conditions and resulting in complete reductive dechlorination to ethene.
- Recent OU-1 groundwater results have been below OU-1 ROD standard limits; therefore, OU-1 groundwater standards have been satisfied. Under the OU-1 ROD and Consent Decree, further treatment is not required.
- Increases in BTEX compounds have been observed at some monitoring wells since the injection of EHC®, most notably at downgradient locations YO-12RX, YO-14X, and YO-117D. Several factors potentially associated with the injections could be causing these conditions, including enhanced preferential pathways and changes in redox conditions and/or co-solubility. As BTEX compounds are readily aerobically biodegradable, the extent of these impacts is expected to be very limited once these contaminants have migrated beyond the injection zone.

2.4 *In Situ* Treatment with PlumeStop®

In October 2018, in a letter to USEPA, on behalf of Alcoa, de maximis proposed a Work Plan to to inject Plumestop®, a colloidal liquid activated carbon (LAC), at the York Oil Superfund Site. Plumestop® was chosen to proactively address increasing BTEX concentrations in the upgradient portion of the OU2 Southern Wetlands, as well as cDCE. The LAC component of Plumestop® is primarily intended to target BTEX. CVOCs also sorb to the LAC and both the BTEX and cVOCs are ultimately expected to biodegrade, freeing binding sites for continuing sorption and degradation.

Activated carbon is widely used for a variety of environmental remediation applications because it effectively removes a variety of organic compounds from the water matrix. EPA has recognized this as shown in the attached April 2018 remedial technology fact sheet "Activated Carbon- Based Technology for In Situ Remediation" (EPA 542-F-18-001 | April 2018).

PlumeStop® LAC is an innovative groundwater remediation and water treatment technology designed to rapidly sorb and degrade contaminants in groundwater through microbial processes. It is applied as a solution of very fine particles of activated carbon suspended in water using unique organic polymer dispersion chemistry. Once in the subsurface, the material forms a biomatrix by binding to aquifer material, where it then is expected to rapidly remove contaminants from groundwater and subsequently support contaminant biodegradation.

This remediation approach accomplishes treatment with the use of highly dispersible, fast-acting, sorption-based technology, capturing and concentrating dissolved-phase contaminants within its matrix-like structure. Once contaminants are sorbed onto the regenerative matrix, biodegradation processes achieve complete remediation. This is accomplished by creating a dynamic environment where sorption dominates desorption and allows for a continuous local supply, while present in dissolved and sorbed phase, of organic compounds within the matrix. This creates an ideal environment for local or introduced microbes to be in constant contact with organic contaminants.

Testing by the manufacturer Regenesis[1] shows that the carbon in PlumeStop® becomes bound in the soil matrix within a short distance from the injection area, thus mitigating continued downgradient migration of sorbed organic compounds. In other words, PlumeStop® substantially increases the solid carbon content of the aquifer matrix, enhancing the sorption component of the plume attenuation capacity. Regenesis' product testing also indicates that the LAC provides a medium for enhanced biodegradation of sorbed VOCs. This continued biodegradation decreases the overall VOC mass on the LAC, freeing carbon binding sites for additional sorption of VOCs.

In November 2018, 8,800 pounds of PlumeStop® LAC was injected using the four existing injection wells installed in 2015: YO-121, YO-122, YO-123, and YO-124 (Figure 3). These injection wells are spaced approximately 30 ft apart and are screened from 19 to 39 ft below ground surface (bgs). Groundwater monitoring occurred in 2019 and 2020 to evaluate effectiveness of this treatment. The following conclusions were made based on these data:

- 2018 *In Situ* PlumeStop® Treatment - Results indicate enhanced sorption and biodegredation within the injection zone, and a consistent reduction in cVOCs and BTEX has been observed in all downgradient wells except YO-117D. cVOC and BTEX concentrations decreased initially following 2018 treatment at YO-117D but have increased since the May 2019 sampling event (Figure 4).
- Decreasing cVOC and BTEX concentrations at the downgradient wells throughout 2019 and 2020 can be attributed to sorption to Plumestop® and natural attenuation. See Figure 5, which shows example data from YO-58.
- The current injection wells are missing/applying only a small amount of PlumeStop® to YO-117D, which is ~55 ft downgradient of the injection wells. However, Plumestop® is reaching YO-58,

[1] Refer to PlumeStop® product information at https://regenesis.com/.

which is ~265 ft downgradient of the injection wells. Thus, a re-conceptualization of the site hydrogeology is needed to understand why concentrations in YO-117D remain elevated.

3.0 HYDROGEOLOGIC REVIEW AND CONCEPTUAL SITE MODEL UPDATE

We reviewed the primary geologic, hydrologic, and contaminant transport data available for the site. The hydrogeologic review involved examining all lithologic logs at the site and published geologic reports and evaluating groundwater elevation data and slug test data. The contaminant transport review consisted of analyzing concentration trend data and conducting a breakthrough curve (BTC) analysis.

3.1 Hydrogeologic Data Review

Based on the hydrogeologic data, we divided the site into shallow and deep groundwater zones. The shallow groundwater zone is unconfined and consists of fill/alluvium underlain by reworked till. The fill/alluvium contains sand, sand with gravel, sand with silt, and clayey silt. The water table lies approximately five ft below the ground surface in the fill/alluvium. Slug tests indicate the hydraulic conductivity (K) of the fill/alluvium averaged 0.72 ft/d (Table 1). The reworked till contains dense sand and silt with gravel and has an average K of 0.79 ft/d as measured by slug tests.

The shallow groundwater zone is underlain by consolidated till, which includes very dense sand and silt with gravel. The distinguishing feature between the consolidated and reworked till is soil density, which is indicated by standard penetration test (SPT) blow counts. SPT blow counts for the consolidated till typically exceed 100 blows over six inches of penetration. The K of the consolidated till averages 0.002 ft/d.

The deep groundwater zone consists of weathered bedrock and competent bedrock. The weathered bedrock, a weathered dolomitic sandstone, lies beneath the consolidated till and is only a few feet thick. This is underlain by competent dolomitic sandstone bedrock, with a K on the order of 0.05 ft/d. The K of the consolidated till is an order of magnitude lower than bedrock K. Thus, the consolidated till has a significant influence on groundwater transport at the site by restricting vertical flow into the bedrock zone.

Using blow count data from the lithologic logs, we contoured the top of consolidated till surface (Figure 6). The consolidated till formed as a basal till during periods of intense glaciation when the site was compacted under thousands of feet of ice. During glacial retreat, paleo-rivers drained glacial melt water through the region, eroding paleochannels into the consolidated till. The eroded consolidated till was broken apart, displaced, and redeposited as reworked till or alluvial outwash. Figure 6 shows one such paleochannel oriented southeast along the edge of the landfill and then turning due south near the OU1 boundary. The grey shading highlights the deepest part of the paleochannel. Hydrogeologically, the paleochannel functions as a preferential groundwater transport pathway.

We also constructed two east-west hydrogeologic cross sections to analyze the site: A-A’ and B-B’ (Figure 7). Cross Section A-A’ is located just south of the OU1 boundary and includes YO-117D. The cross section shows YO-117D is in the deepest portion of the paleochannel (blue dashed oval; Figure 8). YO-117D is screened exclusively within the reworked till unit. Cross section B-B’ is located just north of the OU1 boundary and includes injection wells: YO-121, YO-122, YO-123, and YO-124 (Figure 9). These injection wells have 20 ft well screens and are screened in portions of the fill/alluvium, reworked till, and consolidated till. Hydrofracking was used to enhance the radius of influence (ROI) of the injection wells. Fracked intervals were mostly located in the consolidated till, which results in enhanced transport in the consolidated till unit. The cross section also shows that YO-123 is located upgradient of YO-117D in the deepest part of the paleochannel, but screens only the upper portion of the reworked till. This explains in part why groundwater quality at YO-117D did not improve after the in-situ remediation efforts using permanent injection wells. The consolidated till has been completely eroded away at YO-123 and reworked till lies directly on top of bedrock.

Next, we contoured 2020 groundwater elevation data in the shallow and deep zones (Figures 10 and 11). The shallow zone consists of wells screened in the fill/alluvium and reworked till. The data shows groundwater flow is due south and the paleochannel is a primary control on groundwater transport (Figure 10). The deep zone contains wells screened in weathered bedrock and bedrock. The data also shows groundwater flow in the deep zone is towards the south, but the paleochannel no longer controls groundwater flow (Figure 11).

3.2 Contaminant Transport Data Review

To further evaluate geologic influences on contaminant transport and remediation, we plotted cVOC concentrations from 2011 and 2020 on hydrogeologic cross section A-A’ (Figures 12 and 13). 2011 concentrations were highest in the reworked till and fill/alluvium, with the highest concentration in YO-117D. Therefore, cVOC contamination appears to be mostly limited to the paleochannel. In 2020, cVOC detections greater than 1 microgram per liter (µg/L) were limited to YO-117S and YO-117D, resulting in a smaller, but more concentrated plume limited to the center of the channel and demonstrating that attenuation is occurring. cVOC concentrations are highest in the reworked till and increased at YO-117D from 41.6 µg/L to 124 µg/L between 2011 and 2020. This finding indicates that the reworked till is the primary pathway for contaminant transport.

In October 2009 EHC® was injected into temporary injection points immediately upgradient of the OU1 boundary. Post injection, there were spikes in methyl-ethyl keytone (MEK) and acetone concentrations in groundwater downgradient of the injection locations. MEK and acetone spikes were observed in YO-14ALX and YO-117S (Figures 14A and 14B). These wells are located in the paleochannel and screened in the fill/alluvium. A spike of MEK was also observed in YO-14X and YO-117D (Figures 14C and 14D). These wells are also located in the paleochannel and are screened in the reworked till. The MEK and acetone data were used to compute the travel time[2] and travel distance[3] at each monitoring location. This information was then used to compute the contaminant velocity (Cv) using a modified breakthrough curve (BTC) analysis. The retardation factor (R) and groundwater velocity (V) were computed independently using the groundwater gradient and soil[4] and contaminant properties[5]. BTC hydraulic conductivity (BTC K[6]) was then back calculated from the prior results. The resulting BTC K values for the fill/alluvium were remarkably close and ranged between 0.73 to 0.86 ft/d. The BTC K

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[2]Elapsed time between injection and maximum concentration of MEK or acetone.
[3] Distance between the monitoring well and nearest injection point.
[4] Soil bulk density, effective porosity, fraction organic carbon.
[5] Soil organic carbon-water partition coefficient.
[6] We distinguish between BTC derived hydraulic conductivity and slug test derived hydraulic conductivity because slug tests measure hydraulic properties at wells and are useful for estimating groundwater flow quantities. In contrast, BTC derived hydraulic conductivity may be more representative of contaminant transport quantities.

values calculated for the reworked till ranged from 1.24 to 1.6 ft/d. These values are close to double the values for the fill/alluvium, indicating faster transport within the reworked till.

The BTC K values were then compared to the slug test K values. Figure 15 shows the locations of the BTC analysis and slug tests. As shown, the slug tests were conducted outside the paleochannel, but the BTC analyses were conducted within the paleochannel. The slug test results indicate similar K values for the fill/alluvium and the reworked till, with geomeans of 0.72 ft/d and 0.79 ft/d respectively. The K results for both methods are comparable in the fill/alluvium, with the slug tests producing a geomean of 0.72 ft/d and the BTC results indicating 0.79 ft/d (Table 1). BTC results in the reworked till yield a K of approximately double that of the slug tests. These results suggest that outside the paleochannel the hydraulic properties of the fill/alluvium and reworked till are relatively equivalent. However, within the paleochannel, where the reworked till has been extensively altered, the K is much higher. These results corroborate the finding that the paleochannel is a preferential pathway for contaminant transport and were used to update the conceptual site model and design the next phase of remediation.

3.3 Conceptual Site Model Update

Our review of the primary geologic, hydrologic, and contaminant transport data has allowed us to update the conceptual site model:

- The site contains a glaciofluvial paleochannel, which heads southeast along the edge of the landfill and then turns due south near the OU1 boundary
- The paleochannel is filled with reworked till and fill/alluvium; the base of the paleochannel is defined by the top of the consolidated till
- The paleochannel shape dictates the groundwater flow direction in the reworked till
- The reworked till is a zone of enhanced transport (higher K)
- Contamination is highest in the reworked till (cVOCs and BTEX)
- YO-117D is located within a paleochannel and is screened in the reworked till

4.0 REMEDIATION WORK PLAN

The remediation work plan is designed to target the reworked till in the paleochannel with the injection of Plumestop®. The approach involves installing of a 200-foot-long permeable reactive barrier (PRB) across the paleochannel, just south of the landfill (Figure 16). The PRB will treat groundwater flowing south in the paleochannel through the reworked till zone. Permanent injection wells will be installed along the PRB and screened in the reworked till to administer the Plumestop® (Figure 17).

Soil borings will be drilled using a hollow stem auger rig to bedrock. Two-foot continuous split spoon samples with SPTs (i.e., blow counts) will be collected to identify the reworked till zone. A de maximis geologist will keep a blow count record and a detailed lithologic log during drilling. When blow counts indicate the reworked till has been reached, push-ahead water quality samples will be collected by pushing a temporary screen ahead of the augers and collecting groundwater samples. These samples will be sent to Alpha Analytical for quick turnaround analytical results. Alpha Analytical will analyze for all VOC contaminants of concern (COCs)[7] using the following analytical methods: EPA 8260C and RSK-175. Our anticipated well design involves 4-inch diameter injection wells with schedule 80 PVC solid casing and

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[7] de maximis, inc, September 2020. York Oil Operable Unit 1 & 2 Superfund Site Moira NY Operation Maintenance, and Monitoring Plan. Page 10.

stainless-steel wire wrapped, 0.020" V-slotted stainless-steel screen. The injection wells will be screened in the reworked till, which we approximate as six ft thick. Filter pack, likely #1 Morie sand, will be placed from approximately one foot below the well screen to three to five feet above the top of the screen. A cement bentonite grout mixture will be used to complete the wells. Injection wells will be developed using surge and pump method. Investigation derived waste (IDW) will be drummed and staged by the driller. IDW will be disposed of by an environmental services company following EPA protocols.

Regenesis, the manufacturer of Plumestop®, recommended the installation of 9 injection wells spaced 23 ft apart to cover the 200-foot PRB length. The suggested injection interval is 6 ft and corresponds to the approximate thickness of the reworked till displayed in cross section B-B'. The recommended injection amount is 1,378 pounds per well (lbs/well) or 12,400 pounds (lbs) total (see Appendix A: Plumestop® Application Design Summary). These recommendations assume contamination is present along the full paleochannel width.

However, the western lateral extent of contamination along the proposed PRB is currently not well delineated. For example, just south of the proposed PRB, Figure 18 shows 2020 cVCOC concentrations displayed on cross section A-A'. As shown, cVOCs are present in YO-117S and YO-117D, but the extent of cVOC contamination to the west is not known. Since the lateral extent of contamination is not well defined, we propose a flexible and iterative approach to injection well installation. This involves drilling twelve soil borings and installing up to 9 injection wells. When each soil boring reaches the reworked till zone, push-ahead water quality samples will be collected and sent for quick turnaround analytical results. If VOCs and/or BTEX concentrations exceed 5 µg/L, an injection well will be installed and Plumestop® will be injected. If both VOCs and BTEX concentrations are less than 5 µg/L, the boring will be drilled to bedrock to complete the lithologic log and then abandoned. This will allow the Plumestop® injections to specifically target the portions of the paleochannel that are contaminated. Borings not completed as injection wells will be used to further delineate the site geology and the extent of contaminants present and will be abandoned by filling with bentonite.

The anticipated schedule will allow for drilling in late fall for up to nine weeks. If drilling is completed before winter weather begins, Plumestop® will be injected in late fall over a three week period. If drilling continues into early winter, Plumestop® injection will be pushed to early spring 2022. The total on-site time required for drilling and injection is 12-weeks. We will notify EPA regarding any remediation activities taking place on-site.

Tables

Table 1: Hydraulic Conductivity (K) values from slug tests and BTC results

A) Slug Test Results

K (ft/d)	Fill/Alluvium	Reworked Till	Bedrock
Min	0.48	0.48	0.003
Max	1.22	2.01	0.16
Average	0.79	0.97	0.09
Geomean	0.72	0.79	0.05

B) BTC Results

K (ft/d)	Fill/Alluvium	Reworked Till
Min	0.73	1.24
Max	0.86	1.60
Average	0.80	1.42
Geomean	0.79	1.41

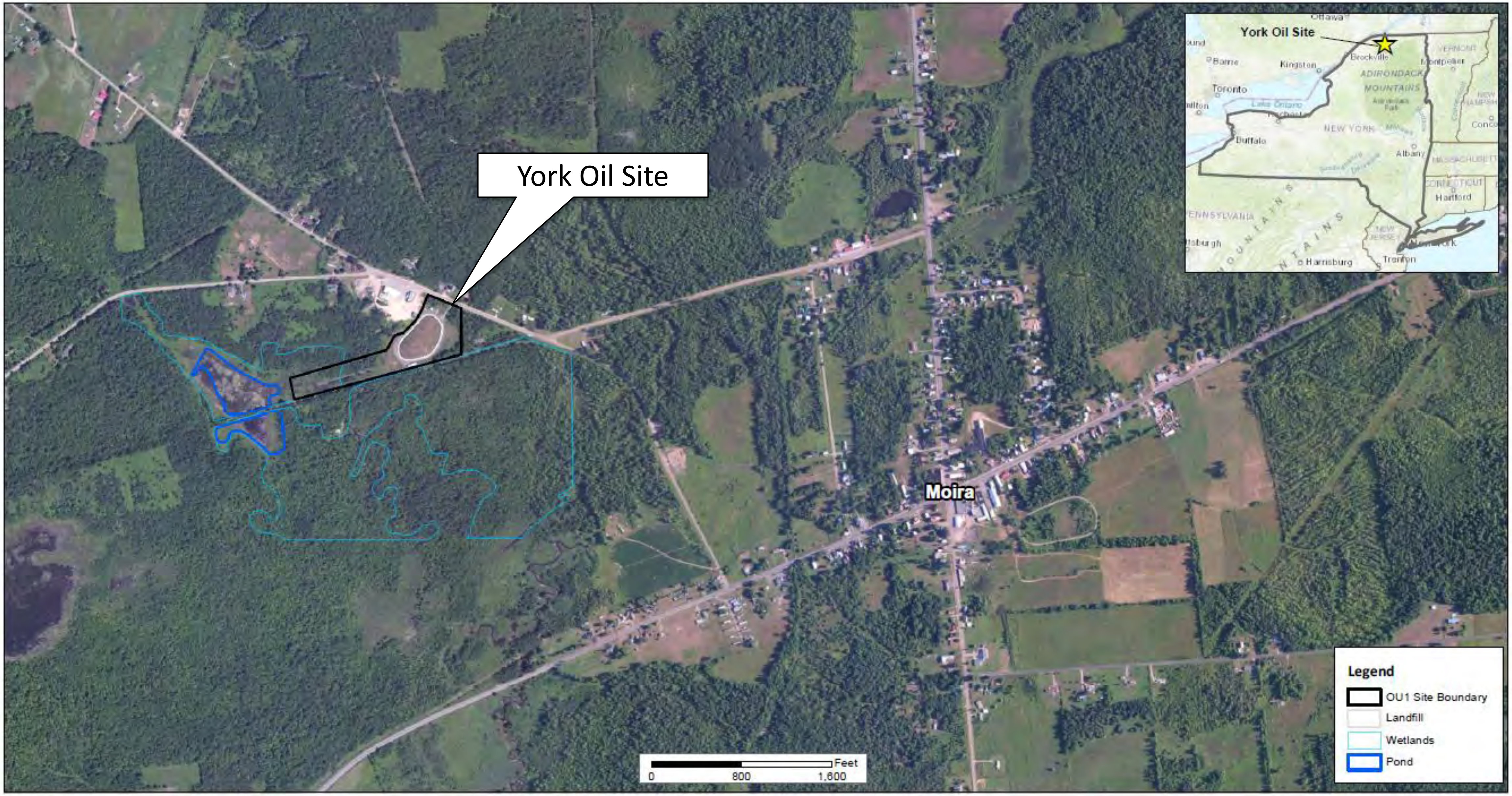

Figure 1– Site Location Map
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: TDR
Date: July 2021

HRS Water Consultants

Remediation Timeline

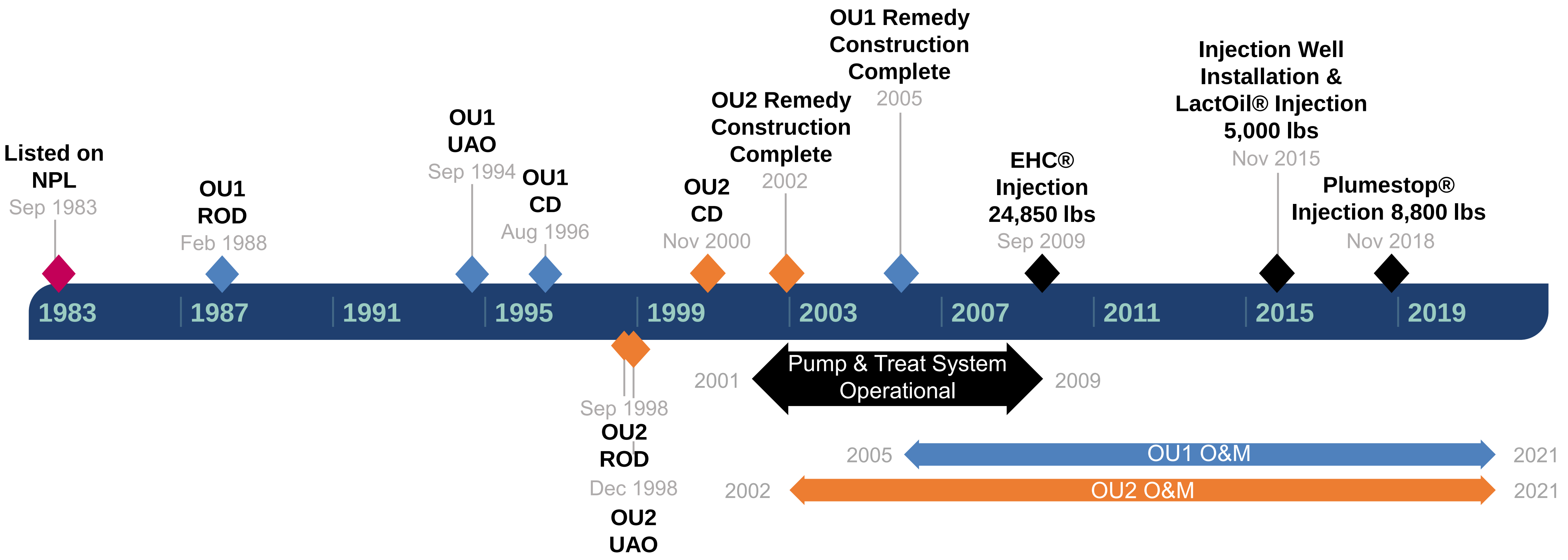

Figure 2– Remediation Timeline
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: FBM
Date: July 2021

HRS Water Consultants

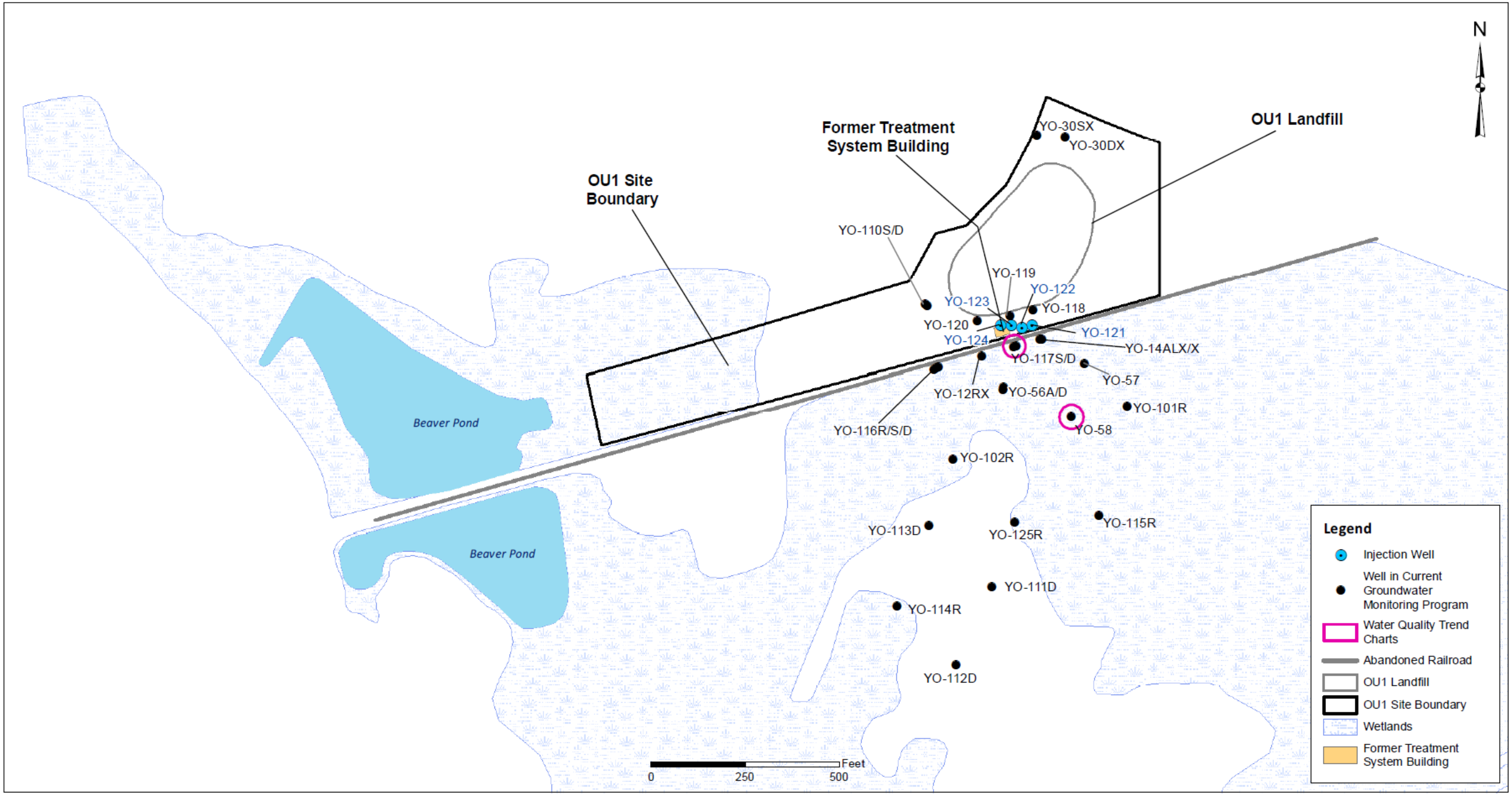

Figure 3– Site Map with Monitored Wells
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: TDR
Date: August 2021

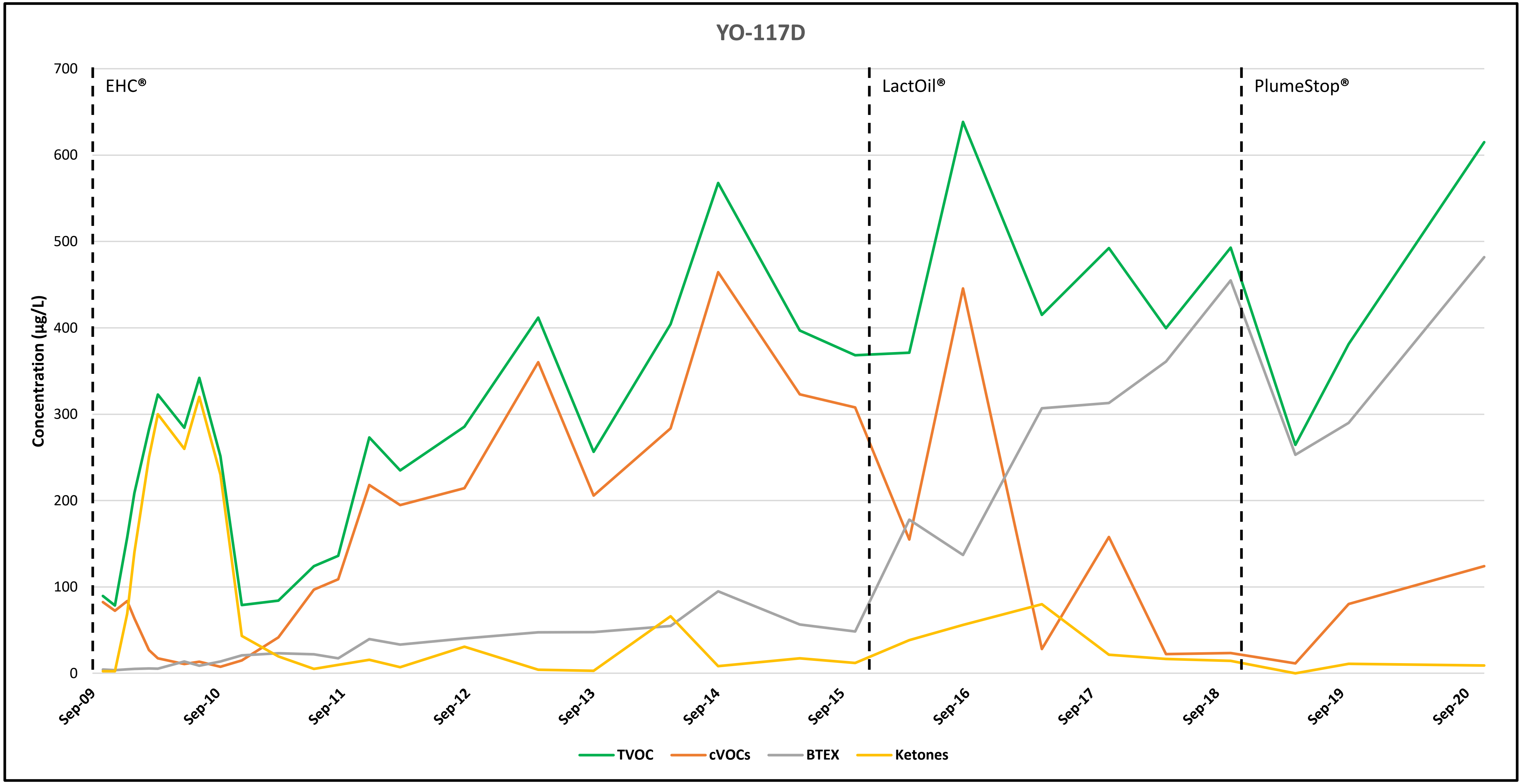

Figure 4 – YO-117D Water Quality Data
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: FBM
Date: July 2021

HRS Water Consultants

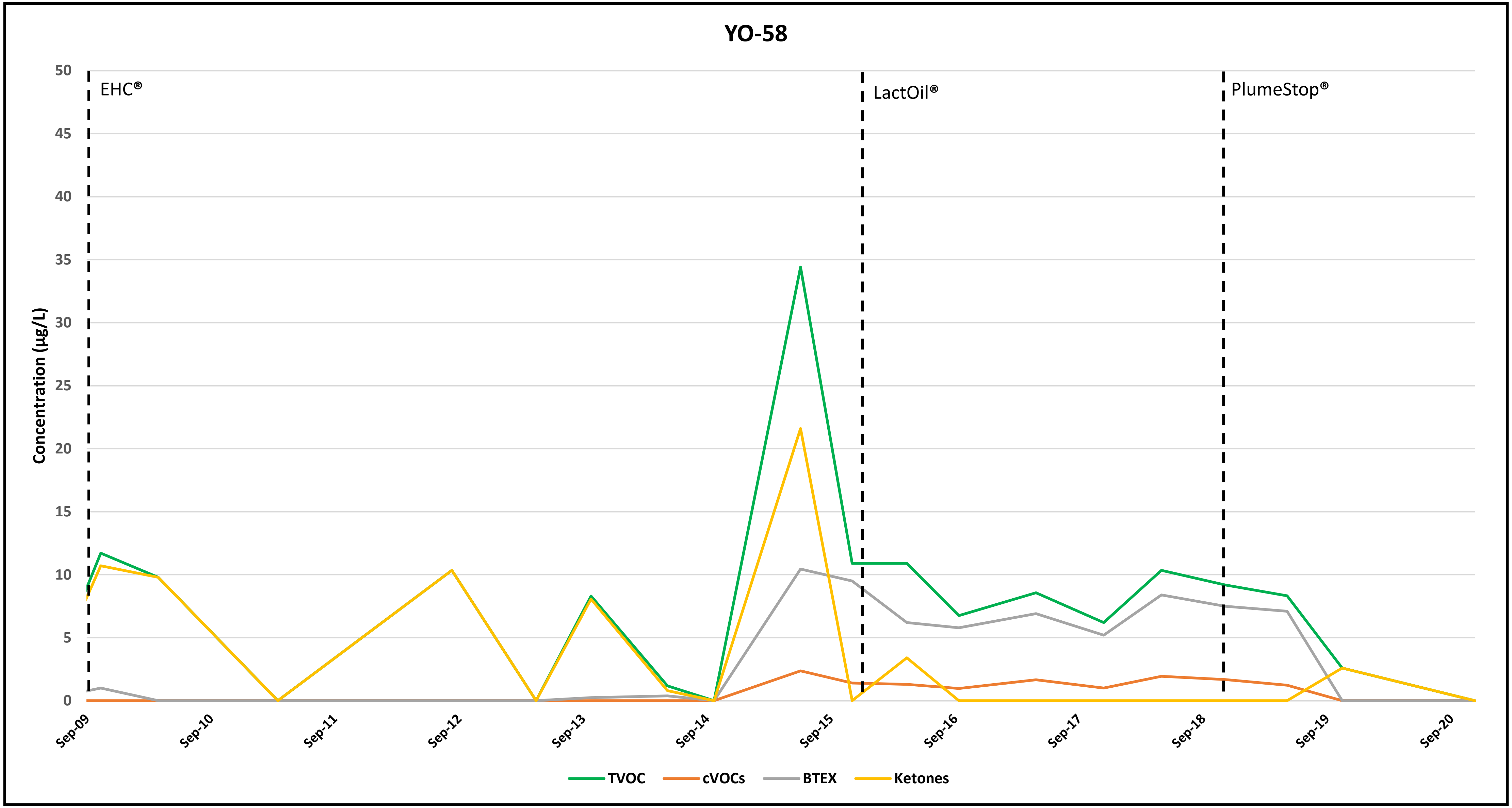

Figure 5 – YO-58 Water Quality Data
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: FBM
Date: July 2021

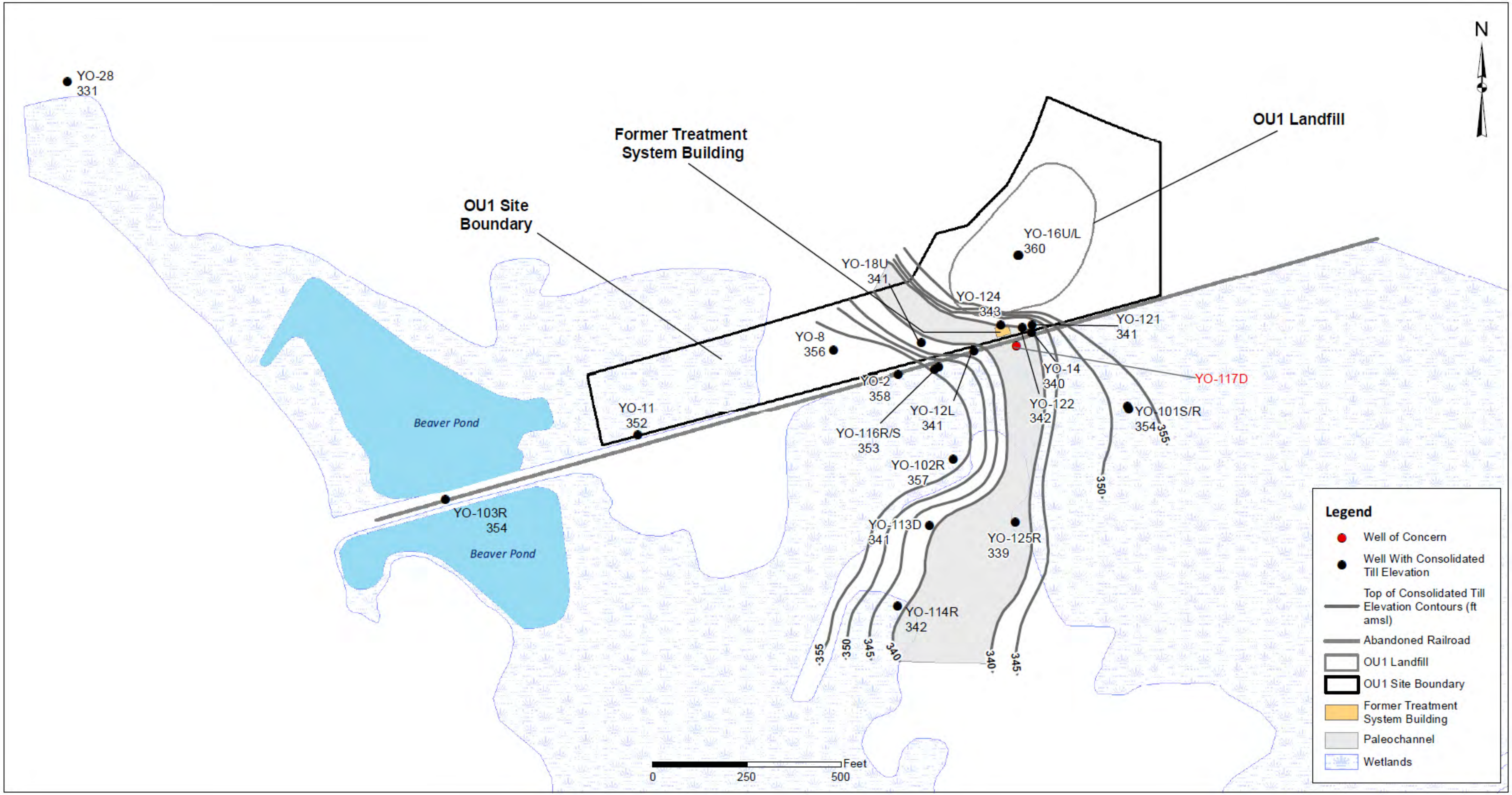

Figure 6– Consolidated Till Elevations
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: TDR
Date: May 2021

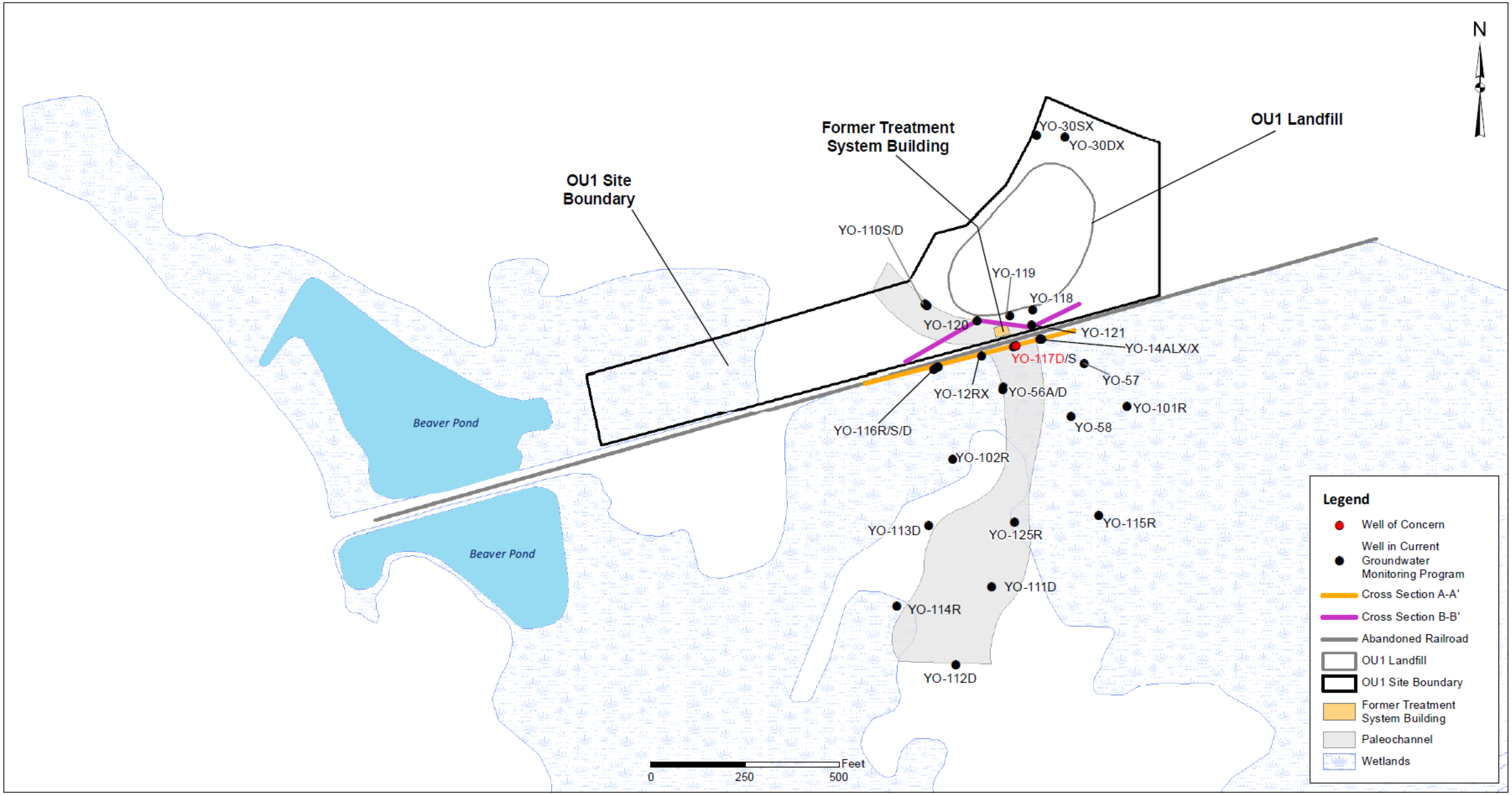

Figure 7– Site Map with Cross Sections
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: TDR
Date: May 2021

HRS Water Consultants

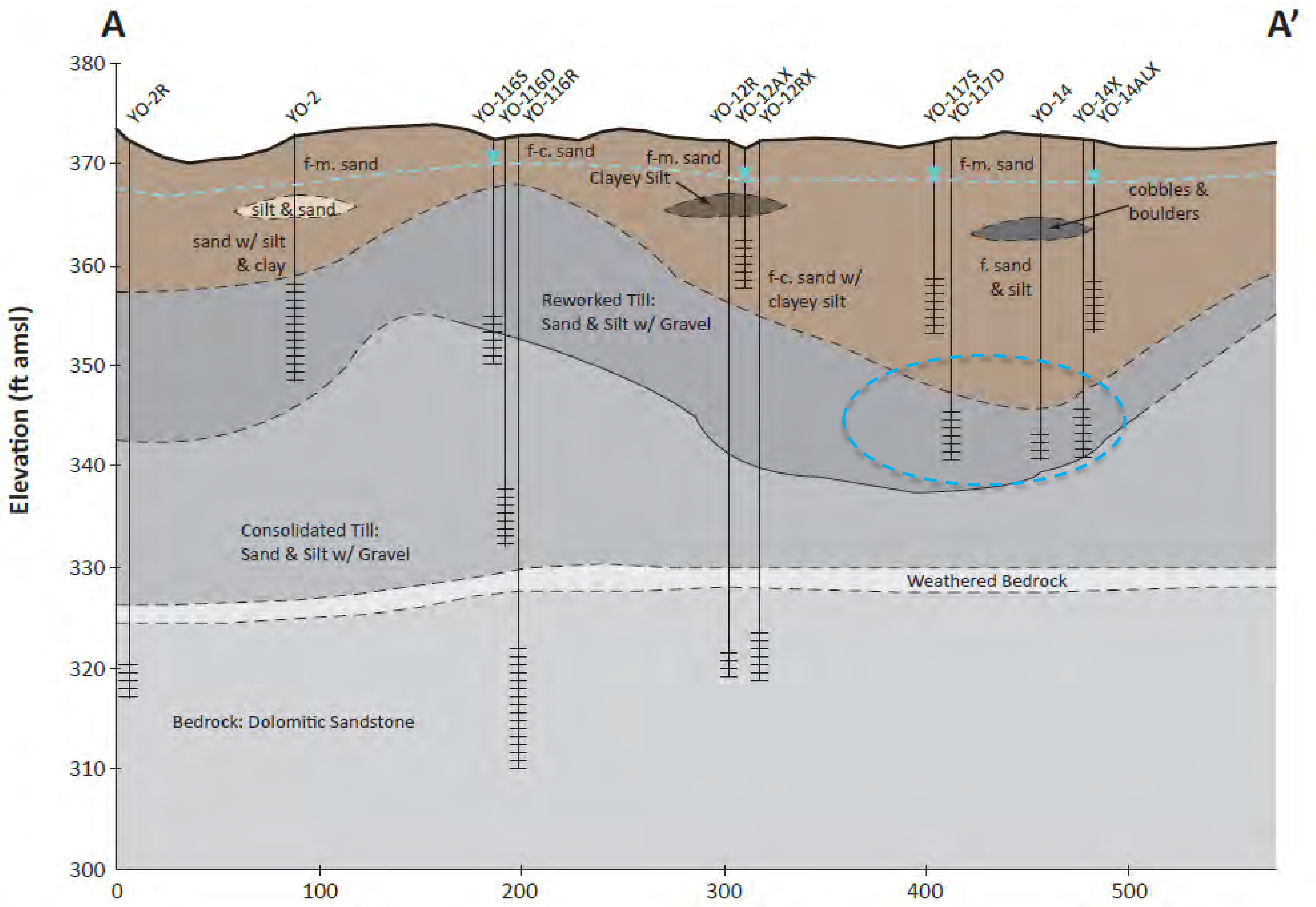

Figure 8– Cross Section A-A’
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: FBM
Date: May 2021

HRS Water Consultants

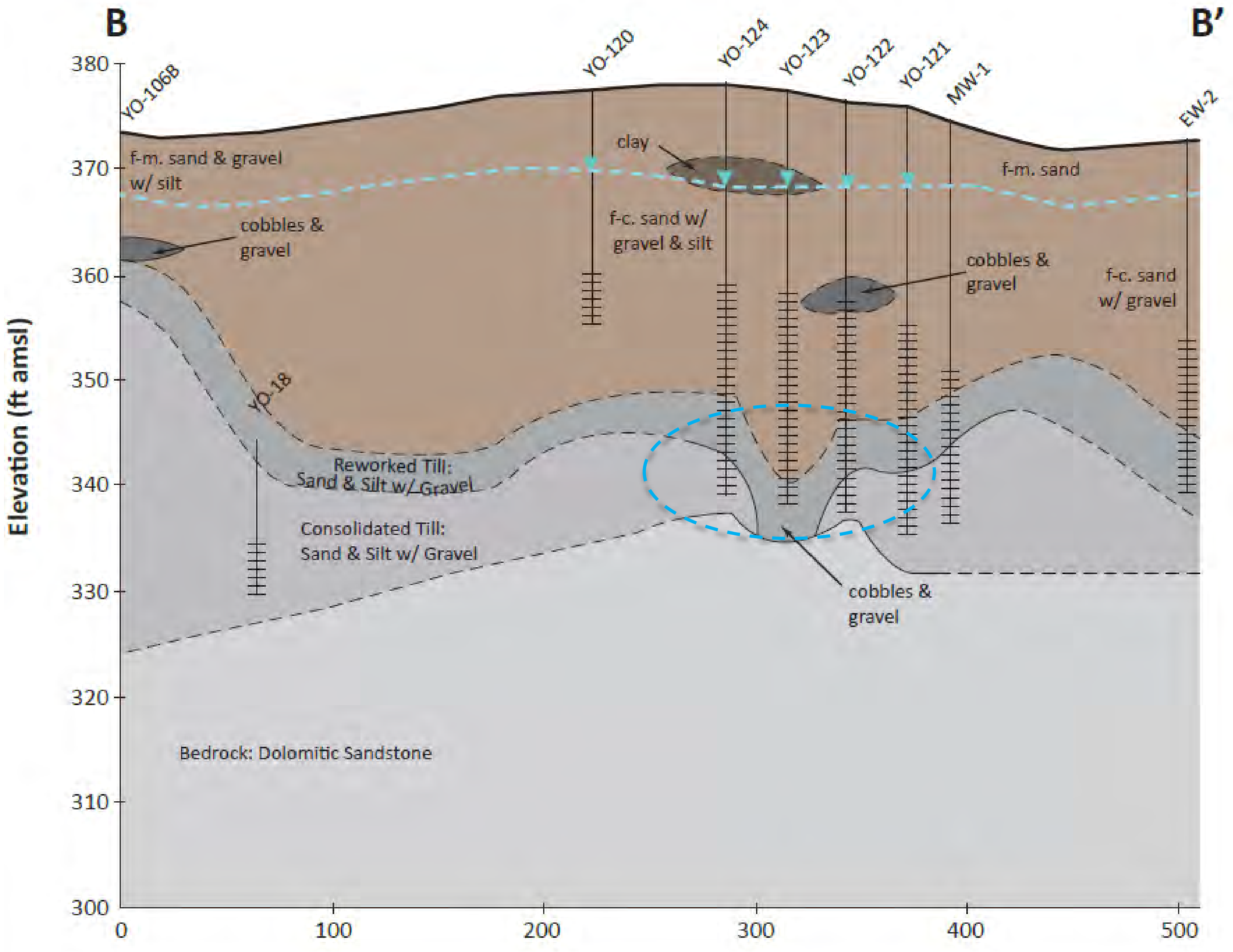

Figure 9– Cross Section B-B'
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: FBM
Date: May 2021

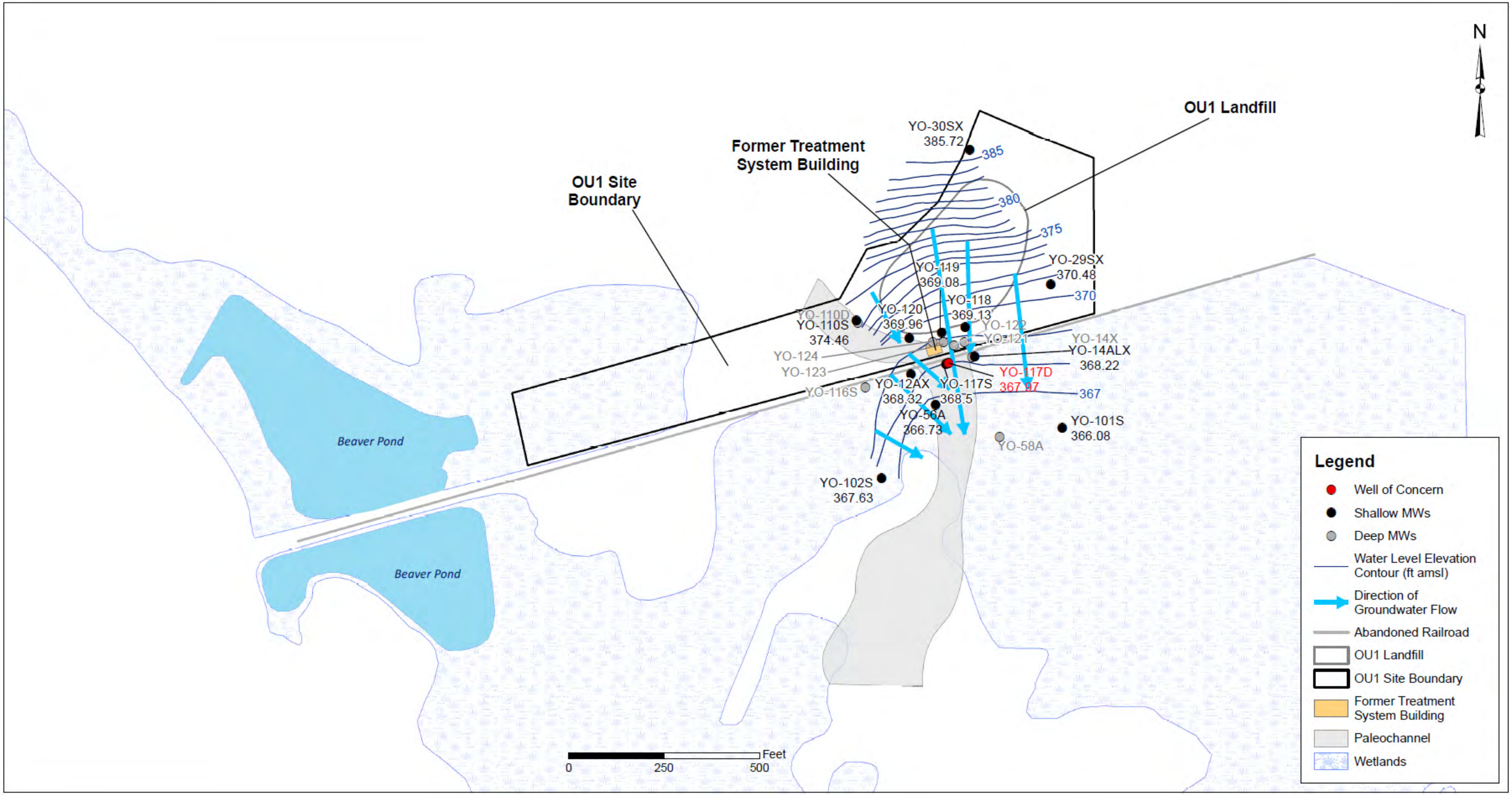

Figure 10– 2020 Shallow Monitoring Well Groundwater Elevations
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: TDR
Date: May 2021

HRS Water Consultants

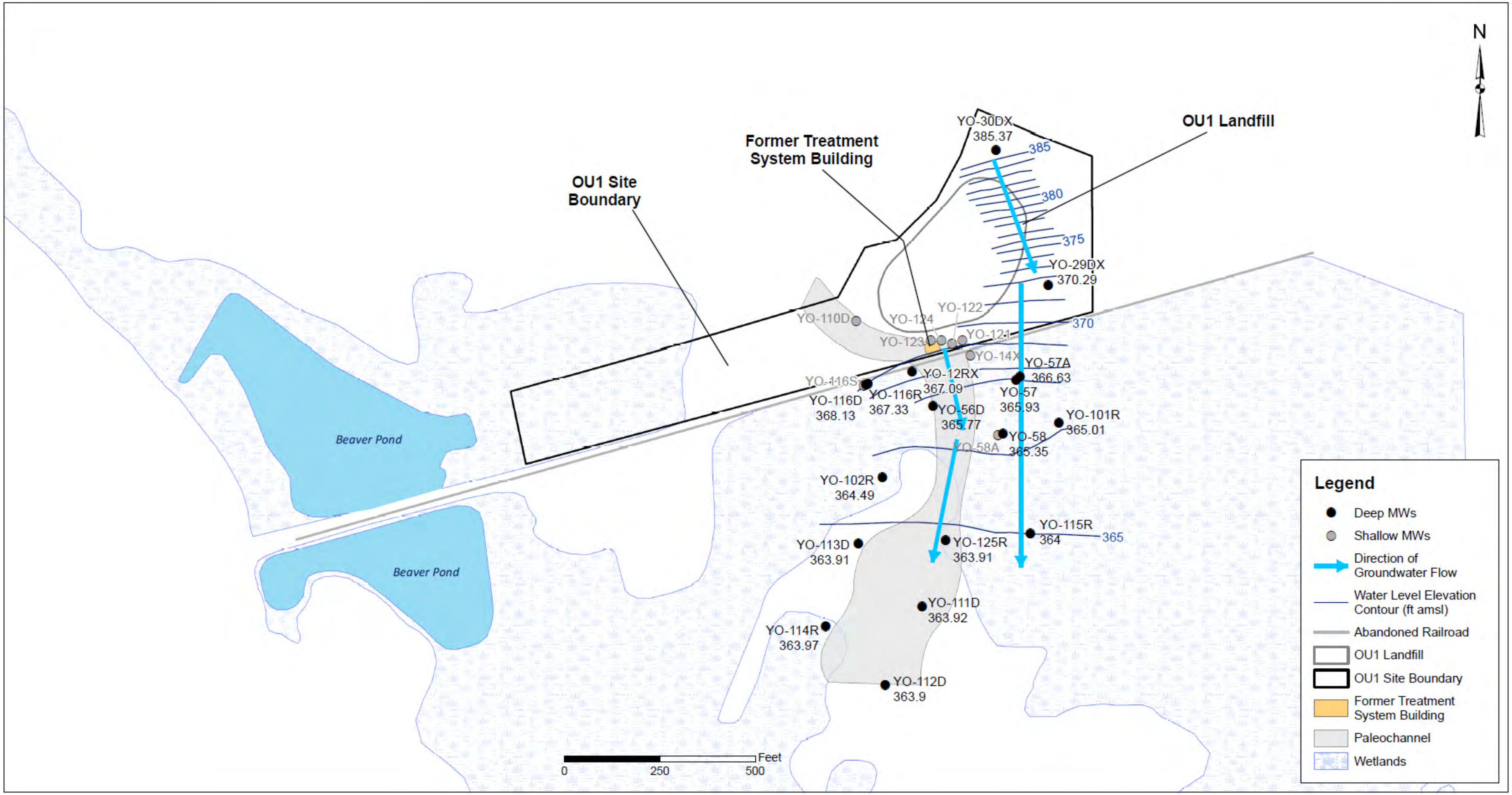

Figure 11– 2020 Deep Monitoring Well Groundwater Elevations
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: TDR
Date: May 2021

HRS Water Consultants

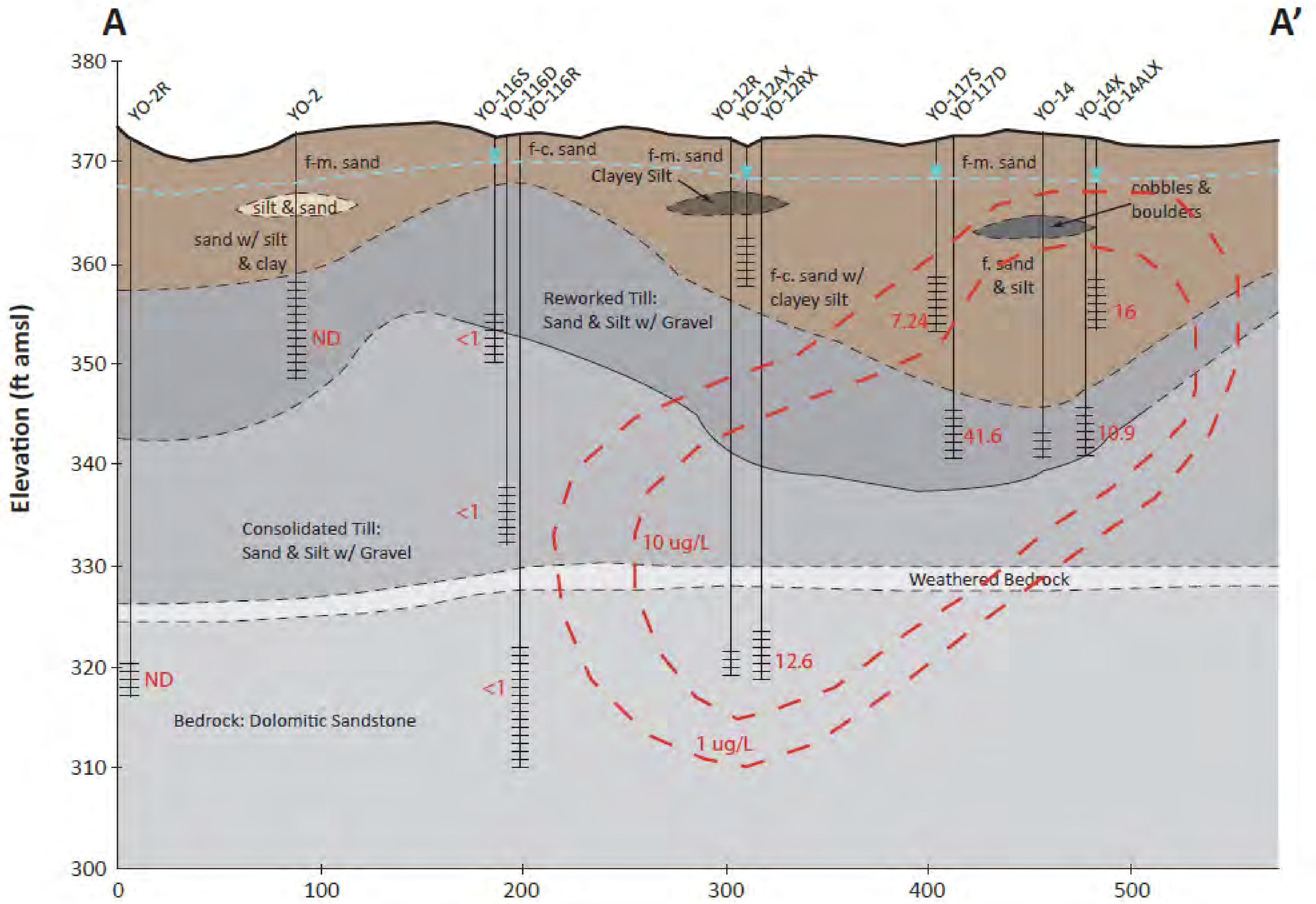

Figure 12– Cross Section A-A': cVOC Concentrations March 2011
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: FBM
Date: May 2021

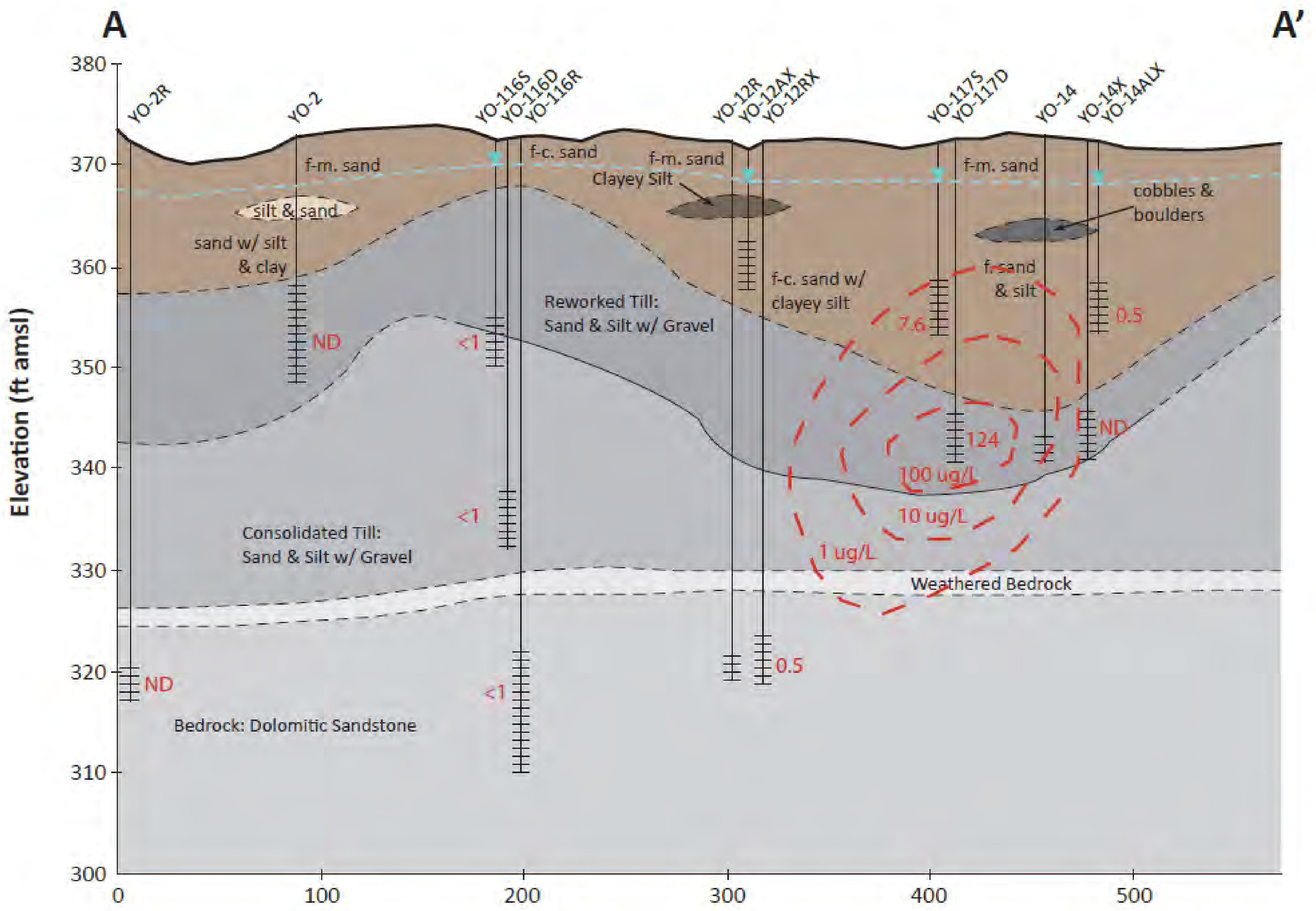

Figure 13– Cross Section A-A': cVOC Concentrations September 2020
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: FBM
Date: May 2021

HRS Water Consultants

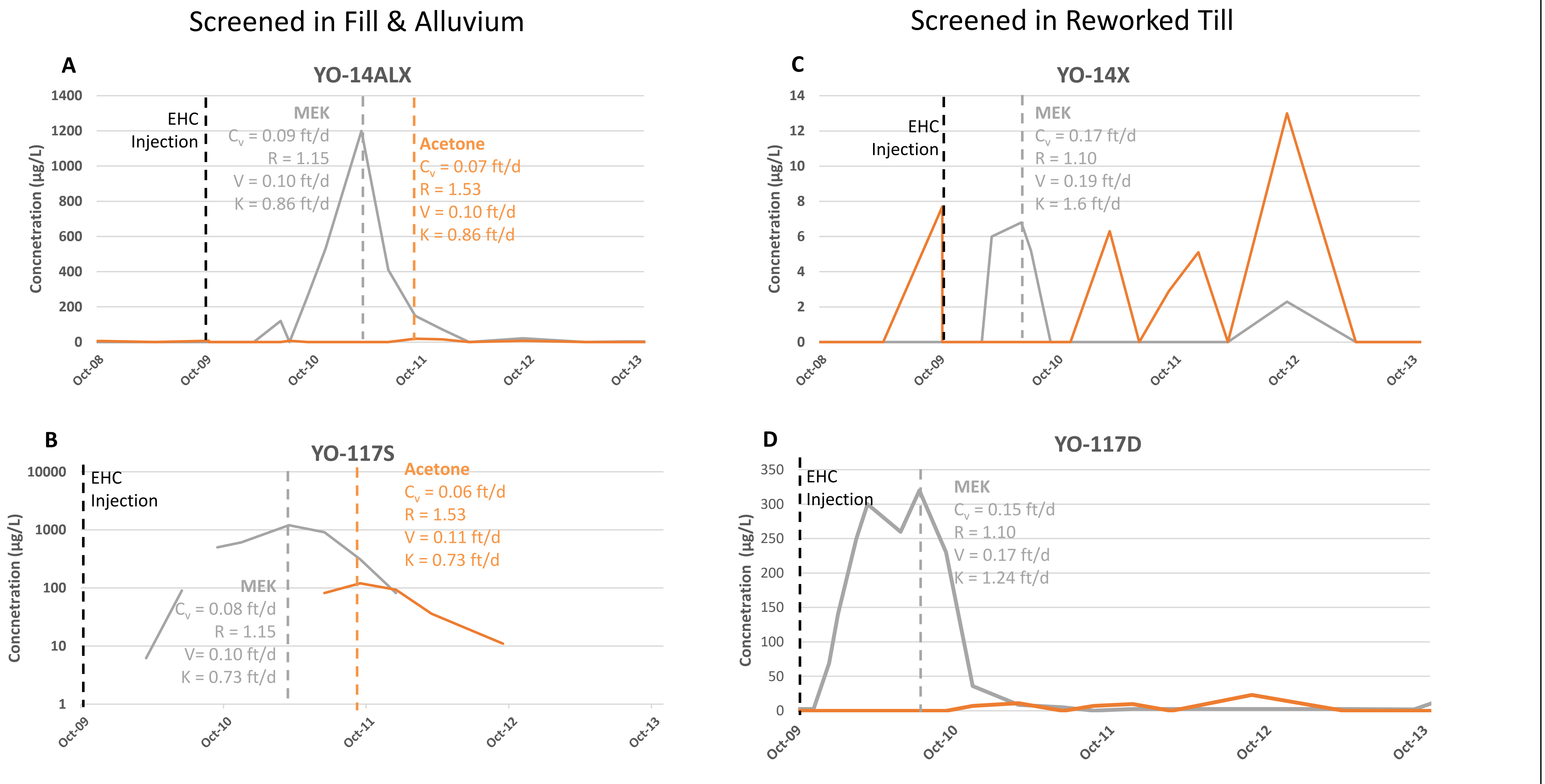

Figure 14– MEK and Acetone Breakthrough Curves
York Oil Site
Moira, NY

C_v = Contaminant Velocity (ft/d)
R = Retardation Factor
V = Groundwater Velocity (ft/d)
K = Hydraulic Conductivity (ft/d)

Job Number: 21-05
Prepared by: FBM
Date: May 2021

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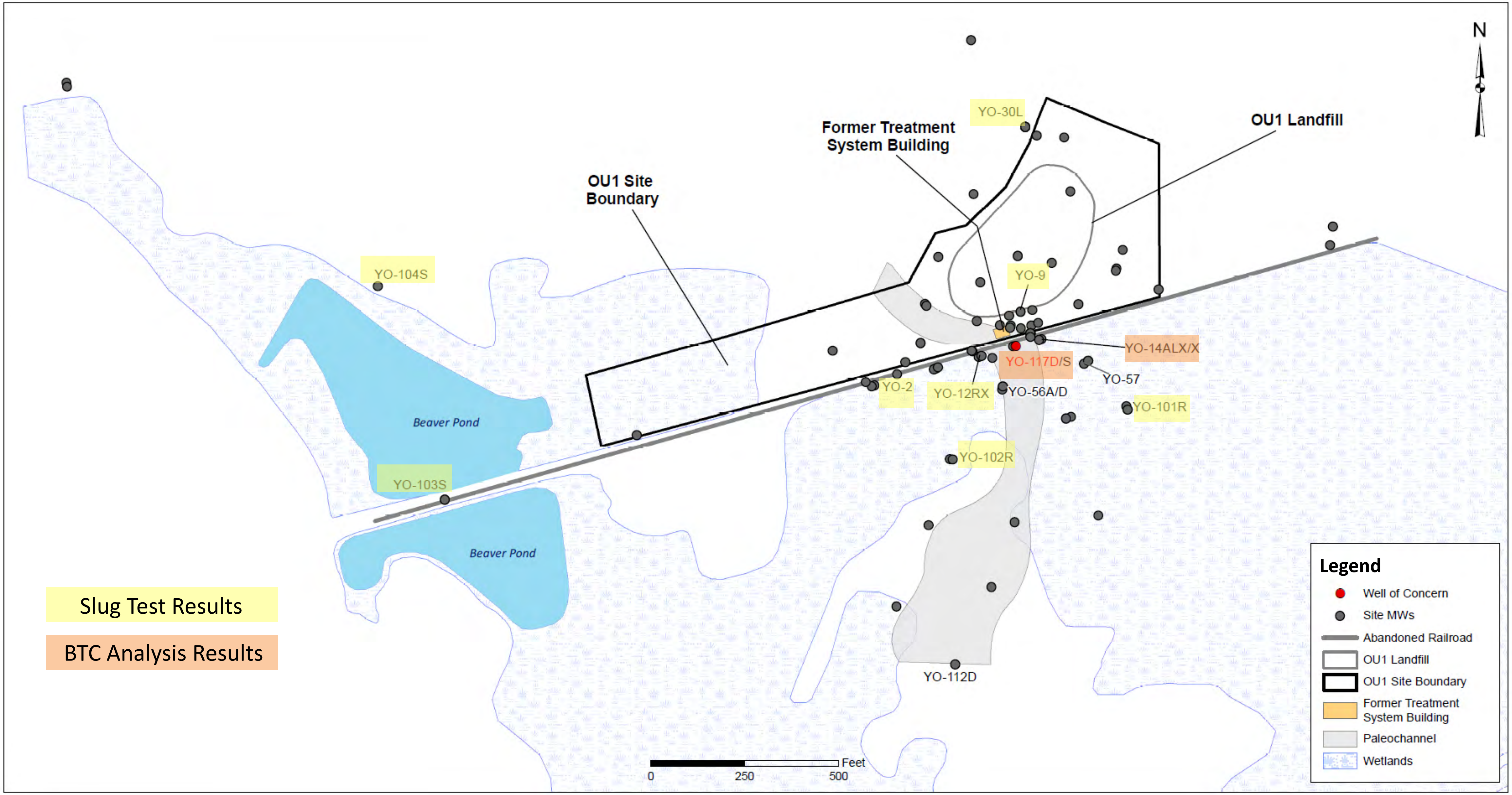

Figure 15– Site Map with Hydrualic Conductivity Test Locations
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: FBM
Date: May 2021

HRS Water Consultants

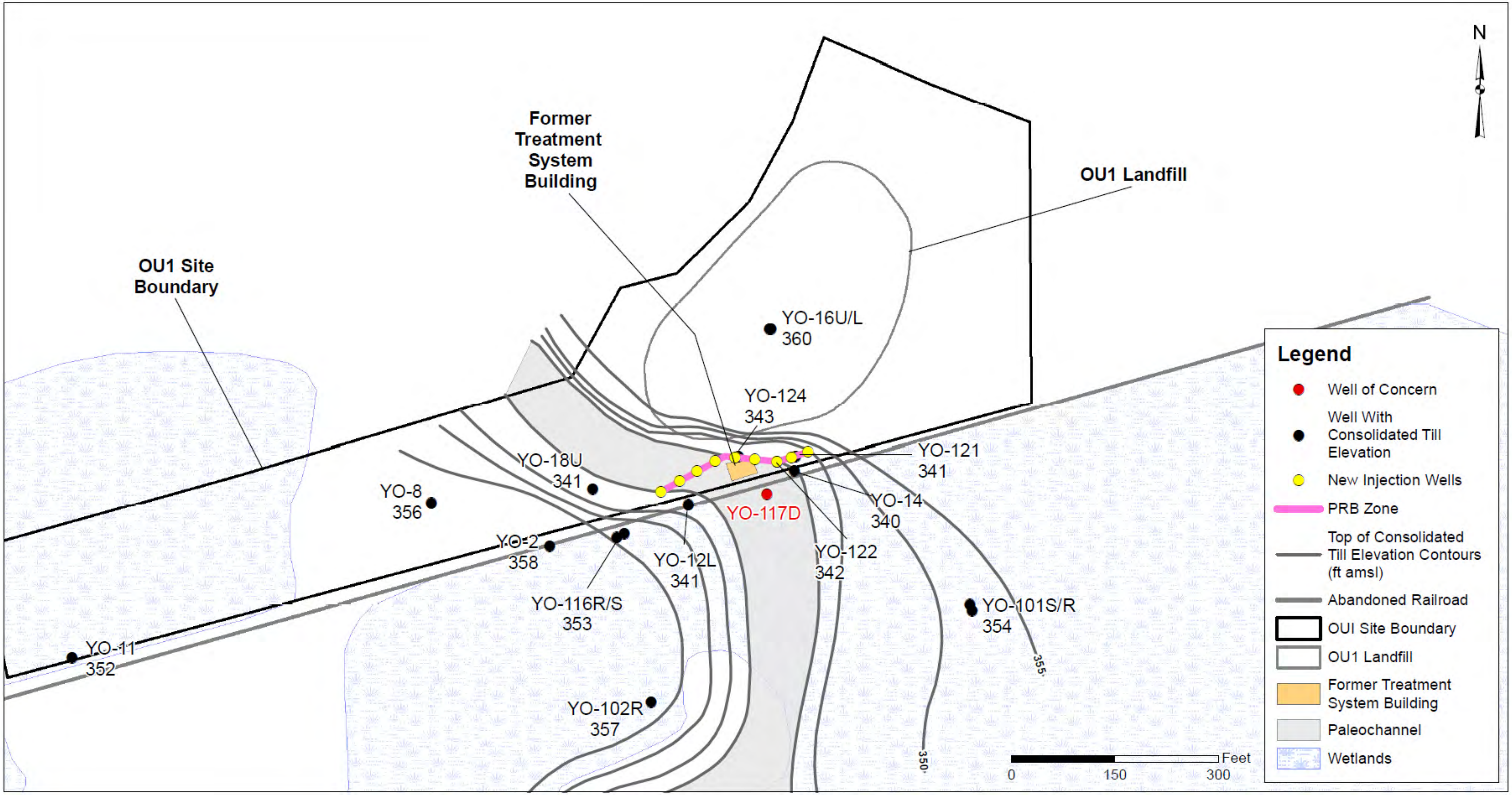

Figure 16 – Remediation Plan
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: TDR
Date: July 2021

HRS Water Consultants

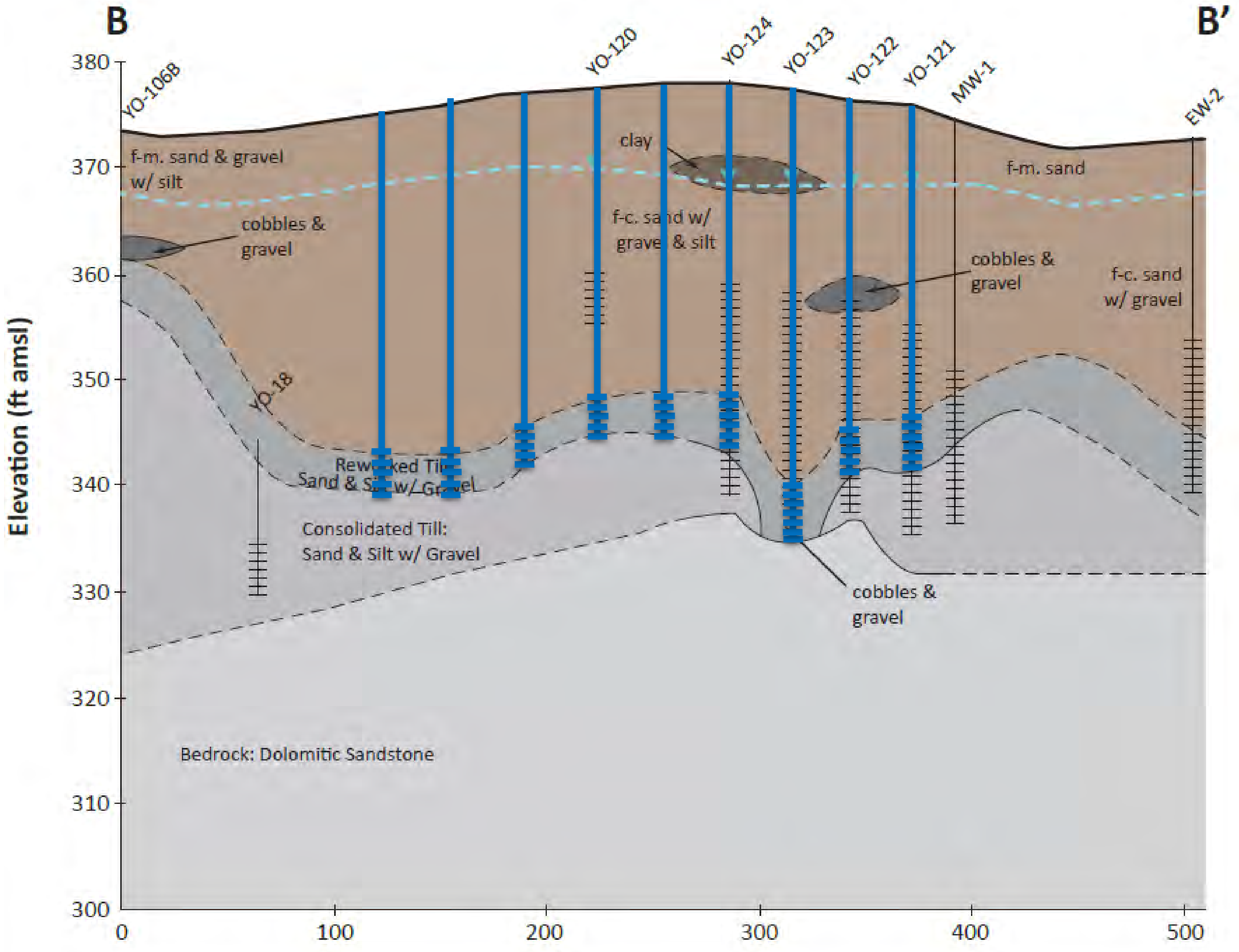

Figure 17 - Proposed New Injection Well Construction
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: FBM
Date: May 2021

Remediation Work Plan - Process

Strategy: Target Reworked Till in Paleochannel

Drill Soil Boring

↓

Collect Push-Ahead Water Sample & send for Analytical Results

If VOCs and/or BTEX > 5 µg/L, install injection well

↓

Inject 3,302 gallons of PlumeStop®

If VOCs and BTEX are <5 µg/L, abandon soil boring

cVOC Concentrations September 2020

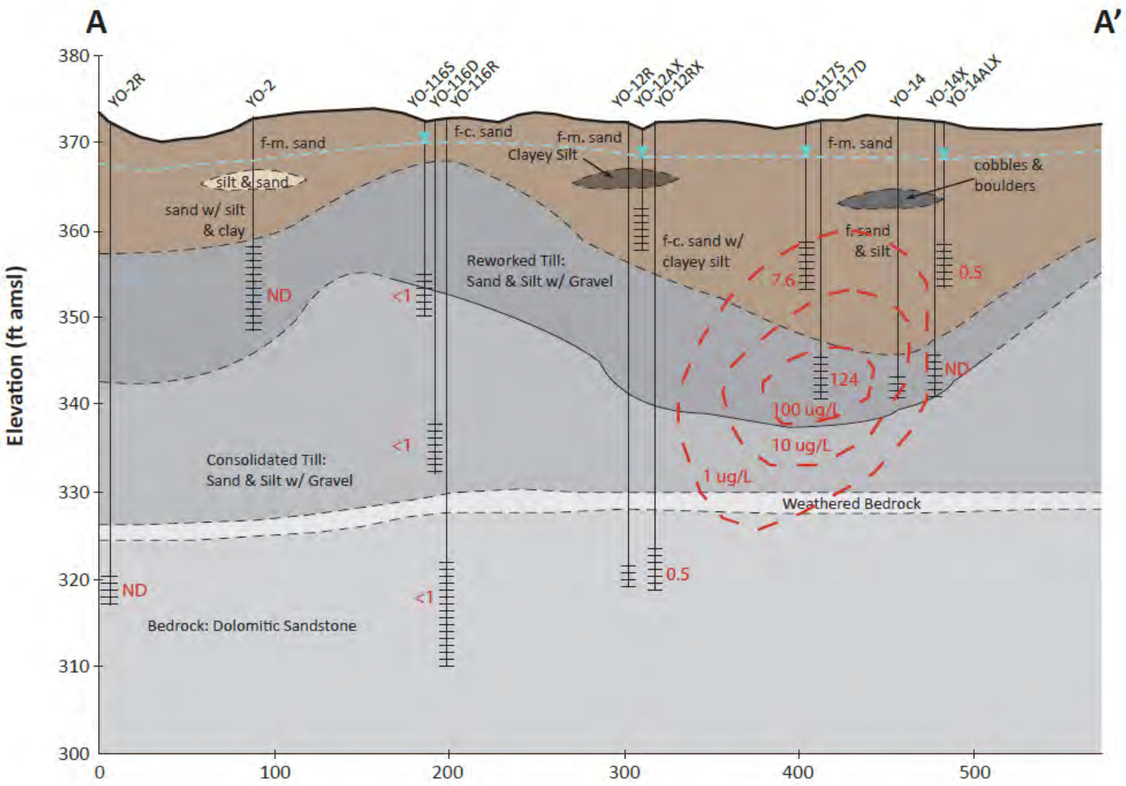

Figure 18 - Remediation Work Plan - Process
York Oil Site
Moira, NY

Job Number: 21-05
Prepared by: FBM
Date: July 2021

Appendix A: Plumestop Application Design Summary

Project Info		
York Oil (Alcoa) Ssuperfund Site		
Moira, NY		
Rwk Till Plume btwn OU-1 & 2		
Prepared For:		
de maximis		
Target Treatment Zone (TTZ) Info	**Unit**	**Value**
Barrier Length	ft	200
Top Treat Depth	ft	29.0
Bot Treat Depth	ft	35.0
Vertical Treatment Interval	ft	6.0
Treatment Zone Volume	ft^3	27,000
Treatment Zone Volume	cy	1,000
Soil Type	---	sand & silt w/ gravel
Porosity	cm^3/cm^3	0.40
Effective Porosity	cm^3/cm^3	0.23
Treatment Zone Pore Volume	gals	80,790
Treatment Zone Effective Pore Volume	gals	46,454
Treatment Zone Pore Volume	liters	305821
Treatment Zone Effective Pore Volume	liters	175847
Fraction Organic Carbon (foc)	g/g	0.003
Soil Density	g/cm^3	1.6
Soil Density	lb/ft^3	100
Soil Weight	lbs	2.7E+06
Hydraulic Conductivity	ft/day	1.4
Hydraulic Conductivity	cm/sec	4.94E-04
Hydraulic Gradient	ft/ft	0.020
GW Velocity	ft/day	0.12
GW Velocity	ft/yr	44
Sources of Oxygen Demand	**Unit**	**Value**
Dissolved Phase Contaminant Mass	lbs	0
Sorbed Phase Contaminant Mass	lbs	0
Fe2+,Mn2+, BOD, COD Mass Equiv.	lbs	34
Total Mass Contributing to O2 Demand	**lbs**	**35**
Mass Flux and ORC Advanced Demand	**Unit**	**Value**
Groundwater Mass Flux through TTZ	L/day	951
Stoichiometric ORC Demand	kg	212
Mass Flux ORC Demand	kg	104
Total ORC Demand	**kg**	**315**
Application Dosing	**Unit**	**Value**
PlumeStop to be Applied	**lbs**	**12,400**

PlumeStop® Application Design Summary

Rwk Till Plume btwn OU-1 & 2

PlumeStop	
Treatment Type	**Barrier**
Distance Perpendicular to Flow (ft)	200
Spacing Within Rows (ft)	23
Number of Rows	1
DPT Injection Points	**9**
Top Application Depth (ft bgs)	29
Bottom Application Depth (ft bgs)	35
PlumeStop to be Applied (lbs)	**12,400**
PlumeStop to be Applied (gals)	1,376
Injection Volume Totals	
Mixing Water (gal)	28,342
Total Application Volume (gals)	**29,718**
Injection Volume per Point (gals)	3,302
Parking agent required	**450 lbs; 4,500 gallons sol.**

Technical Notes/Discussion

Inj. Rad. for Soil Coverage (ft-est.avg.)
14.0

PlumeStop Inject. Conc. (mg/L)
10,000

Special Instructions:

Assumptions/Qualifications

In generating this preliminary estimate, Regenesis relied upon professional judgment and site specific information provided by others. Using this information as input, we performed calculations based upon known chemical and geologic relationships to generate an estimate of the mass of product and subsurface placement required to affect remediation of the site.

REGENESIS developed this Scope of Work in reliance upon the data and professional judgments provided by those whom completed the earlier environmental site assessment(s). The fees and charges associated with the Scope of Work were generated through REGENESIS' proprietary formulas and thus may not conform to billing guidelines, constraints or other limits on fees. REGENESIS does not seek reimbursement directly from any government agency or any governmental reimbursement fund (the "Government"). In any circumstance where REGENESIS may serve as a supplier or subcontractor to an entity which seeks reimbursement from the Government for all or part of the services performed or products provided by REGENESIS, it is the sole responsibility of the entity seeking reimbursement to ensure the Scope of Work and associated charges are in compliance with and acceptable to the Government prior to submission. When serving as a supplier or subcontractor to an entity which seeks reimbursement from the Government, REGENESIS does not knowingly present or cause to be presented any claim for payment to the Government.

Prepared by: DaP55758
Date: 6/21/2021

REGENESIS

Budgetary Purchasing Information		
York Oil (Alcoa) Ssuperfund Site	--	Rwk Till Plume btwn OU-1 & 2
PlumeStop Required	**lbs**	**12,400**
Total Estimated Project Cost Range**	Min	$150,000
	Max	$173,000
Estimated RRS Days to Apply	--	8

*Note that the combined tax and freight costs are preliminary estimates only. Please contact your local sales manager or Customer Service at 949-366-8000 to obtain a shipping quote. You will be asked to provide a ship-to address and estimated time of delivery.

Currently Available Packaging Options

Package Type***	# of packages	lbs required
PlumeStop-2,000 lb reinf. plastic totes	6	12,000
PlumeStop-400 lb poly drums	1	400

**Cost includes Regenesis Remediation Services (RRS) application into existing and new wells to be constructed by de maximis. Total Project cost is only an estimate; actual project cost may change as the final scope and/or RRS proposal are developed.