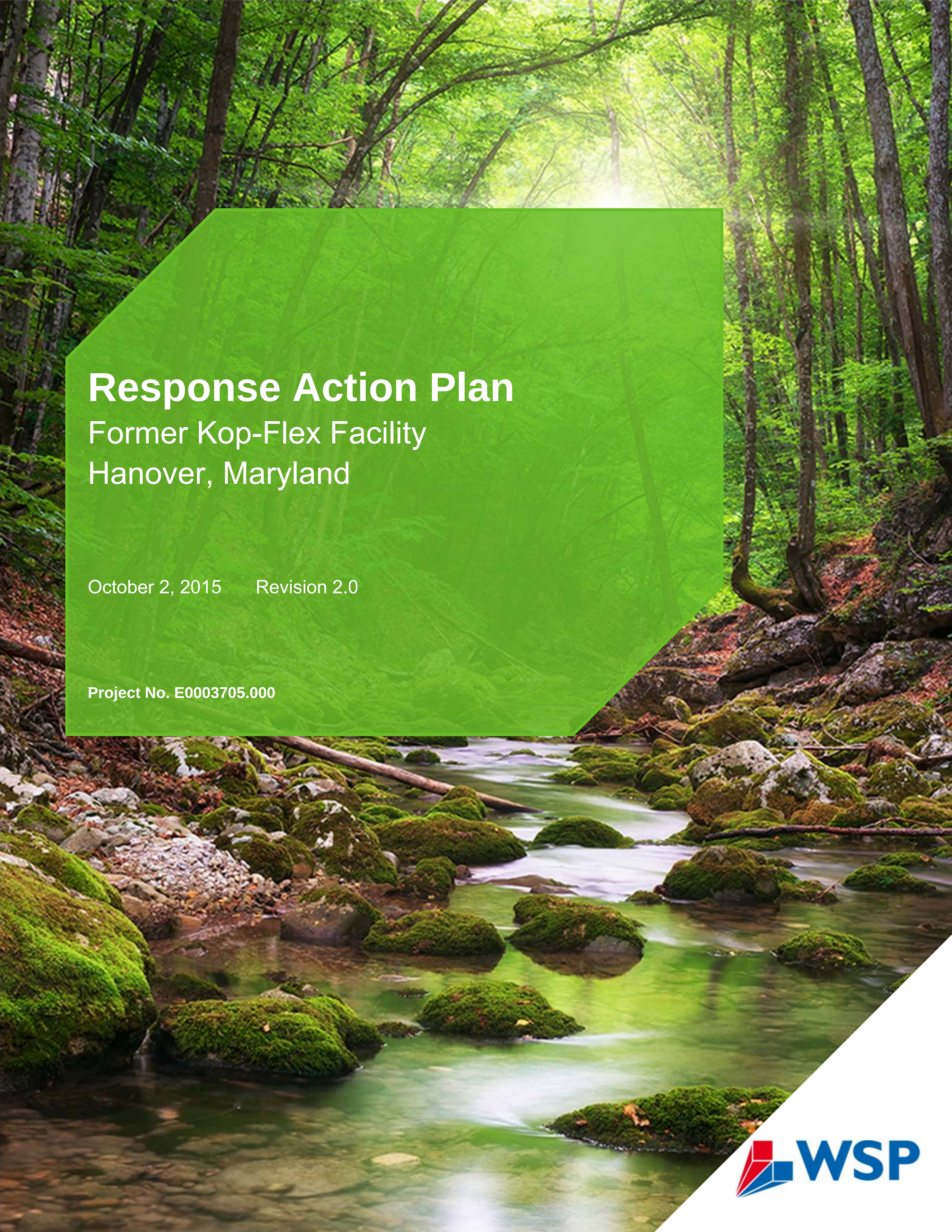

Response Action Plan

Former Kop-Flex Facility
Hanover, Maryland

October 2, 2015 Revision 2.0

Project No. E0003705.000

RESPONSE ACTION PLAN

Former Kop-Flex Facility, Hanover, Maryland

Voluntary Cleanup Program

October 2, 2015

Client

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WRITTEN AGREEMENT

EMERSUB 16 LLC

Former Kop-Flex Facility, Hanover, Maryland

If the response action plan is approved by the Maryland Department of the Environment, the participant agrees, subject to the withdrawal provisions of Section 7-512 of the Environment Article, to comply with the provisions for which it is responsible, as specified in the response action plan. Participant understands that if he fails to implement and complete the specific requirements of the approved plan and schedule, the Maryland Department of the Environment may reach an agreement with the participant to revise the schedule of completion in the approved response action plan or, if an agreement cannot be reached, the Department may withdraw approval of the plan.

Printed Name: Stephen Clarke Title: President

Signature: Date: September 14, 2015

WRITTEN AGREEMENT

TC Harmans Road LLC
Former Kop-Flex Facility, Hanover, Maryland

If the response action plan is approved by the Maryland Department of the Environment, the participant agrees, subject to the withdrawal provisions of Section 7-512 of the Environment Article, to comply with the provisions for which it is responsible, as specified in the response action plan. Participant understands that if he fails to implement and complete the specific requirements of the approved plan and schedule, the Maryland Department of the Environment may reach an agreement with the participant to revise the schedule of completion in the approved response action plan or, if an agreement cannot be reached, the Department may withdraw approval of the plan.

TC HARMANS ROAD, LLC
A Delaware limited liability company

BY: TC MidAtlantic Development V, Inc.
A Delaware limited liability company
Its sole member

By: ________________________________

Name: David Neuman

Title: Vice President

Date: September 16, 2015

1 Introduction

WSP USA Corp (WSP) has prepared this Response Action Plan (RAP) on behalf of EMERSUB 16 LLC (EMERSUB 16), for the former Kop-Flex, Inc. (Kop-Flex) Facility located at 7555 and 7565 Harmans Road in Hanover, Maryland. The former Kop-Flex facility is identified as Brownfield Master Inventory number MD0286 as assigned by the Land Restoration Program. This RAP pertains to the response action activities to be conducted on the former Kop-Flex property; a separate plan will be prepared and submitted to MDE to address the offsite groundwater impacts.

The RAP describes supplemental remedial actions to be conducted to address risks associated with chlorinated volatile organic compounds (VOCs) and 1,4-dioxane present in the vadose zone soil and groundwater on the former Kop-Flex property. The chlorinated VOCs of concern identified in the soil and groundwater consist primarily of 1,1,1-trichloroethane (TCA) and its degradation products (particularly 1,1-dichloroethane [DCA] and 1,1-dichloroethene [DCE]), with lower concentrations of chlorinated ethenes such as trichloroethene and *cis*-1,2-dichloroethene.

The RAP consists of the following sections:

- Section 2 – Site Overview
- Section 3 – Additional Investigation Results
- Section 4 – Aquifer Testing and Results
- Section 5 – Exposure Assessment
- Section 6 – Cleanup Criteria
- Section 7 – Remedial Alternative Selection for Soil and Groundwater
- Section 8 – Soil Response Action
- Section 9 – Groundwater Response Action
- Section 10 – Permits, Notifications, and Contingencies
- Section 11 – Project Implementation Schedule
- Section 12 – Health & Safety
- Section 13 – Waste Management
- Section 14 – Monitoring and Reporting
- Section 15 – Administrative Requirements
- Section 16 – Project Completion
- Section 17 – References
- Section 18 – Acronyms

Appendix A of this RAP includes the engineering plans to support the activities to be completed in addressing the VOC-impacted groundwater. Additional plans supporting the proposed response action activities are provided in Appendix E (Soil Management Plan) and Appendix G (Groundwater Monitoring Plan).

2 Site Background

2.1 Site Description

The former Kop-Flex site is located at 7555 and 7565 Harmans Road in Hanover, Anne Arundel County, Maryland (Figure 1). The site occupies a total area of approximately 25 acres and contains two buildings – an approximately 220,000-square-foot former manufacturing and office building and an approximately 20,000-square-foot former forge building near the eastern property boundary (Figure 2). The property is bordered to the north by a Verizon Communications maintenance facility; to the east by the Williams-Scotsman facility followed by railroad tracks; to the south by the Williams-Scotsman facility followed by Maryland State Route 100; and to the west by undeveloped land along Stony Run, a tributary of the Patapsco River, followed by Harmans Road and a residential area.

The elevation of the former Kop-Flex site varies from approximately 108 feet mean sea level (ft msl) along the drainage channel and flood plain for Stony Run to 130 ft msl in the southeast corner of the property. Although the site topography is generally flat, the main building and adjacent paved areas sit on a slight topographical rise that was reportedly created during facility construction in 1969. The ground surface gradually slopes to the north and west in the vicinity of former manufacturing and office building.

The closest surface water body is Stony Run, which crosses the northwestern portion of the site. The 100-year flood plain of Stony Run includes a portion of a paved parking area located between this stream and the manufacturing building. Stony Run flows northward and eventually discharges into the Patapsco River, which is located 7 miles from the site. In addition to this stream, several small pond areas have been identified and mapped in the vicinity of the site.

2.2 Site History

The facility was constructed on previously undeveloped land in 1969 by Koppers Company, Inc. The separate forge building was built 10 years later (1979). In 1986, an employee group purchased the company from Koppers and formed Kop-Flex, Inc. (Kop-Flex). In 1996, Emerson Electric acquired Kop-Flex.

Kop-Flex formerly manufactured flexible couplings for the mechanical power transmission industry at the site. The forge building produced precision forging of metal parts and included heat treatment and nitriding capabilities. Universal joints, gear spindles, forgings, and power transmission components were produced at the plant from 1979 to 2012. The facility also provided a repair and maintenance program for the components.

Manufacturing operations at the facility ceased in late 2012. After shutting down production activities, all equipment and machine lines were decommissioned and removed from the facility. At present, the onsite buildings are vacant except for the office building which is occupied by a small number of former plant staff. The office operations will be moved to another location in the Baltimore area in the next few months. In December 2014, Emerson transferred the property to EMERSUB 16 in preparation of selling the property to a third party for future redevelopment.

2.3 Environmental Setting

2.3.1 Geology

The former Kop-Flex site lies within the Atlantic Coastal Plain physiographic province. In Anne Arundel County, Maryland, this province is characterized by alternating layers of predominately sand and clay sediments of Cretaceous age. Based on regional hydrogeologic cross-sections for these sedimentary deposits, the inter-layered sequence of sand and clay units dips gently to both the south and east from the north part of the county. In Anne

Arundel County, the Coastal Plain deposits range in thickness from a few tens of feet along the northwestern boundary with Howard County to as much as 2,500 ft in southeastern Anne Arundel County (Vroblesky and Fleck 1991).

Evaluation of borehole lithologic data obtained from field investigations indicates the coastal plain deposits at the site comprise a complexly inter-bedded sequence of predominately coarse-grained (sand with gravel and fines) and fine-grained (silt and clay) units. Given the spatial and vertical heterogeneity typical of the Atlantic Coastal Plain deposits, the unconsolidated materials have been grouped into three gross stratigraphic units, which are generically termed “upper,” “middle,” and “lower” (Figure 3).

The Upper Stratigraphic Unit is comprised primarily of sand, with variable fines content, to gravelly sand along with occasional discontinuous silt and clay lenses of variable extent and thickness. The upper-most sandy sediments present to a depth of approximately 10 feet below ground surface (bgs) in the building area and eastern portion of the site represent fill material emplaced during construction of the facility. Extensive layers of fine-grained (silt and clay) deposits exist in the shallow subsurface in the northern portion of the site and at a depth of approximately 10 to 20 feet (bgs) in the eastern portion of the building area. This upper sandy unit appears to be thickest in the eastern portion of the former Kop-Flex facility and thins to the west.

The Upper Stratigraphic Unit is underlain by the Middle Stratigraphic Unit, which is characterized by zones of coarse-grained (sand to clayey sand) and fine-grained (silty to sandy clay to clayey to sandy silt to finely inter-laminated sand and clay) sediments exhibiting variable thickness and noticeable lateral and vertical heterogeneity. From northwest to southeast across the site, the lithologic characteristics of this unit transition from a thick (20 to 30-foot) sand interval bounded above and below by silt and clay deposits to an area of inter-bedded and inter-fingering coarse and fine-grained deposits underneath the eastern portion of the manufacturing building to a very thick (approximately 65 feet) sequence of predominately silt and clay deposits in the southern-most portion of the site. Occasional sand zones may be present as isolated lenses or layers within the fine-grained deposits, with the coarser sediments being relatively abundant beneath some areas of the building. The thick sand zone in the northern and western portion of the site occurs between the depths of approximately 30 feet to 60 feet bgs and is underlain by a layer of hard, dense silty clay to clayey silt sediments. A review of the boring logs indicates this fine-grained layer is ubiquitous within the subsurface deposits at the site.

The Lower Stratigraphic Unit is present below the Middle Stratigraphic Unit and consists primarily of sand and gravelly sand deposits with occasional discontinuous layers of inter-mixed clay and silt sediments of variable thickness. Based on correlation of the lithologic data, the top of this unit occurs at depths ranging from approximately 50 feet bgs in the northwest portion of the site to approximately 100 feet bgs near the southeastern corner of the property. Evaluation of the lithologic data indicates the gravelly sand deposits are more spatially extensive than similar lithofacies in the Upper Stratigraphic Unit.

2.3.2 Hydrogeology

The complexly stratified deposits comprising the Atlantic Coastal Plain from Virginia to New Jersey form an inter-layered sequence of aquifers and confining beds (Leahy and Martin 1993). In Anne Arundel County, the upper-most water-bearing unit is typically represented by an unconfined surficial aquifer consisting of Quarternary alluvium and terrace deposits. The thickness of the Surficial aquifer is highly variable over the area. The surficial aquifer is underlain by several confined aquifers that include the Patuxent, Lower and Upper Patapsco, and Magothy. These aquifers may be considered unconfined over their outcrop areas, although locally less permeable materials may exist at the surface. Downdip (southeast) of the outcrop and subcrop areas, the aquifers become confined, although the confining units may thin and be regionally discontinuous.

Given the textural variation of the three main stratigraphic units and their associated permeability, the predominately coarse-grained sediments comprising the upper and lower units and the thick sand interval within the middle unit represent the primary zones for groundwater flow at the site. The sand deposits present within the upper and middle units at the site constitute the shallow water-bearing zone, or Surficial aquifer, within the hydrogeologic system. The lower unit is inferred to be upper-most portion of the Lower Patapsco aquifer. Hard silt and clay deposits of the Middle Stratigraphic Unit that occur at depths ranging from approximately 45 feet in the north to 60+ feet in the south form an aquitard that hydraulically separates the Surficial and Lower Patapsco aquifers. In the southern-most portion of the site, these fine-grained, low permeability deposits are believed to represent the Patapsco Confining Unit. Overall, flow paths within these clayey deposits of the Middle Stratigraphic Unit are complex and involve predominately vertical (downward) movement of groundwater.

For the Surficial aquifer, groundwater occurs under an unconfined condition within the shallow coarse-grained deposits and the fine-grained deposits in the western portion of the site (Figure 3). Given the presence of appreciable clayey deposits in the shallow subsurface in the western portions of the site, groundwater within the sand lenses and thick sand layer within the Middle Stratigraphic Unit occurs locally under a partially, or semi-, confined condition within this portion of the surficial zone at the site. The groundwater surface is encountered at depths ranging from 15 feet to18 feet near the eastern site boundary to less than 10 feet in areas to the north and west of the building. Groundwater flow within the Surficial aquifer is in a generally west to northwest direction toward Stony Run (Figure 4). Flow within the upper-most sand units and deeper (partially confined) sand deposits provide base flow to Stony Run; however, limited data is available to unequivocally confirm the discharge contribution from the semi-confined sand zone. The consistency in the west to northwest gradient over the entire thickness of the Surficial aquifer indicates good hydraulic communication between the permeable sand intervals within this hydrogeologic unit.

Groundwater in the Lower Patapsco aquifer also occurs under semi-confined conditions, with the depth to water in wells screened in this zone ranging from approximately 30 feet in the northwest portion of the site to 45 feet bgs along the southern site boundary. Based on contouring of water level data from site monitoring wells, the direction of groundwater flow in the semi-confined Lower Patapsco aquifer is to the south-southeast (Figure 5), which is consistent with published studies of the Coastal Plain Aquifer System in Anne Arundel County, Maryland. In the southern portion of the site, the significant head differences in monitoring wells completed at depths of less than and greater than 60 feet bgs indicate that the hard silt and clay deposits in the lower portion of the Middle Stratigraphic Unit serve as a confining layer, or aquitard, between the overlying Surficial aquifer and deeper Lower Patapsco aquifer in the hydrostratigraphic sequence. However, spatial variations in the lithology and thickness of the sediments comprising the aquitard and associated sedimentary structures within the fine-grained deposits may provide mechanisms for downward leakage of groundwater to the Lower Patapsco sand deposits.

2.4 Current Site Conditions

2.4.1 Soil

2.4.1.1 Southwest Portion of Former Manufacturing Building (Area of Concern 1)

Soil sampling conducted in 1998 and early 1999 during the initial site investigation activities detected the presence of chlorinated VOCs and petroleum hydrocarbons in the unsaturated (vadose) zone beneath a former machining area in the southwest portion of the former manufacturing building (Area of Concern [AOC] 1). Evaluation of the sampling results indicated the zone of VOC-affected soil occurred at depths of greater than 7 feet bgs over the area. Based on these findings, a dual-phase extraction (DPE)/soil vapor extraction (SVE) system was installed and operated to recover chlorinated VOC mass present in the vadose zone soils. In conjunction with the remedy implementation, a former concrete well ring, which was identified as a source of VOCs to the subsurface, and the immediately surrounding soil were removed from the area. (The location of the former well ring excavation area is depicted in Figure 6).

During late 2012 and early 2013, supplemental sampling activities were performed in AOC 1 to gather updated soil quality data and assess the effectiveness of the DPE/SVE system. A total of 18 boreholes were completed over the area, with single or multiple soil samples collected for VOC analysis. The locations of soil borings completed as part of the supplemental investigation are shown in Figure 6. Although the SVE system had been successful in recovering contaminant mass, the sampling results indicate the continued presence of elevated VOC concentrations in the subsurface. Based on the sampling data, 1,4-dioxane comprised the majority of the VOC mass at depths of less than 8 to 9 feet below grade, with chlorinated VOCs becoming more prevalent in the deeper portion of the vadose zone.

Given the findings from the supplemental sampling activities, additional source area removal activities were conducted in late 2013 and early 2014 to further reduce VOC mass in the unsaturated soil and reduce the potential for constituents of concern (COCs) in soil to migrate to indoor air and groundwater. The remedial activities involved the excavation of VOC-containing soils to a depth of 15 feet below the building floor in two rectangular areas, the locations of which are provided in Figure 6. The excavated soil was segregated into stockpiles, characterized, and either transported offsite for disposal (total VOC concentrations greater than 1 milligram per kilogram [mg/kg]) or reused as backfill in the excavations (total VOC concentrations less than 1 milligram per kilogram [mg/kg]). Detailed information concerning the soil removal is provided in the Response Action Completion Report (WSP 2014).

Based on the supplemental soil sampling data, the remaining vadose zone soil beneath the building floor slab in AOC 1 contains low residual levels of site-related VOCs. Unsaturated material to a depth of less than 10 feet below grade (including the recently excavated areas) has total VOC concentrations of less than 3 mg/kg. In the unexcavated areas, the majority of the VOC mass over this depth interval appears to consist of 1,4-dioxane (see tabulated results for borings WSP-84, WSP-88, and WSP-89 in Figure 6). Slightly higher VOC levels (greater than 10 mg/kg) may locally exist in the unexcavated areas at depths below 10 feet below grade (WSP-84 location in Figure 6).

2.4.1.2 Outside Area Near East-Central Portion of Former Manufacturing Building (AOC 2)

Soil and shallow groundwater sampling activities were conducted in the area east of the former manufacturing building between 2006 and 2008, and again in 2012, to further characterize the extent of highly impacted, VOC-containing soil material in this portion of the site. Samples for VOC analysis were collected from approximately 40 borings located both inside and outside of the building (Figure 7). The soil sampling results indicated the presence of VOC-affected soil at depths of greater than 8 feet bgs in the area, and the observed presence of solvent-derived dense non-aqueous phase liquid (DNAPL) at one location immediately adjacent to the east building wall. In addition, concentrations of 1,1,1-TCA indicative of DNAPL were detected in shallow groundwater samples beginning at approximately 8 to 10 feet bgs near the building wall and extending vertically and laterally from this area to the east away from the building along the upper contact of a clay lens in the upper sand unit, and to the west.

Based on evaluation of the sampling data, source area soil removal was conducted in late 2013 to reduce VOC mass in the unsaturated and saturated soils in the area and reduce the potential for COCs to migrate in groundwater. The removal activities involved the excavation of VOC-impacted soils to depths ranging from 18 feet to 23 feet bgs in four shoring cells in the source area. The locations of the shoring cells are shown in Figure 7. The management, characterization, and final disposition of the excavated soil material were similar to the procedures described for the AOC 1 excavation activities. Flowable fill was used to backfill the cells from the terminated depth of the excavations to approximately 15-feet below ground surface to span the interval below the groundwater surface. Additional information concerning the AOC 2 soil removal is provided in the Response Action Completion Report (WSP 2014).

The remaining vadose zone soils to a depth of 8 feet bgs have non-detect to very low concentrations of 1,1,1-TCA and associated degradation compounds. Based on the sampling data, soils with 1,1,1-TCA concentrations above 10 mg/kg are locally present at depths below 8 feet in the area around the excavation cells to the east of the former manufacturing building. For these samples obtained from the deeper vadose zone (8 to 13 feet bgs), the highest 1,1,1-TCA concentration (250 mg/kg) was detected in the sample collected from 8 to 9 feet bgs at the SSI-09 location, with lower levels detected in samples from similar depths at borings SSI-05 (44 mg/kg) and WSP-68 (25 mg/kg) outside the building and WSP-07 (30 mg/kg) inside the building. Given the depth to groundwater is typically less than 13 feet in this portion of the site, the majority of the remaining VOC mass appears to be present in the upper-most portion of the saturated zone (Figure 7).

2.4.2 Groundwater

2.4.2.1 Overview

The initial activities related to understanding the onsite groundwater conditions were conducted as part of the Phase II assessment (ESC 1999a). These investigation activities included the collection and evaluation of data to characterize the subsurface geology, and the installation and sampling of 13 Surficial aquifer monitoring wells (MW-1 through MW-12 and MW-14) on the property (Figure 2). The sample results indicated the presence of site-related COCs, consisting primarily of chlorinated VOCs and petroleum hydrocarbon constituents, in the shallow groundwater system. COC concentrations above the comparative criteria were detected in groundwater samples collected from areas to the east and immediately west of the former manufacturing building.

In addition, limited sampling of extracted groundwater was performed in conjunction with the pilot testing of groundwater remedial technologies in the VOC-impacted areas (ESC 2001a and 2001b). Analytical results for the samples from both tests indicated high total VOC levels in the Surficial Aquifer, with maximum concentrations of greater than 150 milligrams per liter (mg/l).

Based on the pilot test results, a dual phase extraction (DPE)/soil vapor extraction (SVE)system was implemented inside the southwestern portion of the former manufacturing building (AOC 1) and a network of Unterdruck-Verdampfer-Brunnen (UVB), or “vacuum vaporized”, wells were installed to address the VOC-impacted Surficial aquifer east of the manufacturing building (AOC 2). As part of the remedial activities, a groundwater monitoring program was implemented to evaluate trends in VOC concentrations in the Surficial aquifer. The monitoring activities included semi-annual sampling of the 13 Surficial aquifer wells at the site. Table 1 summarizes the historical VOC data obtained during the semi-annual groundwater sampling events from 2009 through 2014.

Several supplemental investigation phases were completed between 2006 and 2013 to further evaluate the horizontal and vertical extent VOCs in the aquifer system (WSP 2013b). These investigations primarily focused on the area east of the main building (AOC 2) and included the following activities related to onsite groundwater:

- groundwater profiling at 14 locations in AOC 2 (2006)
- installation and sampling of five intermediate-depth Surficial aquifer monitoring wells (MW-15, MW-16, MW-17, MW-18 and MW-20) and eight Lower Patapsco aquifer wells (MW-1D, MW-2D, MW-16D, MW-17D, MW-19, MW-21D, MW-22D and MW-23D) (2010 – 2012)[1]
- depth-discrete groundwater sampling to further characterize the extent of VOCs in the Surficial aquifer in AOC 1 and AOC 2, and installation and sampling of one deep monitoring well (MW-26D) in AOC 1 (2012 – 2013)
- installation of an upgradient monitoring well (MW-27D) in the Lower Patapsco aquifer (2013)

The locations of the monitoring wells installed as part of the supplemental investigations are indicated in Figure 2. Groundwater samples collected from the Surficial aquifer in AOC 1 and AOC 2, and Lower Patapsco aquifer in the southern and eastern portions of the site were found to contain elevated concentrations of 1,1,1- TCA, the degradation products 1,1-DCA and 1,1-DCE, and 1,4-dioxane. All new monitoring wells were incorporated into the site-wide, semi-annual groundwater monitoring program to gather additional water quality data for the aquifer system.

During the 2013 response action activities, Emulsified Zero Valent Iron (EZVI) was injected into the shallow groundwater zone in AOC 2 in order to further reduce hot spot VOC concentrations in the saturated soil. The EZVI creates a treatment zone in the shallow groundwater that has the ability to reduce VOCs for an extended period of time via *in situ* abiotic dechlorination. This work is also summarized in the Response Action Completion Report (WSP 2014).

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[1] In addition to the onsite wells, one deep monitoring well (MW-24D) was installed on the adjacent Williams-Scotsman property immediately south of the site.

As discussed in Section 3.3, additional groundwater profiling is planned for the Surficial and Lower Patapsco aquifers to further define the extent of VOC-impacted groundwater to the east of the former Kop-Flex facility in the shallow groundwater and to the north in the deep groundwater.

2.4.2.2 Surficial Aquifer

Discussion of the groundwater quality is based on data from the December 2014 monitoring event, which involved the sampling of 21 shallow (20 to 40 feet bgs) and intermediate (40 to 60 feet bgs) depth wells. The locations of the groundwater monitoring wells are shown on Figure 2. The wells range in depth from 22 feet bgs to 60 feet bgs.

For the Surficial aquifer, the VOCs of concern are 1,1,1-TCA and its degradation products (e.g., 1,1-DCE and 1,1-DCA), chlorinated ethenes such as trichloroethene and tetrachloroethene, and 1,4-dioxane. The highest VOC levels in shallow groundwater are found in the identified source areas underneath and east of the former manufacturing building, and decrease in the direction of groundwater flow. VOC impacts in shallow groundwater extend from the vicinity of wells MW-02, MW-11, MW-12 and MW-16, which are located to the east of the former manufacturing building, to the area west of the building in the vicinity of MW-38. Figures 8 depicts the inferred VOC distribution (including 1,4-dioxane) in the upper portion of the Surficial aquifer at the site.

Well MW-01 is the only Surficial aquifer monitoring point that is situated upgradient of the source areas and provides background water quality data for this hydrogeologic unit. No site related VOCs have been detected in samples from MW-01. VOC concentrations detected in wells near the eastern property boundary (MW-08 and MW-20) are substantially lower than concentrations in wells located in close proximity to the source area to the immediate east of the former manufacturing building (MW-02, MW-11, MW-12, and MW16).

VOCs associated with the source area immediately east of the former manufacturing building have migrated west (downgradient) and commingled with VOCs associated with the source area below the southwest portion of the building. In the area west of the former manufacturing building, the highest VOC concentrations are found in samples collected from the shallow wells screened in the upper, predominately clayey deposits, with trace to non-detect levels in samples from intermediate-depth wells screened in the underlying sand unit (MW-14, MW-18 and MW-39) (Figures 8 and 9). Typically non-detect levels of site-related VOCs have been found in samples from shallows wells MW-03 and MW-07 northwest of the manufacturing building. Based on evaluation of the sampling data, no site-related VOCs appear to be migrating offsite at levels of concern in the shallow portion of the groundwater system.

2.4.2.3 Lower Patapsco Aquifer

The discussion on groundwater quality for the semi-confined Lower Patapsco Unit is based on sampling data from the 10 deep onsite wells and offsite well MW-24D from the December 2014 monitoring event. The locations of the groundwater monitoring wells are shown on Figure 2. These wells generally range in depth between 90 feet bgs and 130 feet bgs.

The VOCs detected in samples from wells installed in the Lower Patapsco aquifer are consistent with those identified for the shallow water-bearing zone: 1,1,1-TCA and its degradation products, chlorinated ethenes, and 1,4-dioxane. An iso-concentration map showing the inferred total VOC distribution is provided in Figure 10. Overall, VOC impacts in the deep groundwater extend from the identified source area to the east of the manufacturing building to the off-property areas to the south-southeast of the former Kop-Flex facility. As indicated in the VOC plume map, the highest VOC concentrations occur in the vicinity of on-property well MW-17D and off-property well MW-24D, which are located immediately downgradient of the source area. Elevated VOC concentrations were also detected in the samples from well MW-1D along the southern property boundary.

Wells MW-19, MW-23D, and MW-27D are located upgradient of the VOC source areas at the site. Trace to non-detect concentrations of VOCs were detected in samples collected from MW-19 and MW-27D. Well MW-23D, which is located approximately 120 feet north of the former manufacturing building, contained low levels of site-related VOCs, primarily 1,4-dioxane and 1,1-DCE.

2.5 Future Land Use

Although the past land use has been industrial, the property will be sold and redeveloped for commercial use. In December 2014, EMERSUB 16 LLC completed a purchase and sale agreement with TC Harmans Road, LLC, who will redevelop the property and construct commercial warehouses. An overlay of the proposed development plan for the property is shown in Figure 2. The planned commercial use of the property was indicated in the new VCP application EMERSUB 16 submitted to MDE on January 30, 2015, and the TC Harmans Road, LLC VCP application, received by MDE on January 20, 2015. Both VCP applications were approved for participation on March 4, 2015.

2.6 Response Actions

2.6.1 Soil

Based on the previous investigation and remediation activities, low concentrations of VOCs (primarily 1,4-dioxane) remain in the shallow soil (less than 10 feet bgs) underneath the southwest portion of the former manufacturing building (AOC 1) (see Figure 2). In addition, soil gas may contain VOCs derived from the partitioning of residual contaminant mass in the unsaturated soil and volatilization of constituents from the groundwater surface. The results of the updated site-specific risk assessment demonstrate the soil and soil vapor conditions do not pose any unacceptable human health risk to facility workers, child or youth intermittent visitors, or construction workers under the current site conditions (WSP 2015). Under the future land use scenario, the calculated risks to workers or visitors associated with COC-containing soil would also be below the target risk values; however, the potential may exist for future risks associated with vapor intrusion into new building structures.

The site response actions for soil will include the implementation of land use and engineering controls to prevent future exposure to soil containing VOCs and other COCs that remain at the site. Institutional controls will consist of filing a land deed notice restricting the property to non-residential use, and developing and implementing soil management procedures for any intrusive activities performed within the known VOC-affected area. Engineering controls will involve the incorporation of a vapor barrier and vapor collection system in future buildings constructed at the site to prevent VOC-containing vapors from entering the structures. Procedures (including recordkeeping) for the inspection and repair/maintenance of the vapor mitigation measures or other engineering controls will be included in the Site Management Plan to be prepared as part of the soil response action activities.

2.6.2 Groundwater

Information on the groundwater quality at the former Kop-Flex facility has been continually gathered from the sampling of onsite monitoring wells. Evaluation of the historical monitoring data indicates concentrations of chlorinated VOCs and 1,4-dioxane above the applicable groundwater standards in the Surficial aquifer below and to the east of the former manufacturing building. The affected area forms a slightly elongate plume of VOC-containing groundwater with the long axis oriented in a generally east-west direction consistent with the overall flow paths in this hydrogeologic unit. Groundwater samples collected from wells along the western (*i.e*., hydraulically downgradient) property portion of the site show that the surficial VOC plume does not extend to the property boundary. (Additional groundwater investigations to further assess the eastern extent of the VOC-impacted groundwater in the surficial zone are described in Section 3.3.) VOC concentrations above the comparative groundwater standards have also been detected in samples from the deeper groundwater zone, which is interpreted to represent the semi-confined portion of the Lower Patapsco aquifer in the Coastal Plain Aquifer System. In this hydrogeologic unit, VOC impacts occur primarily in the southern portion of the site and extends southward off the Kop-Flex property. (Field investigations to further characterize the groundwater quality in the semi-confined portion of the aquifer north of the site are described in Section 3.3.)

Hydraulic containment via the pumping of VOC-containing groundwater has been selected as the response action to address the impacted aquifers at the site. An extraction network of shallow pumping wells screened within the Surficial aquifer and deep wells completed in the Lower Patapsco aquifer will serve to contain the VOC-affected groundwater to the site. Surficial aquifer extraction wells will be located in the western portion of the site near the downgradient limit of the shallow VOC plume, and the extraction wells to control VOC migration in the Lower Patapsco aquifer will be located along the downgradient (south) property boundary. The combined flow from the extraction wells will be treated to remove the site-related contaminants in accordance and the treated effluent will be discharged to Stony Run pursuant to the approved discharge permit. Preliminary (conceptual) engineering drawings of the proposed hydraulic containment systems are provided in Appendix A. Groundwater monitoring activities to be performed during system operation are specified in the Groundwater Monitoring Plan accompanying the RAP.

Potable water at the former Kop-Flex site is obtained from the municipal water system; however, there is no restriction on the use of groundwater at the site. Therefore, an environmental covenant will be enacted to prohibit the use of groundwater at the site. The groundwater use restriction will be recorded in the Anne Arundel County land records office for the property. The Environmental Covenant will be prepared and recorded following the construction of the new warehouse buildings and documented in the Groundwater Construction Completion and Implementation Report to be submitted to MDE.

3 Additional Site Investigations

3.1 Soil Sampling for Proposed Development

In September 2014, thirteen direct-push soil borings were completed to depths of 6 feet bgs in a future loading dock area between two proposed warehouse buildings. Nine boring were installed in the former manufacturing building, one was installed to the west of the building, and three were installed to the east of the building. Soil samples were collected from ten of the thirteen locations and analyzed for VOCs, polycyclic aromatic hydrocarbons, gasoline and diesel range petroleum hydrocarbons, polychlorinated biphenyls, and metals using USEPA-approved test methods. The locations of the shallow soil borings are shown in Figure 11.

Table 2 summarizes the laboratory results for the samples submitted for chemical analysis. The samples contained non-detectable or trace concentrations of site-related VOCs and PAHs. Metal concentrations, except for arsenic in two samples, were below MDE Residential Soil Cleanup Standards. Although two samples had arsenic above the MDE Residential Soil Cleanup Standard, the concentrations were determined to be below the typical MDE bioavailability standard.

3.2 General Hydrogeochemical Parameters

To assess potential hydrogeochemical factors that could influence the treatment process, groundwater samples were collected from selected shallow aquifer wells (MW-05, MW-18, MW-38, and TW-1) in October 2014 and selected deep aquifer wells (MW-1D, MW-2D, MW-16D, MW-17D, MW-21D, and MW-26D) in December 2013. The samples collected from both the shallow and deep wells were analyzed for selected metals (aluminum, copper, iron, lead, manganese, nickel, and zinc) and total hardness (as calcium carbonate) using USEPA-approved test methods. In addition, groundwater samples from Surficial aquifer wells were analyzed for total petroleum hydrocarbons, and samples from the confined Lower Patapsco aquifer wells were tested for total alkalinity. The analytical results for the samples collected from the shallow aquifer and deep aquifer wells are summarized in Tables 3 and 4, respectively. The certified analytical laboratory report for the samples is provided in Appendix B.

3.3 Groundwater Quality Profiling

3.3.1 Overview

As shown in the iso-concentration maps cited in Section 2.4.2, the upgradient extent of VOC-affected groundwater has not been fully delineated in both the Surficial and Lower Patapsco aquifers at the site. Given this data gap, additional field investigations will be conducted to further define the extent of VOC-impacted groundwater to the east of the former Kop-Flex facility in the shallow groundwater and to the north in the deep groundwater. These investigation activities will involve the drilling and groundwater profiling of one shallow borehole (WSP-95) on the adjoining Williams Scotsman, Inc. property and a deep borehole (WSP-96) on the neighboring Verizon property. The proposed locations for the shallow and deep sample boreholes are shown on Figures 8 and 10, respectively. The field and analytical data will be evaluated to determine the appropriate locations for the future installation of permanent groundwater monitoring wells.

3.3.2 Borehole Installation and Depth-Discrete Groundwater Sampling

Each borehole will be advanced using the roto-sonic drilling method, with the shallow borehole (WSP-95) completed to a depth of approximately 60 feet bgs and the deep borehole (WSP-96) extended to approximately 120 feet bgs. The actual borehole depths will be determined in the field based on the lithologic data and the detection of chlorinated VOCs during the field screening of depth-discrete groundwater samples. During borehole installation, continuous, 5-foot-long (WSP-95) and 10-foot long (WSP-96) cores of the unconsolidated geologic materials will be obtained using the drilling method's coring system. The recovered material from each core run will be screened for VOCs at approximately 5-foot intervals using a soil head space procedure and photoionization detector (PID) fitted with an 11.7 electron volt (eV) lamp. The screening process will be compliant with WSP Standard Operating Procedure (SOP) #9. (Copies of applicable field SOPs for the investigation are included in Appendix C.) Field screening results and descriptive information will be recorded by a WSP Geologist in a bound field notebook.

For the shallow boring (WSP-95), groundwater samples will be collected from the predominately sand deposits using a depth-discrete sampling system. Groundwater samples will be collected at approximately 10-foot intervals from a few feet below the water table (approximately 20 feet bgs) to the borehole termination depth, although the vertical interval between successive sampling points will be dictated by the nature and heterogeneity of the unconsolidated deposits. After setting the sampler at the desired sample depth, groundwater will be continuously purged at a low pumping rate to ensure that water representative of aquifer conditions is being collected from the depth interval. During purging, field hydrogeochemical parameters, including temperature, pH, and specific conductance, will be monitored at regular (5-minute) intervals, and the measurements recorded in the field notebook. Once the field parameters have stabilized, groundwater samples will be collected for 1,1-DCE field screening using colorimetric tubes and the Color-Tec procedure, and laboratory analysis. At the deep boring location (WSP-96), the borehole will be advanced through the surficial water-bearing zone and underlying aquitard before commencing the sampling activities. Depth-discrete groundwater samples will be collected at approximately 10-foot intervals beginning at a depth of 5-10 feet below the bottom of the confining unit until termination of the borehole. Each groundwater sample will be collected following stabilization of the field hydrogeochemical parameters during purging and field screened for 1,1-DCE using the Color-Tec procedure. Additionally, a sample will be collected for submittal to an offsite laboratory for chemical analysis. All purge water generated during the sampling activities will be contained in Department of Transportation (DOT)-compliant 55-gallon steel drums and managed in accordance with the procedures described in WSP SOP #5. After completing the sampling activities at a given location, the borehole will be backfilled to a few inches below the paved surface with cement-bentonite grout and then capped with a layer of concrete to match the existing grade.

Each depth-discrete groundwater sample will be submitted to the Phase Separation Science, Inc. laboratory in Baltimore, Maryland and analyzed for VOC and 1,4-dioxane. The groundwater samples for VOC analysis will be analyzed using U.S. EPA SW-846 Test Method 8260B. Samples for 1,4-dioxane analysis will be analyzed using modified U.S. EPA Method 8260B with Selective Ion Monitoring (SIM). Proper quality assurance procedures, including the collection of field quality control (QC) samples, will be implemented in accordance with WSP SOP #4.

3.3.3 Surveying of Sample Locations

A surveyor licensed in the State of Maryland will survey the locations and elevations of the sample boreholes completed during the field investigation activities. The elevation of the ground surface will be surveyed to the nearest 0.01 foot. The horizontal location of the borings will also be determined to the nearest 0.1 foot. Horizontal and vertical data for each location will reference the Maryland State Plane coordinates and the NAVD1988 datum, respectively. The locations will be plotted on a scaled map showing both the former Kop-Flex facility and the surrounding area.

3.3.4 Management of Investigation Derived Media

In addition to the sampler purge water, the following investigation-derived media (IDM) will also be generated during the field investigation activities:

- drill cuttings
- solid-containing drilling water

- decontamination water
- miscellaneous solid materials that come in contact with potentially contaminated soil or groundwater (e.g., personal protective equipment, plastic, tubing, etc.)

All IDM listed will be containerized in DOT-compliant 55-gallon steel drums. The drummed materials will be labeled as “non-hazardous pending analysis”, inventoried and moved to a paved, covered staging area on the property.

During completion of the field activities, composite samples of the solid and liquid IDM will be collected and analyzed to determine the appropriate method for the management of these materials. All IDM will be managed in accordance with state and federal regulations.

4 Aquifer Testing and Results

4.1 Aquifer Testing

4.1.1 Test Design and Performance

Aquifer tests were performed on the Surficial and Lower Patapsco aquifers at the site between April and May 2014. Before initiating any test activities, additional wells and piezometers necessary for conducting the field tests were installed on the former Kop-Flex property. For the Surficial aquifer, one 4-inch diameter extraction well (TW-1), one shallow monitoring well (MW-38), and three deeper monitoring wells and piezometers (MW-39, OW-1, and OW-2) were installed in early April 2014. The extraction well was screened within the predominately sand deposits present in the lower portion of the Surficial aquifer (see section A-A' in Figure 3). A deep, double-cased extraction well (TW-2) was installed along the southern property boundary for conducting the pumping test in the semi-confined portion of the Lower Patapsco aquifer. The locations of the wells and piezometers constructed as part of the test activities are shown in Figure 2. Detailed information on the drilling and installation these additional wells and piezometers (including boring logs) is provided in Appendix D.

The field testing activities were performed in accordance with the Scope of Work for Aquifer Testing, dated March 12, 2014. Aquifer testing was first conducted on the Surficial aquifer in the area immediately west of the former manufacturing building and then on the Lower Patapsco Aquifer in the southern portion of the site. For each test, field data were gathered during (1) pre-test (background) water level monitoring, (2) step-drawdown test of the groundwater extraction well, and (3) 72-hour constant discharge pumping test. The constant discharge test was designed to record water level changes in the aquifer during and following the cessation of groundwater pumping. The groundwater discharge from both tests was treated and eventually discharged to Stony Run at Outfall 001 in accordance with the facility's National Pollutant Discharge Elimination System (NPDES) Permit MD0069094 and State Discharge Permit No. 07-DP-3442. Water level readings over the duration of the constant discharge test were used to calculate the following aquifer hydraulic parameters: hydraulic conductivity (K), transmissivity (T), storativity (S), and leakage.

4.1.2 Test Results

The following section summarizes the results for the aquifer tests conducted for both the Surficial and Lower Patapsco aquifers at the site. Additional discussion of the test procedures, and data reduction and analysis methods is provided in Appendix D.

4.1.2.1 Surficial Aquifer

For the Surficial aquifer constant discharge test, a relatively large area of hydraulic influence was created within both the sand unit screened by pumping well TW-1 and the overlying, predominately finer grained silt and clay deposits at the selected pumping rate of 11 gallons per minute (gpm). The noticeable water level displacement in the shallow observation wells (MW-05 and MW-39) indicated good hydraulic communication within the unconsolidated deposits, with and appreciable vertical flow of water from the shallow clayey unit to the deeper sand unit. Based on the specific capacity (yield per unit of well drawdown) of the pumping well and available drawdown, the long term sustainable yield for a well screened in the sand deposits of the Surficial aquifer is approximately 7 gpm. If the well screen extends into a portion of the overlying silt and clay deposits, then maintaining the groundwater level above the screened interval would result in a smaller maximum available drawdown and corresponding decrease in the long term sustainable yield. For example, an increase in the well screen from 30 feet to 35 feet would cause a reduction in the long term well yield to approximately 4 gpm.

Table 5 summarizes the calculated hydraulic parameters derived from the corrected drawdown and recovery data collected during the constant discharge rate pumping test. Estimated values K and T values for the sand deposits comprising the Surficial aquifer are consistent with typical published values for these types of unconsolidated materials. The K values for the sandy aquifer materials in the area west of the former manufacturing building ranged from 5.2 feet per day (ft/day) to 15.6 ft/day, with a geometric mean of 9.21 ft/day. Based on a leaky confined flow model, the storativity values for the sand deposits ranged from 7 x 10^{-4} to 8 x 10^{-4}.

4.1.2.2 Lower Patapsco Aquifer

A large area of hydraulic influence was also created within the semi-confined Lower Patapsco aquifer during the constant discharge test, with the resultant cone of depression around the pumping well forming a slightly ellipsoidal area elongated in a direction perpendicular to flow. Plots of the corrected drawdown *vs.* time data suggest a leaky or semi-confined condition for the aquifer, although an accurate evaluation of this leakage is difficult due to the abnormal hydrologic conditions during the test. The aquifer response during groundwater withdrawal appears to support the existing conceptual hydrogeologic model of the site, which indicated some very limited hydraulic communication across the confining layer that separates the aquifers at a depth of approximately 60 feet bgs. Based on the observed drawdown during both the step and constant rate tests, an extraction well which is designed similar to TW-2 would be able to achieve long term sustainable yields approaching 50 gpm.

Table 6 summarizes the calculated hydraulic parameters derived from the corrected drawdown and recovery data collected during the constant discharge rate pumping test. Based on hydrogeologic information gathered during the installation of the three MW-25 series offsite monitoring wells, the inferred thickness of the confined Lower Patapsco aquifer in the site vicinity is estimated to be 80 feet. Aquifer transmissivities obtained from the data analysis show a limited range of values, ranging from a minimum of 1,170 square feet per day (ft^2/day) to a maximum of 1,620 ft^2/day. The geometric mean of the transmissivity values obtained from the test is 1,410 ft^2/day. Based on an inferred thickness for the Lower Patapsco aquifer of 80 feet, the calculated hydraulic conductivity values for the aquifer materials in the area around TW-2 varied from 14.6 ft/day to 20.3 ft/day, with a geometric mean K of 17.7 ft/day. The estimated geometric mean T and K values are similar with data cited in other hydrogeologic reports for the Coastal Plain deposits in central Maryland.

4.2 Predictive Flow Simulations for Groundwater Containment

4.2.1 Technical Approach

The proposed response action will involve the installation of a groundwater collection and treatment system for hydraulic containment of the dissolved VOC plumes in the Surficial and Lower Patapsco aquifers. The Surficial aquifer wells will be located in the area west (downgradient) of the former manufacturing building in order to prevent any potential transport of VOCs above the applicable groundwater quality criteria to the Stony Run drainage area. For the deeper, semi-confined Lower Patapsco aquifer, groundwater withdrawal will be focused along the southern property boundary to minimize further VOC migration to the south.

The technical approach for determining the layout of the groundwater extraction well networks for each aquifer consisted of a two-step process. The initial phase, which was discussed above, involved the completion of pumping tests in each aquifer to evaluate the general effectiveness of groundwater withdrawal from wells as a hydraulic control measure for the VOC plumes. The test results and other hydrogeologic data gathered during previous field investigations were then used to predict the water level drawdown and associated flow pathways in response to remedial pumping in each aquifer using a two-dimensional, analytical steady-state groundwater flow model. Evaluation of the predictive flow simulations was conducted to determine the locations and pumping rates for the groundwater extraction wells to achieve plume containment at the site.

The WinFlow analytical groundwater flow modeling tool was used to simulate groundwater movement within the different units at the site. The WinFlow Solver is part of the non-proprietary computer program AquiferWin32 developed by Environmental Simulations Incorporated (ESI) that simulates two-dimensional steady state and transient groundwater flow. The steady state flow module, which was utilized for determining the extraction well lay-out, simulates flow in a horizontal plane using the analytical functions developed by Lindeburg (1989), and the principle of superposition to evaluate the effects of multiple functions (e.g., pumping wells, recharge, etc.) on the uniform flow field. Both unconfined and confined aquifers can be simulated using the steady state flow module. Homogeneous aquifer hydraulic properties were designated over the model areas, and a constant-head condition specified along the upgradient boundaries of the model area based on the local hydrogeologic data. No sources of water to the groundwater system (e.g., areal recharge to the water table via infiltration of precipitation) were included in the analytical functions. For the Surficial aquifer flow simulations, Stony Run was modeled as a constant-head line sink, with the surface water elevation approximately 2 feet below the surrounding ground surface elevation. Reverse particle-tracking simulations were performed to trace the horizontal movement of groundwater in the aquifer and simulate the area of groundwater capture for each remedial pumping scenario.

A discussion of the flow simulations used to select the locations and pumping rates for the groundwater extraction well systems is provided in the following sections.

4.2.2 Surficial Aquifer

Model input parameters are based on hydrogeologic data obtained during previous field investigations at the site and are provided in Table 7. Given the good hydraulic communication between the upper clayey and lower sand units, a uniform equivalent horizontal hydraulic conductivity was calculated for the aquifer based on the borehole lithologic data and parameter estimates from the recent aquifer test and slug tests on dual-phase extraction wells conducted in 2002.

Extraction wells were defined within the inferred extent of the VOC plume in the western portion of the site to select potential spacing and pumping rates for the proposed hydraulic containment system. Based on the inferred width of impacted groundwater in the building area, the Surficial aquifer hydraulic containment system consists of three extraction wells (RW-1S, RW-2S, and RW-3S) located immediately west of the former manufacturing building (Figure 12). Extraction well locations were adjusted slightly during the model runs based on evaluation of the total pumping rate for the well system and percentage of the plume cross-sectional area captured under simulated steady-state flow conditions. The simulated groundwater extraction wells were assigned a diameter of 4 inches, which corresponds to the diameter of the test well used in the 2014 aquifer test. Given the presence of VOCs in both the clayey and sandy units, the extraction wells were modeled with screened intervals within the lower 5 feet of the upper fine-grained layer and fully penetrating the lower coarse-grained deposits. Table 8 summarizes the extraction well construction information input into the groundwater flow model for the remedial pumping scenarios. The extraction well construction information was not varied during the remedial pumping flow simulations.

Groundwater withdrawal was represented as a single stress period with a constant extraction rate at each well. The range of potential pumping rates was based on the long term sustainable well yield determined from the recent aquifer test described in Section 4.1. Withdrawal rates for the stress period were adjusted between model runs by trial and error in light of the presumed range in sustainable well yields for this aquifer. The final simulated pumping rate for each extraction well was determined to be 3 gpm. For the final pumping scenario, the total daily groundwater withdrawal from the Surficial aquifer extraction wells is 12,960 gallons.

The map depicting the simulated groundwater surface, or water table, during remedial pumping of the Surficial aquifer extraction wells is shown in Figure 12. The simulated area of groundwater in-flow to the extraction wells is also shown in Figure 12 for this water-bearing zone. Changes in groundwater levels attributed to remedial pumping appear to be relatively small over the area of interest, with drawdown focused in the vicinity of the extraction wells. As indicated by the groundwater surface map, the simulated particle traces also show the convergence of groundwater flow caused by sustained withdrawals from extraction wells clustered in the area west of the main building. The predicted zone of extraction well in-flow indicates good capture of VOC-impacted groundwater underneath and a short distance west of the former manufacturing building (Figure 12). Comparison of the extraction well in-flow area with the inferred VOC distribution in the aquifer indicates the affected groundwater upgradient of the well system is sufficiently captured by the hydraulic containment system operating at the modeled conditions.

4.2.3 Lower Patapsco Aquifer

As with the remedial pumping flow simulations for the shallow groundwater zone, model input parameters for the semi-confined Lower Patapsco aquifer are based on hydrogeologic data obtained during previous site investigations and are listed in Table 9. Extraction wells were defined within the inferred extent of the VOC plume on the south portion of the property to select potential spacing and pumping rates for the proposed hydraulic containment system. Based on the inferred extent of impacted groundwater in this portion of the aquifer system, two deep extraction wells (RW-1D and RW-2D) were selected in the model area of interest at the locations shown in Figure 13. Given the probable range in withdrawal rates from this aquifer, the simulated groundwater extraction wells were assigned a diameter of 6 inches. Since the profiling data from previous onsite investigations indicates VOC-impacted groundwater is limited to approximately the upper 40-50 feet of the aquifer thickness, extraction wells could be similar in design to test well TW-2 and only partially penetrate the Lower Patapscoaquifer. However, the WinFlow modeling program used to determine the well lay-out only allows for the extraction of groundwater from fully penetrating wells. For this flow simulation, the fully-penetrating extraction wells were designed with 50 feet of well screen to simulate the withdrawal of groundwater from the aquifer. Even though the modeled wells may not coincide with the proposed extraction well construction, the predicted well pumping rates should be conservative and more than sufficient to produce the necessary hydraulic containment effect in the aquifer. Table 8 summarizes the extraction well construction information input into the flow model program. The extraction well construction was not varied during the remedial pumping flow simulations.

Extraction rates were adjusted to maximize the capture area overlapping the cross-sectional area of the VOC plume, while minimizing the total groundwater withdrawal rate. Groundwater withdrawal was represented as a single stress period with a constant pumping rate for each well. The upper bound of potential withdrawal rates was based on the long term sustainable well yield determined from the spring 2014 aquifer test. Pumping rates for the stress period were adjusted between model runs by trial and error in light of the presumed range in sustainable well yields for the aquifer. The final simulated pumping rate for the both extraction wells was 35 gpm, with a total groundwater withdrawal from the aquifer of 100,800 gallons per day (gpd).

A site plan depicting the simulated potentiometric surface and area of groundwater in-flow to the extraction wells during remedial pumping is presented in Figure 13. The configuration of the head contours indicates a few feet of drawdown in the area around the extraction wells and the southern property boundary. The simulated particle traces depict the convergence of groundwater flow caused by the sustained withdrawals from the two extraction wells. The predicted zone of extraction well in-flow shows adequate containment of VOC-impacted groundwater in the confined Lower Patapsco aquifer on the former Kop-Flex property (Figure 13). Comparison of the extraction well in-flow area with the inferred VOC distribution in the aquifer indicates the affected groundwater upgradient of the well system is sufficiently captured by the hydraulic containment system operating at the modeled conditions. It should be noted the VOC distribution in the Lower Patapsco aquifer was determined from geostatistical analysis of available groundwater sampling data. Given the spatial distribution of the monitoring points, there is some degree of uncertainty with respect to the exact location of the plume ‘boundary’ in this area, particularly east of the former Kop-Flex property. This uncertainty was taken in consideration when evaluating remedial pumping scenarios to ensure the operation of the proposed extraction well system achieves the desired response action objectives.

5 Exposure Assessment

Potential exposure pathways and the resulting risks were evaluated in detail in a recent site-specific risk assessment (SSRA; WSP 2015). A summary of the potential exposures is discussed below.

5.1 Site Use

The former Kop-Flex facility was used for manufacturing from 1969 to 2012, when the plant closed. A small number of office employees remain on the property; these office functions will be relocated in the next several months.

Current plans involve the redevelopment of the property as a commercial warehouse facility. Two distribution warehouses are planned, with one on the north portion of the site and a second on the south portion and a loading dock area separating the buildings. The future use of the site will correspond to Tier 2B (Commercial-Restricted) under the Maryland Voluntary Cleanup Program (VCP).

5.2 Media of Concern

5.2.1 Soil

Historical manufacturing activities and storage of hazardous materials and wastes resulted in releases of COCs (primarily VOCs) to the ground surface or to subsurface soils. Previous remediation activities, including excavation and offsite disposal and dual-phase (water and vapor) extraction, addressed soils with the highest VOC concentrations (generally above 10 mg/kg of total VOCs) located beneath and immediately to the east of the main manufacturing building. The SSRA demonstrated that VOC concentrations currently present in surface and subsurface soils do not exceed non-residential direct contact screening levels. COCs detected above screening levels in soil remaining on the property are arsenic, mercury, and polychlorinated biphenyls.

5.2.2 Groundwater

COCs in soil have migrated to the groundwater system. *In situ* treatment of shallow groundwater has been conducted in the area east of the main building with the highest VOC concentrations. The removal or treatment of unsaturated soil and groundwater with the highest VOC concentrations has reduced potential contaminant flux to and through the groundwater system.

Groundwater on the property is not used as a source of either potable or non-potable water. Institutional controls are planned that would ensure that groundwater is not used onsite in the future.

VOC-containing groundwater has migrated offsite to neighboring properties. In areas with VOC-affected groundwater, an alternative water supply has been provided. A groundwater monitoring program is being implemented to ensure that any changes in groundwater quality are detected.

5.2.3 Soil Vapor and Indoor Air

The existence of impacted soil and shallow groundwater onsite may result in the presence of VOC-containing vapors in soil pore spaces beneath buildings. VOCs were detected in sub-slab soil vapor samples and indoor air samples collected from the current onsite building. Indoor air in the warehouse facilities to be constructed as part of the planned site development, or other future buildings, could potentially be affected by these COCs. A vapor barrier and vapor mitigation system will be installed in the warehouse buildings constructed in the affected areas of the site.

5.3 Potentially Exposed Populations

As indicated above, manufacturing operations have ceased at the site, and a small number of office employees remain on the property into the near future. Current potential receptors include facility office workers, visitors (including child or youth intermittent visitors), or trespassers. Visitors and trespassers would generally access the site with much lower frequency and duration, relative to facility office workers. Among the current potential receptors, facility office workers are likely to be present with the highest frequency, resulting in the greatest potential exposure. Actual exposure to COCs in soil is minimized by the presence of the buildings and pavement, which prevent contact with soil over much of the property.

The planned redevelopment to a commercial facility will involve the presence of construction workers on the property, with excavation of soil expected to a maximum depth of up to 4 feet bgs. Over the long term, future uses of the property will be commercial, with the associated presence of commercial facility workers or visitors inside or outside of the warehouse buildings. Institutional controls to prevent residential use of the property or use of groundwater as a source of drinking water will be implemented as part of subsequent remedial measures.

Groundwater containing COCs at concentrations above MCLs has migrated off the property, affecting residential wells that use the groundwater from certain portions of the aquifer system as a potable water source. Risks to this receptor category have not been evaluated quantitatively, although consumption of water with COCs above MCLs is presumed to result in potential risks. In affected areas, an alternative water source has been provided. A groundwater monitoring program is being implemented so that this exposure pathway can continue to be evaluated.

The following receptors on the property were considered in the SSRA (WSP 2015):

- Current or future facility workers (indoor or outdoor)
- Current or future child or youth intermittent visitors
- Future construction workers

Additional receptors could potentially be affected by impacted media but are likely to have lesser exposure than the receptors listed above. For example, trespassers would be expected to have less exposure than facility workers. Utility workers may be on the property to conduct short-term installations or repairs, but would likely be on the property for a shorter duration than construction workers.

5.4 Exposure Pathways for Human Receptors

The presence of COCs in soil and groundwater could result in the following exposure pathways:

- Exposure to COCs in soil through the ingestion, dermal contact, or inhalation routes may affect current or future facility workers, current or future visitors, and future construction workers.
- Inhalation of COCs originating in soil or groundwater and migrating to indoor air, via vapor intrusion into buildings, may affect current or future facility workers and visitors.

Direct contact with soil by facility workers and visitors would only be expected to involve soil near the surface. Surface soil (as well as subsurface soil) does not contain VOC concentrations exceeding screening levels for non-residential direct contact. (It should be noted for the SSRA, potential exposure to all affected soil [0-15 feet bgs] was considered as a conservative, worst-case assumption.) Although vapor intrusion could be a complete exposure pathway under current site conditions, this pathway will be eliminated by the implementation of engineering controls as part of the site redevelopment. The anticipated controls include a vapor barrier and vapor mitigation system in future site buildings constructed over VOC-containing soil and groundwater.

Exposure pathways involving onsite groundwater are not complete. Groundwater is not used as a source of potable or non-potable water, and the implementation of institutional controls will ensure no future use of groundwater from onsite water supply wells. The water table occurs at depths of 10 to 15 feet bgs, which is deeper than any foreseeable construction or utility work; therefore, no direct contact with groundwater will occur during these activities.

As previously discussed, groundwater containing site-related COCs has migrated off the property. This results in a potential exposure pathway involving residents who use groundwater from certain portions of the aquifer system as a source of drinking water. However, residents with impacted wells have been provided with an alternative water supply.

The SSRA (WSP 2015) included a quantitative evaluation of human health risks from the soil direct contact pathway for a facility worker, child or youth intermittent visitor, or construction worker, and from vapor intrusion for a facility worker or visitor. The risks were found to be less than the target levels (hazard index of 1 and cancer risk of 1×10^{-5}).

5.5 Ecological Receptors

The closest body of surface water is Stony Run, which crosses the western portion of the site. The 100-year flood plain of Stony Run includes a portion of the parking lot northwest of the main building. Stony Run flows north across Dorsey Road, located approximately 2,000 feet north of the Kop-Flex property, through the Baltimore Commons Business Park and Patapsco State Park before discharging into the Patapsco River, 7 miles to the north. Wetlands (other than areas along Stony Run) are not present on the former Kop-Flex property.

COCs in the shallow groundwater zone could potentially migrate with groundwater flow to the west-northwest and discharge into Stony Run. Another potential transport mechanism that could affect the stream is erosion of surface soil containing COCs. The transport of COCs into Stony Run and its sediments could result in an exposure pathway involving freshwater aquatic organisms such as benthic macro-invertebrates or fish present in the stream. Terrestrial fauna (reptiles, amphibians, birds, and mammals) may also use the stream area as a source of food and water, or habitat, could also potentially be exposed to COCs reaching the stream ecosystem. However, the main COCs present (e.g., chlorinated VOCs) have a low potential for bio-concentration and have not been detected in surface water samples collected from the stream area.

Soil containing COCs is primarily located at depths of greater than 5 feet beneath or to the east of the former manufacturing building. Based on current and planned future development, the property consists mostly of areas covered by buildings, paved parking lots and roadways, and grass or other landscaping. Releases to soil on the property have not occurred in locations that serve as a habitat for terrestrial plants and animals. Given the planned development, the VOC-affected soil will be predominantly beneath buildings and surface pavement. Given the depth to the water table (10-15 feet bgs), exposure to VOC-containing groundwater by ecological receptors does not occur.

The SSRA (WSP 2015) included a screening-level ecological risk assessment. The screening assessment identified no significant ecological risks at the site.

6 Cleanup Criteria

The cleanup criteria for site COCs in groundwater are provided below. These numeric cleanup levels will be used to demonstrate that hydraulic control of the VOC-affected groundwater has been achieved but not to demonstrate cleanup of the impacted water-bearing zones at the site. As discussed above, soil cleanup has been completed and the risk assessment did not identify any unacceptable risk to current and future site occupants.
As previously discussed in Section 3, the groundwater COCs consist of chlorinated VOCs and 1,4-dioxane. Using the aquifer designations provided in the MDE Cleanup Standards, both the Surficial and Lower Patapsco units meet the definition of a Type I aquifer in the state of Maryland. Given this classification and non-applicability of any exception described in the aforementioned MDE guidance, the cleanup criteria selected for the VOCs, excluding 1,4-dioxane, are the numeric groundwater standards for Type I/II aquifers (Table 1 of the June 2008 interim final guidance).

The cleanup criterion for 1,4-dioxane, which is not included in the list of VOCs with established groundwater cleanup standards, was determined from an evaluation of calculated risk-based concentrations in groundwater. Using the current default exposure factors developed by USEPA and a target cancer risk of 1E-5, the calculated risk-based criterion for 1,4-dioxane is 7.8 µg/l. This value assumes the exposure pathway is from direct ingestion of the chemical via the drinking water source. (Other potential exposure routes for 1,4-dioxane in groundwater [*e.g.*, dermal absorption from bathing or inhalation of volatiles during showering] make a negligible contribution to human health risk.) Given the depth to groundwater and placement of a groundwater use restriction on the property, the direct ingestion exposure pathway would be incomplete for potential onsite receptors. For any groundwater discharged to Stony Run with 1,4-dioxane concentrations greater than 7.8 µg/l, the surface water levels would rapidly decrease in response to mixing with flow from upstream areas south of the site. Based on these conditions, an alternate, property-specific cleanup criterion of 15 µg/l, or approximately 2x the calculated risk-based level, is proposed for the site.

Based on the aquifer designation and MDE risk evaluation, the following numeric cleanup standards are proposed for groundwater at the site.

COC	Proposed Cleanup Standard (µg/l)
Chloroethane	3.6
1,1,1-TCA	200
1,1-DCA	90
1,1-DCE	7
1,2-DCA	5
Tetrachloroethene	5
Trichloroethene	5
cis-1,2-DCE	70
Vinyl Chloride	2
1,4-Dioxane	15

The groundwater response activities described in the RAP will result in the removal and treatment of site-related VOCs present in the aquifer system at the site. The treated water will be discharged to Stony Run in the northwestern portion of the property and, thus returned to the local hydrologic system. In additional to monitoring individual VOC concentrations, the total VOCs discharged to Stony Run will meet a limit of 100 µg/l, as per the August 12, 2015, correspondence from Marjorie Mewborn of the MDE Water Management Administration concerning the pending NPDES permit. In addition to the active remedial measures, institutional controls – groundwater use restriction – will be instituted for the property to mitigate any human health risks associated with exposure to VOC-impacted well water.

The numeric cleanup criteria for the cessation of the hydraulic containment systems and activities specified in the MDE-approved Groundwater Monitoring Plan for evaluating system performance will be reviewed every three years. As part of these 3-year reviews, new or alternate cleanup standards may be proposed for ceasing the operation of one or both of the groundwater collection and treatment systems. Attainment of the cleanup criteria will be achieved by demonstrating hydraulic containment and COC concentrations at boundary monitoring points are below the numeric values specified above for two consecutive groundwater sampling events during operation of the hydraulic containment systems. The designated boundary monitoring wells in the surficial and semi-confined portions of the Lower Patapsco aquifer as listed below.

- **Surficial Water-bearing Zone**
  - MW-03
  - MW-18
  - MW-39
  - MW-42
  - MW-43
  - MW-44
- **Semi-confined Lower Patapsco Aquifer**
  - MW-22D
  - MW-27D
  - MW-40D
  - MW-41D

Methods and procedures for the collection and analysis of groundwater samples from these wells are provided in Groundwater Monitoring Plan, which is included as an appendix in this document.

7 Response Action for Soil and Groundwater

7.1 Soil Remedial Technology and Selection Rationale

As mentioned in Section 5 and the SSRA (WSP 2015), soil concentrations are below the non-residential cleanup criteria or do not pose a significant risk; therefore, no active remediation is required beyond the remedial actions previously completed. Engineering and institutional Controls will be implemented to maintain the protectiveness of the response action, as discussed in Section 8. Although engineering controls for vapor intrusion are not required based on the risk calculations, the evaluation was specific to the current facility building. For the proposed buildings, the SSRA recommended further evaluation or implementation of engineering controls to prevent vapor intrusion. A soil management plan (Appendix E) was prepared for soil excavation activities during property development in areas where VOC-containing soil material may be present in the shallow subsurface.

The objective of the engineering and institutional controls is to reduce the potential risk of exposure to residual contaminants in vadose zone soils through direct contact and vapor intrusion. Procedures (including recordkeeping) for the inspection and repair/maintenance of the vapor mitigation measures or other engineering controls will be specified in the Site Management Plan. In addition, soil management procedures that allow for safely conducting soil excavation activities will be include in this plan.

7.2 Groundwater Response Action

The proposed groundwater response action is containment of VOC-affected groundwater using groundwater extraction and treatment. The following subsections present the remedial alternatives evaluation and descriptions of the proposed response action, land use controls, and post-remediation requirements.

7.3 Groundwater Response Action Objectives

Groundwater Response Action Objectives (RAOs) were developed to establish goals for protecting human health and the environment. Overall, the goal of the groundwater response action is to prevent potential human and ecological exposure to VOCs present in the aquifer system at the site. Specific RAOs for the remedial actions selected for the VOC-impacted groundwater include:

- controlling potential migration of groundwater with VOCs exceeding applicable human health criteria beyond the Kop-Flex property boundary
- restricting groundwater use on the former Kop-Flex property to prevent potential exposure to VOCs present at concentrations above applicable human health criteria
- reducing concentrations of VOCs in the aquifer system

Mass removal from the groundwater system will be facilitated by the recent excavation of shallow soil containing source-type VOC concentrations, which will serve to reduce further migration of constituents to the saturated zone, and the injection of EZVI into the subsurface to the east of the building where excavation was not practical. The achievement of these remedial action objectives will satisfy the requirements of the MDE VCP for the protection of human health and the environment, and will be consistent with commercial use of the property.

7.3.1 Risk Reduction

Potential exposure pathways for current and future receptors were described in Section 5 of this document and the SSRA (WSP 2015). Since VOC transport in the saturated zone occurs exclusively in the dissolved phase, hydraulic control via withdrawals at groundwater sinks (i.e., pumping wells or collection trenches) can be implemented to contain COCs within the site boundary. The groundwater extraction systems will be located hydraulically downgradient of the source area to control any continued migration of dissolved VOCs in the aquifers. A monitoring plan will be developed to evaluate the performance and effectiveness of the hydraulic containment systems in controlling the transport of VOC-containing groundwater to downgradient areas.

Although potable water at the former Kop-Flex facility is obtained from the municipal water system, there are no currently identified restrictions on the use of groundwater at the site. As stated previously, a groundwater use restriction will be instituted for the property to mitigate any human health risks associated with exposure to VOC-impacted well water.

7.3.2 Mass Reduction

In addition to reducing human health risks, the remedial activities are designed to achieve the mass reduction RAO. Mass reduction efforts will be optimized by targeting recovery to permeable zones within the known horizontal and vertical extent of the VOC plumes and using proven technologies that remove or destroy the chemicals of concern. Given the source area locations and plume distributions, mass recovery or treatment in the Surficial aquifer will focus on the area immediately west (hydraulically downgradient) of the former manufacturing building. Recent investigation and monitoring activities have indicated the maximum VOC concentrations in the shallow groundwater zone underneath the building. For the deep groundwater zone, the majority of the VOC mass appears to be present in the southern part of the site and migrating to the south. Mass reduction in this portion of the aquifer system will be optimized by targeting removal of VOC-containing groundwater in the upper 40 feet to 50 feet of the semi-confined Lower Patapsco aquifer.

7.4 Groundwater Remedial Alternative Evaluation

Remedial alternatives were evaluated for their ability to meet the groundwater response action objectives, as well as their applicability to site-specific conditions, including access constraints, contaminants, medium, and the area/depth of concern. Alternatives that were considered include containment (permeable reactive barrier and groundwater extraction and treatment) and in situ and ex situ chemical treatments (in situ/ex situ chemical oxidation, biological reduction). The only alternative that was considered feasible was containment through groundwater collection and treatment to remove COCs. All other alternatives were determined to be ineffective with respect to addressing the contaminants and conditions at the site.

Groundwater collection and treatment is designed to prevent migration of groundwater with VOCs exceeding applicable human health criteria beyond the Kop-Flex property boundary through groundwater extraction, and remove the VOC mass from extracted groundwater through treatment prior to discharge to a surface water body. The extraction well placement and water extraction rates (Section 7.4.2.1) are proposed in accordance with the modeled conditions, and will be achieved using the selected submersible pumps (Section 9.2.1). The system's treatment components (Section 9.3) are capable of removing COCs from groundwater in order to meet the groundwater cleanup standards and discharge permit limits. Therefore, this technology is protective of human health and the environment by reducing the mobility, toxicity, and volume of contaminated groundwater at the site.

7.4.1 Groundwater Collection and Treatment

The preliminary layout of the groundwater collection and treatment system is shown in Appendix A, Sheet 2. A groundwater extraction network of three shallow extraction wells (RW-1S through RW-3S), screened within the Surficial aquifer, and two deep extraction wells (RW-1D and RW-2D), screened in the semi-confined Lower Patapsco aquifer, will contain the VOC-affected groundwater to the former Kop-Flex property. The proposed recovery well construction and operation summary is provided in Table 8.

The extraction wells in the Surficial aquifer will be located across the downgradient, or leading, edge of the shallow plume, and the extraction wells in the Lower Patapsco aquifer will be located across the downgradient property boundary for the deep plume. The total estimated groundwater flow to achieve the response action objectives is 79 gpm (see Section 4.2). Using a safety factor of 1.2, the system's maximum design flow is 95 gpm.

Extracted groundwater will be piped to a treatment system that includes an transfer pumps, bag filters, synthetic resin system for VOCs and 1,4-dioxane removal, and caustic injection system for pH buffering. Additional treatment equipment, including iron sequestration unit and an ion resin exchange system for metals removal, may be incorporated into the system to maintain treatment equipment performance and/or meet the NPDES permit discharge requirements. Alternate VOCs and 1,4-dioxane treatment equipment, including equalization tanks, air stripper, and advanced oxidation process, may be incorporated into the system in place of the synthetic resin equipment, pending bench-test and pilot test evaluation. As discussed in Section 10.1.1, the site currently operates under State Discharge Permit No. 07-DP-3442 and NPDES Permit No. MD 0069094 for discharges from groundwater remediation activities. The most recent permit was issued on July 1, 2009, and expired on June 30, 2014. No discharge will be performed until the NDPES permit renewal is issued by MDE. The design of this system assumes the discharge permit effluent limits and monitoring requirements (Table 10) in the renewed permit will be consistent with the most recent permit, as well as the groundwater cleanup standards. Based on MDE Air and Radiation Management Administration (ARMA) regulations, no treatment will be required for the off gas generated through the synthetic resin's on-site regeneration process or alternate air stripper (see Section 10.1.3). Therefore, off gas from these operations will be discharged directly to the atmosphere. The treatment system will be located within an equipment building with interconnected wiring and plumbing installations completed by the equipment vendor. Following treatment, the water will be discharged to Stony Run via Outfall 001, in accordance with the recent NPDES permit (Appendix A, Sheet 2). The estimated effluent water concentrations are provided in Table 11. Sections 7.4.2 and 9 of this report provide a summary of the design rationale, criteria, and calculations that were used to select and size the pumping, conveyance, and treatment equipment that will comprise the proposed hydraulic containment systems.

Groundwater monitoring activities to be performed during system operation are specified in the Groundwater Monitoring Plan accompanying the RAP.

7.4.2 Rationale for Technology Selection

7.4.2.1 Extraction Well Placement and Flow Rate

The extraction well placement and design flow rates are presented below and based on the aquifer testing and predictive flow simulations presented in Sections 4.1.2 and 4.2. The proposed extraction well locations are shown in Appendix A, Sheet 2, and the flow rates are provided in Appendix A, Table A-1.

In accordance with the flow simulations for the Surficial aquifer (Section 4.2.2), three shallow extraction wells (RW-1S through RW-3S) will be installed immediately west of the former manufacturing building to prevent the potential transport of VOCs above the applicable groundwater quality criteria to the Stony Run drainage area. Based on the final simulated pumping rate, a sustainable pumping rate of 3 gpm per well (combined flow of 9 gpm), is proposed to provide containment of VOC-impacted groundwater in the Surficial aquifer.

Two deep extraction wells (RW-1D and RW-2D) will be installed along the southern property boundary to contain the inferred extent of the VOC plume extending offsite to the south-southeast (Section 4.1.2.2). A sustainable pumping rate of 35 gpm per well, with a combined flow rate of 70 gpm, is estimated to provide containment of VOC-impacted groundwater in the Lower Patapsco aquifer.

7.4.2.2 Mass Loading Rates

Mass loading rate estimates serve as the basis for the treatment system design and required treatment efficiency. The recent groundwater quality data from shallow and deep monitoring wells located within the proposed system's capture area, and the predicted flow rates for each extraction well and the combined flow, were used to estimate dissolved VOC and inorganic mass loading rates for the influent to the treatment system.

Due to variability in the water quality between extraction wells, the influent mass loading was estimated under two scenarios:

- Anticipated Influent Mass Loading Rate: the summation of the mass loading rates from each extraction well, assuming the anticipated concentration and anticipated flow rate (79 gpm).
- Maximum Influent Mass Loading (Worst Case): the maximum anticipated concentration of a constituent from any of the individual extraction wells multiplied by the maximum flow rate (95 gpm).

The mass loading for the treatment system influent was then estimated for each scenario as the concentration multiplied by a flow rate. The estimated mass loading rates are provided in Appendix A, Table A-2.

7.4.2.3 Treatment Requirements

The treated effluent discharge water shall meet the requirements set forth in the NPDES permit at the time of discharge (see Section 10.1.1). The effluent results shall also be consistent with or below the groundwater cleanup standards (Section6). The effluent limits and monitoring requirements for the most recent NPDES permit are provided in Table 10, and the estimated effluent concentrations are provided in Table 11.

7.4.2.4 Site-Specific Conditions Affecting the Design

Site-specific conditions will affect the system configuration and installation of the subsurface piping. As depicted in Appendix A, Sheet 2, subsurface and overhead utilities transect the proposed lay-out for the conveyance piping. Furthermore, the exact location, and in many instances direction, of subsurface utilities are currently unknown. Therefore, all efforts will be made to identify and locate utilities prior to starting construction and care will be taken when excavating above or within the proximity of any utility identified at the site. Well and piping locations may be adjusted during construction of the system to accommodate unanticipated site conditions, and extraction wells will not be installed within 10 feet of any property boundary.

7.5 Proposed Deed Restrictions and Land Use Controls

Given the current soil conditions and results of the updated SSRA, institutional controls will be implemented to limit potential future human exposure to subsurface soils containing residual VOCs. These controls will include restricting the property to commercial use and prohibiting residential use through the recordation of an environmental covenant the land deed.

As discussed in Section 2.6.2, potable water at the former Kop-Flex property is obtained from the municipal water system; however, there are no currently identified restrictions on the use of groundwater at the site. The environmental covenant for the property will include a groundwater use restriction to reduce the potential for:

- Use of and exposure to the VOC-impacted groundwater
- Any artificial penetration of the groundwater-bearing unit(s) containing affected groundwater that could result in potential cross-contamination of clean groundwater-bearing units
- Installation of any new groundwater wells on the Property, except those used for investigative or remediation purposes and approved in advance by MDE
- Use of groundwater for any purpose (including drinking and washing) and the release of groundwater to surface water bodies, whether such release is the result of human activities or is naturally occurring
- Use of the property for other than commercial activities

This institutional control will be implemented following the construction of the new warehouse buildings and documented in the Groundwater Construction Completion and Implementation Report to be submitted to MDE.

Additional institutional controls required by MDE may be included in the Certificate of Completion based on the exposure pathways, site conditions, or quality of implementation or documentation provided.

7.6 Response Action Implementation

The contract purchaser (TC Harmans Road LLC) will be responsible for the demolition of the existing buildings and implementation of the institutional and engineering controls (e.g., passive sub-slab venting system) that constitute the soil response action during the re-development of the site. In addition, TC Harmans Road LLC will be responsible for providing MDE with all available information necessary for attaining the Certificate of Completion for the soil response action, including approval of a Site Management Plan and the following:

- Demolition
- Installation of the new slab and passive sub-slab venting systems
- Soil management plan adherence and soil disposal as needed
- Site maintenance plan adherence
- Recordation of environmental covenant

EMERSUB 16 LLC will be responsible for the successful implementation of the groundwater response action for the site, including submittal of the Groundwater Construction Completion and Implementation Report and Operations and Maintenance (O&M) Plan. Following system installation and start-up, EMERSUB 16 will conduct the necessary monitoring and reporting related to the operation of the groundwater collection and treatment system at the site.

7.7 Future Property Access

The December 2014 purchase and sale agreement between EMERSUB 16 and TC Harmans Road LLC included an access agreement that will allow access to WSP and its subcontractors for both installation of the groundwater remedial system components and performance of operation, maintenance and monitoring (OM&M) activities. A copy of the access agreement between EMERSUB 16 LLC and TC Harmans Road LLC will be provided to MDE following completion of the property transaction. The monitoring activities will include the collection of water level and water quality data from wells included in the approved monitoring program. The access requirement specified in the executed purchase and sale agreement will be binding between the parties for the expected operational period for the hydraulic containment systems. The access agreement provides for MDE access to the property to (1) inspect the site and remedial measures at any time and (2) maintain the hydraulic containment systems in case EMERSUB 16 LLC is no longer fulfilling the requirements in the MDE-approved RAP.

8 Soil Response Action

As mentioned previously, soil cleanup has been completed and the risk assessment did not identify any unacceptable risk to current and future site occupants. The soil response actions will include the implementation of land use and engineering controls to prevent future exposure to soil containing VOCs that remain at the site, as discussed in this Section. The following soil response actions will minimize the risk of exposure to soil containing VOCs that remain at the site.

8.1 Soil Management Plan

The Soil Management Plan (Appendix E) was developed to identify the procedures for safely conducting soil excavation activities in the area where VOC-containing soil material may still be present in the shallow subsurface. All soil movement, grading and/or excavation activities will be conducted according to the Soil Management Plan.

The final grading plan and utility plan for the proposed commercial development of the site will be provided at a later date, and will indicate areas of soil removal during development. Low concentrations of VOCs (including 1,4-dioxane) remain in the shallow soil (less than 10 feet bgs) underneath the southwestern portion of the former manufacturing building (AOC 1) (see Figure 2). All soil excavation activities in the area of the southwestern portion of the former manufacturing building shall be conducted in a manner that minimizes the exposure of potentially contaminated soil to precipitation and the flow of potentially contaminated storm water runoff to surrounding areas. If excavations are backfilled, clean soil shall be used from an off-site borrow area. Geotextile fabric or composite shall be placed on the bottom and side walls of excavations to serve as a marker and barrier between clean soil/fill and impacted soil. Soil will be disposed of at a properly permitted disposal facility licensed to accept the waste. The procedures described in the plan may be revised, as necessary, to ensure that all soil disturbance activities are conducted in accordance with applicable laws and regulations.

8.2 Engineering Controls

8.2.1 Current and Future Building Floor Slabs

The future development of the property will involve the demolition of the existing manufacturing building and construction of two (north and south) warehouse buildings separated by a truck loading area. In the new warehouse building areas, the concrete slab for the existing manufacturing building will remain in place, and a concrete floor slab will be installed over the current slab. In the new truck loading area between the warehouse buildings, the concrete slab for the existing building will be removed, and a new surface pavement consisting of both concrete and heavy-duty asphalt will be emplaced and serve as the paved surface for the truck loading and unloading activities. The thickness of the new concrete pavement adjacent to the warehouse buildings will be 6 inches. The asphalt will be installed along both sides of the surface drainage gutter running between the buildings and have a thickness of 4.5 inches.

The concrete floor slab for the planned south warehouse building will serve as a cap for the VOC-containing soils in this portion of the site. A written statement, signed by a Maryland-licensed Professional Engineer, certifying the design of the building floor slab for the south warehouse is appropriate for use as a soil cap is provided in Appendix F. Annual inspections of the south warehouse concrete floor slab will be conducted following completion of the site development. Procedures (including recordkeeping) for the inspection and repair of the building floor slab, as deemed necessary, will be specified in the Site Management Plan, which will be provided to MDE for review and approval with documentation supporting the implementation of the soil response activities.

8.2.2 Vapor Mitigation Systems

For the proposed buildings, the SSRA recommended further evaluation or implementation of engineering controls to prevent vapor intrusion. The construction plans for the property will include the implementation of engineering controls to prevent vapor intrusion, including incorporation of a passive vapor mitigation system into the construction of the floor slabs for both the north and south warehouse buildings. The vapor mitigation system will include a vapor collection system consisting of 2-inch diameter slotted or perforated polyvinyl chloride (PVC) pipe laterals spaced evenly within the gravel sub-base under the new floor slab and a vapor barrier consisting of a 20-mil polyethylene sheet placed between the gravel sub-base and new concrete floor slabs. The passive vapor mitigation system will prevent vapor intrusion by collecting any VOC vapors that may potentially accumulate in the gravel sub-base under the polyethylene vapor barrier. The collection system will be connected to 4-inch diameter solid PVC pipe on one side of the building that will be used as an inlet for ambient air and similar piping on the opposite side of the building that will run vertically to above the roofline to vent vapors to the atmosphere. Engineering plans and specifications for the sub-slab vapor venting system in both buildings are provided in Appendix G.

Annual inspections will be conducted of the passive vapor mitigation systems in accordance with the Site Management Plan prepared by the developer. Inspection documentation and regular maintenance requirements for the passive vapor mitigation systems will be provided with the final building plans, which will be included in the Site Management Plan. . The Site Management Plan will be submitted to MDE for review and approval with other documentation supporting the property redevelopment and implementation of the engineering controls.

9 Groundwater Response Action

Extracted groundwater will be transferred from the recovery wells to the equipment building, and power and control wiring will be conveyed from the equipment building to the recovery wells, via parallel lines of below ground piping or conduit. The groundwater collection and treatment system design details and calculations are provided in Appendix A.

9.1 Extraction Wells

The extraction well construction details are provided in Table 8. The extraction well depths and anticipated flow rates are based on the predictive flow simulations for the hydraulic containment system (Section 4.2).

Each shallow extraction well will be constructed of 4-inch diameter, Schedule 40 polyvinyl chloride (PVC) screen and riser. The shallow extraction wells will be installed to a total depth of approximately 60 feet bgs, with 35-foot long screens. The screened intervals will be fully saturated and fully penetrate the lower coarse-grained deposits in the Surficial aquifer.

Each deep extraction well will be constructed of 6-inch diameter, schedule 80 PVC screen and riser. The deep wells will be installed to a total depth of approximately 140 feet bgs, with 40-foot long screens. The screened intervals will be fully saturated and partially penetrate the upper, semi-confined portion of the Lower Patapsco aquifer.

Exact well depths will be determined in the field based upon the lithology encountered during drilling. The well screen will be machine-slotted with a slot size of 0.010 inches for the shallow recovery wells and 0.020 inches for the deep recovery wells. The well screens will be surrounded with a high silica content, washed and rounded sand pack. Construction diagrams for the extraction wells and wellhead vaults are shown in Appendix A, Sheet 3.

Each groundwater extraction well borehole will be equipped with a nested 1-inch diameter PVC piezometer that will be used to monitor the groundwater level for the well. Piezometer construction diagrams are also shown in Appendix A, Sheet 3.

9.2 Groundwater Extraction and Conveyance Piping

Groundwater pumping will be used to extract groundwater from the formation. Conveyance piping will transfer the extracted water from the wells to the equipment building, and transfer treated water from the equipment building to the discharge location.

9.2.1 Groundwater Extraction

Groundwater extraction will be performed using submersible pumps capable of overcoming the total dynamic head (TDH) requirement. The dynamic head for each pipe section was calculated using the following Hazen-Williams equation (Lindeburg 2003):

Dynamic Head$_{\text{, feet}}$ = $H_{\text{STAT, feet}} + h_{\text{f, feet}} + h_{\text{m, feet}}$

Where:

$H_{\text{STAT, feet}}$ = static head

$h_{\text{f, feet}}$ = head loss due to friction

$h_{\text{m, feet}}$ = minor losses due to fittings and valves, and

$$h_{f,\ feet} = \frac{10.44 * L_{feet} * V^{1.85}_{gpm}}{C^{1.85} * d^{4.87}_{inches}}$$

Where:

L_{feet} = length of pipe

V_{gpm} = flow

C = Hazen-Williams Coefficient

d_{inches} = diameter of the pipe

The TDH was calculated for pumping from the hydraulically most distant extraction well (RW-2D) on the main header and the hydraulically most distance extraction well on the shallow wells' extension (RW-3S). A safety factor of 1.2 was applied to the anticipated flow rate for each recovery well. According to the TDH calculations provided in Appendix A, Table A-1, the pump in RW-1D will be required to overcome a TDH of 115 feet, and the pump in RW-3S will be required to overcome a TDH of 67 feet.

The Grundfos model SQ05-90 or similar electrical submersible pump has been selected for the shallow extraction well pumps P-1, P-2, and P-3, and the Grundfos model 60S30-5 or similar electrical submersible pump has been selected for the deep extraction well pumps P-4 and P5. These pumps are capable of overcoming the estimated head losses at the shallow and deep wells.

9.2.2 Conveyance Piping

The electrical supply and control wiring conduits will be installed in parallel with the water conveyance piping. The selected materials, sizing, and installation plan are provided below.

9.2.2.1 Materials of Construction

The material of construction for the conveyance piping is based on compatibility with the conveyed media and pipe bedding. Recovered groundwater will be transferred to the equipment building, and treated water transferred from the equipment building, via high density polyethylene (HDPE) conveyance piping. For leak collection and ease of future replacement in the event of pipe degradation or scaling, the untreated groundwater conveyance piping will be installed within a larger diameter HDPE carrier pipe. The electric power supply line and control wiring for operating the submersible pumps will be emplaced inside Schedule 80 PVC electric conduit.

9.2.2.2 Sizing

The electrical conduit will be sized to carry the required number and gauge of power and control wires. Power and control wiring will be installed in separate conduits.

The water conveyance piping is sized to optimize in-pipe water velocities to reduce deposition of solids and minimize the TDH required for conveyance of water from the submersible pumps to the equipment building. Therefore, the conveyance pipe diameters will vary depending upon factors such as hydraulic distance from the equipment building and flow rate over a particular section. The dynamic head calculations and pipe sizes per section are provided in Appendix A, Table A-1, and shown on Sheets 3 and 4.

The protective casing for the water conveyance piping will each be sized at least an inch larger than the inner pipe.

9.2.2.3 Installation

The electrical power and control conduits will be installed in parallel with the water conveyance piping, approximately 18 inches apart in cement-stabilized native soil. The water conveyance piping will be installed at a depth of 3 feet bgs, approximately 6 inches below the frost line in Anne Arundel County, Maryland (Anne Arundel County, 2014). The electrical supply line and control wiring conduits will be installed above the water conveyance piping, at a depth of 2 feet 9 inches bgs. The pipe bedding and compacted backfill will be prepared in accordance with Maryland Department of Transportation State Highway Administration’s Technical Requirements Part III (2009). If the soil removed from the trench is not suitable for use in the pipe bedding, clean fill will be brought to the site for use as bedding material. The backfill source will meet VCP clean fill requirements as per the Soil Management Plan provided in Appendix E. Detector tape stating “Caution: Electrical Line Buried Below” and “Caution: Water Line Buried Below” will be placed above each respective conveyance pipe. A new sub-base that matches any preexisting sub-base will be constructed over the backfill. The trench cuts will be surfaced with new surface material matching the existing surface materials surrounding the trench. Any excavated material not used as backfill will be disposed of offsite in accordance with federal and state regulations.

At pipe junctions, the conveyance piping from an individual extraction well or section of wells will be connected to the main conveyance header. At each extraction well, the conveyance piping will connect with the pumps in each well vault via down-well electrical wiring and discharge hose.

9.2.3 Well Vaults, Pipe Junction Vaults, Valve Vaults, and Cleanouts

The extraction wellheads, pipe junctions, and valve connections will be housed in pre-fabricated steel well vaults. The vaults will be sealed watertight and will be capable of withstanding H-20 traffic loads. The protective casing containing each water pipe will be terminated just inside the entry point of each vault.

The wellhead will be equipped with the following components, as shown in Sheet 3 of Appendix A:

- Backflow preventer
- Ball valve with an electric actuator to regulate flow from the well onsite via a remote control unit and offsite via a Process Logic Control (PLC) system
- Shut off valve
- Vibration dampening clamp attachment on the hydraulic line to absorb shock from vehicular traffic on top of the well vault
- Pressure indicator to monitor for line obstructions indicated by water pressure increases
- Totalizing water flow transmitters to record and transmit the flow rate and total volume of pumped groundwater
- Sample port
- Cleanout port

Iron precipitation or sediment build-up may occur within the water conveyance piping upstream of the treatment system. Therefore, pipe cleanouts will be installed at all water conveyance pipe junctions and changes in direction to allow access for cleaning inside the pipes and fittings.

9.2.4 Backfill Material

The proposed response action requires soil excavation for pipe installation trenches, as well as the installation of extraction well and pipe junction vaults. All excavation and backfill soils will be managed in accordance with the Soil Management Plan (Appendix E). Any backfill source must also meet VCP clean fill requirements as per the Soil Management Plan provided in Appendix E. Excavated areas for installation of the response action will be backfilled with native soil. In high-traffic areas, Portland cement will be mixed into the native backfill soil for added stability.

Off-site backfill material is not anticipated during construction of the response action. However, should any off-site fill material be required, a clean fill sampling work plan will be submitted to MDE for approval prior to backfilling activities. Alternatively, an affidavit stating that the imported material has not been contaminated by controlled hazardous substances or oil will be obtained from the vendor and provided to MDE prior to importing the fill.

The source of the backfill material will be documented and provided in the Construction Completion and Implementation Report.

9.3 Treatment Equipment and Discharge

The purpose of the treatment equipment is to treat recovered groundwater to meet the applicable MDE groundwater standards for COCs and effluent limits established in the pending NPDES permit, which includes a total VOCs limit of 100 μg/l (August 12, 2015, correspondence from Marjorie Mewborn of the MDE Water Management Administration). The effluent limits and monitoring requirements for the recent NPDES permit are provided in Table 10.

The following treatment equipment is included in the design:

- Filtration, for removal of suspended solids
- Synthetic resin (AMBERSORB^{TM} 560) for VOC removal, including 1,4-dioxane
- Caustic injection, for pH buffering

The following alternate or contingency equipment may be incorporated into the treatment system, if required:

- Alternate VOC and 1,4-dioxane removal process equipment, in place of synthetic resin:
  - Equalization tank, for flow equalization and settling of suspended particles
  - Air stripper, for VOC removal
  - Advanced Oxidation Process (with hydrogen peroxide and ozone) for 1,4-dioxane and residual VOC removal
- Ion exchange resin, for metals removal
- Iron sequestering, to reduce formation of iron precipitate
- Liquid-phase granular activated carbon (GAC), for supplemental VOC removal

Additional pre-design testing will be performed to finalize the equipment required to meet the treatment objectives. For example, bench and on-site pilot studies will be performed to select the most appropriate treatment equipment (or combination of equipment) for VOCs and 1,4-dioxane removal (e.g., synthetic resin, air stripping, advanced oxidation). Also, the pre-design studies may include collection of additional geochemical parameters which may impact the treatment equipment's efficacy.

The following sections describe the treatment equipment, as well as the contingency equipment, included in the groundwater response action. Conceptual process diagrams for the groundwater treatment equipment are provided in Appendix A, Sheet 5.

9.3.1 Filtration

Suspended particle filtration downstream of the equalization tank was evaluated for reducing (1) precipitation of dissolved minerals within treatment equipment and (2) effluent suspended particle concentration according to the recent NPDES permit requirement. The system influent's total suspended particle concentrations under anticipated and maximum (worst case) conditions are estimated to be 1.1 mg/l and 9.5 mg/l, respectively. The average particle size is estimated at 2.67 microns under both anticipated and worst case scenarios (Appendix A, Table A-2). These influent concentrations are well below the NPDES requirement for total suspended solids (30 mg/l monthly average, or 45 mg/l maximum). Since a portion of the suspended particles will likely settle out of suspension in the equalization tank, the influent's total suspended solids concentration is a conservative estimate for the probable downstream concentrations. Based on the available data, filtration is not anticipated.

However, should the concentration of suspended solids increase, or equipment inspections identify a build-up of solids, or if the contingency for ion exchange resin is exercised, filtration units will be installed downstream of the air stripper. The filtration units will consist of one or more bag filter vessels, positioned in parallel or in series. The bag filters will remove solid precipitates that may result from precipitation of dissolved minerals within the water treated by the air stripper, thereby removing suspended solids before discharge. The first bag filter in each set will remove larger particles, while the second bag filter will remove finer particles not removed by the previous bag filter. Final mesh sizes for the filter bags will be determined during initial operation of the system. The bag filters will be monitored using pressure indicators installed upstream of every filter unit. These indicators will be used to monitor for pressure build up in the bag filter housing.

9.3.2 Synthetic Resin

AMBERSORB^{TM} 560, a synthetic media, is a treatment technology capable of meeting the treatment objectives for both VOCs and 1,4-dioxane removal. The hydrophobic media consists of a mixture of meso and macropores with a strong affinity for VOCs and 1,4-dioxane. As the influent water passes through the media bed, the organic constituents are absorbed to the media and removed from the water stream. The synthetic resin treatment will consist of a 2-vessel configuration with alternating lead and lag vessels in operation. The water stream passes through the operating vessels for a predetermined time or until breakthrough of the lead vessel occurs, at which time the lead vessel is taken off line and its media bed is regenerated. Once the media bed is regenerated, the vessel is returned to operation as the lag vessel, and the cycle is repeated.

The regeneration process removes the absorbed organic constituents from the media by processing low-pressure steam through the bed. After exiting the bed, the steam (or gas) containing the organic constituents is discharged to the atmosphere. Based on groundwater concentrations and system flow rates assumed under both anticipated (average) and worst case (maximum) conditions (see Appendix A, Table A-1), the regeneration process is anticipated to occur every 6 days and last up to 12 hours; this will be confirmed through pre-design testing to occur prior to installation. As shown in Appendix A, Table A-3, the chlorinated VOC plus 1,4-dioxane discharge rates per day of regeneration under average and maximum conditions, assuming the regeneration process takes 12 hours, are estimated at 5.1 pounds per day and 18.5 pounds per day, respectively. The discharge rates per year under average and maximum conditions, assuming the regeneration process occurs every 6 days, are 308 pounds per year and 1,127 pounds per year, respectively.

9.3.3 pH Buffering

The pH concentrations from the individual extraction wells are estimated at 4.4 to 4.9 standard units (SU). Based on the combined influent flow, the treatment system influent is expected to have an estimated pH of 4.7 SU. As this pH is outside of the anticipated NPDES permit range (6 to 9 SU), pH buffering will be included in the treatment system. The pH buffering system design includes an integrated controller, which will continuously monitor the pH, a metering pump for injecting the buffering solution, and a caustic solution (sodium hydroxide [NaOH]) storage container. The integrated controller will signal a metering pump to inject the caustic solution at a rate designed to maintain pH within the permit range.

9.3.4 Transfer Pumps

Transfer pumps will be used to transfer water through the treatment equipment. The transfer pumps will be rated for at least a minimum flow of 95 gpm and be capable of overcoming the dynamic head to reach the discharge location.

9.3.5 Effluent Discharge

The treated water will be conveyed in a single HDPE conveyance pipe and discharged into Stony Run through Outfall 001. A preliminary layout of the discharge pipe is provided in Appendix A, Sheet 2. No discharge will be performed until the renewed permit is issued by MDE. Water discharge monitoring for flow rate and water quality will be conducted in accordance with the NPDES permit. The effluent results for COCs will also be compared to the groundwater Cleanup criteria (Section 6). To minimize stream erosion, riprap will be installed in the area immediately downstream of the outfall.

9.4 Equipment Building and Utilities

A pre-engineered building, equipped with an overhead door and personnel door, will be used to house the treatment equipment, satellite waste accumulation area, and a work area for storing tools and performing maintenance activities. The building will be sized in accordance with the anticipated and contingent treatment equipment and other proposed uses. The building's approximate location is shown on Sheet 2. Electrical power will be supplied to the treatment building via a separate power drop and meter. Additionally, a public water supply connection will be provided at the building location and a phone or internet service connection will be provided to the PLC for remote monitoring, control, and autodialing capability.

9.5 Process Logic Control

The system design will incorporate telemetry and instrumentation that will provide automated operation and remote monitoring capability. Automatic actuation of the treatment system's equipment will be controlled via a computerized PLC system. The PLC will control the operation of system, including groundwater collection from the subsurface, groundwater conveyance to the treatment system, transfer of groundwater through the treatment system, and discharge of treated groundwater. The PLC will automatically deactivate the entire system in the event of an alarm condition (e.g., preventive overflow switch is activated).

Control of each component of the treatment system (local equipment) and extraction well (via cellular connection to local equipment) will be accomplished using a PLC type system. The control system will allow remote monitoring and control of the treatment system. All controls will be mounted inside a Master Control Panel that will be placed on the equipment building. Alarm conditions will be communicated via automatically delivered electronic message and/or telephone call. The equipment operation is explained as follows.

9.6 Equipment Testing and System Startup

Following installation, all pumping, conveyance, and treatment equipment will be tested to verify proper performance before startup and initial full-scale operation of the system. The groundwater conveyance piping will be hydrostatic leak tested before burial, and all treatment equipment, telemetry, and instrumentation will be calibrated and tested. During the testing, the PLC operation will also be checked to verify proper ladder logic control and signal function.

The system start-up procedure will begin by activating the submersible pump at the hydraulically furthest extraction well (RW-2D). Groundwater from RW-2D will be pumped to the equalization tank inside the treatment building in order to start the treatment process. Subsequently, the pump at the next farthest well (RW-1D) will be turned on followed by extraction wells RW-1S, RW-2S, and RW-3S, respectively. After all extraction wells are contributing to the total flow through the system, the effluent will be monitored and sample(s) collected for off-site laboratory analysis in accordance with the NPDES permit. Additional parameters (e.g., total suspended solids, hardness, etc.) may also be collected to assist with startup monitoring. The system will be turned off until results are received back from the laboratory and confirmed to be within the NPDES permit limits and the groundwater cleanup standards for COCs.

9.7 System Operation, Maintenance and Monitoring

9.7.1 System Operation and Maintenance

After completing the start-up period, long-term operation and maintenance (O&M) activities will be conducted by WSP, or its designated subcontractor, on a regular basis to ensure optimum system performance. WSP will prepare an O&M Plan for the selected treatment system that will include detailed operating and maintenance information, inspection forms, and spare parts list from the vendor(s) selected for equipment delivery and installation. The O&M Plan will be updated to include as-built design drawings, noting any necessary changes during system installation. Equipment failure and shutdown procedures will be incorporated into the system operation, and the information included with the O&M documentation.

9.7.2 System Monitoring

For continuous operation, the discharge will be monitored in accordance with the NPDES permit after the system startup and confirmation testing. Influent and effluent samples will also be collected from the treatment system on a routine basis and analyzed in accordance with permits issued for the operation of the system. At a minimum, water samples will be analyzed using methods approved for VOCs (including 1,4-dioxane) to measure dissolved VOC mass recovery and verify that discharge criteria are satisfied. The number of samples, sampling frequency, and required analysis will be determined upon issuance of permits. The sampling pertaining to system monitoring will be included as part of the operation and maintenance (O&M) activities for the system.

9.7.3 Groundwater Monitoring

Performance groundwater monitoring will be conducted periodically to gather data to evaluate the effectiveness of the groundwater collection system. The primary monitoring objective is to ensure the hydraulic control of the VOC-affected area by limiting further potential migration of VOCs in the groundwater system to off-property receptors. As part of the data analysis to determine achievement of the RAOs, the observed heads, or water levels, from the site will be compared to the modeled heads generated from predictive flow simulations.

The groundwater monitoring program will be conducted in accordance with the Groundwater Monitoring Plan provided in Appendix H. The monitoring well networks designed to gather hydrogeologic and hydrogeochemical data on the aquifer conditions during operation of the hydraulic containment systems are described in Section 3.3 of this plan and will include the installation of new or replacement wells in certain portions of the site. The monitoring frequency and field sampling methods to be used are discussed in Sections 3.4 and 3.5 of the plan, respectively. A field performance test (Section 6 of the monitoring plan) will be conducted to determine the applicability of a passive sampling method (HydraSleeve) for the collection of groundwater samples at the site.

9.8 Action Levels

The action levels for the groundwater response action include the groundwater cleanup criteria for COCs (Section6) and the NDPES permit discharge limits at the time of discharge. The limits for the most recent NPDES permit are provided in Table 10. The groundwater treatment equipment will be designed to meet or exceed these action levels, including the cleanup criterion for 1,4-dioxane; the estimated effluent concentrations are provided in Table 11. However, should the system discharge exceed an action level, the system will be shut down until a contingency measure is implemented to rectify the issue. Immediately thereafter, a confirmation sample of the system effluent will be collected to confirm treatment in accordance with the action levels.

9.9 Potential Contingency Measures for the Groundwater Collection and Treatment System

The proposed groundwater collection and treatment system is a proven technology for hydraulic containment. Groundwater flow modeling using site-specific data from the pumping tests was conducted to optimize extraction well locations and pumping rates to provide adequate capture of the VOC plumes. Potential contingency measures and equipment have been evaluated should unexpected conditions occur.

Contingency measures will be evaluated and implemented should the response action fail to contain and treat the groundwater as designed. If the groundwater collection system does not meet the containment objective, then modifications to the pumping rate(s) at extraction wells will be evaluated. If the water treatment system is not as effective as designed, then contingency treatment equipment will be considered, as outlined below. Should the treated water effluent exceed the NPDES permit limits at the time of discharge, MDE will be notified immediately. The system will be shut down until the cause of the exceedance (e.g., change in influent concentrations or removal efficiency) is determined and resolved, then an additional system effluent sample will be collected to confirm the NPDES permit limits are met.

9.9.1 Contingency Measures for the Selected Groundwater Response Action

The treatment equipment was selected based on the combined influent flow rate and water quality under assumed and worst case (maximum) concentrations. Safety factors and conservative assumptions were applied as appropriate to minimize or eliminate the need for contingency measures. However, the system is capable of being modified to accommodate the unexpected conditions.

Examples of potential contingency measures include:

- Replacement or alternate equipment (e.g., pumps, piping, or treatment equipment)
- Adjusting system flow rate (increasing or decreasing) by adjusting the pumping rate at individual extraction wells, or deactivating extraction wells
- Additional equipment:
  - Iron sequestering in the treatment system to reduce the potential for iron precipitation
  - Ion exchange resin in the treatment system to remove selected metals to achieve discharge limitations
  - Liquid-phase GAC for secondary treatment of VOCs in water

The need for contingency measures will be evaluated during operation.

9.9.1.1 Replacement or Alternate Equipment

If a component of the groundwater collection and treatment system (e.g., submersible pump, transfer pump, piping, or treatment equipment vessel) fails to operate as designed and cannot be repaired, then the inoperable equipment will be taken out of service and replaced in-kind, or replaced with an alternate model capable of meeting the response action objectives.

Equipment may also be replaced if alternate equipment demonstrates a more efficient treatment method for the given COCs. As stated previously, additional information on treatment for 1,4-dioxane will be collected as part of the groundwater treatment system pre-design studies. Equipment required for an alternate VOCs and 1,4-dioxane removal process to the synthetic resin system, including flow equalization tanks, air stripping, and advance oxidation process, is provided below.

9.9.1.1.1 Equalization Tank

A flow equalization tank will stabilize the influent flow and reduce downstream cycling of system components by providing a stable reservoir of untreated water. The residence time in the equalization tank will promote settling of suspended solids into the cone-bottom of the tank and equalize any variability in the influent's water quality concentrations. The sediment level in the cone-bottom of the equalization tank will be monitored during routine site maintenance activities, drained from the tank (as needed), and drummed for off-site disposal in accordance with all local, state, and federal regulations.

9.9.1.1.2 Air Stripper

A sliding tray air stripper will be used to remove chlorinated VOCs from the recovered groundwater by blowing air upward through holes in the trays and forcing dissolved VOCs to partition into the vapor phase. The vapor will be discharged through a stack on top of the stripper, and the treated groundwater will be pumped to the discharge manhole. The air stripper model was selected based on the assumed influent flow rate and minimum 99 percent removal efficiency.

The EZ-Tray 12.4 SS Model manufactured by QED Environmental or other equivalent was selected, which can achieve at least 99 percent removal of the key chlorinated VOCs present in the groundwater. Although an increase in system influent water flow is not anticipated, this air stripper is designed to handle flow rates up to a maximum of 120 gpm, which corresponds to 1.5 times the assumed flow rate and 1.3 times the maximum flow rate. As shown in Appendix A, Table A-4, the air stripper chlorinated VOC removal rate is estimated at 0.5 pounds per day (179 pounds per year) assuming the anticipated chlorinated VOC concentrations in groundwater, and 1.0 pounds per day (378 pounds per year) assuming the maximum (worst case) chlorinated VOC concentrations.

The manufacturer's recommended air flow rate through the stripper is 600 cubic feet per minute (cfm). Based on the water's mass loading rate and recommended air flow rate, the chlorinated VOC vapor concentration is estimated at 9.1 milligrams per cubic meter (mg/m^3) assuming the anticipated VOC concentrations in groundwater, or 19.2 mg/m^3 assuming maximum (worst case) VOC concentrations.

A 7.5 horsepower (hp) blower, sized for a maximum air flow of 1,100 cfm, will be selected, with its motor installed as either totally enclosed, fan cooled (TEFC) or explosive-proof (EXP). The motor's electrical specifications will be either 1- phase or 3-phase, with 230/460 voltage (V) for 3-phase or 230 V for 1-phase.

9.9.1.1.3 Advanced Oxidation Process

Advanced oxidation technology will be used to oxidize1,4-dioxane and residual VOCs (post-air stripping) via chemical reaction with ozone and hydrogen peroxide. The ozone dissociates and reacts with hydrogen peroxide to produce hydroxyl radicals (°OH), which oxidize the organic contaminants. After sufficient reaction time, complete mineralization of the organic contaminants to carbon dioxide and water are achieved.

The advanced oxidation reactor includes a series of injection, mixing, and reaction modules to maintain proper ratios of hydrogen peroxide to ozone (e.g., 1.5:1). The process starts with the injection of a specified dose of hydrogen peroxide into the influent water stream of the HiPOX reactor (e.g., 45 mg/l). As the water processes through the reactor, ozone is injected through multiple points in the reactor. Following each ozone injection port, the dosed fluid processes through an in-line mixer to ensure that the ozone is mixed into solution, and then through a reaction zone.

9.9.1.2 Flow Adjustments

The system flow rate may require adjustment to improve treatment efficiency or equipment operations. This will be accomplished by increasing or decreasing the pumping rate at individual wells or deactivating individual wells.

9.9.1.3 Additional Equipment

Additional equipment may be required if the actual influent concentration differs from the design, or if the equipment does not operate as designed. Additional treatment equipment components evaluated for this response action are listed below.

9.9.1.3.1 Iron Sequestering

Although iron concentrations in the system effluent are not limited by the NPDES permit, iron precipitation from extracted groundwater often leads to iron scaling or buildup of ferric iron sediment on treatment equipment. Therefore, the mass loading of iron was calculated to determine if iron sequestering was required. Based on the groundwater quality data, iron concentrations in the system influent are estimated to be 624.4 μg/l under anticipated conditions and 1,055 μg/l under maximum (worst case) conditions. Calculations presented in Appendix A, Table A-2, indicate that the mass of iron precipitate produced is estimated at 0.593 pounds per day under the anticipated mass loading scenario, and 1.2 pound per day under maximum (worst case) scenario. Based on these calculations, iron sequestering is not deemed necessary.

However, should the iron concentrations measured in the operating system water exceed the design concentrations, or excessive scaling and ferric oxide sediment be observed within treatment equipment, an iron sequestering agent could be injected into the treatment system water. The iron sequestering agent would be metered into the system prior to air stripping to keep the iron in solution and prevent the formation of iron precipitates. The metering rate will be determined based on qualitative observations of the treatment equipment (e.g., observations of iron scaling) and analytical testing for iron.

9.9.1.3.2 Ion Exchange Resin

The current NPDES permit requires monitoring for four metals (zinc, copper, nickel and lead), and includes permit maximum daily concentrations for each total (unfiltered) metal. Based on the anticipated influent concentrations, the total concentrations of all permit-monitored metals are below their respective NPDES permit limits; therefore, ion resin treatment is not anticipated. However, assuming maximum (worst case) influent concentrations, the concentration of total copper (15.4 μg/l) would be above its recent NPDES permit limit (13 μg/l). Therefore, ion resin exchange treatment is a contingency to remove divalent metals from the aqueous water stream. The influent metals concentrations will be evaluated upon system startup, and should the concentrations exceed the NPDES permit in more than one sampling event, treatment of metals using ion resin will be initiated.

Based on the design flow rate, a 60 cubic foot capacity carbon steel vessel would be required. The vessel would be filled with resin in acid, sodium or calcium ionic forms.

9.9.1.3.3 Liquid-Phase GAC

Liquid-phase GAC units may be needed after the air stripper as pre-treatment to reduce operating costs for advanced oxidation. If necessary, the GAC units will be placed downstream of the air stripper and filtration equipment, and will have a minimum design flow rate of 95 gpm.

10 Permits, Notifications, and Contingencies

10.1 Permits

Federal, state, and local permitting and emissions control requirements were evaluated for the groundwater containment system's operation[2]. Based on the proposed remedial system design, the following permit requirements were identified for a more detailed evaluation:

- NPDES General Discharge Permit
- MDE Water Appropriation and Use Permit
- MDE ARMA air emissions control requirements

10.1.1 NPDES Permit

The site currently operates under State Discharge Permit No. 07-DP-3442 and NPDES Permit No. MD 0069094 for discharges from a facility manufacturing high performance or high speed couplings and groundwater remediation activities. The permit was issued on July 1, 2009, and expired on June 30, 2014. No discharge will be performed until the renewed permit is issued by MDE.

10.1.2 MDE Water Appropriation and Use Permit

In Maryland, for sites that plan to perform an activity that withdraws water from the State's surface and/or underground waters, a Water Appropriation and Use Permit issued by the MDE Water Management Administration, Water Supply Program, may apply under Code of Maryland Regulations (COMAR) 26.17.06 and 26.17.07. Based on a review of the applicability criteria and discussions with MDE, any site which has an annual average groundwater use that exceeds 5,000 gpd is subject to the permitting requirements. Additionally, sites with an average withdraw rate of 10,000 gpd or more may be subject to a public information hearing, as well as requirements to notify contiguous property owners and certify compliance with Business Occupations and Professions Article 12, Section 205, Annotated Code of Maryland (water conservation technology).

Since the estimated groundwater withdrawal rates under both anticipated and worst case conditions exceed 100,000 gpd, a water appropriation and use permit will be required for the hydraulic containment systems. A Water Appropriation and Use Permit application will be submitted to MDE in advance of system installation. If any system operations are performed in advance of the permit approval, the average water withdraw will not exceed a maximum of 5,000 gpd until issuance of the permit.

10.1.3 MDE ARMA Air Emissions Control Requirements

The operation of two treatment equipment components, the synthetic resin system (during the regeneration process only) and alternative air stripper, result in air emissions. WSP reviewed the MDE Air Quality Permits Program regulations to determine if an air permit would be required for the construction and operation of the these components. Maryland issues General Permits to Construct, Permits to Construct, Permits to Operate, and Title V Air Permits to regulated sources of air emissions.

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[2] Any applicable permits related to the system's construction (e.g., electrical, plumbing, grading) will be secured by the Contractor in advance of construction.

All installations which are potential sources of air pollution are regulated and require a permit or approval from the MDE, except those installations which are specifically exempt under the State's Air Quality Regulations (COMAR 26.11.02.10). To allow faster processing of permits, the MDE regulates certain small stationary source installations through the issuance of an air quality General Permit to Construct. MDE has a General Permit to Construct for Groundwater Air Strippers and Soil Vapor Extraction Systems. The permit covers systems where the contamination is a result of gasoline, No. 1 and No. 2 fuel oils, kerosene, diesel, and jet fuels; and the soil is treated in place by means of vapor or groundwater extraction. Because the contamination at the subject site is the result of a release of chlorinated VOCs, the general permit does not apply at this site. There are no other general permits that would be applicable for the operation of the proposed air stripper.

WSP reviewed the MDE's sources exempt from permits to construct and operate in COMAR 26.11.02.10, and the estimated VOC discharge rate using maximum flow and maximum concentrations for the synthetic resin (during regeneration process only; Appendix A, Table A-3) and air stripper (continuous discharge; Appendix A, Table A-4). Both the synthetic resin regeneration operations and the air stripper operations meet the exemption in COMAR 26.11.02.10X based on the following:

- The proposed installation is not subject to any source-specific State or federal limitation or emission standard.
- The estimated emissions contain less than 1 pound per day of a Class I toxic air pollutant (COMAR 26.11.15.01B(4)).
- The pre-control potential to emit from the proposed installation combined with any potential increase from other installations that could be caused by the installation of the synthetic resin system or alternative air stripper, are less than 1 ton per calendar year for VOCs, each pollutant for which there is a federal ambient air quality standard, and each Class II toxic air pollutant defined in COMAR 26.11.15.01B(5).

Based on the aforementioned exemption, the synthetic resin system or alternate air stripper would not subject the site to any requirements under the Title V air permit program.

In conclusion, the installation of the synthetic resin system or alternate air stripper onsite does not appear to subject the facility to any MDE air permitting or approval.

10.2 Notifications

MDE will be informed of any changes to the project implementation schedule, as discussed in Section 11, and the construction completion of the response action, as discussed in Section 14.1. MDE will be also be notified if any previously undiscovered contaminants, undiscovered storage tanks, or other environmental concerns are identified.

10.3 Contingencies

Section 9.9 describes contingency measures for the groundwater collection and treatment system. Should unexpected site conditions be encountered (e.g., free product, buried tanks, previously unidentified contamination), a work plan addendum with a proposed response action will be submitted to MDE for approval. A public informational meeting will be held to discuss the change in remedy.

11 Project Implementation Schedule

The proposed project implementation schedule is provided in Figure 14a. Building demolition and installation of the vapor mitigation measures with the new warehouse buildings will be completed during the development of the property. Construction of the proposed hydraulic containment system is expected to begin within 90 calendar days of MDE approval of the RAP and issuance of the required permits. WSP will prepare bid specification documents for Contractors following submittal of this plan, and will submit the bid specification documents to the potential Contractors following MDE's approval. After issuance of permits, WSP will retain a qualified Contractor to install the groundwater collection and treatment system. Assuming no significant delays, the installation and startup of the proposed system should take no more than 120 calendar days to complete.

A Construction Completion Report for the soil response action and Site Management Plan will be provided to MDE within 120 days of completing the re-development of the property. For the groundwater response action, a Construction Completion and Implementation Report and O&M Plan will be submitted to MDE within 60 days of completing system installation and startup. The implementation schedule provides information on the timing for the completion of groundwater monitoring events and submittal of Operation, Maintenance & Monitoring Reports for the hydraulic containment systems. The schedule for conducting the annual inspections of the south warehouse concrete floor slab and passive sub-slab venting systems will be provided in the Site Management Plan. The Remedial Action Report will be submitted within 60 days of completion of remedial activities and decommissioning of the systems.

Weather, procurement of subcontractors, and equipment availability may affect this schedule. However, every effort will be made to adhere to the proposed schedule. Exact schedule details related to various construction activities will be prepared by the contractor prior to commencement of any construction activities. Should any modifications to the implementation schedule become necessary, MDE will be advised of the revised schedule.

12 Health and Safety

A detailed Health and Safety Plan (HASP) will be prepared and submitted to MDE prior to the implementation of the approved RAP. In accordance with MDE guidance, the plan will reference applicable regulations to the project activities (i.e. applicable sections of the Occupational Safety and Health Administration (OSHA) regulations, 29 CFR 1910 [General Industry – Hazardous Waste Site Operations, Excavations, Personal Protective Equipment, Respiratory Protection] and 29 CFR 1926 [Construction]). Components of the HASP will include:

- Appropriate personal protective equipment (PPE) and monitoring devices that must be utilized by workers to ensure that all worker protection requirements are met, and the rationale for the PPE selected.
- Site control measures that will be maintained during RAP implementation to restrict access (e.g. security guards, warning fences).
- Dust abatement or suppression methods.
- Compliance by all on-site workers with OSHA guidelines for managing contaminated material regardless of their characterization as hazardous or non-hazardous. The remedial contractor must possess the necessary certification for the transportation of any controlled hazardous substance.

13 Waste Management

Waste generated during the construction of the groundwater response action will include soil, drilling cuttings, development water, disposable sampling, and PPE. Any waste material generated during construction of the groundwater collection and treatment system will be characterized, managed, and disposed of in accordance with all local, state, and federal regulations.

14 Reporting

14.1 Construction Completion and Implementation Reports

As indicated in the previous section, a Construction Completion Reports will be submitted to MDE to document the soil response action activities and installation and start-up of the groundwater collection and treatment system. The groundwater completion report will summarize the system construction activities and include as-built drawings for the extraction well and other system components. The monitoring data gather during the start-up phase will also be provided in the report and evaluated with respect to the NPDES permit and system design parameters.

14.2 Operation, Maintenance and Monitoring Reports

OM&M reports will be provided to MDE on a quarterly basis for the first year of system operation, as provided in Figure 14b. After this initial operational period, these reports will be submitted annually. Each OM&M Report will be submitted during the first month of the subsequent quarter and include the following information:

- A summary of the quarter’s operations, maintenance, and monitoring activities, including explanations for any periods of non-operation lasting more than one week
- Quarterly, annual, and historical water extraction and mass removal volumes for the system
- System monitoring results along with an evaluation of the treatment system efficiency and compliance with the discharge permit requirements
- Groundwater data collection and evaluation in accordance with the approved Groundwater Monitoring Program
- A summary of any recommended system or monitoring program changes for the coming quarter

15 Administrative Requirements

A copy of the certified zoning statement for the property is included in Appendix I. In accordance with the MDE VCP guidance, the statement certifies the current and proposed future use of the property, upon which the response action is based, are in conformance with all applicable zoning requirements.

EMERSUB 16 LLC plans to utilize Performance Bond 104775256 as financial surety to cover the activities set forth in the RAP. The bond amount will be updated no later than 10 days after MDE approval of the RAP and before conducting any work on the property to ensure adequate funds are available to fulfill the requirements under the VCP. The bond amount will be sufficient to satisfy MDE’s requirements to secure and stabilize the property, if future circumstances warrant. Given the site conditions and planned property redevelopment, the activities to secure and stabilize the site include the following measures:

- Operation of the hydraulic containment systems for the surficial and deep, semi-confined zones of the Lower Patapsco aquifer,
- Routine system maintenance in accordance with the O&M Plan;
- Collection of water level data from monitoring wells to document the hydrologic response in the aquifer;
- Sampling and reporting pursuant to the requirements of the NPDES General Discharge Permit;
- Monitoring and reporting pursuant to the requirements of the MDE Water Appropriation and Use Permit;
- Disposal of treatment system waste materials at a permitted offsite facility

The OM&M activities outlined above will be conducted for one year. The value of Performance Bond 104775256 will be increased from $65,000 to $225,000 to provide sufficient funds for the completion of the hydraulic containment systems O&M during the one year time period.

16 Project Completion

16.1 Criteria for Project Completion

16.1.1 Soil

The activities outlined below will be performed to ensure completion of the soil response action at the site.

- Field oversight during development to ensure the appropriate handling and management of any VOC-impacted soil in accordance with the approved Soil Management Plan.
- Construction quality assurance oversight activities to ensure proper installation of the vapor mitigation components (vapor barrier and passive sub-slab venting system) in the warehouse buildings and building floor slab that will serve as a soil cap in the south warehouse building.
- Completion of initial acceptance tests for passive sub-slab venting systems to gather information on operation and performance.
- MDE approval and subsequent implementation of the Site Management Plan by the property developer.

16.1.2 Groundwater

The activities outlined below will be performed to ensure completion of the groundwater response action at the site.

- Collection and analysis of water level data from monitoring wells to verify the hydraulic control of the VOC plumes during operation of the containment systems.
- Regular monitoring and reporting of effluent samples from the treatment system to ensure adequate VOC removal efficiency and attainment of permit discharge limits.
- Collection and evaluation of water quality data from the perimeter monitoring wells cross-gradient and downgradient of the recovery well systems in both Surficial and Lower Patapsco aquifers to assess mass removal and ensure the capture and containment of site-related VOCs from the groundwater system.

16.2 Certification of Completion

16.2.1 Soil

Conditions related to the impacted soil that will need to be achieved prior to issuance of the Certificate of Completion include the following:

- Submittal of documentation to MDE indicating the recordation of the Environmental Covenant with the land deed on file at the Anne Arundel County Circuit Court Land Records Department that restricts the property to commercial use.
- Submittal of a Construction Completion Report for the soil response action activities to MDE (see Section 14.1). This report will include as-built construction drawings showing the installation of vapor mitigation systems and concrete floor slab cap in building areas and documentation of the characterization and disposal of any VOC-impacted soil material excavated from areas pursuant to applicable regulatory requirements, and certification of imported soil used as clean fill.

- MDE approval of a Site Management Plan that provides information on the operation and maintenance (O&M) and inspection activities for the vapor mitigation systems and building floor slab, and procedures for notifying MDE prior to any future soil disturbance activities at the Site below areas covered by the existing building slab.

TC Harmans Road LLC will be responsible for recordation of the Environmental Covenant on the land deed, and submittal of the Construction Completion Report and Site Management Plan for the soil response action. As indicated above, the implementation of the land use restriction for the property will be completed during development and the Environmental Covenant provided with the completion documentation. All areas of the Site will be subject to the institutional controls specified in the Environmental Covenant.

16.2.2 Groundwater

The conditions necessary for issuance of the Certificate of Completion for the groundwater response action include the following:

- Submittal of documentation to MDE on the recordation of the Environmental Covenant with the land deed that restricts the use of groundwater underlying the property.
- Submittal of the Construction Completion and Implementation Report (see Section 14.1), and O&M Plan for the groundwater collection and treatment systems.
- Evaluation of water level data from the following monitoring wells demonstrating the effective hydraulic control of site-related VOCs in the onsite area during operation of the hydraulic containment systems.
  - **Surficial Aquifer**

    MW-03
    MW-05R
    MW-18
    MW-38R
    MW-39
    MW-42
    MW-43
    MW-44
  - **Semi-confined Lower Patapsco Aquifer**

    MW-1D
    MW-21D
    MW-22D
    MW-24D
    MW-40D
    MW-41D

  The results of the data evaluation indicating hydraulic capture of the VOC-affected groundwater on the property will be provided OM&M reports submitted to MDE for review (see Section 14.2).
- Evaluation of water quality data from the following boundary wells in both the surficial and semi-confined Lower Patapsco aquifer during operation of the hydraulic containment systems that indicate site-related VOC concentrations below the cleanup criteria specified in Section 6 for two consecutive monitoring events.
  - **Surficial Aquifer**

    MW-03
    MW-18
    MW-39
    MW-42
    MW-43
    MW-44
  - **Semi-confined Lower Patapsco Aquifer**

    MW-22D
    MW-27D
    MW-40D
    MW-41D

The results of the sampling data evaluation indicating attainment of the groundwater cleanup criteria for the designated monitoring points will be provided OM&M reports submitted to MDE for review (see Section 14.2).

Given the pending property transfer, TC Harmans Road LLC will be responsible for recordation of the Environmental Covenant specifying the groundwater use restriction. The implementation of the use restriction will be completed during property development and the Environmental Covenant provided with the completion documentation. All areas of the Site will be subject to the institutional controls specified in the Environmental Covenant. EMERSUB 16 LLC will be responsible for the preparation and submittal of the Construction Completion and Implementation Report for the groundwater response action and data demonstrating attainment of hydraulic control of the VOC-impacted groundwater and cleanup criteria in the designated boundary monitoring wells. If requested by MDE, TC Harmans Road LLC and EMERSUB 16 LLC agree to revise the environmental covenant to incorporate the Certificate of Completion and any additional restrictions or land use controls set forth in the Certificate of Completion. TC Harmans Road LLC will maintain ownership and control of the Site during the development.

16.3 Post-Remediation Requirements

Post remediation care requirements will include compliance with the conditions specified in the Certificate of Completion and the institutional controls recorded for the Site. Deed restrictions included as part of the Certificate of Completion and will be recorded either before or no later than 30 days after issuance of the Certificate of Completion. In addition, MDE and the WSSC (for excavations and/or grading within the WSSC easement area) will be provided written notice at least 15 days prior to any planned excavation activities at the Site that will occur within areas of potentially VOC-containing soil . Written notice of planned excavation activities will include the proposed date(s) for the excavation, location of the excavation, health and safety protocols (as required), clean fill source (as required), and proposed characterization.

Continual evaluation of the groundwater monitoring data will be conducted to assess COC concentrations and determine when to terminate pumping within the aquifer units. Information on the data collection and evaluation procedures and decision approach for determining the termination and, if necessary, resumption of operation of the hydraulic containment systems will be provided in either the Operations and Maintenance (O&M) Plan to be prepared as part of the Certificate of Completion or a future OM&M Report.

After a decision is made to cease operation of the hydraulic containment systems(s), two years of quarterly groundwater sample data will be collected from the monitoring network wells to determine attainment of the cleanup standards. The collection of quarterly groundwater samples will be conducted to assess any seasonal differences or fluctuations in COC concentrations in the aquifer. The approach to determine attainment of the groundwater cleanup criteria for the COCs listed in Section 6 will be generally similar to the sequential statistical test method described in the U.S. EPA guidance document *Methods for Evaluating the Attainment of Cleanup Standards, Volume 2: Ground Water* (July 1992). If the 2 years of groundwater sampling data do not indicate attainment of the COC cleanup criteria in one or more monitoring points, additional groundwater sampling will be completed in only those wells. After collecting the additional groundwater quality data, the sampling results will be analyzed using the same approach or another statistical method selected by EMERSUB 16 and acceptable to MDE.

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18 Acronyms

µg/l	Micrograms per liter
AOC	Area of Concern
ARMA	Air and Radiation Management Administration
bgs	Below ground surface
cfm	Cubic feet per minute
COC	Constituents of concern
DCA	Dichloroethane
DCE	Dichloroethene
DPE	dual phase extraction
ESI	Environmental Simulations Incorporated
EZVI	Emulsified Zero Valent Iron
ft	Foot (feet)
ft msl	Feet mean sea level
ft/day	Feet per day
ft^2/day	Square feet per day
GAC	granular activated carbon
gpd	Gallons per day
gpm	Gallons per minute
HASP	Health and safety plan
HDPE	High density polyethylene
hp	Horsepower
K	Hydraulic conductivity
MDE	Maryland Department of the Environment
mg/kg	Milligrams per kilogram
mg/l	Milligrams per liter
mg/m^3	Milligrams per cubic meter
NPDES	National Pollutant Discharge Elimination System
OM&M	Operation, Maintenance and Monitoring
PLC	Process logic control
PPE	Personal protective equipment
PVC	Polyvinyl chloride
RAOs	Response action objectives
RAP	Response Action Plan
S	Storativity
SSRA	Site-specific risk assessment
SU	Standard units
SVE	soil vapor extraction
T	Transmissivity
TCA	Trichloroethane
TDH	Total dynamic head
UVB	Unterdruck-Verdampfer-Brunnen
V	Voltage
VCP	Voluntary Cleanup Program
VOCs	Volatile Organic Compounds

Figures

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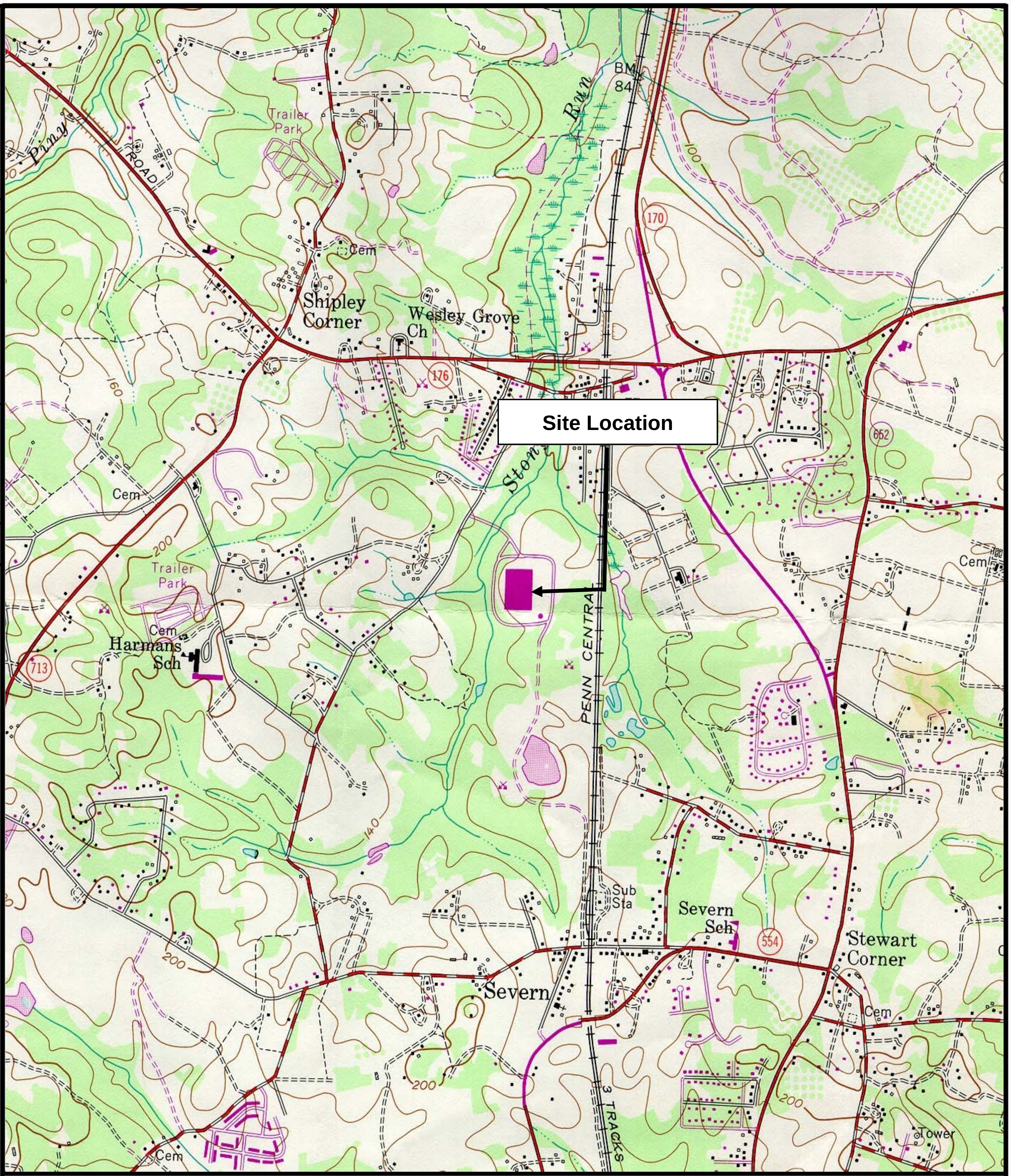

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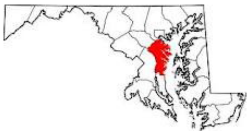

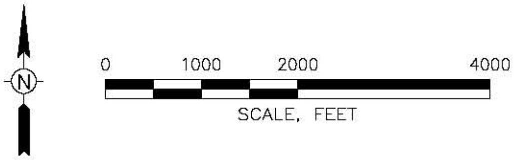

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FIGURE 1

SITE LOCATION MAP

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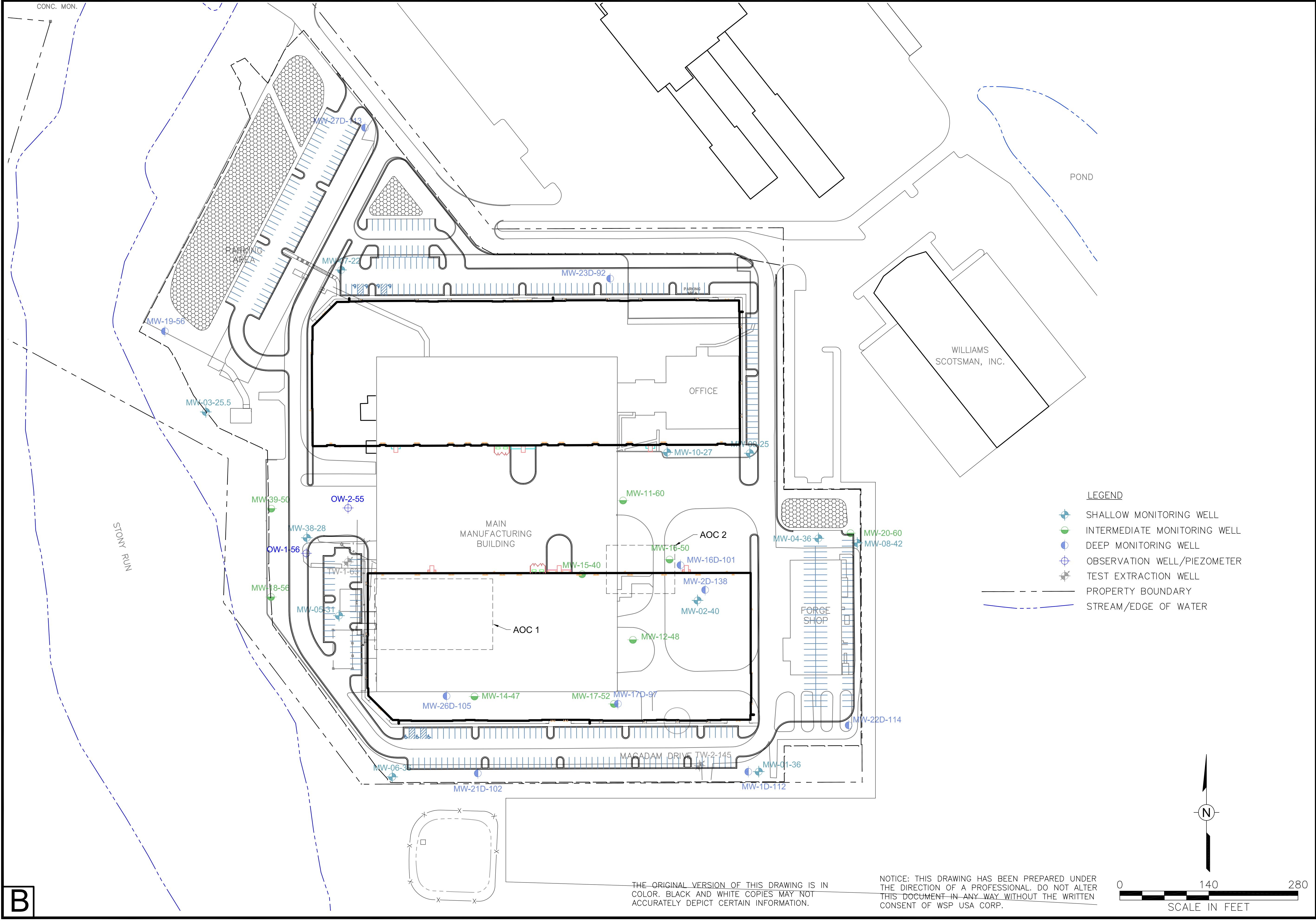

LEGEND

- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- OBSERVATION WELL/PIEZOMETER
- TEST EXTRACTION WELL
- PROPERTY BOUNDARY
- STREAM/EDGE OF WATER

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Figure 2

CURRENT AND FUTURE SITE LAYOUT WITH
EXISTING WELL LOCATIONS

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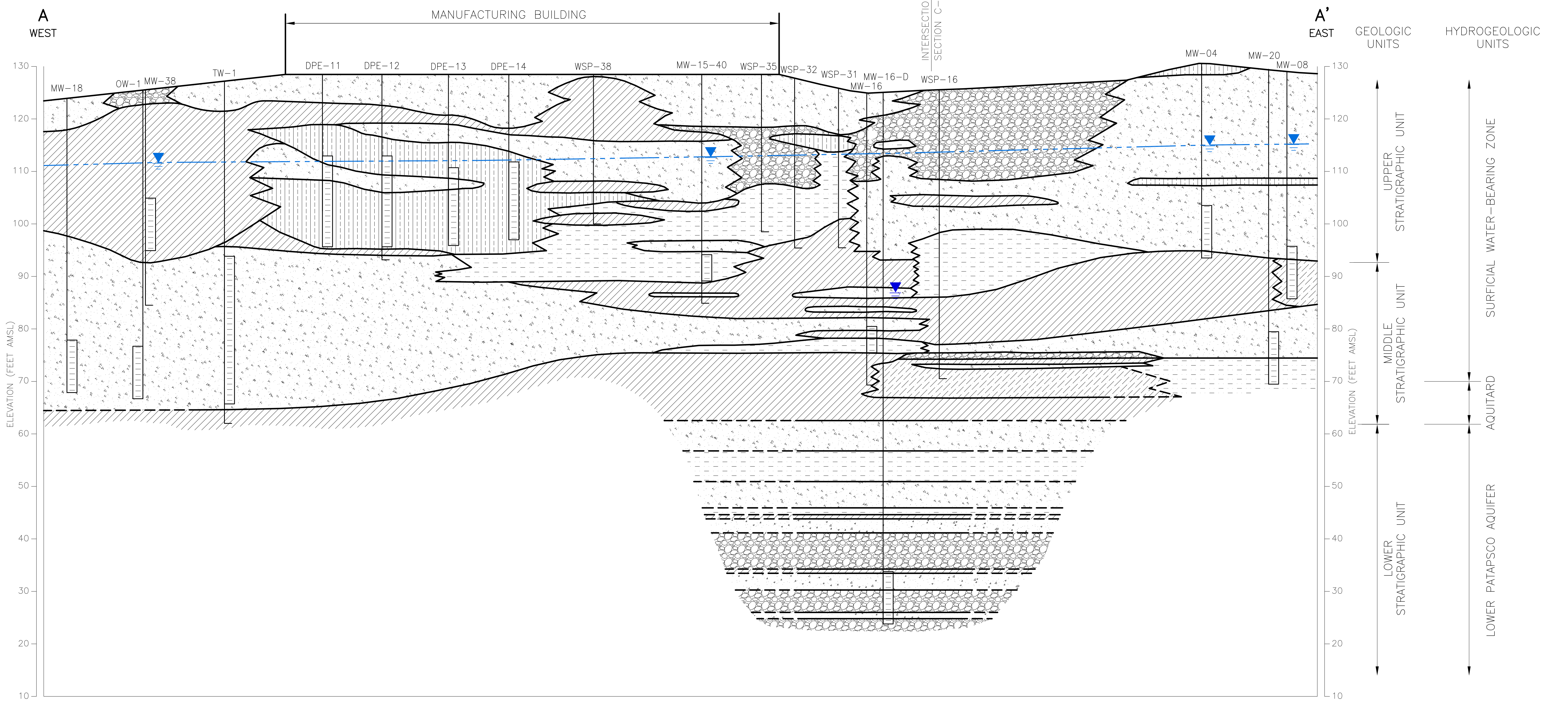
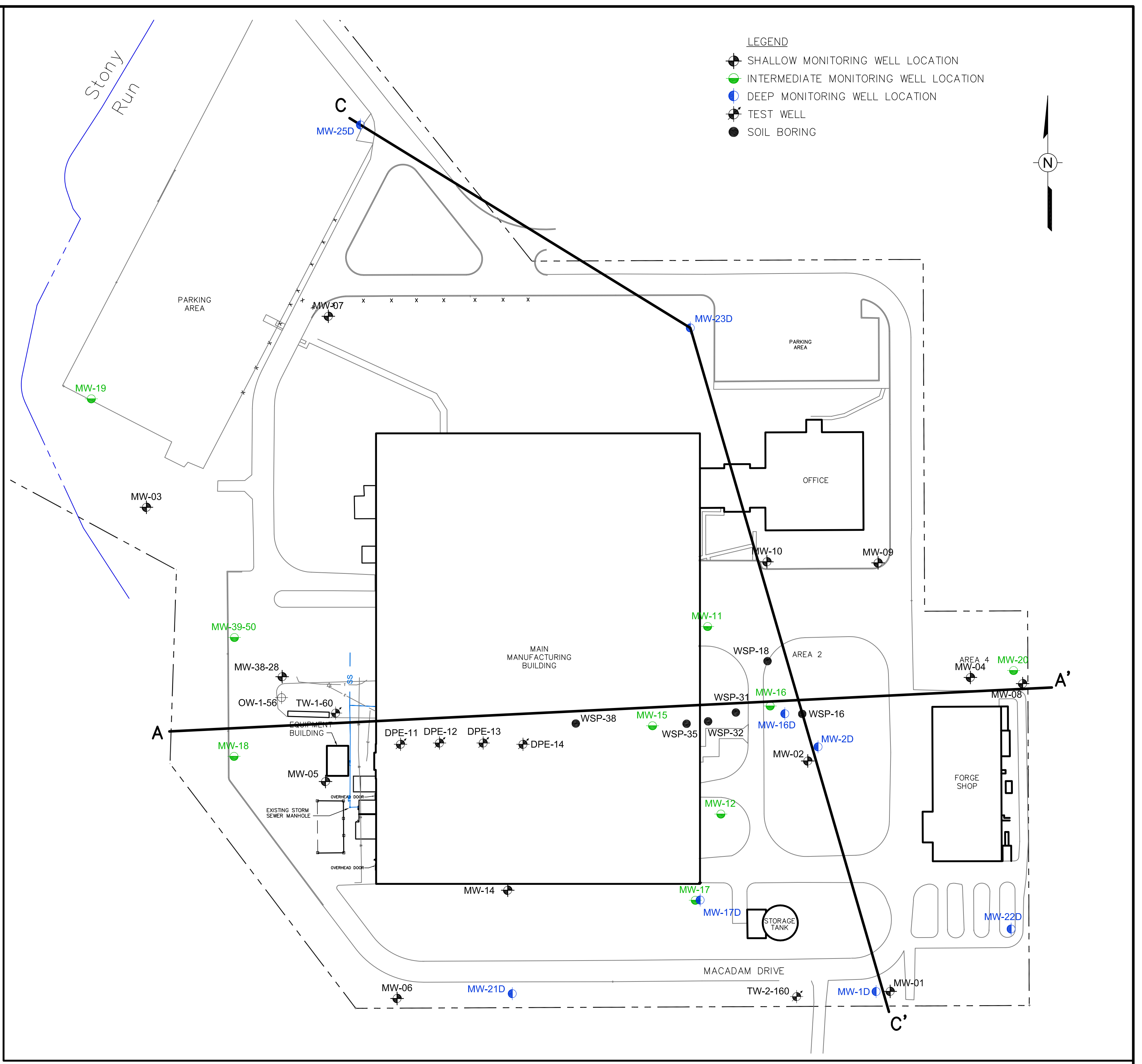
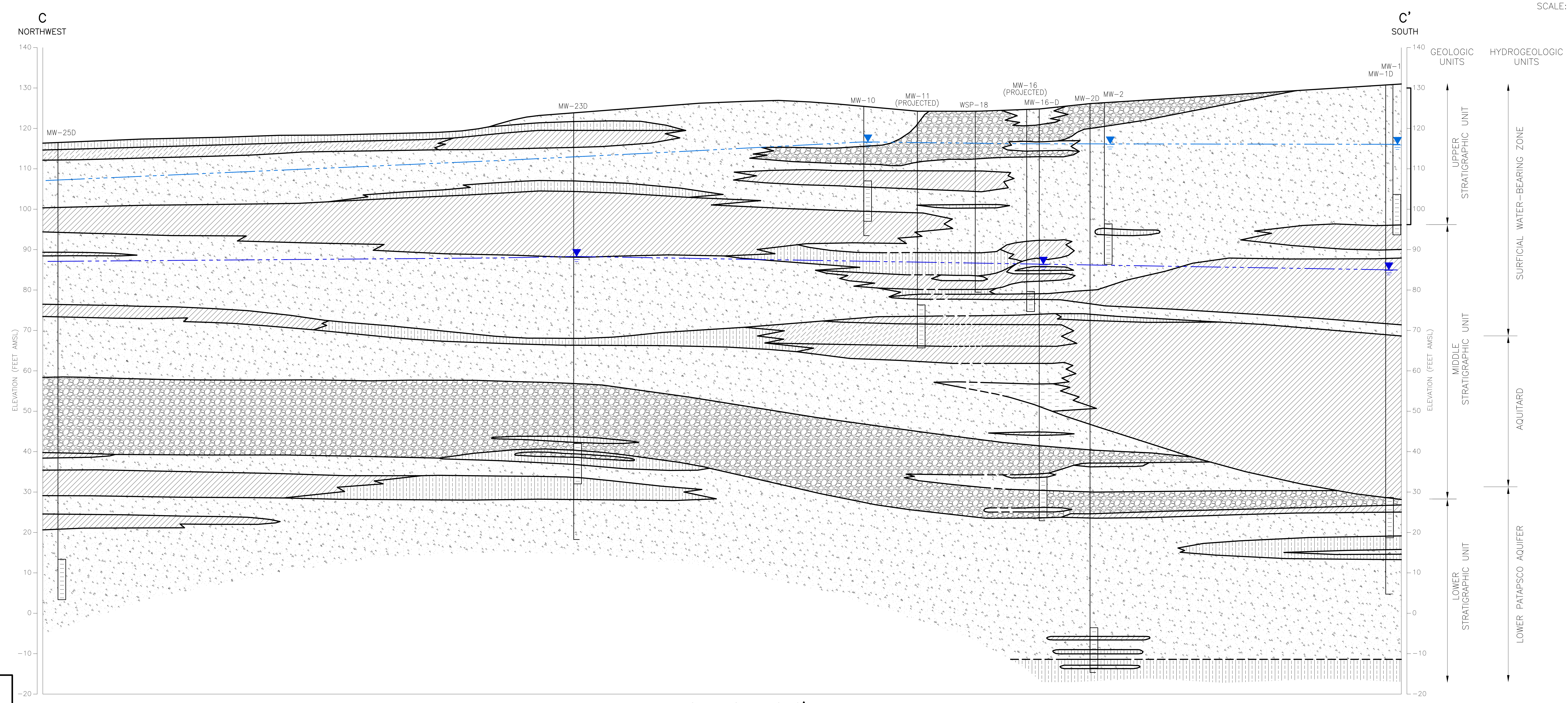


FENCE DIAGRAM A–A'



FENCE DIAGRAM LOCATIONS
SCALE: 1"=120'



FENCE DIAGRAM C–C'

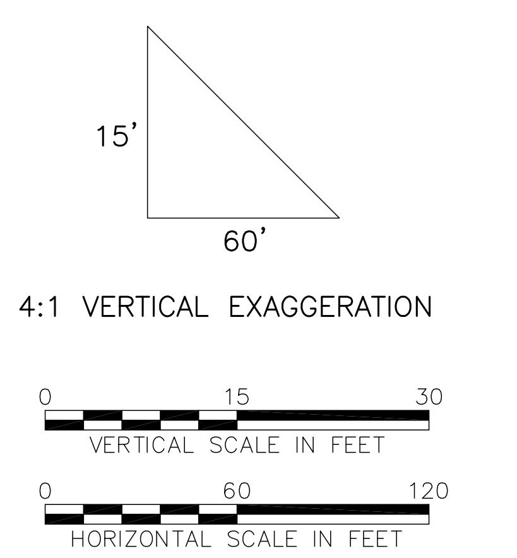
LEGEND

▨	GRAVELLY SAND
▨	SAND – SILTY SAND – CLAYEY SAND
▨	INTERLAYERED SAND AND CLAY
▨	CLAYEY TO SANDY SILT
▨	SANDY TO GRAVELLY CLAY
▨	SILTY CLAY TO CLAY

BOREHOLE
SCREEN
BOTTOM OF BOREHOLE

▼ WATER LEVEL IN SHALLOW MONITORING WELL
▼ WATER LEVEL IN DEEP MONITORING WELL
— - - — SHALLOW ZONE GROUNDWATER SURFACE ELEVATION
— - - — POTENTIOMETRIC SURFACE FOR DEEP GROUNDWATER ZONE

NOTES:
1. GROUNDWATER ELEVATIONS FOR SHALLOW AND INTERMEDIATE WELLS FROM DATA COLLECTED IN JULY 2013.
2. GROUNDWATER ELEVATIONS FOR DEEP WELLS FROM DATA COLLECTED IN SEPTEMBER 2013.



4:1 VERTICAL EXAGGERATION

VERTICAL SCALE IN FEET

HORIZONTAL SCALE IN FEET

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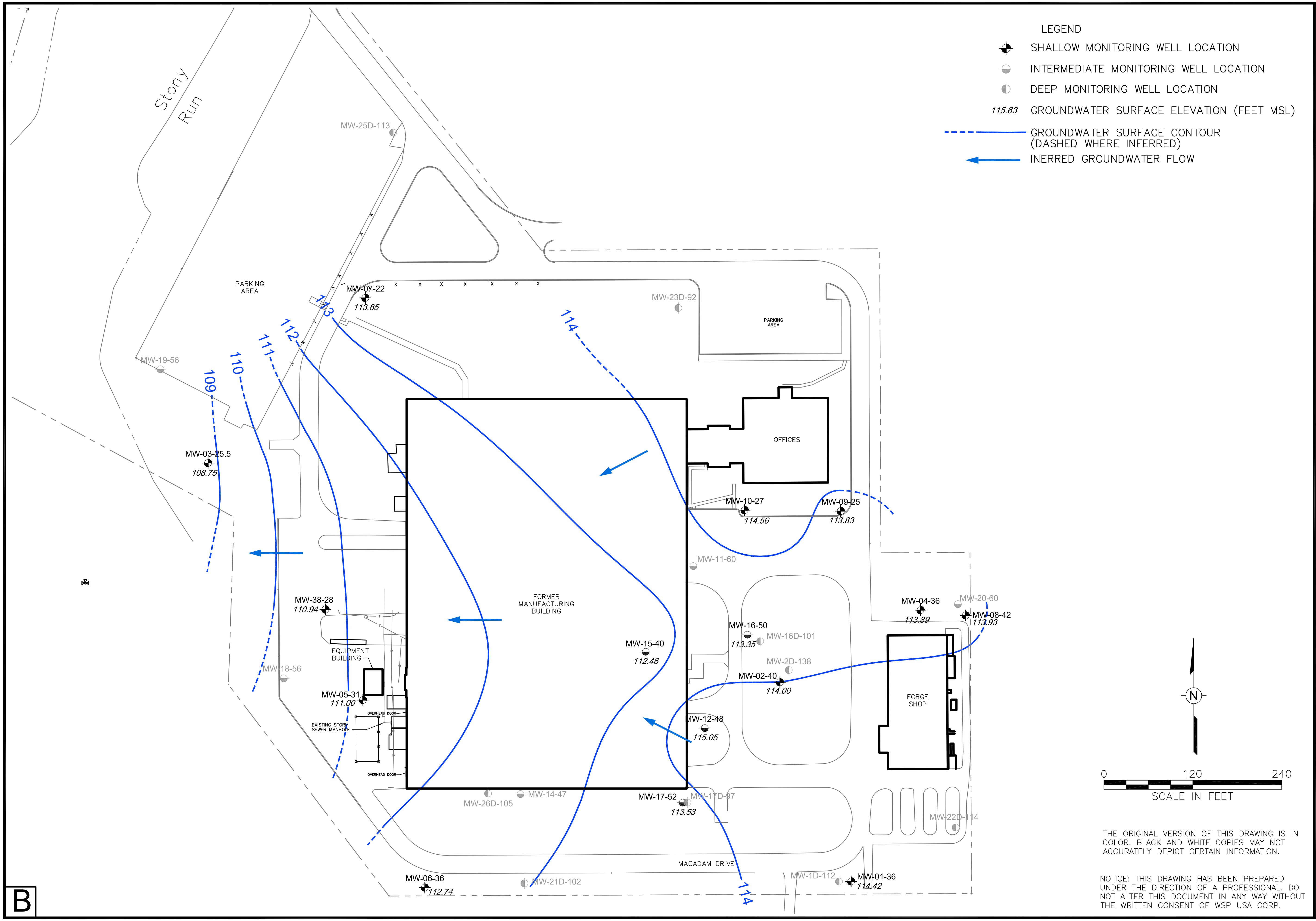

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Figure 4

GROUNDWATER SURFACE CONTOUR MAP
SURFICIAL AQUIFER
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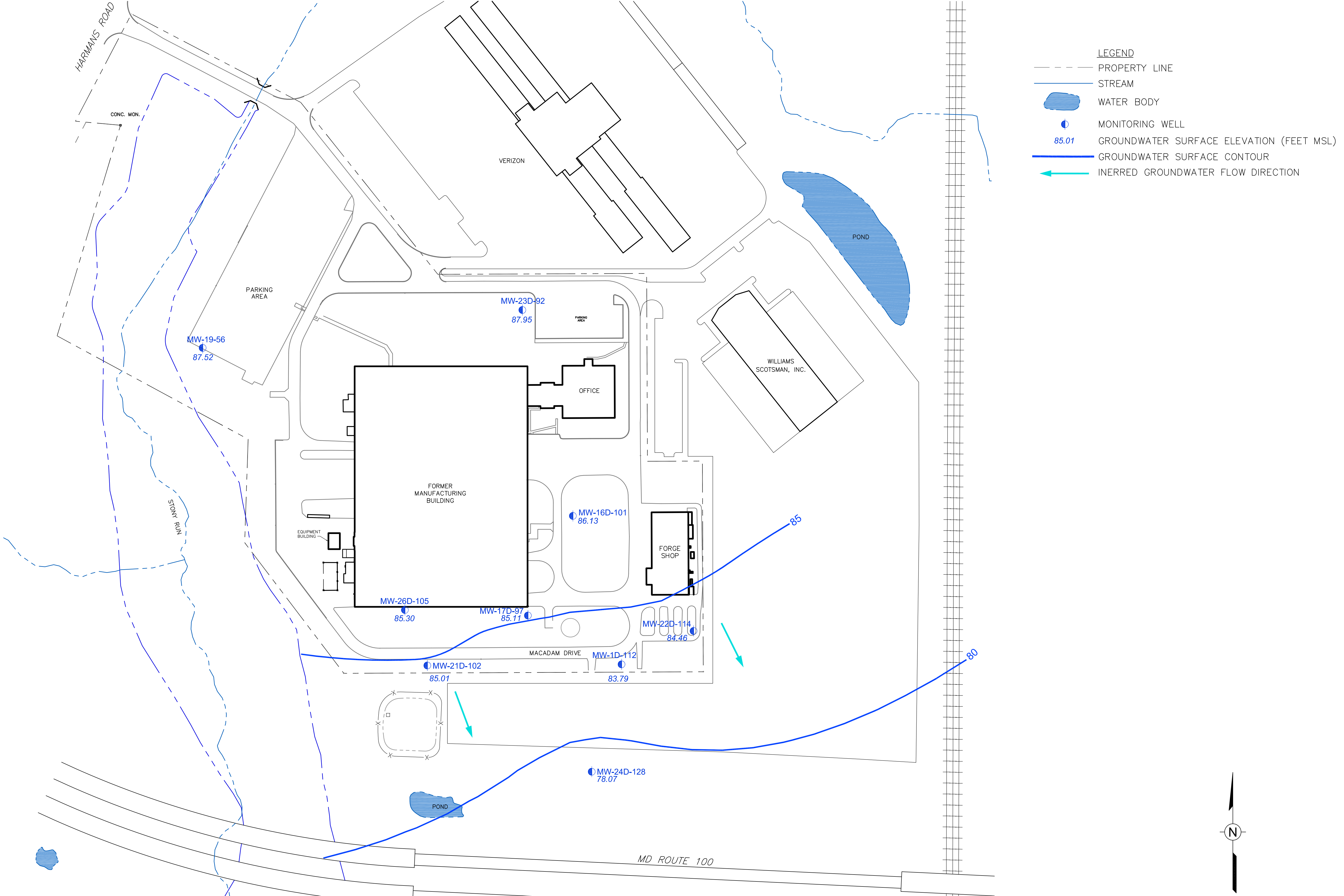

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Figure 5

POTENTIOMETRIC CONTOUR SURFACE MAP
LOWER PATAPSCO AQUIFER
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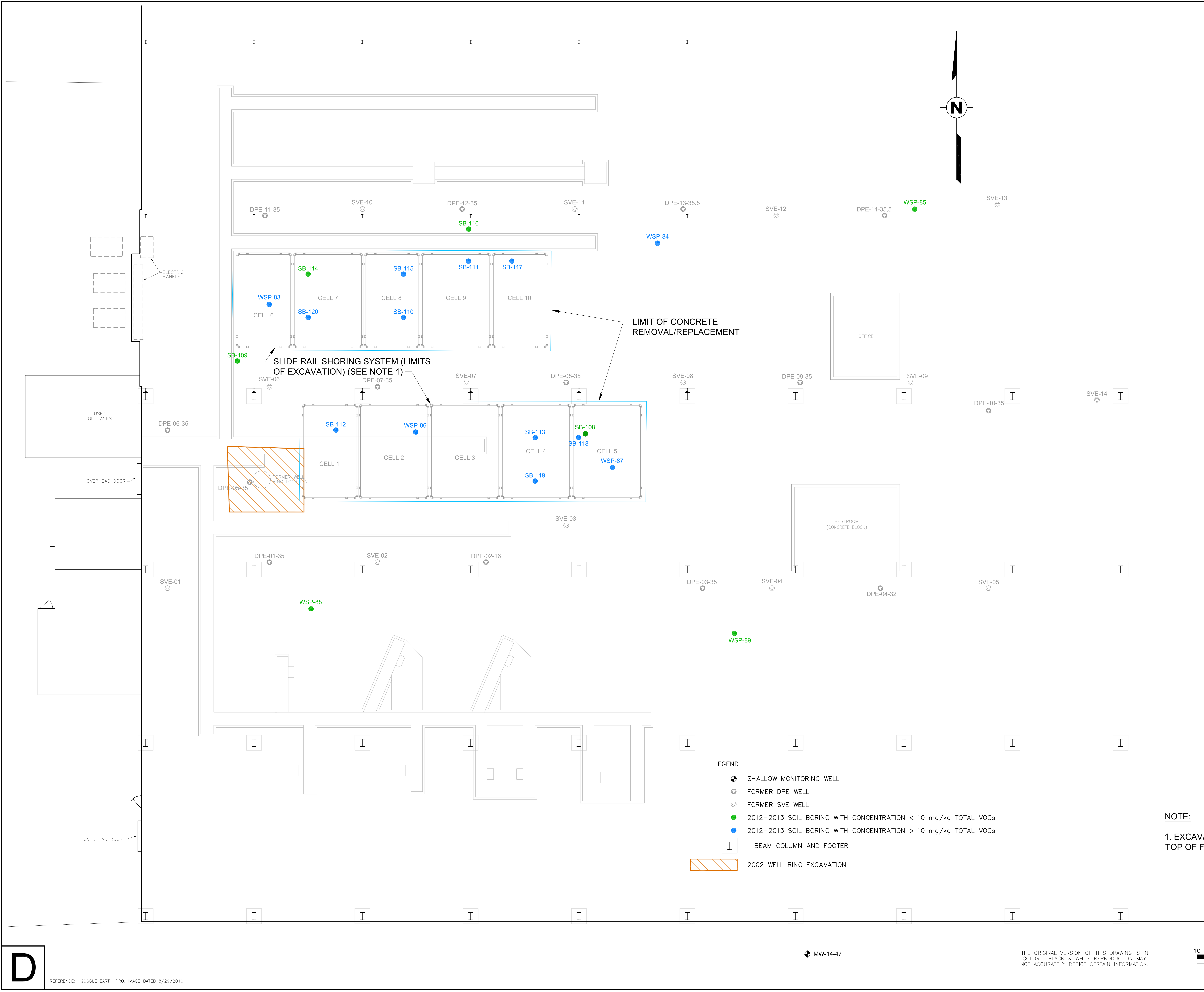

REFERENCE: GOOGLE EARTH PRO, IMAGE DATED 8/29/2010.

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SUPPLEMENTAL SOIL
SAMPLING DATA 2012 - 2013

Location	Depth (ft-bfs)	Total VOCs (mg/kg)	1,4-Dioxane (mg/kg)
WSP-83	6-8	19.4	19.3
WSP-83	10-12	114	8.92
WSP-83	19.9	3.77	3.74
WSP-84	6-8	2.94	2.82
WSP-84	10-12	11.6	<16.6
WSP-84	20.5	2.12	1.97
WSP-85	8-9	2.48	1.49
WSP-85	11-13	1.1	<0.151
WSP-85	18	2.23	1.99
WSP-86	6-8	823	823
WSP-86	10-12	4,460	43.4
WSP-86	17	8.42	7.04
WSP-87	6-8	5.1	5.1
WSP-87	10-12	13.4	13.4
WSP-87	16	2.03	2.02
WSP-88	6-8	0.397	0.397
WSP-88	10-12	0.319	0.319
WSP-88	17	1.86	0.187
WSP-89	6-8	1.87	1.87
WSP-89	10-12	2.05	2.05
WSP-89	17	2.88	2.35
SB-110	14	112	59.7
SB-111	14	10.22	5.96
SB-112	12	161	149
SB-113	11	1,289	31
SB-114	12	0.39	6.94
SB-115	14	12.34	8.1
SB-116	12	6.88	0.643
SB-117	14	69.91	49.1
SB-118	12	81.51	24.4
SB-119	14	132	90.4
SB-120	14	47	42.5

GREEN = CONCENTRATION < 10 mg/kg TOTAL VOCs
BLUE = CONCENTRATION > 10 mg/kg TOTAL VOCs
ND = NON-DETECT

NOTE:

1. EXCAVATION ADVANCED TO 15 FEET BELOW TOP OF FLOOR IN ALL SHORING CELLS.

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AOC 1 SUPPLEMENTAL SOIL BORING LOCATIONS, RESULTS, AND EXCAVATION LIMITS

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FIGURE 6

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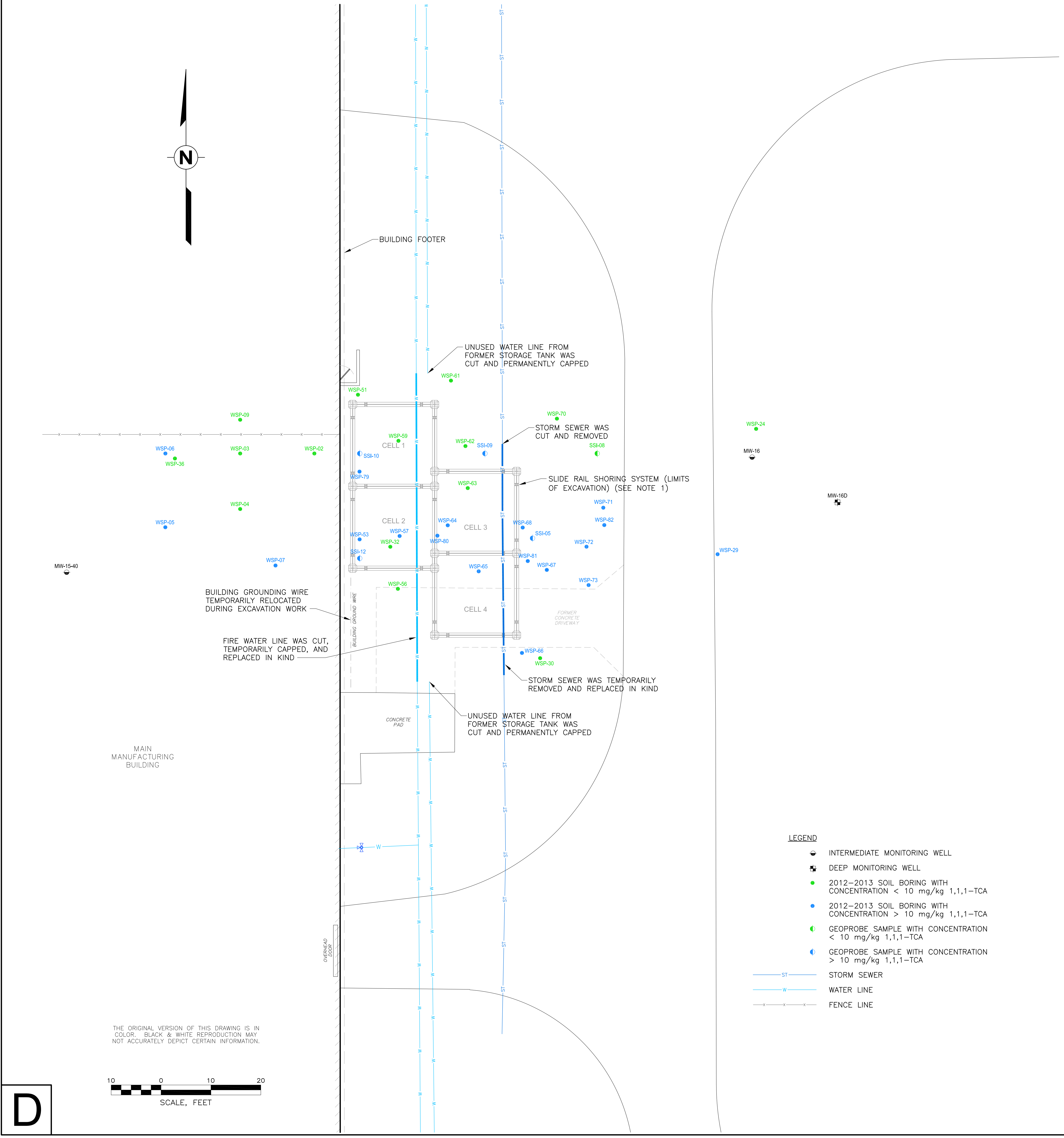

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SUPPLEMENTAL SOIL SAMPLING DATA 2012 - 2013

Location	Depth (ft-bgs)	1,1,1-TCA (mg/kg)	1,4-Dioxane (mg/kg)
WSP-79	**8.5-9**	**89.2**	ND
WSP-79	11-12.5	0.7	ND
WSP-80	**12.5-14**	**38.2**	ND
WSP-80	**16.5-18**	**21.5**	ND
WSP-81	**20-21.5**	**1,120**	ND
WSP-81	23-24.5	3.3	ND
WSP-82	**15.5-17**	**13.1**	ND
WSP-82	18.5-20	2.1	ND

GREEN = CONCENTRATION < 10 mg/kg 1,1,1-TCA
BLUE = CONCENTRATION > 10 mg/kg 1,1,1-TCA
ND = NON-DETECT

HISTORICAL SOIL SAMPLING DATA 2007 - 2008

Location	Depth (ft-bfs)	1,1,1-TCA (mg/kg)
SSI-05	**9**	**44**
SSI-08	7-8	ND
SSI-09	**8-9**	**250**
SSI-10	**9**	**3,500**
SSI-12	**13**	**29**
WSP-02	10-11	ND
WSP-03	12-13	ND
WSP-04	13-14	ND
WSP-05	**13.5-14.5**	**50**
WSP-06	**11-12**	**85**
WSP-07	**9-10**	**30**
WSP-09	7-7.5	0.03
WSP-24	31-31.5	0.43
WSP-29	**21-22**	**570**
WSP-30	19-19.5	9
WSP-32	22	7
WSP-36	15	4
WSP-51	23-24	0.08
WSP-53	**10-11**	**12**
WSP-56	21.25-23	5
WSP-57	**7-8**	**290**
WSP-59	23-24	0.04
WSP-61	21-23.5	0.02
WSP-62	15-18	0.14
WSP-63	16.5-18	0.27
WSP-64	**7-9.25**	**5,100**
WSP-65	**18.5-19**	**73**
WSP-66	**18-19**	**55**
WSP-67	**19-21.5**	**21**
WSP-68	**9.24-10**	**25**
WSP-70	13.5-15	2
WSP-71	**15-17**	**2,400**
WSP-72	**19.5-20**	**30**
WSP-73	**18-19**	**32**

LEGEND

◒	INTERMEDIATE MONITORING WELL
▚	DEEP MONITORING WELL
●	2012–2013 SOIL BORING WITH CONCENTRATION < 10 mg/kg 1,1,1–TCA
●	2012–2013 SOIL BORING WITH CONCENTRATION > 10 mg/kg 1,1,1–TCA
◐	GEOPROBE SAMPLE WITH CONCENTRATION < 10 mg/kg 1,1,1–TCA
◐	GEOPROBE SAMPLE WITH CONCENTRATION > 10 mg/kg 1,1,1–TCA
—ST—	STORM SEWER
—W—	WATER LINE
—x—	FENCE LINE

NOTE:

1. EXCAVATION DEPTHS:
   CELL 1 – 20 FEET BGS
   CELL 2 – 18 FEET BGS
   CELL 3 – 21 FEET BGS
   CELL 4 – 23 FEET BGS

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AOC 2 HISTORICAL BORING LOCATIONS, RESULTS, AND EXCAVATION LIMITS

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FIGURE 7

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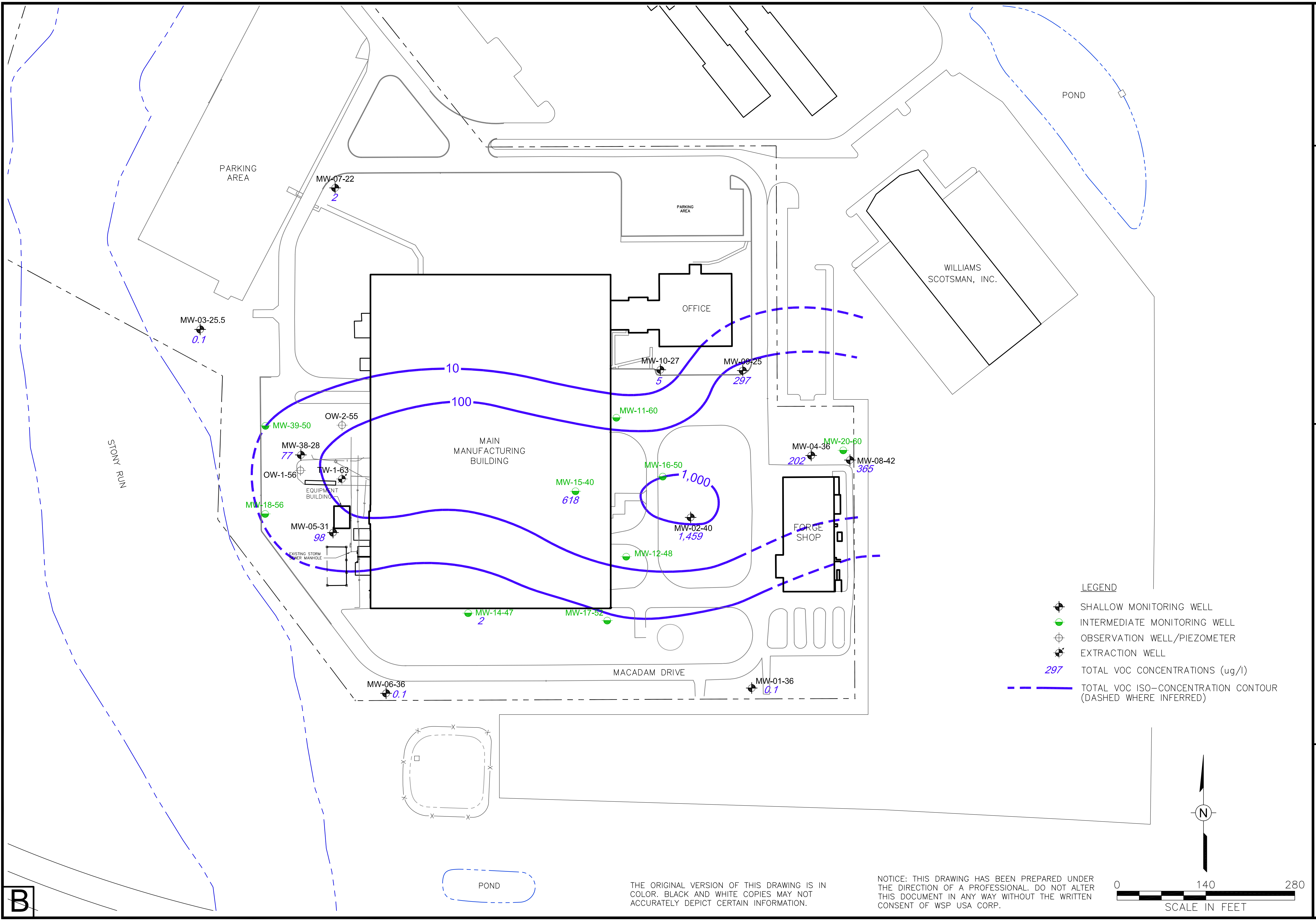

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Figure 8

CURRENT SITE LAYOUT WITH TOTAL VOC CONCENTRATIONS IN SHALLOW GROUNDWATER (DECEMBER 2014)

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LEGEND

▨ GRAVELLY SAND
▨ SAND – SILTY SAND – CLAYEY SAND
▨ INTERLAYERED SAND AND CLAY
▨ CLAYEY TO SANDY SILT
▨ SANDY TO GRAVELLY CLAY
▨ SILTY CLAY TO CLAY

BOREHOLE
SCREEN
BOTTOM OF BOREHOLE

▼ WATER LEVEL IN SHALLOW MONITORING WELL

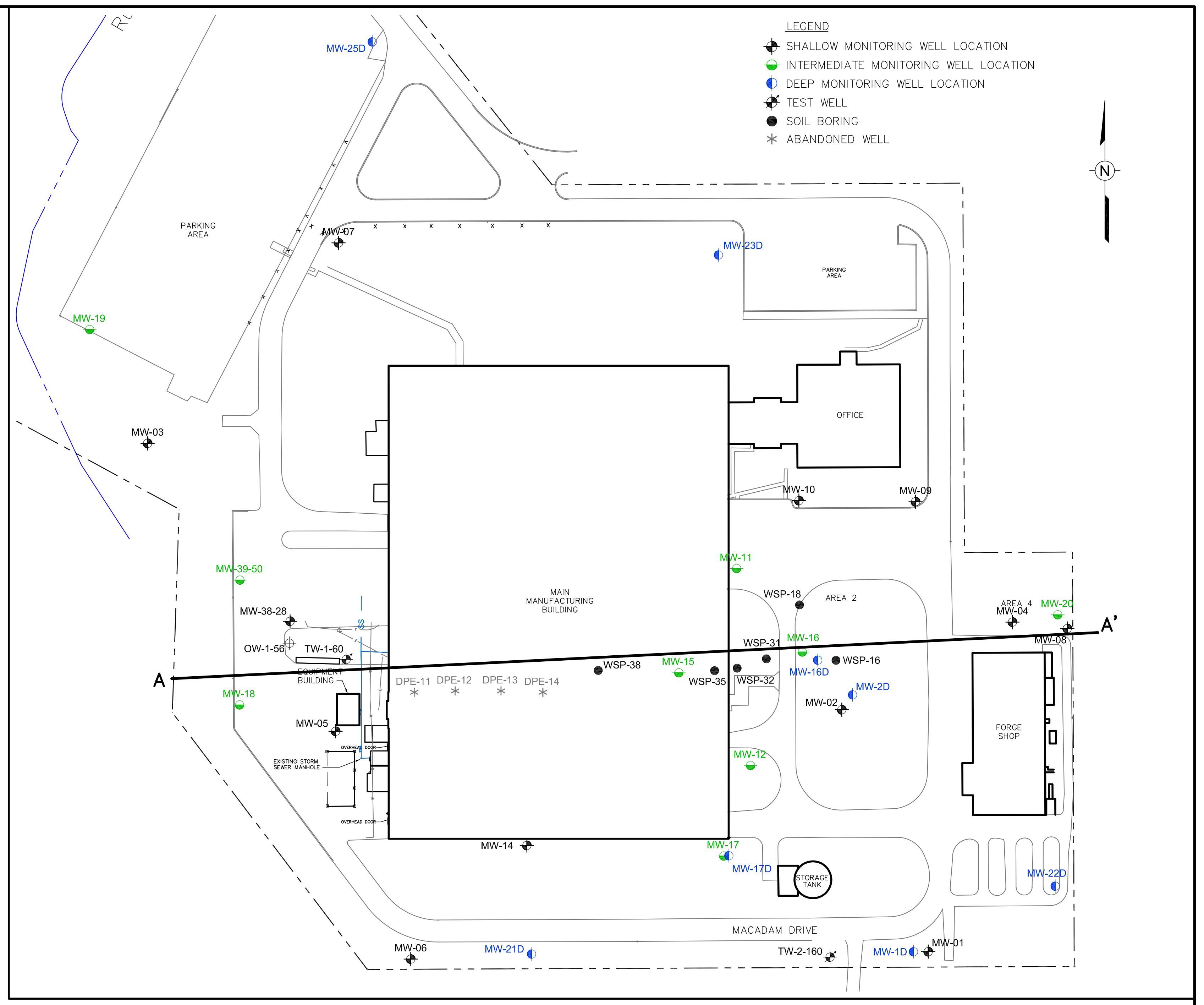
SHALLOW ZONE GROUNDWATER SURFACE ELEVATION

MW-15	Dec-14
1,1,1-TCA	20.7
1,1-DCA	71
1,1-DCE	318
1,4-Dioxane	208

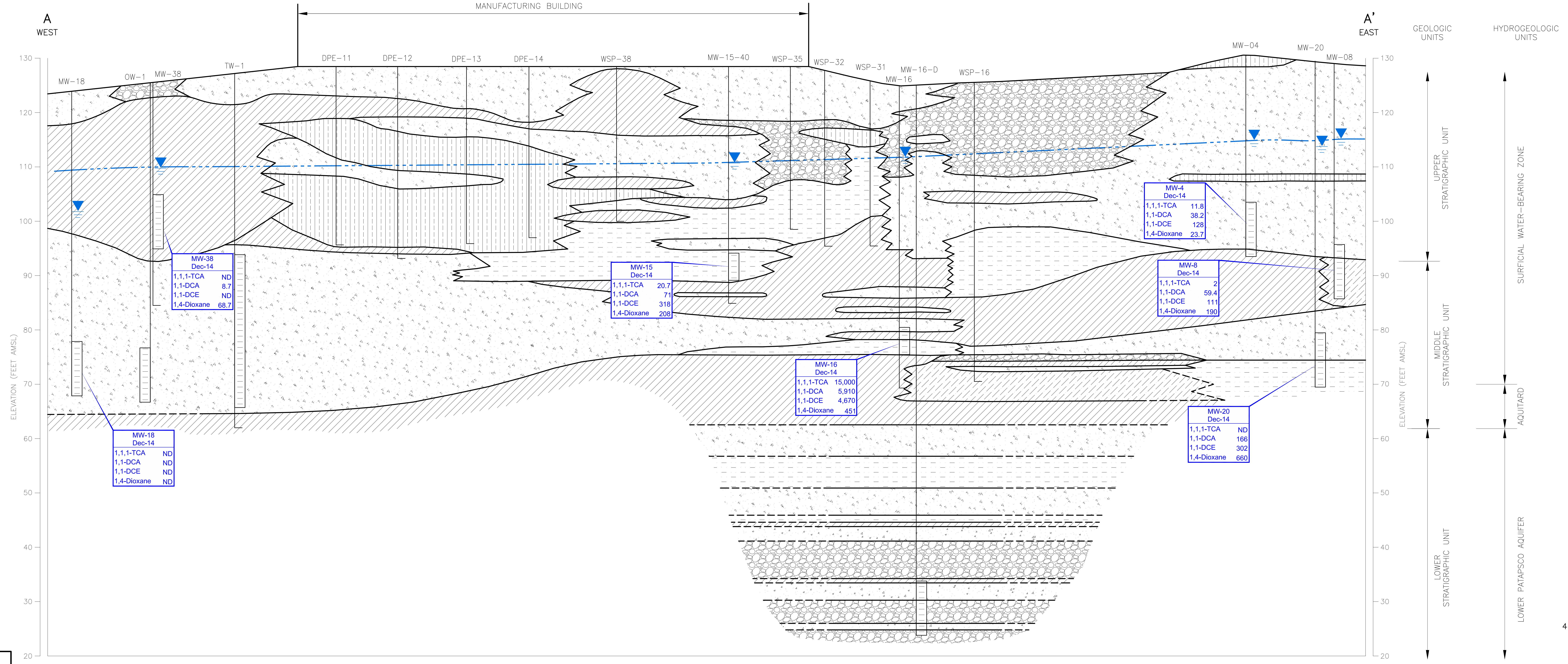
WELL ID
DATE
CONCENTRATION
CONSTITUENT

NOTE:

GROUNDWATER ELEVATIONS FOR SHALLOW AND INTERMEDIATE WELLS FROM DATA COLLECTED IN DECEMBER 2014.



FENCE DIAGRAM LOCATIONS
SCALE: 1"=120'



MW-18	Dec-14
1,1,1-TCA	ND
1,1-DCA	ND
1,1-DCE	ND
1,4-Dioxane	ND

MW-38	Dec-14
1,1,1-TCA	ND
1,1-DCA	8.7
1,1-DCE	ND
1,4-Dioxane	68.7

MW-15	Dec-14
1,1,1-TCA	20.7
1,1-DCA	71
1,1-DCE	318
1,4-Dioxane	208

MW-16	Dec-14
1,1,1-TCA	15,000
1,1-DCA	5,910
1,1-DCE	4,670
1,4-Dioxane	451

MW-4	Dec-14
1,1,1-TCA	11.8
1,1-DCA	38.2
1,1-DCE	128
1,4-Dioxane	23.7

MW-8	Dec-14
1,1,1-TCA	2
1,1-DCA	59.4
1,1-DCE	111
1,4-Dioxane	190

MW-20	Dec-14
1,1,1-TCA	ND
1,1-DCA	166
1,1-DCE	302
1,4-Dioxane	660

10
40
4:1 VERTICAL EXAGGERATION

0 10 20
VERTICAL SCALE IN FEET

0 40 80
HORIZONTAL SCALE IN FEET

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REVISIONS

REV	DESCRIPTION		
1	Revised:	Chkd:	Appr.:
2	Revised:	Chkd:	Appr.:
3	Revised:	Chkd:	Appr.:

SEAL

DATE

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HYDROGEOLOGIC FENCE DIAGRAM WITH SITE-RELATED VOC CONCENTRATIONS

KOPFLEX FACILITY, INC.
HANOVER, MARYLAND
PREPARED FOR
EMERSON

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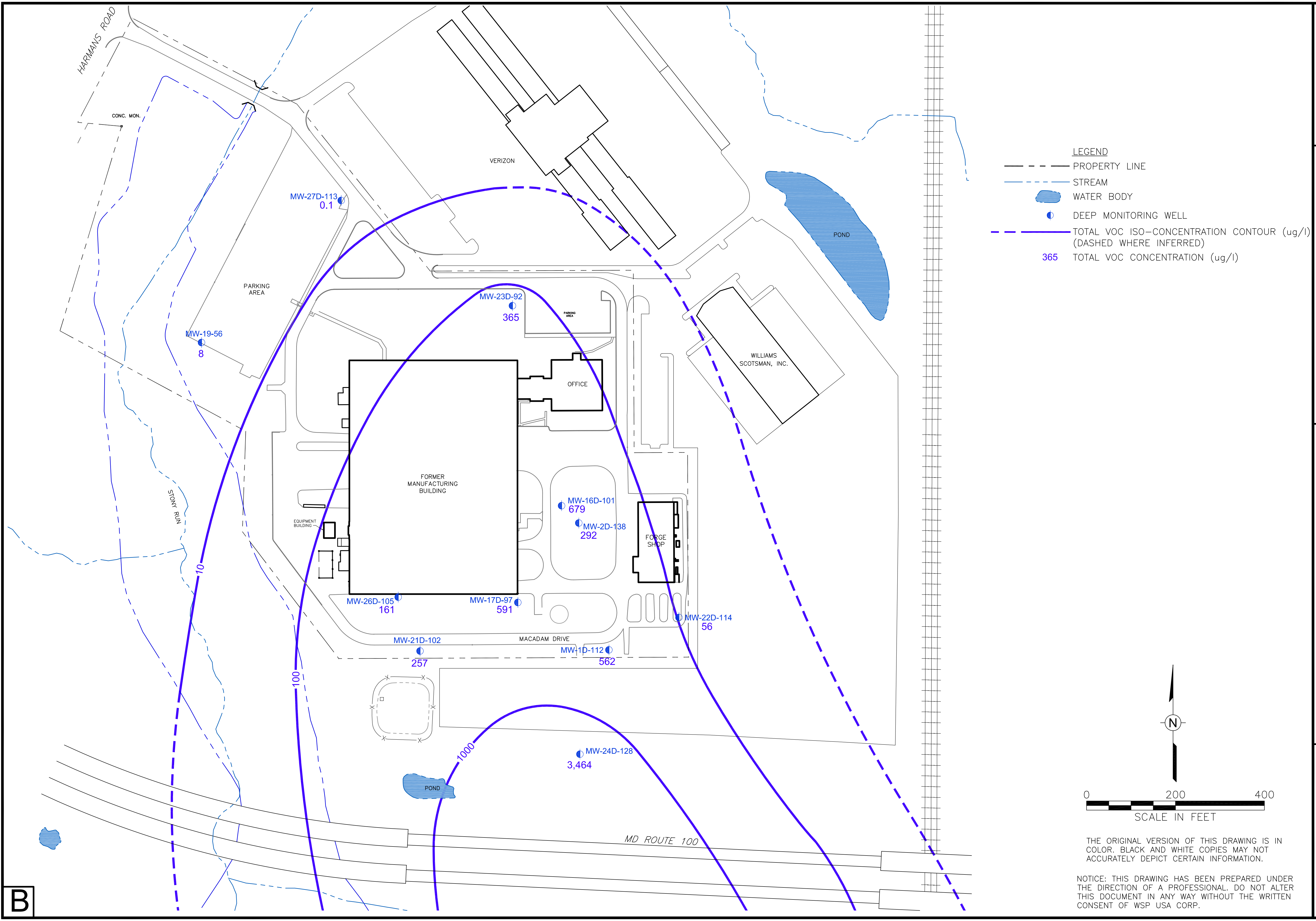
FIGURE 9

Drawing Number
00003705–208



LEGEND

— - —	PROPERTY LINE
- - -	STREAM
▨	WATER BODY
◐	DEEP MONITORING WELL
— —	TOTAL VOC ISO-CONCENTRATION CONTOUR (ug/l) (DASHED WHERE INFERRED)
365	TOTAL VOC CONCENTRATION (ug/l)

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Figure 10

CURRENT SITE LAYOUT WITH TOTAL VOC CONCENTRATIONS IN THE SEMI-CONFINED PORTION OF THE LOWER PATAPSCO AQUIFER (DECEMBER 2014)

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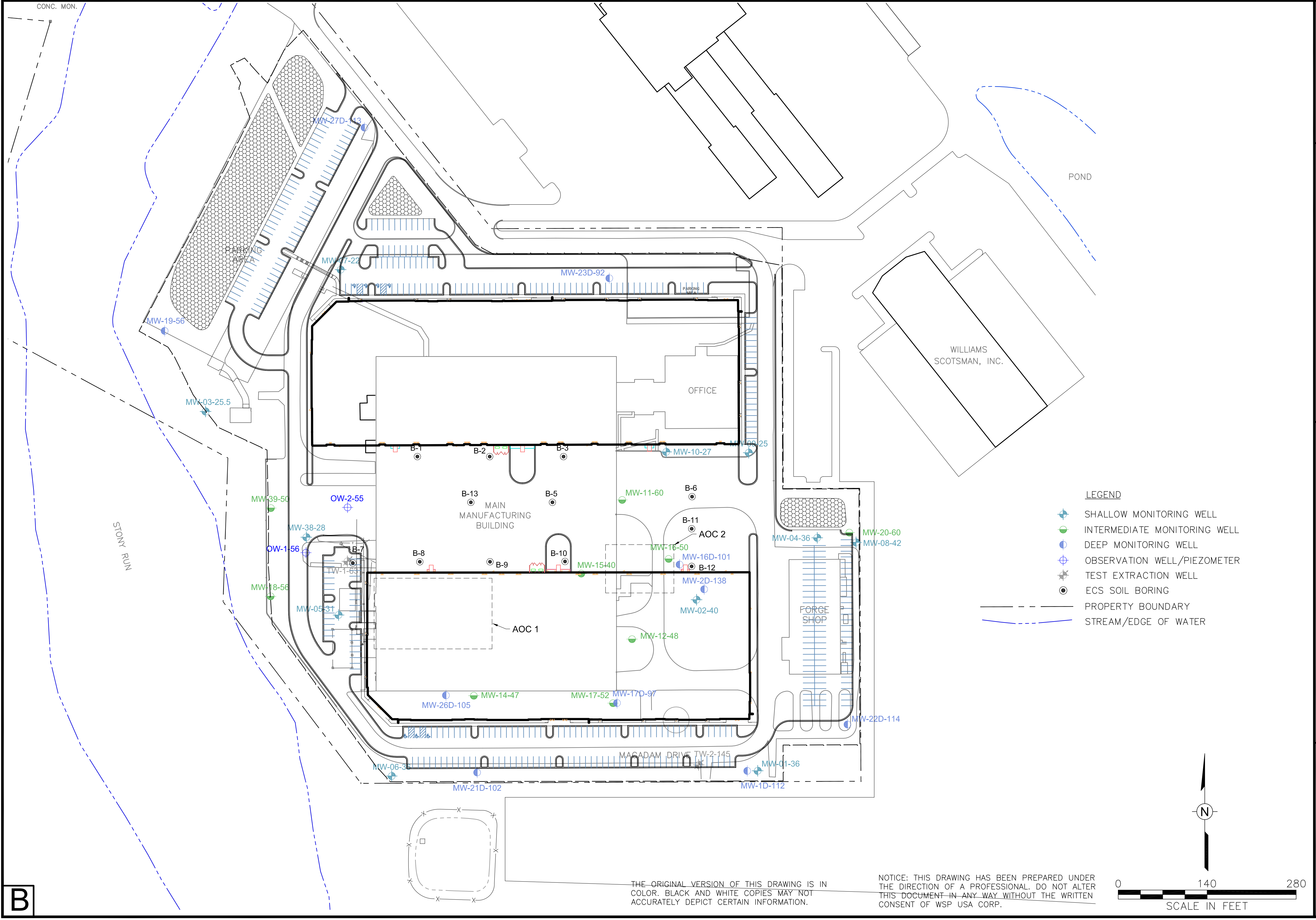

LEGEND

- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- OBSERVATION WELL/PIEZOMETER
- TEST EXTRACTION WELL
- ECS SOIL BORING
- PROPERTY BOUNDARY
- STREAM/EDGE OF WATER

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Figure 11

ECS SOIL BORING LOCATIONS IN THE FUTURE LOADING DOCK AREA (SEPTEMBER 2014)

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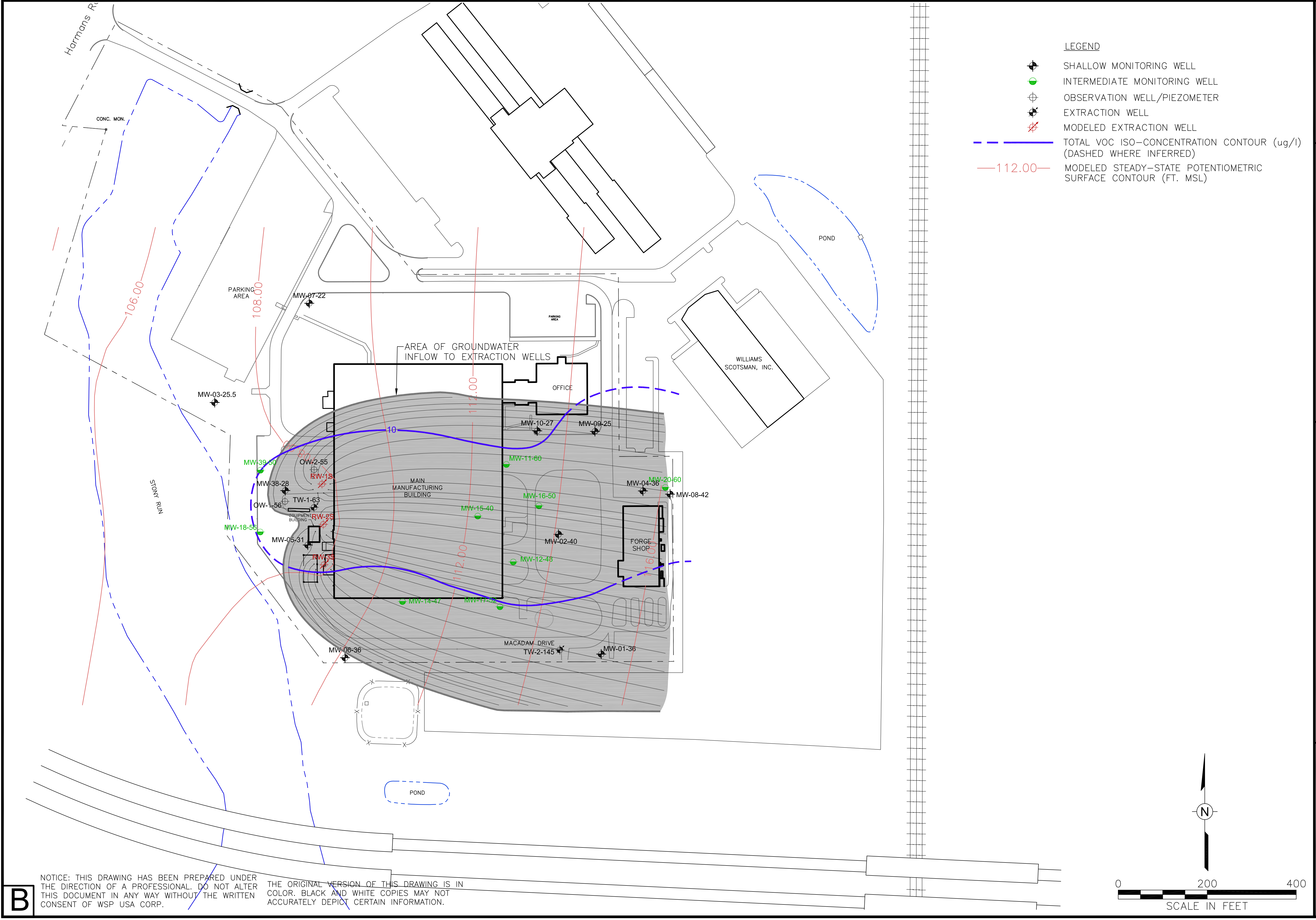

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Figure 12

CURRENT SITE LAYOUT WITH SIMULATED CAPTURE AREA FOR THE UNCONFINED SURFICIAL WATER-BEARING ZONE (INDIVIDUAL WELL DISCHARGE=3 GPM)

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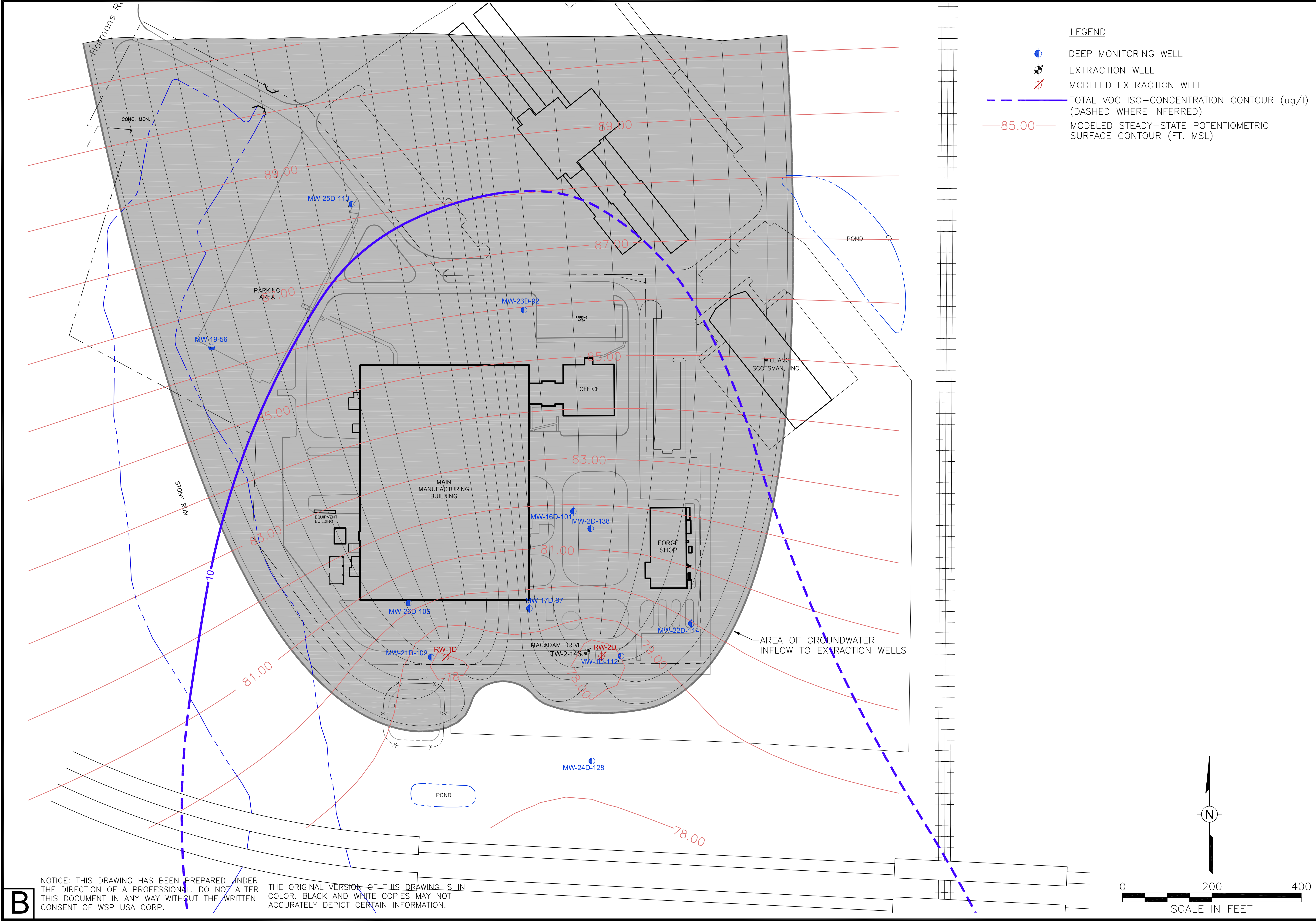

AREA OF GROUNDWATER INFLOW TO EXTRACTION WELLS

LEGEND

◐	DEEP MONITORING WELL
⊕	EXTRACTION WELL
⊕	MODELED EXTRACTION WELL
— — —	TOTAL VOC ISO-CONCENTRATION CONTOUR (ug/l) (DASHED WHERE INFERRED)
—85.00—	MODELED STEADY-STATE POTENTIOMETRIC SURFACE CONTOUR (FT. MSL)

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HANOVER, MARYLAND
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Figure 13

CURRENT SITE LAYOUT WITH SIMULATED CAPTURE AREA FOR THE SEMI-CONFINED PORTION OF THE LOWER PATAPSCO AQUIFER (INDIVIDUAL WELL DISCHARGE=35 GPM)

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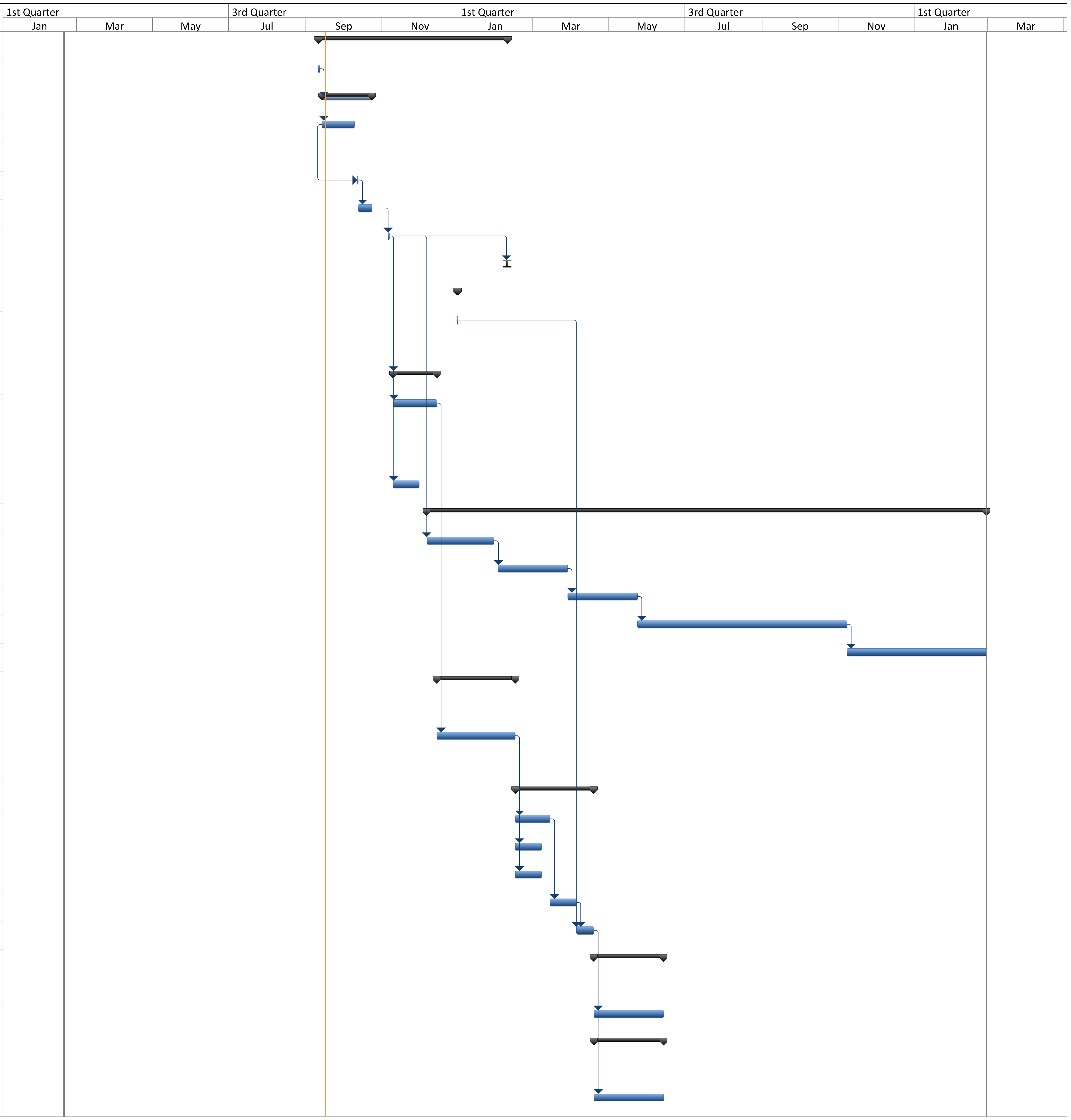
Figure 14a
Preliminary Project Implementation Schedule
Former Kop-Flex Property
Hanover, Maryland

ID	Task Name	Duration	Start	Finish
1	**1. Response Work Plan (RAP)**	**108 days**	**Fri 9/11/15**	**Tue 2/9/16**
2	Submit Plan to MDE	1 day	Fri 9/11/15	Fri 9/11/15
3	**MDE Plan Review (30 Calendar Days)**	**30 days**	**Mon 9/14/15**	**Fri 10/23/15**
4	Public Notification and Comments	20 days	Mon 9/14/15	Fri 10/9/15
5	Public Meeting	1 day	Wed 10/14/15	Wed 10/14/15
6	MDE Plan Formal Review and Comments Letter	1 day	Mon 10/12/15	Mon 10/12/15
7	Response to MDE Comments and Revisions to RAP	9 days	Tue 10/13/15	Fri 10/23/15
8	MDE Approval	1 day	Fri 11/6/15	Fri 11/6/15
9	Update Existing Performance Bond for One Year O&M Costs	1 day	Tue 2/9/16	Tue 2/9/16
10	**2. Water Discharge and Withdrawal Permits**	**1 day**	**Thu 12/31/15**	**Thu 12/31/15**
11	MDE Issuance of NPDES Permit Renewal Application and Water Appropriation and Use Permit Application	1 day	Thu 12/31/15	Thu 12/31/15
12	**3. Groundwater Response Action Design**	**25 days**	**Tue 11/10/15**	**Mon 12/14/15**
13	Electrical Design, Process and Instrumentation Controls Design, Equipment Selection, and Equipment Building Selection	25 days	Tue 11/10/15	Mon 12/14/15
14	Prepare and Submit Health & Safety Plan to MDE	15 days	Tue 11/10/15	Mon 11/30/15
15	**4. Property Redevelopment**	**321 days**	**Mon 12/7/15**	**Mon 2/27/17**
16	Building Demolition	40 days	Mon 12/7/15	Fri 1/29/16
17	Earthwork	40 days	Tue 2/2/16	Mon 3/28/16
18	Vapor Mitigtation System	40 days	Tue 3/29/16	Mon 5/23/16
19	Building Construction	120 days	Tue 5/24/16	Mon 11/7/16
20	Soil Construction Completion Report	80 days	Tue 11/8/16	Mon 2/27/17
21	**5. Groundwater Response Action Bid Solicitation & Contractor Procurement**	**45 days**	**Tue 12/15/15**	**Mon 2/15/16**
22	Earthwork, Well Installation, Electical, Control Panel, Equipment, and Equipment Building	45 days	Tue 12/15/15	Mon 2/15/16
23	**6. Groundwater Response Action Installation & Startup**	**45 days**	**Tue 2/16/16**	**Mon 4/18/16**
24	Equipment and Equipment Building Fabrication	20 days	Tue 2/16/16	Mon 3/14/16
25	Well Installation	15 days	Tue 2/16/16	Mon 3/7/16
26	Earthwork	15 days	Tue 2/16/16	Mon 3/7/16
27	Equipment Delivery and Installation	15 days	Tue 3/15/16	Mon 4/4/16
28	Startup	10 days	Tue 4/5/16	Mon 4/18/16
29	**7. Groundwater Response Action Construction Completion & Implementation Report**	**40 days**	**Tue 4/19/16**	**Mon 6/13/16**
30	Submit Report to MDE	40 days	Tue 4/19/16	Mon 6/13/16
31	**8. Groundwater Response Action Operations & Maintenance Plan**	**40 days**	**Tue 4/19/16**	**Mon 6/13/16**
32	Submit Report to MDE	40 days	Tue 4/19/16	Mon 6/13/16



Note: Schedule is subject to change depending on MDE input and approval. Property redevelopment schedule is subject to change based on developer's schedule.

WSP USA Corp.
Kopflex Schedule

Figure 14b
Preliminary Project Groundwater Treatment System Schedule for Routine Monitoring Activities - Annual Activities
Former Kop-Flex Property
Hanover, Maryland

Task Name	Year 1 of Response Action Operations												Years 2 and Beyond of Response Action Operations											
	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			1st Quarter			2nd Quarter			3rd Quarter			4th Quarter		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Groundwater Treatment System Sampling (Influent and Effluent)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Quarterly Submittal of Discharge Monitoring Report to MDE	●			●			●			●			●			●			●			●		
Operation, Maintenance and Monitoring (OM&M) Report Submittal to MDE (Quarterly First Year of Operation)	●			●			●			●														
OM&M Report Submittal to MDE (Annually after First Year of Operation)														●										
Water Appropriation & Use Permit Groundwater Use Semi-Annual Reporting Form Submittal to MDE	●						●						●						●					

Note: Schedule is subject to change depending on MDE input and approval. As noted above, the OM&M Report submittals to MDE are quarterly the first year of operation, then annually thereafter.

Tables

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well		Acetone	Benzene	Bromoform	2-Butanone (MEK)	Chloroethane	Chloroform	Chloromethane	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,1-Dichloroethane	1,2-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethene	cis-1,2-Dichloroethene	1,4- Dioxane	Ethylbenzene	Isopropylbenzene	p-Isopropyltoluene
MW-01-36																			
	May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
	Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
	May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
	Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	NA	ND	ND	NA
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	NA	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	NA	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	11.6	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
MW-01D-112																			
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	63	ND	310	NR	ND	430	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	77	6.4	380	NR	ND	422	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	70.9	6.2	389	NR	ND	439.0	ND	NA	ND
	Dec-13 (g)	ND	ND	ND	ND	ND	ND	ND	ND	ND	45.2	4.40	288	NR	ND	290.0 (l)	ND	NA	ND
	Jun-14 (g)	ND	ND	ND	ND	ND	ND	ND	ND	ND	45.7	4.70	320	NR	ND	326.0 (c)	ND	NA	ND
	Dec-14 (n)	ND	ND	ND	ND	ND	ND	ND	ND	ND	34.0	4.00	209	NR	ND	279.0 (c)	ND	NA	ND
MW-02-40																			
	May-09	ND	ND	ND	ND	120	ND	ND	ND	ND	1,200	9	600	7	NR	NA	ND	ND	NA
	Oct-09	ND	ND	ND	17	240	ND	ND	ND	ND	2,900	12	1,200	12	NR	NA	ND	ND	NA
	May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	3,200	16	1,800	15	NR	NA	ND	ND	NA
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	3,400	15	2,000	13	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	280	ND	ND	ND	ND	3,300	ND	2,200	ND	NR	NA	ND	ND	NA
	Nov-11	ND	ND	ND	22	130	1	ND	ND	ND	1,600	15	1,800	NR	9	1140	ND	ND	NA
	Jun-12 (d)	ND	ND	ND	ND	ND	ND	ND	ND	ND	1,900	ND	1,900	NR	ND	983	ND	ND	NA
	Dec-12	ND	ND	ND	ND	62	ND	ND	ND	ND	880	10	820	NR	5.8	747	ND	ND	NA
	Jul-13	ND	ND	ND	7	47.6	ND	ND	ND	ND	755	10.3	890	NR	5.6	933.0	ND	NA	ND
	Dec-13 (h)	ND	ND	ND	ND	29	ND	ND	ND	ND	486.0	5.60	457	NR	ND	671.0 (i)	ND	NA	ND
	Jun-14 (h)	ND	ND	ND	ND	28.7	ND	ND	ND	ND	643.0	8.50	678	NR	ND	629.0 (c)	ND	NA	ND
	Dec-14 (h)	ND	ND	ND	ND	29	ND	ND	ND	ND	567	7	528	NR	ND	301 (c)	ND	NA	ND
MW-02D-138																			
	Jul-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	16	2	120	ND	NR	NA	ND	ND	NA
	Nov-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	17	2	130	NR	ND	116	ND	ND	NA
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	16	ND	130	NR	ND	118	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	17	2.0	130	NR	ND	101	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	18.5	2.1	170	NR	ND	130.0	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	13.0	1.50	118	NR	ND	109.0 (h)	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	19.7	1.80	166	NR	ND	121.0 (n)	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	19.7	1.80	147	NR	ND	103.0 (n)	ND	NA	ND

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well		Acetone	Benzene	Bromoform	2-Butanone (MEK)	Chloroethane	Chloroform	Chloromethane	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,1-Dichloroethane	1,2-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethene	cis-1,2-Dichloroethene	1,4- Dioxane	Ethylbenzene	Isopropylbenzene	p-Isopropyltoluene
MW-03-25.5																			
	May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
	Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
	May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
	Nov-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	ND	NA
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
MW-04-36																			
	May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	130	ND	350	ND	NR	NA	ND	ND	NA
	Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	150	ND	410	3	NR	NA	ND	ND	NA
	May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	290	8	1,100	ND	NR	NA	ND	ND	NA
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	130	3	360	ND	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	81	2	200	ND	NR	NA	ND	ND	NA
	Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	87	2	250	NR	ND	212	ND	ND	NA
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	68	ND	180	NR	ND	158	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	100	2	210	NR	ND	188	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	108	2.3	233	NR	ND	232.0	ND	ND	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	67.0	1.40	188	NR	ND	178.0 (h)	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	1.3	ND	ND	ND	198.0 (c)	7.20	908 (c)	NR	ND	456.0 (h)	ND	NA	ND
	Dec-14 (g)	ND	ND	ND	ND	ND	ND	ND	ND	ND	38.2	ND	128	NR	ND	23.7	ND	NA	ND
MW-05-31																			
	May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	9	ND	4	ND	NR	NA	ND	ND	NA
	Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	11	ND	5	ND	NR	NA	ND	ND	NA
	May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	12	ND	7	ND	NR	NA	ND	ND	NA
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	8	ND	4	ND	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	7	ND	3	ND	NR	NA	ND	ND	NA
	Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.1	ND	ND	NR	ND	246	ND	ND	NA
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	7	ND	ND	NR	ND	211	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.4	ND	ND	NR	ND	245	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.3	ND	2.2	NR	ND	205.0	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.9	ND	1.5	NR	ND	137.0 (h)	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.0	ND	1.9	NR	ND	92.3	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.8	ND	1.7	NR	ND	91.2	ND	NA	ND

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well	Acetone	Benzene	Bromoform	2-Butanone (MEK)	Chloroethane	Chloroform	Chloromethane	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,1-Dichloroethane	1,2-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethene	cis-1,2-Dichloroethene	1,4- Dioxane	Ethylbenzene	Isopropylbenzene	p-Isopropyltoluene
MW-06-36																		
May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	ND	NA
Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	ND	NA
Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	ND	NA
Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
MW-07-22																		
May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	ND	NA
Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	ND	NA
Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	ND	NA
Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	2.4	ND	NA	ND
Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	2.2	ND	NA	ND
MW-08-42																		
May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	210	5	250	1	NR	NA	ND	ND	NA
Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	260	5	310	1	NR	NA	ND	ND	NA
May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	249	5	240	1	NR	NA	ND	ND	NA
Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	170	3	200	ND	NR	NA	ND	ND	NA
Jun-11	ND	ND	ND	ND	ND	3	ND	ND	ND	300	6	350	1	NR	NA	ND	ND	NA
Dec-11	ND	ND	ND	ND	ND	2	ND	ND	ND	140	3	190	NR	ND	361	ND	ND	NA
Jun-12 (g)	ND	ND	ND	ND	ND	ND	ND	ND	ND	140	ND	150	NR	ND	445	ND	ND	NA
Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	180	4.1	210	NR	ND	418	ND	ND	NA
Jul-13	ND	ND	ND	ND	ND	1.1	ND	ND	ND	164	4.4	208	NR	1.2	456.0	ND	ND	ND
Dec-13	ND	ND	ND	ND	ND	1.2	ND	ND	ND	78.2	2.00	129	NR	ND	254.0 (h)	ND	NA	ND
Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	89.9	1.90	142	NR	ND	219.0 (h)	ND	NA	ND
Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	59.4	1.60	111	NR	ND	190.0	ND	NA	ND
MW-09-25																		
May-09	ND	ND	ND	ND	ND	1	ND	ND	ND	17	2	250	ND	NR	NA	ND	ND	NA
Oct-09	ND	ND	ND	ND	ND	1	ND	ND	ND	18	ND	300	ND	NR	NA	ND	ND	NA
May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	16	2	240	ND	NR	NA	ND	ND	NA
Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	16	2	290	ND	NR	NA	ND	ND	NA
Nov-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	14	1	220	NR	ND	86	ND	ND	NA
Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	8	ND	160	NR	ND	71.3	ND	ND	NA
Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	12	1.2	150	NR	ND	69.2	ND	ND	NA
Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.9	1.2	170	NR	ND	69.5	ND	NA	ND
Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.5	1.30	181	NR	ND	97.7 (h)	ND	NA	ND
Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.5	1.20	193	NR	ND	53.9 (h)	ND	NA	ND
Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	11.1	1.40	179	NR	ND	96.1	ND	NA	ND

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well		Acetone	Benzene	Bromoform	2-Butanone (MEK)	Chloroethane	Chloroform	Chloromethane	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,1-Dichloroethane	1,2-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethene	cis-1,2-Dichloroethene	1,4- Dioxane	Ethylbenzene	Isopropylbenzene	p-Isopropyltoluene
MW-10-27																			
	May-09	ND	ND	ND	ND	ND	6	ND	ND	ND	ND	ND	4	ND	NR	NA	ND	ND	NA
	Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	NR	NA	ND	ND	NA
	May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4	ND	NR	NA	ND	ND	NA
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4	ND	NR	NA	ND	ND	NA
	Nov-11	ND	ND	ND	ND	ND	4	ND	ND	ND	ND	ND	4	NR	ND	ND	ND	ND	NA
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	3.3	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.4	NR	ND	ND	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.9	NR	ND	ND	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.9	NR	ND	3.4	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.3	NR	ND	13.1	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.1	NR	ND	2.4	ND	NA	ND
MW-11-60																			
	May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	67	9	740	2	NR	NA	ND	ND	NA
	Oct-09	ND	ND	ND	ND	38	2	ND	ND	ND	620	16	2,100	8	NR	NA	ND	ND	NA
	May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	130	10	750	3	NR	NA	ND	ND	NA
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	110	9	540	2	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	94	8	720	2	NR	NA	ND	ND	NA
	Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	60	7	430	NR	ND	575	ND	ND	NA
	Jun-12 (h)	ND	ND	ND	ND	ND	ND	ND	ND	ND	130	ND	730	NR	ND	487	ND	ND	NA
	Dec-12	ND	ND	ND	ND	40	1.9	ND	ND	ND	1,000	20	1,800	NR	12	1,160	ND	ND	NA
	Jul-13	ND	ND	ND	ND	11.6	1.4	ND	ND	ND	403	13	1,360	NR	7.2	787.0	ND	NA	ND
	Dec-13 (c)	ND	ND	ND	ND	38.1	ND	ND	ND	ND	742.0	12.80	1,520	NR	10.5	1,000.0	ND	NA	ND
	Jun-14 (m)	ND	ND	ND	ND	ND	ND	ND	ND	ND	75.2	4.90	442	NR	ND	372.0 (c)	ND	NA	ND
	Dec-14 (c)	ND	ND	ND	ND	ND	ND	ND	ND	ND	190.0	ND	695	NR	ND	397.0 (c)	ND	NA	ND
MW-12-48																			
	May-09	ND	ND	ND	ND	7	2	ND	ND	ND	840	29	2,200	22	NR	NA	ND	ND	NA
	Oct-09	ND	ND	ND	ND	5	1	ND	ND	ND	680	21	1,900	16	NR	NA	ND	ND	NA
	May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	1,100	20	2,300	25	NR	NA	ND	ND	NA
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	610	26	2,200	19	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	11	2	ND	ND	ND	750	34	2,800	24	NR	NA	ND	ND	NA
	Nov-11	ND	ND	ND	ND	6	3	ND	ND	ND	440	39	2,400	NR	22	1,550	ND	ND	NA
	Jun-12 (c)	ND	ND	ND	ND	ND	ND	ND	ND	ND	430	ND	1,700	NR	ND	1,130	ND	ND	NA
	Dec-12	ND	ND	ND	ND	30	2.0	ND	ND	ND	460	31	1,600	NR	19	1,240	ND	ND	NA
	Jul-13	ND	ND	ND	ND	152	2.1	ND	ND	ND	869	39.2	2,840	NR	35.2	1,530.0	ND	NA	ND
	Dec-13 (l)	ND	ND	ND	ND	52	ND	ND	ND	ND	439.0	26.20	1,530	NR	ND	1,720.0 (i)	ND	NA	ND
	Jun-14 (c)	ND	ND	ND	ND	83.6	ND	ND	ND	ND	1,210.0	43.50	3,510	NR	33.2	182.0 (n)	ND	NA	ND
	Dec-14 (i)	ND	ND	ND	ND	145.0	ND	ND	ND	ND	1,370.0	37.50	3,350	NR	34.8	1,270.0 (n)	ND	NA	ND
MW-14-47																			
	May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	NA	ND	ND	NA
	Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	NR	NA	ND	ND	NA
	May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5	ND	NR	NA	ND	ND	NA
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5	ND	NR	NA	ND	ND	NA
	Nov-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.8	NR	ND	6.9	ND	ND	NA
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5	NR	ND	7.4	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	3.6	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.6	NR	ND	3.0	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.2	NR	ND	3.3	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	2.2	ND	NA	ND

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well		Acetone	Benzene	Bromoform	2-Butanone (MEK)	Chloroethane	Chloroform	Chloromethane	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,1-Dichloroethane	1,2-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethene	cis-1,2-Dichloroethene	1,4- Dioxane	Ethylbenzene	Isopropylbenzene	p-Isopropyltoluene
MW-15-40																			
	Sep-10	ND	ND	ND	ND	4	1	ND	ND	ND	370	16	1,300	9	NR	NA	ND	ND	NA
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	180	9	670	5	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	8	ND	ND	ND	ND	210	3	300	2	NR	NA	ND	ND	NA
	Dec-11	ND	ND	ND	ND	4	ND	ND	ND	ND	190	7	530	NR	3	345	ND	ND	NA
	Jun-12 (h)	ND	ND	ND	ND	ND	ND	ND	ND	ND	200	ND	500	NR	ND	575	ND	ND	NA
	Dec-12	ND	ND	ND	ND	11	ND	ND	ND	ND	320	5.2	540	NR	4.2	272	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	153	ND	465	NR	5.5	2,530.0	ND	NA	ND
	Dec-13 (g)	ND	ND	ND	ND	3	ND	ND	ND	ND	181.0	3.00	289	NR	2.8	228.0 (h)	ND	NA	ND
	Jun-14 (n)	ND	ND	ND	ND	ND	ND	ND	ND	ND	57.0	4.40	433 (c)	NR	5.8	92.8 (g)	ND	NA	ND
	Dec-14 (m)	ND	ND	ND	ND	ND	ND	ND	ND	ND	71.0	ND	318	NR	ND	208.0 (n)	ND	NA	ND
MW-16-50																			
	Sep-10	ND	ND	ND	23	480	13	6	3	ND	8,300	57	16,000	67	NR	NA	22	10	NA
	Oct-10	ND	ND	ND				ND	ND	ND	4,900	42	12,000	52	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	660	ND	ND	ND	ND	3,400	ND	19,000	ND	NR	NA	ND	ND	NA
	Dec-11	ND	ND	ND	23	560	7	ND	1.7	ND	8,200	53	18,000	NR	59	1,930	12	4.6	NA
	Jun-12 (f)	ND	ND	ND	ND	ND	ND	ND	ND	ND	4,300	ND	11,000	NR	ND	2,050	ND	ND	NA
	Dec-12	ND	ND	ND	18	460	5.8	ND	1.3	1.1	14,000	52	14,000	NR	56	1,740	7.6	3.3	NA
	Jul-13	46.5	ND	1.8	ND	1,290	7.2	2.7	1.4	ND	3,600	61.3	17,900	NR	59.1	2,260.0	9.9	NA	ND
	Dec-13 (k)	ND	ND	ND	ND	266	ND	ND	ND	ND	2,050.0	ND	19,400	NR	ND	2,840.0 (d)	ND	NA	ND
	Jun-14 (k)	ND	ND	ND	ND	278	ND	ND	ND	ND	3,850.0	ND	16,400	NR	ND	1,570.0 (i)	ND	NA	ND
	Dec-14	ND	ND	ND	17	ND	2.2	ND	ND	ND	5,910.0 (p)	18.90	4,670 (p)	NR	32.6	451.0 (h)	4	NA	2
MW-16D-101																			
	Jan-11	ND	ND	ND	ND	3	4	ND	ND	ND	110	4	330	ND	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	100	4	400	ND	NR	NA	ND	ND	NA
	Dec-11	ND	2	ND	ND	ND	ND	ND	ND	ND	72	4	240	NR	ND	267	ND	ND	NA
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	49	ND	150	NR	ND	215	ND	ND	NA
	Dec-12	ND	1.3	ND	ND	ND	ND	ND	ND	ND	55	3	130	NR	ND	189	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	54.3	3	193	NR	ND	246.0	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	43.2	2.20	155	NR	ND	218.0 (h)	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	57.6	3.50	191	NR	ND	232.0 (h)	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	90.0	4.10 (n)	288	NR	ND	251.0 (h)	ND	NA	ND
MW-17-52																			
	Sep-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	10	ND	7	ND	NR	NA	ND	ND	NA
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	5	ND	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	2	ND	NR	NA	ND	ND	NA
	Nov-11	ND	ND	ND	ND	1	ND	ND	ND	ND	46	ND	41	NR	ND	22	ND	ND	NA
	Jun-12 (c)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	10.2	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	4.4	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.6	NR	ND	4.3	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.4	NR	ND	34.3	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	2.5	ND	NA	ND
MW-17D-97																			
	Sep-10	ND	ND	ND	ND	4	1	ND	ND	ND	150	12	940	7	NR	NA	ND	ND	NA
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	190	13	1,300	9	NR	NA	ND	ND	NA
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	290	ND	2,100	ND	NR	NA	ND	ND	NA
	Nov-11	ND	ND	ND	ND	15	1	ND	ND	ND	270	14	1,900	NR	14	575	ND	ND	NA
	Jun-12 (c)	ND	ND	ND	ND	ND	ND	ND	ND	ND	290	ND	1,000	NR	ND	618	ND	ND	NA
	Dec-12	ND	ND	ND	ND	41	1.3	ND	ND	ND	470	17	1,800	NR	19	669	ND	ND	NA
	Jul-13	ND	ND	ND	ND	68.4	1.3	ND	ND	ND	496	17	2,310	NR	22.3	612.0	ND	NA	ND
	Dec-13 (m)	ND	ND	ND	ND	37	ND	ND	ND	ND	326.0	13.60	2,100	NR	16.8	592.0 (l)	ND	NA	ND
	Jun-14 (c)	ND	ND	ND	ND	ND	ND	ND	ND	ND	143.0	10.20	1,260	NR	ND	435.0	ND	NA	ND
	Dec-14	ND	ND	ND	ND	2	ND	ND	ND	ND	66.2	4.60	484	NR	3.8	23.3	ND	NA	ND

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well		Acetone	Benzene	Bromoform	2-Butanone (MEK)	Chloroethane	Chloroform	Chloromethane	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,1-Dichloroethane	1,2-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethene	cis-1,2-Dichloroethene	1,4- Dioxane	Ethylbenzene	Isopropylbenzene	p-Isopropyltoluene
MW-18-56																			
	Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	13.6	ND	ND	NA
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	4.6	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
MW-19-56																			
	Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8	NR	ND	5.9	ND	ND	NA
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	4.0	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	3.6	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6	NR	ND	5.5	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.5	NR	ND	4.1	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.7	NR	ND	6.3	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.0	NR	ND	4.2	ND	NA	ND
MW-20-60																			
	Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	11.9	ND	ND	NA
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.5	ND	51	NR	ND	272	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	30	3.1	120	NR	ND	506	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	83.8	6.2	255	NR	1.5	845.0	ND	NA	ND
	Dec-13 (g)	ND	ND	ND	ND	ND	ND	ND	ND	ND	121.0	7.00	333	NR	ND	1,230.0 (i)	ND	NA	ND
	Jun-14 (g)	ND	ND	ND	ND	ND	ND	ND	ND	ND	173.0	8.80	359	NR	2.1	1,010.0 (i)	ND	NA	ND
	Dec-14 (m)	ND	ND	ND	ND	ND	ND	ND	ND	ND	166.0	9.30	302	NR	ND	660.0 (i)	ND	NA	ND
MW-21D-102																			
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	12	ND	90	NR	ND	84.2	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	14	ND	90	NR	ND	81.8	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	11.9	ND	102	NR	ND	80.1	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.1	ND	82.4	NR	ND	70.0	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.3	ND	76.5	NR	ND	77.0 (g)	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.4	ND	105.0	NR	ND	138.0	ND	NA	ND
MW-22D-114																			
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	27	NR	ND	29	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.5	ND	38	NR	ND	41	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.7	ND	34.2	NR	ND	31.8	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.7	ND	43.5	NR	ND	35.3 (g)	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.5	ND	44.2	NR	ND	39.3	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.0	ND	27.0	NR	ND	22.8	ND	NA	ND
MW-23D-92																			
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	29	ND	120	NR	ND	149	ND	ND	NA
	Aug-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	39	2.2	130	NR	ND	NA	ND	ND	NA
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	32	2.0	110	NR	ND	130	ND	ND	NA
	Jul-13	ND	ND	ND	ND	ND	ND	1.5	ND	ND	32.7	2.3	131	NR	ND	186.0	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	25.6	1.7	101	NR	ND	165.0 (h)	ND	ND	ND
	Jun-14	ND	1.2	ND	ND	ND	ND	ND	ND	ND	29.1	2.3	101	NR	ND	132.0 (g)	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	28.3	1.90	157.0	NR	ND	151.0	ND	NA	ND
MW-27D-113																			
	Sep-13	ND	ND	ND	ND	ND	2.1	ND	ND	ND	ND	0.17 J	ND	NR	ND	0.9 J	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well		Acetone	Benzene	Bromoform	2-Butanone (MEK)	Chloroethane	Chloroform	Chloromethane	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,1-Dichloroethane	1,2-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethene	cis-1,2-Dichloroethene	1,4- Dioxane	Ethylbenzene	Isopropylbenzene	p-Isopropyltoluene
MW-26D-105																			
	Mar-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	12.4	ND	98.2	NR	ND	118.0	ND	NA	ND
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	13.5	ND	120	NR	ND	99.2	ND	NA	ND
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.9	ND	51.5	NR	ND	60.7	ND	NA	ND
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.2	ND	42.4	NR	ND	39.8	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.5	ND	78	NR	ND	73.0	ND	NA	ND
MW-38-28																			
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.5	ND	ND	NR	ND	51.8	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.7	ND	ND	NR	ND	68.7	ND	NA	ND
MW-39-50																			
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.2	NR	ND	6.3	ND	NA	ND
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	NA	ND

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well		Methylene Chloride	Methyl-tert-butyl Ether	Naphthalene	Tetrachloroethene	Toluene	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	Vinyl Chloride	Xylene (total)	Total Detected VOCs
MW-01-36												
	May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
MW-01D-112												
	Jun-12	ND	ND	ND	ND	ND	96	ND	ND	ND	ND	899
	Dec-12	ND	ND	ND	ND	ND	120	1.6	1.7	ND	ND	1,009
	Jul-13	ND	ND	ND	ND	ND	98.8	1.5	1.8	ND	ND	1,007
	Dec-13 (g)	ND	ND	ND	ND	ND	62.4	ND	ND	ND	ND	690
	Jun-14 (g)	ND	ND	ND	ND	ND	62.4	ND	ND	ND	ND	759
	Dec-14 (n)	ND	ND	ND	ND	ND	35.8	ND	ND	ND	ND	562
MW-02-40												
	May-09	3	ND	ND	3	ND	150	ND	8	2	ND	2,102
	Oct-09	5	ND	ND	7	ND	380	ND	17	4	3	4,797
	May-10	ND	ND	ND	11	ND	520	ND	22	5	ND	5,589
	Oct-10	ND	ND	ND	11	ND	2,700	ND	23	4	ND	8,166
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5,780
	Nov-11	4.4	ND	ND	8	ND	2,800	1	22	6	3.3	7,561
	Jun-12 (d)	ND	ND	ND	ND	ND	6,100	ND	ND	ND	ND	10,883
	Dec-12	ND	ND	ND	3.6	ND	350	ND	11	ND	ND	2,889
	Jul-13	ND	ND	ND	4	ND	541	ND	11.7	2.8	ND	3,208
	Dec-13 (h)	ND	ND	ND	ND	ND	228.0	ND	5.7	ND	ND	1,882
	Jun-14 (h)	16.3	ND	ND	ND	ND	599.0	ND	11.2	ND	ND	2,614
	Dec-14 (h)	ND	ND	ND	ND	ND	21	ND	6	ND	ND	1,459
MW-02D-138												
	Jul-11	ND	ND	ND	ND	ND	28	ND	ND	ND	ND	166
	Nov-11	ND	ND	ND	ND	ND	27	ND	ND	ND	ND	292
	Jun-12	ND	ND	ND	ND	ND	28	ND	ND	ND	ND	292
	Dec-12	ND	ND	ND	ND	ND	23	ND	ND	ND	ND	273
	Jul-13	ND	ND	ND	ND	ND	23	ND	ND	ND	ND	344
	Dec-13	ND	ND	ND	ND	ND	15.9	ND	ND	ND	ND	257
	Jun-14	ND	ND	ND	ND	ND	26.9	ND	ND	ND	ND	335
	Dec-14	ND	ND	ND	ND	ND	20.2	ND	ND	ND	ND	292

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well		Methylene Chloride	Methyl-tert-butyl Ether	Naphthalene	Tetrachloroethene	Toluene	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	Vinyl Chloride	Xylene (total)	Total Detected VOCs
MW-03-25.5												
	May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Nov-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
MW-04-36												
	May-09	ND	ND	ND	1	ND	100	ND	3	ND	ND	584
	Oct-09	ND	ND	ND	1	ND	100	ND	3	ND	ND	667
	May-10	ND	ND	ND	5	ND	180	ND	8	ND	ND	1,591
	Oct-10	ND	ND	ND	2	ND	75	ND	3	ND	ND	573
	Jun-11	ND	ND	ND	ND	ND	32	ND	2	ND	ND	317
	Dec-11	ND	ND	ND	ND	ND	47	ND	2	ND	ND	600
	Jun-12	ND	ND	ND	ND	ND	25	ND	ND	ND	ND	431
	Dec-12	ND	ND	ND	ND	ND	26	ND	2	ND	ND	528
	Jul-13	ND	ND	ND	ND	ND	27.9	ND	2.3	ND	ND	606
	Dec-13	ND	ND	ND	ND	ND	21.3	ND	1.7	ND	ND	457
	Jun-14	ND	ND	ND	3.2	ND	104.0	ND	8.0	ND	ND	1,686
	Dec-14 (g)	ND	ND	ND	ND	ND	11.8	ND	ND	ND	ND	202
MW-05-31												
	May-09	ND	ND	ND	ND	ND	6	ND	ND	ND	ND	19
	Oct-09	ND	ND	ND	ND	ND	6	ND	ND	ND	ND	22
	May-10	ND	ND	ND	ND	ND	6	ND	ND	ND	ND	25
	Oct-10	ND	ND	ND	ND	ND	5	ND	ND	ND	ND	17
	Jun-11	ND	ND	ND	ND	ND	5	ND	ND	ND	ND	15
	Dec-11	ND	ND	ND	ND	ND	4	ND	ND	ND	ND	255
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	218
	Dec-12	ND	ND	ND	ND	ND	2.2	ND	ND	ND	ND	251
	Jul-13	ND	ND	ND	ND	ND	2.4	ND	ND	ND	ND	213
	Dec-13	ND	ND	ND	ND	ND	1.8	ND	ND	ND	ND	143
	Jun-14	ND	ND	ND	ND	ND	2.5	ND	ND	ND	ND	100
	Dec-14	ND	ND	ND	ND	ND	2.0	ND	ND	ND	ND	98

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well		Methylene Chloride	Methyl-tert-butyl Ether	Naphthalene	Tetrachloroethene	Toluene	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	Vinyl Chloride	Xylene (total)	Total Detected VOCs
MW-06-36												
	May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
MW-07-22												
	May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2
MW-08-42												
	May-09	ND	ND	ND	1	ND	100	ND	4	ND	ND	571
	Oct-09	ND	ND	ND	1	ND	70	ND	4	ND	ND	651
	May-10	ND	ND	ND	2	ND	65	ND	4	ND	ND	566
	Oct-10	ND	ND	ND	ND	ND	25	ND	3	ND	ND	401
	Jun-11	ND	ND	ND	1	ND	23	ND	4	ND	ND	688
	Dec-11	ND	ND	ND	ND	ND	13	ND	2	ND	ND	711
	Jun-12 (g)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	735
	Dec-12	ND	ND	ND	ND	ND	9.0	ND	3.1	ND	ND	824
	Jul-13	ND	ND	ND	1.1	ND	6.4	ND	3.6	ND	ND	846
	Dec-13	ND	ND	ND	ND	ND	4.7	ND	1.8	ND	ND	471
	Jun-14	ND	ND	ND	ND	ND	3.3	ND	1.6	ND	ND	458
	Dec-14	ND	ND	ND	ND	ND	2.0	ND	1.3	ND	ND	365
MW-09-25												
	May-09	ND	ND	ND	ND	ND	16	ND	ND	ND	ND	286
	Oct-09	ND	ND	ND	ND	ND	13	ND	ND	ND	ND	332
	May-10	ND	ND	ND	ND	ND	10	ND	ND	ND	ND	268
	Jun-11	ND	ND	ND	ND	ND	10	ND	ND	ND	ND	318
	Nov-11	ND	ND	ND	ND	ND	8	ND	ND	ND	ND	330
	Jun-12	ND	ND	ND	ND	ND	6	ND	ND	ND	ND	245
	Dec-12	ND	ND	ND	ND	ND	5.5	ND	ND	ND	ND	238
	Jul-13	ND	ND	ND	ND	ND	6.4	ND	ND	ND	ND	258
	Dec-13	ND	ND	ND	ND	ND	4.6	ND	ND	ND	ND	295
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	257
	Dec-14	ND	ND	ND	ND	ND	9.4	ND	ND	ND	ND	297

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well	Methylene Chloride	Methyl-tert-butyl Ether	Naphthalene	Tetrachloroethene	Toluene	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	Vinyl Chloride	Xylene (total)	Total Detected VOCs
MW-10-27											
May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10
Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3
May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4
Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3
Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4
Nov-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8
Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3
Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2
Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3
Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5
Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	15
Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5
MW-11-60											
May-09	ND	ND	ND	ND	ND	47	ND	4	ND	ND	869
Oct-09	4	ND	ND	3	ND	230	2	13	1	ND	3,037
May-10	ND	ND	ND	ND	ND	67	ND	5	ND	ND	965
Oct-10	ND	ND	ND	ND	ND	52	ND	5	ND	ND	718
Jun-11	ND	ND	ND	ND	ND	29	ND	3	ND	ND	856
Dec-11	ND	ND	ND	ND	ND	16	ND	ND	ND	ND	1,088
Jun-12 (h)	ND	ND	ND	ND	ND	35	ND	ND	ND	ND	1,382
Dec-12	6.7	ND	ND	4	ND	300	2.9	13	ND	ND	4,360
Jul-13	ND	ND	ND	1.6	ND	103	1	8.8	1.6	ND	2,699
Dec-13 (c)	ND	ND	ND	ND	ND	343.0	ND	10.3	ND	ND	3,677
Jun-14 (m)	9	ND	ND	ND	ND	21.7	ND	ND	ND	ND	925
Dec-14 (c)	ND	ND	ND	ND	ND	28.8	ND	ND	ND	ND	1,311
MW-12-48											
May-09	3	ND	ND	4	ND	120	3	16	2	ND	3,248
Oct-09	2	ND	ND	3	ND	87	2	13	2	ND	2,732
May-10	ND	ND	ND	4	ND	160	ND	9	3	ND	3,621
Oct-10		ND	ND	3	ND	110	2	13	2	ND	2,985
Jun-11	3	ND	ND	3	ND	110	3	16	2	ND	3,758
Nov-11	2	ND	ND	3	ND	85	4	17	2	ND	4,573
Jun-12 (c)	ND	ND	ND	ND	ND	63	ND	ND	ND	ND	3,323
Dec-12	ND	ND	ND	2.0	ND	48	3.3	13	ND	ND	3,448
Jul-13	6.6	ND	ND	4	ND	77.2	3.2	16.7	2.6	ND	5,578
Dec-13 (l)	ND	ND	ND	ND	ND	41.8	ND	ND	ND	ND	3,809
Jun-14 (c)	ND	ND	ND	ND	ND	125.0	ND	17.8	ND	ND	5,205
Dec-14 (i)	ND	ND	ND	ND	ND	78.8	ND	ND	ND	ND	6,286
MW-14-47											
May-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
Oct-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3
May-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5
Oct-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3
Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5
Nov-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	13
Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12
Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4
Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6
Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6
Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well		Methylene Chloride	Methyl-tert-butyl Ether	Naphthalene	Tetrachloroethene	Toluene	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	Vinyl Chloride	Xylene (total)	Total Detected VOCs
MW-15-40												
	Sep-10	ND	ND	ND	4	ND	27	2	15	1	ND	1,749
	Oct-10	ND	ND	ND	2	ND	22	2	7	ND	ND	897
	Jun-11	ND	ND	ND	ND	ND	51	ND	2	ND	ND	576
	Dec-11	ND	ND	ND	1	ND	48	ND	4.7	ND	ND	1,133
	Jun-12 (h)	ND	ND	ND	ND	ND	47	ND	ND	ND	ND	1,322
	Dec-12	ND	ND	ND	1.2	ND	150	ND	5.2	ND	ND	1,309
	Jul-13	ND	ND	ND	ND	ND	43.2	ND	ND	ND	ND	3,197
	Dec-13 (g)	ND	ND	ND	ND	ND	107.0	ND	2.4	ND	ND	817
	Jun-14 (n)	10.2	ND	ND	ND	ND	13.7	ND	ND	ND	ND	617
	Dec-14 (m)	ND	ND	ND	ND	ND	20.7	ND	ND	ND	ND	618
MW-16-50												
	Sep-10	28	ND	17	250	7	160,000	4	370	ND	101	185,758
	Oct-10	ND	ND	ND	140	ND	71,000	3	190	6	ND	88,333
	Jun-11	ND	ND	ND	ND	ND	21,000	ND	130	ND	ND	44,190
	Dec-11	30	ND	7.1	110	4.2	100,000	3	220	14	57	129,295
	Jun-12 (f)	ND	ND	ND	ND	ND	41,000	ND	ND	ND	ND	58,350
	Dec-12	30	ND	4.5	69	3.4	30,000	3.5	160	9.2	36	60,661
	Jul-13	29.5	ND	6	83.8	4.4	29,400	4.3	ND	17.7	46.2	54,832
	Dec-13 (k)	ND	ND	ND	ND	ND	12,000.0	ND	ND	ND	ND	36,556
	Jun-14 (k)	ND	ND	ND	ND	ND	30,500.0	ND	213.0	ND	ND	52,811
	Dec-14	7	ND	3	30.7	1.6	15,000.0 (p)	ND	63.8	5.1	17	26,236
MW-16D-101												
	Jan-11	8	ND	2	ND	ND	82	ND	2	ND	3	548
	Jun-11	ND	ND	ND	ND	ND	75	ND	2	ND	ND	581
	Dec-11	ND	ND	ND	ND	ND	64	ND	1	ND	ND	650
	Jun-12	ND	ND	ND	ND	ND	33	ND	ND	ND	ND	447
	Dec-12	ND	ND	ND	ND	ND	29	ND	ND	ND	ND	407
	Jul-13	ND	ND	ND	ND	ND	23.8	ND	ND	ND	ND	520
	Dec-13	ND	ND	ND	ND	ND	21.3	ND	ND	ND	ND	440
	Jun-14	ND	ND	ND	ND	ND	28.9	ND	ND	ND	ND	513
	Dec-14	ND	ND	ND	ND	ND	44.3	ND	1.8	ND	ND	679
MW-17-52												
	Sep-10	ND	ND	ND	ND	ND	7	ND	ND	ND	ND	24
	Oct-10	ND	ND	ND	ND	ND	2	ND	ND	ND	ND	10
	Jun-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4
	Nov-11	ND	ND	ND	ND	ND	22	ND	ND	ND	ND	132
	Jun-12 (c)	ND	ND	ND	ND	ND	23	ND	ND	ND	ND	33
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	37
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3
MW-17D-97												
	Sep-10	5	ND	ND	1	ND	26	ND	9	1	ND	1,156
	Oct-10	ND	ND	ND	2	ND	42	ND	10	ND	ND	1,566
	Jun-11	ND	ND	ND	ND	ND	29	ND	ND	ND	ND	2,419
	Nov-11	3	ND	ND	3	ND	38	2	12	ND	ND	2,847
	Jun-12 (c)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1,908
	Dec-12	4.7	ND	ND	1.5	ND	36.0	ND	11	ND	ND	3,071
	Jul-13	6.6	ND	ND	2	ND	36.2	ND	10.9	1.5	ND	3,584
	Dec-13 (m)	ND	ND	ND	ND	ND	22.6	ND	7.9	ND	ND	3,116
	Jun-14 (c)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1,848
	Dec-14	ND	ND	ND	ND	ND	4.3	ND	2.9	ND	ND	591

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well		Methylene Chloride	Methyl-tert-butyl Ether	Naphthalene	Tetrachloroethene	Toluene	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	Vinyl Chloride	Xylene (total)	Total Detected VOCs
MW-18-56												
	Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	14
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---
MW-19-56												
	Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	14
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4
	Jul-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12
	Dec-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8
MW-20-60												
	Dec-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12
	Jun-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	332
	Dec-12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	659
	Jul-13	ND	ND	ND	ND	ND	ND	2	ND	ND	ND	1,194
	Dec-13 (g)	ND	ND	ND	ND	ND	ND	2.5	ND	ND	ND	1,694
	Jun-14 (g)	5.6	ND	ND	ND	ND	ND	3.3	2.1	ND	ND	1,564
	Dec-14 (m)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1,137
MW-21D-102												
	Jun-12	ND	ND	ND	ND	ND	8	ND	ND	ND	ND	194
	Dec-12	ND	ND	ND	ND	ND	5.7	ND	ND	ND	ND	192
	Jul-13	ND	ND	ND	ND	ND	5	ND	ND	ND	ND	199
	Dec-13	ND	ND	ND	ND	ND	4.1	ND	ND	ND	ND	167
	Jun-14	ND	ND	ND	ND	ND	2.8	ND	ND	ND	ND	165
	Dec-14	ND	ND	ND	ND	ND	3.2	ND	ND	ND	ND	257
MW-22D-114												
	Jun-12	ND	ND	ND	ND	ND	8	ND	ND	ND	ND	64
	Dec-12	ND	ND	ND	ND	ND	10	ND	ND	ND	ND	94
	Jul-13	ND	ND	ND	ND	ND	6.5	ND	ND	ND	ND	75
	Dec-13	ND	ND	ND	ND	ND	8.4	ND	ND	ND	ND	91
	Jun-14	ND	ND	ND	ND	ND	9.0	ND	ND	ND	ND	96
	Dec-14	ND	ND	ND	ND	ND	4.2	ND	ND	ND	ND	56
MW-23D-92												
	Jun-12	ND	ND	ND	ND	ND	36	ND	ND	ND	ND	334
	Aug-12	ND	ND	ND	ND	ND	35	ND	ND	ND	ND	206
	Dec-12	ND	ND	ND	ND	ND	31	ND	ND	ND	ND	305
	Jul-13	ND	ND	ND	ND	ND	28.6	ND	ND	ND	ND	382
	Dec-13	ND	ND	ND	ND	ND	21.3	ND	ND	ND	ND	315
	Jun-14	ND	ND	ND	ND	ND	24.7	ND	ND	ND	ND	290
	Dec-14	ND	ND	ND	ND	ND	26.5	ND	ND	ND	ND	365
MW-27D-113												
	Sep-13	ND	1.3	ND	ND	ND	ND	ND	ND	ND	ND	4
	Dec-13	ND	1.4	ND	ND	ND	ND	ND	ND	ND	ND	1
	Jun-14	ND	1.6	ND	ND	ND	ND	ND	ND	ND	ND	2
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---

Table 1

Summary of COCs Detected in Groundwater Samples (2009 - 2014)
On-Property Monitoring Wells
Former Kop-Flex Facility
Hanover, Maryland (a)

Monitoring Well		Methylene Chloride	Methyl-tert-butyl Ether	Naphthalene	Tetrachloroethene	Toluene	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	Vinyl Chloride	Xylene (total)	Total Detected VOCs
MW-26D-105												
	Mar-13	ND	ND	ND	ND	5.6	6.3	ND	ND	ND	ND	241
	Jul-13	ND	ND	ND	ND	ND	6.6	ND	ND	ND	ND	239
	Dec-13	ND	ND	ND	ND	ND	2.7	ND	ND	ND	ND	122
	Jun-14	ND	ND	ND	ND	ND	1.8	ND	ND	ND	ND	89
	Dec-14	ND	ND	ND	ND	ND	2.8	ND	ND	ND	ND	161
MW-38-28												
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	61
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	77
MW-39-50												
	Jun-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10
	Dec-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	---

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a/ all samples measured in ppb (ug/L);
E = result exceeds calibration range
ND = not detected; NA = Not analyzed
NR = not reported
b/suspected laboratory contaminant
c/ sample run at a 10x dilution
d/ sample run at 50x dilution
e/ estimated below the detection limit;
f/sample run at a 250x dilution
g/sample run at a 2x dilution
h/sample run at a 5x dilution
i/sample run at a 25x dilution
k/sample run at 200x dilution
l/sample run at 20x dilution
m/sample run at 4x dilution
n/sample run at 2.5x dilution
p/sample run at 400x dilution

Table 2

Soil Sample Results, Proposed Loading Dock Area
Former Kop-Flex Facility
Hanover, MD
September 2014 (a)

Analyte	**Sample ID** **Date Collected** **Sample Depth (ft)**	B-1 25-Sep-14 3-4		B-2 25-Sep-14 2-3		B-3 25-Sep-14 3-4		B-4 25-Sep-14 3-4		B-5 25-Sep-14 1-2		B-6 25-Sep-14 2-3		B-7 25-Sep-14 4-5		B-8 25-Sep-14 4-5		B-9 25-Sep-14 3-4		B-10 25-Sep-14 2-3	
Volatile Organic Compounds (mg/kg)	**MDE Residential Soil Cleanup Standard (mg/kg)**																				
Carbon Disulfide	780	0.0053	U	0.0049	U	0.0057	U	0.0043	U	0.0028	J	0.0055	U	0.0051	U	0.0033		0.0055	U	0.0046	U
1,1,1-Trichloroethane	16,000	0.0053	U	0.0049	U	0.0057	U	0.0043	U	0.0056	U	0.0084		0.0051	U	0.0054	U	0.0055	U	0.0046	U
Polycyclic Aromatic Hydrocarbons (mg/kg)																					
Fluoranthene	310	0.01	U	0.01	U	0.01	U	0.0163		0.01	U	0.0105	U	0.0111	U	0.0106	U	0.0102	U	0.0355	
Phenanthrene	2,300	0.01	U	0.01	U	0.01	U	0.0158		0.01	U	0.0105	U	0.0111	U	0.0106	U	0.0102	U	0.108	U
Pyrene	230	0.01	U	0.01	U	0.01	U	0.0102	U	0.01	U	0.0105	U	0.0111	U	0.0106	U	0.0102	U	0.0199	
Gasoline Range Organics (mg/kg)																					
Gasoline Range Organics	230	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.11	U	0.11	U	0.11	U	0.1	U	0.11	U
Diesel Range Organics (mg/kg)																					
Diesel Range Organics	230	8	U	8	U	8	U	8	U	8	U	8.4	U	8.9	U	8.5	U	8.2	U	8.6	U
Polychlorinated Biphenyls (mg/kg)																					
Total Polychlorinated Biphenyls	NA	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Total Metals Analysis (mg/kg)																					
Arsenic	3.6 (c)	1.79		2.19		0.605		0.527		1.21		1.15		1.73		5.3		6.06		2.37	
Barium	1,600	9		2.73		1.27		3.03		2.39		7.55		6.54		7.42		1.63		3.32	
Cadmium	3.9	0.414	Ub	0.388	Ub	0.401	Ub	0.411	Ub	0.397	Ub	0.412	Ub	0.411	Ub	0.401	Ub	0.342	Ub	0.426	Ub
Chromium	23	10.3		2.08		1.75		2.9		2		3.89		6.14		13.2		4.4		5.42	
Lead	400	3.04		0.906		0.526		1.06		0.849		2.04		2.73		2.41		0.766		1.1	
Mercury	2.3	0.0829	Ub	0.0775	Ub	0.0802	Ub	0.0821	Ub	0.0795	Ub	0.0825	Ub	0.0823	Ub	0.0802	Ub	0.0684	Ub	0.0853	Ub
Selenium	39	0.945		0.388	Ub	0.401	Ub	0.411	Ub	0.397	Ub	0.591		0.631		0.865		0.342	Ub	0.464	
Silver	39	0.414	Ub	0.388	Ub	0.401	Ub	0.411	Ub	0.397	Ub	0.412	Ub	0.411	Ub	0.401	Ub	0.342	Ub	0.426	Ub

a - All samples were collected by ECS Mid-Atlantic, LLC
b - Samples analyzed at dilution factor of 2
U - Undetected, value reported is the laboratory reporting limit
J - Indicates an estimated value between method detection limit and reporting limit
NA -not analyzed
ND- not detected
mg/kg - milligrams per kilogram
c - Anticipated Typical Concentrations for Eastern Maryland

Table 3

Groundwater Sampling Results for Additional Hydrogeochemical Parameters
Surficial Aquifer
Former Kop-Flex Facility
Hanover, Maryland (a, b)

Sample ID	**MW-05-31**	**MW-18-56**	**MW-38-28**	**TW-01-63**
Date Sampled	10/02/14	10/02/14	10/02/14	10/02/14
Parameters				
Metals (µg/L)				
Aluminum (total)	2,280	207	1,930	723
Aluminum (dissolved)	2,190	165	1,400	692
Copper (total)	10.7	5 U	5 U	9.4
Copper (dissolved)	12.1	5.7	5 U	8.4
Iron (total)	50 U	50 U	2,640	50 U
Iron (dissolved)	50 U	50 U	2,280	50 U
Lead (total)	5 U	5 U	5 U	5 U
Lead (dissolved)	5 U	5 U	5 U	5 U
Manganese (total)	71.6	17.6	7.7	15
Manganese (dissolved)	70.3	17.1	7.3	14.7
Nickel (total)	5 U	8.5	151	19.2
Nickel (dissolved)	5 U	8.9	147	18.8
Zinc (total)	16.3	10.3	175	11.4
Zinc (dissolved)	25	18.2	171	10 U
Total Hardness (mg/L)	51.9	16.9	2.9	18.5
Total Petroleum Hydrocarbons (mg/L)	5 U	5 U	5 U	5 U
Total Suspended Solids (mg/L)	5.1 U	3	27.3	2.5 U

---

a/ ug/L = micrograms per liter; mg/L = miligrams per liter

b/ Data Validation Qualifier:
U = analyte not detected above reporting limit

Table 4

Groundwater Sampling Results for Inorganic Parameters
Lower Patapsco Aquifer
Former Kop-Flex Facility
Hanover, Maryland (a, b)

Sample ID	**MW-1D**		**MW-2D**		**MW-16D**		**MW-17D**		**MW-21D**		**MW-26D**	
Date Sampled	12/12/13		12/11/13		12/11/13		12/13/13		12/12/13		12/12/13	
Parameters												
Metals (ug/L)												
Copper (total)	29		3.4		7.3		22		2.7		6.3	
Copper (dissolved)	4.3		2		4.4		1	U	1.8		1.4	
Iron (total)	430		100	U	290		3,400		150		200	
Iron (dissolved)	130		100	U	100	U	100	U	100	U	100	U
Lead (total)	2		1	U	1	U	1.3		1	U	1	U
Lead (dissolved)	1	U	1	U	1	U	1	U	1	U	1	U
Manganese (total)	60		14		35		150		5.6		12	
Manganese (dissolved)	46		12		25		11		3.7		8.7	
Nickel (total)	22		9.5		20		20		3.1		6.1	
Nickel (dissolved)	12		8.1		16		4.2		3.5		6.2	
Zinc (total)	44		20	U	37		47		20	U	35	
Zinc (dissolved)	22		20	U	32		20	U	20	U	20	U
Hardness (mg/L)	17		16		27		160		8.8		16	
Total Alkalinity (mg/L)	17		NA		NA		140		10	U	13	

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a/ ug/L = micrograms per liter; mg/L = miligrams per liter; NA = not analyzed

b/ Data Validation Qualifier:

U = analyte not detected above reporting limit

Table 5

Aquifer Property Estimates from April-May 2014 Constant Rate Test
on the Surficial Aquifer
Former Kop-Flex Facility
Hanover, Maryland

Well ID	Hydraulic Conductivity (feet/day) (a) Drawdown	Hydraulic Conductivity (feet/day) (a) Recovery	Transmissivity ($feet^2$/day) Drawdown	Transmissivity ($feet^2$/day) Recovery	Storativity
TW-1	5.2	5.8	146	162	---
MW-18	8.5	10.1	237	282	0.00071
MW-39	8.2	15.6	139	266	0.00082
OW-1	10.6	10.5	298	295	0.00073
OW-2	11	10.8	308	301	0.00087
Geometric Mean:	9.21		245		

---

a/ Hydraulic conductivity was calculate by dividing the transmissivity by the thickness of the sand unit. An average sand unit thickness of 28 feet was used for all wells except MW-39, where the thickness value was 17 feet.

Table 6

Aquifer Property Estimates from May 2014 Constant Rate Test on the Lower Patapsco Aquifer
Former Kop-Flex Facility
Hanover, Maryland

	Hydraulic Conductivity (feet/day) (a)		Transmissivity ($feet^2$/day)		
Well ID	**Drawdown**	**Recovery**	**Drawdown**	**Recovery**	**Storativity**
TW-2	16.5	17.8	1,320	1,420	---
MW-1D	14.6	19.0	1,170	1,520	0.000092
MW-17D	17.8	17.5	1,420	1,400	0.00018
MW-21D	18.5	18.1	1,480	1,450	0.00015
MW-22D	17.3	16.3	1,380	1,300	0.00060
MW-24D	18.4	17.3	1,470	1,380	0.00060
MW-16D	19.3	---	1,540	---	0.00015
MW-26D	20.3	---	1,620	---	0.00011
Geometric Mean:	17.7		1,410		

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a/ Hydraulic conductivity was calculate by dividing the transmissivity by the assumed thickness of the Lower Patapsco Aquifer (80 feet).

Table 7

Input Parameters for Steady State Flow Simulations in the Surficial Aquifer
Former Kop-Flex Facility
Hanover, Maryland

Parameter	**Value**	**Source**
Local Groundwater Flow Regime		
Upgradient Reference Head	115.5 feet MSL	Monitoring well hydrographs (2008-2014)
Hydraulic Gradient (magnitude)	0.008	2013 and 2014 groundwater surface contours
Hydraulic Gradient (direction)	West-Northwest	2013 and 2014 groundwater surface contours
Stony Run Head Values	106 - 108 feet MSL	Assumed values based on ground surface topography
Aquifer Properties		
Aquifer Top	124 feet MSL	Approximate ground surface elevation in main building are
Aquifer Bottom	67 feet MSL	Site hydrogeologic cross-sections
Porosity	0.35	Assumed value for unconsolidated silt and sand (Schwartz and Zheng 2003)
Hydraulic Conductivity	5.5 feet/day	Equivalent value for layered clayey and sandy deposits
Pond Recharge	0.001 feet/day	Assumed value from evaluation of flow system
Extraction Wells Design		
Screen Length	35 feet	
Depth to Top of Screen	22 feet	
Well Diameter	4 inches	
Borehole Diameter	8 inches	

Table 8

Proposed Recovery Well Construction and Operation Summary
Groundwater Containment System
Former Kop-Flex Facility
Hanover, Maryland (a, b)

Location	Aquifer	Well Diameter	Well Construction Material	Estimated Extraction Well Screened Interval			Anticipated Pump Intake Depth	Piezometer Diameter	Piezometer Construction Material	Estimated Piezometer Screened Interval			Anticipated Flow Rate	Maximum Flow Rate
		(inches)		(ft bgs)		(ft bgs)	(ft bgs)	(inches)	(inches)	(ft bgs)		(ft bgs)	(gpm)	(gpm)
RW-1S	Surficial	4	PVC	25	-	60	50	1	PVC	25	-	60	3.0	3.3
RW-2S	Surficial	4	PVC	25	-	60	50	1	PVC	25	-	60	3.0	3.3
RW-3S	Surficial	4	PVC	25	-	60	50	1	PVC	25	-	60	3.0	3.3
RW-1D	Lower Patapsco	6	PVC	100	-	140	90	1	PVC	100	-	140	35.0	38.5
RW-2D	Lower Patapsco	6	PVC	100	-	140	90	1	PVC	100	-	140	35.0	38.5
												Total:	79.0	86.9

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a/ gpm = gallons per minute; ft bgs = feet below ground surface
b/ Maximum flow rate is the anticipated flow multiplied by a safety factor of 1.1.

Table 9

Input Parameters for Steady State Flow Simulations in the Lower Patapsco Aquifer
Former Kop-Flex Facility
Hanover, Maryland

Parameter	Value	Source
Local Groundwater Flow Regime		
Upgradient Reference Head	88 feet MSL	Well MW-23D hydrograph (2012-2014)
Hydraulic Gradient (magnitude)	0.006	2013 and 2014 potentiometric surface contours
Hydraulic Gradient (direction)	South-Southeast	2013 and 2014 potentiometric surface contours
Aquifer Properties		
Aquifer Top	50 feet MSL	Site hydrogeologic cross-sections
Aquifer Bottom	-30 feet MSL	Site hydrogeologic cross-sections
Porosity	0.30	Assumed value from published modeling studies of aquife (Achmad 1991, Wilson and Achmad 1995)
Hydraulic Conductivity	15 feet/day	2014 constant discharge pumping test
Extraction Wells Design		
Screen Length	50 feet	
Depth to Top of Screen	100 feet	
Well Diameter	6 inches	
Borehole Diameter	10 inches	

Table 10

Previous NPDES Permit Monitoring Requirements
Former Kop-Flex Facility
Hanover, Maryland

		Quality or Concentration			Frequency	Sample	
Parameter	**Units**	**Minimum**	**Monthly Average**	**Daily Maximum**	**of Analysis**	**Type**	
Flow	gpd			-	1/Month	Measured	(a)
Total Volatile Organics	ug/l			100	1/Month	Grab	(a, b)
1,1-Dichloroethene	ug/l		32		1/Month	Grab	(a, b)
BOD5	mg/l		30	45	1/Month	Grab	
Total Suspended Solids	mg/l		30	45	1/Month	Grab	
Oil & Grease	mg/l			15	1/Month	Grab	
Dissolved Oxygen	mg/l	5			1/Month	Grab	
pH	SU	6.0		9.0	1/Month	Grab	
Total Zinc	ug/l			120	1/Month	Grab	(c)
Dissolved Zinc	ug/l			Report	1/Month	Grab	(c)
Total Copper	ug/l			13	1/Month	Grab	(c)
Dissolved Copper	ug/l			Report	1/Month	Grab	(c)
Total Nickel	ug/l			470	1/Month	Grab	(c)
Dissolved Nickel	ug/l			Report	1/Month	Grab	(c)
Total Lead	ug/l			65	1/Month	Grab	(c)
Dissolved Lead	ug/l			Report	1/Month	Grab	(c)
Hardness (as CaCO3)	mg/l			Report	1/Month	Grab	

There shall be no discharge of floating solids or persistent foam in other than trace amounts. Persistent foam is foam that does not dissipate within one half-hour of point of discharge.

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a/ The Department may authorize a monitoring frequency reduction to once per month, based upon a written request by the permittee. Such a request shall describe the alternate method(s) being employed by the permittee to ensure consistent compliance with effluent limitations. These alternate methods may consist of alternate effluent monitoring tests and/or modified inspection, operation, or maintenance procedures which are used to prevent or predict effluent variability, or the additional use of carbon column units as part of the treatment system operation.

b/ Total Volatile Organics is defined as the sum of the constituents present in the wastewater according to EPA Method 601. The permittee shall include in the quarterly Discharge Monitoring Report the total sum and each individual concentration of detected constituents.

c/ The permittee shall use EPA Methods 200.7 or 200.8 for testing. An alternate test method may be substituted as long as the Department concurs that its detection level is less than the applicable Toxic Substance Criteria in COMAR 26.08.02.03 or the permittee demonstrates to the Department that a lower detection level is not practically achievable for this wastewater. Sample preservation procedures, container materials, and maximum allowable holding times must be specified in any application to the Department for use of an alternate test method(s). Written approval from the Department must be given before any alternate test method(s) is used. The integrity of all testing shall be ensured by following all sample preservation procedures, container materials, and maximum allowable holding times for the test method(s) specified. If a variance from the prescribed preservation techniques, container materials, and maximum holding times applicable is requested sufficient data shall be provided in the application to the Department to assure the integrity of the sample.

Table 11

Estimated Effluent Water Concentrations
Groundwater Containment System
Former Kop-Flex Facility
Hanover, Maryland

Constituents	Groundwater Cleanup Standards	Previous NPDES Permit Limits (b)	Estimated Effluent Water Concentration
VOC\\:			
1,1,1-Trichloroethane	200	NS	< 200
1,1,2-Trichloroethane	5	NS	< 5
1,1-Dichloroethane	90	NS	< 90
1,1-Dichloroethene	7	32 (c)	< 7
1,2-Dichloroethane	5	NS	< 5
Trichloroethene	5	NS	< 5
cis-1,2-Dichloroethene	70	NS	< 70
Vinyl Chloride	2	NS	< 2
Total VOCs	-	100 (d)	< 100
1,4-dioxane	6	NS	< 6

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a/ All concentrations provided in micrograms per liter (ug/l); NS = no standard; VOCs = volatile organic compounds

b/ NPDES Discharge Permit Limits provided by the site's State Discharge Permit No. 07-DP-3442 and NPDES Permit No. MD 0069094, which was issued on July 1, 2009, and expired on June 30, 2014. No discharge will be performed until the renewed permit is issued by MDE.

c/ NPDES permit monthly average concentration maximum.

d/ NPDES permit daily maximum concentration limit.

Appendix A – Engineering Design Drawings and Calculations

Appendix B – Analytical Results

Appendix C – WSP Field Standard Operating Procedures

Appendix D – Summary of Aquifer Test Results

Appendix E – Soil Management Plan

Appendix F – Engineering Certification of South Warehouse Building Floor Slab as Soil Cap

Appendix G – Sub-Slab Vapor Venting System Plans and Specifications

Appendix H – Groundwater Monitoring Plan

Appendix I – Administrative Requirements - Zoning

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