DRAFT FOR PUBLIC COMMENT PURPOSES

EXPLANATION OF SIGNIFICANT DIFFERENCES

VELSICOL CHEMICAL CORPORATION SUPERFUND SITE

OPERABLE UNIT 1

SAINT LOUIS, MICHIGAN

EPA SITE ID: MID000722439

PREPARED BY:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 5

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U.S. Environmental Protection Agency

Region 5

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Executive Summary

This Explanation of Significant Differences (ESD) describes changes within the remedy that addresses contamination at Operable Unit (OU) 1 of the Velsicol Chemical Corporation Superfund Site and is in accordance with Section 117(c) of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. § 9617(c) and Section 300.435(c)(2)(i) of the National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. § 300.435. This ESD documents the change in two of the fourteen remedy components of the selected remedy as described in the 2012 Record of Decision for OU1, signed by the Michigan Department of Environment, Great Lakes, and Energy (formerly known as the Michigan Department of Environmental Quality) Director on June 19, 2012, and by the EPA Region 5 Superfund Division Director on June 22, 2012.

The OU1 remedy is a combination of containment, treatment, removal, and municipal wellfield replacement. The two remedy components that necessitate this ESD are part of the containment portion of the OU1 remedy and include 1) repair of the existing upgradient slurry wall as part of a vertical barrier wall containment around the former plant site (FPS) and 2) removal of the need for a dense nonaqueous phase liquid/ groundwater collection system extension segment to address the monitoring well 19 area (MW-19 Area). Since the signing of the 2012 Record of Decision, changed conditions, as documented in associated investigations, evaluation technical memoranda, and summary reports support implementation of upgradient slurry wall repair and removal of the need for a dense nonaqueous phase liquid (DNAPL)/ groundwater collection system extension segment in the MW-19 Area.

Specifically, the upgradient portion of the slurry wall is found to have been constructed to sufficiently influence shallow groundwater flow patterns and act as a barrier to shallow unit groundwater migration. However, a 20-foot breach and a 350-foot area of substandard hydraulic performance surrounding the breach, due to groundwater leaking through the breach, were identified. It is determined that, based on seven lines of evidence from information and data collected during the 2002-2006 remedial investigations through the most recent predesign investigations in 2020 and 2023, a repair of the current upgradient slurry wall is warranted rather than installation of a steel sheet pile wall along the entire 3,100 linear foot upgradient alignment of the slurry wall.

In 2019 in situ thermal treatment was implemented in Area 1 and removed over 55,000 pounds of contaminants, of which approximately 51,000 pounds were dense nonaqueous phase liquid. Area 1 is located immediately adjacent and upgradient to the MW-19 Area. A predesign investigation in the MW-19 Area was conducted to document the changed conditions in the shallow unit, as the majority of DNAPL in this area was addressed by the Area 1 in situ thermal treatment. The investigation found an absence of widespread DNAPL with only localized residuals on the till unit. Observed DNAPL is attributed to isolated occurrences of locally trapped contaminants within or on the till surface with an observed lack of DNAPL continuity. Furthermore, the future design and implementation of a groundwater perimeter drain and

groundwater treatment system, as set forth by the ROD, will address locally trapped DNAPL and groundwater contamination from the MW-19 Area.

These two sets of changed conditions require significant changes to the OU1 remedy and are documented herein. These changes are still expected to meet the specified requirement of FPS containment, achieve the containment remedial action objectives, and address risk to human health and the environment as specified in the OU1 ROD. Furthermore, additional portions of the OU1 remedy, such as the groundwater perimeter drain (collection tile), groundwater treatment system with inward gradient, and engineered cap are anticipated to also contain FPS contaminants upon their upcoming design and implementation.

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[2] Transcript will be included after the public meeting and presented in the Final ESD

Explanation of Significant Differences

Velsicol Chemical Corporation Superfund Site – Operable Unit 1

I. Introduction

A. Site Name and Location

The Velsicol Chemical Corporation Superfund Site (the Site) encompasses approximately 100 acres in St. Louis, Michigan. At this Site, a chemical manufacturer operated, experimented with, and manufactured various chemicals from the mid-1930s until it was demolished in 1978. Industrial operations at the plant, which included manufacturing pesticides and fire retardants, resulted in widespread contamination of the former plant site (FPS).

Two main parts of the Site include the FPS and the residential properties that border the FPS; the residential area is referred to as the "adjacent or nearby properties" (Figure 1). The FPS is approximately 51 acres, fenced, and bordered on the south and east by the adjacent or nearby properties, with Washington Avenue (also known as Michigan State Route 46 [M-46]) along its southern edge. Watson Street and North Avenue mark the eastern edge, and the Pine River and Mill Pond form the western and northern boundaries. The adjacent or nearby properties span approximately 12 blocks and are primarily composed of residential properties that lie south and east of the FPS boundary. A small number of commercial properties are also located south of the FPS, along M-46/Washington Avenue.

The U.S. Environmental Protection Agency (EPA) divided the Site into four operable units (OUs; Figure 1):

- OU1—FPS and adjacent or nearby properties, for which remedial design and remedial action activities are in progress.
- OU2—Pine River and Mill Pond sediment adjacent and upstream from the St. Louis hydroelectric dam, for which remedial action activities were completed in 2006.
- OU3—Pine River sediments stretching from the St. Louis hydroelectric dam to approximately 1.25 miles downstream of the dam, for which a Record of Decision (ROD) was signed October 10, 2022. Remedial design activities are near completion with remedial action planned for 2025.
- OU4—Pine River sediments stretching from approximately 1.25 miles downstream of the St. Louis hydroelectric dam to the confluence of the Pine, Chippewa, and Tittabawassee rivers, for which remedial investigation activities are in progress.

There are three naturally occurring unconsolidated geologic deposits sitewide: shallow unit, till unit, and lower unit. Within this document the focus will be on the shallow unit and the underlying till unit. The shallow unit thickness varies between 20 and 30 feet and is composed of fill, alluvium, and lacustrine deposits. Debris (i.e., concrete and metal) is also present within the shallow unit from prior operations. The till unit thickness ranges from 30 to 80 feet and is

composed of sandy silt with variable amounts of sand, gravel, and cobbles. The thickness of sand and gravel seams within the till unit range from a few inches to several feet. The lower unit extends from the base of the till unit to the top of bedrock (approximately 280 feet below ground surface) and consists of a series of saturated sands subdivided by the two aquitards.

This Explanation of Significant Differences (ESD) addresses changes to the selected remedy at OU1.

B. Identification of Lead and Support Agencies

The lead agency for the OU1 remedial investigation/feasibility study was the Michigan Department of Environment, Great Lakes, and Energy (EGLE). The EPA is the lead agency for the OU1 remedial design and remedial action and EGLE is the support agency.

C. Statement of Purpose

This document sets forth the basis for changes to two OU1 remedy components – 1) repairing the existing upgradient slurry wall (Figure 2) as part of a vertical barrier wall containment around the FPS and 2) removing the need for the dense nonaqueous phase liquid (DNAPL)/ groundwater collection system extension segment to address the monitoring well 19 area (MW-19 Area).

D. Statutory Basis Issuance of the ESD

Section 117(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) at 40 C.F.R. § 300.435(c)(2)(i) establish procedures for explaining, documenting, and informing the public of significant changes to a remedy that occur after the EPA has signed a ROD. The EPA is required to issue an ESD when the remedial action to be taken differs significantly from the remedy selected in the ROD but does not fundamentally alter the selected remedy with respect to scope, performance, or cost.

E. Summary of Circumstances Necessitating this ESD

The OU1 ROD (EPA 2012) selects and describes a 14-part remedy to address risks to human health and the environment in this operable unit. This ESD addresses two of the 14 remedy components. The OU1 remedy is a combination of containment, treatment, removal, and municipal wellfield replacement (Table 1). The two remedy components that necessitate this ESD are part of the containment portion of the OU1 remedy. Table 1 also shows the breakdown of all 14 remedy components and indicates the status of each of those components (i.e., completed, in progress, etc.).

The OU1 ROD (EPA 2012) includes installation of a vertical barrier wall surrounding the FPS (remedy component #1 in Table 1). This ESD describes the repair for the upgradient portion of the existing slurry wall (Figure 3), so that the upgradient portion will not need a new wall, while a new sheet pile wall will be installed for the downgradient portion only, along the Pine River. The implementation of an upgradient slurry wall repair with the installation of the downgradient vertical barrier wall will meet the specified requirement of FPS containment with

a vertical barrier wall, achieve the remedial action objectives (RAOs), and address risk to human health and the environment as specified in the OU1 ROD. Furthermore, additional portions of the OU1 remedy, groundwater perimeter drain (collection tile) with an inward gradient and groundwater treatment system, as well as the engineered cap will contain FPS contaminants upon their future design and implementation.

The OU1 ROD (EPA 2012) also includes the expansion of the current DNAPL/ groundwater collection system into the MW-19 Area (remedy component #4 in Table 1). This ESD will remove this remedy component, as the source material, DNAPL, in this area was addressed by the Area 1 in situ thermal treatment (ISTT) (remedy component #5 in Table 1) (Figure 4). Furthermore, the future design and implementation of a groundwater perimeter drain and groundwater treatment system, along with the continued operation of the current DNAPL/ groundwater collection system, as set forth by the 2012 OU1 ROD, would also address DNAPL and groundwater contamination from the MW-19 Area while still achieving the containment RAOs.

Further details regarding remedy components #1 and #4 are provided in *Section II, Basis for the ESD*.

F. Agency Determination

In consultation with EGLE, the EPA has reviewed the two proposed changes in the selected OU1 remedy. The review has considered the standards set forth in CERCLA and the NCP as well as relevant EPA policies and guidance. Additionally, the EPA and EGLE have reviewed the associated and relevant investigations and evaluations including those since the OU1 ROD (EPA 2012). The changes to 2 of the 14 remedy components are significant, but the changes do not fundamentally alter the selected remedy with respect to scope, performance, or cost.

These changes comply with the NCP and the statutory requirements of CERCLA. The OU1 remedy remains protective of human health and the environment as the OU1 remedy will continue to meet the following RAOs:

- Eliminate offsite migration of DNAPL to prevent the contamination of the surface water and recontamination of sediments of the Pine River.
- Prevent ingestion, inhalation, and direct contact of site-related contaminants of concern (COCs) in groundwater to human and ecological receptors.
- Prevent the migration of site-related COCs from unsaturated and saturated subsurface media to the groundwater or surface water beyond the point of compliance (Figure 2).

For these reasons, it is appropriate for the EPA to issue an ESD to document the changed circumstances resulting in these changes to the remedy and not necessary for the EPA to amend the ROD.

G. Administrative Record

In accordance with the NCP at 40 C.F.R. §§ 300.435(c) and 300.825(a)(2), this ESD and supporting documentation will become part of the Administrative Record (Appendix A) for the Site.

The Administrative Record file and other relevant reports and documents are available online for public review, by appointment only, Monday through Friday between the hours of 8:00 a.m. and 4:00 p.m. at EPA Region 5 office. An appointment may be scheduled at the following location by calling Records Specialist at (312) 886-4465:

EPA Region 5 Records Center
77 West Jackson Boulevard – 7th Floor
Chicago, IL 60604

The Administrative Record is Record is available online at www.epa.gov/superfund/velsicol-chemical-michigan and available online at the following location:

T. A. Cutler Memorial Library
312 Michigan Avenue
St. Louis, Michigan

H. Site History

Operations

The FPS was used for industrial and chemical operations beginning in the mid-1800s until 1977. Historical operations at the site included a lumber mill, oil refinery, salt-processing plant, and chemical manufacturing plant. Storage facilities for raw and finished products, including warehouses and storage tanks constructed above- and belowground, were also integrated throughout the FPS. Historical documents identify several lagoons that are either known or presumed to be associated with waste-disposal practices. In 1935, Michigan Chemical Corporation purchased the property and operated a chemical manufacturing business. In 1965, Velsicol Chemical Corporation gained a controlling interest in Michigan Chemical Corporation. The chemical company manufactured a wide variety of products at the FPS from 1936 through 1977, including the following: various salts; magnesium oxide; rare earth chemicals; dichlorodiphenyl trichloroethane (DDT); and fire retardants, including polybrominated biphenyl (PBB) and tris(2,3-dibromopropyl)phosphate (TRIS).

PBB Chemical Disaster

In early 1973, both PBB (sold under the trade name FireMaster) and magnesium oxide (a cattle feed supplement sold under the trade name NutriMaster) were produced by the Michigan Chemical Company. A shortage of preprinted paper bag sacks led to an estimated 10 to 20 unlabeled 50-pound bags of PBB (FireMaster), instead of NutriMaster, accidentally being sent to the Michigan Farm Bureau Services for distribution to local farmers to augment their feed supply. The accident was not recognized until long after the bags had been shipped to feed mills and used in the production of animal feed. By the time the error was discovered in April 1974, PBB had entered the food chain through human consumption of milk and other dairy products,

beef products, and contaminated swine, sheep, chickens, and eggs. As a result of this incident, over 500 contaminated Michigan farms were quarantined, and approximately 30,000 cattle, 4,500 swine, 1,500 sheep, and 1.5 million chickens were destroyed, along with over 800 tons of animal feed, 18,000 pounds of cheese, 2,500 pound of butter, 5 million eggs, and 34,000 pounds of dried milk products.

In 1977, production operations at the FPS were terminated. Following plant closure, in 1978 Velsicol Chemical Company decommissioned the facility, which included the demolition of all aboveground structures and subsequent burial of building debris, rail lines, storage tanks and process piping.

Consent Judgment and Original Remedy

In 1982, the United States of America and the State of Michigan negotiated and entered a Consent Judgment with Velsicol Chemical Corporation for the FPS and the former burn area (now known as the Velsicol Burn Pit Superfund Site). The 1982 Consent Judgment gave Velsicol Chemical Corporation a release from any liability under CERCLA, the Resource Conservation and Recovery Act, and state environmental laws for the Site, with a limited reopener. Pursuant to the Consent Judgment, Velsicol Chemical Corporation submitted plans and specifications for construction and installation of a containment system. The containment strategy consisted of a 2-foot-thick low permeability slurry wall around the 51-acre FPS and the installation of a cap to control water infiltration. The underlying glacial till acts as a confining layer (barrier) to limit the downward migration of contaminants. The slurry wall was set back approximately 50 to 140 feet from the bank of the Pine River and groundwater was to be maintained inside the slurry wall to a specified elevation.

Per the Consent Judgment, the requirements of the containment system to be implemented by the Velsicol Chemical Corporation were:

- Construct a slurry wall around the entire 51-acre boundary of the FPS and keyed to a minimum of 30 inches into the underlying clay till unit to achieve a permeability of 1×10^{-7} centimeters per second (cm/s).
- Maintain groundwater levels inside the slurry wall and beneath the cap to no greater than 724.13 feet above mean sea level. The specified elevation was based on water level measurements in 14 onsite wells.
- Build a cap 36 inches thick over the FPS and compacted to achieve a permeability of 1×10^{-7} cm/s.
- Consolidate and place approximately 68,000 cubic yards of waste material, excavated from the former burn pit area, under the FPS cap.

Ownership

Tasks specified in the Consent Judgment were completed by 1986. Also in 1986, in a complicated confidential buyout arrangement, Velsicol Chemical Corporation transferred ownership of the FPS to a Fruit of the Loom subsidiary, NWI Land Management. Fruit of the Loom agreed to assume 100 percent of the liability for the FPS previously owned by Velsicol Chemical Corporation in an Assumption and Indemnity Agreement. Velsicol Chemical Corporation continued to manage the FPS for Fruit of the Loom under a contract with NWI Land

Management until Fruit of the Loom filed for bankruptcy in 1999, after which NWI Land Management took over management of the FPS. After the 1999 bankruptcy filing by Fruit of the Loom, the EPA learned that Fruit of the Loom's subsidiary owned the FPS, not Velsicol Chemical Corporation. In 2002, a bankruptcy settlement vested title to the FPS in a newly established Custodial Trust. In 2023, ownership transferred to the Michigan State Land Bank Authority, which currently holds the property title.

I. Contaminants of Concern

At the Site, the COCs are a combination of various volatile organic compounds, semi-volatile organic compounds, pesticides, total polychlorinated biphenyls, and DNAPL (as a contaminant source) found in OU1 soil and groundwater. COCs for the FPS are listed in Table 2. Chemicals identified as COCs were found to be risk drivers with cancer risks greater than 1×10^{-4} and/or a Hazard Index greater than 1 as a result of the quantitative risk assessment. The potential receptor groups considered for the FPS included future residents, future commercial and industrial workers, future construction workers and future recreational users of the area. Cancer risks and non-cancer hazards from exposure to contaminated soil and groundwater at the FPS were estimated for each soil sampling location and monitoring well location. Additional details, and calculations about individual COCs or screening criteria, are presented in the 2012 OU1 ROD.

DNAPL is a source material and principal threat waste at the Site and found in both soil sampling locations and monitoring wells. DNAPL is one of a group of organic chemicals that is relatively insoluble in water and, because it is heavier than water, it sinks vertically through aquifers. Two types of DNAPL are present at the Site and both contain several chemical constituents. One type of DNAPL onsite contains very high concentrations of 1,2-dichloroethane mixed with a large number of identified and unidentified brominated compounds, including PBB, hexabromobiphenyl (HBB), 1,2-dibromo-3-chloropropane (DBCP), and TRIS. A second type of DNAPL present at the Site includes high concentrations of chlorobenzene mixed with DDT and its isomers dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethene (DDE). DNAPL is present in Site soils and groundwater and the constituents listed above are COCs in both media. The groundwater also contains a by-product of DDT production called parachlorobenzene sulfonic acid (pCBSA), which is also a COC in the groundwater.

J. Selected Remedy

The OU1 ROD (EPA 2012) selects a remedy that requires the implementation of 14 components to address the FPS and the adjacent or nearby properties. The OU1 remedy is a combination of containment, treatment, and municipal wellfield replacement. The components work in concert to address risks to human health and the environment at the Site. Source materials constituting principal threats at the Site are addressed through a combination of ISTT, in situ chemical oxidation, and offsite disposal. Table 1 shows the remedy components that have been implemented, those in progress, and those to be implemented.

The selected remedy includes the following 14 components:

1. Installation of a vertical barrier surrounding the FPS to decrease the potential for DNAPL and dissolved-phase contaminants to directly discharge to the Pine River from the shallow unit.
2. Installation of a perimeter drain system to capture contaminated groundwater from the shallow unit for treatment and to maintain an inward hydraulic gradient.
3. Continued operation of the existing DNAPL/groundwater collection system to capture DNAPL and contaminated groundwater migrating from the shallow unit and prevent recontamination of the Pine River and sediments.
4. Installation of an additional DNAPL/ groundwater collection system segment to address possible DNAPL and groundwater contamination from the MW-19 area.
5. Implementation of ISTT to address the two DNAPL-contaminated areas. The ISTT system would be operated until the maximum practical volume of DNAPL, defined as 95 percent of the theoretical volume, is achieved. The primary objective for ISTT implementation is to reduce the potential for mobile DNAPL within the FPS to re-contaminate the sediments of the Pine River and prevent migration into the lower unit.
6. Collection of DNAPL in the lower unit (100 feet below ground surface) near the WMW-48 location through use of a collection sump and transportation of collected fluids offsite for incineration.
7. In situ chemical oxidation, or excavation with offsite disposal, of up to four potential source areas (75,090 cubic yards). Two potential source areas will be excavated (42,939 cubic yards) to the soil saturation concentration for soils (Csat) with subsequent offsite disposal. Two potential source areas (32,151 cubic yards) with groundwater contamination greater than their respective water solubility concentrations will be treated by in situ chemical oxidation until the concentration of COCs are below their respective water solubility concentrations.
8. Installation of an engineered cap meeting the requirements of Subtitle C of the Resource Conservation Recovery Act and Part 111 of the Michigan National Resources and Environmental Protection Act to eliminate the direct contact threat and prevent infiltration.
9. Replacement of the City of St. Louis, Michigan, municipal water supply to avoid increased, non-cost-effective long-term groundwater extraction and treatment costs.

10. Restoration of groundwater to drinking water standards outside the point of compliance and technical impracticability (TI) waiver zone, and containment within the point of compliance (POC) through groundwater extraction and treatment (see Figure 2 for locations).
11. Excavation and offsite disposal of soils exceeding 5 parts per million (ppm) total dichlorodiphenyl trichlorethane (DDT); 1.2 ppm polybrominated biphenyl (PBB), and 4.4 ppm TRIS in the adjacent and nearby properties to address risk to human health and the environment. Excavated properties will be backfilled with clean fill and restored.
12. Monitoring well installation and groundwater monitoring program.
13. Site restoration.
14. Institutional controls such as a restrictive covenant, an ordinance restricting groundwater use near the Site, continuing fish advisories, and appropriate signage.

This ESD addresses changes to OU1 remedy component #1 and removal of the need for remedy component #4 and are detailed in *Section II, Basis for ESD*.

As described in the OU1 ROD, due to the presence of DNAPL directly under the Pine River, the EPA found that it is appropriate to waive certain applicable or relevant and appropriate requirements (ARARs) as described below based on Tl from an engineering perspective as authorized under CERCLA Section 121 (d)(4)(C). The TI Waiver Zone, as shown in Figure 2, includes the area adjacent to the FPS that is directly under the Pine River including the Mill Pond and applies to the selected remedy. The TI Waiver was due to DNAPL that is present in sand seams within the till unit and the DNAPL cannot be fully delineated or treated due to its location under the Pine River. The site conditions and information pertaining to the basis for the Tl Waiver are documented in *Technical Impracticability of Groundwater Restoration, Velsicol Chemical Superfund Site, St. Louis, Michigan* (CH2M 2012) and the TI Waiver is discussed on Pages 37 and 60-61 of the OU1 ROD. The ARARs that do not apply to the TI Waiver Zone are the maximum contaminant limits under the Safe Drinking Water Act, 40 CFR § 141.61 (maximum contaminant levels for organic contaminants), 40 CFR § 141.62 (maximum contaminant limits for inorganic contaminants), 40 CFR § 141.66 (maximum contaminant limits for radionuclides), Michigan Administrative Rules 299.5701-299.5752; and Michigan Administrative Rules 325.10601-325.10604 (State Drinking Water Standards and Analytical Techniques).

The Feasibility Study (Weston 2011) detailed analysis and the ROD (EPA 2012), Alternative – 3 (Selected Remedy) was determined to be in compliance with ARARs. Therefore, the changed OU1 remedy, with a repair of the upgradient slurry wall and removal of the MW-19 Area DNAPL collection system extension, would still be in compliance with ARARs.

II. Basis for ESD

This ESD presents significant changes to two OU1 remedy components, #1 and #4, as presented in the OU1 ROD and repeated in *Section I*, the numbered list in *Section J*, and Table 1. Changed conditions, as documented in associated investigations, evaluation technical memoranda, and summary reports for these two remedy components (inclusion of an upgradient slurry wall repair and removal of the DNAPL/ groundwater collection system extension in the MW-19 Area) are detailed below.

A. Upgradient Slurry Wall Repair

As specified in the OU1 ROD, the vertical barrier wall remedy component includes the following fundamental details:

1. Install vertical barrier around the entire perimeter of FPS.
2. Decrease potential for DNAPL and dissolved phase COCs to discharge to Pine River.
3. Use a vertical barrier technology; sealed sheet piling is presented as a "representative technology" in the OU1 ROD.
    a. Located outside current slurry wall and current groundwater collection trench.
    b. Installed 10 feet into the top of the till unit.
    c. Backfill placed between riverbank and sealable sheet piling.

These three core elements of the vertical barrier remedy component will remain. Bullets #2 and #3 apply only to the downgradient portion of the FPS that is along the Pine River. The "representative technology" was presented in the ROD for discussion and construction cost estimation. However, the construction method/vertical barrier technology is not specified in the ROD, thereby allowing selection of the vertical barrier technology to be determined during the remedial design phase. The EPA divided the current vertical barrier wall, the FPS-surrounding slurry wall from 1982 Consent Judgment original remedy, into upgradient and downgradient sections. The downgradient slurry wall leakage/failure has been demonstrated in various documents (MEC 1997, CH2M 2002, Weston 2006, 2009) and is currently being addressed with the implementation of the vertical barrier wall (combination sealed sheet pile wall) as designed in the *Final Basis of Design Report for the Downgradient Vertical Barrier Wall* (CH2M 2023a).

Changed Condition

During detailed analysis of the shallow unit groundwater system completed as part of the remedial design investigations (CH2M 2017), the EPA noted that shallow unit groundwater elevations in the vicinity of the upgradient slurry wall indicated that its presence was impacting groundwater flow (i.e., ability to allow the formation of a groundwater mound), in agreement with the conclusions and groundwater flow maps presented in the remedial investigation report. Based on those conclusions, the EPA, with concurrence from EGLE, began the extensive data collection in 2019 and 2022 to evaluate the upgradient slurry wall.

The EPA conducted two detailed investigations of the upgradient slurry wall to supplement the limited investigation and evaluation of the upgradient slurry wall completed by the State of

Michigan during the remedial investigation (Weston 2006, 2009). New information the EPA obtained through the 2019 and 2022 investigations, combined with changes to the groundwater hydrology since the shutdown of the municipal drinking water supply wells (2014 – 2015), obligated the Agency to reevaluate the upgradient portion of the implementation of a vertical barrier as presented in the 2012 OU1 ROD.

These findings represent a refined and improved understanding of the existing condition of the upgradient slurry wall and, based on multiple lines of evidence, represent a changed condition since the 2012 OU1 ROD. A summary of upgradient slurry wall investigation results and subsequent groundwater modeling provided a basis for the EPA's reevaluation of the upgradient vertical barrier implementation and supports reuse of the current upgradient slurry wall with repair.

Lines of Evidence

A multiple lines of evidence approach was used to collect information and draw conclusions for the upgradient slurry wall. These lines of evidence are summarized in Table 3 with additional figures in Appendix C. Documents containing and detailing the multiple lines of evidence information are contained in the upgradient slurry wall remedial design investigations (CH2M 2020, 2023c), groundwater flow model update (CH2M 2023b), and remedial investigation efforts (Weston 2006, 2009).

The two recent upgradient slurry wall investigations were conducted to evaluate the condition of the approximately 3,100 linear feet of the upgradient slurry wall bordering state highway M-46 and the adjacent or nearby properties (CH2M 2020, 2023c). The results were based on the seven lines of evidence, summarized in Table 3 and discussed below, and indicate that the upgradient slurry wall is able to function as part of the vertical barrier wall system in most locations evaluated, by acting as a hydraulic barrier for shallow unit groundwater. The seven lines of evidence are as follows:

1. Groundwater flow contours
2. Groundwater elevation measurements
3. Soil boring logs
4. Groundwater analytical data
5. Groundwater modeling
6. Dye Testing
7. Hydraulic conductivity

Groundwater Flow Contours - Shallow unit groundwater flow direction before the slurry wall installation in the early 1980s flowed from the southeast to the northwest through the adjacent or nearby properties through the FPS into the Pine River. The slurry wall installation caused a groundwater divide and groundwater flowed, and continues to flow to this day, to the northeast and to the southwest around the FPS (Figure 3 and Appendix C).

Groundwater Elevation Measurements – Manual and transducer groundwater elevation measurements, as well as local precipitation data, were used for this assessment. Evaluation of the groundwater elevation measurements indicate that the slurry wall retains shallow unit groundwater and that the presence of the slurry wall causes groundwater mounding inside the slurry wall (on the FPS) as there is an outward head differential relative to the slurry wall. This means that groundwater elevations inside the wall are greater than the groundwater elevations outside the upgradient slurry wall except at one location. The one exception is a 20-foot leakage area, or breach, between soil borings CSW-003 and CSW-005 in the vicinity of piezometer cluster 28 (CPZ-28; Figure 3 and Appendix C).

Surrounding the 20-foot breach is an area approximately 350-feet wide between CPZ-30 and CPZ-25 (Figure 3) reflecting substandard hydraulic performance. The substandard performance is defined in this area because inward hydraulic gradients (Appendix C) are observed in piezometer clusters CPZ-27-5 (immediately north of breach area) and CPZ-29 (immediately south of breach area). These inward gradients are likely caused by shallow groundwater inside the FPS discharging through the 20-foot breach, resulting in a depression of groundwater elevations near these locations and diminished localized mounding on the interior side of the slurry wall. The exterior piezometers are unaffected by this process and continue to be a hydraulic barrier. Figure 3 shows the 20-foot breach area and the 350-feet area that will be repaired.

Additionally, the shutdown of the municipal drinking water wells (2014-2015) influenced the Site groundwater and has greatly reduced, and at some locations eliminated, the downward hydraulic gradient previously noted in the subsurface. The significant reduction of downward vertical gradient greatly reduces the ability of contaminants to exit the shallow unit and enter the till unit below the Site.

Soil Boring Logs – Soil borings completed during the investigation show a 3.25-foot-thick sand lens between the bottom of the slurry wall and the top of the till in this 20-foot area between soil borings CSW-003 and CSW-005 and in the vicinity of piezometer cluster CPZ-28. The sand lens observation indicates that the slurry wall is not keyed into the till at this location (Appendix C).

Groundwater Analytical Data – Analytical results from groundwater samples collected in the shallow unit in the adjacent or nearby properties indicate that contamination is not leaving the Site toward the residential properties adjacent to the Site. In addition, COC analytical results from groundwater samples collected adjacent to the upgradient slurry wall breach do not exceed the EPA maximum contaminant limits. This is important given that the current shallow unit hydrogeologic conditions at the Site have been present for at least 30 years and have not resulted in a groundwater plume emanating from the Site due to the slurry wall breach. This data was not available during the development of the 2012 OU1 ROD.

Groundwater Flow Model – The EPA developed the Velsicol groundwater flow model in 2009-2010, updated it in 2016-2017, and refined it again in 2022-2023. The latest update calibrated the model to groundwater levels averaged over 2018 to 2022 at 335 well locations as well as updated aquifer properties using data from the recent upgradient slurry wall investigations.

The EPA performed detailed groundwater modeling to evaluate groundwater flow on the upgradient portion of the Site under 3 scenarios (upgradient vertical barrier wall installed; slurry wall breach repaired; upgradient slurry wall left as is) and the effect each would have on flow rates to the (future) groundwater remediation/treatment system. Results show minimal groundwater flow differences between the scenarios. Specifically, results indicated that repairing the breach or installing a vertical sheet pile wall would only change the combined flow rate from the remediation system by less than 1 gallon per minute (Table 3 and Table 4).

Dye Testing – Dye testing was conducted during both recent slurry wall investigations (CH2M 2020, 2023). Lab results from the first dye test indicated that there was an absence of dye outside the upgradient slurry wall in 8 of the 9 exterior piezometers. The one piezometer with dye was located at CPZ-26. which is the area adjacent to the breach with substandard hydraulic performance. The second dye test confirmed the groundwater flow anomalies measured in and around the 20-foot breach and the surrounding 350-foot substandard performance area (Table 3).

Hydraulic Conductivity – Five upgradient slurry wall samples were collected in 2019 and six upgradient slurry wall samples were collected in 2022 for hydraulic conductivity analysis. The hydraulic conductivities ranged from 1.70 x 19^{-8} cm/s to 7.48 x 10^{-6} cm/s. Of these samples, one was in the 10^{-6} cm/s range, three were in the 10^{-7} cm/s range, and the remaining seven samples were in the 10^{-8} cm/s range. A total of 10 of the 11 hydraulic conductivity values are consistent with permeability standards (10^{-7} cm/s) established by the 1982 Consent Judgment and are representative of values for engineered low-permeability layers (Table 3 and Appendix C).

Repair Technology

Since a majority of the upgradient slurry wall is performing adequately, the 20-foot breach and surrounding 350-foot substandard performance area may be repaired in lieu of installing a steel sheet pile wall along the entire 3,100 linear foot upgradient alignment of the slurry wall. Various technologies are available for repair of the upgradient vertical barrier wall. With respect to repairing the current slurry wall versus installation of a new steel sheet pile vertical barrier wall, the upgradient slurry wall repair would be easier and quicker to implement, more effective long-term, and cost approximately one-twentieth what a new sheet pile wall would cost (see Table 5).

An engineering evaluation (CH2M 2024) was conducted and assessed six repair methods. Implementability, effectiveness, design life, and cost were evaluated for each method. Based on that evaluation, the technology to repair the upgradient slurry wall is soil mixing. An upgradient

slurry wall repair remedial design will provide further details and specifications regarding the design method and is estimated to be completed in calendar year 2024.

The representative repair technology, soil mixing, typically uses large diameter augers mounted on a hollow stem spindle attached to an excavator or crane to mix soil with cement grout, bentonite slurry, clay slurry, or other stabilizing reagent slurries to install continuous subsurface soil-cement walls for excavation support and groundwater or underground pollutants. In all cases, the soil's compressibility is increased and hydraulic conductivity is reduced during this process. The implementability is high as materials and equipment are readily available and can be installed along the alignment of the existing slurry wall. Placement would provide isolation of the FPS after soil mixing has cured. Furthermore, the soil mixing columns, once cured, are highly effective long term and the anticipated design life of the soil mixing column is 75 years, minimum. This is the longest duration of the possible repair technologies. Capital costs associated with soil mixing are typically low compared to other slurry wall repair technologies. Finally, proper field quality assurance and quality control during construction is crucial for any of the technologies and must be implemented to verify the repair technology will maintain its seal with the existing slurry wall.

Cost Comparison

The 2012 ROD presents the cost of the entire sealed sheet pile wall, as first presented and detailed in the 2011 Feasibility Study. Based on the information presented in those two documents the upgradient portion of the vertical barrier wall is approximately $11,428,000. This includes construction costs, mobilization and demobilization, contingency, and professional services costs in 2012 dollars. Escalating this cost to 2025 prices, the estimated total for an upgradient vertical barrier wall is approximately $22,627,000. An upgradient slurry wall repair using soil mixing to be constructed in 2025 is estimated at approximately $1,126,000 (CH2M 2023). Table 5 shows this cost comparison.

B. DNAPL in MW-19 Area

The 2012 ROD included the expansion of the current DNAPL/ groundwater collection system to address groundwater contamination and DNAPL potentially present in the MW-19 Area (remedy component #4 in Table 1). This ESD removes component #4 from the selected OU1 remedy.

Changed Condition

Through the 2018 implementation of OU1 remedy component #5, ISTT, there was removal of 51,000 pounds of DNAPL, 607 pounds of groundwater contaminants, and 4,300 pounds of vapor contaminants in the MW-19-adjacent source area, known as Area 1 (Figure 3). Because Area 1 is located immediately upgradient of MW-19, the DNAPL source in that area, significantly reduced through ISTT, represents changed conditions. Therefore, in 2022, the EPA conducted a predesign investigation to characterize the soil, groundwater, and presence/absence of DNAPL in the shallow unit near monitoring well MW-19 (CH2M 2023d).

Lines of Evidence

Several lines of evidence were used to draw conclusions regarding the need for a new DNAPL collection segment. These include:

1. DNAPL Screening
2. Groundwater Sampling
3. Groundwater/DNAPL Level Measurements
4. Soil Sampling

The predesign investigation consisted of the following tasks:

- Installation of soil borings to facilitate subsurface soil characterization, analytical soil sample collection, and NAPL screening.
- Installation of two new monitoring wells to facilitate groundwater sample collection, static water-level monitoring, and NAPL groundwater screening.
- Collection of two rounds of groundwater elevation data and analytical samples from seven select monitoring wells located within the MW-19 Area (April and July 2022).

DNAPL Screening, Groundwater Sampling, and Groundwater/DNAPL Level Measurements - Field observations obtained during the predesign investigation confirmed the absence of widespread DNAPL in the areas surrounding MW-19. Visible DNAPL was encountered and verified by positive DNAPL test kit results in two soil borings (SB004 and SB014, Figure 4) and therefore, at soil boring SB014, a new monitoring well (CMW-19S1) was installed during the investigation. Following the April 2022 installation of CMW-19S1, EPA measured approximately 5 inches of DNAPL in the well during the July 2022 groundwater sampling event. Subsequently, the DNAPL thickness was measured on August 3, 2022, and January 5, 2023, and indicated that the thickness of DNAPL was unchanged. The stable thickness of DNAPL in CMW-19S1 demonstrates that DNAPL volume is stable, not increasing, and likely the result of local residual DNAPL on the till.

Soil Sampling - Given the high spatial density of soil borings advanced during the MW-19 Area predesign investigation and the low frequency of confirmed DNAPL observations, observed NAPL is attributed to isolated occurrences of locally trapped contaminants within or on the till surface with an observed lack of DNAPL continuity (Figure 4).

The results of the predesign investigation were evaluated and the EPA determined that there is not a need to design and install a new section of the DNAPL/ groundwater collection system in the MW-19 Area. Furthermore, this extension is no longer necessary to achieve the RAOs established in the 2012 OU1 ROD.

The future design and implementation of the perimeter drain and groundwater treatment system, remedy components #2 and #10, will also address shallow unit groundwater contaminants and DNAPL that remains at the Site and is expected to achieve the RAOs in the 2012 OU1 ROD. This ESD removes component #4 from the OU1 remedy.

III. State Comments

EGLE has reviewed this ESD and concurred with the changes in the selected remedy. The concurrence letter has been made a part of the Administrative Record.

IV. Statutory Determinations

The EPA has determined that the remedy changes, as documented in this ESD, are in accordance with Section 121 of CERCLA and are protective of human health and the environment. The change complies with federal and state requirements that are applicable and/or relevant and appropriate, the remedy uses permanent solutions to the maximum extent practicable, and the remedy is cost-effective. Since hazardous substances will remain on-site at levels that do not allow for unrestricted use and unlimited exposure, five-year reviews of the remedy are required.

V. Public Participation Compliance

In accordance with Section 117(d) of CERCLA, 42 U.S.C. Section 9617(d) and Section 300.435 of the NCP, 40 CFR Section 300.435, EPA will publish a public notice in the newspaper informing the public of the availability of this proposed ESD for review and comment. EPA is providing the public an opportunity to comment on the changes described in this proposed ESD. A thirty (30) day public comment period is established with the issuance of this proposed ESD. EPA's responses to comments received during this period will be documented in a Responsiveness Summary, which will be included as an attachment to the final ESD.

This proposed ESD, and the documents which form the basis for the decision to modify the ROD are part of the administrative record maintained for the Site in accordance with Section 300.825(a)(2) of the NCP. This ESD will also be placed in the Administrative Record and information repositories, which are located at the T. A. Cutler Memorial Library and in the EPA Region 5 Records Center as required by the NCP at 40 C.F.R. § 300.435(c)(2)(i)(A). See Section I, paragraph G, of this ESD for further details about the information repositories. An electronic copy of this ESD will be available online at https://www.epa.gov/superfund/velsicol-chemical-michigan.

VI. Declaration by the EPA

The EPA has determined that the changes to the OU1 remedy, the repair of the upgradient slurry wall and removal of the MW-19 Area DNAPL collection trench, meet the conditions set forth in the ROD. These changes are significant but do not fundamentally alter the overall remedial action for OU1. For the reasons set forth above, EPA issues this ESD for the Velsicol Chemical Corporation Superfund Site.

VII. References

CH2M HILL, Inc. (CH2M). 2024. *Engineering Evaluation of Methods to Repair the Upgradient Slurry Wall Leakage Area. Velsicol Chemical Corporation Superfund Site*. March 14.

CH2M. 2023a. *Final Basis of Design Report. Remedial Design of the Velsicol Chemical Corporation Superfund Site. Downgradient Vertical Barrier* Wall, *St Louis, Michigan*. September.

CH2M. 2023b. *Velsicol Groundwater Flow Model 2023 Update. Velsicol Chemical Corporation Superfund Site St. Louis, Michigan.* September.

CH2M. 2023c. *Technical Memorandum – Supplemental Upgradient Slurry Wall Investigation*, *Velsicol Chemical Corporation/Pine River Superfund Site, St. Louis, Michigan*. August.

CH2M. 2023d. *MW-19 Area Investigation Technical Memorandum*. *Velsicol Chemical Corporation Superfund Site*. March 15.

CH2M. 2020. *Data Evaluation Report. Velsicol Former Plant Site. Upgradient Slurry Wall Investigation. St. Louis, Michigan*. August.

CH2M. 2017. *Remedial Design Investigation Report. Velsicol Chemical Corporation Superfund Site. Former Plant Site Remedial Design Groundwater Characterization, St. Louis, Michigan.* January.

CH2M. 2012. T*echnical Impracticability of Groundwater Restoration, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan*.

CH2M. 2002. *Summary of Information Regarding Slurry Wall Velsicol Chemical/Pine River Site St. Louis, Michigan*. January.

Memphis Environmental Center (MEC), Inc. 1997. *Final Containment System Assessment Report: Former Michigan Chemical Plant Site, St. Louis, Michigan*. October.

United States of America and The State of Michigan v. Velsicol Chemical Corporation a Delaware Corporation, Successor-in-Interest to Michigan Chemical Corporation. 1982. *Consent Judgment*. December 27.

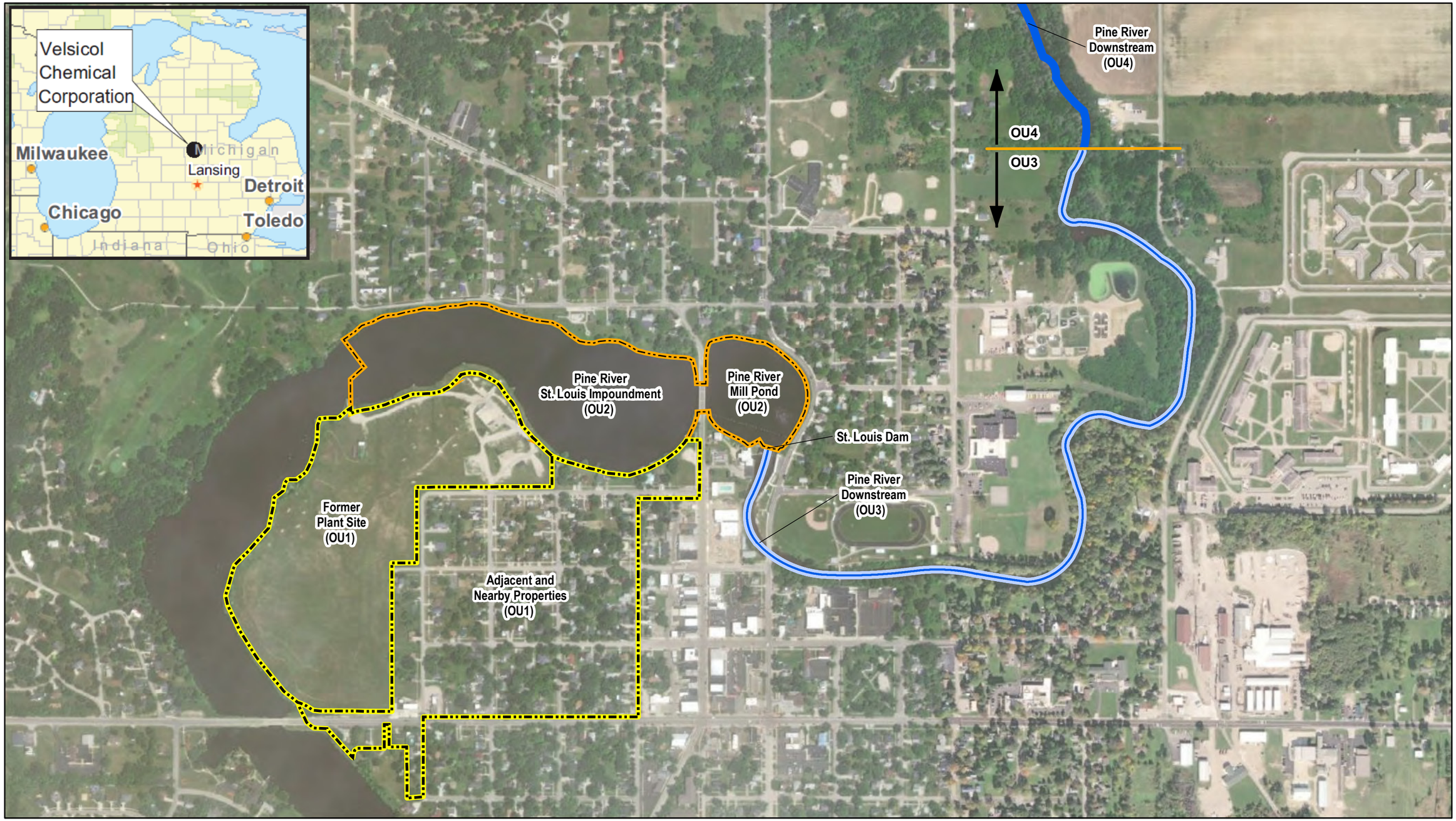
United States Environmental Protection Agency (EPA). 2012. *Record of Decision, Velsicol Chemical Corporation/Pine River Superfund Site, Former Plant Site – Operable Unit 1, St. Louis, Michigan*. June 22.

Weston Solutions of Michigan, Inc. (Weston). 2006. *Remedial Investigation Report for Operable Unit One, Velsicol Chemical Corporation Superfund Site, St. Louis, Gratiot County, Michigan.* November.

Weston. 2009. *Remedial Investigation Addendum Report for Operable Unit One, Velsicol Chemical Corporation Superfund Site, St. Louis, Gratiot County, Michigan*. January.

Weston. 2011. *Feasibility Study Operable Unit One, Velsicol Chemical Corporation Superfund Site, St. Louis, Gratiot County, Michigan*. November

Figures



Legend

- FORMER PLANT SITE AND ADJACENT AND NEARBY PROPERTIES (OU1)
- PINE RIVER - ST. LOUIS IMPOUNDMENT (OU2)
- PINE RIVER DOWNSTREAM (OU3)
- PINE RIVER DOWNSTREAM (OU4)

N

0 600 1,200

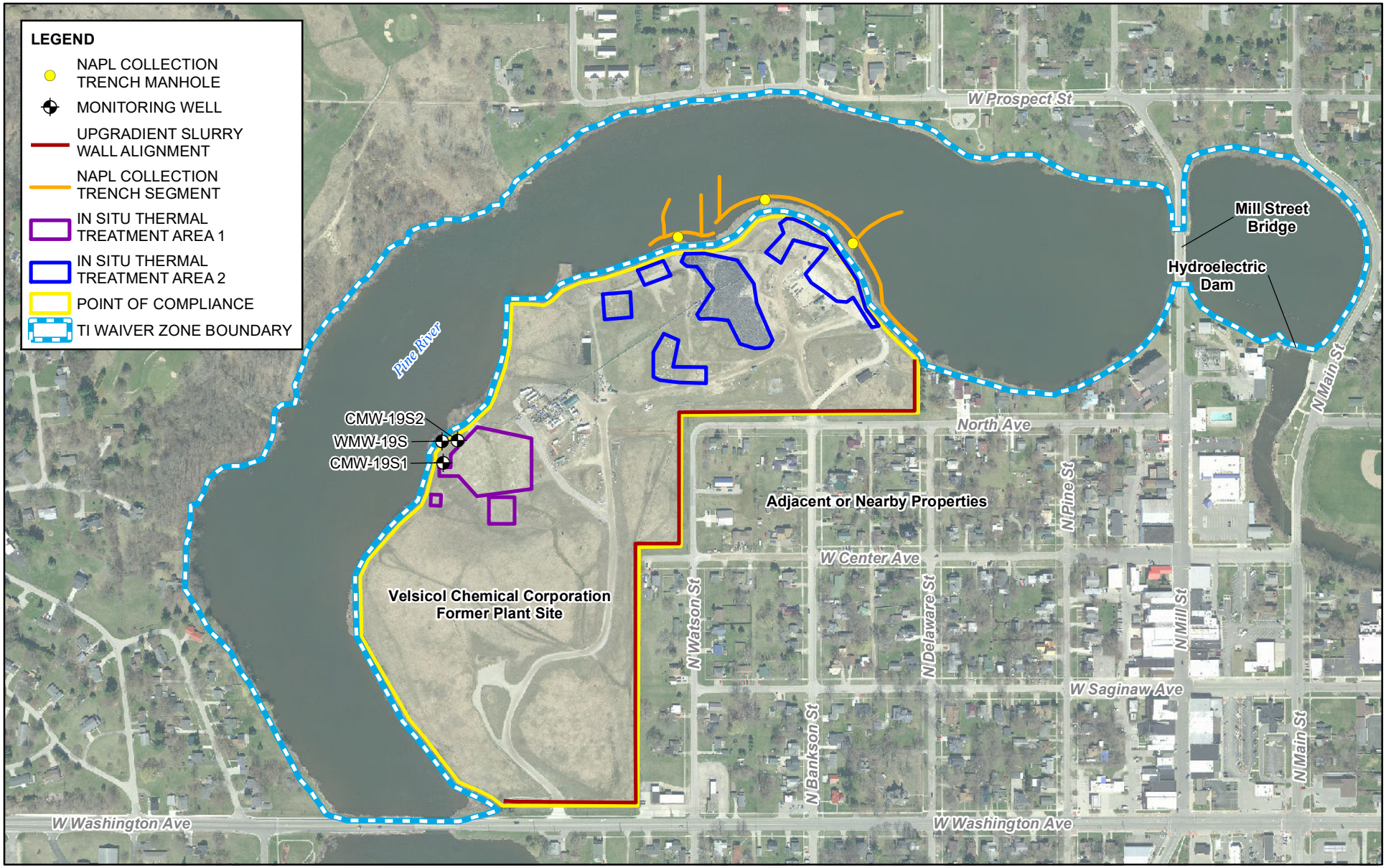
Feet

FIGURE 1

Site Location and Operable Units

Velsicol Chemical Corporation Superfund Site

St. Louis, Michigan



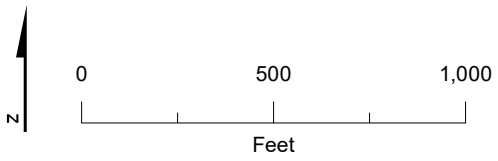
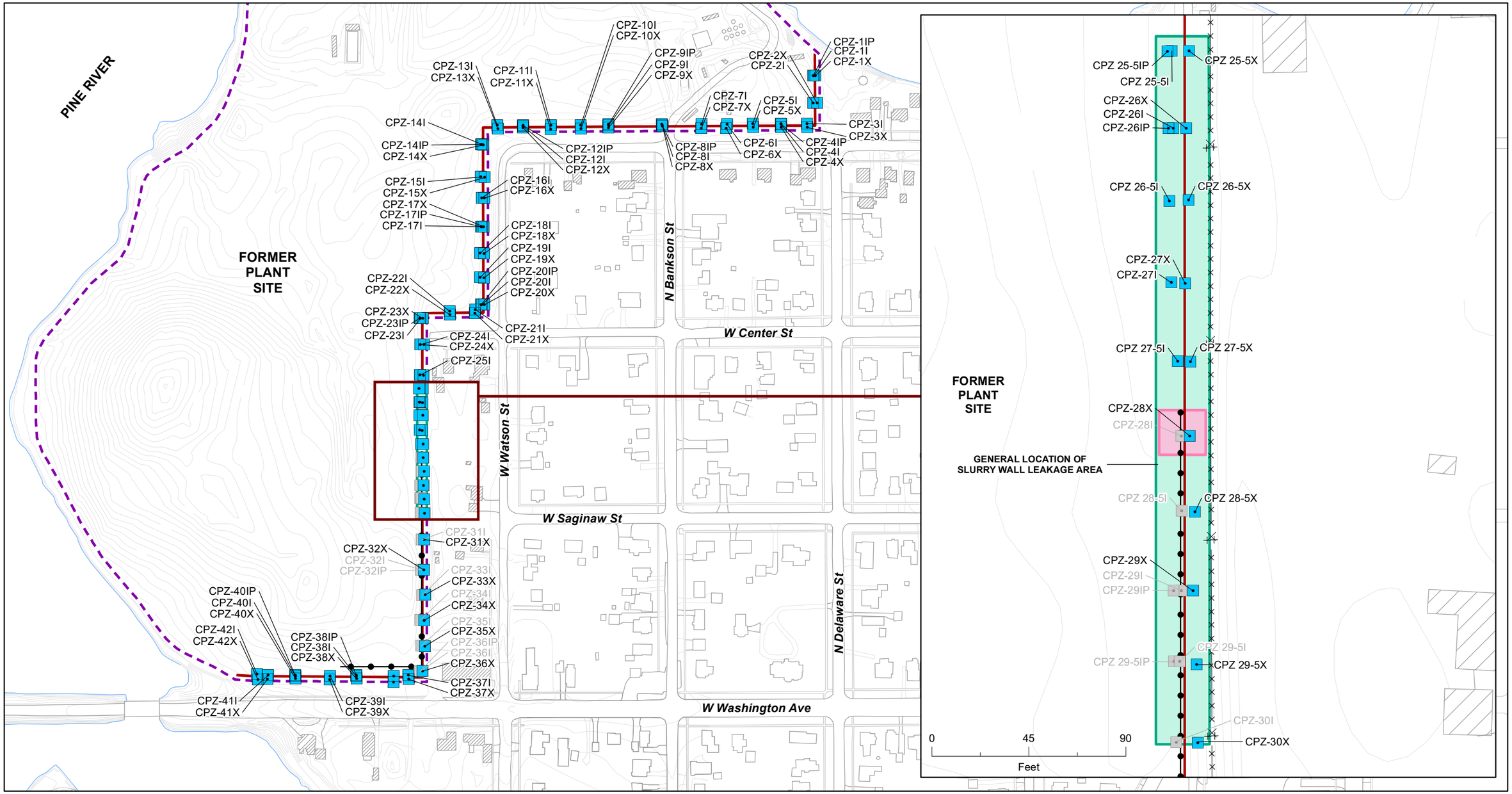


FIGURE 2

Site Features

Velsicol Chemical Corporation Superfund Site

St. Louis, Michigan



Legend

- EXISTING PIEZOMETER CLUSTER
- ABANDONED PIEZOMETER CLUSTER
- APPROXIMATE UPGRADIENT SLURRY WALL ALIGNMENT
- APPROXIMATE LOCATION OF POTENTIAL SOURCE AREA 1 EXCAVATION SUPPORT WALL
- APPROXIMATE FENCE ALIGNMENT
- AREA OF SUBSTANDARD PERFORMANCE
- SLURRY WALL BREACH IDENTIFIED BY SLURRY WALL BORINGS
- APPROXIMATE OU1 BOUNDARY

N

0 250 500

Feet

FIGURE 3

Upgradient Slurry Wall Repair Area

Velsicol Chemical Corporation Superfund Site

St. Louis, Michigan

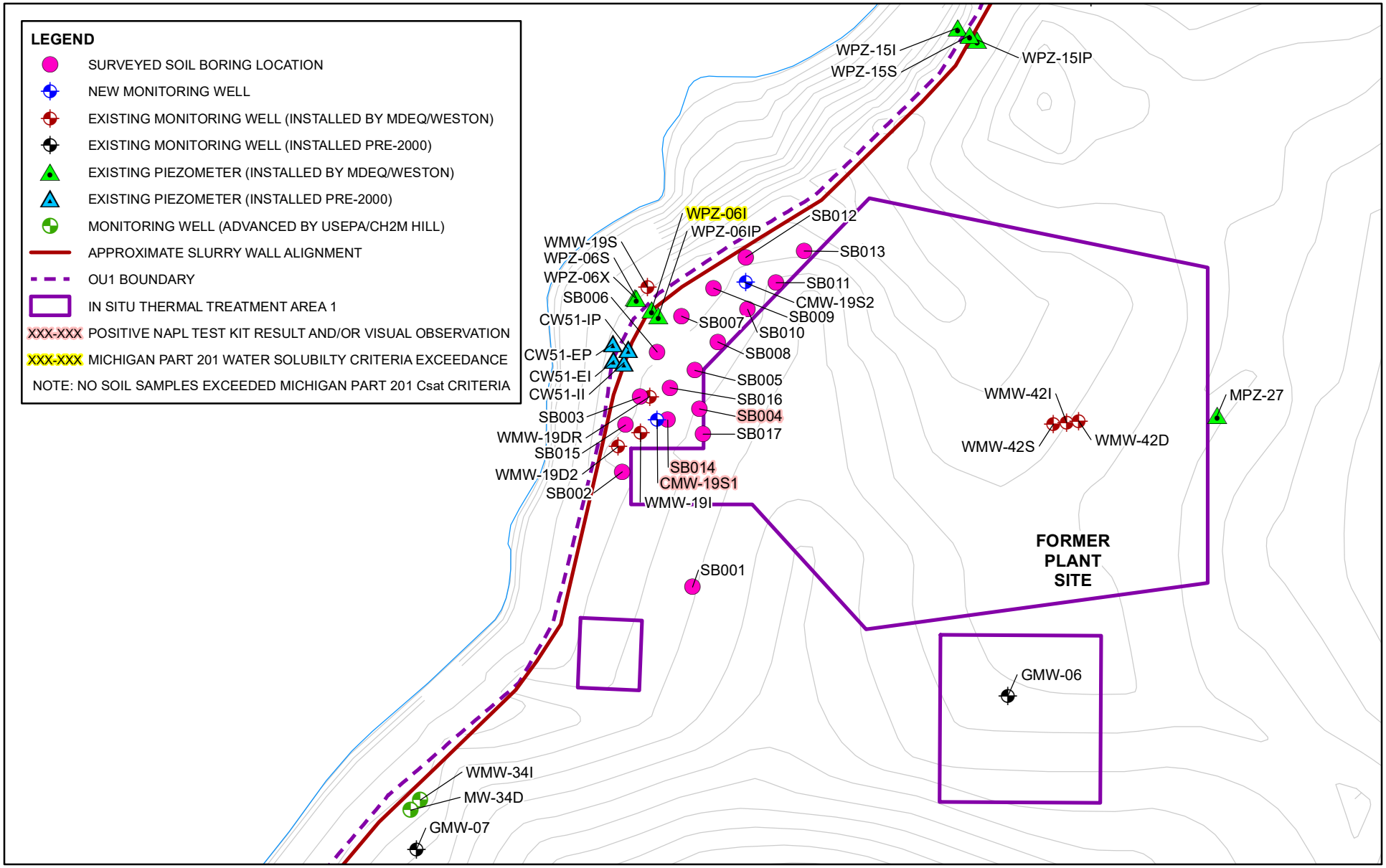


FIGURE 4

MW-19 Area

Velsicol Chemical Corporation Superfund Site

St. Louis, MI

Tables

Table 1: OU1 ROD Remedy Components
Velsicol Chemical Corporation Superfund Site

Containment	Source Control		Other
	Treatment	Removal	
1. Vertical Barrier Wall	5. ISTT for NAPL/DBCP Areas	6. DNAPL Recovery from Lower Outwash Unit	9. Replacement of the City of St. Louis Municipal Water Supply
2. Perimeter Drain System	7. ISCO for PSA-3 and PSA-4	7. PSA-1 and PSA-2 Excavation	12. Groundwater Monitoring Program
3. Continue operation of existing DNAPL/GWCS		11. ANP Excavation	13. Site Restoration
4. DNAPL/GWCS segment in MW-19 Area			14. Institutional Controls
8. Cap			
10. Groundwater Pump and Treatment System			

Notes:

Each number corresponds to each of the 14 remedy components listed in this Explanation of Significant Differences and the Velsicol OU1 Record of Decision (EPA 2012)

ANP – Adjacent and nearby properties
DNAPL – Dense nonaqueous phase liquid
GWCS – Groundwater collection system
ISCO – In situ chemical oxidation
ISTT – In situ thermal Treatment
MW – Monitoring well
PSA – Potential source area

Bold Text – Remedy components addressed in this Explanation of Significant Differences
Green Highlighted Text – Remedy implementation is in progress
Yellow Highlighted Text – Remedy component has been implemented at OU1

Table 2. Summary of Contaminants of Concern as defined in the 2012 OU1 Record of Decision for Former Plant Site Soil and Groundwater
Velsicol Chemical Corporation Superfund Site

Contaminants of Concern (COCs)[1]	Subsurface Soil	Groundwater Shallow On-site	Groundwater Deep On-site
Volatile Organic Compounds (VOCs)			
1,2 Dichloroethane	x		x
1,2 Dichloropropane			x
2 Butanone		x	
Benzene	x	x	x
Chlorobenzene		x	x
Methylene Chloride			x
Toluene		x	
Semi-volatile Organic Compounds (SVOCs)			
Benzo(a)pyrene	x		
Bis(2-ethylhexyl)phthalate			x
Polybrominated biphenyl (PBB)	x		
Tris (2,3 Dibromo-1-propyl) Phosphate (TRIS)	x		x
Pesticides			
Alpha BHC			x
4,4' Dichlorodiphenyldichloroethylene (4,4' DDE)	x		
Total dichloro-diphenyl-trichloroethane (DDT as 4,4' DDT and 2,4' DDT)[2]	x		
Dieldrin	x		
para chlorobenzene sulfonic acid (pCBSA)[2]		x	x
Polychlorinated biphenyls (PCBs)			
Total PCBs	x		
Metals			
Barium			x
DNAPL[3]	x	x	x

Notes:

1. Chemicals identified as COCs were found to be risk drivers (cancer risks >10-4 and/or Hazard Index >1) as a result of the quantitative risk assessment.

2. Para chlorobenzene sulfonic acid (pCBSA) is a a by-product of DDT production

3. DNAPL is a contaminant source. There are two types of DNAPL at the Site. One type of DNAPL contains high concentrations of 1,2-dichloroethane mixed with a large number of identified and unidentified brominated compounds, including PBB, hexabromobiphenyl (HBB), and 1,2-dibromo-3-chloropropane (DBCP). A second type of DNAPL present at the Site includes high concentrations of chlorobenzene mixed with DDT and its isomers dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethene (DDE).

Table 3. Summary of Multiple Lines of Evidence Supporting ESD Changes
Velsicol Chemical Corporation Superfund Site

Line of Evidence	Development Information	Investigative Findings to Support Decision Making	Conclusion	Associated Figures or Tables in this ESD	References
UPGRADIENT SLURRY WALL REPAIR					
1. Groundwater Flow Contours	Review of shallow unit groundwater flow contours before and after the installation of the slurry wall in 1983.	1. Before the installation of the slurry wall: a. Groundwater flow moved towards the Pine River from the southeast to the northwest. b. Groundwater flowed through the adjacent or nearby properties through the Former Plant Site into the Pine River. 2. After installation of slurry wall: a. A groundwater divide formed causing upgradient shallow unit groundwater to flow around the slurry wall and Former Plant Site. b. Groundwater flowed (and continues to flow to this day) from the southeast and splits to the northeast and to the southwest causing groundwater to flow around the Former Plant Site and towards the Pine River.	Offsite groundwater does not flow onto the Former Plant Site.	Appendix C - Figures 1 and 2	MEC 1997; CH2M 2002, 2017, 2012, 2020, 2023b, c, d
2. Groundwater Elevation Measurements	Groundwater elevation measurements have been collected for over 40 years both before and after slurry wall installation. Focused upgradient slurry wall studies in 2019 and 2022 collected manual and transducer groundwater elevation measurements in 54 piezometers.	a. Upgradient slurry wall retains shallow unit groundwater except at one location and the presence of the slurry wall causes groundwater mounding on the Former Plant Site (inside slurry wall). The differential in groundwater elevations show that the one exception is a 20-foot leakage area, or breach, between borings CSW-003 and CSW-005 in the vicinity of piezometer cluster CPZ-28. Surrounding the 20-foot breach is an area approximately 350-feet wide area between CPZ-30 and CPZ-25 reflecting substandard hydraulic performance. b. Shutdown of municipal drinking water wells (2014-2015) influenced the Site groundwater and has greatly reduced, and at some locations eliminated, the downward hydraulic gradient previously noted in the subsurface.	a. Groundwater elevation data indicate the location and extent of the breach and substandard performance area. b. Due to the shutdown of municipal drinking water wells the significant reduction of downward vertical gradient greatly reduces the ability of contaminants to exit the shallow unit and enter the till unit below the Site.	Appendix C - Figures 3, 4, 5, and 6	Weston 2006 & 2009; CH2M 2017, 2020, 2023b, c, d
3. Soil Boring Logs	A total of 48 new piezometer pairs were installed along the upgradient slurry wall alignment. All borings were logged to the till unit.	The soil boring at CPZ-28 showed a 3.25 foot layer of sand between the bottom of the slurry wall (15 ft below ground surface)and the top of the till surface (18.25 ft below ground surface).	The slurry wall was not keyed into the till layer during the 1983 slurry wall installation. This is the location of and the reason for the breach.	Appendix C - Figures 7 and 8	CH2M 2020 and 2023c
4. Groundwater Analytical Data	Analytical Results have been collected from the shallow unit groundwater in the adjacent or nearby properties for at least 30 years.	COC analytical results from shallow unit groundwater samples collected adjacent to the upgradient slurry wall breach do not exceed EPA maximum contaminant levels.	There is no plume emanating from the Site due to the slurry wall breach.	Appendix C - Figure 9	Weston 2006 & 2009; CH2M 2017, 2020, 2023b, c, d

Line of Evidence	Development Information	Investigative Findings to Support Decision Making	Conclusion	Associated Figures or Tables in this ESD	References
5. Groundwater Modeling	A groundwater flow model was developed to simulate groundwater flow beneath and adjacent to the Site and has been updated since 2009. In 2023, the model was updated with the recent groundwater data collected at the new piezometer clusters along the upgradient slurry wall alignment. The 2023 objective is to project the volume of extracted groundwater from a perimeter drain and extraction wells as described in the OU1 ROD, based on three scenarios. The scenarios are: 1) installation of upgradient sheet pile vertical barrier wall 2) repair of slurry wall breach; and 3) current condition of the upgradient slurry wall.	The model simulations based on the updated 2023 flow model show that the combined modeled extraction rates for all three scenarios are nearly equal (less than 1 gallon per minute), and the minor differences results from the perimeter drain flows.	Improvements to the upgradient slurry wall are not projected to reduce remediation extraction rates. The benefit of improving the slurry wall at the breach and substandard performance area would reduce the potential for offsite contaminant migration.	Table 4	CH2M 2023b
6. Dye Testing	As part of the 2019 remedial design investigation, a dye trace data was competed across the 3,100 feet upgradient slurry wall at 15 test locations. A supplemental dye tracer study was completed in 2022 using two unique dyes (fluorescein and sulphorhodamine B) to further evaluate groundwater flow pathways near the previously defined upgradient slurry wall leakage area.	Results from the 2019 remedial design investigation dye tracer study indicated the only area where dye was detected outside the slurry wall was at CPZ-26. The supplemental dye tracer completed near the leakage area indicates that although hydraulic gradients exist between interior and exterior piezometers, which suggests the upgradient slurry wall is acting as a hydraulic barrier, the presence of fluorescein dye at the end of the study in groundwater from piezometer CPZ-26X suggests another area of the upgradient slurry wall leakage may be present near the CPZ-26 cluster. The dye tracer studies completed between piezometer clusters CPZ-25 and CPZ-30 indicates that groundwater will eventually exit the FPS through the upgradient slurry wall leakage area.	Based on collective groundwater elevation measurements inside and outside of the upgradient slurry wall and the dye study results, performance of the upgradient slurry wall over approximately 350 linear feet is degraded specifically between piezometer clusters CPZ-25-5-5 and CPZ-30. The affected 350 foot section includes the breach observed in the vicinity of piezometer cluster CPZ-28.	--	CH2M 2020 and 2023c
7. Hydraulic Conductivity	5 Shelby tube samples were collected in 2019 and an additional 6 were collected in 2022.	Hydraulic conductivities ranging from 10^{-8} cm/s to 10-6 cm/s. Of these samples, one was in the 10^{-6} cm/s range, 3 were 10^{-7} cm/s range, and the remaining 7 samples were in the 10^{-8} cm/s range. Hydraulic conductivity values are consistent with permeability standards established by the 1982 Consent Judgement.	Hydraulic conductivity values are representative of values for engineered low-permeable layers and act as a barrier to groundwater flow.	Appendix C - Figure 10	CH2M 2002, 2020 and 2023c

Line of Evidence	Development Information	Investigative Findings to Support Decision Making	Conclusion	Associated Figures or Tables in this ESD	References
MW-19 AREA - REMOVAL OF NEED FOR DNAPL COLLECTION TRENCH SEGMENT					
1. DNAPL Screening	During intrusive work, if contamination was encountered that looked like DNAPL it was noted on the soil boring and tested with field kits.	DNAPL was encountered and verified in two locations, SB004 and SB014.	New monitoring well installed in the vicinity of the 2 DNAPL occurrences, to measure DNAPL thickness (and thereby mobility/fluctuations) over time.	Appendix C - Figures 11, 12, 13, and 14	CH2M 2023d
2. Groundwater Sampling	Two new monitoring wells were installed and a total of 7 monitoring wells were sampled for this investigation.	Groundwater sampling events in the MW-19 Area were completed in April and July 2022. The April 2022 groundwater sampling collected from WPZ-06I had a HBB concentration of 0.53 ug/L, which is above the water solubility criterion for HBB (0.17 ug/L). The HBB concentration at WPZ-06I was below the water solubility criterion during the July 2022 groundwater sampling event. No other groundwater samples exceeded water solubility criteria during either sampling event.	Groundwater sample analytical data do not show widespread exceedances of the Michigan Part 201 water solubility criteria (2012 ROD groundwater performance standard). This supports the conclusion that DNAPL occurrences are isolated.		
3. Groundwater and DNAPL Measurements	DNAPL was measured at one monitoring well, the new monitoring well, CMW-19SI.	Approximately 5 inches of DNAPL was measured in CMW-19SI at two different dates, August 3, 2022 and January 5, 2023, and the thickness was unchanged.	DNAPL thickness is stable, indicating the DNAPL is likely immobile and an isolated occurrence.		
4. Soil Sampling	17 new soil borings were advanced during this predesign investigation.	High spatial density of the soil borings and low frequency of DNAPL observations.	DNAPL is attributed to isolated or local occurrences within or on the till surface. There is also a lack of DNAPL continuity across the MW-19 Area.		

Table 4. Modeled Remedy Extraction Summary

Velsicol Chemical Corporation Superfund Site

Modeled Flows	Scenario 1 Existing UGSW with Leakage Area	Scenario 2 Repaired UGSW in Leakage Area	Scenario 3 Sheet Pile Wall around UGSW
Perimter Drain	14.8	14.7	13.9
14 Remediation Wells	73.0	73.0	73.0
Sum	87.8	87.7	86.9
Reduction in Flow Relative to Scenario 1	0	0.1	0.9

Notes:

1. Flow values in table are in unit of gallons per minute.

Table 5. Estimated Cost Comparison Between Upgradient Vertical Barrier Wall Implementation and Upgradient Slurry Wall Repair

Velsicol Chemical Corporation Superfund Site

	Total Estimated Cost of Upgradient Barrier Wall[c] ($)	Total Estimated Cost Upgradient Slurry Wall Repair[d] ($)
Cost from Feasibility Study and 2012 OU1 Record of Decision (ROD)[a] (construction costs + mobe/demob + contingency + professional services)	$ 11,428,000	--
Cost from 2012 OU1 ROD with 5% escalation rate[b]	**$ 22,627,000**	--
Cost from Engineering Evaluation Technical Memorandum (2023) [b]	--	**$ 1,126,000**

Notes:

a. Based on 2011/2012 costs in presented Feasibility Study and ROD cost estimates

b. Based on assumed 2025 costs

c. ROD assumes sealed sheet pile wall installation

d. Engineering Evaluation assumes soil mixing for repair

Appendix A

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR THE
VELSICOL CHEMICAL CORPORATION SITE
ST. LOUIS, GRATIOT COUNTY, MICHIGAN

UPDATE 4
JULY, 2024
SEMS ID:

NO.	SEMS ID	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	931741	1/1/17	CH2M HILL	U.S. EPA	Report - Regarding: Remedial Design Investigation - Former Plant Site Remedial Design Groundwater Characterization, St. Louis, Michigan	438
2	960532	8/1/20	CH2M HILL	U.S. EPA	Report - Regarding: Data Evaluation Report, Velsicol Former Plant Site - Upgradient Slurry Wall Investigation - St. Louis, Michigan	178
3	973779	3/1/22	CH2M HILL	Alcamo, T., U.S. EPA	Technical Memorandum - Regarding: MW - 19 Area Investigation Work Plan, Velsicol Chemical Corporation Superfund Site	158
4	980340	3/15/23	CH2M HILL	U.S. EPA	Report - Regarding: MW - 19 Area Investigation Technical Memorandum, Velsicol Chemical Corporation Superfund Site	4057
5	985841	8/7/23	CH2M HILL	Alcamo, T., U.S. EPA	Technical Memorandum - Regarding: Supplemental Upgradient Slurry Wall Investigation, Velsicol Chemical Corporation - Pine River Superfund Site, St. Louis, Michigan	368
6	985290	9/1/23	CH2M HILL	Alcamo, T., U.S. EPA	Report - Regrading: Velsicol Groundwater Flow Model 2023 Update - Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan	60

NO.	SEMS ID	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
7	985941	3/14/24	CH2M HILL	U.S. EPA	Technical Memorandum - Regarding: Engineering Evaluation of Methods to Repair the Upgradient Slurry Wall Leakage Area, Velsicol Chemical Corporation Superfund Site (Redacted)	27
8	992244	6/17/24	Roos, P., EGLE	Ballotti, D., U.S. EPA	Letter via Email - Regarding: Concurrence with the Explanation of Significant Differences for a Remedy Modification for Operable Unit 1; Velsicol Chemical Superfund Site, St. Louis, Gratiot County, Michigan	2
9	****	****	****	****	Newspaper: EPA Announces *(Pending)*	****
10	****	****	****	****	Factsheet *(Pending)*	****
11	****	****	****	****	ESD *(Pending)*	****

Appendix B

STATE OF MICHIGAN
DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY
LANSING

GRETCHEN WHITMER
GOVERNOR

PHILLIP D. ROOS
DIRECTOR

June 17, 2024

VIA EMAIL

Douglas E. Ballotti, Director
Superfund and Emergency Management Division
United States Environmental Protection Agency
Region 5
77 West Jackson Boulevard (S-6J)
Chicago, Illinois 60604-3507

Dear Douglas E. Ballotti:

SUBJECT: Concurrence with the Explanation of Significant Differences for a Remedy Modification for Operable Unit 1; Velsicol Chemical Superfund Site; St. Louis, Gratiot County, Michigan

The Michigan Department of Environment, Great Lakes, and Energy (EGLE) has received a copy of the Explanation of Significant Differences (ESD) for Operable Unit (OU) 1 at the Velsicol Chemical Superfund Site in St. Louis, Gratiot County, Michigan. The United States Environmental Protection Agency (USEPA) has requested concurrence from the State of Michigan with the ESD for the site.

EGLE concurs with the proposed remedy modifications that necessitate this ESD. These remedy modifications are part of the containment portion of the OU1 remedy and include the repair of the existing upgradient slurry wall as part of a vertical barrier wall containment around the former plant site and the removal of the need for a dense nonaqueous phase liquid/groundwater collection system extension to address the MW-19 Area.

If you need further information, please contact Mike Neller, Director, Remediation and Redevelopment Division, at 517-512-5859; NellerM@Michigan.gov; or EGLE, P.O. Box 30426, Lansing, Michigan 48909-7926; or you may contact me.

Sincerely,

Phillip D. Roos
Director
517-284-6700

cc: Jennifer Knoepfle, USEPA, Region 5
Aaron B. Keatley, Chief Deputy Director, EGLE
Mike Neller, EGLE
Kalan Briggs, EGLE
Robert Franks, EGLE
Matt Baltusis, EGLE

Appendix C

Pine River Downstream (OU4)

OU4

OU3

Pine River St. Louis Impoundment (OU2)

Pine River Mill Pond (OU2)

St. Louis Dam

Pine River Downstream (OU3)

Former Plant Site (OU1)

Adjacent and Nearby Properties (OU1)

Legend

- Former Plant Site and Adjacent and Nearby Properties (OU1)
- Pine River and Pine River Mill Pond – St. Louis Impoundment (OU2)
- Pine River Downstream (OU3)
- Pine River Downstream (OU4)

N

0 600 1,200

Approximate scale in feet

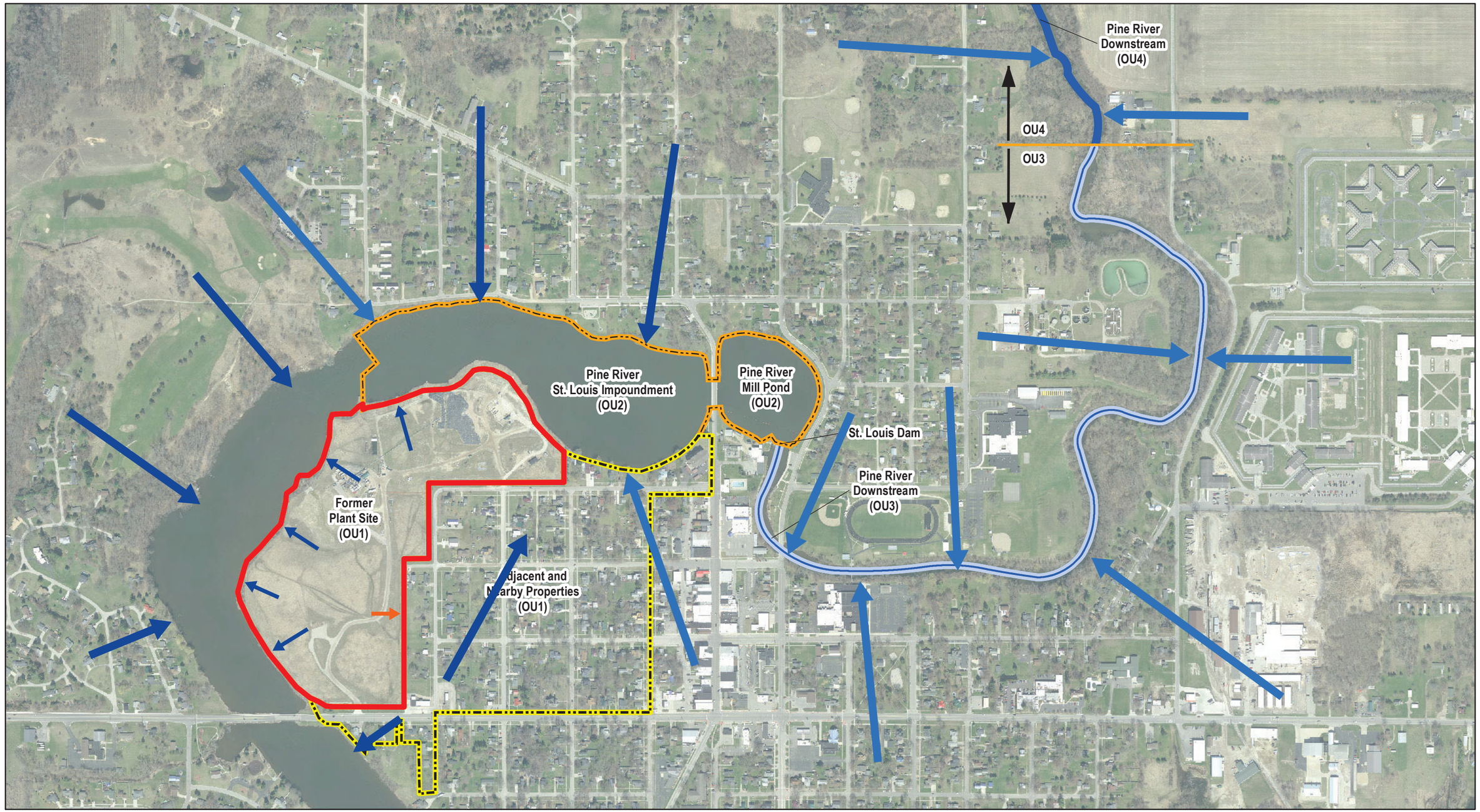
Appendix C - FIGURE 1

Shallow Unit Groundwater Flow Direction

Before Slurry wall Installation

Velsicol Chemical Corporation Superfund Site

Saint Louis, Michigan



Legend

- Former Plant Site and Adjacent and Nearby Properties (OU1)
- Pine River and Pine River Mill Pond – St. Louis Impoundment (OU2)
- Pine River Downstream (OU3)
- Pine River Downstream (OU4)

N

0 600 1,200

Approximate scale in feet

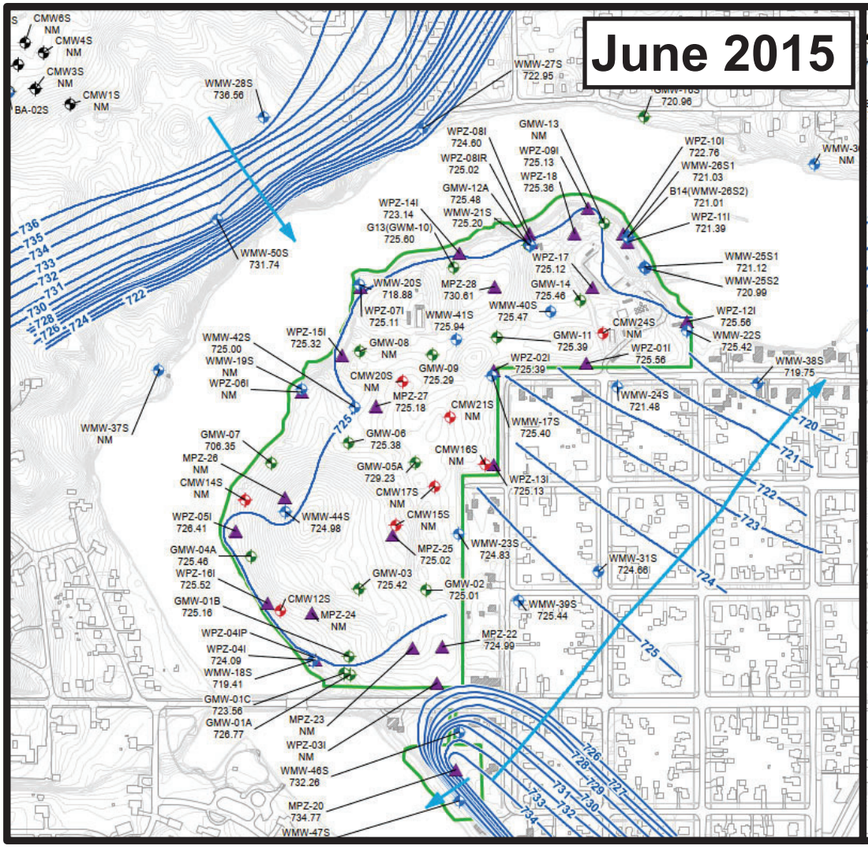
Appendix C - FIGURE 2

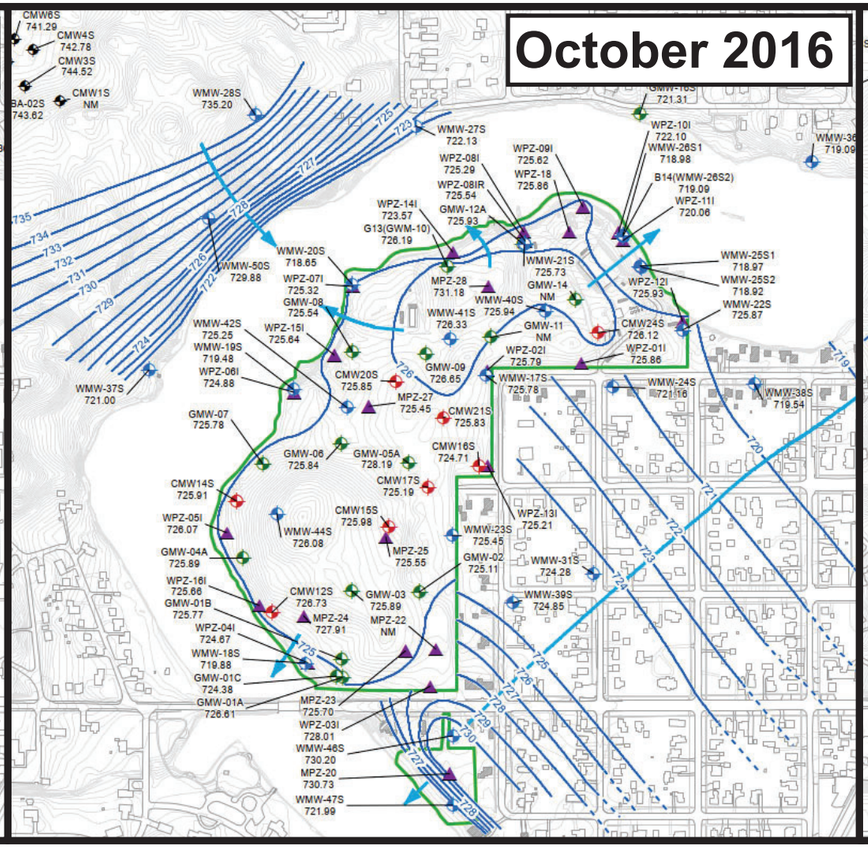
Shallow Unit Groundwater Flow Direction

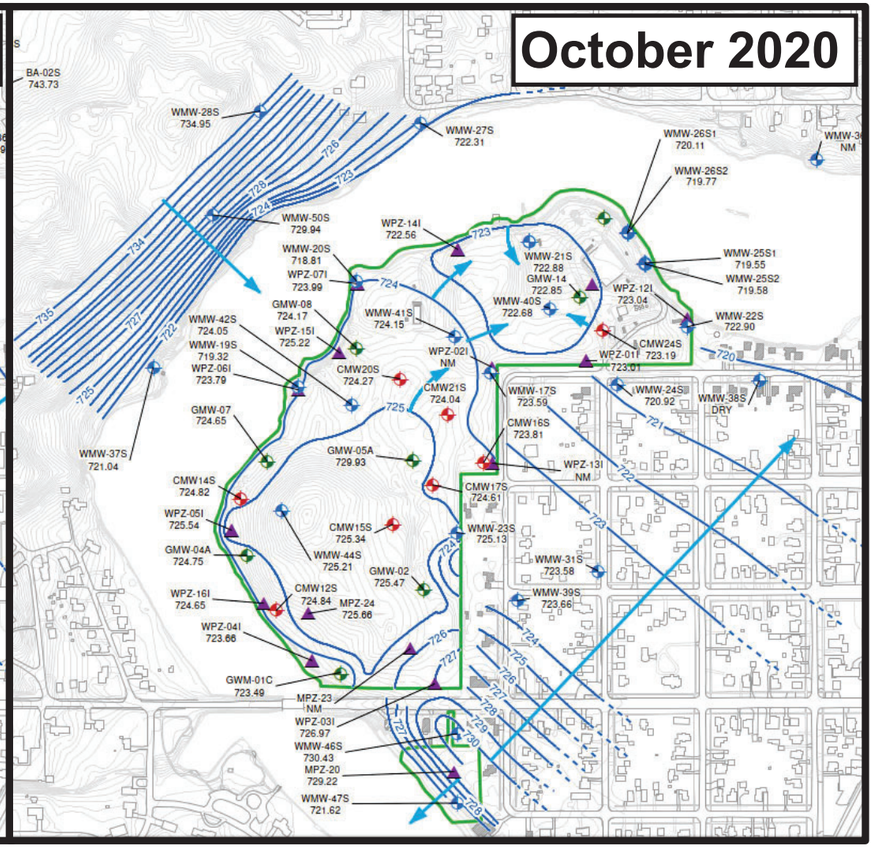
After Slurry wall Installation

Velsicol Chemical Corporation Superfund Site

Saint Louis, Michigan



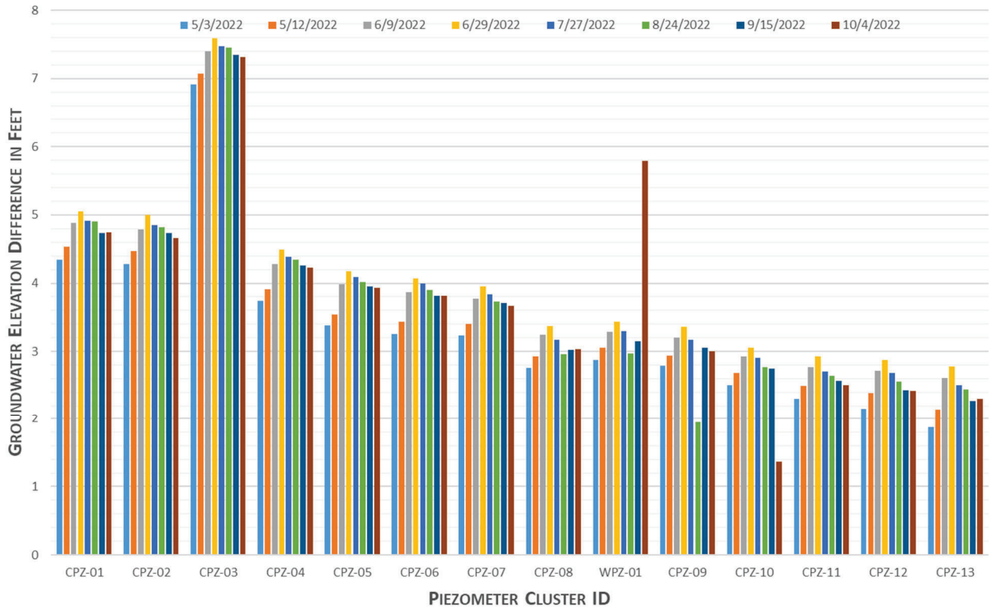


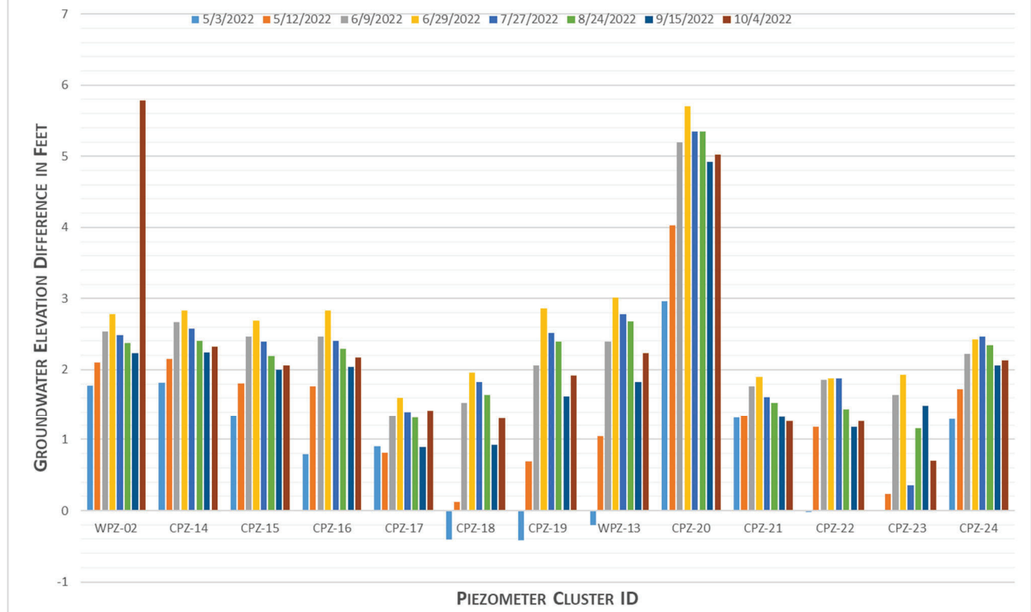


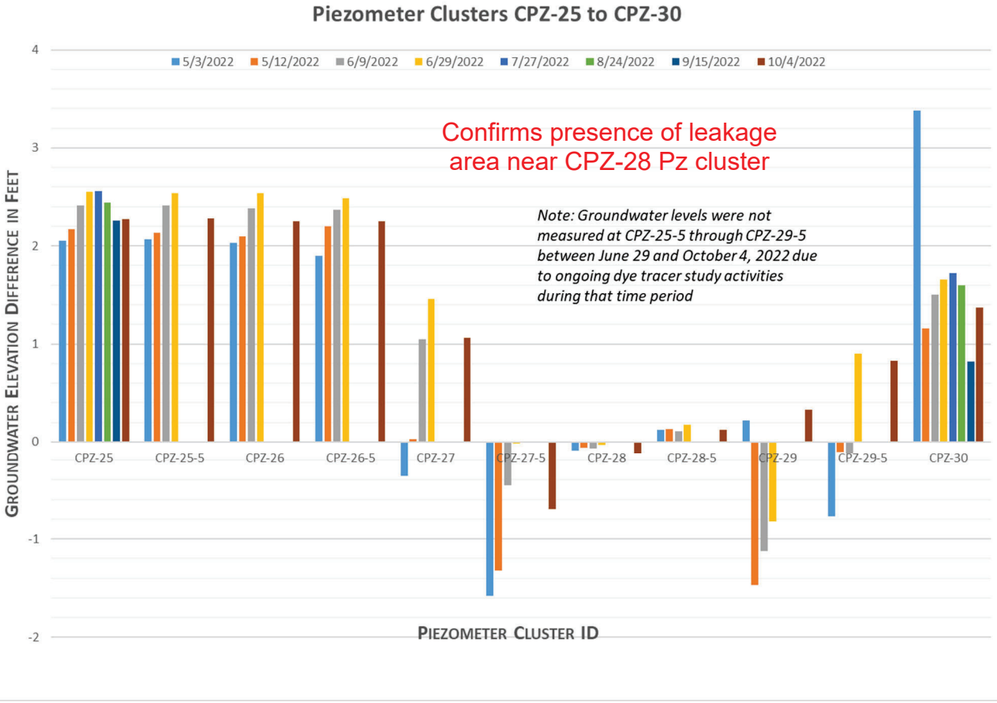
Legend

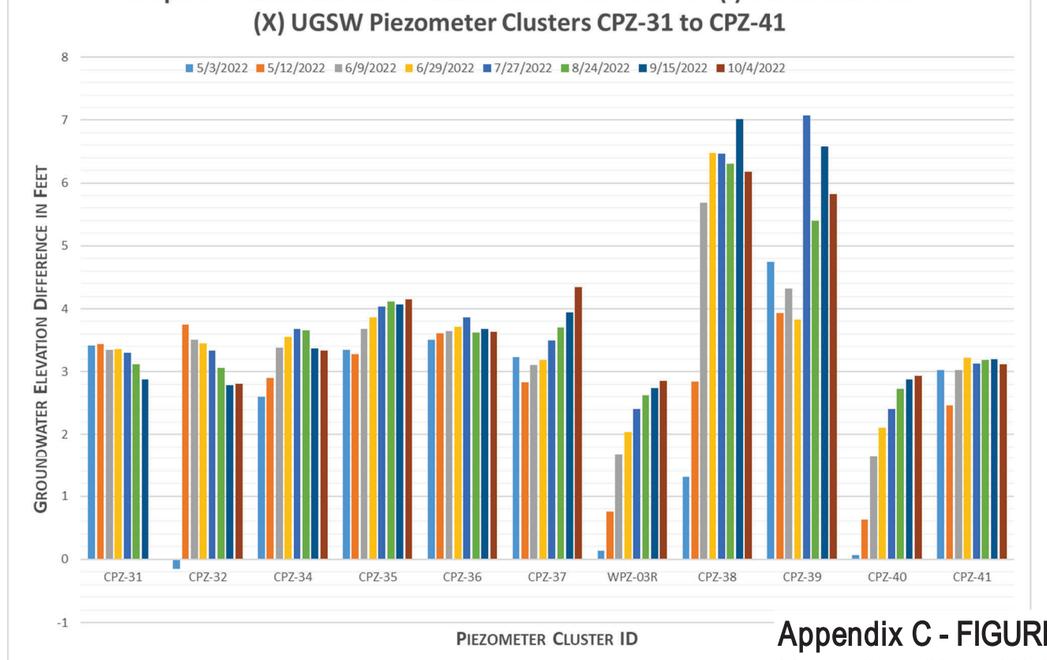
- Existing Monitoring Well (Installed by CH2M 2015)
- Existing Monitoring Well (Installed by MDEQ/Weston)
- Existing Monitoring Well (Installed Pre-2000)
- Existing Piezometer (Installed by MDEQ/Weston)
- Groundwater Directional Flow Lines
- Shallow Groundwater Contours (Dashed where inferred)

Appendix C - FIGURE 3
OU1 Shallow Unit Groundwater Elevation Contours
Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan



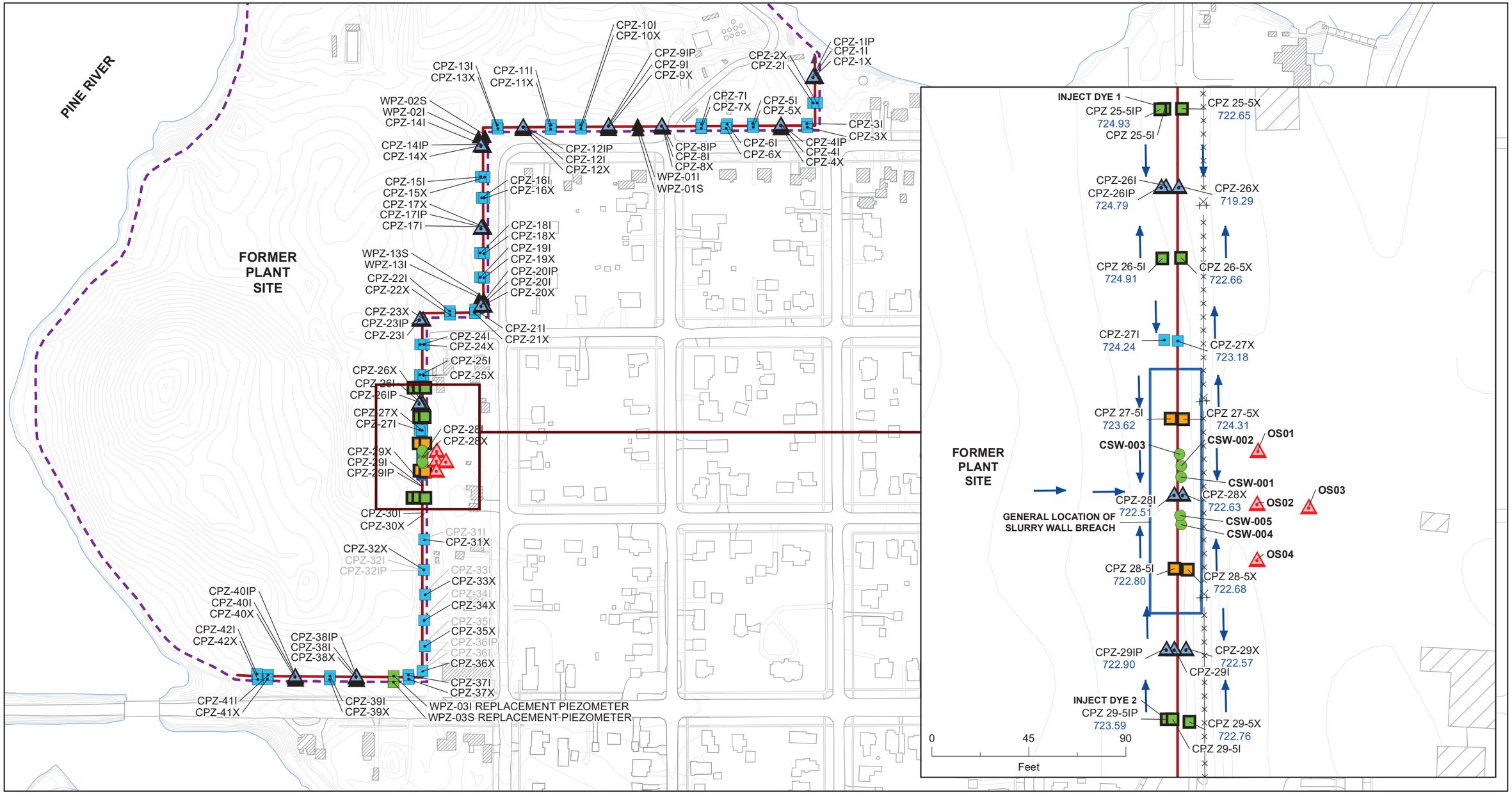






Notes:
1. Bar Graphs greater than Zero = Positive hydraulic gradients (away from site) and indicate upgradient slurry wall is effective.
2. Bar Graphs less than or close to Zero = Negative or negligible hydraulic gradients (inward/toward the site) indicate substandard upgradient slurry wall effectiveness.

Appendix C - FIGURE 4
Upgradient Slurry Wall Piezometer Results - 2022 Groundwater Elevation Measurements
Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan



Legend

- OFFSITE GROUNDWATER SAMPLE
- UGSW EXPLORATION BORING
- NEW TWO/THREE PIEZOMETER CLUSTER WITHIN POTENTIAL SLURRY WALL BREACH
- NEW TWO/THREE PIEZOMETER CLUSTER
- EXISTING TWO PIEZOMETER CLUSTER
- WPZ-03 PIEZOMETER REPLACEMENT
- EXISTING THREE PIEZOMETER CLUSTER
- WPZ PIEZOMETER
- GENERAL LOCATION OF SLURRY WALL LEAKAGE AREA
- APPROXIMATE OPERABLE UNIT 1 BOUNDARY
- UPGRADIENT SLURRY WALL
- GROUNDWATER FLOW DIRECTION
- 722.90 GROUNDWATER ELEVATION

N

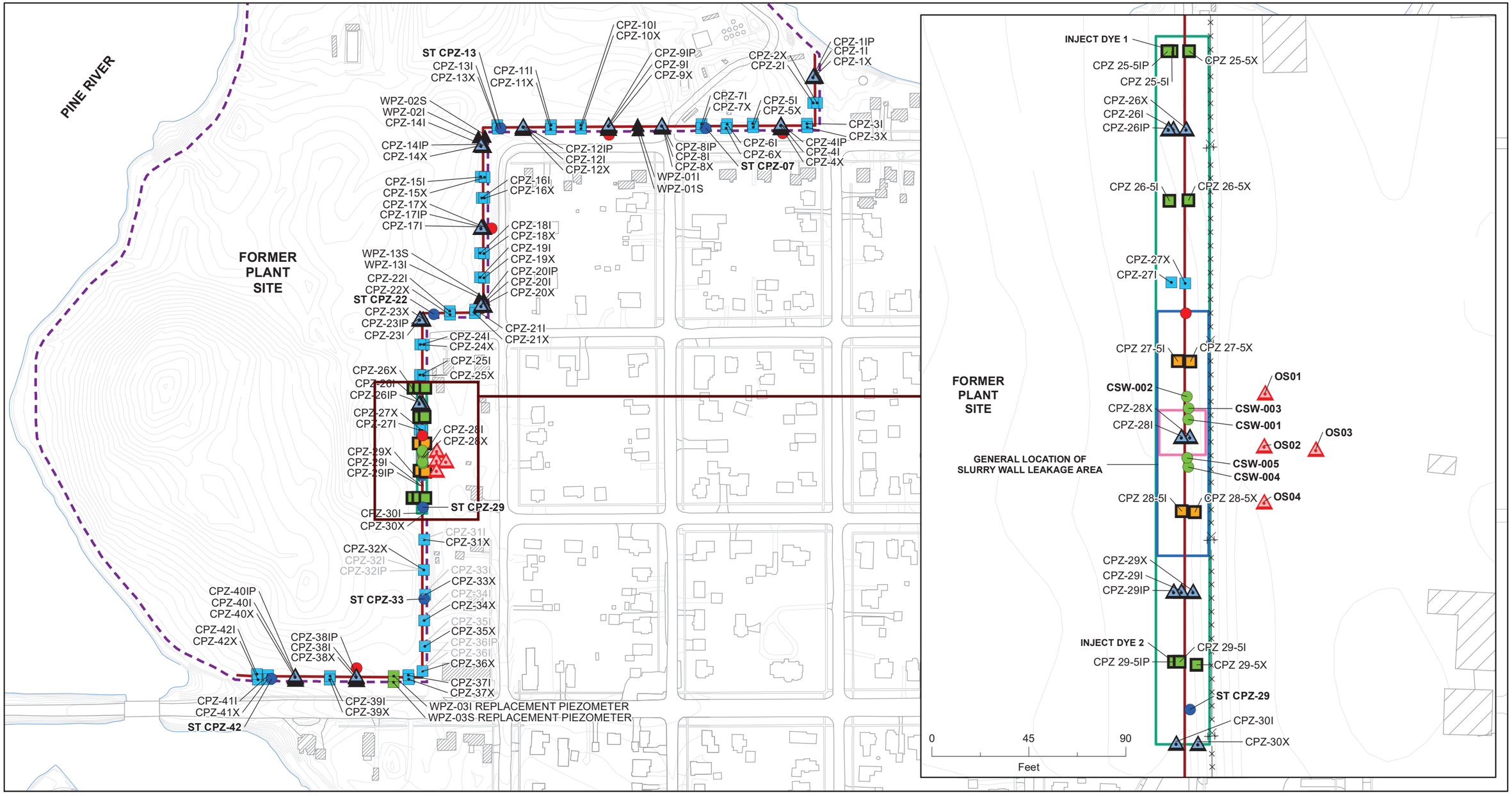
0 250 500

Feet

Appendix C - FIGURE 5

Groundwater Flow Near CPZ-28 Cluster

Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan



Legend

- OFFSITE GROUNDWATER SAMPLE
- UGSW EXPLORATION BORING
- NEW TWO/THREE PIEZOMETER CLUSTER WITHIN POTENTIAL SLURRY WALL BREACH
- NEW TWO/THREE PIEZOMETER CLUSTER
- EXISTING TWO PIEZOMETER CLUSTER
- WPZ-03 PIEZOMETER REPLACEMENT
- EXISTING THREE PIEZOMETER CLUSTER
- 2022 SHELBY TUBE SAMPLE
- 2019 SHELBY TUBE SAMPLE
- WPZ PIEZOMETER
- UPGRADIENT SLURRY WALL
- APPROXIMATE FENCE ALIGNMENT
- AREA OF DEGRADED UGSW PERFORMANCE
- SLURRY WALL BREACH IDENTIFIED BY SLURRY WALL BORINGS
- GENERAL LOCATION OF SLURRY WALL LEAKAGE AREA
- APPROXIMATE OPERABLE UNIT 1 BOUNDARY

N

0 250 500

Feet

Appendix C - FIGURE 6

Location of Breach and Substandard Performance Area in Upgradient Slurry Wall

Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan

South

North

Elevation (Feet amsl)

735
730
725
720
715
710

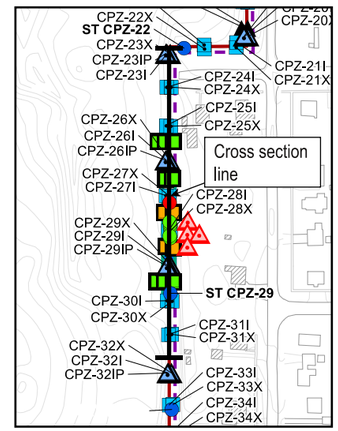
CPZ-31I
CPZ-30I
CPZ-29-5I
CPZ-29I
CPZ-28-5I
CPZ-28I
CPZ-27-5I
CPZ-27I
CPZ-26-5I
CPZ-26I
CPZ-25-5I
CPZ-25I
CPZ-24I
CPZ-23I

LEGEND

- Silty Clay to Clayey Silt - Cap Material
- Interbedded silty clay, sandy clay and clayey sand; with occasional thin (<2") sand seams (fine grain) present
- Sand - Primarily fine to medium sand with occasional layers of fine to coarse sand and silty sand
- Sandy Silt
- Silty Clay to Clayey Silt with occasional sand and silty sand seams - till
- Soil Boring
- Piezometer Screen Location
- Water Table (Approximate)
- General groundwater flow direction
- Slurry wall vertical extent shown. This boring located 5' east of CPZ-28I
- Extrapolated slurry wall vertical and horizontal extent

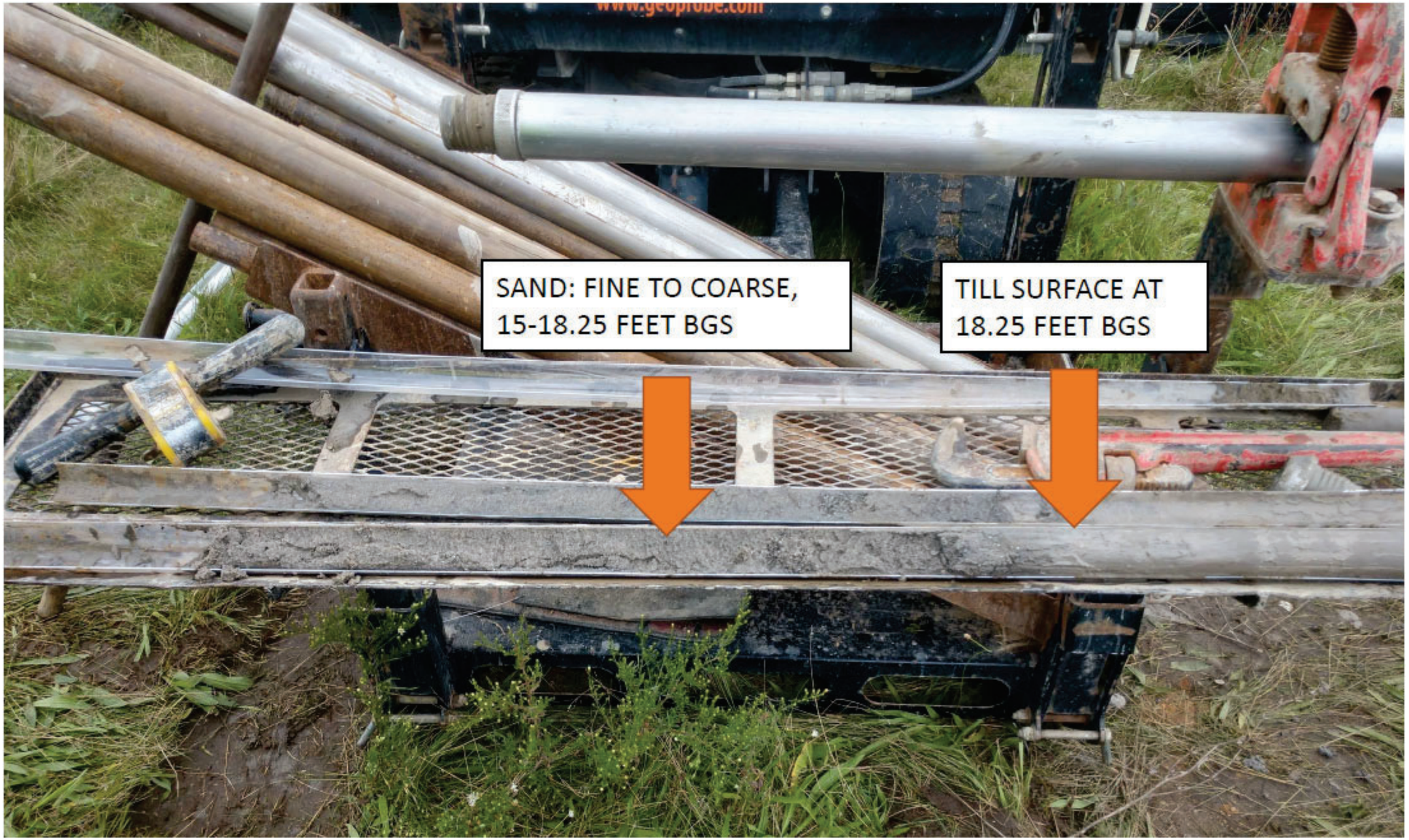
Static water table measurements taken on 10/04/2022

Horizontal : 1" = 50'
Vertical: 1.4" = 5'
Vertical Exaggeration = 10x

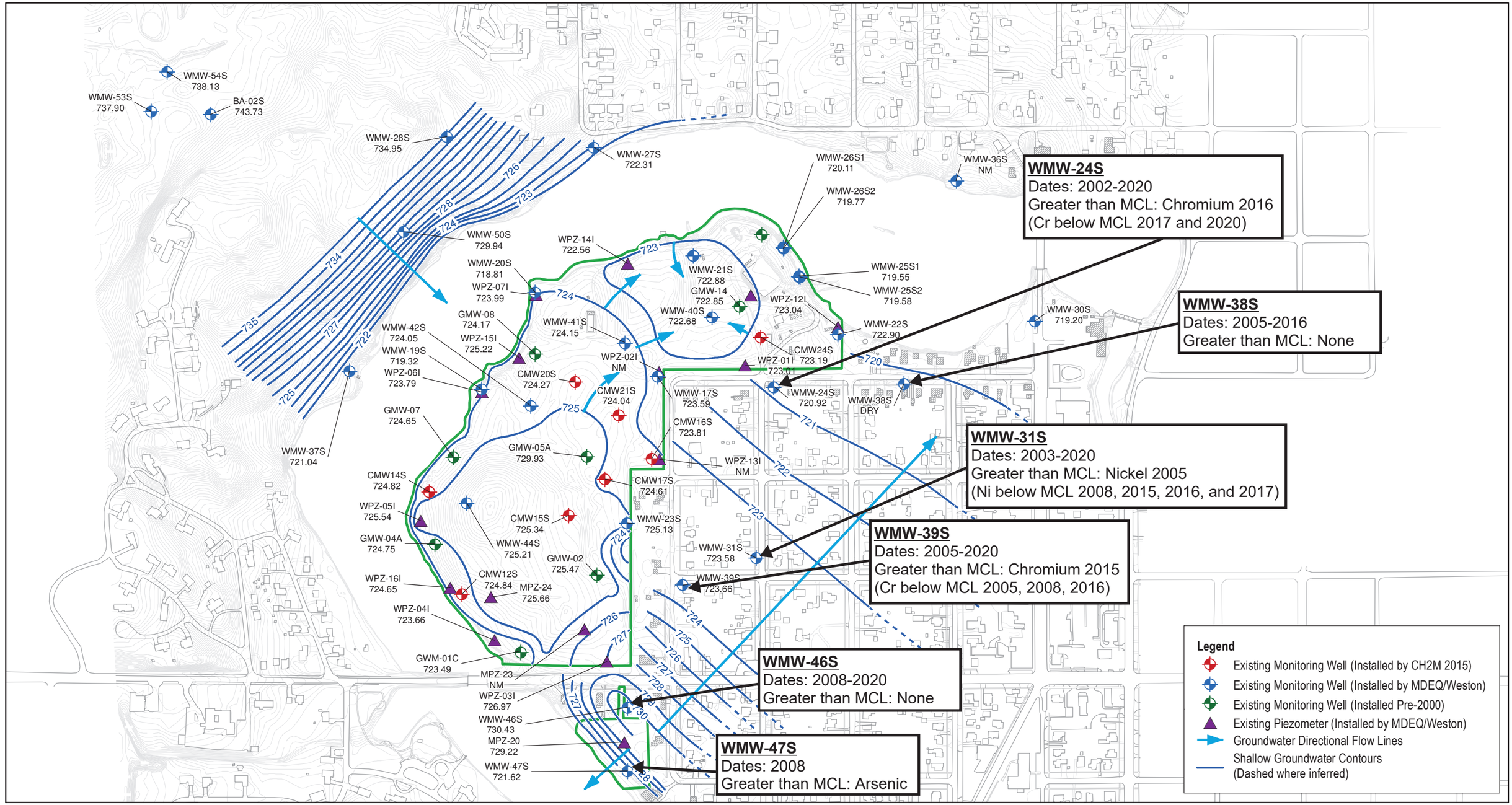


Note: Stratigraphy lines are based on interpretations between soil borings and represent approximate boundaries. Actual transitions between soil boring locations may vary from those presented in this cross section.

Appendix C - FIGURE 7
Upgradient Slurry Wall North-South Hydrogeologic Cross-Section
Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan



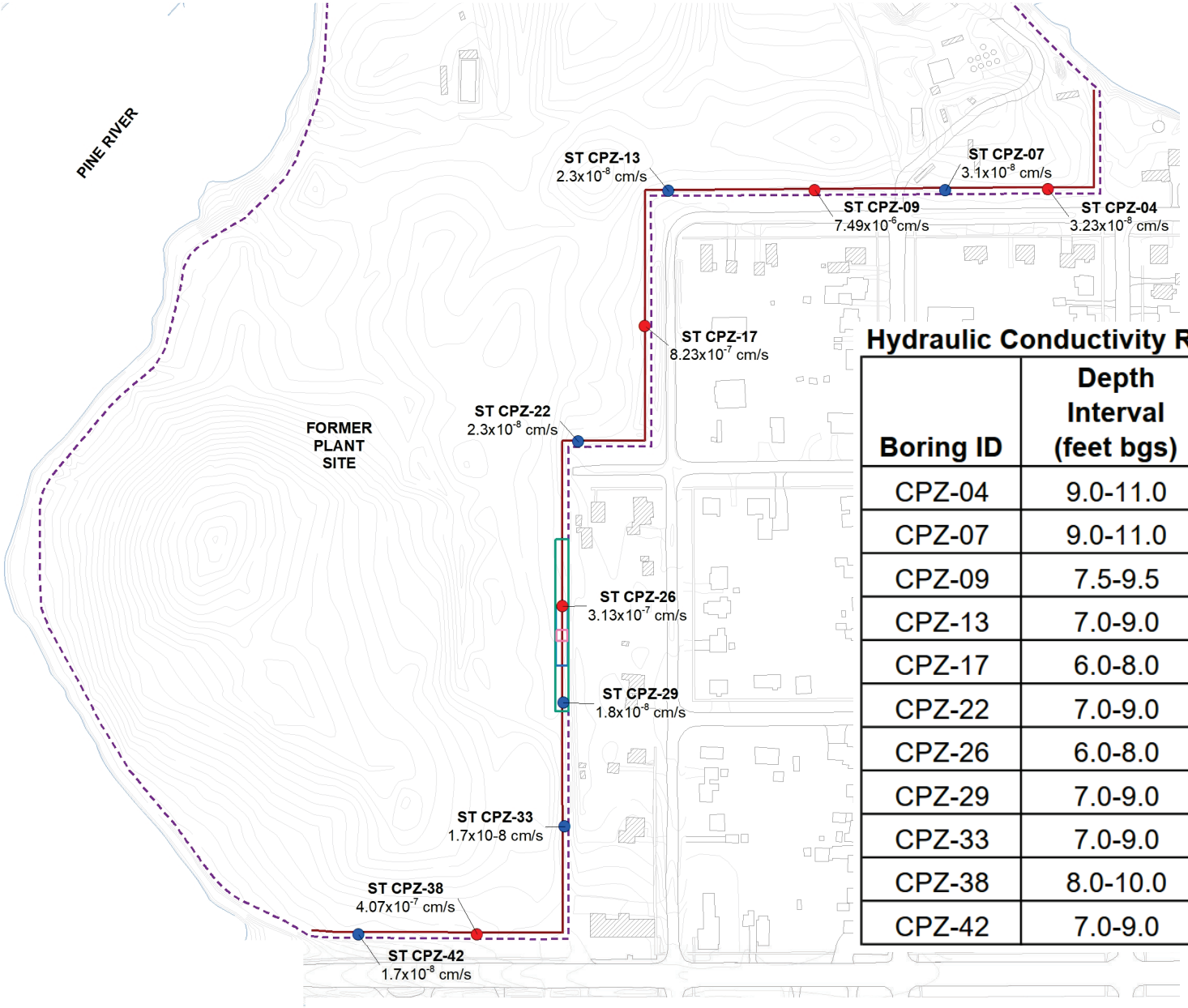
Appendix C - FIGURE 8
CPZ-28 Upgradient Slurry Wall Boring Sample
Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan



NOTES:

1. BASE MAP PROVIDED BY WESTON SOLUTIONS OF MICHIGAN, INC.
2. LAND SURVEY ELEVATIONS WERE REFERENCED TO NAVD OF 1988 FEET MSL. THE HORIZONTAL LOCATIONS WERE REFERENCED TO THE MICHIGAN STATE PLANE COORDINATE SYSTEM NAD83, INTERNATIONAL FEET - SOUTH (2113) ZONE.

Appendix C - FIGURE 9
OU1 Shallow Unit Groundwater Analytical Data from Adjacent or Nearby Properties
Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan

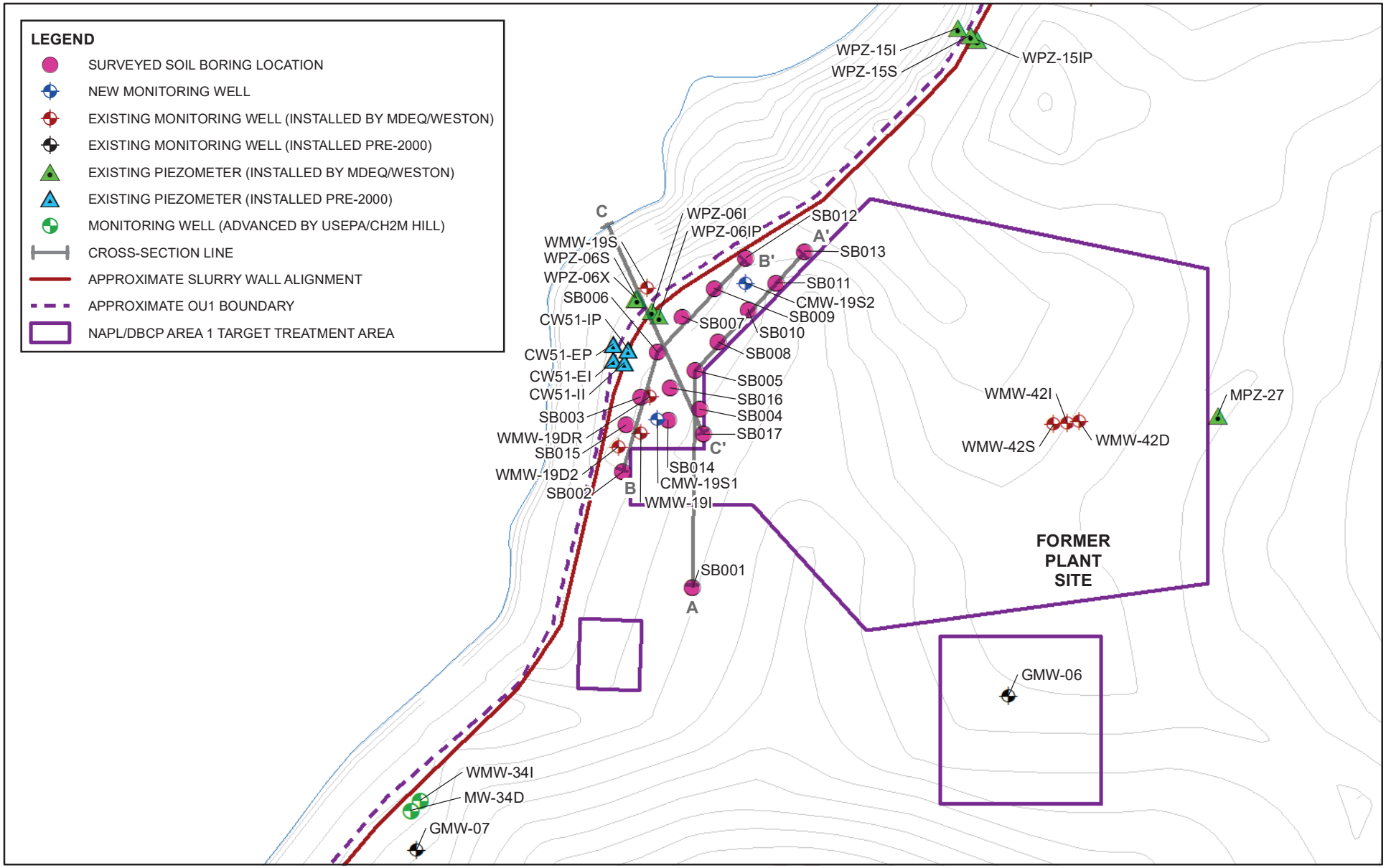


Hydraulic Conductivity Results - Upgradient Slurry Wall

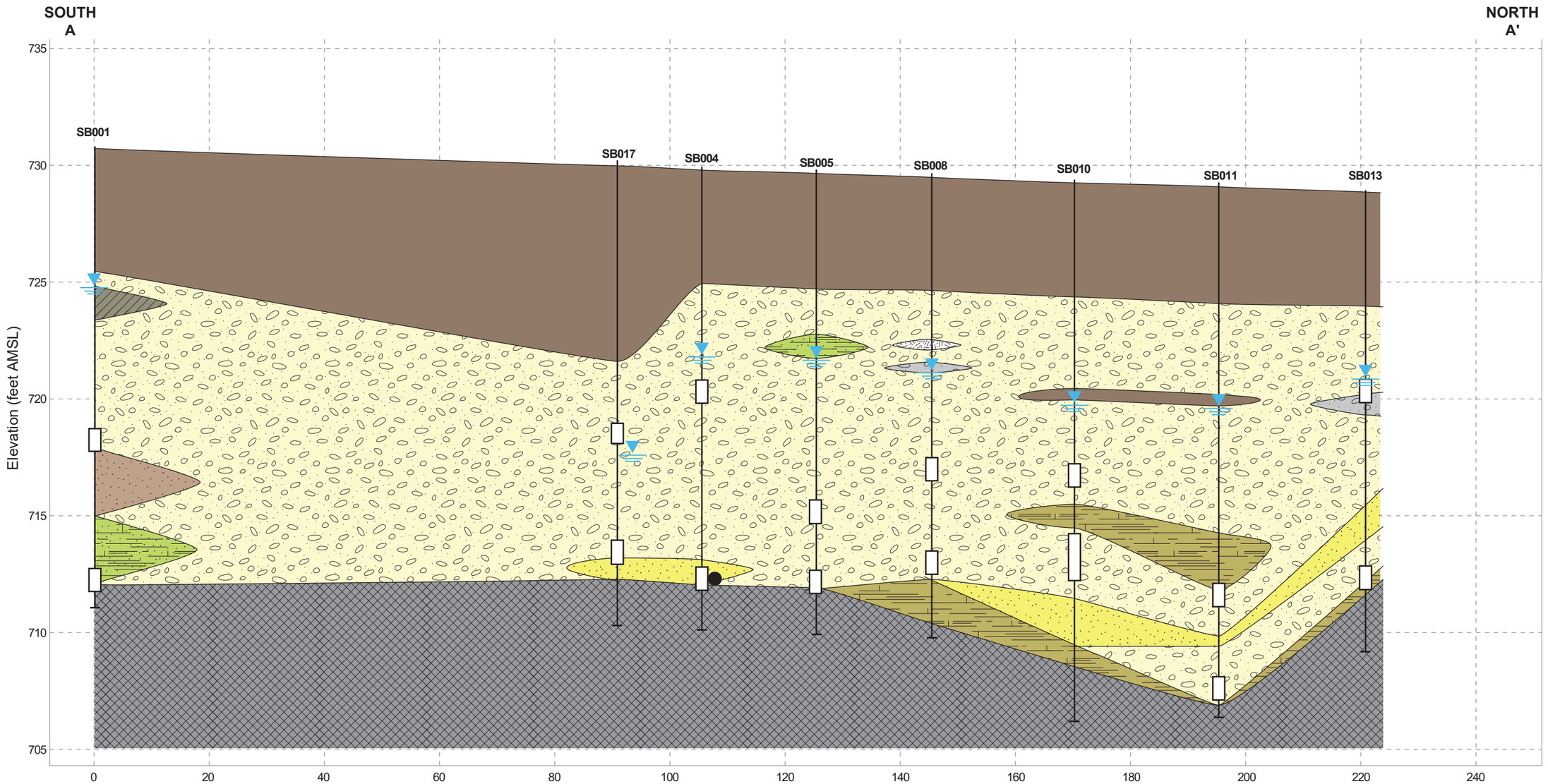
Boring ID	Depth Interval (feet bgs)	Hydraulic Conductivity (cm/s)	Sample Collected (year)
CPZ-04	9.0-11.0	3.2×10^{-8}	2019
CPZ-07	9.0-11.0	3.1×10^{-8}	2022
CPZ-09	7.5-9.5	7.5×10^{-6}	2019
CPZ-13	7.0-9.0	2.3×10^{-8}	2022
CPZ-17	6.0-8.0	8.2×10^{-7}	2019
CPZ-22	7.0-9.0	2.3×10^{-8}	2022
CPZ-26	6.0-8.0	3.1×10^{-7}	2019
CPZ-29	7.0-9.0	1.8×10^{-8}	2022
CPZ-33	7.0-9.0	1.7×10^{-8}	2022
CPZ-38	8.0-10.0	4.0×10^{-7}	2019
CPZ-42	7.0-9.0	1.7×10^{-8}	2022

Notes:
1. Samples collected in 2019 and 2022.
2. 10 of 11 samples are 10^{-7} cm/s or lower (7 samples=10^{-8} cm/s, 3 samples=10^{-7} cm/s, 1 sample=10^{-6} cm/s).
3. Conductivity values are consistent with permeability standards established by the 1982 Consent Judgment for containment wall performance.

Appendix C - FIGURE 10
Upgradient Slurry Wall Hydraulic Conductivity Results
Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan

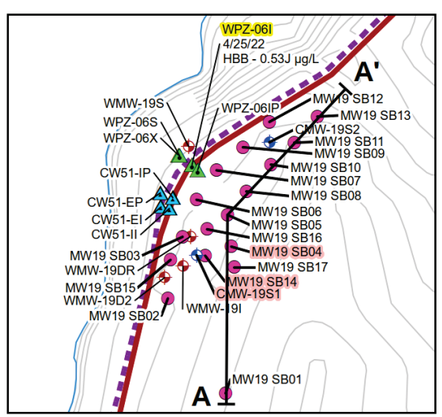


Appendix C - FIGURE 11
MW-19 Area and ISTT Area 1 with Cross-Section Lines
Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan



Legend
(Lithologic units dashed where inferred)

- Well Graded Sand
- Poorly Graded Sand
- Clay
- Lime Clay
- Sandy Clay
- Silt
- Silty Sand
- Till
- Gravel
- Non-native material, unknown composition
- Positive NAPL Test Kit Result
- Sample Interval
- Groundwater Level



Appendix C - FIGURE 12
Cross Section A–A'
Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan

SOUTH
B

NORTH
B'

SB002 SB015 SB003 SB006 SB007 SB009 SB012

Elevation (feet AMSL)

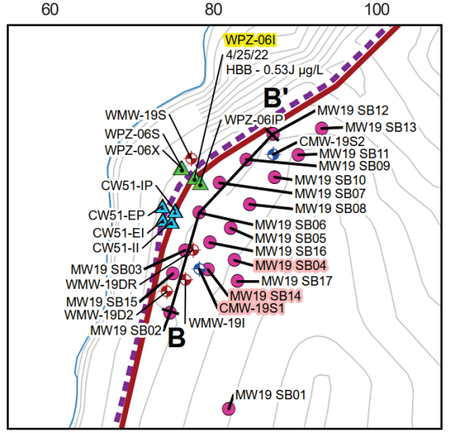
735
730
725
720
715
710
705

0 20 40 60 80 100 120 140 160 180 200 220 240

Distance Along Baseline (feet)

Legend
(Lithologic units dashed where inferred)

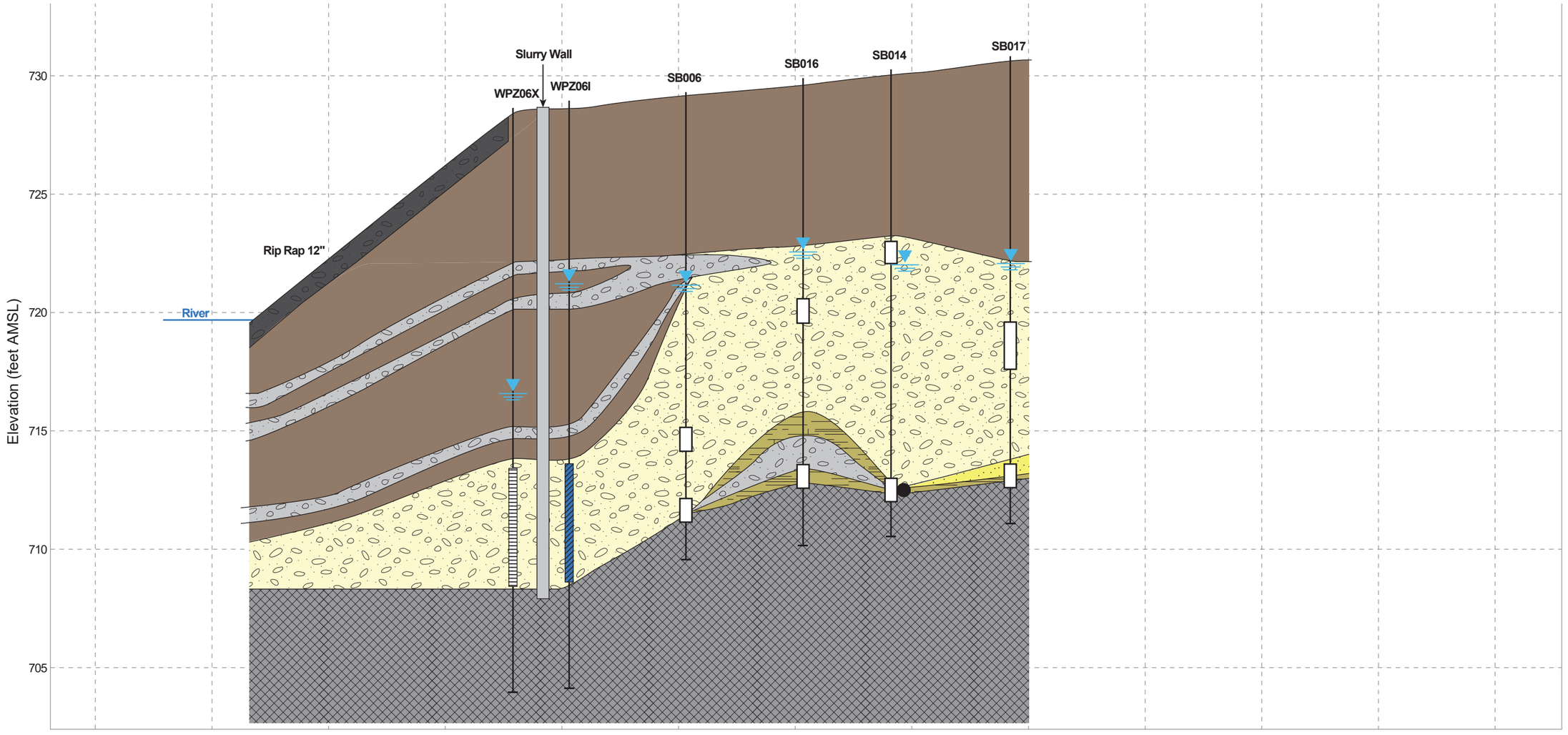
- Well Graded Sand
- Poorly Graded Sand
- Clay
- Lime Clay
- Sandy Clay
- Silt
- Silty Sand
- Till
- Gravel
- Non-native material, unknown composition
- Sample Interval
- Groundwater Level



Appendix C - FIGURE 13
Cross Section B–B'
Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan

NORTH
C

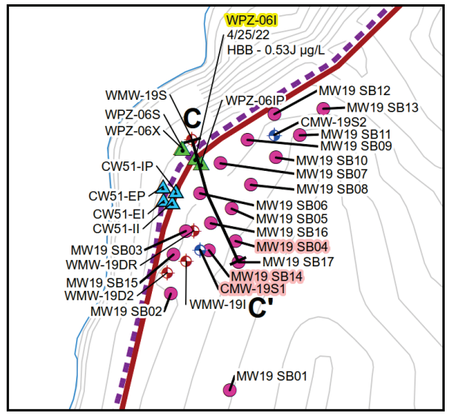
SOUTH
C'



Legend
(Lithologic units dashed where inferred)

- Well Graded Sand
- Poorly Graded Sand
- Clay
- Lime Clay
- Sandy Clay
- Silt
- Silty Sand
- Till
- Gravel

- Positive NAPL Test Kit Result
- Sample Interval
- Groundwater Level
- Monitoring Well
- Groundwater Sample Location - Analytical Result > Water Solubility Criteria for one or more pesticides and/or SVOCs



Appendix C - FIGURE 14
Cross Section C–C'
Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan

Appendix D

Appendix E