Superfund Proposed Plan

Hopewell Precision Area Groundwater Contamination Site

Hopewell Junction, Dutchess County, New York

EPA

JULY 2009

PURPOSE OF THE PROPOSED PLAN

This Proposed Plan identifies the preferred remedy for Operable Unit (OU) 1 at the Hopewell Precision site (the Site), and provides the rationale for this preference. The U.S. Environmental Protection Agency's (EPA's) preferred remedy consists of the following components:

- An investigation and pilot study of aerobic cometabolic bioremediation (ACB) to determine the rate and the parameters for full-scale enhancement of aerobic cometabolic degradation in the aquifer.
- Remedial design and implementation of full-scale enhancement of the ACB remedy to achieve restoration of the groundwater to drinking water standards within a reasonable time period.
- Long-term monitoring to track the movement of and changes in the contaminated groundwater plume.
- Vapor monitoring of homes determined to be "at risk" for vapor intrusion and implementation of vapor mitigation systems in houses that exceed protective levels, based on changes in the plume.

The Site consists of the Hopewell Precision facility and the hydraulically downgradient area affected by the contaminated groundwater plume and vapors. This Proposed Plan was developed by the EPA in consultation with the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH). The preferred remedy for OU 1 addresses contaminated groundwater and vapors at the Site (see Figures 1 and 2). Dilute groundwater plumes, such as the one found at the Hopewell site, are particularly difficult to address through active remediation because of the relatively low levels of contamination and the size of the plume. Traditional treatment technologies work best when applied to much higher levels of contamination. At the Hopewell site, EPA has determined that it is appropriate to utilize an innovative technology – aerobic cometabolic bioremediation – to accelerate the reduction in contaminant levels in the aquifer. ACB involves a process whereby micro-organisms present in the aquifer consume organic substrates and oxygen under aerobic conditions and produce an enzyme which destroys contaminants such as trichloroethene (TCE). Aquifer conditions at the Site are favorable for reduction of the site contaminants through this technology.

EPA divides Superfund sites into remedial phases or OUs to prioritize and accelerate selection of a remedy, when warranted. EPA has divided the Hopewell Precision site into two OUs. OU 1, which is the focus of this Proposed Plan,

Mark Your Calendar

July 31, 2009 – August 30, 2009: Public Comment Period on the Proposed Plan.

August 11, 2009 at 7:00 p.m.: The U.S. EPA will hold a Public Meeting to explain the Proposed Plan. The meeting will be held at the Gayhead Elementary School, 15 Entry Road, Hopewell Junction, New York 12533. Telephone: (845) 227-1756.

For more information, the Administrative Record file (which will include the Proposed Plan and supporting documents), is available at the following locations:

Town of East Fishkill Community Library
348 Route 376
Hopewell Junction, NY 12533
Telephone: (845) 221-9943
Website: www.eastfishkilllibrary.org
Hours:Monday-Thursday: 10 am – 8 pm
Friday: 10 am – 6 pm
Saturday: 10 am – 5 pm

and

USEPA-Region 2
Superfund Records Center
290 Broadway, 18th Floor
New York, NY 10007-1866
(212) 637-4308
Hours:Monday-Friday, 9:00 a.m. - 5:00 p.m.

Written comments on this Proposed Plan should be addressed to:

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The EPA has a web page for the Hopewell Precision Site at www.epa.gov/region2/superfund/npl/hopewell.

addresses exposures to contaminated or potentially contaminated media such as the groundwater, soils, surface water, sediments and vapors associated with the Hopewell groundwater plume. OU 2 includes provision of an alternate water supply to the area with private drinking water wells that have been or have the potential to be affected by the groundwater plume from the Hopewell Precision facility. The OU 2 Record of Decision (ROD) was completed in September 2008.

OU 1 elements summarized in this Proposed Plan are further described in the June 2008 Remedial Investigation (RI) Report and the July 2009 Feasibility Study (FS) Report. EPA and NYSDEC encourage the public to review these documents to gain a more comprehensive understanding of the Site and the Superfund activities that have been conducted there.

EPA is issuing this Proposed Plan as part of its public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA, also commonly known as the federal "Superfund" law), and Sections 300.430(f) and 300.435(c) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The Proposed Plan is being provided to inform the public of EPA's preferred remedy and to solicit public comments on the preferred remedy and the remedial alternatives that were evaluated.

The remedy described in this Proposed Plan is EPA's and NYSDEC's preferred remedy for OU 1 at the Site. Changes to the preferred remedy or a change from the preferred remedy to another remedy may be made if public comments or additional data indicate that such a change will result in a more appropriate remedial action. The final decision regarding the selected remedy for OU 1 will be made after EPA has taken into consideration all public comments. EPA is soliciting public comment on all of the alternatives considered in this Proposed Plan.

COMMUNITY ROLE IN SELECTION PROCESS

EPA and NYSDEC rely on public input to ensure that the concerns of the community are considered in selecting an effective remedy for each Superfund site. To meet this goal, the Proposed Plan, along with the supporting Remedial Investigation and Feasibility Study Reports, has been made available to the public for a public comment period which begins on July 31, 2009 and concludes on August 30, 2009.

A public meeting will be held on August 11, 2009 at 7:00 P.M. during the public comment period at the Gayhead Elementary School, 15 Entry Road, Hopewell Junction, New York, to present the preferred remedy (or "Proposed Plan") and to receive public comments.

Comments received at the public meeting, as well as written comments that EPA receives during the comment period, will be documented in the Responsiveness Summary Section of the ROD, the document which formalizes the selection of the remedy.

SCOPE AND ROLE OF ACTION

This Proposed Plan presents the preferred remedy for OU 1 at the Site. The objective of the preferred remedy is restore the groundwater to drinking water standards within a reasonable time period as well to ensure that homes over the contaminated plume do not have unacceptable levels of contaminants due to vapor migrations from the soil and groundwater and to prevent the build-up of contaminated vapors in those situations. OU 2 has been addressed in a separate Proposed Plan and ROD.

SITE BACKGROUND

Site Description

The Hopewell Precision site is located in Hopewell Junction, Dutchess County, New York. The Site consists of the Hopewell Precision facility and the hydraulically downgradient area affected by the groundwater plume and its vapors. The Hopewell Precision facility was located at 15 Ryan Drive from 1977 to 1980. The facility moved to the adjacent property at 19 Ryan Drive in 1980 and continues to operate at that location. The combined size of the two properties is 5.7 acres. The rest of the Site consists mostly of residential neighborhoods, all of which are currently served by private wells and septic systems. An alternate water supply will be provided in the near future, in accordance with the OU 2 ROD dated September 30, 2008. Almost 27,000 people live within 4 miles of the Hopewell Precision facility. Commercial development (e.g., strip malls, businesses, and gas stations) in the area is primarily along New York State Route 82, which traverses the area in a northeast-southwest direction. An area of farmland borders the eastern side of a section of Route 82. Whortlekill Creek flows in a southerly direction across the residential area and along the western border of the Site. Several ponds are present within the area, including two large former quarries (Redwing Lake and the gravel pit) that are partially fed by groundwater.

Site Geology/Hydrogeology

The Site is situated in a glaciated valley underlain by the Hudson River Formation in the northern portion of the Site and the Stockbridge Limestone in the southern portion. The bedrock is overlain by unconsolidated sediments deposited by glaciers and glacial meltwater. The glacial outwash deposits are a complex mixture of boulders, gravel, sand, silt, and clay which form discontinuous beds or lenses. Due to multiple glaciation events, subsurface units are heterogeneous and highly localized. Glacial till deposits are also present in some areas of the Site, including a tear drop shaped mound between Creamery Road and Clove Branch Road. Glacial tills generally have low permeability and limited ability to transmit groundwater.

The unconsolidated deposits at the Site have been grouped into three hydrostratigraphic units: 1) sand and gravel unit (including silty sand, silty gravel, and mixtures of sand, silt, and gravel), 2) silt and clay (including silty clay), and 3) the till mound between Creamery Road and Clove Branch Road. The sand and gravel units transmit groundwater more readily than the silt and clay units and act as preferential flow paths for groundwater contamination. All of these units are localized and discontinuous, and they are likely to create multiple complex flow pathways throughout the unconsolidated deposits.

In general, groundwater flow is towards the valley from the upland areas on the east and west sides of the valley. In the valley, groundwater flow is generally towards the southwest along the valley axis. The glacial till mound located between Creamery Road and Clove Branch Road impedes groundwater flow within the valley. Groundwater flows preferentially in silty sand and gravel units. The vertical gradient in most monitoring wells is upwards, indicating groundwater discharges into the valley and Whortlekill Creek which runs along the axis of the valley and also flows toward the southwest. The contaminant flow velocity at the Site was estimated to average from 0.8 to 1.1 feet per day in the permeable preferential flow pathways. The depth to groundwater across the Site varies but is generally about 15 feet below the ground surface. The groundwater at the Site is classified by NYSDEC as Class GA, indicating it is considered a source of drinking water.

Dissolved oxygen readings were collected during groundwater sampling to evaluate the aerobic nature of the aquifer. The dissolved oxygen readings ranged from 3.4 to 6.4 milligrams per liter (mg/L) in the background monitoring wells. As the groundwater flows across the facility toward the plume core, no apparent decrease in dissolved oxygen was observed (e.g., readings greater than 5 mg/L in plume core wells during both sampling rounds) and the aquifer conditions remained aerobic. Downgradient and beyond the plume core area, dissolved oxygen readings showed more variation, but generally remained well in the aerobic range.

Site History

Hopewell Precision manufactures sheet metal parts that are assembled into furniture. The property at 19 Ryan Drive was vacant land prior to 1980, and the company has been the sole occupant of the building. Since 1981, the former facility at 15 Ryan Drive has been used by Nicholas Brothers Moving Company for equipment storage and office space.

Processes at Hopewell Precision include shearing, punching, bending, welding, and painting. The painting process includes degreasing prior to application of the wet spray paint application. Hopewell Precision currently uses a water-based degreaser, but the company used TCE and 1,1,1-trichloroethane (1,1,1-TCA) in a vapor degreasing machine until 1998.

EPA was made aware of Hopewell Precision in October 1979 through a letter from a former Hopewell Precision employee. During an on-site inspection at the former facility (15 Ryan Drive) in November 1979, EPA observed solvent odors coming from an open disposal area. At the time of the 1979 inspection, Hopewell Precision was dumping one to five gallons per day of waste solvents, paint pigments, and sodium nitrate directly onto the ground. In August 2003, a former employee reported that the common practice for disposal of waste solvents at the former facility was to pour the material on the ground outside the building. Waste paints and thinners were dumped on a daily basis and waste solvents from the degreasers were dumped on a biweekly basis while he worked at Hopewell Precision in 1979 and 1980. The results of EPA's November 1979 inspection were sent to the NYSDEC, along with a memorandum recommending that the facility be required to drum the solvents and dispose of them in a proper manner rather than open dumping.

NYSDEC installed three monitoring wells at the former facility in May 1985 and sampled the wells in March 1986. The analytical results for Monitoring Well B-3, located between the current and former buildings, indicated the presence of 1,1,1-TCA at 23 micrograms per liter (µg/L) and TCE at an estimated 4 µg/L. In 1985, the Dutchess County Department of Health sampled four private drinking water wells near the Site, and no volatile organic compounds (VOCs) were detected in any of the samples.

NYSDEC performed a Hazardous Waste Compliance Inspection of Hopewell Precision in May 1987. The inspector observed eleven 55-gallon drums of waste paint and thinners; six 55-gallon drums of waste 1,1,1-TCA; and one 55-gallon drum of unknown material. During another inspection in October 2002, NYSDEC observed four full or partially full 55-gallon drums of waste paint and solvent at the facility.

In February 2003, as part of an effort to make final decisions on whether to archive historic sites, EPA sampled 75 residential wells near the Hopewell Precision facility. Analysis of these samples revealed that five residential wells were contaminated with TCE ranging from 1.2 µg/L to 250 µg/L. At that time, NYSDEC, on behalf of NYSDOH, requested that EPA conduct a removal action at the Site, including installation of carbon filter systems on the residential wells.

From February to November 2003, EPA collected groundwater samples from hundreds of private drinking water wells in the vicinity of Hopewell Precision. TCE and 1,1,1-TCA were detected in numerous private well samples, at individual concentrations up to 250 µg/L for TCE and 11.7 µg/L for 1,1,1-TCA. EPA subsequently installed point of entry treatment (POET) systems to remove VOCs at 41 homes where TCE exceeded or approached the maximum contaminant level (MCL). NYSDEC installed POET systems at 14 homes in the southern part of the groundwater plume, to remove 1,1,1-TCA that exceeded its New York State drinking water standard, but that fell below the Federal MCL.

In April 2003, EPA also collected water and sediment samples from small, unnamed ponds located about 300

feet south-southwest (downgradient) of the Hopewell Precision facility. TCE was detected at concentrations of 4 µg/L and 3.4 µg/L in the water samples and 88 micrograms per kilogram (µg/kg) in one of the two sediment samples. EPA collected additional samples from two unnamed ponds located approximately 900 and 4,500 feet southwest of Hopewell Precision in May 2003. TCE was detected at an estimated concentration of 3.6 µg/kg in a sediment sample from the closer pond, but was not detected in a water sample from the same location or in sediment and water samples collected from the distal pond on Creamery Road.

In July 2003, EPA collected 19 soil samples at and downgradient of the Hopewell Precision facility. TCE was detected in two on-site soil samples and 1,1,1-TCA was detected in one on-site sample, but neither contaminant was detected in any off-site samples. Additional sampling was conducted at the Hopewell Precision facility in December 2003. TCE was detected in five soil samples, at depths ranging from 0 to 12 feet. The maximum detected concentration was 3.7 µg/kg; TCE was not detected in background samples from the same depth range.

In October and December 2003, EPA installed and sampled temporary shallow monitoring wells on both properties, 15 and 19 Ryan Drive. The results indicated TCE concentrations up to 144 µg/L in groundwater at depths ranging from 10 to 30 feet below the ground surface.

EPA has conducted vapor intrusion indoor air testing at the Site. Since February 2004, EPA has collected sub-slab and/or indoor air samples from over 200 homes in the area above the groundwater plume. EPA installed sub-slab ventilation systems (SVSs) at 53 homes with vapors above the action level to reduce the residents' exposure to indoor air contaminants associated with the Site. The SVS systems are designed to vent vapors from beneath the foundation, thereby preventing the entry into the structure. In addition, at selected locations, EPA conducts annual vapor sampling during the winter heating season to monitor the migration of vapors to structures that may be at potential risk in the area of the groundwater plume.

The Site was listed on the National Priorities List in April 2005.

SUMMARY OF REMEDIAL INVESTIGATION SAMPLING

In December 2005, EPA initiated a remedial investigation and feasibility study (RI/FS) as part of the long-term Site cleanup phase. The RI/FS evaluated the nature and extent of groundwater, soil, sediment, surface water, and vapor contamination at the Site, and will help EPA determine the appropriate cleanup alternatives for the identified contamination prior to selection of a comprehensive cleanup plan for the Site. EPA completed all RI field activities during the Summer of 2007 and publicly released the RI Report in June 2008 and the OU 1 FS Report, the subject of this Proposed Plan, in July 2009.

The field activities performed as part of the RI for OU 1 included two rounds of monitoring well sampling, soil sampling at the properties occupied by Hopewell Precision, surface water and sediment sampling in Whortlekill Creek and two ponds, and vapor sampling. Residential well sampling results were summarized in the Proposed Plan for OU 2. The results of the sampling related to OU 1 are summarized below.

Monitoring Well Results

During the RI, two rounds of groundwater samples were collected from 35 monitoring wells installed during the RI and from three monitoring wells installed by NYSDEC at the Hopewell Precision facility. Two wells, EPA-07S and EPA-07D, are background wells. All of the wells were installed in the unconsolidated sediments, with shallow wells generally screened just below the groundwater table and deep wells screened just above the top of weathered bedrock. The analytical results were compared to the Federal MCLs and the New York State Drinking Water Standards. The following summary focuses on the seven contaminants that were determined to be related to activities at the Hopewell Precision facility. The site-related contaminants include TCE, 1,1,1-TCA, 1,1-dichloroethene (1,1-DCE), cis-1,2-dichloroethene (cis-1,2-DCE), chloromethane, methyl ethyl ketone (MEK) and tetrachloroethene (PCE). Although the discussions below do not include the results from the residential wells (see Proposed Plan for OU 2), the results from these wells were included in all mapping of the groundwater contaminant plumes. Figure 1 indicates the locations of monitoring wells and Figure 2 shows the mapped TCE and 1,1,1-TCE groundwater plumes. The monitoring well results will be discussed from north to south, based on proximity to the Hopewell Precision facility.

Upgradient of the Hopewell Precision Facility: Monitoring wells EPA-07S and EPA-07D were installed upgradient of the Hopewell Precision facility to determine background groundwater conditions. No site-related contaminants were detected in either well during Round 1. During Round 2, 1,1,1-TCA was detected at trace levels in both upgradient wells (0.052 J µg/L at EPA-07S and 0.065 J µg/L at EPA-07D), below the screening criterion of 5 µg/L. The "J" qualifier indicates the results were estimated. No other site-related contaminants were detected in the Round 2 samples at EPA-07S or EPA-07D.

Hopewell Precision Facility: Five wells at the Hopewell Precision facility were sampled (EPA-05, MW-B1, MW-B3, EPA-08S, and EPA-08I). In Round 1, TCE and 1,1,1-TCA were detected in MW-B3 at 0.58 J µg/L and 0.11 J µg/L, respectively, both below the screening criteria of 5 µg/L. In Round 2, 1,1,1-TCA was detected in four of the five wells at concentrations ranging from 0.094 J µg/L at EPA-08S and MW-B3 to 0.05 J µg/L at MW-B1. PCE was only detected in one of the five wells, EPA-08I, in the Round 2 sample at 0.076 J µg/L, below the screening criterion of 5 µg/L. PCE was not detected in any of the Round 1 samples. TCE was detected in two of the five wells, MW-B3 and EPA-08S, at 0.56 µg/L and 3.1 µg/L, respectively. None of the

detections of site-related contaminants in these wells exceeded screening criteria.

Oak Ridge Road to Hamilton Road: Ten wells are located between Oak Ridge Road and Hamilton Road (EPA-10S, EPA-10D, EPA-12S, EPA-12D, EPA-14S, EPA-15D, EPA-16S, EPA-16D, EPA-19S, and EPA-19D). At 6 of the 10 wells (EPA-10S, EPA-12S, EPA-15D, EPA-16S, EPA-16D, and EPA-19S), TCE was detected above the screening criterion of 5 µg/L during both sampling rounds. Levels ranged from 94 µg/L at EPA-10S to 13 µg/L at EPA-19S. 1,1,1-TCA was detected in these six wells at concentrations below the screening criterion of 5 µg/L, ranging from 2.7 µg/L in EPA-16D to 0.67 µg/L in EPA-15D. No PCE or chloromethane was detected in these six wells.

Four of the 10 wells (EPA-10D, EPA-12D, EPA-14S, and EPA-19D) had no site-related contaminants above the screening criteria of 5 µg/L. EPA-10D, EPA-12D, and EPA-19D are likely screened below the plume core and EPA-14S is located on the western edge of the plume. TCE was detected in all four wells at low levels, ranging from 1.9 µg/L at EPA-10D to 0.1 J µg/L at EPA-14S. 1,1,1-TCA was detected in two of the four wells, EPA-12D and EPA-19D, at 2.4 µg/L and 0.54 µg/L, respectively. PCE was detected in EPA-10D, EPA-14S, and EPA-19D at concentrations ranging from 0.61 µg/L at EPA-10D to 0.099 J µg/L at EPA-14S.

Hamilton Road to the Gravel Pit: Eleven wells were located downgradient of the plume core, between Hamilton Road and the gravel pit (EPA-18S, EPA-18D, EPA-21S, EPA-21D, EPA-23S, EPA-23D, EPA-24S, EPA-25S, EPA-25D, EPA-26S, and EPA-26D). Concentrations of site-related contaminants in these wells were below the screening criteria of 5 µg/L. 1,1,1-TCA was detected in 8 of the 11 wells ranging from 3.7 µg/L in EPA-23S to 0.08 J µg/L in EPA-26D. TCE was detected in two of 11 wells, EPA-21S and EPA-21D, at 0.29 J µg/L and 0.52 µg/L, respectively. PCE was not detected in any of these wells during Round 1, but was detected in four of the 11 wells (EPA-18D, EPA-21S, EPA-21D, and EPA-23D) during Round 2, at concentrations ranging from 0.23 J µg/L at EPA-23D to 0.11 J µg/L at EPA-18D. TCE was not detected in samples collected from EPA-25S and EPA-25D during Rounds 1 and 2.

Other Site Monitoring Wells: No site-related contaminants were detected during either round of sampling at EPA-09S, EPA-11S, EPA-11D, EPA-17S, EPA-20S, or EPA-22S. EPA-09S is likely to the west of the plume and EPA-11S, EPA-11D, EPA-17S, EPA-20S, and EPA-22S are likely to the east of the plume. The results for Round 1 indicated that EPA-13S, EPA-13D, EPA-17D, and EPA-22D were also outside of the plume boundary. However, PCE was detected at concentrations an order of magnitude below the screening criterion of 5 µg/L in each of these wells during Round 2.

Chloromethane was detected in three monitoring wells, EPA-19S, EPA-23D and EPA-25S, at concentrations ranging from 0.46 J µg/L at EPA-25S to 0.19 J µg/L at both EPA-23D and EPA-19S. Levels were below the screening criterion of 5 µg/L. No 1,1-DCE, cis-1,2-DCE, or MEK was detected in either round of monitoring well samples.

Summary of Groundwater Contamination: As shown in Figure 2, the shape of the TCE plume is indicative of the heterogeneous nature of the aquifer and the presence of preferential flow paths. The area of highest concentration, or the plume core, is denoted by the 50 µg/L contour. This area extends from just south of Oak Ridge Road to just north of Creamery Road. The shape of the plume mirrors the potentiometric surface and shows the groundwater turning to the west in this area as it flows preferentially between a low conductivity till to the north and the till mound to the south. The till mound is further defined by an area where TCE is not detected. The plume appears to flow around the till to both the east and west. There are low-level detections of TCE both to the west and south of the 5 µg/L contour and low levels of TCE discharge to the stream, Redwing Lake and the gravel pit.

Figure 2 also shows the outline of the 1,1,1-TCA plume to the 1 µg/L level. The 1 µg/L level was chosen because the majority of the detections were approximately 1 µg/L; detections above the screening criterion (5 µg/L) are rare. The concentrations and extent of the 1,1,1-TCA plume are significantly different than the TCE plume. 1,1,1-TCA is not detected in the groundwater in the eastern TCE lobe. The lower overall concentrations of 1,1,1-TCA may reflect the history of disposal practices at the Hopewell Precision facility. It may also be caused by 1,1,1-TCA's low vapor pressure and greater tendency to partition to the atmosphere or soil vapor. In addition, 1,1,1-TCA degrades approximately three times faster than TCE in groundwater.

Soil Results

Several VOCs were detected in soil samples as described below. The soil screening criteria were the most conservative of available federal and New York State standards.

15 Ryan Drive Sample Results: A total of 33 soil samples were collected from the former facility location varying in depth from 2-4 feet bgs to 13-15 feet bgs. Four site-related contaminants were detected. TCE was detected in 10 samples from five borings, ranging in concentration from 0.29 J µg/kg to 5.9 µg/kg; only one sample exceeded the screening criterion of 3 µg/kg. TCE was predominantly detected in the deeper samples, at 10-12 feet and/or 13-15 feet. PCE was detected at B-21 at 13-15 feet at 2.6 J µg/kg, and at B-24 at 13-15 feet at 1.7 J µg/kg, below the screening criterion of 3 µg/kg. Cis-1,2-DCE was detected in borings B-21 and B-24 in the deepest samples, with concentrations of 0.47 J µg/kg and 0.58 J µg/kg, below the screening criterion of 20 µg/kg. MEK (2-butanone) was detected once, in B-16 at 10-12 feet at 11 µg/kg, below the screening criterion of 120 µg/kg.

19 Ryan Drive Sample Results: A total of 39 soil samples were collected from the current location of the Hopewell Precision facility, varying in depth from 2-4 feet to 13-15 feet. One site-related contaminant was detected. TCE was detected in four samples from two borings (B-10 and B-11) south of the building, ranging in concentration from

0.44 J µg/kg to 1.4 J µg/kg. All concentrations were below the screening criterion of 3 µg/kg.

Background Sample Results: Three background samples were collected from one boring (B-25) in a background/upgradient location (north) of 15 and 19 Ryan Drive. Two contaminants identified as related to site activities were detected in these samples. However, as they are upgradient from the Site, they are from sources other than the Site. PCE was detected in all three samples at concentrations ranging from 2.2 J µg/kg to 3.3 J µg/kg. The PCE detection at B-25 at 8-10 feet (3.3 J µg/kg) exceeded the site-specific screening criterion of 3 µg/kg. Cis-1,2-DCE was detected below the 20 µg/kg screening criterion in all three samples, ranging from 0.52 J µg/kg to 1.2 J µg/kg.

Summary of Soil Contamination: The low concentrations and limited distribution of site-related contaminants indicate that no significant soil source remains at the facility. PCE and cis-1,2-DCE were not detected in the groundwater samples at the facility, so the concentrations in soil do not appear to impact the local groundwater.

Surface Water Results

Surface water samples were collected at 37 locations downgradient of the Hopewell Precision facility, and two background samples. Analytical results for surface water samples were compared to New York State surface water standards. Sampling areas included: Ryan Drive wetland area, Unnamed Pond 1, Unnamed Pond 2, a pond on Clove Branch Road, Redwing Lake, the gravel pit and Whortlekill Creek.

Ryan Drive Wetland Area: One sample, SW-001, was collected from the Ryan Drive Wetland area. No site-related contaminants were detected.

Unnamed Ponds 1 and 2 and Pond on Clove Branch Road: Two samples, SW-002 and SW-003, were collected from Unnamed Pond 1. No site-related contaminants were detected in either sample.

Three samples, SW-004 through SW-006, were collected from Unnamed Pond 2. No site-related contaminants were detected.

One sample, SW-027, was collected from a pond on Clove Branch Road. TCE was detected at 0.28 J µg/L, but did not exceed the 5 µg/L screening criterion.

Redwing Lake: Ten samples, SW-007 through SW-016, were collected from Redwing Lake. No site-related contaminants were detected.

Gravel Pit: Ten samples, SW-017 through SW-026, were collected from the gravel pit. Site-related contaminants 1,1,1-TCA and chloromethane were both detected at SW-017, below the 5 µg/L screening criteria for these compounds. 1,1,1-TCA was detected at SW-018 and chloromethane was detected at SW-021, SW-025 and SW-026. No site-related contaminants exceeded screening criteria.

Whortlekill Creek: Ten samples, SW-028 through SW-037, were collected from Whortlekill Creek. Site-related contaminants 1,1,1-TCA and TCE were both detected at SW-030 and SW-031. 1,1,1-TCA was detected at SW-028 and SW-029 and TCE was detected at SW-033. Concentrations did not exceed the 5 µg/L screening criteria.

Background: Two background samples, SW-038 and SW-039, were collected from Whortlekill Creek upstream of the Hopewell Precision facility in areas that should not be impacted by activities at the facility. No site-related contaminants were detected.

Summary of Surface Water Contamination: Potentiometric data show that the southern portion of Whortlekill Creek is characterized as a gaining stream. This is supported by detections of site-related contaminants at locations immediately north and south of Clove Branch Road, indicating very low levels of contaminated groundwater discharge into the water bodies. In addition, the southern portion of the creek does not flow in a distinct channel; the water is very slow moving, and prone to marshy areas. However, no site-related contaminants identified in surface water samples exceeded their screening criteria.

Sediment Sample Results

Sediment samples were collected at the same locations as surface water samples. Analytical results were compared to New York State sediment criteria. The sediment sampling areas include: Ryan Drive wetland area, Unnamed Pond 1, Unnamed Pond 2, a pond on Clove Branch Road, Redwing Lake, the gravel pit and Whortlekill Creek.

Ryan Drive Wetland Area: One sample, SD-001, was collected from the Ryan Drive Wetland area. No site-related contaminants were detected.

Unnamed Ponds 1 and 2 and Pond on Clove Branch Road: Two samples, SD-002 and SD-003, were collected from Unnamed Pond 1. No site-related contaminants were detected.

Three samples, SD-004 through SD-006, were collected from Unnamed Pond 2. No site-related contaminants were detected.

One sample, SD-027, was collected from a pond on Clove Branch Road. No site-related contaminants were detected.

Redwing Lake: Ten samples, SD-007 through SD-016, were collected from the Redwing Lake. MEK (2-butanone) was detected at 7 µg/kg at SD-014; no screening criterion is available for MEK. No other site-related contaminants were detected.

Gravel Pit: Ten samples, SD-017 through SD-026, were collected from the gravel pit. No site-related contaminants were detected.

Whortlekill Creek: Ten samples, SD-028 through SD-037, were collected from Whortlekill Creek. No site-related contaminants were detected.

Background: Two samples, SD-038 and SD-039, were collected from Whortlekill Creek in areas that should not be impacted by activities at the Hopewell Precision facility and were designated as background samples. No site-related contaminants were detected.

Summary of Sediment Contamination: No site-related contaminants were detected in any sediment samples with the exception of MEK (2-butanone) in one sample from Redwing Lake. The sediments in the area are generally free of site-related contaminants.

Deep Water Sample Results

Ten deep water samples were collected from Redwing Lake and from the gravel pit. Results were compared to surface water criteria.

Redwing Lake: TCE was detected below the 5 µg/L screening criterion at DW-001 at 0.26 J µg/L. No other site-related contaminants were detected.

Gravel Pit: Ten samples, DW-011 through DW-020, were collected from the gravel pit. 1,1,1-TCA was detected at DW-013, DW-015, DW-016, DW-017, DW-018, DW-019, and DW-020, ranging from 0.15 J µg/L to 0.37 J µg/L. TCE was detected at DW-018 at 0.14 J µg/L. Concentrations of both compounds did not exceed the 5 µg/L screening criteria.

Summary of Deep Water Contamination: Site-related contaminants 1,1,1-TCA, and TCE were detected in deep water samples; however, all concentrations were well below the screening criteria. Results of the deep water samples were similar to the surface water in that most site-related contaminants were found in the gravel pit at very low levels. The presence of very low levels of site-related contaminants indicates that groundwater discharges to the two ponds that were formerly gravel pits.

Sub-slab and Indoor Air Results

Sub-slab and indoor air investigations included two rounds of sampling for sub-slab air and one round for indoor air. The first round of sub-slab sampling included 64 properties in the winter of 2006, and the second round included 135 properties in the winter of 2007. The only round of indoor air sampling was conducted at 44 properties in the winter of 2007. Air analytical results were compared to the screening criteria developed by EPA Region 2 risk assessors. The analytical results are discussed by rounds and are described as clusters by street names.

Round 1 Sub-Slab Air Sample Results

Seventy-three samples were collected in February and March 2006 from various locations southwest of the Hopewell Precision facility, primarily in the area where the groundwater plume is dominated by 1,1,1-TCA.

Sub-Slab TCE: TCE was only detected in two samples during Round 1. The sample from Cavelo Road exceeded the screening criterion with a concentration of 18 micrograms per cubic meter (µg/m^3). The sample from Hamilton Road contained 1.5 µg/m^3, below the site-specific screening criterion. There were no other detections of TCE during Round 1 sub-slab air sampling.

Sub-Slab 1,1,1-TCA: 1,1,1-TCA was detected at 31 sample locations; none exceeded the screening criteria. A cluster of detections is located south of Clove Branch Road and north of Cavelo Road. Concentrations within this cluster range from 3 µg/m^3 to 94 µg/ m^3; all below the site-specific screening criterion. A second cluster is located north of West Old Farm Road, with concentrations ranging from 8.8 µg/m^3 to 270 µg/m^3. There were no detections of 1,1,1-TCA east of Route 82. Blue Jay Boulevard and Mockingbird Court had two detections at 0.89 µg/m^3 and 5.5 µg/m^3. Two detections were observed north of Clove Branch Road, west of Route 82 and south of Creamery Road, at 1.8 µg/m^3 to 270 µg/m^3.

Sub-Slab PCE: PCE was detected in 23 samples; none exceeded the screening criterion. A small cluster of detections were located east of Route 82 and north of Clove Branch Road, with concentrations ranging from 1.2 µg/m^3 to 7.1 µg/m^3. One detection was found south of Clove Branch Road, west of Route 82 with a concentration of 3.8 µg/m^3. The majority of detections were found in an area bounded by Old Farm Road to the south, Clove Branch Road to the north, Route 82 to the east and Purse Lane and Mockingbird Court to the west. Concentrations of PCE ranged from 1.2 µg/m^3 to 14 µg/m^3. There were two detections of PCE north of Creamery Road and west of Route 82, at 1.1 µg/m^3 and 1.2 µg/m^3.

Sub-Slab Other Site-Related Compounds: MEK (2-butanone) was detected in 17 samples at concentrations ranging from 2.2 to 16 µg/m^3. All detections were below the screening criterion. The detections were sporadic, with the majority of detections on Clove Branch Road, southern Route 82 and west of Farm Road. The highest concentration was detected at Blue Jay Boulevard.

Chloromethane was detected in 11 samples with concentrations ranging from 0.33 to 1.4 µg/m^3. All detections were below the screening criterion. More than half of the detections of chloromethane were located along Clove Branch Road. Cis-1,2-DCE was detected in two samples and 1,1-DCE was detected in one sample at concentrations below screening criteria.

Round 2 Sub-slab Sample Results

Sub-slab samples were collected in February and March 2007 from 135 buildings lying over the TCE/1,1,1-TCA groundwater plume.

Sub-Slab TCE: TCE was detected in 30 samples during Round 2; 16 exceeded the screening criterion. Detections generally lie along a north-south line from Creamery Road to Clove Branch Road and ranged in concentration from 1 $\mu g/m^3$ to 280 $\mu g/m^3$. This cluster is surrounded to the east and west by non-detects.

Sub-Slab 1,1,1-TCA: Eighty-one samples had 1,1,1-TCA concentrations ranging from 0.76 $\mu g/m^3$ to 120 $\mu g/m^3$. Detections did not exceed the screening criterion. Detections were scattered, from immediately bordering the Hopewell Precision facility to areas southwest of the facility. Detections immediately surrounding the facility ranged from 1.1 $\mu g/m^3$ to 19 $\mu g/m^3$. Further south of the facility, 1,1,1-TCA was detected in a cluster north of Creamery Road, ranging from 1.9 $\mu g/m^3$ to 21 $\mu g/m^3$. West of Route 82, detections follow Route 82 to Clove Branch Road, ranging from 0.76 $\mu g/m^3$ to 32 $\mu g/m^3$. West of Route 82, the largest cluster of detections was found between Creamery Road and West Old Farm Road, with the majority of detections west of Hamilton Drive. Concentrations ranged from 0.78 $\mu g/m^3$ to 120 $\mu g/m^3$.

Sub-Slab PCE: PCE was detected in 54 samples during Round 2. Three samples exceeded the site-specific screening criterion; two were located east of Route 82 with detections of 170 $\mu g/m^3$ to 9,800 $\mu g/m^3$. The third location was west of Route 82 with a concentration of 250 $\mu g/m^3$. Detections greater than 10 $\mu g/m^3$ but below the screening criterion were observed throughout the area south of Creamery Road and north of West Old Farm Road. A cluster of PCE detections was found west of Route 82 and east of Cavelo Road, ranging from 1.1 $\mu g/m^3$ to 10 $\mu g/m^3$. Sporadic detections below 10 $\mu g/m^3$ were observed throughout the sample area.

Sub-Slab Other Site-Related Compounds: Cis-1,2-DCE was detected in four of the samples at concentrations ranging from 1.1 to 15 $\mu g/m^3$, one detection exceeded the screening criterion. 1,1-Dichloroethene was detected in 10 samples at concentrations ranging from 0.55J to 2 $\mu g/m^3$, with all concentrations below the screening criterion.

Round 2 Indoor Air Sample Results

Forty-three air samples were collected during Round 2 in March 2007, at locations that exceeded the sub-slab screening criteria during Round 2. Three samples were generally collected at each residence, including a sub-slab sample, an indoor sample, and an ambient (outdoor) air sample. The following samples were collected: 14 indoor samples, 17 sub-slab samples, and 12 ambient samples. If buildings were closely spaced, one ambient air sample was designated to be representative of multiple structures. The properties sampled during Round 2 are scattered throughout the sampling area. No VOCs were detected in the ambient air samples so they will not be discussed further.

Sub-Slab and Indoor TCE: TCE was detected in 13 sub-slab air samples, with 10 exceeding the sub-slab criterion. Concentrations ranged from 0.24 $\mu g/m^3$ to 150 $\mu g/m3$. TCE was detected in seven indoor air samples. All exceeded the indoor screening criterion. Concentrations ranged from 0.89 $\mu g/m^3$ to 20 $\mu g/m^3$.

Sub-Slab and Indoor 1,1,1-TCA: 1,1,1-TCA was detected in 13 sub-slab air samples collected during Round 2; none exceeded the screening criterion. Concentrations ranged from 4.9 $\mu g/m^3$ to 51 $\mu g/m^3$. 1,1,1-TCA was detected in four indoor air samples: none exceeded the screening criterion. Concentrations ranged from 0.86 $\mu g/m^3$ to 2.6 $\mu g/m^3$.

Sub-Slab and Indoor PCE: PCE was detected in five sub-slab air samples; none exceeded the screening criterion. Concentrations ranged from 1.5 $\mu g/m^3$ to 16 $\mu g/m^3$. PCE was detected in six indoor air samples. One sample exceeded the site-specific screening criterion with a concentration of 560 $\mu g/m^3$. A second sample was just below the screening criterion at 98 $\mu g/m^3$. The remaining detections of PCE ranged from 1.1 $\mu g/m^3$ to 5.9 $\mu g/m^3$.

Summary of Vapor Sample Results

TCE is the primary contaminant detected above its screening criterion. 1,1,1-TCA was frequently detected, however, all of the detections were below the screening criterion. PCE was also frequently detected but only one sample, collected from an automotive garage, exceeded the screening criterion. MEK, 1,1-DCE, cis-1,2-DCE and chloromethane were all detected in at least one sample, but the detections were sporadic.

The distribution of vapors in the subsurface is controlled by processes and stratigraphy similar to those controlling the distribution of contamination in groundwater. The areas of vapor detections generally correlate with areas of groundwater detections. However, there does not appear to be a direct correlation between the magnitude of groundwater contamination and the magnitude of vapor contamination in a given area. The large area of till south of Creamery Road appears to impede the vapors and groundwater contamination in that area. No homes in this area had VOC detections in sub-slab samples.

The Round 2 sub-slab air sample results were compared to the Round 2 indoor air sample results. Seven of the locations sampled showed detections of the same compounds at similar magnitudes in both Round 2 sub-slab air samples and the indoor air samples. Four of the locations had detections in the sub-slab during both sub-slab and indoor air sampling, but there were no detections in the indoor air samples. Three locations showed no correlation between the compounds detected or the magnitude of detection between the various samples. The migration of sub-slab vapors to indoor air is affected by a number of factors, including the construction and age of the

building and the presence of cracks or other migration pathways in the substructure of the building.

RISK SUMMARY

The purpose of the risk assessment is to identify potential cancer risks and noncancer health hazards at the Site assuming that no further remedial action is taken. This Proposed Plan presents the results of the Human Health Risk Assessment and the Screening Level Ecological Risk Assessment.

Human Health Risk Assessment

As part of the RI/FS, a baseline human health risk assessment was conducted to estimate the current and future cancer risks and noncancer health hazards associated with the current and future effects of contaminants on human health and the environment. A baseline human health risk assessment is an analysis of the potential adverse human health effects caused by hazardous-substance exposure in the absence of any actions to control or mitigate these exposures under current and future land uses.

A four-step human health risk assessment process was used for assessing site-related cancer risks and noncancer health hazards. The four-step process is comprised of: Hazard Identification of Chemicals of Potential Concern (COPCs), Exposure Assessment, Toxicity Assessment, and Risk Characterization (see box "What is Risk and How is it Calculated").

The baseline human health risk assessment began with selecting COPCs in the groundwater, soil, surface water and sediment, using RI data, which could potentially cause adverse health effects in exposed populations. The populations evaluated are indicated below for each medium. In this assessment, exposure point concentrations were estimated using either the maximum detected concentration of a contaminant or the 95 percent upper confidence limit of the average concentration. Chronic daily intakes were calculated based on the reasonable maximum exposure (RME), which is the highest exposure reasonably anticipated to occur at the Site. The RME is intended to estimate a conservative exposure scenario that is still within the range of possible exposures. Central tendency exposure (CTE) assumptions, which represent typical average exposures, were also developed. A complete summary of all exposure scenarios can be found in the baseline human health risk assessment.

Groundwater

Risks and hazards were evaluated for current and future adult and child residents for ingestion of untreated tap water, dermal contact with untreated tap water, and inhalation of vapors during showering or bathing. Risks and hazards were evaluated for current and future facility workers for ingestion of untreated tap water at the Hopewell Precision facility. The total incremental lifetime cancer risk estimates were:

- Adult: RME = 7×10^{-4}; CTE = 4×10^{-5}
- Child: RME = 1×10^{-3}; CTE = 2×10^{-4}
- Facility Worker: RME = 2×10^{-5}; CTE = 6×10^{-6}

These estimates of risk were above EPA's target range of 1×10^{-6} to 1×10^{-4}. Exposure to TCE and arsenic in groundwater accounted for approximately 65 and 35 percent, respectively, of the total excess cancer risk. Arsenic is considered a known human carcinogen (Group A) by EPA. However, arsenic is not related to any activities at the Hopewell Precision facility, and it was only detected in one monitoring well sample. Therefore, risks from arsenic are likely to be minimal.

Hazard indices (HIs) greater than 1.0 indicate the potential for noncancer hazards. The calculated HIs were:

- Adult: RME HI = 4; CTE HI = 3
- Child: RME HI = 12; CTE HI = 4
- Facility Worker: RME HI = 0.2; CTE HI = 0.1

The total HI for the adult and child resident, based on individual health endpoints, is above EPA's acceptable threshold of 1 and could possibly have adverse effects on the liver, kidney, central nervous system, fetus, endocrine, and skin. TCE and arsenic contribute most of the potential noncancer hazard.

The installation of a public water supply in the area affected by the Hopewell groundwater plume will eliminate risks to residents from consumption of and contact with contaminated drinking water.

Vapor Intrusion

Inhalation of vapors volatilizing from the subsurface into indoor air is also a potentially completed exposure pathway related to the groundwater contamination from the Hopewell Precision site. A quantitative evaluation of risks and hazards associated with this pathway was not completed as part of the groundwater investigation. Instead, EPA's Response and Prevention Branch conducted and addressed vapor intrusion and indoor air issues on a house-by-house basis using a multiple-line of evidence approach. A similar approach (i.e., evaluating subslab soil gas, indoor air concentrations, and other site-specific factors) will be utilized to monitor and respond to "at risk" homes (i.e., homes that lie over the contaminated groundwater plume without mitigation systems) as part of the proposed remedy.

Surface Water/Sediment

Risks and hazards were evaluated for current and future recreational users for incidental ingestion of and dermal contact with sediment and surface water. Each water body was evaluated separately. The total incremental lifetime cancer risk estimates and HIs are shown below.

Redwing Lake

- Adult: RME = 1×10^{-6}; RME HI = 0.3
- Child: RME = 2×10^{-6}; CTE = 7×10^{-7}; RME HI = 3; CTE HI = 0.7

Gravel Pit

- Adult: RME = 3×10^{-5}; CTE = 3×10^{-6}; RME HI = 1
- Child: RME = 5×10^{-5}; CTE = 1×10^{-5}; RME HI = 13; CTE HI = 3

WHAT IS RISK AND HOW IS IT CALCULATED?

A Superfund baseline human health risk assessment is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these under current- and future-land uses. A four-step process is utilized to assess site-related human health risks for reasonable maximum exposure scenarios.

Hazard Identification: In this step, the chemicals of potential concern (COPCs) at a site in various media (*i.e.*, soil, groundwater, surface water, and air) are identified based on such factors as toxicity, frequency of occurrence, and fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation.

Exposure Assessment: In this step, the different exposure pathways through which people might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of contaminated groundwater. Factors relating to the exposure assessment include, but are not limited to, the concentrations that people might be exposed to and the potential frequency and duration of exposure. Using these factors, a Areasonable maximum exposure@ scenario, which portrays the highest level of human exposure that could reasonably be expected to occur, is calculated.

Toxicity Assessment: In this step, the types of adverse health effects associated with chemical exposures and the relationship between magnitude of exposure and severity of adverse effects are determined. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other noncancer health effects, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some chemicals are capable of causing both cancer and noncancer health effects.

Risk Characterization: This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks. Exposures are evaluated based on the potential risk of developing cancer and the potential for non-cancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means a one-in-ten-thousand excess cancer risk@; or one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions explained in the Exposure Assessment. Current Superfund guidelines for acceptable exposures are an individual lifetime excess cancer risk in the range of 10^{-4} to 10^{-6} (corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk) with 10^{-6} being the point of departure. For noncancer health effects, a hazard index (HI) is calculated. An HI represents the sum of the individual exposure levels compared to their corresponding reference doses. The key concept for a non-cancer HI is that a threshold level (measured as an HI of less than 1) exists below which non-cancer health effects are not expected to occur.

Whortlekill Creek

- Adolescent: RME cancer risk: 5×10^{-6} and CTE cancer risk: 2×10^{-6}; RME HI = 0.08

Unnamed Pond 1

- Adolescent: RME = 4×10^{-7}; RME HI = 0.04

Unnamed Pond 2

- Adolescent: RME = 6×10^{-7}; RME HI = 0.05

Pond on Clove Branch Road

- Adolescent: RME = 5×10^{-7}; RME HI = 0.04

Wetland Area South of Ryan Drive

- Adolescent: RME = 1×10^{-6}; RME HI = 0.09

These estimates for recreational users are within or below EPA's target range of 1 × 10-6 to 1 × 10-4, with the exception of the total HI for a child in Redwing Lake and the gravel pit. For Redwing Lake and the gravel pit, the calculations for the child RME scenario is above EPA's acceptable threshold of 1.0. The calculations suggest the potential for adverse effects on the whole body and blood due to concentrations of antimony. Antimony is not a site-related chemical. All other total HIs are below EPA's acceptable threshold of 1.0.

Subsurface Soil

Risks and hazards were evaluated for future construction workers for incidental ingestion of, dermal contact with, and inhalation of particulates released from subsurface soil. The total incremental lifetime cancer risk estimate and HI are shown below.

- RME = 3×10^{-7}; RME HI = 0.1

This estimate is below EPA's target range of 1×10^{-6} to 1×10^{-4}. The total HI based on individual health endpoints for the RME scenario is below EPA's acceptable threshold of 1.0.

Screening Level Ecological Risk Assessment

The SLERA evaluated the potential ecological impact of contaminants in surface water and sediment at the Site. Conservative assumptions were used to identify exposure pathways and, where possible, quantify potential ecological risks. Based on a comparison of maximum detected concentrations of contaminants in site sediment and surface water to conservatively-derived ecological screening levels (ESLs), there is no potential for ecological risk from contaminants related to the Hopewell Precision site. The SLERA indicated the potential for ecological risk from contaminants not related to the site. Specifically, hazard quotients (HQs) greater than 1.0 may indicate potential risk from exposure to the following media-specific contaminants:

Sediment

VOCs: acetone and carbon disulfide
Semi-volatile organic compounds (SVOCs): acenaphthene, anthracene, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (g,h,i,) perylene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, dibenzofuran, fluoranthene, fluorene, indeno (1,2,3-cd) pyrene, phenanthrene, and pyrene
Pesticides: 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, beta-BHC, alpha-chlordane, and gamma-chlordane
Inorganics: antimony, arsenic, cadmium, chromium, copper, cyanide, iron, lead, manganese, nickel, selenium, and silver

Surface Water

SVOCs: benzo(a)pyrene and fluoranthene
Pesticides: 4,4'-DDT, gamma-chlordane, and heptachlor
Inorganics: barium, copper, iron, manganese, and vanadium

COPCs in the SLERA were comprised of different classes of contaminants; none are the identified site-related contaminants. TCE and 1,1,1-TCA were detected in some surface water samples; however, levels detected were orders of magnitude below their respective screening criteria. In addition, MEK (2-butanone) was detected in one sediment sample below its screening criterion. These site-related compounds were not retained as COPCs due to their low concentrations. Chloromethane was identified as a site-related contaminant and was retained as a COPC because no ESL was located; however, only trace levels were detected in surface water. It is unlikely any risks exist to ecological receptors from exposure to this compound.

The SLERA indicates no risk to ecological receptors from site-related contaminants. COPCs such as polycyclic aromatic hydrocarbons and pesticides are typically associated with suburban/agricultural areas such as those within the Hopewell area, and are unlikely to be related to activities at the Hopewell Precision facility. In addition, Whortlekill Creek receives surface and road runoff via overland flow and storm water drains; other surface water bodies are subject to overland flow, further contributing to the loading of non site-related COPCs. Although groundwater has been observed to discharge to several surface water bodies in the site vicinity (e.g., Whortlekill Creek, Redwing Lake, and the gravel pit), the contaminant levels discharging to water bodies are expected to remain at extremely low levels or decrease as the groundwater plume dissipates. Therefore, no further ecological investigations or risk assessments were warranted.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are media-specific goals to protect human health and the environment. These objectives are based on available information and standards such as applicable or relevant and appropriate

requirements (ARARs), to-be-considered (TBC) guidance, and risk-based levels established in the risk assessment.

The overall RAO is to ensure the protection of human health and the environment. The specific RAOs identified for OU 1 at the Site are listed below.

For groundwater:

- Prevent inhalation of contaminants from groundwater.
- Restore the groundwater aquifer to drinking water standards throughout the plume within a reasonable time frame.

For soil vapor:

- Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at the Site.

Remediation Goals

Remediation goals or cleanup levels for OU 1 were selected based on federal and state promulgated ARARs known as groundwater Federal MCLs and New York State Drinking Water Standards, respectively. These MCLs were then used as a benchmark in the technology screening, alternative development and screening, and detailed evaluation of alternatives presented in the FS Report. The cleanup levels for groundwater are the most conservative of Federal MCLs or New York State Drinking Water Standards and are shown in Table 1 below.

Table 1: Remediation Goals

Site-Related Contaminants	Remediation Goals for Groundwater (ug/L) *
Trichloroethene (TCE)	5
1,1,1-Trichloroethane (1,1,1-TCA)	5
1,1-Dichloroethene (1,1-DCE)	5
Cis-1,2-Dichloroethene (cis-1,2-DCE)	5
Chloromethane	5
Methyl ethyl ketone (MEK)	50
Tetrachloroethene (PCE)	5

* Groundwater Cleanup levels for site-related contaminants are based on the more conservative of the Federal MCLs and the New York State Drinking Water Standards.

SUMMARY OF REMEDIAL ALTERNATIVES

CERCLA Section 121(b)(1), 42 U.S.C. Section 9621(b)(1), mandates that remedial actions must be protective of human health and the environment, cost-effective, comply with ARARs, and utilize permanent solutions and alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. Section 121(b)(1) also establishes a preference for remedial actions which employ, as a principal element, treatment to permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants at a site. CERCLA Section 121(d), 42 U.S.C. Section 9621(d) further specifies that a remedial action must attain a level or standard of control of the hazardous substances, pollutants, and contaminants, which at least attains ARARs under federal and state laws, unless a waiver can be justified pursuant to CERCLA Section 121(d)(4), 42 U.S.C. Section 9621(d)(4).

The objective of the FS for OU 1 was to identify and evaluate remedial action alternatives for contaminated groundwater at the Site, and also to mitigate impacts to human health resulting from existing, or the potential for, soil vapor intrusion into building at a site.

Detailed descriptions of the groundwater remedial alternatives for the Site can be found in the FS report. The sections below present a summary of the four alternatives that were evaluated. All alternatives were evaluated for a duration of 30 years and used a 7 percent discount rate because these are the standard default timeframe and interest rate used for comparison purposes. The use of the 30-year timeframe does not imply that the remedy would become ineffective or be removed after 30 years.

Consistent with EPA Region 2's Clean and Green policy, EPA will evaluate the use of sustainable technologies and practices with respect to any remedial alternative selected for the Site.

Alternative 1 – No Action

Capital Cost: $0
Annual Cost: $0
Present-Worth Cost: $0
Duration Time: 0 years

The "No Action" alternative is considered in accordance with NCP requirements and provides a baseline for comparison with other alternatives. If this alternative were implemented, the current status of the Site would remain unchanged. No remedial actions would be implemented as part of this alternative. Groundwater would continue to migrate and contamination would continue to attenuate through dilution. This alternative does not include institutional controls or long-term groundwater monitoring.

Alternative 2 – Aerobic Cometabolic Bioremediation

Capital Cost: $6,790,000
Annual Cost: $410,000
Present-Worth Cost: $12,000,000
Duration Time: 30 years
Construction Time: 2 years

Under Alternative 2, a pre-design investigation of aerobic cometabolic bioremediation (ACB) would be conducted along with a pilot study, and long-term monitoring. ACB involves a process whereby micro-organisms while consuming organic substrates such as methane or propane, and oxygen, produce an enzyme which fortuitously destroys contaminants. The pilot study results

will be used to design and scale-up ACB in a manner that would enhance and accelerate ACB processes.

The pre-design investigation of aerobic cometabolism would involve collection of samples from 8 to 10 monitoring wells for standard groundwater chemistry parameters, enzyme probe assays, and application of molecular biological tools (i.e., DNA analysis to provide evidence that the blueprint for the enzyme is present). The wells would be selected to represent various conditions at the Site (e.g., relatively higher and lower concentration areas, and background wells not impacted by the plume). Results would be compiled and evaluated with the groundwater chemistry, contaminant results, the enzyme probe results, the DNA results, and historical data to determine the degree to which ACB is occurring and to estimate an overall contamination degradation rate. The second step would involve laboratory microcosm studies, using Site groundwater, to simulate in-situ biodegradation of TCE in the Site aquifer. Specifically, these microcosm studies would measure TCE degradation and enzyme activity in Site groundwater; these results would then be used to estimate actual intrinsic cometabolic degradation rates.

In addition to more fully documenting the occurrence of intrinsic ACB and estimating the effective degradation rate, a pilot study would be conducted to determine the best methods to enhance the rate of ACB. The objective of the pilot study would be to investigate available primary substrates suitable for the site conditions; optimal concentrations of the primary substrate and oxygen for the enhancement; and proper layout and configurations of the enhancement system.

Based on the results of the initial aerobic cometabolism investigation and the pilot study, a full-scale system for adding the substrate will be developed and constructed. The full-scale ACB enhancement will be designed to address the entire groundwater contaminant plume, including the plume core defined by the 50 µg/L contour. Alternative 2 would consist of up to two rows of diffuser wells, with the wells estimated to be 5 feet apart. Approximately 160 diffuser wells would be installed. The wells would be flush mounted with piping connected to each well head for delivery of additive. Final configuration, however, will be determined during the remedial design. A staging area would be needed for each row.

Under this alternative, long-term monitoring would include groundwater samples collected initially annually from the monitoring well network of 35 wells strategically located in and around the groundwater plume. The analytical results would be used to evaluate the migration of and changes in the contaminant plume over time. The monitoring well samples would be collected in the late spring or early summer to allow adequate time to evaluate changes in the geometry of the plume in order to plan the vapor sampling during the winter heating season.

Vapor intrusion caused by volatilization from the groundwater contaminant plume has been monitored and mitigated by EPA for several years. Under the long-term monitoring program, a periodic inspection would be conducted of the 53 existing vapor extraction systems to ensure that the systems are working properly. In addition, EPA would initially conduct a vapor sampling program each winter heating season at homes within the areas of the Site considered to have the potential to experience vapor intrusion, based on the groundwater plume as determined by the periodic monitoring well sampling and previously conducted vapor sampling. Since 2003, EPA has conducted vapor sampling at 209 homes over the groundwater plume, with many of the homes sampled multiple times. During the initial years of annual vapor sampling, the vapor monitoring would focus on structures that have never been sampled (approximately 18 homes) and/or homes that have been sampled for vapors only once (approximately 35 homes). This would ensure that each home would have been sampled at least twice. After the first few years of annual vapor monitoring, homes to be sampled each year would be selected based primarily on other factors including, any changes in the contaminant plume, especially in any areas where the groundwater contaminant levels might show the potential to increase, and proximity to properties experiencing vapor intrusion.

Alternative 3 – Pump and Treat

Capital Cost: $7,980,000
Annual Cost: $940,000
Present-Worth Cost*: $17,470,000
Duration Time: 30 years
Construction Time: 1.5 years
* annual operation, maintenance and monitoring (O&M) costs for treatment for years 2 to 15.

Under Alternative 3, contaminated groundwater would be extracted from the core of the plume and treated, in order to enhance the restoration of the aquifer and to alleviate the occurrence of vapor intrusion. Since the contaminant plume is large and has generally reached a steady state, and TCE concentrations within a large portion of the plume are relatively low, it is neither practical nor cost-effective to extract and treat the entire plume. In the FS, the groundwater extraction wells are designed to capture the 50 µg/L TCE contaminant plume. A pre-design investigation would be conducted to obtain additional lithologic and hydrogeologic data and to further delineate the vertical characteristics of the plume and preferential flow paths. The existing groundwater flow model would be further developed. The final locations and configuration of groundwater extraction wells would be determined by additional groundwater modeling and the pre-design investigations. Contaminated groundwater extracted from the extraction wells would be treated with an ex-situ treatment system such as precipitation for iron and manganese removal, air-stripper and/or liquid phase carbon adsorption units for TCE/VOC removal. The treated groundwater would meet appropriate state and federal standards so that it could be re-injected into the aquifer, discharged to a local recharge basin, or discharged to Whortlekill Creek.

It is important to note that there are residential wells in operation within the 50 µg/L contaminant plume. The

impact of groundwater extraction wells on the yields of the residential wells was not evaluated because the OU2 ROD selected an alternate water supply for the residential area impacted by the contaminant plume.

Under the pump-and-treat alternative, long-term monitoring of groundwater and vapor intrusion identical to Alternative 2 would be implemented for the groundwater and vapors.

Alternative 4 – In-Situ Chemical Oxidation

Capital Cost: $10,720,000
Annual Cost: $4,600,000*
Present-Worth Cost*: $25,530,000
Duration Time: 30 years
Construction Time: 2 years
* annual O&M costs for treatment for years 2 to 4.

Under Alternative 4, an oxidant would be injected into selected locations of the plume core areas (i.e., greater than 50 ug/L) to reduce dissolved TCE concentrations and to enhance the restoration of the aquifer. Because the oxidation reaction can be non-selective between contaminants in groundwater and soil constituents, in-situ chemical oxidation (ISCO) would involve high costs. In the FS, it was assumed that only selected areas within the 50 µg/L TCE plume would be treated.

Alternative 4 would consist of four rows of injection wells. Within each row, the injection wells would be approximately 30 feet apart and 10 to 18 wells would be in each row. The wells would be flush mounted, with piping connecting each well head to oxidant tanks during injection. A staging area comprised of tanks, pumps and chemicals would be required for each row. A pre-design investigation would be necessary to better define the horizontal and vertical extents of the treatment area. Depending on what oxidant was used, a bench-scale treatability study would be necessary to determine the quantity of oxidant required. Furthermore, the groundwater geochemistry within the treatment zone would be temporarily altered after the injection of the oxidant. Groundwater samples would be collected prior to and post-chemical injection to evaluate the changes in groundwater quality and the effectiveness of ISCO treatment.

Under the ISCO alternative, long-term monitoring of groundwater and vapor intrusion identical to Alternative 2 would be implemented for the groundwater and vapors.

EVALUATION OF ALTERNATIVES

In selecting a remedy for a site, EPA considers the factors set forth in CERCLA '121, 42 U.S.C. '9621, by conducting a detailed analysis of the viable remedial alternatives pursuant to the NCP, 40 CFR '300.430(e)(9) and OSWER Directive 9355.3-01. The detailed analysis consists of an assessment of the individual alternatives against each of nine evaluation criteria and a comparative analysis focusing upon the relative performance of each alternative against those criteria.

- Overall protection of human health and the environment addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure pathway (based on a reasonable maximum exposure scenario) are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

- Compliance with applicable or relevant and appropriate requirements addresses whether or not a remedy would meet all of the ARARs of federal and state environmental statutes and regulations or provide grounds for invoking a waiver.

- Long-Term effectiveness and permanence refer to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met. It also addresses the magnitude and effectiveness of the measures that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

- Reduction of toxicity, mobility, or volume (TMV) through treatment is the anticipated performance of the treatment technologies, with respect to these parameters, that a remedy may employ.

- Short-Term effectiveness addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

- Implementability is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

- Cost includes estimated capital and annual operation and maintenance costs, and net present-worth costs.

- State acceptance indicates whether, based on its review of the RI/FS reports and the Proposed Plan, the State concurs with, opposes, or has no comment on the preferred remedy at the present time.

- Community acceptance will be assessed in the ROD, and refers to the public's general response to the alternatives described in the Proposed Plan and the RI/FS reports.

A comparative analysis of the remedial alternatives for OU 1, based upon the evaluation criteria noted above, is presented below.

Comparative Analysis of Alternatives

- Overall Protection of Human Health and the Environment

For all four alternatives, protection of human health from the contaminated groundwater is provided through

installation of a potable water system throughout the impacted community under the OU 2 ROD. Alternative 1 - No Action would not include any monitoring or remedial measures, and as such, would not provide any additional protection of human health or the environment. Alternative 2 – Aerobic Cometabolic Bioremediation includes evaluation of intrinsic cometabolic degradation of TCE and pilot testing followed by implementation of measures to enhance ACB. Due to presence of favorable aerobic conditions in the aquifer, it is highly likely that cometabolic degradation of TCE is occurring, which would provide TCE destruction and would protect human health and the environment. Alternatives 2, 3, and 4 would accelerate the cleanup of the plume by reducing groundwater contaminant concentrations within the plume. Alternatives 2, 3, and 4 would also rely on certain natural processes to achieve the cleanup levels for areas outside of the treatment zones. The long-term monitoring program for groundwater and vapor would monitor the migration and fate of the contaminants and ensure human health is protected. Alternative 1 would not meet the RAOs. Alternatives 2, 3, and 4 would meet the RAOs.

- Compliance with ARARs

Alternative 1 would not comply with chemical-specific ARARs because no action would be taken. Alternatives 2, 3, and 4 would comply with chemical-specific ARARs through treatment and certain natural processes (dilution, dispersion, and discharge to surface waters). Alternatives 2, 3, and 4 would comply with action-specific ARARs for all associated well-drilling activities. Alternative 3 would also comply with action-specific ARARs by controlling emissions of hazardous vapors and complying with effluent discharge requirements. Alternatives 2, 3, and 4 would comply with location-specific ARARs by minimizing any wetland impact from their implementation (e.g, well-drilling activities).

- Long-Term Effectiveness and Permanence

Alternative 1 is not considered a permanent remedy since no action would be taken. Alternative 2 would provide long-term effectiveness and permanence through aerobic cometabolic degradation of TCE and accelerated destruction of the toxic compounds through enhancements to the process, thereby decreasing the time for aquifer restoration. Alternatives 3 and 4 would provide long-term effectiveness and permanence by treating contaminated groundwater within the 50 µg/L TCE plume to shorten the time required for overall aquifer restoration. Groundwater contamination outside the 50 µg/L plume would decrease through certain natural processes including dilution, dispersion, and discharge to surface waters. Alternatives 2, 3 and 4 also would provide annual vapor sampling and vapor intrusion mitigation as necessary.

- Reduction in Toxicity, Mobility or Volume (TMV)

Alternative 1 would not reduce TMV through treatment since no treatment would be implemented. Alternative 2 would reduce TMV through cometabolic degradation of TCE through certain natural processes and measures to enhance these processes. Alternative 3 would reduce the mobility and volume of the contaminant plume through groundwater extraction and reduce the toxicity of water through ex-situ treatment using air-stripper and/or liquid phase carbon adsorption units. Alternative 4 would reduce the toxicity of the contaminant plume through in-situ destruction of the contaminants. The volume and mobility of the contaminant plume would also be reduced by the ISCO process.

- Short-Term Effectiveness

Alternative 1 would not have any short-term impact since no action would be taken. Alternative 2 would have some impact to the community during the pilot testing and enhancement pre-design investigation and installation of wells. Construction of the treatment system may require access to private property. Alternative 3 would involve the use of heavy equipment and the traffic on local roads would be impacted. Alternative 4 would also have some impact on the community since access to private properties would be necessary.

- Implementability

Alternative 1 involves no action. Because Alternative 2 involves an innovative technology, understanding of the cometabolic process and selection of proper equipment are still under development. Property access may add to the implementation challenges. Alternative 3 would be easy to implement technically, but challenging to implement administratively. Obtaining land for the treatment system and piping of influent and effluent lines would be difficult in the fully-developed residential area. Discharge of the treated effluent would also need to be resolved. Like the other action alternatives, land access would be needed to implement Alternative 4; however, access to a larger number of private properties would be required. An experienced vendor would be necessary in order to effectively distribute the oxidant in the subsurface via multiple injection wells. Implementation of ISCO in widespread and groundwater dilute plumes is typically not a proven and cost-effective technology.

- Cost

The estimated capital, annual cost, and present-worth costs for each alternative are presented in Table 2. All costs are presented in U.S. dollars and were developed using a discount rate of 7%.

Table 2: Cost Comparison for Groundwater Alternatives

Remedial Alternative	Capital Cost	Annual Cost	Present Worth	Duration
1	0	0	0	NA
2	6,790,000	410,000	12,000,000	30 yrs
3	7,980,000	940,000	17,470,000	30 yrs
4	10,720,000	460,000	25,530,000	30 yrs

According to the capital cost, annual cost and present-worth cost estimates, Alternative 1 has the lowest cost and *Alternative 4 has the highest cost when comparing all* alternatives.

- State Acceptance

NYSDEC concurs with the preferred remedy.

- Community Acceptance

Community acceptance of the preferred remedy will be assessed in the ROD following review of the public comments received on the Proposed Plan.

PREFERRED REMEDY

Based upon an evaluation of the four alternatives, EPA recommends Alternative 2 – Aerobic Cometabolic Bioremediation - as the preferred remedy for OU 1. Implementation of this alternative would be expected to provide the best overall protection of human health, especially when combined with the OU 2 alternative water supply remedy. Alternative 2 will include testing to determine to what degree TCE levels are decreasing due to cometabolic degradation and allow calculation of degradation rates. Pilot testing will determine the types of appropriate substrate(s) that can be added to the aquifer to accelerate the rate of biodegradation of TCE. Based on the pilot test results, a system for adding the substrate will be developed and constructed. In addition, long-term monitoring of the groundwater will track and monitor changes in the groundwater contamination through collection of samples on an annual or more frequent basis from the monitoring well network around the Site. An assessment of the groundwater plume indicates that contaminant levels are generally decreasing and would be expected to continue to decrease through certain natural processes within the aquifer. Limited areas where the contaminant levels are potentially not decreasing will be monitored closely for soil vapor and groundwater. The annual monitoring well sample results would be used to track changes in the contaminant plume in order to determine homes considered "at risk" for vapor intrusion. Selected structures/homes determined to be "at risk" would be sampled periodically for vapor intrusion during the winter heating season.

A work plan detailing the testing for ACB and the pilot study would be developed along with a long-term monitoring plan during the design phase of the project. The results from the long-term monitoring program would be used to evaluate the migration and changes in the contaminant plume over time. The long-term monitoring program would be modified accordingly.

Vapor intrusion caused by volatilization from the groundwater contaminant plume has been monitored by EPA. As of July 2009, 53 homes have been outfitted with vapor mitigation systems. These systems would be inspected periodically to ensure they are operating properly. A review of groundwater and vapor data would be relied upon to determine which homes without vapor mitigation systems would be tested in that year's monitoring program. These homes would be monitored through collection of three samples (sub-slab, basement, and first floor) at each building. Vapor extraction systems would be installed, if warranted.

Basis for the Remedy Preference

EPA is proposing Alternative 2 due to the somewhat unique set of conditions at the Site (e.g., large, dilute plume) which presents a particular challenge for existing remedial tools and approaches. While the scientific understanding of ACB processes and tools for implementing and monitoring ACB continue to evolve, most field work to date has focused on monitored natural attenuation of dissolved phase plumes. Deploying ACB as an 'active' remedy will require careful attention to substrate effectiveness and cost-effectiveness of delivery systems for such large volumes. The remedy will determine the rate of aerobic degradation of TCE in the aquifer via certain natural processes, and also determine, through a pilot study, the extent to which natural conditions can be enhanced to accelerate reduction of TCE to non-toxic compounds. Long-term monitoring of the groundwater and vapors will track and monitor the groundwater contamination at the Site, in combination with the remedy selected for OU 2. The Agency believes that these combined remedies for the Site would be the most protective of human health in the long-term.

While Alternative 3 would include installation of extraction wells and a treatment system for the extracted groundwater, it would be difficult to locate extraction wells and a treatment system in the core of the plume since it is beneath a fully-developed residential area. Construction activities under Alternative 3, which would involve the use of heavy equipment (e.g., drill rigs), would impact the traffic on local roads during its construction duration of one and a half years.

Alternative 4 would also require access to private properties in order to install a number wells to inject the oxidant chemical into the aquifer. Multiple injections are likely to be necessary over time. In addition, ISCO is typically employed to reduce high levels of groundwater contamination in smaller geographic areas. It is not expected to be a cost-effective technology under the conditions at the Hopewell site, where the groundwater contamination is relatively dilute and spread over a large area.

Alternative 1, No Action, would rely solely on certain natural processes to restore groundwater quality to beneficial use, and it does not include any long-term groundwater monitoring to assess the effectiveness of this remedy.

Therefore, EPA and NYSDEC believe that Alternative 2, Aerobic Cometabolic Bioremediation, when combined with the selected remedy for OU 2, would provide the best balance of trade-offs among the alternatives with respect to the evaluation criteria.

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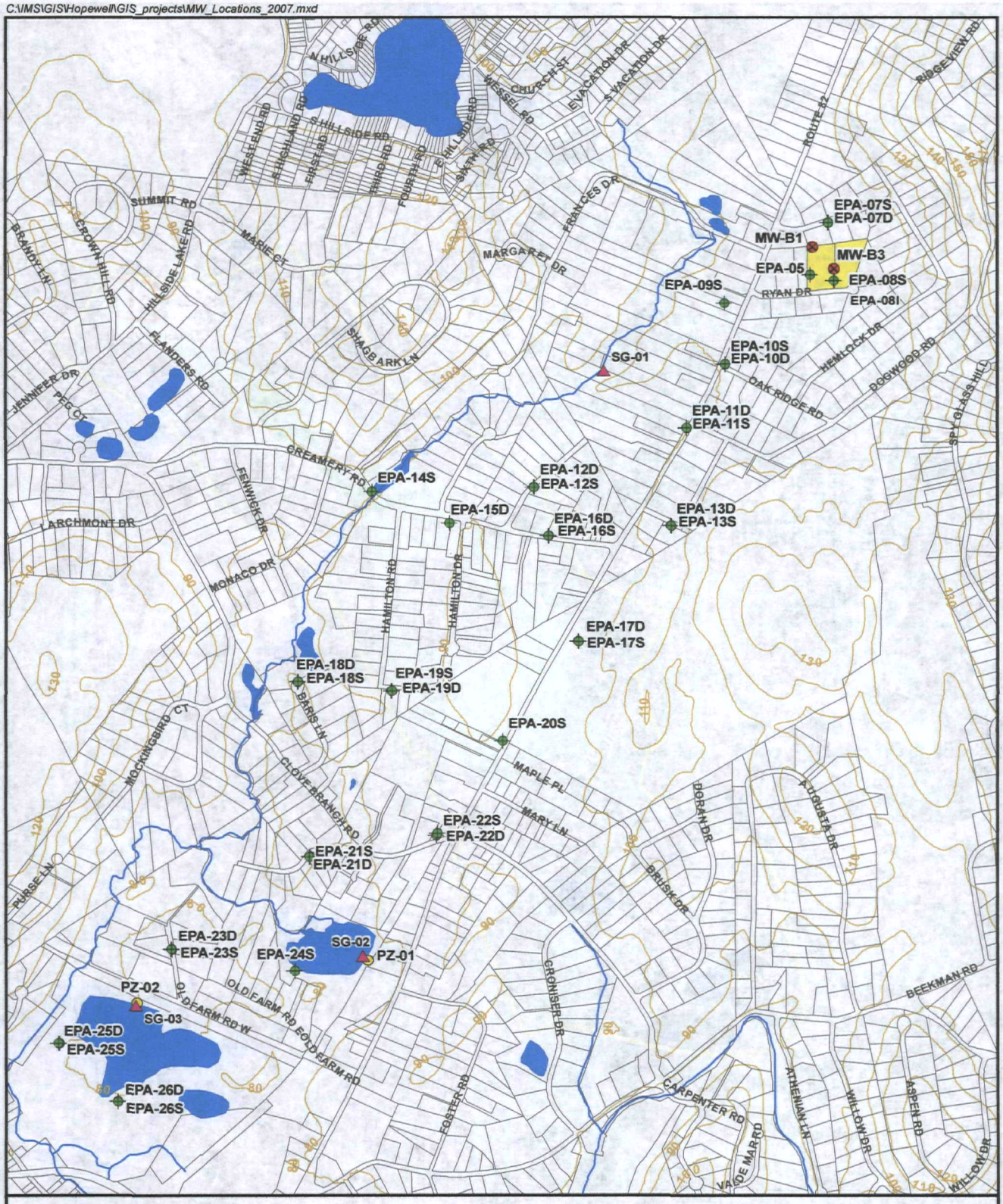

Figure 1
Monitoring Well and Piezometer Locations
Hopewell Precision Site
Hopewell Junction, New York

10.00018

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Figure 2
Contaminant Plumes
Hopewell Precision Site
Hopewell Junction, New York

CDM

10.00019