Exhibit C

Final EE/CA

TETRA TECH

September 24, 2010
112G01225

Mr. Eric Newman, 3HS23
Work Assignment Manager
USEPA Region III
1650 Arch Street
Philadelphia PA 19103-2029

Subject: Final EE/CA Report
Big John Salvage-Hoult Road, Fairmont, West Virginia

Dear Mr. Newman:

Tetra Tech NUS, Inc. (Tetra Tech) is pleased to submit the Final Engineering Evaluation/Cost Analysis (EE/CA) Report for the Big John Salvage Site in Fairmont, West Virginia. This submittal includes both hard copies of the report and a CD with electronic files.

This final report addressed all the EPA review team's comments provided for the July 2009 version, as well as subsequent comments that you provided us.

If you have any questions or comments, please feel free to contact me at 302-283-2235.

Sincerely,

Junchul Kim

Junchul Kim, Ph.D., P.E.
Project Manager

CD

jp
Enclosure

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FINAL
ENGINEERING EVALUATION/COST ANALYSIS (EE/CA) REPORT

Big John Salvage - Hoult Road Site
Fairmont, Marion County, West Virginia

Work Assignment No. 029-RICO-0371
Contract EP-S3-07-04

SEPTEMBER 2010

Prepared by:

Tetra Tech NUS, Inc.

Prepared for:

U.S. Environmental Protection Agency, Region III
Philadelphia, PA

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EXECUTIVE SUMMARY

PURPOSE

The United States Environmental Protection Agency (EPA) Region 3 has determined that a non-time critical removal action may be appropriate for the Big John Salvage-Hoult Road (BJS) Site in Fairmont, West Virginia, with respect to contamination in groundwater, soils, on-site surface water and sediment, and adjacent Monongahela River sediment. Accordingly, the Engineering Evaluation/Cost Analysis (EE/CA) has been prepared as part of Work Assignment No. 29 under Contract EP-S3-07-04 for this Site.

The goals of this EE/CA are to identify the objectives of the removal action, analyze the various removal alternatives that may be used to satisfy those objectives, and recommend the most appropriate response action to accomplish substantial, prioritized risk reduction for the Site and prevent off-site migration of contamination.

SITE DESCRIPTION AND HISTORY

The BJS Site is located in Fairmont, Marion County, West Virginia, and lies along the eastern edge of WV Route 150 (Hoult Road), approximately 1,320 feet east of the Monongahela River. The Site is approximately 38 acres in size and situated in a mixed industrial/residential area. There are several surface water courses on the Site, including Sharon Steel Run; Unnamed Tributaries #1 and #2; and West, Middle, and East Tributaries. The Sharon Steel (Fairmont Coke) Superfund site is also located on the southeastern side of the Site.

Operations at the Site began in 1925 when F.J. Lewis Manufacturing Company acquired the property. F.J. Lewis changed its name several times and eventually renamed it Reilly Corporation ("Reilly") in 1933. Reilly received and processed crude coal tar primarily from the adjacent Sharon Steel site from 1928 through 1973 - crude coal tar was also received at the Site from the DuPont Belle plant located near Charleston, WV. The wastes generated were primarily retained in unlined impoundments located near the southern portion of the Site and various other areas throughout the Site. Discharge from the primary facility impoundment reportedly flowed through a pipe into Sharon Steel Run and eventually into the Monongahela River.

In January 1973, Reilly sold the property to Big John Salvage, Inc, which operated a salvage facility through 1984. During its operation, Big John Salvage accepted various scrap and salvageable materials as well as waste materials, including glass cullet (crushed non-saleable fluorescent light bulbs) and drums containing various hazardous and non-hazardous substances. The contents of the drums were reportedly emptied into holding tanks at the Site.

In 1984, Big John Salvage, Inc. filed for bankruptcy under Chapter 11. Since 1997, Steel Fabricators, Inc. has owned the property and used it for logging-related operations.

The Site was formally added to the National Priorities List (NPL) in July 2000. Reilly, who is one of the potential responsible parties (PRPs), installed a groundwater collection system in 2001, consisting of two trenches and a pre-treatment system. Reilly continues to operate this system. In September 2001, EPA granted an exemption from the statutory limits for removal actions at the Site. The exemption waived the limitation on the amount of funds and length of time EPA can take on removal actions.

Between October 2001 and July 2003, EPA conducted additional site stabilization and removal actions. These actions included consolidation and disposal of contaminated soils, asbestos material removal, and contaminated sediment removal. During these actions, approximately 194 tons of non-hazardous and 3,000 tons of hazardous wastes were removed from the Site, and 44,000 cubic yards of excavated soil and sediment were stockpiled on the Site.

Since 2003, additional removal activities have been performed, including the consolidation of soil and sediment piled on-site; removal of additional soils and drums; and excavation of sediment from a settling pond near the mouth of Sharon Steel Run. Additional impacted sediment was removed in 2007 from the impounded portion of Sharon Steel Run near its confluence with the Monongahela River, and was staged on the upland portion of the Site pending future remediation efforts.

A full-scale remedial investigation (RI) of the Site began in 2005 and continued through 2007. Data collected during the RI were used to assess human health and ecological risks posed by the Site, and to evaluate removal action alternatives. The Draft Final RI report was completed in March 2009 and is available under a separate cover.

NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination associated with the Site was characterized during the RI. The following is a summary of the major conclusions regarding the nature and extent of contamination at the Site:

Surface Soil

The surface soils at the Site contained polycyclic aromatic hydrocarbons (PAHs) at concentrations ranging from 2 mg/kg to greater than 1,500 mg/kg. The distribution of PAHs was widespread, and nearly 75% of the locations sampled during the RI contained concentrations of PAHs in excess of either human health or ecological risk assessment screening criteria. The highest concentrations of PAH were detected in the northwestern portion of the Site in forested, brushy areas, and in storm-water swale drainage areas that were not previously addressed by removal activities.

Heavy metals, including arsenic, aluminum, copper, iron, manganese, mercury, nickel, and vanadium, were also widely distributed throughout the Site, but only arsenic, copper, mercury, and zinc are present at concentrations of human health or ecological concern. The highest concentrations of mercury were found in the vicinity of the historic glass cullet operations.

Subsurface Soil

During the RI, contaminated subsurface soils were found in more than 80% of the 62 soil borings in depths ranging from immediately below the surface to more than 20 feet below grade. There appeared to be a few areas with elevated volatile organic compound (VOC) levels (e.g., BTEX > 70 mg/kg), but PAHs were the most widespread contaminant detected at the Site, with the highest concentrations (e.g., >20,000 mg/kg) found in the current soil stockpile area.

There were a wide variety of inorganics present in subsurface soils throughout the Site with no apparent pattern observed in the extent of detection. Mercury was detected in several borings in the vicinity of the former cullet processing area, and several other heavy metals (lead, arsenic, cadmium, mercury, and nickel) were also found at high concentrations near the top of the West Tributary.

Groundwater

Organic compounds (predominantly BTEX and naphthalene) were present in the overburden aquifer in the central portion of the Site in areas consistent with historical operations. The types of contaminants detected in the overburden groundwater were consistent with those detected in subsurface soils. The highest BTEX concentrations were nearly 0.5 mg/l, and the highest total PAH concentrations were more than 3 mg/l. No light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL) were observed in any of the RI monitoring wells. The overburden groundwater also contains a wide variety of inorganics, which were widely distributed with no apparent pattern in the extent of detection.

Only low levels of VOCs and semivolatile organic compounds (SVOCs) were infrequently detected in most bedrock monitoring well samples. The majority of the compounds detected (benzene, toluene, xylene and naphthalene) were similar to those found in the overburden aquifer; however, the concentrations detected in the bedrock aquifer ranged only from 1 to 7 ug/l. Otherwise, the bedrock aquifer at the Site appeared to be generally unimpacted by organic compounds.

Bedrock groundwater contained a wide variety of dissolved and total inorganics, which were widely distributed across the Site, with no apparent pattern observed. The nature and distribution of the inorganics were primarily related to the various rock types underlying the Site (i.e., shale, sandstone, and limestone).

On-Site Surface Water

Only low levels of organic compounds (benzene and several PAHs) were detected in surface water samples collected from Sharon Steel Run and Unnamed Tributary #2 drainages (note that these are the only drainages with water in them during the RI field efforts - see Section 1.4.6 for an additional detailed description of the surface water drainage features at the Site). Benzene was detected at several locations at concentrations ranging from non-detect to 110 ug/l in the main Sharon Steel Run drainage. The source of the benzene is likely discharge from the overburden aquifer in the area, potentially from contaminant sources located on Site as well as from the adjacent Sharon Steel Fairmont Coke Works Site, which historically has high benzene concentrations in the groundwater. PAHs are also both human health and ecological chemicals of concern. The inorganics were widely distributed with no apparent trend in concentration change for most analytes, except in localized areas where the influence of the local overburden groundwater discharge was apparent in the surface water quality.

The surface water sample collected farthest upstream from the Site within the Sharon Steel Run related drainages had elevated concentrations of iron and manganese. This suggests that the groundwater discharging at and upstream from this location (which is located at the edge of the Sharon Steel Fairmont Coke Works Site) may also be impacted.

On-Site Sediment Assessment

A wide variety of PAHs, a few SVOCs, and very low concentrations of some pesticides and polychlorinated biphenyls (PCBs) were detected in sediment samples collected from the Sharon Steel Run drainage and Unnamed Tributary #2. In general, the concentrations of PAHs detected in the sediments were less than those detected in the on-site soil samples. The on-site drainages have been subject to extensive removal actions, so the current sediment contamination reflects a combination of residual contamination left over from prior removal actions (such as those impacted sediments that remain in the West Tributary), contamination related to continued surface water runoff from the Site, and contamination related to subsurface leaching from groundwater.

The concentrations of total PAH compounds in the Sharon Steel Run drainage ranged from non-detect to 81 mg/kg. Along Sharon Steel Run, low concentrations of total PAHs were found in the sediments in the stretch immediately downstream of the East Tributary, while high concentrations (~30 - 80 mg/kg) were found associated with the impoundment near the confluence with the Monongahela River. Sediments upstream of the Site also had total PAH concentrations ranging from 54 - 67 mg/kg. No PAHs were detected in the Sharon Steel Tributary. The highest concentration of total PAHs was found in the Unnamed Tributary #2 where PAH concentrations ranged from 297 to 510 mg/kg for the locations on the north side of the Site, and from 4 to 440 mg/kg on the portion of this drainage located off the property.

The sediment samples contained a wide variety of inorganics; however, there appeared to be no atypical inorganic detections that were widespread across the Site. The inorganics were widely distributed with no apparent pattern observed in the extent of detection, although mercury showed an increasing concentration trend in Sharon Steel Run downstream of the West Tributary. Concentrations of selected inorganics (including aluminum, barium, cadmium, iron, lead, manganese, and mercury) were present in sediment at concentrations in excess of risk screening levels. These heavy metals were most likely bioavailable.

Monongahela River

The analytical results indicated that the discharge from Sharon Steel Run was not affecting the Monongahela River water quality, as there was no major change in water quality observed above and below the confluence even if it does not meet Total Maximum Daily Load (TMDL).

With respect to the sediment sample results for the river, a wide variety of PAHs, a few SVOCs, and very low concentrations of some pesticides and PCBs were detected. The total PAH concentrations in the river sediment increase substantially below the confluence with Sharon Steel Run. Elevated total PAH concentrations extended at least 2,000 feet downstream from the confluence along the eastern bank of the river. A black semi-solid deposit (BSD) was observed in the sample collected approximately 100 feet downstream from the confluence, and the high total PAH concentrations (>1,500 mg/kg) were detected in sediments approximately 1 foot below the river bottom, approximately 300 feet downstream from the confluence.

In June 2005, Reilly delineated impacted river sediment areas downstream of the confluence using divers. The underwater visual inspection indicated the presence of the BSD extending at least 50-75 feet away from the east bank, and approximately 250 feet downstream from the confluence. The BSD was also observed extending about 25 feet upstream of the current confluence location. Further, the divers delineated stained sediments under a surficial layer of clean sediments extending at least 800 feet downstream. Reilly also collected samples of the BSD and reported total PAH concentrations for most samples in excess of 20,000 mg/kg.

The river sediment contained a wide variety of inorganics; however, there generally appeared to be no atypical inorganic detections that were widespread across the reach of river investigated during the April

2005 and April 2007 sampling events. Common inorganics detected in most samples included arsenic, antimony, cadmium, copper, cyanide, iron, lead, manganese, silver and zinc. However, some anomalously high lead concentrations were detected in sediments immediately downstream from the Sharon Steel Run confluence during the April 2005 sampling event. Based on acid volatile sulfide/simultaneous extracted metals (AVS/SEM) analysis, the metals present in the sediment are likely to be bioavailable.

Additional river sediment sampling conducted in 2007 indicated that the total PAH concentrations in the shallow river sediment generally ranged from 1.89 mg/kg to 4.76 mg/kg, with two exceptions noted at locations collected near the delineated BSD area, where total PAH concentrations were detected at 27 mg/kg and 1,289 mg/kg. Total organic carbon (TOC) content in the sediments ranged from 19,000 to 44,000 mg/kg.

In addition to surface water and sediment sampling, additional sampling was conducted in the Monongahela River to support ecological characterization. Clam samples were collected from two locations in the river— one from a location with relatively unimpacted sediments (total PAH concentrations < 2 mg/kg), and one from a location heavily impacted (total PAH concentrations ~ 1,300 mg/kg). The total PAH concentration in clam tissue collected from the less impacted location was 710 ug/kg, whereas the total PAH concentration in clam tissue collected from the impacted sediment location was 220 mg/kg, which clearly indicates PAH uptake into the clam tissue.

Sediment toxicity tests revealed that the sediment collected from the vicinity of the BSD caused significant mortality to Hyalella azteca after 28 days of exposure (note that this location had a total PAH concentration of ~ 1,300 mg/kg.) Finally, the aquatic invertebrate study suggests that some factor downstream of the Sharon Steel Run confluence appears to be negatively influencing invertebrates. The community metrics were the lowest (compared to the upstream reference point) in the reach comprising the three sampling stations located immediately downstream from the Sharon Steel Run confluence.

PRELIMINARY REMOVAL GOALS

Based on the findings of the human health risk assessment (HHRA) and baseline ecological risk assessment (BERA), the contaminants of concern (COCs) that would be major contributors to the risk for each major medium at the Site were determined, including those for soil, groundwater, on-site surface water, on-site sediment, and the Monongahela River sediments. No human health or ecological risks were found associated with the Monongahela River surface water.

In addition to the COCs, applicable or relevant and appropriate requirements (ARARs) and other to be considered (TBCs) were also considered in the development of the preliminary removal goals (PRGs), which are medium-specific contaminant concentrations that are protective of human health and the environment if present in the media of concern.

The proposed PRGs were intended to meet EPA's target risk range for both human and ecological receptors (soil, groundwater, sediment and surface water media), as well as meet chemical-specific ARARs where appropriate (groundwater and surface water media). Note that a goal of protection for carcinogenic risks were concentrations equating to a 1x10E-5 risk level, while the goal of protection for non-carcinogenic risks were concentrations equating to a hazard index of 1.0.

The EE/CA PRGs for the Site were proposed for each COC in the following media:

- Soil - including both surface soil (human health and ecological risk) and subsurface soil (human health risk, as it relates to both direct exposure and soil-to-groundwater pathway considerations)
- On-Site Surface Water* - including Sharon Steel Run and all associated tributaries, as well as Unnamed Tributary #2
- On-Site Sediment* - including Sharon Steel Run and all associated tributaries, as well as Unnamed Tributary #2
- On-Site Groundwater* - both overburden and bedrock aquifers
- Monongahela River Sediment – the bottoms solid deposit (BSD) material and stained sediments (ecological and human health risk)

* Note that for the purpose of the EE/CA, on-site surface water, groundwater, and sediment refer to contaminated media associated with the BJS property itself.

DETERMINATION OF REMOVAL SCOPE

The scope of the removal action is site-wide, and includes all areas and media impacted with contaminants that exceed the Removal Performance Standards identified. The scope of the removal action for each impacted media and the related removal action objectives are summarized below:

Soil

There are approximately 312,000 cubic yards (~505,000 tons) of impacted soils at the Site to be addressed as part of the removal action. This encompasses the following:

- 122,000 cubic yards (~197,000 tons) of surface soil (0-5 feet);
- 93,500 cubic yards (~152,000 tons) of deeper soil with high polycyclic aromatic hydrocarbon (PAH) concentrations and/or observable contamination;
- 44,500 cubic yards (~72,000 tons) of deeper soil with both high volatile organic compound (VOC) and PAH concentrations; and
- 52,000 cubic yards (~84,000 tons) of PAH contaminated soils/sediment currently stockpiled at the Site from prior EPA removal actions.

Groundwater

The contaminated groundwater was found in both overburden and underlying bedrock aquifers. The primary COCs were PAHs and several VOCs. There were also several heavy metals, which are also of concern, including iron and manganese (both overburden and bedrock aquifers), as well as arsenic and thallium (infrequently detected in the overburden aquifer only).

Overburden Aquifer: With regard to the overburden aquifer, an area encompassing approximately 360,000 square feet (~8.25 acres) was identified to contain Site-related COCs. The depth to groundwater in the overburden ranged from 21 to 45 feet below land surface. The saturated thickness of the overburden aquifer ranged in thickness from 4 to 11 feet. Given the nature of the overburden (silty clay with a basal sand unit and a typical porosity of 40%), the impacted area of the aquifer was estimated to contain approximately 8 million gallons of water (based on an average saturated thickness of 7.5 feet). Small volumes of Non-Aqueous Phase Liquids (NAPL) flow down the Middle and East Tributaries along the bedrock interface and are mostly captured for treatment in collection sumps at the base of the respective tributaries.

Bedrock Aquifer: With regard to the bedrock aquifer, an area encompassing approximately 500,000 square feet (~11.7 acres) may contain Site-related COCs. The depth to groundwater measured in the bedrock aquifer wells ranged from artesian (free flowing) to more than 130 feet below the surface. The volume of water impacted in the bedrock aquifer could not be determined during the RI, as storage in the bedrock is a function of fracture occurrence and density.

On-Site Sediment

The contaminated on-site sediment includes surficial sediments found primarily in Sharon Steel Run, Unnamed Tributaries #1 and #2, as well as the West, Middle, and East Tributaries. The primary COCs included PAHs and a few heavy metals (i.e., lead, manganese, and mercury) present at concentrations in excess of PRGs. Approximately 3,280 cubic yards (~5,000 tons) of impacted on- and near-Site sediments were considered as part of the EE/CA.

On-Site Surface Water

The impacted surface water at the Site is derived from a combination of surface water runoff and groundwater discharge, including Sharon Steel Run/Unnamed Tributary #1 (approximately 1,800 feet of stream segment) and Unnamed Tributary #2 (approximately 800 feet of stream segment). The primary COCs associated with on-site surface water included benzene, PAHs, and metals.

Monongahela River Sediment

The impacted Monongahela River sediment includes both shallow sediment (posing unacceptable human health and ecological risk) and deep sediment (posing human health risk). For the purposes of the EE/CA, the response action focuses on the hotspot of high PAH concentrations demonstrating active toxicity to aquatic organisms and acting as a source of contamination further downstream. The shallow sediment consists of the sediment layer primarily ecologically available (0-12 inches below the bottom of the river), whereas the deep sediment is considered to extend from 12 inches to a maximum of 60 inches below the bottom of the river.

Based on the RI, the two most significant types of impacted sediments in the Monongahela River are:

- Black semi-solid deposits (BSD) - Analytical results for the BSD indicate that total PAH concentrations can be in excess of 20,000 mg/kg). Consequently, all sediments with BSD are considered impacted. The estimated extent of this material ranged from 50 to 100 feet wide, extending from approximately 25-50 feet upstream to 350 feet downstream from the Sharon Steel Run confluence. This equates to a total area of approximately 40,000 square feet. The thickness of this material was estimated to range from 1 to 3 feet thick, such that the volume of the BSD and related impacted sediments is estimated to be approximately 4,500 cubic yards or 7,500 tons.
- Stained sediment deposits (SSD) - Analytical results from the samples in the general area mapped as "stained" indicated a concentration of 1,289 mg/kg. Consequently, all shallow stained sediments were considered impacted. The estimated extent of this stained area is approximately 30 feet wide by 800 feet long. This equates to a total area of approximately 24,000 square feet.

The thickness of this stained layer is unknown, but may be up to 1 foot thick (or more), so the volume of stained sediments is approximately 900 cubic yards or 1,400 tons. For reference, concentrations of total PAHs in the stained sediments are expected to be in excess of 100-500 mg/kg.

Additionally, sediment demonstrating lower concentrations of PAHs which are above PRGs includes:

- Deep sediment deposits (DSD) - Deep sediment samples indicated elevated concentrations of total PAHs, ranging from 32 to 63 mg/kg, which are in excess of the PRG goal of 26 mg/kg for protection of ecological receptors. These concentrations may be considered impacted in the event that erosion was to bring these sediments to the surface of the river bottom. The total extent of impacted deep sediments were not fully delineated during the RI; however, the approximate area is 450,000 square feet. Given the thickness of deep sediment through this stretch of the river (ranging from 2 to 5 feet), the estimated volume of potentially impacted deep sediments ranges from approximately 34,000 to 85,000 cubic yards or 55,000 to 136,000 tons.

Note that only the BSD and stained sediment deposits are proposed to be addressed by this EE/CA. The deep sediment deposits will be further evaluated in the future as part of the final risk evaluation and record of decision (ROD) developed for this Site.

REMOVAL ACTION OBJECTIVES

The objectives established for this removal action guided the development of the alternatives, and provided the focus to the comparison of acceptable removal action alternatives. These removal action objectives (RAOs) also assisted in clarifying the goal of reducing the hazard posed by the various contaminants in the surface soil, subsurface soil, groundwater, sediment, and surface water at the Site, and achieving an acceptable level of protection to the public health and the environment. These objectives also established goals for restoration of impacted media to meet ARARS or for the benefit of human health and environment.

Objectives for Soils

Removal action objectives to address risks associated with surface and subsurface soils include:

- Prevent current and future workers, future residents, and ecological receptors from adverse effects that may result from exposure (dermal, ingestion, and vapor inhalation) to contaminated soils.
- Minimize the infiltration of precipitation into the soil to reduce the potential for leaching of soil contaminants into groundwater.
- Prevent the continued migration of tar derived material to the surface.
- Prevent erosion and surface water runoff to prevent migration of soil contaminants.

Objectives for Groundwater

Removal action objectives to address risks and ARARs associated with groundwater include:

- Prevent future exposure of workers and residents to contaminated groundwater.
- Prevent further migration of the contaminant plume.
- Prevent contaminated groundwater discharge to surface water.

- Restore groundwater quality in the overburden and bedrock aquifers.

Objectives for Surface Water (other than the river)

Removal action objectives to address risks and ARARs associated with surface water include:

- Mitigate contaminated surface water discharge from the Site to meet water quality standards.
- Restore surface water quality to acceptable human/ecological risk levels.
- Restore surface water drainage quantity and ecological functions in and along the waterway.

Objectives for Stream Sediments

Removal action objectives to address risks and ARARs associated with the Sharon Steel Run/Unnamed Tributary #1, Unnamed Tributary #2, and West Tributary sediment include:

- Prevent further migration of contaminated sediments to the Monongahela River.
- Prevent exposure of contaminated sediments to receptors.
- Restore sediment quality to acceptable human/ecological risk levels and to promote ecological function in the waterway.

Objectives for Monongahela River Sediments

Removal action objectives to address the risks and ARARs associated with Monongahela River sediments include:

- Remove industrial wastes (black semi-solid deposits [BSD]), tar materials, and any visible residuals and fragments) and stained sediments containing high concentrations of PAHs (>100 - 500 mg/kg) from the river bottom..

Note that although the improvement of river sediment quality, restoration of river sediment quality to acceptable human/ecological risk levels, and promotion of the ecological function of the waterway are the ultimate long-term objectives for the Monongahela River sediments, these objectives will not be specifically addressed as part of the scope of this EE/CA. These additional objectives will be further considered and evaluated in the future after the completion of any non-time critical removal action as part of the final risk evaluation and subsequent action (if any) required for the Site as determined by the future record of decision (ROD).

REMOVAL ACTION ALTERNATIVES

The EE/CA developed the removal action alternatives for the various media at the Site. The process began with identifying general response actions available to meet removal action objectives. The technologies that could be used to implement the response actions were then identified, analyzed to determine their applicability for this Site, and eventually combined to form removal action alternatives.

The EE/CA identified, screened, and evaluated the following removal alternatives for each major medium of concern for their effectiveness, implementability, and cost:

Soil

Alternative SO1: No-Action
Alternative SO2: No Further Action*
Alternative SO3: Excavation and On-Site Thermal Treatment*
Alternative SO4: Excavation and Off-Site Disposal/Treatment*
Alternative SO5: Capping/Containment
Alternative SO6: In-Situ Treatment - Chemical Oxidation
Alternative SO7: In-Situ Treatment - Stabilization/Solidification*

Groundwater

Alternative GW1: No-Action
Alternative GW2: No Further Action*
Alternative GW3: Monitored Natural Attenuation*
Alternative GW4: Expansion of Existing Groundwater Containment System
Alternative GW5: In-Situ Chemical Oxidation
Alternative GW6: In-Situ Bioremediation*

On-Site Sediment

Alternative OSS1: No-Action
Alternative OSS2: Excavation and Off-Site Disposal/Treatment
Alternative OSS3: Excavation and On-Site Confinement
Alternative OSS4: Monitored Natural Recovery*

Monongahela River Sediment

Alternative RS1: No-Action
Alternative RS2: Excavation and Off-Site Disposal/Treatment
Alternative RS3: Excavation and On-Site Confinement
Alternative RS4: Monitored Natural Recovery

* These alternatives were screened out, based on their effectiveness, implementability, or cost. A comparative analysis was then conducted for those retained to identify the most appropriate removal action for each medium.

RECOMMENDED REMOVAL ACTION

The recommended removal action alternatives for the site are as follows:

SOIL

The recommended removal action to address the soil RAOs is Alternative SO5 - Capping/Containment. This alternative would address all of the soil RAO's including:

- Prevention of future exposure to human and ecological receptors to contaminated soil through the construction of a barrier;

- Elimination of infiltration of precipitation into the soil through the construction of a relatively impermeable barrier, thereby reducing the potential for continued leaching of contaminants in the vadose zone to the groundwater; and
- Elimination of contaminated soil erosion and surface water runoff through the construction of a barrier.

This soil removal alternative could also incorporate the sediments to be removed from the on-site waterways.

The actual extent and configuration of the cap under this alternative would be selected during design. Additional pre-design studies would ultimately establish the size of the cap (18 acres or less), as well as address how the steep slope area with on-going tar seeps will be managed. Contaminated soils which have eroded onto adjacent parcels will be consolidated on-site. Select excavation and on-site or off-site disposal of hot spot areas around the perimeter of the Site could further reduce the cap size. The future land use of the site would also influence the selection of the cap profile (i.e., typical RCRA Subtitle D cap, expanded cap, asphalt cap, or other alternative cap that is protective to human health and the environment).

Innovative storm-water management features will be considered to restore the base flow to the waterways adjacent to the Site to enhance overall ecological restoration for the Site. Storm-water management features such as retention basins (permanent wet ponds with capacity to store and discharge storm water), detention basins (dry ponds with the capacity to store and discharge storm water), and infiltration basins placed in unimpacted soil areas outside the cap could be used to enhance the base-flow conditions of the Site waterways. These design features would assist in meeting surface water RAOs related to restoration of surface water quality and quantity.

Further, the overall cost of the design and construction of the cap can potentially be reduced through the use of alternative capping materials (such as biosolids, compost, recycled ground glass as a replacement for part of the topsoil), use of alternative capping approaches (such as phytostabilization for the areas on the north side of Sharon Steel Run), and the use of native plants (which would reduce the maintenance interval on the final cap system).

The present worth cost of the various capping scenarios developed for this alternative ranges from $7,142,000 (Subtitle D cap) to $8,332,000 (Subtitle D cap with asphalt).

GROUNDWATER

The recommended removal action to address the groundwater RAOs is Alternative GW4 - Expansion of Existing Groundwater Containment System - Option A - Upgrade of Existing Plant and Continued Discharge to the City of Fairmont Sewer System. This alternative will address all of the risk-related groundwater RAO's, including:

- Prevention of further migration of the contaminant plume and groundwater discharge to the surface water via an expanded groundwater collection and containment system; and
- Prevention of future exposure to workers and residents to contaminated groundwater through institutional controls.

This alternative also helps to address several surface water RAOs, including the mitigation of contaminated surface water discharge and restoration of surface water quality through a reduction in contaminated groundwater discharge to the surface water.

This alternative will not meet the total area groundwater restoration RAO; however, GW4 can achieve groundwater performance standards within the area of attainment within a reasonable time frame (i.e., <10 years). The expansion of the groundwater collection system will allow for more contaminant mass to be removed from the groundwater than the current system. Expanded groundwater collection will slowly contribute to the restoration of the aquifer, but attainment of the groundwater PRGs would take many years to accomplish.

Restoration of the groundwater in the overburden aquifer would only be possible through the removal or treatment of the large volume of contaminated soils, which is a continuing source of the groundwater contamination - however, major contaminated soil complete source removal or treatment is not the recommended removal action to address the soil RAOs (see above). However, the capping/containment removal action for the soil will ultimately reduce the infiltration of precipitation through the contaminated soil in the unsaturated zone, thereby reducing some of the source that contributes to groundwater contamination at the Site.

Consequently, the establishment of a Waste Management Area (WMA) is recommended for the overburden aquifer areas as well as the bedrock aquifer. In general, the bedrock aquifer has not been substantially impacted by organic contaminants to date, although it contains some inorganics at concentrations in excess of groundwater PRGs related to changes in aquifer geochemistry caused by the contamination in the overburden aquifer. Continued monitoring of the adjacent overburden and bedrock aquifer areas would be used to confirm the effectiveness of the expanded groundwater containment system for controlling groundwater migration and meeting performance standards in the area of attainment.

The continued discharge of treated groundwater to the City of Fairmont Sewer System is recommended over an on-site treatment and discharge approach because of operational and cost considerations. Given the relatively small volume of groundwater discharge to the Sharon Steel Run system from the Site (3-6 gallons per minute on average), it would be more feasible to design innovative storm-water management features for base-flow improvement as part of the soil capping and containment removal action rather than treat and discharge this small volume of groundwater using an on-site system. The use of detention basins, retention basins, and infiltration basins in unimpacted portions of the Site to manage storm water would be a more effective way to improve base-flow conditions in the area waterways.

The present worth analysis cost for this alternative is $5,073,000.

ON-SITE SEDIMENT

The recommended removal action to address the on-site sediment RAOs is Alternative OSS3 - Excavation and On-Site Confinement. This alternative will address all of the on-site sediment RAOs, including:

- Prevention of further migration of the on-site contaminated sediments to the Monongahela River, as they will be consolidated and confined beneath a cap;
- Prevention of future exposure of human and ecological receptors to contaminated sediments as

they will be removed and confined; and
- Restoration of sediment quality to acceptable human health/ecological risk levels through removal and the promotion of ecological function through restoration actions conducted as part of sediment removal activities.

Approximately 3,300 cubic yards of sediments would be removed from the on-site waterways using various means, and then placed on the main part of the Site for dewatering (with collection and treatment of decant water), consolidation with the on-site soil stockpile, and amendment (if necessary for stabilization/solidification) prior to incorporation into the foundation layer for the soil cap. Restoration efforts in the waterways will also be monitored for a period of 5 years after the completion of removal activities.

The present worth cost for this alternative is $523,000.

MONONGAHELA RIVER SEDIMENT

The recommended removal action to address the Monongahela River sediment RAOs is Alternative RS2 - Excavation and Off-Site Disposal/Treatment (Removal Option B) to address the black semi-solid deposit (BSD) and stained sediment deposits (SSD).

This alternative will address most of the Monongahela River sediment RAOs, including:

- Removal of the BSD from the river bottom, thereby uncovering smothered benthic habitat and eliminating a source of continued contaminant migration to other parts of the river;
- Prevention of exposure by receptors to the most contaminated sediments (BSD and SSD) through removal and off-site disposal/treatment of these highly contaminated sediments; and
- Restoration of sediment quality through the removal of and off-site disposal of highly contaminated sediments to promote improved ecological function of the waterway.

Approximately 5,400 cubic yards of BSD and SSD impacted sediments would be removed from the Monongahela River using various means, and then would be temporarily staged on the main part of the Site for dewatering (with collection and treatment of decant water) and amendment (if necessary for stabilization/solidification) prior to off-site disposal/treatment.

The removal of the most contaminated sediments in the Monongahela River, coupled with the elimination of further sediment transport from the Site through the construction of an on-site cap, better containment of seeps, and the removal of on-site sediments should reduce the COC concentration and mass enough to allow natural attenuation processes to begin to reduce the exposure to safe levels over time. This section of river should begin to restore itself in the future once the most contaminated sediments are removed. Annual monitoring for an initial period of 5 years will be used to assess the restoration of the Monongahela River sediments upon completion of the other removal actions. The risks of residual contaminants in the river sediments after the completion of the removal action will ultimately be further addressed in the future as part of the final risk evaluation and record of decision (ROD) developed for this Site.

The present worth cost for this alternative is $5,056,000.

SUMMARY

The total estimated cost for all of these removal actions is as follows:

Groundwater - Alternative GW4		$5,073,000
Soil - Alternative SO5		$7,142,000 to $8,332,000
On-Site Sediments - Alternative OSS3		$523,000
Monongahela River Sediments - Alternatives RS2 (Option B) and RS4		$5,056,000
	Total	$17,794,000 to $18,984,000

It is estimated that the full implementation of these alternatives would take 24 to 36 months, including all design and initial construction elements. For cost estimating purposes, groundwater monitoring is assumed to be conducted over a period of 30 years, whereas initial stream and sediment restoration monitoring is assumed to be conducted over a period of 5 years.

1.0 INTRODUCTION

As part of Work Assignment No. 29 under Contract EP-S3-07-04, Tetra Tech NUS, Inc. (Tetra Tech) is submitting this Engineering Evaluation/Cost Analysis (EE/CA) for the Big John Salvage-Hoult Road (BJS) Site in Fairmont, West Virginia. The purpose of the EE/CA is to meet the requirements of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. The United States Environmental Protection Agency (EPA) Region 3 has determined that a non-time critical removal action may be appropriate for the groundwater, soil, and sediment contamination at this Site.

This section includes a brief discussion of the Site, the current and potential threat posed by the site conditions, and the scope and objectives of the removal action, as well as the removal action alternatives and comparative analysis.

1.1 PURPOSE OF THE REPORT

The purpose of the EE/CA process is to evaluate information sufficient to select the most appropriate remedy for a given site, based on an informed risk management decision-making process. A Remedial Investigation (RI) was previously performed for the Site (Tetra Tech, 2007). The RI fieldwork focused on characterizing known and potential sources of contamination at the Site. This EE/CA incorporates the results of the RI report to develop and evaluate potential removal alternatives for addressing unacceptable risks associated with this Site.

Based on the RI results, EPA determined that a non-time critical removal action was appropriate for the soil, groundwater, and stream and river sediment at the Site. An EE/CA is required under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP)[Section 300.415(b)(4)(1)] for all non-time-critical removal actions. The EE/CA identifies the objectives of the removal action, analyzes the various alternatives that may be used to satisfy those objectives, and recommends the most appropriate response action to mitigate potential exposures to the site contamination.

Note that this EE/CA references many of the findings and conclusions from the 2007 RI report, and the reader is referred to that RI document for additional details.

1.2 SITE DESCRIPTION AND HISTORY

The BJS Site is located in Fairmont, Marion County, West Virginia on the east bank of the Monongahela River (see Figure 1-1 for a general location map). For the purposes of this EE/CA, the study area consists of both the BJS property (depicted on Figure 1-1 as the area within the Site boundary), and potentially affected and adjacent off-property areas, including the Monongahela River downstream (north) of the property.

The BJS Site is approximately 38 acres in size and is situated in a mixed industrial/residential area of Fairmont, West Virginia (See Figures 1-2 and 1-3). The property lies along the eastern edge of WV Route 150 (Hoult Road), approximately 1,320 feet east of the Monongahela River. Steel Fabricators, Inc. ("Steel Fabricators") currently owns the 20-acre Big John's Property. In terms of historic industrial use, these 20 acres constitute the most important portion of the 38-acre Site (see a tax parcel map of Figure 1-3 in the RI report).

The Site also includes 18 acres of adjacent areas, including a low lying drainage area that is currently known as Sharon Steel Run (also formerly known as Unnamed Tributary #1 in some historic reports). This portion of the Site is vegetated with trees and shrubs, and has steep hillsides dropping off to Sharon Steel Run and the Monongahela River. To the north and east, the Site is also bordered by generally steeply sloped, wooded terrain. Surface water runoff from the Site generally flows in a southerly direction toward Sharon Steel Run through three intermittent tributaries (East, Middle and West Tributaries).

Operations began at the Site with the acquisition of the Big John's Property by F.J. Lewis Manufacturing Company on October 24, 1925. On December 29, 1928, F.J. Lewis changed its name to International Combustion Tar and Chemical Corporation. On December 31, 1932, International Combustion Tar and Chemical Corporation changed its name to Reilly Tar and Chemical Corporation. Finally, on May 2, 1933, Reilly Tar and Chemical Corporation changed its name to the Reilly Corporation ("Reilly").

Reilly processed approximately 12,000 gallons of crude coal tar per day at the Site from 1928 through 1973. Most of the crude coal tar received at the Site was from the adjacent Sharon Steel site, but some crude coal tar was also received from the DuPont Belle plant in Belle WV near Charleston. Crude tar was pumped from the railroad tank cars into storage tanks. The crude tar was then separated by distillation and condensation processes into products, which included creosote, phenol, road tar, pitch, and naphthalene. Intermediate products such as acid oil and crude acids not refined at the plant were shipped to other Reilly plants for further processing.

Wastes from the coal tar refining process included materials such as tar storage tank residues and still bottoms, lime sludge, still bottoms in the form of pitch, surplus water from the pitch pond, drainage and leakage from various plant operations, coal tar, sulfuric acid waste, water from acid oil and water separated from crude phenol distillation. The wastes generated during the years of operation were discharged through a series of impoundments at various locations throughout the Site. According to the limited historical documents available, the impoundments received industrial wastes from various sewers and drainage ditches located on the property in addition to the cooling waters, acid wastes, and tar wastes. Discharge from the impoundments reportedly discharged into the East and West Tributaries, the Sharon Steel Run (also known as the Unnamed Tributary #1) and eventually into the Monongahela River.

In January 1973, Reilly sold the property to Big John Salvage, Inc. Big John Salvage owned and operated a salvage facility on the property until approximately 1984. During its operation, Big John Salvage accepted various scrap and salvageable materials as well as waste materials at the property. Some of the material disposed at the property included glass cullet (crushed non-saleable fluorescent light bulbs), lead dust, and mercury containing oil from the Westinghouse Electrical Corporation's ("WEC") light bulb manufacturing plant located across the street from the Big John's Property. Westinghouse Electric Corporation later changed its name to CBS Corporation, which was later merged with Viacom, Inc.

The salvage operation also disposed of drums containing petroleum distillates, xylene, turpentine, and other hazardous and non-hazardous substances from sources other than WEC. The contents of the drums were reportedly emptied into holding tanks at the Big John's Property. The emptied drums were rinsed on-site and then were reportedly transported to the Dakota Drum Site located in northeast Fairmont and/or to a property located on Route 250 in Fairmont, where they were crushed and sold as scrap. The owner of the Big John Salvage, Inc., Mr. John Boyee, was also the owner of the Dakota Drum Site.

On June 11, 1984, Big John's Salvage, Inc. filed for bankruptcy under Chapter 11 of the Bankruptcy Act. In 1990, the property was acquired by the state of West Virginia for nonpayment of taxes. In August 1992, the property was turned over to Marion County by the State. On November 14, 1997, the Deputy Commissioner of Delinquent and Nonentered Lands of Marion County, West Virginia, transferred title of the Big John's Property to Steel Fabricators, Inc., who is the current owner of the Big John's Property. Steel Fabricators had used the Big John's Property for logging-related operations prior to the start of EPA removal operations at the Site in 2000, with a hiatus during the EPA removal action in 1998.

The Site was proposed to the National Priorities List (NPL) on February 4, 2000. The Site was formally added to the NPL on July 27, 2000, making it eligible for federal cleanup funds. Reilly installed a groundwater collection system in 2001, consisting of two groundwater collection trenches and a pre-treatment system. After the water goes through the pre-treatment system (oil/water separator and carbon system), the water is discharged to the municipal sewer system.

The history of the site operations using aerial photographs has been compiled previously by EPA (2002) and is included in Appendix 1A of the RI Report (Tetra Tech, 2007).

1.3 INVESTIGATIONS AND RESPONSE ACTIONS

The Site has been subject to regulatory interest since the mid-1940's, and several EPA removal actions have already been implemented at the Site, commencing in 1983 and continuing through the present. The following is a summary of the previous EPA removal actions implemented at the Site:

1983 - In early 1983, the West Virginia Department of Natural Resources (WVDNR) conducted an inspection of the Site, and requested assistance from EPA. In May 1983, EPA performed a preliminary assessment that included sampling of various soil, sediment, and surface water at the Site. At the time of the initial inspection, storage tanks, an oil/water separator system, a cullet pile, tar pits, and 75-100 drums were observed as concerns for the Site. Based on the results of the analyses, EPA determined that hazardous substances at the Site presented immediate threats to human health and the environment. In June 1983, EPA issued oral demands to potentially responsible parties (PRPs), including John Boyce (owner of Big John Salvage, Inc.), WEC, and Reilly for mitigative actions to abate the immediate threat posed by hazardous substances at the Site.

After the PRPs declined to take immediate action, EPA initiated removal actions in July 1983, which included an extent-of-contamination survey conducted by the EPA Technical Assistance Team ("TAT") and the Emergency Response Team ("ERT"), who collected tar, surface water, sediment, and biological samples from the Site. An EPA contractor also installed sediment erosion control silt fencing, as well as a perimeter site fence around critical areas on the Site.

1984 - 1985 - In January 1984, EPA entered into a Consent Order with the owner of Big John Salvage, Inc., requiring the removal of all drums and cullet piles. The order also required Big John Salvage, Inc., to drain the oil separator and complete all work by June of 1984. ERT also collected additional samples in January 1984. Based on the January 1984 findings, the Center for Disease Control ("CDC"), with consultation from EPA, advised that the Site presented an imminent and substantial threat to human health and the environment in April 1984.

Although Big John Salvage, Inc. had conducted some mitigation efforts in early 1984, it filed for bankruptcy in May 1984, and EPA subsequently determined in June 1984 that insufficient work had been completed to mitigate the risk. EPA issued further demand letters to PRPs in July 1984. Although bankrupt, Big John Salvage, Inc. advised of its intent to pursue cleanup of the cullet pile; however, the company ultimately did not remove the cullet pile. Further, WEC advised EPA of its refusal to take action at the Site at this time.

Reilly subsequently expressed interest in performing mitigation efforts attributable to its past operations, and ultimately, a Consent Order, EPA Docket Number III-85-2-DC ("Reilly Order") was executed in October 1984 wherein Reilly agreed to remove all on-site coal tar related wastes. The primary mitigation action conducted by Reilly was started on October 30, 1984, and completed on April 16, 1985, when EPA and WVDNR agreed that the initial cleanup actions at the time were acceptable. During this initial removal action, Reilly removed 4,100 tons of coal tar waste solids and 18,500 tons of liquid non-hazardous waste.

<u>1991 - 1993</u> - In October 1991, the WVDNR conducted an inspection of the Site and found various containers with potentially hazardous substances. EPA TAT collected samples in December 1991, which confirmed the presence of hazardous materials. EPA conducted further reconnaissance in May 1992 identifying more than 100 containers at the Site (presumably placed at the Site sometime between 1985 and 1991), and a removal action was implemented in late 1992/early 1993. A total of 129 overpacks were removed from the Site, as well as 39 cubic yards of asbestos. Removal operations ended on March 31, 1993.

<u>1998</u> - In March 1998, a West Virginia Department of Environmental Protection ("WVDEP") RCRA inspection of the Site discovered that a previously empty 20,000-gallon vertical tank had been removed and transported to the adjacent Sharon Steel Property. The tank was later found to contain used oil or coal tar oil. WVDEP also observed two large excavation pits containing used oil at the Site, and requested EPA assistance in April 1998. The City of Fairmont and WVDEP expressed concern about the site operations being conducted by Steel Fabricators, Inc. and the potential release of hazardous substances from the Site to the Monongahela River. Sampling conducted by EPA in May 1998 confirmed the presence of oil, antifreeze, and diesel fuel in the pits, as well as CERCLA hazardous substances. Initial oil removal actions commenced in May 1998, but the scope of this work was ultimately expanded to include all waste oil removal and on-site stabilization of oil-saturated soil with cement kiln dust. Approximately 10,413 gallons of waste oil and 521 tons of non-hazardous stabilized soil from the pits were removed and disposed of off-site. The removal action was completed in December 1998.

<u>2000 - 2001</u> - In 2000, EPA determined that significant hazardous substances remained at the Site, which presented both short-term immediate threats and long-term risks to human health and the environment. EPA initiated a two-part strategy to take immediate action pursuant to CERCLA removal authorities to address the short-term threats and propose the Site for the NPL, making the property eligible for long-term remedial action necessary to make the property safe for reuse. Accordingly, on March 31, 2000, EPA issued a Determination of Threat to Public Health or Welfare or the Environment, which found that conditions at the Site presented an imminent and substantial endangerment to the public health or welfare or the environment. In addition, based on the findings of the Site Inspection (SI) and Hazard Ranking System scoring, the Site was listed on the NPL on July 27, 2000.

In April 2000, EPA notified the PRPs through a Removal Notice Letter. EPA subsequently negotiated an Administrative Order on Consent ("AOC") with Viacom, Inc. (which had merged with WEC) and Steel Fabricators, Inc. in September 2000 to clean up the cullet and associated contamination from the cullet.

Reilly would not negotiate an AOC, but EPA subsequently issued a Unilateral Administrative Order ("UAO") for Reilly to address the imminent and substantial threat in late September 2000.

Cullet removal operations by the AOC signatory PRPs began in October 2000 and ended in July 2001. EPA subsequently approved the final report for the cullet removal in August 2001. Nearly 7,300 tons of cullet were removed (approximately 4,000 tons of which were disposed of as hazardous waste). Nearly 16,000 gallons of water were removed from the sedimentation basins, which were also disposed of as hazardous. However, excavation of the cullet area revealed additional coal tar contaminated soils in the area formerly overlain by the cullet pile.

Under the terms of the UAO, Reilly submitted a remedial action plan (RAP) to EPA in October 2000, and with EPA approval, Reilly began additional removal actions in November 2000. During the period November 2000 through May 2001, Reilly conducted a variety of remedial measures, including the excavation and on-site stockpile of approximately 3,000 tons of coal tar contaminated soil from the East and Middle Tributaries (which were segregated into five separate stockpiles), and the installation of a collection system in the East and Middle Tributaries. These systems were designed to collect tar seeps into a manhole in each tributary, which was then pumped to a treatment system with the effluent ultimately discharged to the City of Fairmont sewer system. Reilly continues to operate and maintain this collection and treatment system.

On May 11, 2001, representatives from EPA, WVDEP, and Reilly met to identify outstanding removal work at the Site. Following this meeting, Reilly was notified in writing by EPA on May 16, 2001 of work that still needed to be completed. On June 15, 2001, Reilly responded to EPA indicating they were only willing to conduct a limited amount of the work required by EPA. EPA reiterated to Reilly the requirement to fully implement the actions described in EPA's May 16, 2001, letter. Reilly responded verbally on August 30, 2001 and in writing on August 31, 2001, that they were unwilling to undertake the actions necessary to fully address the EPA items.

Due to Reilly's refusal to fully implement the requirements outlined in the UAO, EPA signed a request on September 21, 2001, for additional funding and an exemption from the statutory limits for a removal action. A fund lead removal action was immediately implemented.

2001 - 2003 - In October 2001, the EPA began additional site stabilization and removal actions. The primary activities completed during this removal action included consolidation and disposal of contaminated soil excavated by Reilly, excavation and backfilling of coal tar contaminated areas, excavation of concrete pads and impacted soil, demolition of on-site buildings and removal of asbestos material, construction of a clay barrier northwest of the East Tributary collection system, construction of an access road along Sharon Steel Run, and excavation of contaminated sediments from Sharon Steel Run and the settling pond near the confluence of Sharon Steel Run with the Monongahela River. With the Site stabilized, this removal effort was completed in July 2003. During this action, approximately 194 tons of non-hazardous waste and 3,000 tons of hazardous (K-listed waste) were removed from the Site. In addition, approximately 44,000 cubic yards of excavated soil and sediment remained staged on-site in six different cells at the completion of this effort. The soil piles are proposed to be addressed as part of the later EPA activities for the Site.

Further, on June 4, 2002, EPA provided the PRPs with special notice letters requesting a meeting to start negotiations for performance of the Remedial Investigation and Feasibility Study (RI/FS). The PRPs declined EPA's request to perform the RI/FS. As a result, EPA initiated the RI/FS, which commenced in December 2002.

2003 - 2007 - Since 2003, EPA has contracted with the United States Army Corps of Engineers (USACE) to conduct additional stabilization activities at the Site, including the consolidation of the six soil and sediment piles established in 2003 into two piles; removal of additional concrete pads and contaminated soils; and additional excavation of sediments from the settling pond near the mouth of Sharon Steel Run. Further, in July 2005, as a result of the pile consolidation task, additional drums and contaminated soil were found buried under one of the piles located in the former cullet pile area. These drums were subsequently removed and disposed of off-site, and the highly contaminated soil was segregated from the rest of the consolidated soil pile. USACE currently maintains drainage features and stabilizes the staged soil piles at the Site.

2007 - In 2007, EPA contracted with USACE to remove sediment from the impounded portion of Sharon Steel Run near its confluence with the Monongahela River. Approximately 7,800 to 8,000 cubic yards of sediment were removed from the pond, and transported to an area near the top of the West Tributary. The sediment was spread over an area of 52,000 to 54,000 square feet, at a thickness ranging from 6 inches to 6 feet near the south berm, and then surrounded by silt fence. Stone check dams were also constructed through the lower portion of the South berm, outside the berm, and through the West Tributary to control future erosion in this area.

1.4 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

1.4.1 Site Features

The BJS Site currently consists of barren/impacted areas (historic work areas and waste piles); open field uplands, forested uplands, Sharon Steel Run (and its minor tributaries), and the Monongahela River. A general description of these surface features follows:

Barren/Impacted Areas. The barren/impacted areas in the main portion of the Site have been subject to extensive earth moving activities associated with EPA activities over the last four years, and are either bare or sparsely vegetated. There is soil from prior EPA removal actions currently staged at the Site. This portion of the Site also includes miscellaneous concrete pads, and also has the single remaining building.

Open Field Uplands. The open field uplands at the Site include areas adjacent to the barren/impacted areas, primarily areas on the eastern and western side of the Site that have been previously regraded and revegetated as part of EPA activities to remove surface soil contamination in these areas. This area also includes the unnamed drainage swale north of the Site. The open field upland areas adjacent to Sharon Steel Run are generally steep slopes with native grasses. In many areas, these are eroded or stabilized by rip-rap. The fill areas are dominated by turf grasses planted as part of the erosion stabilization as well as pioneering species of native grasses.

Forested Uplands. The forested uplands dominate most of the area between Sharon Steel Run and the western portions of the Site and the Monongahela River. The forested uplands are dominated by a mature overstory dominated by white pine, red oak, white ash, sycamore and princess-tree. There is little understory development in the forested upland area.

Sharon Steel Run (and related tributaries). Sharon Steel Run originates south and east of the Site at the Sharon Steel Fairmont Coke Works Superfund Site, primarily as a treated discharge associated with remedial activities on that site as well as surface water runoff and groundwater discharge from the areas to the east. This stream also receives storm-water runoff, as well as ground-water discharge from the overburden and bedrock aquifers at the Site. The ground-water discharge is via small springs and several seeps emerging from the Site. No historical flow measurements are available for this waterway, but the EPA Total Maximum Daily Load (TMDL) study conducted in 2001 estimated an average daily flow of 0.374 cubic feet per second (cfs - or approximately 167 gallons per minute) was discharging from the 187-acre watershed through Sharon Steel Run during the period 1998-1999 (a combination of both surface water and groundwater discharge). The 2001 EPA TMDL study further estimated that the contribution of the BJS site portion of the watershed to daily discharge in Sharon Steel Run was approximately 0.0254 cfs (~ 11gpm), or approximately 6.6% of the average Sharon Steel Run daily discharge.

This stream has been highly disturbed by previous sediment removal activities, as well as road and earthwork associated with other on-site activities, including the construction of access roads along the stream. The stream itself is relatively small (less than 3 feet wide of flowing water) and shallow (most areas are less than 6 inches deep), and flows across a muddy and silty substrate. The water in the stream varies in turbidity, and has been observed to range from extremely muddy and turbid to relatively clear and colorless. Areas immediately adjacent to the stream on both sides have been extensively reworked, and there is an access road that has been constructed along the entire length of the stream as it flows alongside the Site. The stream banks are eroded or have been stabilized with rip-rap. Adjacent areas to the south of the stream are less disturbed and are mostly forested.

There are some stream areas that flow through relatively flat areas containing some emergent wetland plants. The stream becomes more channelized as it flows through a steep ravine and turns more westward before it flows into the impoundment.

The impoundment is reported to be a long-term feature situated near the confluence with the Monongahela River, originally retained by a berm constructed by the railroad to support the rail line in this area in the early 1900's. This berm was repaired in the 2000-2001 timeframe by EPA contractors after a flood event washed out most of the center section of the berm, resulting in the release of contaminated sediments from the impoundment into the Monongahela River.

The current impoundment configuration controls the discharge of Sharon Steel Run to the Monongahela River through a series of corrugated pipes, which flow over rip rap before mixing with the river below. Banks in the confluence area are more natural although there are signs of bank erosion and reworking during removal activities. This impoundment has been subject to several removal actions (most recently in late 2007), when sediments have been excavated and staged in upland areas of the Site awaiting further management in the future.

Monongahela River. The Monongahela River is a major river that flows northward where it discharges into the Ohio River approximately 125 miles downstream from the Site. The Site is located along a section of the Monongahela River, which is known as the Opekiska water pool. This pool extends between mile marker 115.4 (Opekiska Lock) and mile marker 130 on the Monongahela River (note the confluence of Sharon Steel Run with the Monongahela River is located approximately at river mile 125.25).

At the confluence with Sharon Steel Run, the Monongahela River is more than 350 feet wide and more than 8-15 feet in depth. The City of Fairmont Wastewater Treatment Plant (WWTP) discharge is located just upstream from the confluence. During the 2005 RI, the water was observed to be clear, and the shallow areas visible along the west bank contained a cobble and silt substrate. The stream banks are rather steep, and there is no floodplain along the Site's side (i.e., east side) of the river. The stream bank is wooded, primarily with white ash and sycamore.

In addition to these main site elements, other notable features currently present at the BJS site include the following:

- The site is currently fenced along the perimeter, with locking gates near the Hoult Road entrance, as well as near the Sharon Steel Run and Monongahela River confluence along a rail trail (old railroad bed) that is situated along the Monongahela River.
- There is a buried natural gas pipeline that bisects the western portion of the Site (located in the Open Field/Uplands Area).
- There is a treatment trailer unit at the Site that has been used by Reilly Industries as part of the on-going pump-and-treat system since 2001 (also located in the Open Field/Uplands area of the site). Water is pumped from two collection sumps—one situated at the bottom of the East Tributary, and the other situated at the bottom of the Middle Tributary. In general, these sumps are connected to French drains, which extend to the top of these drainage features. Water is pumped from the sumps up to a treatment trailer, where the water is passed through bag filters and carbon canisters, prior to discharge to a City of Fairmont sewer manhole located on the north side of the BJS Site. During the period from March 2001 to July 2008, approximately 9,322,400 gallons of water were collected and treated at the Site.

1.4.2 Demography

The site lies within the City of Fairmont on land zoned industrial. It is surrounded on the north, east and south by residential and industrial areas. Other industrial complexes located nearby include Philips Lighting (formerly the Westinghouse Electric Corporation), Everlasting Covenant Church (formerly Creative Labels), and Owens-Illinois Company.

The population of Fairmont is 19,049 (2005 estimate from US Census Bureau website).

Currently, the nearest residence (a part-time resident) is approximately 150 feet northeast of the Site. The next nearest and permanent residences are approximately 250 feet east from the northeastern corner of the BJS site. According to the 2005 public health assessment report by the Agency for Toxic Substances and Disease Registry (ATSDR) (ATSDR, 2005), approximately 18 residences are within 0.25 mile of this Site to the east, and additional 41 residences and five small businesses are located between 0.25 and 0.5 mile east of the Site.

Approximately 130 people live within 0.5-mile of the Site in the residential areas located east of the Site. Although the closest residences are situated to the east of the Site, the higher population is found in the area west of the Site across the Monongahela River. The downtown Fairmont business district is located approximately 1.5 miles southwest of the BJS site.

According to the 2000 Census data, approximately 2,400 people live within a one-mile radius of the Site. Of these people, 92% were white and 8% were African Americans. Of the residents located within the one-mile radius, 120 (5%) are 4 years old or younger, 336 (14%) are between 5 and 18 years old, 1,464 (61%) are between 19 and 64 years old, and 480 (20%) are 65 years of age or older.

1.4.3 Climate

The climate in this area is generally continental (a climate that is characterized by winter temperatures cold enough to support a fixed period of snow cover each year, and relatively moderate precipitation occurring mostly in summer). The annual average rainfall is approximately 40 inches. Prevailing winds are from the west to northwest.

1.4.4 Water Supply

The entire area in the vicinity of the BJS site is served by the City of Fairmont Utility Department (Fairmont Water Works). There are currently no drinking water well users within one mile of the Site, based on the original Hazard Ranking Documentation, drive-by inspections, and interviews with the City of Fairmont Utility Department. The aquifer in this area could be considered a Class IIc aquifer according to the EPA aquifer vulnerability classification system (i.e., generally consisting of fairly permeable sandstone or conglomerate that contains lesser amounts of interbedded fine-grained clastics and occasionally carbonate units with well yields less than 50 gpm, overlain by less than 50 feet of overburden - see USEPA/600/2-91/043 - Regional Assessment of Aquifer Vulnerability and Sensitivity in the Conterminous United States, 1991 - note that Class I aquifers are considered to be most vulnerable, and Class III aquifers less vulnerable - the Class IIc classification would also be considered less vulnerable on that scale).

There are no drinking water intakes on the Monongahela River within 15 miles downstream of the Site.

1.4.5 Soils

According to the United States Department of Agriculture Natural Resources Conservation Service (NRCS), most of the BJS site is underlain by soils classified primarily as Urban Land. Soils on adjacent lands are classified as part of the Westmoreland or Culleoka-Westmoreland series soil groups. The soils on the hillsides in the vicinity of the Site are all mapped as silt loams.

The Westmoreland series consists of deep and very deep well-drained soils formed in residuum and colluvium from siltstone, sandstone, and limestone. They are on dissected uplands of the Allegheny Plateau. Slope ranges from 0 to 70 percent. Permeability is moderate. Westmoreland soils are formed in weathered interbedded siltstone, sandstone and limestone, and are on interfluves, hillsides, nose slopes and head slopes on dissected uplands.

The Culleoka series is very similar to the Westmoreland, and also consists of moderately deep, well-drained soils formed in colluvium or residuum from siltstone or interbedded shale, limestone, siltstone, and fine grained sandstone.

The area designated as "Urban Land" by the NRCS includes the majority of the Site that had been previously developed for the original coal tar refinery and later salvage operations. This entire area has been altered during the various removal actions over the last 20 years, which included the removal of surface and subsurface soils, as well as the import of off-site soils.

However, the original soils that were present in the flat/northern portion of the Site prior to development have a somewhat different origin from those on the adjacent hillsides. While the adjacent hillside soils were derived from siltstone, sandstone, and limestone bedrock parent material, the flat/north portion of the Site soils have an origin from the underlying fluvial parent material, which was deposited in a historical meander or lake associated with the Monongahela River. Consequently, the types of soils that would be derived from the fluvial parent would be different than those derived from the bedrock parent in this area. These soils would be more consistent with the Allegheny series soils mapped in the area, which consist of very deep, well-drained, moderately permeable soils formed in alluvium on stream terraces, foot slopes and alluvial fans.

1.4.6 Surface Hydrology

The center of the BJS site is located approximately 500 feet northeast of the Monongahela River and is situated at an elevation approximately 130 feet above the level of the river in the former building/production area.

The surface water courses on the Site are localized, mostly intermittent, and drain relatively small areas - the only exception to this is Sharon Steel Run, which is the main tributary draining the BJS Site and adjacent Sharon Steel Site area, which ultimately discharges to the Monongahela River. A description of the main drainage features at the Site, as depicted on Figure 1-3, is provided below:

- **West Tributary** - This is a historic drainage feature on the BJS Site that was extensively altered during EPA removal activities. A temporary roadway was constructed down this swale to provide access to the Unnamed Tributary #1. Waste material and impacted soil remains present beneath this roadway. Water is only present in this drainage during periods of high precipitation.
- **Middle Tributary** - This is a historic drainage feature on the BJS Site that was extensively altered during EPA removal activities and has been filled. One of the Reilly groundwater/tar collection systems is located at the bottom of this tributary near its confluence with Sharon Steel Run. Water is present in this drainage only during periods of high precipitation.
- **East Tributary** - This is a historic drainage feature on the BJS Site that was extensively altered during EPA removal activities, and now partially contains a roadway as well as a french drain groundwater collection system. The second Reilly groundwater/tar collection sumps is located at the bottom of this tributary near its confluence with Unnamed Tributary #1. Water is present in this drainage only during periods of high precipitation.
- **Far East Tributary** - This is an existing drainage feature on the Sharon Steel site and is located east of the BJS Site. This tributary was also reportedly subject to prior sediment removal actions. Water is present in this drainage only during periods of high precipitation.
- **Unnamed Tributary #1** - This is an existing drainage feature that originates in the northwest portion of the Sharon Steel site. It receives drainage from the Far East and East Tributary prior to its confluence with Sharon Steel Tributary to form Sharon Steel Run. Water is always flowing in this drainage feature. Note that historically, the term Unnamed Tributary #1 was used to describe the entire main drainage system extending from the headwaters on the Sharon Steel Site to the confluence with the Monongahela River.

- **Sharon Steel Tributary** - This is the existing drainage feature that originates in the western portion of the Sharon Steel site. It combines with Unnamed Tributary #1 to form Sharon Steel Run.
- **Sharon Steel Run** - This is the main surface water drainage along the southern boundary of the BJS Site. It is formed by the confluence of Unnamed Tributary #1 and the Sharon Steel Tributary. It receives additional drainage from the Middle and West Tributaries prior to its confluence with the Monongahela River.
- **Unnamed Tributary #2** - This is the former railroad bed, which is now the current drainage swale located along the northern boundary of the BJS Site. Water is present in this drainage only during periods of high precipitation. Water from this drainage discharges to the Monongahela River at two locations—one location is immediately north of the BJS Site through an adjacent property, and the other location is farther to the north through the former Fairmont Cullet Pile site (which has been subject to a previous RCRA action).

It should be noted that the "tributaries" that extend from the Site were historically "ravines" draining the relatively flat portion of the upper site, and likely never contained sustained discharges of groundwater (base flow) - they primarily conveyed surface water runoff, as the Site's total groundwater contribution to Sharon Steel Run base flow is calculated to average only about 5 gpm (see additional discussion in Section 1.4.9). Consequently, the historic flow in any given ravine (tributary) would likely be less than 1-2 gpm (considering the West Tributary, Middle Tributary, and East Tributary), which would be equivalent to more of a seep than a flow.

Runoff from the northern portion of the Site flows through Unnamed Tributary #2, which is actually a drainage type swale along the northern boundary of the Site. This swale is normally dry and only has water present during high precipitation events. Flow in this swale eventually discharges into a drain, which along with other drainage from areas located to the northwest, flows via pipe under the former Creative Labels site, and then subsequently discharges to a small drainage at the top of a very steep hill. This drainage tributary normally has some small flow of water (combination of flow from pipe discharge and groundwater and overland runoff), and this drainage ultimately discharges to the Monongahela River approximately 600 feet downstream from the Sharon Steel Run/Monongahela River confluence.

1.4.7 Regional Geology

The Site is located in the Appalachian Plateau physiographic province. The general bedrock geology is flat-lying sandstone, shale, and limestone. Topography in the area is maturely dissected, consisting of steep-sided valleys and narrow ridges with ridges capped by more resistant rock types.

The Site is underlain by the upper Pennsylvanian Conemaugh group. Generally, the Conemaugh group consists of interbedded shale and sandstone with some beds of limestone, siltstone and coal. The boundaries of the group are the Upper Freeport coal at the bottom and the Pittsburgh coal at the top. The Conemaugh ranges in thickness from 500 to 600 feet in the area. Based on a review of structure contour maps available for the Pittsburgh Coal, bedrock in the area dips toward the northwest (strike N 35□ E) at approximately 3°.

The Pittsburgh Coal unit has been mined underground extensively in areas to the north and west of the Site. The closest area that has been mined underground is the hillside that is located immediately across Hoult Road north of the Site. The Pittsburgh Coal was also recently surface mined from a hilltop southeast of the Site at the adjacent Sharon Steel site. Based on the structure contour maps, there is no

Pittsburgh Coal underlying the majority of the Site, having been eroded away by the ancient Monongahela River.

The geomorphology of the area in the vicinity of the BJS site is primarily related to the Monongahela River. The Site sits on a former meander of the Monongahela River, which cut a terrace into the bedrock sometime in the early Pleistocene period (IT, 2000). This terrace is approximately 130 feet above the current Monongahela River location. The terrace in the vicinity of the Site is generally covered with a combination of alluvial deposits from the former river and lacustrine deposits from ancient Glacial Lake Monongahela, which was formed by outwash, or possibly ice, damming the north-flowing Monongahela River and its tributaries just above the tip of the northern panhandle of West Virginia.

See Appendix A for excerpts from the BJS 2007 RI, which provide additional information regarding the geology and hydrogeology of the BJS Site.

1.4.8 Regional Hydrogeology

Groundwater in the Monongahela River Basin occurs under both confined and unconfined conditions. Springs are common throughout the basin due to perched water tables that discharge from hillsides. The hydrogeology of this region is dominated by bedrock aquifers in which all flow is through fractures, creating aquifers of relatively low permeability.

Regionally, the Conemaugh sandstone is currently the only viable source of groundwater within this group for water supply, but groundwater is also present in other members, including fractured limestone members. Since the bedrock dips slightly toward the Monongahela River, the regional groundwater flow on the east side of the river is toward the north and west.

The Conemaugh aquifer yields 1 to 400 gpm, with an average of 16 gpm. In the adjacent counties of Monongalia and Harrison, yields from the Conemaugh aquifer average less than 5 gpm. Similar yields would probably be expected in Marion County. The groundwater within the Conemaugh is moderately hard, consisting of mixed sodium and calcium bicarbonate hardness. The water is generally high in sulfate and low in iron, chlorides and total dissolved solids.

1.4.9 Site Geology and Hydrogeology

See Appendix A for excerpts from the BJS 2007 RI. which provide additional information regarding the geology and hydrogeology of the BJS Site. A summary of the site geology and hydrogeology follows.

The Site is underlain by two major geologic units—unconsolidated sediments and sedimentary bedrock. The unconsolidated sediments are glacio-fluvial or lacustrine in nature, and range in texture from clay to sand, although most of the sediments are silts and clays with relative low permeability. They are up to 40 feet thick in the center portion of the Site, although the typical thickness is 20-25 feet across the Site. There is a prevalent sandy unit (i.e., sand and silty sand) - up to 20 feet thick - situated at the base of the unconsolidated sediments, and is found to be thickest in the center of the Site. The underlying bedrock includes the rocks of the lower members of the Pittsburgh Formation of the Monongahela Group and the Casselman Formation of the Conemaugh Group. Both formations consist of cyclically repeating beds of calcareous shale, shaley limestone and sandstone, with periodic coal beds. The majority of the Site is underlain by the Casselman Formation, and most of the rocks underlying the Site are shales, with minor interbedded sandstones and limestones.

The saturated unconsolidated sediments form the overburden aquifer at the Site. The unconsolidated sediments predominantly consist of silts and clay, with minor sand lenses throughout the unit. There is also a basal sandy unit, which contains most of the groundwater within the unconsolidated sediments at the Site. The saturated thickness in the overburden ranges from 4 to 11 feet. The yield for wells in this aquifer is generally less than 1 or 2 gallons per minute. The overburden aquifer receives recharge from a combination of sources, including precipitation that falls directly on the Site, surface water runoff from Hoult Road and other topographically high areas north and northeast of the Site, and upward flow from the underlying bedrock aquifer.

Discharge from the overburden aquifer is primarily by gravity flow to the main drainage features, including the West Tributary, Middle Tributary, and East Tributary, as well as the Far East Tributary. Flow in these tributaries subsequently discharges to Sharon Steel Run. Groundwater discharge from both the overburden and bedrock aquifers (throughout the watersheds) appears to provide the base flow for this stream.

According to the 2001 EPA TMDL study for Sharon Steel Run, the total average daily discharge in this water body for the period 1998-1999 was 0.347 cfs (~ 167 gpm), including both surface water and groundwater discharges (note that this was considered to be a drought year, so it presumably represents the least flow scenario). Of this total flow, approximately 30 to 50% (or 0.10 to 0.17 cfs or 47-76 gpm)is estimated to comprise base flow originating from groundwater discharges. Note that the 30 to 50% estimate of base flow component is based on general water budget principals for the mid-Atlantic area, as well as general estimates for groundwater recharge rates in the Monongahela River Basin estimated by the USGS (USGS Aquifer Characteristics Data for West Virginia - Water Resources Investigation Report 01-4036, 2001).

Specifically related to the BJS Site, the 2001 EPA TMDL study estimated that the contribution of the BJS Site portion of the watershed to daily discharge in Sharon Steel Run during the study period was approximately 0.0254 cfs (~ 11gpm), or approximately 6.6% of the average Sharon Steel Run daily discharge. Therefore, the estimated stream base flow contribution (i.e., groundwater discharge using the 30 to 50% recharge rate range) from the BJS Site for that study period ranges from 0.008 to .013 cfs, or approximately 3.5 to 5.7 gpm. Consequently, the groundwater discharge component from the BJS Site to Sharon Steel Run is estimated to be less than 4% of the total discharge of that stream for the period reviewed in the TMDL study.

The silt and clay fraction in the overburden aquifer can cause localized perched water conditions, as well as preferential flow paths. Horizontal flow of groundwater in the overburden aquifer can follow preferred pathways in the subsurface, typically following more permeable units (i.e., sand lenses) to lower gradient areas. The distribution of some of the visually contaminated subsurface soils provides further evidence of the flow of liquids through preferred pathways.

The existing groundwater recovery system at the Site (french drain type structures located in the Middle and East Tributaries) continues to collect contaminated groundwater discharging from the overburden aquifer - some tar is also collected in this system. However, no major tar deposits were encountered in the borings or monitoring wells installed during the RI, but some were observed in test pits conducted during the various removal activities. Based on the variability and heterogeneity of the overburden sediments, it is likely that the locations selected for borings and wells did not intersect some of the preferred pathways in the aquifer conveying the most contaminated groundwater and tar to the recovery system.

The overburden aquifer is not likely providing much recharge to the bedrock aquifer in the central and eastern portions of the Site, as the bedrock aquifer potentiometric levels measured in this area indicated a generally upward flow into the overburden aquifer. Consequently, based on the potentiometric surface interpretation, it is unlikely that contaminants in the overburden groundwater would substantially impact the underlying bedrock aquifer in the central and eastern areas.

The general flow direction in the overburden aquifer was variable, but was generally toward the south and east toward the main drainage tributaries (West, Middle, and East Tributaries). The existing groundwater collection system installed in the Middle and East Tributaries probably has an influence on the nature and direction of groundwater flow in the overburden aquifer in these areas, as these systems provide a preferred pathway for groundwater flow.

Water-yielding zones encountered during drilling were found to be randomly distributed through all lithologies. The borehole yields encountered during drilling ranged from approximately 1 gpm to more than 50 gpm. Some of the highest yielding zones occurred in the limestone and shale intervals, and some of the lowest yields were from sandstone units.

In general, the potentiometric levels in deeper rock units are higher than those found in shallower rock units, indicating that the deeper rock units are confined across most of the Site, with bedrock aquifer recharge areas to the east, and discharge areas to the west.

The bedrock wells located immediately adjacent to Sharon Steel Run are commonly artesian or have water levels within the casing higher than the surrounding land surface, indicating that Sharon Steel Run is a discharge point for the bedrock aquifer in this area.

The water levels in the bedrock wells situated along the Monongahela River have a potentiometric surface that is nearly equal to the normal pool elevation of the river, which is approximately 857 feet. This would suggest that the river and underlying rocks are hydrologically connected, and it is also possible that the Monongahela River may provide recharge to these rocks.

The groundwater flow direction in the bedrock aquifer has several components, the result of which is a general flow direction to the west/southwest.

1.4.10 Site Ecology

There are several types of terrestrial and aquatic habitats at the Site. The primary habitats are described below:

Barren/Impacted Areas - The barren/impacted areas have been subject to extensive earth moving activities associated with EPA activities over the last four years, and are either bare or sparsely vegetated. Much of this area provides little ecological habitat value; however, this habitat may occasionally provide some cover and forage for songbirds and small mammals. In addition, it is likely that these soils may support some invertebrates, including insects and earthworms, which could provide a food source for wildlife. Crows and starlings were observed in this area in April 2003, and deer and turkey were observed traversing the area during fieldwork conducted in 2005. The approximate area of this habitat is 7.61 acres.

Open Field Uplands - The open field uplands include areas adjacent to, and east of, the barren/impacted areas of the Site that have been previously regraded and revegetated as part of EPA activities to remove surface soil contamination in these areas. The open field upland areas adjacent to Sharon Steel Run are generally steep slopes with native grasses. In many areas, these are eroded or stabilized by rip-rap. The fill areas are dominated by turf grasses planted as part of the erosion stabilization as well as pioneering species of native grasses. These habitats may provide cover, forage, and breeding areas for mammals, birds, and reptiles. In addition, it is likely that these soils may support communities of invertebrates, including insects and earthworms, which could provide a food source for wildlife. The plants themselves may also provide a food source for herbivorous wildlife. The approximate area of this habitat is 4.085 acres.

Forested Uplands - The forested uplands are the largest relatively native habitat on the Site and dominate most of the area between Sharon Steel Run and the Monongahela River. The edge of this forested area, where it is adjacent to Sharon Steel Run and the open areas to the east, is an ecotone. Ecotones are particularly important for mobile animals, as they can exploit more than one set of habitats within a short distance. This can produce an edge effect along the boundary line, with the area displaying a greater than usual diversity of species. At the Site, the ecotone also provides significant ecological habitat value and provides perching, cover, forage, and breeding areas for birds and mammals. Crows, starlings, cowbirds, and American robins were observed in this area in 2005. The forested uplands are dominated by a mature overstory dominated by white pine, red oak, white ash, sycamore and princess-tree. There is little understory development in the forested upland area. The forested habitat likely provides cover, forage, and breeding areas for mammals, birds, reptiles, and amphibians. There is significant leaf litter in the forested areas which provides rich habitat for soil organisms including microbes, earthworms, and insects. Seeds and nuts dropped from the trees also provide a source of food for seed-eating wildlife such as squirrels, chipmunks, and songbirds. Low leaves may also provide a food source for leaf-eating animals such as white-tailed deer. The approximate area of this habitat is 13.56 acres.

Emergent Wetlands - Isolated areas of emergent wetland are located within and adjacent to Sharon Steel Run, and are generally associated with sediment/soil erosion deposits, seeps and springs, and the impoundment near the Monongahela River. These wetlands are dominated by herbaceous species such as jewelweed, common reed, rushes, sedges and occasional shrubs. Most of these emergent wetlands have been severely impacted by EPA activities, which previously have removed significant amount of contaminated sediments from Sharon Steel Run. However, in 2005, more wetland vegetation was observed to be taking hold near the stream and impoundment area. The wetland areas add to the richness of the ecotone and provide additional cover and forage for the same species observed in the nearby upland habitats. The approximate area of this habitat in 2005 was 1.37 acres, but has likely increased since that time as vegetation continues to reestablish itself along Sharon Steel Run.

Sharon Steel Run and its Tributaries - These streams have been highly disturbed by previous sediment removal activities, as well as road and earthwork associated with other on-site activities, including the construction of access roads along the stream. The streams themselves are relatively small (less than 3 feet wide of flowing water) and shallow (most areas are less than 6 inches deep) and flow across a muddy and silty substrate. The water varies in turbidity, and has been observed to range from extremely muddy and turbid to relatively clear and colorless. Areas immediately adjacent to the streams on both sides have been extensively reworked, and there is an access road that has been constructed along the entire length of

Sharon Steel Run as it flows alongside the Site. The banks of Sharon Steel Run are eroded or have been stabilized with rip-rap. Adjacent areas to the south of Sharon Steel Run are less disturbed and are mostly forested. There are some stream areas that flow through relatively flat areas containing some emergent wetland plants.

Because of the highly disturbed nature of Sharon Steel Run and surrounding areas, there is very little aquatic habitat currently provided, although the general habitat is likely improving each year as vegetation is reestablished along the stream banks and the stream establishes a new gradient (with pools and riffles) through this stretch. In general, the turbidity of the water and the muddy stream substrate itself make most of this stream habitat currently unusable for most ecological receptors. It is possible that the stream may provide a limited source of drinking water for ecological receptors from the adjacent terrestrial habitats. In the impoundment, there were signs that turtles (most likely sliders) regularly traverse the impoundment. No aquatic organisms were observed in the impoundment or the stream during the RI field activities in 2005; however, there have been no formal benthic surveys conducted since that time to evaluate habitat improvement. Based on these observations, Sharon Steel Run is not currently considered an ecological habitat of concern, but is potential future habitat, as this headwater system is considered to be a valuable ecological resource for this area. The approximate area of this collective feature is 0.7 acres.

Monongahela River - The Monongahela River is known to be used for multiple recreational purposes including boating and sport fishing, as well as for commerce, mainly coal and other materials barging. This river is protected as a warm-water fishery and, according to the regional fish biologist for the West Virginia Department of Natural Resources, the State stocks the Monongahela River in the area of the Site with fish. The Site is located along a section of the Monongahela River that is known as the Opekiska water pool. The Opekiska pool is the site of several bass-fishing tournaments throughout the year.

The river is known to support a rich and diverse fish community. Based on this information, the river would be expected to provide habitat for freshwater clams and mussels, benthic invertebrates, and fishes as well as predatory terrestrial wildlife species. Due to the excessive water depth in most of the river, the significant foraging zone for predatory terrestrial wildlife would be along the shallow banks of the river. Piscivorous birds could be expected to prey on small fish throughout the river.

According to West Virginia state officials (WVDNR, 2006), there are no sensitive environments or endangered species present at or adjacent to the Site, including the Monongahela River near the Site.

1.5 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

1.5.1 Historical Sources of Contamination

Given the long history of the Site as a tar processor and salvage yard, there are various historical sources of contamination at the Site. Figure 1-4 depicts a summary of all the historical areas of interest at the Site that were investigated as part of the RI. For the purposes of the EE/CA, these historical source areas are designated and briefly described below:

- **Area 1 - East Tributary** - This tributary area appears to have historically received most of the storm water and other discharges from the Site. The headwaters of this area have historically been described as the East Tributary, whereas the lower portion of this area was described as Unnamed Tributary #1, which is now designated as Area 4. This area contained the most contaminated sediments and seeps. The primary tar and seeps and contaminated sediment have been removed from this area by EPA. The area has been reworked extensively, and currently provides storm water drainage from the central portion of the Site. The flow in this tributary is intermittent.

- **Area 2 - Unnamed Tributary #2** - This tributary area provides drainage of the northernmost portion of the Site. This drainage starts from an area slightly east of the Site (Sharon Steel site), and moves west along the northern boundary of the Site, adjacent to the former building/operations area. The tributary continues to the northwest off the property, joins a culvert, and ultimately flows west across the adjacent former Creative Labels property in an underground pipe prior to discharging to the surface at the top of a steep hill, eventually discharging to the Monongahela River in a gully approximately 600 feet northwest of where Unnamed Tributary #1 discharges to the Monongahela River. Sampling of this tributary conducted during March 1999 indicated high concentrations of polynuclear aromatic hydrocarbons (PAHs) in the sediments in this tributary at the easternmost property line, and at the confluence with the Monongahela River. The flow in this tributary was historically intermittent, and continues to be intermittent, with runoff and flow present during heavy precipitation events only.

- **Area 3 - Sharon Steel Run** - This surface water body drains the Sharon Steel site above its confluence with Unnamed Tributary #1, and drains the BJS Site downstream of that confluence. Historically, Sharon Steel Run was the pathway for discharges from the Site (via the East Tributary and Unnamed Tributary #1) to the Monongahela River. Contaminated sediment has been removed from this drainage area by EPA. The area has been reworked extensively, and continues to drain both the Sharon Steel and BJS Sites.

- **Area 4 - Unnamed Tributary #1** - This drainage area, located east of the Site on the Sharon Steel property, receives discharge from the Far East Tributary and East Tributary prior to its confluence with Sharon Steel Run, and was the subject of previous concern by EPA as having potentially received drainage and releases from the BJS Site along the northeast property boundary. It reportedly contained coal tar and coke breeze (a residue of the burning of coke approximately 10 mm in diameter) during previous investigations. This area does not appear to have been extensively disturbed by EPA response actions.

- **Area 5 - Former Debris/Waste Storage Area (West)** - This large area was identified in the aerial photographic record (see the RI, Tetra Tech 2007) as being the location for various types of material, debris, and waste storage throughout the period of operations, but primarily during the Big John Salvage time of operation. This area has been partially disturbed by EPA actions, but currently is mostly wooded or covered in brush.

- **Area 6 - Former Glass Cullet Storage/Processing Area** - This area was formerly used for storage and processing of glass cullet (crushed non-saleable fluorescent light bulbs) from at least the late 1970's through the late 1980's. Sampling of this area in 1984 indicated high concentrations of mercury and other heavy metals in this area. The primary contaminants known to be associated with fluorescent light bulbs include mercury, PCBs (from ballasts), and di-

ethylhexyl phthalate (DEHP) (from ballasts - DEHP was used to replace PCBs in certain ballast capacitors beginning in 1979).
The glass piles were removed from the Site by PRPs during the period October 2000 through July 2001, and demonstration of attainment to West Virginia human health industrial standards was achieved. However, some areas were not sampled for attainment because of the presence of coal tar contamination. Nearly 7,300 tons of cullet were removed (approximately 4,000 tons were disposed of as hazardous waste) from this area. This area is currently open space and covered with grass/brush, or covered with a soil stockpile.

- **Area 7 - Cullet Washing Sedimentation Basin and Drainage/West Tributary** - This area contained a small sedimentation basin that was used to collect the runoff from the cullet storage area. This area also includes the drainage swale (also known as the West Tributary) located downstream of the sedimentation basin. Nearly 16,000 gallons of water from the sedimentation basins were removed and disposed of as hazardous waste during the glass cullet removal action in 2000/2001. The contaminants of concern for this area are the same as the glass cullet area—mercury (and other heavy metals), PCB congeners, DEHP, and coal tar. This drainage has been extensively reworked by EPA activities, and currently contains a dirt road. The sedimentation basin is also no longer present. Historically, former tar operations also discharged to the West Tributary, and tar deposits in the West Tributary were buried during EPA removal work (i.e., under the road).

  This area also currently collects drainage from the northwest corner of Area 9 and the existing EPA soil stockpile area.

- **Area 8 - Former Tar/Pitch Impoundment Areas** - This area contained the crude naphthalene production unit until production was relocated to the southeast corner of the property. Area 8 contained two approximate 80-foot wide by 200-foot long basins used for liquid or other storage that were visible in the 1938 through 1957 aerial photographs. In a 1937 Reilly Tar General Plant Layout Drawing, these features are identified as No. 1 Bay (northernmost impoundment - with a floor designated 5 feet below grade) and No. 3 Bay (southernmost impoundment - with a floor designated 6 feet below grade). These features were no longer present by the 1967 photograph. Based on a review of the historical information, this impoundment was used as a "lime basin" and/or "pitch pond" during the tar refinement process. The aerial photographs for this area show the basin either completely filled with liquid (1955 and 1957 photographs), or partially filled with liquid (1938 and 1953 photographs). The northwest corner of Area 8 also housed one of two steam plants at the Site.

  According to field observations indicated by the WVDEP, the pitch pit was earthen with an earthen floor with dimensions of 207 feet long by 55 feet wide by 6 feet deep, and reportedly contains approximately 4 feet of tar. It is reported that some unknown time, approximately 12 to 18 inches of gravel was placed on the tar, and that ultimately concrete of varying thicknesses (but not greater than 6 inches) was placed on top of the gravel. Tar can reportedly be observed seeping through cracks in the concrete. The surface of this area has been extensively reworked by EPA actions, and currently is a combination of open space, gravel area, and concrete pads.

- **Area 9 - Former Tar Pit/Major Tar Seep Area** - This area is located south of the former tank storage area (Area 10), and was reported to contain active tar pits and tar seeps. The tar pit and tar seeps in this area were also visible in 1974 and 1978 aerial photographs. This area has a long history of disturbances and was extensively reworked by EPA activities. Area 9 currently is open space.

- **Area 10 - Former Tank Storage Area** - This area contained the tanks used during the tar refining process. There were seven large vertical tanks during the period 1938 through the early 1980's. The tanks were used for both storage and processing, and may have historically contained crude tar, creosote oil, naphthalene, phenol, acid oil, and carbolic acid. The 1974 aerial photograph showed extensive soil staining in the vicinity of the tanks. The tanks and tank pads were removed by EPA, and the area is currently open space with grass/brush or covered in concrete rubble.

- **Area 11 - Former Drainage Pond/Former Oil Water Separator Area** - This area appeared to contain the former drainage pond, as well as the former oil-water separator. This area was located between the large storage tanks at the top of the East Tributary/Unnamed Tributary #1. The former drainage pond reportedly received drainage from three sewers, and included tar waste, sulfuric acid waste, water separated from crude phenol distillation, and other cooling and condensing water. An oil water separator was reportedly installed in this area sometime before 1983, but reportedly was heavily contaminated with PAHs. The area has been extensively reworked by EPA activities, and currently is open space or has concrete rubble present at the surface.

- **Area 12 - Former Pit Area (East)** - This area contained a small pond near the eastern edge of the tank storage area (Area 10). It was visible on aerial photographs throughout the period of record from 1938 through 1997, and was no longer apparent as a feature in the 2000 survey of the Site. The historical purpose of this pond is unknown, but it appears to have been located on or adjacent to the property line in this area. The area has been extensively reworked by EPA activities, and is currently slightly wooded/brushy.

- **Area 13 - Monongahela River** - The Monongahela River was historically impacted by the discharges from the Site, as described previously. Sediment contamination attributable to the Site is believed to extend approximately 25 feet upstream of the current confluence of Sharon Steel Run and approximately 2,000 feet downstream from the confluence.

- **Area 14 - Former Acid Plant Area** - This was the former acid plant area as identified on the 1937 plant drawing. It originally consisted of lime and acid storage tanks, and a small building. Area 14 has been extensively reworked by EPA activities and currently is open space.

- **Area 15 - Former Lime Sludge and Acid Plant Waste Area** - This was the location of a former impoundment identified on the 1937 Reilly Tar and Chemical plant drawing. It was located immediately west of the former tank storage area and the headwaters of the West Tributary. Prior to the EPA removal activities, the impoundment had been filled with wastes and debris. During EPA removal activities at Area 15, most of the contents of the impoundment were removed and staged on Site. Excavated materials included industrial tar waste as well as drums containing tar residue. The drums were crushed and properly disposed of off-site.

- **Area 16 - Former Tar Storage Area** - This was the location of a former storage area for material in barrels as identified on the 1937 plant drawing. It was located between the two railroad spurs at the Site, and extended between the No. 1 Bay to the west and the pipe shop to the east. This area was also known as the former distillation and steam plant area, as shown in Figure 1-4. There is currently a building in this area and open space.

- **Area 17 - Former Acid Still Area and Crude Naphthalene Area** - This was the location of acid still and naphthalene process equipment as identified on the 1937 plant drawing. Underground storage tanks were also present in this area on the 1937 drawing. The area has been extensively reworked by EPA activities, and a portion of a soil stockpile overlies Area 17.

The RI focused on collecting additional data from each of these potential source areas. The RI findings for these various source areas are summarized in the following section.

1.5.2 Nature and Extent of Contamination

The nature and extent of contamination associated with the Site was characterized as part of a remedial investigation performed at the Site (Tetra Tech, 2007). The following is a summary of the major conclusions regarding the nature and extent of contamination at the Site:

1.5.2.1 Surface Soil Assessment

The surface soils at the property contained PAHs at concentrations ranging from 2 mg/kg to greater than 1,500 mg/kg. The distribution of PAHs was widespread, and nearly 75% of the locations sampled during the RI sampling effort contained concentrations of PAHs in excess of either human health or ecological risk assessment screening criteria. The highest concentrations of PAH were detected in the northwestern portion of the Site in forested, brushy areas, and storm water swale drainage areas that were not previously addressed by removal activities. Low levels of pesticides were also detected, although none were present at concentrations that pose a human health or environmental risk.

Heavy metals are also widely distributed across the Site, with arsenic, aluminum, copper, iron, manganese, mercury, nickel, and vanadium present at nearly every location. However, based on a background comparison with off-site locations, only copper and mercury are present on-site above background concentrations. Note that the highest concentrations of mercury were found in the vicinity of the historic cullet operations (Area 6).

A wide variety of PAHs, several semi-volatile organic compounds (SVOCs), and low levels of some pesticides were detected in samples collected from the adjacent off-property locations, but little to no PAHs, SVOCs, or pesticides were detected at more distant background locations. No PCB aroclors were detected in any of these samples, but low levels of PCB congeners were found in several samples. The total PAH concentrations in the adjacent off-site locations ranged from non-detect to 180 mg/kg, and the highest concentrations were detected in the samples collected immediately north of Hoult Road.

It appeared that the areas adjacent to, but hydrologically upgradient to the Site have been impacted by PAHs, likely as a result of atmospheric deposition, either from historic airborne emissions during prior industrial operations in the area, or through on-going deposition of particulates from the heavy truck traffic in the area (Hoult Road locations). In the immediate vicinity of the Site, the background level of PAHs was at least 10 mg/kg in the areas north of Hoult Road and south of Sharon Steel Run.

Heavy metals were also widely distributed at the off-site surface soil sample locations as well, with arsenic, aluminum, beryllium, copper, iron, manganese, mercury, nickel, and vanadium present at nearly every location. With the exception of arsenic, copper and mercury, off-site concentrations of heavy metals in the soil were similar to on-site concentrations of heavy metals in the soil. On-site concentrations of arsenic, copper and mercury were found to be higher than off-site background concentrations.

1.5.2.2 Subsurface Soils Assessment

Test pit investigations performed as part of the RI indicated that most of the western portion of the Site (Area 5) is underlain by surface fill material from 2 to 5 feet deep. Seemingly unimpacted native materials were encountered at most locations below a depth of approximately 5 feet. However, a large area under former stockpile #2 (near the head of the West Tributary - see Figure 1-3) contained buried drums, which were removed and disposed off-site. Additional contaminated soil was also excavated from this general area and added to the consolidated stockpile currently staged at the Site. However, a single sample collected from the bottom of the excavation prior to backfilling activities indicated very high concentrations of VOCs (in excess of 3,000 mg/kg), and PAHs (in excess of 20,000 mg/kg) were present in the subsurface in this area.

Given a combination of analytical results and field observations, contaminated subsurface soils were found in more than 80% of the 62 soil borings conducted as part of the RI, ranging in depths from immediately below the surface to more than 20 feet below grade. There appeared to be a few areas with elevated VOC levels (BTEX concentrations detected at greater than 70 mg/kg), but PAHs were the most widespread contaminant detected at the Site, with the highest concentrations found near the center of the Site. Very low concentrations of some pesticides were detected in a few subsurface soil samples; however, no PCB Aroclors were detected in any of the subsurface soil samples.

There were a wide variety of inorganics present in subsurface soils. With a few exceptions (mercury in the area in the vicinity of the head of the West Tributary), most heavy metals are randomly distributed throughout the Site with no apparent pattern observed in the extent of detection. Mercury was detected in several borings in the vicinity of the former cullet processing area (Area 6), and high concentrations of several heavy metals (lead, arsenic, cadmium, mercury, and nickel) were also found in borings near the top of the West Tributary in the vicinity of the 2005 drum excavation area. Both areas are likely indicative of elevated levels of contamination.

None of the five visually contaminated samples submitted for waste characterization exhibited RCRA hazardous waste characteristics, and the waste (mostly soil) has very little heat value (<454 Btu/lb), indicating that it would have very little value as a recycled fuel supplement. In the absence of a listed waste classification of the material, most of the contaminated soil at the Site would not likely be considered a hazardous waste. However, there are likely hot spots of soil and waste present (such as in the drum excavation area) that do have sufficiently high concentrations of VOCs and SVOCs that may exhibit RCRA hazardous waste characteristic; therefore, could be subject to disposal or treatment for RCRA hazardous waste.

1.5.2.3 Groundwater Quality Assessment

There are two types of aquifers at the Site—the overburden and the bedrock. The overburden aquifer consists of unconsolidated sediments, predominantly silts and clay.. The saturated thickness in the overburden ranges from 4 to 11 feet. The yield for wells in this aquifer is generally less than 1 or 2 gpm. The bedrock aquifer underlies this and extends over 100 feet deep. The yield for wells in the bedrock aquifer ranges from 1 to more than 50 gpm. For reference purposes, see Appendix A for various figures from the RI illustrating the potentiometric contour maps, which illustrate the groundwater flow direction in both the overburden and bedrock aquifers at the Site.

Organic compounds (predominantly BTEX and naphthalene) were present in the overburden aquifer in the central portion of the Site in areas consistent with historical operations. The types of contaminants detected in the overburden groundwater were consistent with those detected in subsurface soils. The highest BTEX concentrations were nearly 0.5 mg/l, and the highest total PAH concentrations were more than 3 mg/l. During the RI sampling events, no light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL) were observed in any of the RI monitoring wells. However, the two French Drain collection points at the base of the Middle and East Tributaries continue to collect NAPL from the groundwater collection system. For reference purposes, see Appendix A for various figures from the RI illustrating the nature and extent of volatile organic compounds and PAHs in the overburden aquifer at the Site.

The overburden groundwater also contains a wide variety of inorganics in both the total and dissolved fractions, which were widely distributed with no apparent pattern observed in the extent of detection for any given analyte. No unusually high or anomalous concentrations were noted, although some inorganics were present at concentrations in excess of initial risk screening criteria.

The data collected for evaluation of natural attenuation processes at the Site indicated that anaerobic degradation appeared to be occurring in the vicinity of well MW-05A (the well with the second highest concentration of organic compounds). However, it also appeared that the conditions in the subsurface in the vicinity of well MW-4A (the well with the highest concentrations of organic compounds) were not nearly as conducive to anaerobic degradation as those found near well MW-5A. See Section 3.1.2 (Alternative GW2 - Monitored Natural Attenuation) for additional discussion about the overburden aquifer geochemistry.

Only low levels of VOCs and SVOCs were infrequently detected in most bedrock monitoring well samples. The majority of the compounds detected (benzene, toluene, xylene and naphthalene) were similar to those found in the overburden aquifer; however the concentrations detected in the bedrock aquifer ranged only from 1 to 7 ug/l (note that all results in selected wells were J-qualified (estimated). Only one bedrock well (MW-5B) had detections in both April and July 2005 sampling events - all other bedrock wells had only single event low concentration detections). There were also infrequent low level detections of other SVOCs and pesticides. Otherwise, the bedrock aquifer at the Site appeared to be generally unimpacted by organic compounds.

Bedrock groundwater contained a wide variety of dissolved and total inorganics, which were widely distributed across the Site; however, there was no apparent pattern of high concentration areas observed. The nature and distribution of the inorganics were primarily related to the various rock types underlying the Site (i.e., shale, sandstone, and limestone).

1.5.2.4 Surface Water Assessment

Only low levels of organic compounds (benzene and several PAHs) were detected in surface water samples collected from Sharon Steel Run and Unnamed Tributary #2 drainages. No organic compounds were detected at any background locations. Benzene was detected at several locations at concentrations ranging from non-detect to 110 ug/l in the Sharon Steel Run drainage. The source of the benzene is likely discharge from the overburden aquifer in the area, potentially from contaminant sources located on-site as well as from the adjacent Sharon Steel Fairmont Coke Works Site, which historically has high benzene concentrations in the groundwater. The inorganics were widely distributed with no apparent trend in concentration change for most analytes, except in localized areas where the influence of the local overburden groundwater discharge was apparent in the surface water quality.

The water sample collected farthest upstream from the Site and East Tributary had elevated concentrations of iron and manganese. This suggests that the groundwater discharging at and upstream from this location (which is located at the edge of the Sharon Steel Fairmont Coke Works Site) may also be impacted.

The surface water collected from the Sharon Steel Tributary, upstream of the confluence with Unnamed Tributary #1, had a noticeably different inorganic chemistry, compared to the surface water sampled in the Unnamed Tributary #1 and Sharon Steel Run. The water upstream of this tributary in April 2005 was characterized as having concentrations of calcium, iron, cobalt, magnesium, manganese, sodium, and zinc that were generally much less than concentrations observed in the Unnamed Tributary #1 and Sharon Steel Run. These differences suggested that the surface water in the Unnamed Tributary #1 and Sharon Steel Run were not currently being impacted by the surface water discharging from the Sharon Steel Tributary.

EPA established a total maximum daily load (TMDL) for Sharon Steel Run in September 2001 for iron (1.5 mg/l), manganese (1.0 mg/l), and pH (6-9). In the sample collected in 2005, the Sharon Steel Run discharges to the Monongahela River with iron and manganese concentrations at 4.85 mg/l and 2.15 mg/l, respectively; therefore, the water quality in Sharon Steel Run does not meet this TMDL.

1.5.2.5 Sediment Assessment

A wide variety of PAHs, a few SVOCs, and very low concentrations of some pesticides and PCBs were detected in sediment samples collected from the Sharon Steel Run drainage and Unnamed Tributary #2. In general, the concentrations of PAHs detected in the sediments were less than those detected in soil samples.

It should be noted that the sediments from the impoundment near the confluence of Sharon Steel Run and the Monongahela River were removed in late 2007 - consequently the historical sediment data from the impoundment area (some of which is incorporated in the discussion that follows) is no longer considered representative for that area. However, the general trends of nature and extent of contamination discussed below remain representative of the overall sediment quality in Sharon Steel Run.

The concentrations of total PAH compounds in the Sharon Steel Run drainage ranged from non-detect to 81 mg/kg. Along Sharon Steel Run, low concentrations of total PAHs were found in the sediments in the stretch immediately downstream of the East Tributary, while high concentrations (~30 - 80 mg/kg) were found associated with the impoundment near the confluence with the Monongahela River. Sediments upstream of the Site also had total PAH concentrations ranging from 54 - 67 mg/kg. No PAHs were detected in the Sharon Steel Tributary. The highest concentration of total PAHs was found in the Unnamed Tributary #2 where PAH concentrations ranged from 297 to 510 mg/kg for the locations on the north side of the Site, and from 4 to 440 mg/kg on the portion of this drainage located off the property.

The sediment samples contained a wide variety of inorganics; however, there appeared to be no atypical inorganic detections that were widespread across the Site. The inorganics were widely distributed with no apparent pattern observed in the extent of detection, although mercury showed an increasing concentration trend in Sharon Steel Run downstream of the West Tributary. Concentrations of selected inorganics (including aluminum, barium, cadmium, iron, lead, manganese, and mercury) were present in sediment at concentrations in excess of risk screening levels. These heavy metals were most likely bioavailable.

Porewater samples collected from the sediments at certain locations along Sharon Steel Run in April 2007 contained low concentrations of PAHs, with most detections present at concentrations less than 1 ug/l. The highest concentrations detected in the porewater were found in samples collected downstream of the West Tributary and within the East Tributary.

1.5.2.6 Monongahela River Assessment

Surface water sampling conducted in April 2005 and April 2007 revealed only minor detections of organic compounds. Only a single organic compound (bis [2-ethylhexyl] phthalate) was detected in Monongahela River water samples collected during April 2005, and low concentrations of PAH compounds (< 0.5 ug/l) were detected at two sample stations in April 2007. Only select inorganics were detected in the river water in both sampling events (aluminum, barium, calcium, cobalt, iron, magnesium, manganese, potassium, sodium, zinc and vanadium). Most inorganics were present in every sample in both sampling rounds, and there were no anomalous readings for most analytes throughout the reach of river investigated. These results indicated that the discharge from Sharon Steel Run was not affecting the Monongahela River water quality, as there was no major change in water quality observed above and below the confluence even if it does not meet TMDL.

The sediments of the Monongahela River in the study area ranged in thickness from 1 to 8 feet, with most deposition occurring on the western side of the river downstream of the confluence with Buffalo Creek, primarily related to the influence of sediment introduced by Buffalo Creek. The sediments in the deeper channel areas were comprised mostly of coarse sand and gravel, with coal pieces making up a large portion of the sediment in the area. The sediments in depositional areas were comprised primarily of silt and clay, with some fine sand. Several cores in the study area section showed interlayered beds of fine and coarse grain material, indicating a variable depositional setting on this section of river, ranging from high velocity to low velocity depositional episodes.

With respect to the sediment sample results for the river, a wide variety of PAHs, a few SVOCs, and very low concentrations of some pesticides and PCBs were detected. The total PAH concentrations in the river sediment increase substantially below the confluence with Sharon Steel Run. Elevated total PAH concentrations extend at least 2,000 feet downstream from the confluence along the eastern bank of the river. A black semi-solid material (BSM) was observed in the sample collected approximately 100 feet downstream from the confluence, and the high total PAH concentrations (>1,500 mg/kg) were detected in sediments approximately 1 foot below the river bottom approximately 300 feet downstream from the confluence.

In a separate investigation conducted in June 2005, Reilly Industries delineated impacted river sediment areas downstream of the confluence using divers. The underwater visual inspection indicated the presence of the BSM extending at least 50-75 feet away from the east bank, and approximately 250 feet downstream from the confluence. The BSM was also observed extending about 25 feet upstream of the current confluence location. Further, the divers delineated stained sediments under a surficial layer of clean sediments extending at least 800 feet downstream. Reilly also collected samples of the BSM and reported total PAH concentrations for most samples in excess of 20,000 mg/kg.

The river sediment contained a wide variety of inorganics; however, there generally appeared to be no atypical inorganic detections that were widespread across the reach of river investigated during the April 2005 and April 2007 sampling events. Common inorganics detected in most samples included arsenic, antimony, cadmium, copper, cyanide, iron, lead, manganese, silver and zinc. However, some anomalously high lead concentrations were detected in sediments immediately downstream from the Sharon Steel Run confluence during the April 2005 sampling event. Based on acid volatile sulfide/simultaneous extracted metals (AVS/SEM) analysis, the metals present in the sediment are likely to be bioavailable.

Additional river sediment sampling was conducted in 2007 to support additional ecological characterization activities. The results indicated that the total PAH concentrations in the shallow river sediment generally ranged from 1.89 mg/kg to 4.76 mg/kg, with two exceptions noted at locations collected near the delineated BSM area, where total PAH concentrations were detected at 27 mg/kg and 1,289 mg/kg. The upstream/background station had a concentration of 2.75 mg/kg. Total organic carbon (TOC) content in the sediments ranged from 19,000 to 44,000 mg/kg.

In addition to surface water and sediment sampling, additional sampling was also conducted in the Monongahela River to support ecological characterization. This included porewater sampling, fish sampling for quality and histopathology, macroinvertebrate (clam) sampling, and sediment sampling for toxicity testing. A macroinvertebrate survey was also conducted in the river.

Porewater was collected from two locations in the Monongahela River—one adjacent near the confluence with Sharon Steel Run and one further downstream. The porewater sample collected near the Sharon Steel Run confluence contained the highest concentrations of total PAHs greater than 15 ug/l, with acenaphthene, fluorene, and naphthalene comprising the majority of the total concentration of PAHs present.

With regard to the Monongahela River fish collection, with the exception of one large fish sample with two low concentrations slightly above quantitation limit detections of PAHs, no PAHs were detected in the large fish samples collected. Concentrations of mercury in small fish (note that small fish were analyzed for mercury only) ranged from 0.17 to 0.37 mg/kg, with concentrations generally increasing downstream in the study area. The fish histopathology findings concluded that a number of changes observed in the fish (abnormal bile ducts, altered foci, and abnormal hepatocytes) suggest exposure to contaminants, most likely ones metabolized by the liver.

Clam samples were collected from two locations in the river—one from a location with relatively unimpacted sediments (total PAH concentrations < 2 mg/kg), and one from a location heavily impacted (total PAH concentrations ~ 1,300 mg/kg). The total PAH concentration in clam tissue collected from the less impacted location was 710 ug/kg, whereas the total PAH concentration in clam tissue collected from the impacted sediment location was 220 mg/kg, which clearly indicates PAH uptake into the clam tissue.

Sediment toxicity tests revealed that the sediment collected from the vicinity of the BSM caused significant mortality to Hyalella azteca after 28 days of exposure (note that this location, SD-07, also had a total PAH concentration of ~ 1,300 mg/kg). However, no other sediment locations were found to be significantly different from the reference control sediment with respect to toxicity.

Finally, the aquatic invertebrate study suggests that some factor downstream of the Sharon Steel Run confluence appears to be negatively influencing invertebrates. The community metrics were the lowest (compared to the upstream reference point) in the reach comprising the three sampling stations located immediately downstream from the Sharon Steel Run confluence.

1.5.2.7 Soil Vapor Assessment

Only relatively low concentrations (< 5 ppbv) of aromatic hydrocarbons (BTEX) were detected in soil gas samples collected at four locations at the Site in 2007, and naphthalene was only detected at a single location at a low concentration (2 ppbv). Some aliphatic hydrocarbons (butane, pentane, hexane, etc.) were also detected in the soil gas at some locations.

1.6 HUMAN HEALTH RISK ASSESSMENT SUMMARY

A comprehensive human health risk assessment (HHRA) and baseline ecological risk assessment (BERA) were undertaken during the RI.

The HHRA was conducted to estimate the risks to human health resulting from the presence of contamination at the Site. The risk assessment covered river sediments, soil, groundwater, stream water, and stream sediments. The following are the current major conclusions of the HHRA for the Site:

Current/Future Visitor or Resident, Adult and Child (Monongahela River Sediments and Fish) - Exposure to chemicals of potential concern (COPCs) in shallow sediments in the Monongahela River resulted in a noncancerous hazard equivalent to the noncancerous hazard threshold of 1 and a cancer risk estimate that was within the cancer risk management range. Therefore, measures to reduce current concentrations of COPCs in the shallow surface sediments of the Monongahela River to protect visitors or nearby residents involved in recreational activities at the Monongahela River may not be warranted. Exposure to COPCs in deeper sediments in the Monongahela River also resulted in a noncancerous risk hazard equivalent to the noncancerous hazard threshold of 1. However, the reasonable maximum exposure (RME) cancer risk estimate exceeded the upper bound of the cancer risk management range (10^{-4}); the central tendency exposure (CTE) cancer risk estimate was within the cancer risk management range (10^{-6} to 10^{-4}). Carcinogenic PAH, specifically benzo(a)pyrene (BaP) and benzo(a)anthracene (BaA), were the primary cancer risk drivers for the deeper Monongahela River sediments. Although the deeper sediments (greater than 1 foot below the surface) may not currently be exposed and thus available for direct contact, there is a potential that future erosion or other activities (such as dredging) could make the deeper sediments available at the sediment surface in the future. Further, data collected in 2007 after substantial completion of the risk assessment demonstrate that the shallow river sediment samples were comparable to the deep river sediments in contaminant concentrations. Therefore, the human health risk is likely to be a factor for shallow sediments as well. Consequently, measures to reduce current concentrations of COPCs, or prevent future contact with COPCs, in both the shallow and deeper sediments may be warranted.

With respect to fish consumption, exposure to COPCs in fish tissue through consumption resulted in a noncancerous hazard that exceeded the noncancerous hazard threshold of 1 (HI= 13), as well as a cancer risk in excess of the acceptable risk range of 10E-4 to 10E-6 (cancer risk - 4x10E-4) – however, the risk is not driven by PAHs, but rather from certain heavy metals (iron, mercury, chromium, copper, and selenium) and a single PCB (Aroclor 1260).

Current/Future Construction Worker (Soil and Groundwater) - Exposure to COPCs in soil and volatile COPCs in groundwater resulted in a noncancerous hazard that exceeded the noncancerous hazard threshold of 1 (HI = 2); however HIs for the target organ analysis were equivalent to, or below, the threshold of 1. The cancer risk estimate was within the cancer risk management range (10^{-6} to 10^{-4}). Therefore, measures to reduce current concentrations of COPCs in soil or volatile COPCs in groundwater to protect construction workers involved in intrusive activities, such as construction or utility installation, may not be warranted.

Future Commercial/Industrial Worker (Soil and Groundwater) - Exposure to PAHs in soil, specifically BaP and naphthalene, contributed to a RME cancer risk that exceeds the upper bound of the risk management range (10^{-4}) and a noncancerous hazard greater than 1; the CTE cancer risk estimate was within the risk management range (10^{-6} to 10^{-4}). Exposure to inorganic chemicals (arsenic, iron, manganese, and thallium) in groundwater contributed to a noncancerous hazard greater than 1. The results of the background analysis indicate that concentrations of arsenic, iron, manganese, and thallium in groundwater at the Site may be greater than background levels. Groundwater beneath the Site is not currently used as a potable water source. Measures may be warranted to reduce current concentrations of PAHs in soil and to reduce, or prevent exposure to, concentrations of inorganic chemicals in groundwater.

Future Resident, Adult and Child (Soil and Groundwater) - Exposure to soil and groundwater resulted in a noncancerous hazard above the threshold of 1 and a cancer risk probability that exceeded the upper bound of the cancer risk management range (10^{-4}). Carcinogenic PAHs in soil and groundwater were the primary cancer risk drivers. In groundwater, detections of carcinogenic PAHs were limited to three monitoring wells. Benzene and 1,2-dibromo-3-chloropropane (1,2 -DBCP) in groundwater also contributed to the excess cancer risk; detections of 1,2-DBCP, which also contributed to the cancer risk for groundwater, was limited to one monitoring well. Arsenic in soil and groundwater also contributed to the excess cancer risk. Naphthalene in soil (vapor intrusion) and groundwater, and 2-methylnaphthalene in groundwater, were the primary contributors to the noncancerous hazard for the future resident. Contributors to the noncancerous hazard for soil include iron, manganese, and vanadium; based on the results of the background analysis, concentrations of these inorganic chemicals in soil may not be greater than background concentrations. Iron, manganese, and thallium in groundwater contributed to the noncancerous hazard; based on the results of the background analysis, concentrations of these inorganic chemicals appeared to be greater than background. Based on the results of the HHRA, further action may be warranted to address concentrations of PAHs (including carcinogenic PAHs, naphthalene, and 2-methylnaphthalene) in soil and groundwater. In addition, measures to reduce, or prevent contact with, concentrations of arsenic, iron, manganese, and thallium in groundwater may be warranted. Groundwater beneath the Site is not currently used as a potable water source.

Current/Future Recreational Users, Adult and Child (Stream Sediments and Surface Water) - Further action may be warranted to address concentrations of carcinogenic PAHs in stream sediments and surface water. The highest concentrations of carcinogenic PAHs were detected in Unnamed Tributary #2. Concentrations of BaP and di-benzo (ah) anthracene (Db(ah)A) that exceed their respective toxicity screening criteria were also detected at several locations in Unnamed Tributary #1/Sharon Steel Run. Manganese was identified as a primary contributor to the noncancerous hazard for both sediment and surface water; the background analysis indicated that concentrations of manganese in surface water may be greater than the background concentrations. However, the analysis indicated that concentrations of manganese in sediments may not be greater than background concentrations.

See Section 1.8 for a complete summary of the chemicals of concern determined by the HHRA.

1.7 BASELINE ECOLOGICAL RISK ASSESSMENT SUMMARY

The Baseline Ecological Risk Assessment (BERA) was prepared to evaluate risks to ecological receptors that were predicted to be at the greatest risk. The predominant habitats at the Site are the barren/impacted area, the open field upland habitat, and the forested upland habitat.

Barren/Impacted Area Habitat

In the barren/impacted area habitat, the plant and soil invertebrate community is likely adversely impacted by physical and chemical stressors. The physical stressors in this habitat were related to the extensive earth moving activities associated with EPA activities during the period 2000 through 2005, which resulted in bare or sparsely vegetated soils (note however that since 2005, the vegetation has naturally reestablished itself in some of these previously barren/impacted areas). The chemical stressors for plants and soil invertebrates included several PAHs and metals (copper and mercury). In addition, PAHs were at levels of concern for both mammalian and avian vermivores; and mercury was at levels of concern for mammalian herbivores as well as mammalian and avian vermivores.

Open Field Upland Habitat

In the open field upland habitat, the plant and soil invertebrate community may be adversely impacted by chemical stressors. The chemical stressors for plants and soil invertebrates included several PAHs and mercury. In addition, PAHs were at levels of concern for both mammalian and avian vermivores; and mercury was at levels of concern for mammalian herbivores as well as mammalian and avian vermivores.

Forested Upland Habitat

In the forested upland habitat, the plant and soil invertebrate community may be adversely impacted by chemical stressors. The chemical stressors for plants and soil invertebrates included several PAHs and methoxychlor. In addition, PAHs were at levels of concern for both mammalian and avian vermivores.

Emergent Wetland Habitat

In the emergent wetland habitat, the plant and soil invertebrate community may be adversely impacted by chemical stressors. The chemical stressors for plants and soil invertebrates included several PAHs, zinc and cyanide. In addition, PAHs were at levels of concern for avian vermivores.

Sharon Steel Run and Its Tributaries Aquatic Habitat

In Sharon Steel Run and its tributaries, aquatic habitat, future benthic invertebrates, aquatic invertebrates, fish, avian insectivores, as well as mammalian and avian piscivores were likely adversely impacted by chemical stressors in porewater, surface water and sediment. The chemical stressors for future benthic invertebrates included total PAHs and heavy metals. The chemical stressors for future aquatic invertebrates and fish included several PAHs, aluminum, barium, cadmium, iron, lead, manganese and mercury. Results of the porewater sampling indicated that PAHs, metals and a few other chemicals (acetophenone, caprolactam, and 2,4-dimethylphenol) may also adversely impact future aquatic life. In addition, PAHs are at levels of concern for future avian insectivores and piscivores, and mercury was at levels of concern for future mammalian and avian piscivores.

Monongahela River Aquatic Habitat

In the Monongahela River, aquatic habitat, benthic invertebrates, aquatic invertebrates, fish, avian insectivores, as well as mammalian and avian piscivores may be adversely impacted by chemical stressors in porewater, surface water, and sediment. The chemical stressors for benthic invertebrates included total PAHs and heavy metals. Results of the porewater sampling indicated that PAHs, metals and a few other chemicals (acetophenone, caprolactam, and 2,4-dimethylphenol) may also adversely impact future aquatic life. PAHs were also determined to be adversely affecting fish based on the results of the fish histopathology examination, which confirmed fish exposure to PAHs in the river sediments. In addition, PAHs were at levels of concern for avian insectivores, and mercury is at levels of concern for mammalian and avian piscivores.

1.8 SUMMARY OF RISK ASSESSMENT IDENTIFIED CHEMICALS OF CONCERN (COCs)

Based on the findings of the HHRA and BERA, the following table summarizes the chemicals of concern (COCs) determined by the risk assessment to be major contributors to the risk for each major medium at the Site, including those for soil, groundwater, on-site surface water, on-site sediment, and the Monongahela River sediments. No risks were found associated with the Monongahela River surface water. Note that although the BERA identified separate porewater COCs, no COCs are presented in this list as porewater is not considered to be a major medium - any porewater COCs are expected to be addressed as part of any sediment action, since the porewater COCs are typically similar to the sediment COCs.

With respect to the risks found associated with the fish tissue (COCs in fish tissue contributing to this risk include iron, mercury, chromium, selenium, copper and Arochlor-1260), these will be further evaluated in the future and are not considered part of the current EE/CA and related potential removal action. The risks attributable to fish ingestion will be further evaluated after the completion of any Monongahela River sediment removal actions and as part of any final risk evaluation and Record of Decision (ROD) for the Site.

These COCs will form part of the basis for the development of the preliminary removal goals (PRGs) further described in Section 2.2. In addition to the COCs, ARARs and other to be considered values (TBCs) will also be considered in the development of the PRGs.

SUMMARY OF RISK IDENTIFIED CHEMICALS OF CONCERN

Media	Chemical of Concern	HHRA Determined COC	BERA Determined COC
Soil	Acenaphthene		X
Soil	Acenaphthylene		X
Soil	Anthracene		X
Soil	Benzo(a)anthracene	X	X
Soil	Benzo(a)pyrene	X	X
Soil	Benzo(b)fluoranthene	X	X
Soil	Benzo(g,h,i)perylene		X
Soil	Benzo(k)fluoranthene		X
Soil	Carbozole		X
Soil	Chrysene		X
Soil	Dibenzo(a,h)anthracene	X	X
Soil	Dibenzofuran		X
Soil	Fluoranthene		X

SUMMARY OF RISK IDENTIFIED CHEMICALS OF CONCERN			
Media	Chemical of Concern	HHRA Determined COC	BERA Determined COC
Soil	Fluorene		X
Soil	Indeno (1,2,3-cd)pyrene	X	X
Soil	Naphthalene	X	X
Soil	Phenanthrene		X
Soil	Pyrene		X
Soil	Methoxychlor		X
Soil	Arsenic	X	
Soil	Copper		X
Soil	Mercury		X
Soil	Zinc		X
Soil	Cyanide		X
Soil Vapor	Benzene	X	
Soil Vapor	Naphthalene	X	
Groundwater	1,2-Dibromo-3-chloropropane	X	
Groundwater	2-Methylnaphthalene	X	
Groundwater	Benzo(a)anthracene	X	
Groundwater	Benzo(b)fluoranthene	X	
Groundwater	Benzo(k)fluoranthene	X	
Groundwater	Naphthalene	X	
Groundwater	Arsenic	X	
Groundwater	Iron	X	
Groundwater	Manganese	X	
Groundwater	Thallium	X	
Groundwater	Vanadium	X	
Groundwater Vapor	Naphthalene	X	

SUMMARY OF RISK IDENTIFIED CHEMICALS OF CONCERN

Media	Chemical of Concern	HHRA Determined COC	BERA Determined COC
On-Site Sediment	Acenaphthene		X
On-Site Sediment	Acenaphthylene		X
On-Site Sediment	Anthracene		X
On-Site Sediment	Benzo(a)anthracene	X	X
On-Site Sediment	Benzo(a)pyrene	X	X
On-Site Sediment	Benzo(b)fluoranthene	X	X
On-Site Sediment	Benzo(g,h,i)perylene		X
On-Site Sediment	Benzo(k)fluoranthene		X
On-Site Sediment	Chrysene		X
On-Site Sediment	Dibenzo(a,h)anthracene	X	X
On-Site Sediment	Dibenzofuran		X
On-Site Sediment	Fluoranthene		X
On-Site Sediment	Fluorene		X
On-Site Sediment	Indeno (1,2,3-cd)pyrene		X
On-Site Sediment	Naphthalene		X
On-Site Sediment	Phenanthrene		X
On-Site Sediment	Pyrene		X
On-Site Sediment	Lead		X
On-Site Sediment	Mercury		X
On-Site Surface Water	Benzo(a)anthracene	X	X
On-Site Surface Water	Benzo(a)pyrene	X	X
On-Site Surface Water	Benzo(b)fluoranthene	X	
On-Site Surface Water	Dibenzo(a,h)anthracene	X	
On-Site Surface Water	Fluoranthene		X
On-Site Surface Water	Indeno(1,2,3-cd)pyrene	X	
On-Site Surface Water	Naphthalene		X

SUMMARY OF RISK IDENTIFIED CHEMICALS OF CONCERN

Media	Chemical of Concern	HHRA Determined COC	BERA Determined COC
On-Site Surface Water	Pyrene		X
On-Site Surface Water	Aluminum		X
On-Site Surface Water	Barium		X
On-Site Surface Water	Cadmium		X
On-Site Surface Water	Iron		X
On-Site Surface Water	Lead		X
On-Site Surface Water	Manganese		X
On-Site Surface Water	Mercury		X
Monongahela River Sediment	Acenaphthene		X
Monongahela River Sediment	Acenaphthylene		X
Monongahela River Sediment	Anthracene		X
Monongahela River Sediment	Benzo(a)anthracene	X	X
Monongahela River Sediment	Benzo(a)pyrene	X	X
Monongahela River Sediment	Benzo(b)fluoranthene		X
Monongahela River Sediment	Benzo(g,h,i)perylene		X
Monongahela River Sediment	Benzo(k)fluoranthene		X
Monongahela River Sediment	Chrysene		X
Monongahela River Sediment	Dibenzo(a,h)anthracene		X
Monongahela River Sediment	Dibenzofuran		X
Monongahela River Sediment	Fluoranthene		X
Monongahela River Sediment	Fluorene		X
Monongahela River Sediment	Indeno (1,2,3-cd)pyrene		X
Monongahela River Sediment	Naphthalene		X
Monongahela River Sediment	Phenanthrene		X
Monongahela River Sediment	Pyrene		X

1.9 REPORT ORGANIZATION

The following sections highlight the information contained in this EE/CA.

- Section 1.0 provides an introduction and a brief summary of the Site. The introduction contains descriptions and physical characteristics of the facility, the known nature of site contamination, and the risk assessment for the site.
- Section 2.0 discusses removal action objectives for the site, applicable or relevant and appropriate requirements (ARARs) and preliminary removal goals (PRGs).
- Section 3.0 presents the development and screening of removal alternatives.
- Section 4.0 presents a comparative analysis of removal alternatives.
- Section 5.0 presents the recommended removal alternatives.

2.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

The removal action objectives are developed to provide guidelines for evaluating the removal actions and ensuring that the proposed action complies with regulatory requirements. Section 2.1 provides a preliminary listing of applicable or relevant and appropriate requirements (ARARs) and other guidance to be considered (TBCs) in establishing cleanup goals and proposed removal actions. Section 2.2 discusses the preliminary removal goals (PRGs) and cleanup goals for the removal actions, media of concern, and the area and/or volume to be addressed under the removal actions. Section 2.3 identifies the scope of the removal actions for each medium of concern. Section 2.4 presents the removal action objectives for the contaminated media at the Site. Section 2.5 discusses the statutory limits on the removal actions.

2.1 COMPLIANCE WITH ARARs AND TBCs

ARARs are promulgated, enforceable federal and state environmental or public health requirements that are determined to be legally applicable or relevant and appropriate to the hazardous substances, response actions, or other circumstances at a CERCLA site. Section 300.430 of the NCP states that removal actions at CERCLA sites must meet ARARs unless there are grounds for invoking a waiver. A waiver is required if ARARs cannot be achieved. The two classes of ARARs, "applicable" and "relevant and appropriate", are defined below.

- **Applicable Requirements** - Section 300.5 of the NCP defines applicable requirements as those remediation standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial (removal) action, location, or other circumstance at a CERCLA site. Only those state standards that are identified by a state in a timely manner, are enforced in a consistent manner, and are more stringent than federal requirements may be considered as applicable requirements.

- **Relevant and Appropriate Requirements** - Section 300.5 of the NCP defines relevant and appropriate requirements as those remedial (removal) standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not directly applicable to a hazardous substance, pollutant, contaminant, remedial (removal) action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the particular site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be considered as relevant and appropriate requirements.

ARARs fall into three categories, based on the manner in which they are applied. The characterization of each category is not distinctive, because many requirements are combinations of the three types of ARARs. The categories are as follows:

- Chemical-Specific: Health- or risk-based numerical values or methodologies that establish concentrations or discharge limits for particular contaminants. Chemical-specific ARARs may be concentration-based cleanup goals or may provide the basis for calculating such levels. In cases where no chemical-specific ARAR exists, chemical advisories may be used to develop removal action objectives. Examples of contaminant-specific ARARs include maximum contaminant levels (MCLs) and Clean Water Act (CWA) Ambient Water Quality Criteria (AWQCs).

- Location-Specific: Restrictions based on the concentration of hazardous substances or the conduct of activities in specific locations. These may restrict or preclude certain removal actions or may apply only to certain portions of a site. Examples of location-specific ARARs include wetland regulations and floodplain management regulations.

- Action-Specific: These are regulations and guidelines that must be followed depending on the activity performed at a site. For example, proper handling, storage, and disposal of hazardous substances may be regulated by EPA or state guidelines.

In addition to ARARs, other regulations and guidance may be classified as guidance "To Be Considered" (TBC). TBCs are non-promulgated advisories or guidance that may be useful for developing removal actions or are necessary for determining what is protective of human health or the environment. TBCs at are not legally binding. For example, EPA Health Advisories and RfDs are non-promulgated criteria that are used to assess health risks from contaminants present at the CERCLA sites.

The state and federal ARARs, and TBCs were identified for the Site, and are summarized in Table 2-1

2.2 PRELIMINARY REMOVAL GOALS

Preliminary Removal Goals (PRGs) are medium-specific contaminant concentrations that are protective of human health and the environment if present in the media of concern. They incorporate both Site-specific risk-based concentrations developed, based on the HHRA and BERA, as well as ARARs and TBCs.

Based on the findings of the Site-specific risk assessment, the following are the impacted media to be evaluated as part of this EE/CA:

- Soil - including both surface soil (human health and ecological risk) and subsurface soil (human health risk, as it relates to both direct exposure and soil-to-groundwater pathway considerations)
- On-Site Surfacewater - including Sharon Steel Run and all associated tributaries, as well as Unnamed Tributary #2
- On-Site Sediment - including Sharon Steel Run and all associated tributaries, as well as Unnamed Tributary #2
- On-Site Groundwater - both overburden and bedrock aquifers
- Monongahela River Sediment - both shallow (ecological risk and human health risk) and deep sediment (human health risk)

Note that certain COCs detected in soil vapor and porewater were also found to pose potential risks to human health (soil vapor) or the environment (porewater); however, these media are not considered separately for the development of PRGs since these specific media are directly related to other media (i.e., soil vapor COCs are directly related to the COCs present in the soil, whereas groundwater and porewater COCs are directly related to the COCs present in the sediment, surface water, and groundwater media), and any risk associated with those media is expected to be addressed with the related media PRGs.

Further, certain COCs detected in fish tissue were also found to pose potential risks to human health, however, the fish tissue media will not be considered as part of this EE/CA. It will be further evaluated as part of site risk management activities considered in the future.

The PRGs proposed for the Site are presented in Table 2-2. See Appendix B for detailed rationale on the development and selection of the PRGs. The PRGs proposed are generally intended to meet EPA's target risk range for both human health and ecological risk receptors (soil, groundwater, sediment and surface water media), as well as meet chemical-specific ARARs where appropriate (groundwater and surface water media). Note that in general a goal of protection for carcinogenic risks were concentrations equating to a 1x10E-5 risk level, whereas the goal of protection for non-carcinogenic risks were concentrations equating to a hazard index of 1.0.

Note that the PRGs included in this EE/CA are provided for consideration as part of the overall risk management approach for the site. Any exceedances of PRGs remaining after the implementation of any non-time critical removal action will be further evaluated in the future as part of the final risk evaluation and record of decision (ROD) developed for this site.

2.3 DETERMINATION OF REMOVAL SCOPE

The scope of the removal action is site-wide, and includes all areas and media impacted with contaminants that exceed the Removal Performance Standards identified in Table 2-3. This includes all surface and subsurface soils (within site boundaries), groundwater (overburden and bedrock aquifer), surface water (including the West, Middle, and East Tributaries, as well as Sharon Steel Run), sediment (within Sharon Steel Run, and the West, Middle, and East Tributaries, as well as within Unnamed Tributary #2), and sediments associated with the Monongahela River.

A detailed summary of the scope of the removal action for each impacted media follows:

2.3.1 Soil

The impacted soil includes both surface soil (human health and ecological risk) and subsurface soil (human health risk). Note that for risk assessment purposes, soil to a depth of 5 feet and soil to a depth greater than 5 feet were considered surface and subsurface soil, respectively.

Based on the PRGs developed for soil, the total area of the Site with impacted surface soils is estimated to be approximately 657,000 square feet, as depicted on Figure 2-1. The primary COCs in the surface soil are PAHs, and the general area where the total PAH concentrations exceed PRGs is depicted on Figure 2-1. This area also encompasses those locations exceeding PRGs for copper, mercury, and zinc (ecological risk). Assuming a 5-foot depth (as per the risk assessment assumption), approximately 3,285,000 cubic feet (~122,000 cubic yards) or 197,000 tons (assuming 120 pounds/cubic foot or 1.62 tons/cubic yard) of impacted soil material pose a risk to human health or the environment via current or future direct contact pathways.

In addition to the impacted soil in the 0-5 foot range, soil deeper than 5 feet is also impacted at the Site. These deeper impacted soils are an on-going source of groundwater contamination (PAH and VOCs, as well as heavy metals), and are also a source for soil vapors (benzene and naphthalene only) that pose a future human health risk.

Based on the April 2005 field results (primarily elevated VOC and PAH analytical results or field observations of odor, staining, or the presence of coal tar), evidence of deeper soil contamination was found in more than 80% of the 62 soil borings completed during the April 2005 field event. The depth of deeper soil contamination ranged from 5 feet to more than 20 feet below grade. The total estimated area of deeper soil with evidence of PAH and VOC contamination is depicted on Figure 2-2, and equates to approximately 504,000 square feet, of which approximately 129,000 square feet is the area with both elevated VOC and PAH concentrations. Note that the general area of deeper soil impact is somewhat similar to that of the impacted surface soil as depicted in Figure 2-1.

Based on a review of the soil boring logs and estimated depth of contaminated soil at each boring location, the total volume of impacted deeper soil (either PAH and/or VOC contamination) is approximately 3,710,000 cubic feet (~138,000 cubic yards) or 223,000 tons. Of this total, approximately 1,200,000 cubic feet (~44,500 cubic yards) or 72,000 tons include deeper soil impacted with elevated VOC concentrations, including benzene and naphthalene. Note that this volume estimate for impacted deep soils is probably lower than what could actually be present on-site - the direct push sampling technique used during the RI to collect subsurface soil data had depth limitations (generally limited to less than 20-30 feet), and deeper sections of overburden are present in some areas (up to 40 feet deep). Consequently, there are certain areas that were not fully characterized for impacted deeper soil. Based on findings at shallower depths, these deeper zones are also likely impacted with PAHs and VOCs.

In addition to these impacted surface and deeper soils at the Site, there is also a stockpile of approximately 44,000 cubic yards (~72,000 tons) of soil and sediment staged at the Site from EPA removal actions conducted prior to 2005. There are also an additional 8,000 cubic yards (~13,000 tons) of sediment now staged at the Site from a December 2007 EPA removal action that involved the clean out of the impoundment near the mouth of Sharon Steel Run.

In summary, there are approximately 312,000 cubic yards (~505,000 tons) of impacted soil at the Site to be addressed as part of the removal action. This encompasses the following:

- 122,000 cubic yards (~197,000 tons) of surface soil (0-5 feet);
- 93,500 cubic yards (~152,000 tons) of deeper soil with high PAH concentrations and/or observable contamination;
- 44,500 cubic yards (~72,000 tons) of deeper soil with both high VOC and PAH concentrations; and
- 52,000 cubic yards (~84,000 tons) of PAH contaminated soils/sediment currently stockpiled at the Site from prior EPA removal actions.

2.3.2 Groundwater

The impacted groundwater was found in both the overburden and underlying bedrock aquifers. The primary COCs are PAHs and several VOCs, including BTEX. There are also several heavy metals which are also of concern, including iron and manganese (both overburden and bedrock aquifers), as well as arsenic and thallium (infrequently detected in the overburden aquifer only). The heavy metals are likely present at higher concentrations in some areas as a result of changes in the aquifer geochemistry that have allowed these metals to leach out of the sediments/rocks. The changes in aquifer geochemistry, specifically changes in pH and redox potential, are likely related to the on-going process of biological attenuation of the organic contaminants.

See Figure 2-3 for a depiction of the area with impacted groundwater in both the overburden and bedrock aquifers.

Overburden Aquifer

With regard to the overburden aquifer, an area encompassing approximately 360,000 square feet (~8.25 acres) has been identified to contain Site-related COCs. The depth to groundwater in the overburden ranges from 21 to 45 feet below land surface. The saturated thickness of the overburden aquifer is not extensive, and ranged in thickness from 4 to 11 feet, as measured in 2005. Given the nature of the overburden (silty clay with a basal sand unit and a typical porosity of 40%), the impacted area of the aquifer is estimated to contain approximately 8 million gallons of water (based on an average saturated thickness assumption of 7.5 feet).

Bedrock Aquifer

With regard to the bedrock aquifer, an area encompassing approximately 500,000 square feet (~11.7 acres) may contain Site-related COCs. The depth to groundwater measured in the bedrock aquifer wells ranged from artesian (free flowing) to over 130 feet below the surface. No attempt was made to estimate the volume of water impacted in the bedrock aquifer, as storage in the bedrock is a function of fracture occurrence and density, which cannot be estimated.

Although there are infrequent detections of some organic compounds at some monitoring well locations (including MW-5B, MW-6B, MW-8B, MW-13B, MW-13C, and MW-15B), no consistently present organic compounds (i.e., detected at the same location in both the April and July 2005 sampling events) were detected in the bedrock aquifer in excess of groundwater PRGs. Various inorganics were also detected in the bedrock aquifer wells, but with the exception of iron and manganese, no consistently present inorganics were detected in the bedrock aquifer in excess of groundwater PRGs.

Iron concentrations in excess of PRGs were consistently detected (i.e., detected at the same location in both the April and July 2005 sampling events) at bedrock well locations MW1-B, MW-3B, MW-4B, MW-6B, MW-12B, MW-15B, MW-7C, MW-8C, MW-12C, and MW-17I. Manganese concentrations in excess of PRGs were detected at bedrock well locations MW-1B, MW-3B, MW-5B, MW-6B, MW-12B, MW-13B, MW-14B, MW-15B, MW-7C, MW-12C, and MW-17I. The high iron and manganese concentrations at these well locations are likely related to geochemical changes in the aquifer, which have allowed iron and manganese to leach out of the bedrock units. It should be noted that the high concentrations of iron and manganese at some of these deeper bedrock wells may be related to natural conditions in these deeper stratigraphic zones rather than the result of Site impacts.

For example, based on the groundwater flow directions, bedrock well locations MW-1B and MW-3B, which are located in the same stratigraphic unit (designated as Stratigraphic Unit #1 in the RI), are situated upgradient from the major source areas. Therefore, it is likely the detections in these wells are representative of natural conditions.

On the contrary, wells MW-4B and MW-5B are in the same stratigraphic unit (Stratigraphic Unit #2), and are in close proximity to the overburden aquifer in this area, which has high iron and manganese concentrations, likely as a result of aquifer geochemistry changes associated with the presence of organic contaminants. Therefore, the high concentrations detected in these bedrock wells are likely Site-related. Further, the high concentrations detected in wells MW-13B and MW-14B, which are in the same stratigraphic unit and hydrologically downgradient of wells MW-4B and MW-5B, are also likely Site-related.

Likewise, based on the same types of stratigraphic and hydrologic gradient relationships, the high iron and manganese concentrations detected in wells MW-6B, MW-15B, MW-8C (iron only), and MW12-B (all screened within Stratigraphic Unit #3) are also likely Site-related.

Finally, the high iron and manganese concentrations detected at wells MW-7C and MW-12C (Stratigraphic Unit #4) are probably not Site-related. Well MW-7C is generally at a location hydrologically side gradient to the major historic source areas at the Site. However, this well location is downgradient from the adjacent Sharon Steel Fairmont Coke Works Site, which may be a source for the high iron and manganese concentrations detected in well MW-7C as well as further downgradient well MW-12C.

2.3.3 On-Site Sediment

The impacted on-site sediment medium includes those surficial sediments found primarily in Sharon Steel Run, Unnamed Tributaries #1 and #2, as well as the West, Middle, and East Tributaries. The primary COCs in the sediment are PAHs, with a few heavy metals (lead, manganese, and mercury) also present at concentrations in excess of PRGs. See Figure 2-4 for a depiction of the area where COCs in the sediments exceed the sediment PRGs. The primary impacted areas include Sharon Steel Run/Unnamed Tributary #1; Unnamed Tributary #2; and the West Tributary.

Sharon Steel Run/Unnamed Tributary #1

As a result of historic EPA removal actions conducted at the Site, there is very little sediment remaining in Sharon Steel Run and Unnamed Tributary #1. For example, the most recent EPA removal action completed in December 2007 removed 8,000 cubic yards of sediments from the impoundment area near the mouth of Sharon Steel Run. Consequently, most of the remaining sediment in this watercourse has been derived from the on-going runoff from the Site and adjacent watershed areas, and has accumulated only as a thin veneer (generally 6 to 12 inches in thickness) in occasional deposition areas spread out between the Far East Tributary (farthest upstream point) and the top of the impoundment area (a stream length of approximately 1,500 feet). Assuming a conservative residual sediment thickness estimate of 6 inches over that entire stream length and an average stream bed width of 10 feet, the resulting estimate for remaining sediment in Sharon Steel Run is approximately 7,500 cubic feet (~280 cubic yards) or 450 tons (assuming 1.62 tons/cubic yards).

Unnamed Tributary #2

The feature identified as Unnamed Tributary #2 is actually a drainage swale, which only has surface water present during periods of precipitation. The on-site segment of this feature is approximately 800 feet long, and it drains the Site, as well as areas north of the Site (along Hoult Road). The swale continues off-site on property owned by Westinghouse Electric Co. (now Philips) for another ~650 feet downhill, where it connects with a buried storm water pipe that carries it under the former Creative Labels property. The storm water pipe, which is approximately 400-500 feet long, discharges to a steep hillside drainage channel and then ultimately discharges to the Monongahela River. The final steep hillside drainage channel segment is approximately 300 feet long.

The extent of impacted sediments within Unnamed Tributary #2 has not been fully delineated. The on-site segment (assumed to be 800 feet long by 10 feet wide) and the downstream steep hillside drainage channel segment (assumed to be 300 feet long by 10 feet wide) have been characterized, but the drainage segment on the Westinghouse Electric Co property (assumed to be 650 feet long by 10 feet wide) or the 400-500 long storm water pipe section (assume a 24-inch pipe) has not been fully characterized.

For the purposes of the EE/CA, it is assumed that 36 inches of sediment will be removed from Unnamed Tributary #2 along the segment upstream of the storm water pipe. This depth of excavation for this segment was selected based on the observation that this drainage swale is nearly completely full of sediment/debris/vegetation and no longer drains properly, and has probably not been cleaned for many years (if at all) since the cessation of industrial activities at the Site. This equates to a volume of sediment for this segment of approximately 43,500 cubic feet (~1,600 cubic yards) or 2,600 tons.

With regard to the storm water pipe, it is assumed that the entire storm pipe would be cleaned (assume 4 inches of sediment in the pipe bottom), which equates to approximately 400 cubic feet (~15 cubic yards) or 24 tons. Finally, it is assumed that only 12 inches of sediment would be removed from the 300-foot long by 10-foot wide downstream segment of the steep hillside drainage channel (there is less sediment in this area because of the rock outcropping on this slope). This equates to a volume of sediment for this segment of approximately 3,000 cubic feet (~115 cubic yards) or 190 tons.

In summary, the total estimate of impacted sediment in the Unnamed Tributary #2 is approximately 1,730 cubic yards or 2,800 tons.

West Tributary

The West Tributary has been reworked extensively since original EPA removal actions, and a temporary construction roadway was built down along the West Tributary to provide access to Sharon Steel Run. According to the WVDEP, the waste material within the West Tributary was not removed prior to the construction of that temporary roadway. The nature and extent of contaminants in the West Tributary could not be investigated during the RI field effort because of difficulty in accessing this area (i.e., steep slope, very wet soil conditions). However, given the historic waste practices conducted in the vicinity of this feature (i.e., cullet washing) as well as the findings of the 2005 removal action conducted near the head of the West Tributary (i.e., buried drums containing tar residue and highly contaminated subsurface soil), it is likely that additional tar and contaminated sediment/soil is present in the West Tributary under the existing access roadway. Consequently, it is considered an "impacted" sediment area for the purposes of the EE/CA.

The West Tributary is approximately 200 feet long and 40 to 60 feet wide. Assuming that 36 inches of sediment would be removed throughout this area, this equates to approximately 30,000 cubic feet (~1,100 cubic yards) or 1,800 tons.

In summary, it is estimated that there is approximately 3,280 cubic yards (~5,000 tons) of impacted on- and near-Site sediments to be considered as part of the EE/CA.

2.3.4 On-Site Surface Water

The impacted surface water at the Site is derived from a combination of surface water runoff and groundwater discharge.

See Figure 2-5 for a depiction of the area that will be subject to the surface water PRGs, based on the historic surface water sampling results. The area to be addressed as part of the EE/CA includes Sharon Steel Run/Unnamed Tributary #1 (approximately 1,800 feet of stream segment) and Unnamed Tributary #2 (approximately 800 feet of stream segment).

Note that there are no removal alternatives specifically developed and described in Section 3.0 that address surface water exclusively. Given that the surface water is impacted by a combination of site runoff, groundwater discharge, and sediment quality, the surface water quality will be directly affected by the soil, groundwater, and sediment removal alternatives. Consequently, any removal action selected for the site will ultimately have to meet the surface water ARARs (in-stream standards) to be protective of human health and the environment.

2.3.5 Monongahela River Sediment

The impacted Monongahela River sediment includes both shallow sediment (human health and ecological risk) and deep sediment (human health risk). For the purposes of the EE/CA, the response action focuses on the hotspot of high PAH concentrations demonstrating active toxicity to aquatic organisms and acting as a source of contamination further downstream. The shallow sediment consists of the sediment layer primarily ecologically available (0-12 inches below the bottom of the river), whereas the deep sediment is considered to extend from 12 inches to a maximum of 60 inches below the bottom of the river (which generally coincides with the maximum depth of contamination in the river sediments).

The PRGs applicable to the Monongahela River sediments for the scope of this EE/CA are associated with the black semi-solid deposits (BSD) and stained sediments containing high concentrations of PAHs for the protection of human health and the environment. A PRG is proposed for removal of both the BSD and visually stained sediments containing high concentrations of PAHs (for protection of human health and ecological receptors). Although not directly applicable to this EE/CA given the limited scope of the removal action to be considered (i.e., the removal of BSD and stained sediments only), PRGs are also presented for reference for total PAHs (for the protection of ecological receptors) and total benzo(a)pyrene (BAP) equivalents (for protection of human health). Attainment of these reference PRGs would ultimately help meet some of the long term cleanup objectives considered for the river sediments that will be further evaluated in the future, including restoration of sediment quality and promotion of ecological function of the waterway .

Note that the lateral and vertical extent of impacted sediments in the Monongahela River has not been fully delineated; therefore, the general extent of impacted sediments is inferred for the purposes of this EE/CA, based on various sediment data collected during the 2005 and 2007 RI field activities, as well as sediment data collected by others (Reilly, 2005 and Reilly, 2006). However, there are sufficient contaminant delineation data available to support the removal alternatives analysis.

The estimated area of impacted Monongahela River sediments is depicted on Figure 2-6. This depiction is based on the following data:

- April 2005/April 2007 RI Field Data - The April 2005 and April 2007 RI field sampling efforts provided sediment data from 30 separate locations in the river between RM 126 and RM 124 (i.e., ~2 river miles). Visible BSD or total PAH concentrations in excess of PRGs were detected at four locations in the April 2005 deep sediment cores (MON4X, MON4W, MON4Z, and

MON5E) within an approximate 1,850-foot section of riverbed downstream of the Sharon Steel Run confluence. The visible BSD or total PAH concentrations in excess of the PRGs were detected in the deeper sediments to depths ranging from 2 feet (MON4W and MON4Z) to 5 feet (MON4X and MON5E) below the river bottom. Total PAH concentrations in excess of PRGs were detected at two shallow sediment locations in the April 2007 sampling event (SD-07 and SD-08) that are situated within an approximate 800-foot section of riverbed downstream of the Sharon Steel confluence.

Note that the downstream extent of deep sediments with total PAH concentrations in excess of PRGs is not specifically defined - no total PAHs were detected in excess of the PRGs at transect location MON6 (off map), which is approximately 1,800 feet downstream from transect location MON5. Therefore, the downstream extent of deep sediments in excess of PRGs is probably somewhere between transect locations MON5 and MON6.

- <u>Reilly 2005 River Sediment Field Investigation and 2006 Supplemental Underwater Survey</u> - Reilly Industries conducted additional investigation of the nature and extent of the BSD in the river in June 2005. Reilly employed divers to conduct visual inspections along 100-foot wide transects of the bottom sediments in the vicinity of and downstream of the Sharon Steel Run confluence. The divers observed two types of impacts on the sediments—an asphalt like material (specifically described as the BSD) and visibly stained sediment. The visual inspection indicated the presence of BSD in a band up to 50 to 100 feet wide extending from the east bank, and approximately 350 feet downstream from the confluence. The BSD was observed at the bank near the confluence, but generally moved 30 to 40 feet offshore downstream of the confluence. The BSD was also observed extending ~25+ feet upstream of the current confluence location. Further, the divers delineated stained sediments under a surficial layer of clean sediments in a swath approximately 30 feet wide extending at least 800 feet downstream from where the asphalt material ended (or approximately 1,150 feet downstream from the Sharon Steel Run confluence). The downstream extent of the stained material was not fully delineated by the divers. Where present, the stained area was observed to be approximately 40 feet off the eastern shore of the river.

  Reilly also collected six samples of the BSD and submitted them for various types of analysis. The reported total PAH concentrations for most of these samples were greater than 20,000 mg/kg. Qualitative analysis of these elevated PAH concentrations in surface sediment affirm that BSD presents an unacceptable risk to both human heath health and the environment.

  Reilly conducted an additional field investigation with divers in April 2006 to visually confirm the 2005 findings. The 2006 supplemental survey concluded that the 2005 map of the size and shape of the BSD was a reasonably accurate representation of the river conditions. Divers investigated three locations and recorded that the BSD was typically 3-4 inches thick with mounds up to 12 inches thick.

Based on the field findings, the two most significant types of impacted sediments in the Monongahela River are:

- <u>Black semi-solid deposits (BSD)</u> - Analytical results reported by Reilly (2005) for the BSD indicate that total PAH concentrations (>20,000 mg/kg) are well in excess of the related PAH PRGs. Consequently, all sediments with BSD are considered impacted. The estimated extent of this material is based exclusively on the Reilly dive inspections and ranges from 50 to 100 feet wide, extending from approximately 25-50 feet upstream to 350 downstream from the Sharon Steel Run confluence. This conservatively equates to a total area of approximately 40,000 square feet. The thickness of this material (and any impacted sediments underlying this material - note that the material itself was found to be up to 1 foot thick in sections) is estimated to range from 1 to 3 feet thick (maximum), so the volume of the BSD and related impacted sediments is estimated to be approximately 4,500 cubic yards or 7,500 tons.

- Stained sediment deposits - Analytical results from the April 2007 sample collected from location SD-07 (which was collected from the general area mapped as "stained" by Reilly in 2005) indicated a concentration of 1,289 mg/kg total PAHs. Sediment toxicity testing indicated that that sediment collected at location SD-07 was toxic to aquatic test organisms (Hyalella azteca). Consequently, it is assumed that all shallow stained sediments are considered impacted. The estimated extent of this stained area, based on the Reilly dive inspections, is approximately 30 feet wide by more than 800 feet long (note the downstream extent has not been mapped). This equates to a total area of approximately 24,000 square feet. The thickness of this stained layer is unknown, but estimated to be up to 1 foot thick, so the volume of stained sediments is approximately 900 cubic yards or 1,400 tons. For reference, concentrations of total PAHs in the stained sediments are expected to be in excess of 100-500 mg/kg.

Additionally, sediment demonstrating lower concentrations of PAHs which are above PRGs includes:

- Deep sediment deposits - Deep sediment samples (up to depths of 5 feet below the bottom of the river) collected in April 2005 from sediment cores MON4X and MON5E indicated elevated concentrations of total PAHs in the deep sediments, ranging from 32 to 63 mg/kg. These concentrations exceed the reference PAH PRGs and may be considered impacted in the event that erosion were to bring these sediments to the surface of the river bottom. The total extent of "impacted deep sediments" has not yet been fully delineated; however, the approximate area impacted, based on a combination of the Reilly stained sediment observations and April 2005 deep sediment core data, is approximately 450,000 square feet (based on the approximate triangular area connecting deep core locations MON4X, MON5E, and the Sharon Steel Run confluence). Given the thickness of deep sediment through this stretch of the river (ranging from 2 to 5 feet), the estimated volume of potentially impacted deep sediments ranges from approximately 34,000 to 85,000 cubic yards or 55,000 to 136,000 tons.

Note that only the BSD and stained sediment deposits are proposed to be addressed by this EE/CA. The deep sediment deposits will be further addressed in the future as part of the final risk evaluation and record of decision (ROD) developed for this site.

2.4 REMOVAL ACTION OBJECTIVES

The objectives established for this removal action guide the development of the alternatives, and provide the focus to the comparison of acceptable removal action alternatives. These objectives also assist in clarifying the goal of reducing the hazard posed by the various contaminants in the surface soil, subsurface soil, groundwater, sediment, and surface water at the Site, and achieving an acceptable level of protection to the public health and the environment. These objectives also establish goals for restoration of impacted media to meet ARARS or for the benefit of human health and environment.

Objectives for Soils

Removal action objectives to address risks associated with surface and subsurface soils include:

- Prevent current and future workers, future residents, and ecological receptors from adverse effects that may result from exposure (dermal, ingestion, and vapor inhalation) to contaminated soils.
- Minimize the infiltration of precipitation into the soil to reduce the potential for leaching of soil contaminants into groundwater.
- Prevent the continued migration of tar-derived material to the surface.
- Prevent erosion and surface water runoff to prevent migration of soil contaminants.

Objectives for Groundwater

Removal action objectives to address risks and ARARs associated with groundwater include:

- Prevent future exposure of workers and residents to contaminated groundwater.
- Prevent further migration of the contaminant plume.
- Prevent contaminated groundwater discharge to surface water.
- Restore groundwater quality in the overburden and bedrock aquifers.

Objectives for Surface Water (other than the river)

Removal action objectives to address risks and ARARs associated with surface water include:

- Mitigate contaminated surface water discharge from the Site to meet water quality standards.
- Restore surface water quality to acceptable human/ecological risk levels.
- Restore surface water drainage quantity and ecological functions in and along the waterway.

Objectives for Stream Sediments

Removal action objectives to address risks and ARARs associated with the Sharon Steel Run/Unnamed Tributary #1, Unnamed Tributary #2, and West Tributary sediment include:

- Prevent further migration of contaminated sediments to the Monongahela River.
- Prevent exposure of contaminated sediments to receptors.
- Restore sediment quality to acceptable human/ecological risk levels and to promote ecological function in the waterway.

Objectives for Monongahela River Sediments

Removal action objectives to address the risks and ARARs associated with Monongahela River sediments include:

- Remove industrial wastes (black semi-solid deposits [BSD]), tar materials, and any visible residuals and fragments) and stained sediments containing high concentrations of PAHs (>100 -500 mg/kg) from the river bottom..

Note that although the improvement of river sediment quality, restoration of river sediment quality to acceptable human/ecological risk levels, and promotion of the ecological function of the waterway are the ultimate long term objectives for the Monongahela River sediments, these objectives will not be addressed as part of the scope of this EE/CA. These additional objectives will be addressed in the future after the completion of any non-time critical removal action as part of the final risk evaluation and subsequent action (if any) required for the site as determined by the future record of decision (ROD).

2.5 STATUTORY LIMITS ON REMOVAL ACTIONS

On September 21, 2001, EPA granted an exemption from the statutory limits for removal actions at the Site. The exemption waived the limitation on the amount of money and length of time EPA can take on removal actions.

3.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section of the report develops the removal action alternatives for the various components of the Big John Salvage/Hoult Road Site. The process starts with identifying general response actions available to meet removal action objectives. The technologies that can be used to implement the response actions are then identified, analyzed to determine their applicability for this Site, and eventually combined to form removal action alternatives. The following sections identify removal alternatives for soil, groundwater, on-site surface water and sediment, and river sediment, and analyze their effectiveness, implementability, and cost.

With regard to effectiveness, the alternatives are evaluated for:

- Overall Protection of Public Health and the Environment;
- Compliance with ARARs and Other Criteria, Advisories, and Guidance;
- Long-Term Effectiveness and Permanence;
- Reduction of Toxicity, Mobility, or Volume through Treatment; and
  Short-Term Effectiveness

With regard to implementability, the alternatives will be evaluated for:

- Technical Feasibility;
- Administrative Feasibility;
- Availability of Services and Materials;
- State Acceptance; and
- Community Acceptance

With regard to cost, the alternatives will be evaluated for:

- Direct and Indirect Capital Costs;
- Annual Operations and Maintenance Costs; and
- Present Worth Analysis Costs

To assist the reader with the evaluation of the alternatives, a simple graduated descriptor (good, fair, poor) has been provided for most of the effectiveness and implementability criteria headings for each alternative (note that no descriptor is provided for state or community acceptance as this has not yet been determined). This description is intended to generally describe how well the alternative meets the criteria for effectiveness and implementability to assist with the overall comparison of the alternatives.

Note that the general design concepts and discussions presented in this section are provided to assess the feasibility of this alternative as well as to develop cost estimates only - the actual configuration of any removal alternative would be developed during the design phase of any future removal action.

This section evaluates alternatives for each major media as follows:

Section 3.1	Soil Alternatives
Section 3.2	Groundwater Alternatives
Section 3.3	On-Site Sediment Alternatives

Section 3.4 River Sediment Alternatives

In addition, at the end of each major section, there is a brief summary of the alternatives that are retained for final comparative analysis in Section 4.0.

It should be noted that there are no alternatives developed or evaluated specifically for surface water. The surface water removal action objectives will be directly addressed through the other soil, groundwater, and on-site sediment alternatives, as collectively these alternatives affect surface water quality and quantity at the Site. For example, containing contaminated groundwater discharge to the surface water will address surface water quality issues. Further, the removal of contaminated sediments and elimination of contaminated surface water runoff will also improve surface water quality. Proper design of any soil capping containment system (with respect to proper storm-water quantity controls) will also address surface water quantity issues. Collectively, some of these alternatives will address the surface water removal action objectives. Where appropriate, each alternative discusses the surface water considerations in the analysis.

3.1 SOIL ALTERNATIVES

As discussed previously in Section 2.3 (Determination of Removal Scope), there is extensive surface and subsurface soil contamination on the BJS Site. Surface soil is contaminated with PAHs and heavy metals, including copper, mercury, and zinc. Subsurface soil is contaminated primarily with PAHs, although there are hot spot areas of VOC contamination as well as heavy metal contamination. Contaminated surface soil covers an area of 657,000 square feet (~ 15 acres) at depths up to 5 feet, while contaminated subsurface soil covers an area of 504,000 square feet (~ 11.5 acres) at depths up to 40 feet below grade.

In summary, there are approximately 312,000 cubic yards (~505,000 tons) of impacted soil at the Site to be addressed as part of the removal action. This encompasses the following:

- 122,000 cubic yards (~197,000 tons) of surface soil (0-5 feet);
- 93,500 cubic yards (~152,000 tons) of deeper soil with high PAH concentrations and/or observable contamination;
- 44,500 cubic yards (~72,000 tons) of deeper soil with both high VOC and PAH concentrations; and
- 52,000 cubic yards (~84,000 tons) of PAH contaminated soils/sediment currently stockpiled at the Site from prior EPA removal actions.

The following alternatives have been identified for evaluation to address the impacted soil at the BJS Site:

Alternative SO1: No Action
Alternative SO2: No Further Action
Alternative SO3: Excavation and On-Site Thermal Treatment
Alternative SO4: Excavation and Off-Site Disposal/Treatment
Alternative SO5: Capping/Containment
Alternative SO6: In-Situ Treatment - Chemical Oxidation
Alternative SO7: In-Situ Treatment - Stabilization/Solidification

These alternatives are discussed in the following sections.

3.1.1 Alternative SO1: No Action

The No Action alternative does not utilize any removal technologies or techniques to further reduce contaminant mobility, toxicity, or volume. Because no removal activities would be implemented, long-term human health and environmental risks for the Site would be the same as those identified in the baseline risk assessment. The No Action alternative would not attain any objectives established within the scope of the removal actions for soil. However, this alternative is considered in the detailed analysis for comparison purposes, as required by the NCP.

The following is a discussion of the effectiveness, implementability, and cost of the No Action removal alternative for soil:

Effectiveness:

Overall Protection of Public Health and the Environment - NO

- No removal actions would be taken as part of this alternative. Consequently the existing unacceptable risk to human health and the environment would remain. The No Action alternative would not be protective of the public health or the environment.

Compliance with ARARs - YES

- There are currently no ARARs establishing acceptable concentrations for contaminants in soil at the Site. However, the human health risk assessment and the ecological risk assessment determined that the concentration of contaminants in the soil do present an unacceptable risk to human health and the environment. The site-specific risk assessments are "To Be Considered" requirements.

Long-Term Effectiveness and Permanence - POOR

- Since there would be no work done on the soil at the Site, there would be no effectiveness or permanence. Soil at the Site would not be removed or contained; therefore, exposure to contamination would remain. Five-year reviews would be required since contaminants would be left in place.
- The No Action alternative would not attain any objectives established within the scope of the removal actions.

Reduction in Contaminant Toxicity, Mobility, or Volume through Treatment - POOR

- There would be no reduction in the volume, mobility, or toxicity of contamination with this alternative.

Short-Term Effectiveness - POOR

- There would be no increased or additional risks posed to the community, the workers, or the environment from this alternative beyond those already present.

- This alternative would not be effective in the short term.

Implementability:

Technical Feasibility - GOOD

- There are no technical difficulties posed by this alternative since no additional action would be taken.

Administrative Feasibility - POOR

- The EPA would have difficulty issuing a decision document that was not consistent with the soil removal objectives established for the Site.

Availability of Services and Materials - GOOD

- No resources or support would be required.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumptions made, are provided in Appendix C.

The O&M and capital costs for this alternative are summarized as follows:

Capital Cost:	$0
Annual O&M Cost:	$0
Total Present Worth Cost:	$0 (with a discount rate of 7% for 30 years)

3.1.2 Alternative SO2: No Further Action

Similar to No Action alternative, there would be no further soil removal actions beyond those already completed at the Site under this alternative. However, it would include long-term maintenance of the existing on-site features, including sediment erosion control silt fencing and a site perimeter fence that an EPA contractor installed in 1983.

Accordingly, operating and maintenance (O&M) costs for this alternative would consist of routine monitoring of the Site, and maintenance of the fence and sediment erosion control silt fencing on a semi-annual basis for a period of 30 years.

The following is a discussion of the effectiveness, implementability, and cost of the no action removal alternative for soil:

Effectiveness:

Overall Protection of Public Health and the Environment - NO

- No removal actions would be taken as part of this alternative. Consequently, the existing unacceptable risk to human health and the environment would remain. This alternative would not be protective of the public health or the environment.
- Proper maintenance of a perimeter fence would minimize public access (trespassing) to the Site, thereby preventing direct contact with on-site contaminated soil.
- This alternative would provide some degree of sediment erosion control; however, it would not provide complete sediment erosion control, especially during heavy rainfall events, and likely allow off-site migration of contaminated sediment.

Compliance with ARARs - YES

- There are currently no ARARs establishing acceptable concentrations for contaminants in soil at the Site. However, the human health risk assessment and the ecological risk assessment determined that the concentration of contaminants in the soil do present an unacceptable risk to human health and the environment. The site-specific risk assessments are "To Be Considered" requirements.

Long-Term Effectiveness and Permanence - POOR

- Since there would be no further work on the contaminated soil at the Site, there would be no long-term effectiveness or permanence of this alternative. Soil at the Site would not be removed or contained; therefore, exposure to soil contamination would remain. Five-year reviews would be required since contaminants would be left in place.
- This alternative would partially attain the sediment erosion control objective established within the scope of the soil removal actions if silt fencing is maintained properly for the long-term.

Reduction in Contaminant Toxicity, Mobility, or Volume through Treatment - POOR

- There would be no reduction in the volume, mobility, or toxicity of contamination with this alternative.

Short-Term Effectiveness - POOR

- There would be no increased or additional risks posed to the community, the workers, or the environment from this alternative beyond those already present.

Implementability:

Technical Feasibility - GOOD

- There are no technical difficulties posed by this alternative since no additional action would be taken.

Administrative Feasibility - POOR

- The EPA would have difficulty issuing a decision document that was not consistent with the soil removal objectives established for the Site.

Availability of Services and Materials - GOOD

- No resources or support would be required.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumptions made, are provided in Appendix C.

The O&M and capital costs for this alternative are summarized as follows:

Capital Cost:	$0
Annual O&M Cost:	$60,000
Total Present Worth Cost:	$745,000 (with a discount rate of 7% for 30 years)

3.1.3 Alternative SO3: Excavation and On-Site Thermal Treatment

This alternative would consist of excavating the contaminated soil on the site and treating it on-site using thermal desorption technology. Upon completion of treatment, the excavated area would be backfilled with treated soil, covered with a layer of clean top soil to encourage vegetation growth, and then seeded with a perennial grass mixture suitable for the Site.

The volume of soil to be excavated/treated would consist of all soil/sediment currently stockpiled at the Site (~52,000 cubic yards or 84,000 tons), and all surface and subsurface soil containing VOC and PAH concentrations in excess of PRGs or visible contamination. This is estimated to be approximately 312,000 cubic yards or 505,000 tons of soil (assuming 1.62 tons per cubic yard). The general extent of the excavation would be the soil contamination areas delineated in Figures 2-1 and 2-2. Confirmatory samples collected during excavation may identify additional soil to be excavated, as needed.

Thermal desorption is an environmental remediation technology that utilizes heat to increase the volatility of contaminants such that they can be removed (separated) from the solid matrix (typically soil, sludge or filter cake). A thermal desorption process typically consists of two steps—desorption and off-gas treatment. The thermal desorption unit uses less fuel and operates at a lower temperature (200-1300°F) than incineration, and does not actually destroy the contaminants like incineration does. Once separated, contaminants are then captured by a collection system such as a cyclone or a wet scrubber, and subsequently destroyed by an off-gas treatment unit such as an afterburner, secondary combustion chamber, or thermal oxidizer. In addition to managing the volatilized components, the particulate matters (dust) that exit the desorber must also be removed from the off-gas. Further, depending on the concentration of mercury in the soil, additional off-gas treatment (such as activated carbon treatment) may be required to address any mercury emissions from the process.

The soil would need to be prescreened to remove rocks and debris before being put into the desorption system. Therefore, dust control would be required. The desorption system would remove VOCs, PAHs, and other organics as well as mercury, but would not remove other metals of concern (i.e., arsenic, copper, zinc, and cyanide) from the soil. However, the metals of concern are not the primary contaminants at the Site, so this technique would be applicable to most of the major contamination present at the Site.

In addition, prior to treating the soil with thermal desorption, stack testing and Proof of Performance (POP) testing would be required to determine the maximum throughput rate for the treatment units. The volume of soil that can be treated each day would be determined by the specific retention time required for the treatment of the soil at the Site, and may be further limited if high throughput overloads the air pollution controls.

Portable thermal treatment units can typically treat soil at rates of 5 to 10 tons per hour. Considering the volume of soil to be treated, multiple units would be required to achieve a treatment rate of at least 50 tons per hour. At this rate of treatment, it would take approximately 3 years to complete the treatment part alone.

The following assumptions are made for the evaluation of this alternative:

- Confirmatory soil sampling: Extensive confirmatory sampling is required to ensure that all contaminated soil has been excavated for subsequent thermal treatment. Further, performance testing of the treated soil will also be required to confirm that treatment has been effective. Confirmatory sampling would involve grid sampling over the site post excavation - grid spacing of 50 feet x 50 feet is assumed. Given the area of expected excavation (~ 650,000 square feet), this would require a minimum of 300 confirmatory samples. Performance testing would assume a sampling frequency of one sample per thousand tons of treated soil (approximately equal to a single day of production), or an estimated minimum of 500 samples. For cost estimating purposes, 1000 samples are assumed.
- Emission testing: In addition to the full stack testing completed during the proof of performance assessment used to develop the operating limits, which will ensure compliance with air emission standards, full stack tests would be performed once per year to confirm continued compliance.
- Continuous real-time air monitoring would be performed at four locations situated around the Site, and the performance of this monitoring would be confirmed with static perimeter air testing (e.g., using summa canisters) monthly to ensure no airborne contaminants migrate off-site.

- Extensive erosion control measures: Erosion controls would be required during the excavation and replacement of the soil.

Operating and maintenance costs for this alternative would consist of routine monitoring of the Site, maintenance of the fence, and erosion controls on a semi-annual basis for 30 years. Inorganic contaminants of concern (except mercury) would not be removed from the soil by thermal treatment. Post-construction soil sampling would determine if residual inorganic contamination would require continued land use restrictions.

The following is a discussion of the effectiveness, implementability, and cost of the excavation and on-site thermal treatment alternative for soil:

Effectiveness:

Overall Protection of Public Health and the Environment - YES

- This alternative would eliminate organic contaminants of concern (i.e., VOCs, PAHs, etc.). Thermal treatment would not destroy many inorganics of concern (i.e., arsenic, copper, zinc), but the inorganics of concern are relatively minor in contribution to the total risk at the site. Further, the excavation and processing would homogenize the soils. Consequently, this alternative would substantially reduce the overall risks at the site and would likely meet the overall protection of human health and the environment goals.

Compliance with ARARs - YES

- There are currently no ARARs establishing acceptable concentrations for contaminants in soil at the Site. This alternative would be operated in compliance with the ARARs applicable to soil removal and on-site treatment and management activities, including, fugitive dust emissions control (40 CFR 50 - Ambient Air Quality Standards for Particulate Matter), control of discharges of other air pollutants (WV Air Pollution Control Act), Federal Regulations governing Hazardous Air Pollutants (NESHAPS), and control of storm-water discharge (Clean Water Act).

Long-Term Effectiveness and Permanence - GOOD

- The overall long-term effectiveness and permanence of this alternative is good to excellent. This alternative would be highly effective in meeting the soil PRGs for VOCs, PAHs, and mercury. Mixing associated with excavation, screening, and processing through the thermal treatment unit would likely result in meeting inorganic PRGs.
- Thermal destruction of VOCs and PAHs is a permanent, non-reversible process.
- This alternative would eliminate a source of VOC and PAH contamination to groundwater.

Reduction in Contaminant Toxicity, Mobility, or Volume through Treatment - FAIR

- The thermal desorption technology employed in this alternative would substantially reduce toxicity, mobility, and volume of VOCs, PAHs, and mercury through treatment. Most of the mass would be separated for subsequent capture and appropriate disposal but some would be destroyed. Thermal desorption would not reduce toxicity, mobility, or volume of other inorganic contaminants of concern through treatment

Short-Term Effectiveness - FAIR

- Excavation followed by thermal desorption would provide good short-term effectiveness in removing VOCs, PAHs, and mercury from soil, but would not be effective in removing other inorganic contaminants.
- This alternative would be accomplished in a manner that would not pose additional risks to the community, the workers, or the environment. Risks incumbent to construction would be managed continuously and carefully by dust control and air monitoring; nuisance concerns such as non-toxic odors and noise would also be managed as best as possible.
- Potential short-term impacts to removal construction workers, the community, or the environment would be minimized through implementation of a site-specific health and safety plan. Proper protective clothing and air monitoring would minimize risk of chemical exposure during excavation activities. Workers would be required to have training and medical examinations, in accordance with 29 CFR 1910.120.

Implementability:

Technical Feasibility - FAIR

- The soil at the Site is very heterogeneous and wet, which would make thermal treatment of the soil challenging. Substantial pre-processing of the soil may be required prior to thermal treatment (screening, drying, mixing, etc.).. There are no technical difficulties posed by the excavation portion of this alternative since well-developed standard construction techniques would be utilized.
- The thermal treatment of the soil has been performed on multiple sites, and could be implemented relatively easily, although the scale of this project presents a technical challenge. Multiple treatment units would need to be operated in parallel to meet reasonable completion schedule.
- An optimized treatment train, including excavation, thermal treatment, backfilling, and air emission controls (including those for mercury) would be developed and managed to keep excavations dry, minimize precipitation on feed stock, control odors and meet both site-specific performance standards and emission limits. Significant space will be required to store treated material first waiting for confirmation sampling and then waiting for areas to be prepared to accept clean backfill.
- Available space may be limited to manage treatment train.

Administrative Feasibility -FAIR

- Plan approval and meeting substantive requirements of applicable permits would be needed prior to site excavation and the operation of the thermal treatment system.
- Negative public perceptions regarding thermal treatment can sometimes influence the ability to site a facility.
- Proof of Performance tests would need to demonstrate that the constructed treatment train performance standards, including air emissions, can be met prior to full-scale startup.

Availability of Services and Materials - GOOD

- The necessary resources and support would be readily available for the excavation. For the thermal treatment, the necessary equipment is available, but there might be issues with adequate lead-time.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments. However, public acceptance of using an on-site thermal treatment unit would be challenging.

Cost:

Detailed cost estimates, including assumptions made, are provided in Appendix C. The O&M and capital costs for this alternative are summarized as follows:

Capital Cost:	$93,888,000
Annual O&M Cost:	$60,000
Total Present Worth Cost:	$94,633,000 (with a discount rate of 7% for 30 years)

3.1.4 Alternative SO4: Excavation and Off-Site Disposal/Treatment

This alternative would consist of excavating the contaminated soil, and either disposing of it in an off-site landfill (as either non-hazardous or hazardous, depending on the ultimate waste classification) or treating it off-site (most likely thermally). The excavated soil could be shipped by truck to the rail yard located east of the Site and then transported via railroad to the destination. This alternative assumed that any soil removed from the Site would be disposed of off-site, and that the excavated area would be regraded, covered with some backfill (to meet regrading requirements - assume 50,000 cubic yards), a layer of top soil (minimum of 6 inches), and revegetated.

As described in Alternative SO3, approximately 505,000 tons of contaminated soil would be addressed under this alternative.

A power generation facility has expressed an interest in using the soil from the Site for its fuel value. It would typically mix 90% coal with 10% soil from the Site, and burn it as fuel. In general, soil (or other wastes) with a heating value above 4,000-5,000 Btu/lb is preferred for use as a fuel supplement, as soil or other wastes with lower values has less organic content and will ultimately produce more residual ash. Note that the energy content analysis conducted during the RI indicated that the Site soil samples had a maximum heat value of 454 Btu/lb for those samples collected (although other samples collected by EPA in other hot spot tar areas had Btu/lb values ranging from 2,950-12,500), and that the power generation facility can utilize only 65 tons of soil per day or 23,700 tons per year. Accordingly, this alternative assumed that some of the highly contaminated soil would be thermally treated off-site to recover heating value and the rest would be sent to an off-site landfill. This alternative also assumes that residual ash tests non-hazardous.

For the costing purpose, the following assumption was made under this alternative:

- Confirmatory soil sampling: Extensive confirmatory sampling is required to ensure that all contaminated soil has been excavated for off-site disposal. Further, characterization testing of the soil as it is being excavated for off-site disposal would also likely be required by the disposal facility. Confirmatory sampling would involve grid sampling over the site post excavation - grid spacing of 50 feet x 50 feet is assumed. Given the area of expected excavation (~650,000 square feet), this would require a minimum of 300 confirmatory samples. Characterization testing would assume a sampling frequency of one sample per 500 tons (approximately one sample per thirty truckloads) of excavated soil, or an estimated minimum of approximately 1000 samples. For cost estimating purposes, 1500 samples are assumed.
- Extensive erosion control measures: Erosion controls would be required during the excavation and regrading.
- Off-site thermal treatment: It was assumed that a total of 71,100 tons (or 44,000 cubic yards) of soil with a TPAH level of 300 mg/kg or higher (e.g., soil in the northwestern portion of the Site) would be treated at the power generation facility for 3 years.
- Off-site disposal: 433,900 tons (or 268,000 cubic yards) of the remaining soil would be sent to the off-site landfill.

Operating and maintenance costs for this alternative would consist of routine monitoring of the Site, maintenance of the fence, and erosion controls on a semi-annual basis for 30 years.

The following is a discussion of the effectiveness, implementability, and cost of the excavation and off-site treatment/disposal:

Effectiveness:

Overall Protection of Public Health and the Environment - YES

- This alternative would protect human health and the environment by removing all the contaminated soil on the Site for off-site treatment or disposal.
- Upon removal of all contaminated soil, the Site would be available for unrestricted use.

Compliance with ARARs - YES

- There are currently no ARARs establishing acceptable concentrations for contaminants in soil at the Site. This alternative would be operated in compliance with the ARARs applicable to soil excavation and management activities, including, fugitive dust emissions control (40 CFR 50 - Ambient Air Quality Standards for Particulate Matter), control of discharges of other air pollutants (WV Air Pollution Control Act), Federal Regulations governing Hazardous Air Pollutants (NESHAPS), and control of storm-water discharge (Clean Water Act).

Long-Term Effectiveness and Permanence - GOOD

- This alternative would be effective in meeting the objectives established within the scope of the removal actions for the long-term since all contaminated soil at the Site would be removed and treated and/or disposed of off-site.
- Post-excavation confirmatory sampling would ensure completeness of all contaminated soil removal, and, therefore, establish long-term effectiveness and permanence of this alternative.

Reduction in Contaminant Toxicity, Mobility, or Volume through Treatment - GOOD

- This alternative would remove all the contaminated soil, therefore reducing volume of the contamination at the Site. The off-site treatment component would reduce toxicity, mobility, and volume of contaminants in soil.

Short-Term Effectiveness - GOOD

- Potential short-term impacts to removal construction workers, the community, or the environment would be minimal under this alternative through a site-specific health and safety plan. Proper protective clothing and air monitoring would minimize risk of chemical exposure during excavation activities. Workers would be required to have training and medical examinations, in accordance with 29 CFR 1910.120.
- This alternative would be accomplished in a manner that would not pose additional risks to the community, the workers, or the environment. Risks incumbent to construction would be managed continuously and carefully by dust control and air monitoring; nuisance concerns such as non-toxic odors and noise would also be managed as best as possible.
- It is estimated that full implementation of this alternative would take approximately three years, due to the volume of soil that can be accepted by the off-site energy generation facility discussed above. Alternate or additional off-site facilities with similar capabilities would be considered and could reduce the implementation time.

Implementability:

Technical Feasibility - GOOD

- There are no technical difficulties posed by the excavation portion of this alternative since well-developed standard construction techniques would be utilized.
- Thermal treatment of PAH-contaminated soil has been performed at multiple sites and should be implemented relatively easily. Ash would be sampled and disposed of in an appropriate manner.

Administrative Feasibility - GOOD

- Plan approval would be required prior to excavation and the off-site shipment of the excavated soil.
- Standard waste manifests would be required for off-site treatment/disposal of excavated soil.

Availability of Services and Materials - GOOD

- The necessary resources and support for the soil excavation and transport are readily available.

- The off-site thermal treatment system has limited capacity (i.e., 65 tons per day), which might lead to scheduling issues. Additional treatment facilities may be available.
- The thermal treatment system is located approximately 190 miles from the Site, and an active landfill (Subtitle D) is located within 20 miles from the Site in Bridgeport, WV. There is also a Subtitle D landfill in the City of Fairmont, WV.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumptions made, are provided in Appendix C. The O&M and capital costs for this alternative are summarized as follows:

Capital Cost:	$49,240,000
Annual O&M Cost:	$60,000
Total Present Worth Cost:	$49,985,000 (with a discount rate of 7% for 30 years)

3.1.5 Alternative SO5: Capping/Containment

This alternative would consist of placing a cap over the entire impacted area of the Site to prevent future human and ecological receptors from contacting with the contaminated soil at the Site. The area to be capped would encompass the entire area shown in Figure 2-1 (i.e., the area encompassing all of the impacted surface soils as well as subsurface soils - ~650,000 square feet - ~15 acres). The steep slope areas on the north side of Sharon Steel Run, which is the location for some of the historical tar seeps, would also be addressed as part of the capping/containment alternative (~120,000 square feet). Consequently, for cost estimation purposes, the total area for capping/containment is estimated at ~770,000 square feet, or approximately 18 acres. Actual configuration of the footprint and profile of the cap may be modified during design. Further, consolidation of waste materials from perimeter areas could result in a smaller capped area. Obvious masses of tar derived materials encountered at the surface before and during earthwork would be segregated to the extent practical for appropriate off-site disposal. For the cost estimating purposes of this EE/CA it is assumed that 1,500 cubic yards of obvious tar derived materials would be segregated and sent off-site for disposal.

In accordance with applicable State ARARs (West Virginia Solid Waste and Hazardous Waste Management Rules), a RCRA Subtitle D-type cap would be appropriate as a minimum type of cover for the Site. For the purposes of eliminating the risk to human health and ecological receptors, a Subtitle D-type cap would be sufficient to prevent direct exposure to contaminated surface and subsurface soil and "pockets" of buried or spilled waste materials. A Subtitle D-type cap would also substantially reduce or eliminate the infiltration of precipitation into the subsurface, thereby controlling the further migration of soil contaminants into the groundwater. Note that a Subtitle C-type cap would not expected to be applicable to this Site as there is no current determination that the contaminated on-site soil is a RCRA-hazardous waste, nor would the additional cap components beyond those of a Subtitle D-type cap typically included in a Subtitle C-type cap design (such as two feet of clay as part of the low permeability layer in addition to a geomembrane) be necessary to eliminate the risk posed by the contaminated soils at the Site.

The assumptions to be considered for this alternative as it relates to the general components of a RCRA Subtitle D cap include the following (from bottom to top):

- Foundation Fill Layer: This layer is not required by Federal ARAR 40 CFR 258.60; however, it is included to provide a workable graded surface on which to construct the cap. On-site soil would be regraded to provide a good foundation for the placement of the overlying layers. The existing soil piles (~52,000 cubic yards) at the site would be worked into this foundation fill layer, as would any sediments removed from the drainage channels (~3,300 cubic yards) or the Monongahela River (5,600 cubic yards if BSD and stained sediments are removed) if these removal elements were selected. The upper 12-24 inches of surface soil would be reworked and compacted/amended to support the placement of the geotextiles and geomembrane. No new fill would be required for this layer. However, the ultimate design of this layer would depend on the ultimate final land use selected for the Site.
- Hydraulic barrier or low permeability layer: A layer with a permeability no greater than 10^{-5} cm/sec is required. This layer would consist of a 40 mil geomembrane liner - note that geomembrane liners of this kind typically have a permeability of less than 10^{-7} cm/sec (most have permeabilities less than 10^{-10} cm/sec) , which exceeds the minimum permeability requirement of 10^{-5} cm/sec. Functionally, the geomembrane would also prevent the underlying tar from migrating up through the cap to the surface.
- Geocomposite drainage layer: A geocomposite drainage layer would be placed over the geomembrane hydraulic barrier to drain the infiltrated water captured above the geomembrane. The geocomposite is comprised of geosynthetic materials consisting of a high-density polyethylene (HDPE) geonet core enveloped on each side by a geotextile fabric or other material with permeability equivalent to that of 12 inches of sand ($1x10^{-2}$ cm/sec). The upper geotextile layer of the geocomposite provides separation with the overlying cover soil layer, preventing the fines of overlying soils from clogging the geonet drainage channels. The purpose for the heat-bonded lower geotextile is to maximize friction characteristics between the geomembrane to geocomposite interface and to protect the geomembrane from the geonet core. The geocomposite drainage layer horizontally conveys infiltrated water captured above the geomembrane layer to perimeter pipe drains and/or day-lighted toe drains laying on the perimeter of the cap area.
- Infiltration layer/cover soil layer: This layer consists of a minimum of 9 inches of soil, but typically consists of 18 inches of soil to better protect the underlying liner from degradation due to frost and human or animal contact. The cover soil layer material would be imported from off-site sources, having a Unified Soil Classification System (USCS) soil textures of SC (clayey sand), SM (silty sand), SP (poorly-graded sand), and SW (well-graded sand, fine-to-coarse sand). The ultimate design thickness of this cover soil layer would be determined based on the future land use considered for the site. For example, this layer may be designed to be thicker to allow for the establishment of deeper rooted plants, or may be designed to be thinner if the cap was intended to be paved with asphalt.
- Erosion control layer/vegetative cover: This layer consists of a minimum of 6 inches of topsoil that is capable of supporting vegetation on top of it. The vegetation would be a low-maintenance vegetation native to the region that would stabilize the landfill cap system and reduce the potential for erosion. Vegetation also increases evapotranspiration, greatly reducing the amount

of infiltration Again, the ultimate design thickness of this erosion control layer/vegetative cover would depend on the future land use considerations of the capped area. The installation of pavement over some or all portions of the cap would also be a possibility based on the future land use.

Note that this type of cap construction would be applicable only to the main portion of the Site - the steep slope outcrop areas draining down to Sharon Steel Run would require a different type of capping/containment structure such as capping or containment with a retaining wall (stone or concrete), shotcrete encapsulation of the rock outcropping, or other capping method. Cut and fill techniques to minimize slopes or alternative cap approaches (e.g., phytostabilization) on the steep slope areas may also be designed with equal effectiveness.

A key component to any capping/containment system would be an integrated storm-water management system that would promote the restoration of water quantity and quality to the on-site drainage features that discharge to Sharon Steel Run. To the extent possible the storm-water management features would be designed to mimic natural conditions - for example, natural materials and native vegetation would be used instead of quarried rock and turf grass. This approach will help to achieve the restoration of the drainage ways and their riparian corridors.

As part of this alternative, institutional controls such as deed restrictions would be implemented to prevent or control future excavation at the Site and disruption of the cap. This alternative would also require soil sampling along the cap perimeter to confirm that all areas with contaminated soil are capped. The operating and maintenance costs for this alternative would consist of routine maintenance of the cap to ensure cap integrity, the site perimeter fence, and sediment and erosion controls on a semi-annual basis for 30 years. Implementation of this alternative would require five-year reviews.

For the purposes of the EE/CA, cost estimates for three alternatives have been developed:

- Capping/Containment Option A - Minimal RCRA Subtitle D Cap, including the placement of a geomembrane liner, geotextile drainage layer, and 24 inches of cover/top soil and grass type revegetation scheme;
- Capping/Containment Option B - Expanded RCRA Subtitle D Cap, including the placement of a geomembrane liner, geotextile drainage layer, and 36 inches of cover/top soil to promote more vegetation diversity allowing for deeper rooted vegetation (i.e., trees and shrubs); and
- Capping/Containment Option C - Asphalt Paved Cap, including the placement of a geomembrane liner, geotextile drainage layer, 8 inches of asphalt foundation fill (crusher run), and 3-inch thick asphalt paving layer to promote reuse of the Site for parking-type future land use.

The following is a discussion of the effectiveness, implementability, and cost of the on-site capping of the soil:

Effectiveness:

Overall Protection of Public Health and the Environment - YES

- This alternative would protect human health and the environment by containing the contaminated soil, preventing direct contact and exposure to the material, and reducing off-site migration of contamination.

- Institutional controls would ensure safe redevelopment of the site, as well as prevent the installation of potable water supply wells at the Site. Any post-remediation construction work requiring breach of the cap would be subject to a site-specific health and safety plan in compliance with 29 CFR 1910.

Compliance with ARARs - YES

- This alternative would contain contaminated soils and buried or spilled industrial wastes with an appropriate RCRA Sub-Title D landfill cap which is a relevant and appropriate regulation should the wastes be managed in-place. The cap would be designed to comply with the EPA Technical Guidance for RCRA/CERCLA Final Covers (TBC) and WV Solid Waste Management Rules (33 CSR 1).
- This alternative would also comply with other ARARs and TBCs associated with soil excavation and capping containment activities. Specifically, this alternative would control fugitive dust emissions (40 CFR 50 - Ambient Air Quality Standards for Particulate Matter), control discharges of other air pollutants (WV Air Pollution Control Act), Federal Regulations governing Hazardous Air Pollutants (NESHAPS), and control discharge of storm-water runoff (Clean Water Act).

- This alternative would prevent exposure to soil or waste material with concentrations of hazardous substances exceeding the site-specific PRGs developed in the risk assessment process (TBC).

Long-Term Effectiveness and Permanence - GOOD

- This alternative would meet the removal action objectives established for the soil. Human and environmental exposure to contamination would be limited through the use of engineering controls.
- Long-term maintenance of the cap integrity and institutional controls would prevent human and ecological receptors from being exposed to contamination.

Reduction in Contaminant Toxicity, Mobility, or Volume through Treatment - FAIR

- The primary component of this soil alternative does not involve treatment (some degree of natural attenuation may occur), accordingly there is little reduction in contaminant toxicity or volume through treatment. Obvious waste material, including chunks or semi-solid tar masses, on the surface of the site would be segregated to the extent practical and sent for appropriate treatment and/or disposal. Engineering controls would be utilized to reduce mobility of the waste by minimizing infiltration and leaching of contaminants into groundwater.

- Note that previous removal actions conducted by EPA included off-site treatment of approximately 4,000 tons of K-listed waste at a RCRA-approved TSDF.

Short-Term Effectiveness - GOOD

- The short-term effectiveness would be good. Material handling and excavation would be limited to consolidation and surface grading only - most contaminated soil would be contained in place.
- Potential short-term impacts to removal construction workers would be minimal. A site-specific health and safety plan requiring proper protective clothing and air monitoring would minimize

risk of chemical exposure during construction activities. Workers would be required to have training in accordance with 29 CFR 1910.120.

- Construction would utilize standard practices to minimize any nuisance to the community near the Site due to noise and dust during grubbing, grading, and capping. Engineering controls for dust suppression and erosion prevention would be implemented. Perimeter air monitoring would confirm that there are no additional risks to the community.
- It would take approximately twelve to eighteen months to fully implement this alternative.

Implementability:

Technical Feasibility - GOOD

- There are no major technical difficulties posed by this alternative, although controlling seeps on the steep slopes along Sharon Steel Run will require more sophisticated engineering and construction approaches. This alternative utilizes standard landfill cap construction techniques that are well developed.

Administrative Feasibility - GOOD

- State and local permits would not be required for capping of the Site. Strict construction standards and in-field QA/QC protocols must be met to ensure cap reliability.

Availability of Services and Materials - GOOD

- Capping is performed frequently for landfills, and the required support and materials are readily available.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumptions made, are provided in Appendix C. Capital and O&M costs for various caps are presented as follows:

Option A - RCRA Subtitle D Cap

Capital Cost:	$6,211,000
Annual O&M Cost:	$75,000
Total Present Worth Cost:	$7,142,000 (with a discount rate of 7% for 30 years)

Option B - Expanded RCRA Subtitle D Cap

Capital Cost:	$7,307,000
Annual O&M Cost:	$75,000
Total Present Worth Cost:	$8,238,000 (with a discount rate of 7% for 30 years)

Option C - RCRA Subtitle D Cap with Asphalt Final Cover

Capital Cost:	$7,401,000
Annual O&M Cost:	$75,000
Total Present Worth Cost:	$8,332,000 (with a discount rate of 7% for 30 years)

3.1.6 Alternative SO6: In-Situ Chemical Oxidation (ISCO)

This alternative involves the use of ISCO to address soil contamination at the Site and is the same general technology as the alternative described in detail in Section 3.2.5 (Alternative GW5). Chemical oxidation requires a chemical with a high oxidation potential (reagent), such as hydrogen peroxide, to come into direct contact with the target contaminants. The reagent then chemically reacts with and degrades the toxic compound to simpler, less toxic parts. A successful chemical oxidation project requires that 1) the chemical(s) of concern be amenable to oxidation, and 2) the reagent must be delivered to the contaminant where it occurs. Adequate mass of the reagent must be delivered to the contaminants for the reaction to eliminate the contaminant of concern. In the field, the challenge is to deliver the reagent to the target COCs in-situ. Often mechanically mixing the soils with a large auger, for example, can be used to assist the reaction.

The following is a discussion of the effectiveness, implementability, and cost of the in-situ chemical oxidation of the soil (note that this is generally the same as that presented in Section 3.2.5, except as modified for the soil instead of groundwater scenario):

Effectiveness:

Ideally, the in-situ chemical oxidation alternative could result in remediation of both the soil and groundwater at the site - consequently, this alternative would meet the removal action objectives for soil - specifically:

- Adequate mass of reagent would be delivered to buried wastes and subsurface contaminated soil
- This alternative would destroy the most prevalent contaminants (organics) in the soil, thereby preventing receptors from adverse effects that may result from exposure and reducing or eliminating the potential for leaching of soil contaminants into the groundwater

This alternative would not address the inorganic contaminants that present an unacceptable exposure risk to human health (arsenic) and ecological receptors (mercury, copper and zinc), although the inorganics are not the major risk drivers in the soil at this Site.

Further, some key environmental parameters at the site affecting the overall effectiveness of this alternative include the intrinsic natural oxidant demand (NOD) of the overburden sediments (soil) as well as the variable permeability of the overburden sediments (soil). The oxidants injected are generally non-selective to both target contaminants and naturally occurring organic matter. The presence of natural organic matter in the treatment zone could consume a large portion of the injected oxidants, substantially increasing the mass of reagent that would be injected. Therefore the associated cost for reagent could increase. This is especially important for the BJS Site because of the high organic-rich silts and clays in the overburden related to the historic lacustrine depositional environment. In addition, these sediments are highly variable (sand, silt, clay, gravel sized sediments) - consequently, it will be difficult to design a delivery system in both the unsaturated and saturated portion of the overburden to ensure complete contact of oxidant with all impacted subsurface soil.

Overall Protection of Public Health and the Environment - YES

- If implemented successfully, the in-situ oxidation with permanganate would destroy organic COCs such as PAHs in the surface and subsurface soil - other oxidants can destroy the BTEX compounds as well. Fully implemented, this alternative could completely mitigate or reduce risks to human health and the environment posed by organic compounds in the soil and meet organic compound PRGs; however, this alternative would not meet the PRGs established for inorganics.
- Long-term monitoring would confirm effectiveness of in-situ oxidation in treating contaminants of concern and provide information regarding the decrease in contaminant concentrations with time.
- This alternative would restore soil quality in a reasonable time frame (i.e., <10 years).

Compliance with ARARs - YES

- There are currently no ARARs establishing acceptable concentrations for contaminants in soil at the Site. This alternative would prevent exposure to soil or waste material with concentrations of hazardous substances exceeding the site-specific PRGs developed in the risk assessment process (TBC).
- This alternative would be operated in compliance with the ARARs applicable to soil removal and on-site treatment and management activities, including, fugitive dust emissions control (40 CFR 50 - Ambient Air Quality Standards for Particulate Matter) and control of storm-water discharge (Clean Water Act). In-situ chemical oxidation would be employed in a manner that would be consistent with the requirements for the Underground Injection Control (UIC) program of the Safe Drinking Water Act (SDWA), administered in West Virginia by EPA.

Long-Term Effectiveness/Permanence - FAIR

- The larger PAH molecules are more difficult to degrade but successful destruction of organic contaminants is permanent and irreversible. There is no destruction or immobilization of inorganic contaminants.
- If the targeted (source) area is successfully treated, the long-term effectiveness of this alternative will be excellent since groundwater would not become re-contaminated (i.e., source area remediated). The degree of effectiveness will be directly related to the ability to completely degrade the target compounds in-situ.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment - GOOD

- In-situ chemical oxidation would reduce toxicity of site-related organic contaminants in the soil permanently. There is no change in toxicity or volume of inorganics, although the mobility may be affected by changes in soil geochemistry.

Short-Term Effectiveness - FAIR

- This alternative would achieve PRGs for organic COCs within a relatively short time frame (< 5 yrs); however, it would not achieve PRGs for inorganics.
- This alternative could be fully implemented within 2-3 years (including design, pilot testing, and construction).
- Chemical oxidation is an exothermic reaction (gives off heat). Any additional volatilization of contaminants should be minimal.
- There would be no additional risks posed to the community, site workers, or the environment as a result of this alternative. The risk to chemical exposure during removal operations is minimized through the use of proper protective clothing and other standard operating procedures in accordance with 29 CFR 1910.120.

Implementability:

Technical Feasibility - POOR

- This alternative employs a developing technology that is dependent on delivering the oxidant to the chemicals of concern - physical mixing may be required to ensure successful implementation. Therefore, bench- and pilot-scale treatability studies would be required to assess the potential significance of the environmental parameters and to gain insight on the feasibility of ISCO for the Site remediation. Laboratory studies would result in the selection of the most appropriate oxidant or oxidants.
- Further engineering judgment would be required during operation to determine the operational parameters because test conditions at bench-scale are significantly different from those at field-scale and do not fully represent field conditions.
- Coal tar derivatives found on the Site are non-polar, meaning that they do not readily mix with water. This makes effective mixing of the water-bourn oxidant with the contamination difficult. .
- The physical properties such as high solubility and density (greater than water) of oxidants may allow for density-driven delivery and distribution of the oxidant throughout the subsurface.
- Significant pre-treatment grid sampling program will be necessary to identify the mass of organic contamination at each cubic unit. Stoichiometry, calculation of quantities of reactants relative to target contaminant mass, will need to be considered to ensure that adequate mass of reagent is delivered to each respective cubic unit.
- If mechanical mixing is required to assist the required oxidation reaction, the ground will become very soft (e.g., mousse). In this case, a solidification agent such as cement or kiln dust would be mixed in to provide sufficient load bearing capacity to support a productive future use of the Site.
- Adequate in-situ mixing with an auger may be a challenge due to the presence of buried rocks, concrete or other subsurface wastes and debris.
- Due to the non-selective reactivity of the oxidants, the presence of natural organic matter and minerals in the treatment zones could consume a large portion of the injected oxidants, substantially increasing the cost of this alternative.

- Due to the strength of the oxidants and large quantity of hazardous chemicals employed, this alternative does pose significant handling concerns, requiring stringent and costly personal protection equipment and controls.
- This alternative would likely require a large quantity of water (10-15 million gallons) to deliver the oxidant (permanganate) to the subsurface. This would require coordination with local water purveyors to ensure that the supply can be provided. If potable water cannot be provided, it is possible that water from Sharon Steel Run or the Monongahela River could be utilized.

Administrative Feasibility - GOOD

- The injection of oxidants is regulated primarily by the UIC program of the Safe Drinking Water Act (SDWA), which is administered through EPA for applications in West Virginia. ISCO with permanganate and other oxidants has been authorized in the past in West Virginia.
- There are no other administrative difficulties posed by this alternative.

Availability of Services and Materials - FAIR

- The engineering services and materials would be readily available for implementing this alternative, although there are a limited number of manufacturers or providers of ISCO services and chemicals, given the specialty nature of these services.
- Conventional construction techniques and equipment would be used for the installation of injection wells and treatment trenches. Large diameter augers with injector ports are available for in-situ mixing.
- Necessary sampling resources and laboratory support are readily available.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumptions used, are provided in Appendix C. A summary of the capital and O&M costs for this alternative are as follows:

Capital costs:	$13,897,000
Annual O&M cost:	$70,000
Present worth cost:	$14,766,000 (with a discount rate of 7% for 30 years)

3.1.7 Alternative SO7: In-Situ Treatment - Stabilization/Solidification

This alternative would employ in-situ stabilization/solidification (S/S) treatment to address contaminated soil at the Site. S/S reduces the mobility of contaminants in soil by trapping or immobilizing contaminants within their "host" medium (i.e., soil).

This alternative would consider cement-based S/S, which involves mixing Portland cement (a mixture of limestone and clay) and bentonite into the contaminated soil while the soil remained in place. These binding reagents are commonly delivered into the soil with a soil mixing auger. Approximately 20% of Portland cement and 1-2% of bentonite would be added to the total volume of the soil to be treated, and followed by the addition of water for hydration (if necessary), resulting in a rock-like, monolithic, hardened mass.

In-situ S/S is best suited for inorganic contaminants. Due to the high pH of the cement, the metals are retained in the form of insoluble hydroxide or carbonate salts within the hardened structure. Studies have shown that inorganic COCs such as arsenic, copper, iron, manganese, mercury, and zinc are likely bound in the matrix, and become insoluble. Although leaching of organic contaminants from the treated soil is expected to be reduced by changing the permeability of the soil, only limited data are available on organics; therefore, it is uncertain that this alternative would meet PRGs established for organic COCs in soil. In addition, mixing water and cement is an exothermic reaction, which could enhance volatilization of VOCs such as benzene from soil.

Reducing the permeability (or hydraulic conductivity) of treated soil by an order of magnitude would result in the groundwater and surface water flowing around the treated mass instead of through it. Performance specifications for the treated soil would be required, including a maximum hydraulic conductivity (e.g., 1×10^{-5} cm/sec) and unconfined compressive strength (e.g., 10 to 50 psi). In addition, leachability testing with treated soil would be required to measure effectiveness of the immobilization.

Prior to implementing this alternative, the Site would need to be grubbed to remove the existing vegetation. In addition, 52,000 cubic yards (84,000 tons) of stockpiled soil would be spread throughout the Site, as part of a general regrading of the Site. As will be discussed later under removal alternatives for the on-site sediment and the Monongahela River sediment, the sediment consolidated from these removal actions could also be spread on the Site prior to implementing this alternative.

An area of approximately 14 acres at a depth of up to 40 feet would be treated. An overlapping pattern of mixing columns would be used to ensure complete treatment of the soil. It would take about 1 to 1.5 years to fully implement this alternative at the Site. Upon completion, the treated area would be graded and covered with top soil with vegetation.

The operating and maintenance costs for this alternative would consist of routine maintenance of the site perimeter fence, and sediment and erosion controls on a semi-annual basis for 30 years. Five-year reviews would be required since organic COCs in soil would remain on Site at levels that would not allow unrestricted use.

The following is a discussion of the effectiveness, implementability, and cost of this alternative:

Effectiveness:

Overall Protection of Public Health and the Environment - NO

- This alternative would reduce the threat to human and environmental receptors by immobilizing site-related inorganic COCs in soil. In-situ stabilization/solidification would not be protective of human health and the environment because it would have limited effectiveness against organic

COCs in soil such as PAHs and benzene. Buried wastes and contaminated soils would continue to be a source of hazardous substances migrating to the ground water. The solidified material may hinder future site use.

Compliance with ARARs - YES

- There are currently no ARARs establishing acceptable concentrations for contaminants in soil at the Site. This alternative should successfully prevent exposure to soil or waste material with concentrations of hazardous substances exceeding the site-specific PRGs developed in the risk assessment process (TBC).
- This alternative would be operated in compliance with the ARARs applicable to soil mixing activities, including control of fugitive dust emissions (40 CFR 50 - Ambient Air Quality Standards for Particulate Matter), control of discharges of other air pollutants (WV Air Pollution Control Act), Federal Regulations governing Hazardous Air Pollutants (NESHAPS), and control of storm-water discharge (Clean Water Act).
- In-situ chemical mixing would be employed in a manner consistent with the requirements for the Underground Injection Control (UIC) program of the Safe Drinking Water Act (SDWA), administered in West Virginia by EPA.

Long-Term Effectiveness and Permanence - POOR

- The long-term effects of weathering (e.g., freeze-thaw cycles, acid rain precipitation, and wind erosion), groundwater infiltration, and physical disturbance associated with productive future land use can significantly affect the integrity of the stabilized mass and contaminant mobility in ways that cannot be predicted by laboratory tests.
- Uncertain long-term effectiveness on organic COCs in soil by implementing this alternative.
- Long-term soil sampling would be required to determine permanence of immobilization of inorganic COCs in soil and measure the reduced migration rate expected of organics in soil.

Reduction in Contaminant Toxicity, Mobility, or Volume through Treatment - POOR

- This alternative does not chemically treat contaminants in soil; therefore toxicity would not be reduced. Solidification/stabilization reagents would be introduced and therefore increase the volume of contaminated material. The solidification/stabilization reagent would reduce the mobility of inorganic COCs in soil by immobilizing them, and organic COCs in some degree by reducing permeability of the treated soil.

Short-Term Effectiveness - FAIR

- This alternative would have immediate effectiveness on inorganic COCs since in-situ S/S is an established technology that has been used to treat inorganic contaminants at many Superfund sites.
- There would be short-term effectiveness on leachability of organic COCs in soil since permeability of the treated soil would be greatly reduced.
- Potential short-term impacts to removal construction workers, the community, or the environment would be minimized through implementation of a site-specific health and safety plan. Proper protective clothing and air monitoring would minimize any risk during removal activities.

Workers would be required to have training and medical examinations, in accordance with 29 CFR 1910.120.

- Engineering controls for dust suppression and erosion prevention would be employed to eliminate potential impact to the community during implementation.
- Full implementation of this alternative is estimated to take approximately 1 year.

Implementability:

Technical Feasibility - POOR

- Any auger mixing system may have difficulty at this Site since there could be buried rocks, concrete, and other debris.
- Reagent delivery and effective mixing with soil up to a depth of 40 feet would be challenging.
- Soil mixing with binding reagents would significantly increase the volume of material at the Site.
- Confirmatory soil sampling would be performed to ensure all contaminated soil is mixed and treated with binding reagents; however, soil sampling at a depth of 40 feet would be required.

Administrative Feasibility - FAIR

- This alternative may have regulatory concerns regarding mixing the stabilization material into the subsurface.

Availability of Services and Materials - GOOD

- This alternative utilizes conventional construction techniques and equipment. Therefore, the engineering services and materials should be readily available for implementing this alternative.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumptions made, are provided in Appendix C.

Capital Cost:	$22,975,000
Annual O&M Cost:	$60,000
Total Present Worth Cost:	$23,720,000 (with a discount rate of 7% for 30 years)

3.1.8 Summary of Soil Alternatives Retained for Comparative Analysis

Of the seven alternatives evaluated in this section, only three will be retained for comparative analysis in Section 4.0:

Alternative SO1 - No Action
Alternative SO5 - Capping and Containment
Alternative SO6 - In-situ Treatment - Chemical Oxidation

The following alternatives are screened out of the evaluation process for the following reasons:

- Alternative SO2 - No Further Action - This alternative is not retained because it does not meet any of the soil RAOs - specifically, it does not further prevent exposure to the soil by receptors, reduce the potential for leaching of soil contaminants into the groundwater, and does not prevent erosion and surface water runoff of contaminants.
- Alternative SO3 - Excavation and On-Site Thermal Treatment – Although this alternative meets the protectiveness and ARAR goals, and would also meet all of the soil RAOs after the completion of the removal action, this alternative is not retained because of its extremely high cost ($94,633,000) as compared to the other alternatives – consequently, it would not be as cost effective as the other effective risk reduction alternatives that have been retained for comparative analysis.
- Alternative SO4 - Excavation and Off-Site Disposal – Similar to Alternative SO4, this alternative also meets the protectiveness and ARAR goals, and would also meet all the soil RAOs after the completion of the removal action. However, this alternative is also not retained because of the extremely high cost ($49,985,000) as compared to other alternatives – consequently, it would not be as cost effective as other effective risk reduction alternative that have been retained for comparative analysis.
- Alternative SO7 - In-Situ Treatment - Stabilization and Solidification - This alternative is not retained because of its lack of effectiveness, difficulty in implementation and high and relatively uncertain cost.

3.2 GROUNDWATER ALTERNATIVES

As described previously in Section 2.3, groundwater in both the overburden and bedrock aquifers has been impacted by historic Site activities.

The overburden aquifer has been directly impacted by historic Site activities and contains a number of organic compounds (primarily PAHs and petroleum-related VOCs such as BTEX) that are related to wastes handled previously at the Site. Further, as the likely result of changes in aquifer geochemistry caused by ongoing natural degradation processes of subsurface contaminants (i.e., changes in aquifer pH and oxidation/reduction conditions that allow inorganics to leach out of the subsurface sediments), the overburden aquifer also contains several inorganics (primarily iron and manganese, and to a lesser extent arsenic and thallium) that are present at concentrations in excess of acceptable risk levels and/or ARARs.

The bedrock aquifer, although not directly impacted by organic contaminants (i.e., no organics were consistently detected in the bedrock aquifer in excess of PRGs), appears to have been indirectly impacted by the degraded water quality in the overlying overburden aquifer, which has likely caused changes in the bedrock aquifer geochemistry. As a result, iron and manganese have leached out of the rock and are present in the bedrock aquifer in certain areas at concentrations in excess of acceptable human health risk levels.

Given that the water quality problem in the bedrock aquifer (iron and manganese only) appears to be directly related to the water quality in the overburden aquifer, actively addressing the overburden aquifer would also ultimately address the bedrock aquifer water quality problem. **Consequently, this groundwater removal action would focus primarily on the overburden aquifer only.**

In general, groundwater removal alternatives presented herein consider not only contaminants that are dissolved, but also contaminated soil or other subsurface sources (i.e., tar) that may come in contact with the groundwater and can continue to leach into groundwater. Accordingly, removal alternatives for groundwater are developed based on findings during the RI, and the general extent of contamination in the overburden aquifer and soil at the Site as summarized in Section 2.3.

The following alternatives have been identified for addressing contaminated groundwater at the Big John Site:

Alternative GW1: No Action
Alternative GW2: No Further Action
Alternative GW3: Monitored Natural Attenuation
Alternative GW4: Expansion of Existing Groundwater Containment System
Alternative GW5: In-Situ Chemical Oxidation
Alternative GW6: In-Situ Bioremediation

A description of each alternative, as well as an evaluation of its effectiveness in meeting removal action objectives (RAOs), implementability, and cost considerations is provided in the following sections.

Note that aquifer restoration is one of the groundwater RAOs. Given the large contaminant source area present at the Site (i.e., more than 300,000 cubic yards/500,000 tons of impacted soil) that can contribute to groundwater impacts, restoration of groundwater quality throughout the aquifer at the Site may not be practical. However, restoration of the groundwater outside the major source areas is likely feasible. Therefore, each groundwater alternative will be evaluated for two aquifer restoration scenarios as described below:

- *Total Aquifer Restoration Scenario (TARS)* - This restoration scenario includes the complete restoration of both the overburden and bedrock aquifers throughout the Site, inclusive of the entire Site area between Hoult Road to the north, Monongahela River to the west, Sharon Steel Run to the south, and the Sharon Steel site to the east. Note that this scenario could only be accomplished if the source of groundwater contamination is sufficiently removed, degraded, or otherwise immobilized.

- *Area of Attainment Restoration Scenario (AOARS)* - This restoration scenario involves the establishment of a Waste Management Area (WMA) associated with a residual source area where restoration of the groundwater would not be an RAO given the technical infeasibility of removing, degrading, or immobilizing the source material. However, this scenario would also include a designated area of attainment (AOA) outside the WMA where restoration of the groundwater is feasible. This type of scenario would require an institutional control to prevent the use of groundwater within the WMA.

  The WMA proposed for the Site would be equivalent to the areas depicted on Figure 2-1 and Figure 2-2, which delineates the area of impacted surface and subsurface soils that remain a source for groundwater contamination. If a source containment remedy is selected (such as a cap), the WMA would encompass the entire area underlain by any capping system, as the capping system would ultimately cover all of the contained waste areas and leachate collection system.

The AOA proposed for the Site would include the following:

- Sharon Steel Run and related tributaries surface water discharge - Some of the groundwater from the site discharges directly to the surface water drainages in the area via seeps and fractures. As there is no overburden in the immediate vicinity of these surface water courses (only bedrock), the surface discharge itself would be considered a reliable surrogate for groundwater quality in the area. Therefore, the Sharon Steel Run and related tributary discharge would be part of the AOA where groundwater PRGs would apply.
- Overburden Aquifer in the Western Portion of the Site - The western portion of the Site (in the vicinity of monitoring well cluster MW-13 (see Figure 2-3) does not have any evidence of impacted surface soil or subsurface soil, and subsequently would not be encompassed by any capping system. Consequently, the overburden aquifer in this area, which would be located immediately to the west of the WMA, would be another AOA where groundwater PRGs would apply. Note that there is no overburden aquifer to the north of the Site (only bedrock).
- Bedrock Aquifer - North, South, East and West of the WMA - The bedrock aquifer area located around the perimeter of the Site and outside the boundaries of the WMA would also be defined as an AOA. This would include the downgradient area to the south currently monitored by bedrock wells MW-7, MW-9, and MW-10 along the Sharon Steel Run water course; the downgradient area to the west currently monitored by bedrock wells MW-11, MW-12, and MW-14 along the Monongahela River; and the upgradient area to the north currently monitored by bedrock wells MW-1, MW-2, MW-3, MW-16, and MW-17. There would also be a defined AOA to the east of the site (beyond the Fairmont Coke Works Site boundary) - however, there are currently no bedrock monitoring wells established in the area immediately east of the site.

The restoration of surface water quality (which would be part of the area of attainment) to below human/ecological risk levels is one of the surface water RAOs that will be directly affected by restoration of the groundwater quality at the site. Given that groundwater provides the base flow for Sharon Steel Run and the other tributaries, any change in on-site groundwater quality will directly impact the water quality of the surface water.

3.2.1 Alternative GW1: No Action

The No Action alternative for groundwater is retained for consideration as a potential response action at the Site as required by the National Oil and Hazardous Substance Pollution Contingency Plan (NCP). The No Action alternative will be evaluated to provide a comparative baseline against which other alternatives can be evaluated. Under this alternative, there would be no additional removal actions beyond those already completed at the Site, and the existing on-site groundwater collection system operation (which consists of the collection of groundwater from two sumps, on-site treatment including activated carbon, and subsequent discharge to the City of Fairmont sewer system) would be discontinued.

The following is a discussion of the effectiveness, implementability, and cost of the No Action removal alternative:

Effectiveness:

The No Action alternative would cease operation of the existing groundwater collection and aboveground treatment ("Pump-and-Treat"), and no other removal actions would be implemented. As discussed previously, more than 9 million gallons of groundwater and tar have been collected and treated at the Site through August 2008. Since its construction in 2001, this pump-and-treat system has demonstrated limited success collecting and treating site-related contaminants migrating down the middle and east tributaries from the upland portion of the Site. The leachate collection points have reduced the quantity of contaminants discharging from the groundwater into Sharon Steel Run. However, the existing collection trenches have not been completely effective in collecting all groundwater in the overburden aquifer at the Site, as evidenced by the water quality impacts observed in Sharon Steel Run. Discontinuing the current pump-and-treat action would allow more impacted groundwater to discharge to the adjacent surface water.

Consequently, the cessation of the existing groundwater collection and treatment system would not be effective in meeting the removal action objectives for groundwater - specifically:

- The contaminated groundwater would remain throughout the impacted area of the Site.
- The contaminated groundwater would continue to discharge to Sharon Steel Run, thereby impacting the surface water quality.
- There would be no restoration of the groundwater quality in either the overburden or bedrock aquifer under either the TARS or AOARS scenarios.

Overall Protection of Public Health and the Environment - NO

- Would not be protective of human health or the environment because it would allow for an increase in the discharge of contaminated groundwater to Sharon Steel Run. Risks to human health and the environment related to the surface water in Sharon Steel Run would increase.
- Would not be protective of human health for future receptors (water supply use) as it would not result in the restoration of the groundwater quality in either the overburden or bedrock aquifer.
- Current unacceptable risk level posed to the Site associated with groundwater would remain for a long period of time.

Compliance with ARARs - NO

- Increase in contaminated groundwater discharge to Sharon Steel Run would contribute to on-going non-compliance of established Sharon Steel Run TMDL (iron and manganese) and state water quality criteria.
- Groundwater does not achieve EPA's policy for groundwater restoration (TBC) for either the overburden or bedrock aquifer, or meet EPA Safe Drinking Water Standards (MCLs) or WV groundwater quality standards.

Long-Term Effectiveness and Permanence - POOR

- Long-term human health and environmental risks at the Site would remain the same as those identified in the baseline risk assessments.
- The overburden and bedrock aquifers at the Site would remain contaminated for the long-term.

- Groundwater discharge would be a continuing source of surface water contamination in Sharon Steel Run.
- The No Action alternative would not attain any long-term objectives for groundwater established within the scope of the removal actions.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment - POOR

- This alternative would increase the mobility of contaminants in the overburden groundwater (allowing for more discharge to the surface water), and would not reduce the toxicity or volume of contaminants in the groundwater.
- This alternative does not achieve the goal of preventing further migration of the contaminant plume, as more groundwater contaminants could discharge to surface water.

Short-Term Effectiveness - POOR

- This alternative would not achieve the PRGs for the overburden or bedrock groundwater in a relatively short time frame.
- There could be additional risks posed to the community, the workers, or the environment as a result of this alternative being implemented as contaminant concentrations in Sharon Steel Run could increase as a result of the cessation of groundwater collection and treatment.

Implementability:

Technical Feasibility - GOOD

- There are no technical difficulties posed by the implementation of this alternative. The only actions required to implement this alternative would be the removal of the existing trailer-mounted treatment system, and disconnection of electric service and sewer connections.

Administrative Feasibility - POOR

- The EPA would have difficulty issuing a decision document that fails to reduce risk to within the acceptable risk range set forth in the NCP and fails to comply with ARARs.

Availability of Services and Materials - GOOD

- The necessary resources and support are readily available to cease operations and dismantle the treatment system.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

There would be minimal costs associated with this alternative related to the dismantling and removal of the existing on-site treatment system. The costs are expected to be less than $15,000.

3.2.2 Alternative GW2: No Further Action

Under this alternative, the existing groundwater collection and treatment system would continue to be operated as it has been operated since March 2001, with no improvements or expansion beyond that currently in operation. There would also be no further removal actions beyond those already completed at the Site.

As per a removal action plan (RAP) submitted to EPA in October 2000, PRP Reilly installed a limited groundwater seep collection and treat system in 2001, consisting of two groundwater collection trenches (French drain system) installed in the Middle and East Tributaries, and an on-site treatment trailer with oil/water separation and carbon filtration prior to discharge to the local sanitary sewer. The locations of these features are shown in Figure 3-1.

The collection trench in each tributary consists of an approximately 3-foot wide by 3-foot deep trench that was excavated into the tributary and lined with a permeable geotextile. A perforated pipe was placed at the bottom of the trench and backfilled with gravel. The trench extends to a collection manhole at the mouth of each tributary where a bentonite dam was constructed downstream of the manhole to retain the water around the manhole. The bentonite dams were not "keyed-in" to the underlying bedrock. Pumps in the manholes convey the collected NAPL fraction and water to an on-site treatment plant for carbon filtration, and the treated water is ultimately discharged to the City of Fairmont sewer system through the discharge manhole located adjacent to the Site.

The EPA also installed a subsurface clay barrier in the area between the Middle and East Tributaries in an attempt to control coal tar seeps in this area. However, this "hanging" clay barrier was installed only to a depth of 10-15 feet below grade. The clay barrier was not constructed to a sufficient depth to restrict groundwater flow as the base of the overburden aquifer ranges from 20 to 30 feet below grade in this area.

The average inflow rate to the on-site treatment plant is reportedly approximately 5 gpm, except during the summer months when it can become less than 2 gpm. During the time period of March 2001 through July 2008 (88 months), approximately 9.3 million gallons of groundwater/tar have been collected, treated, and discharged to the sewer (note that there is no estimate available on the actual quantity of tar removed - it is part of the overall quantity collected). This equates to approximately 3,500 gallons per day or 2.4 gpm.

The existing collection trenches were ideally located since the overburden aquifer generally flows toward these main drainage tributaries. The collection system also likely has an influence on the groundwater flow direction in the overburden aquifer at the Site. Since no major tar seeps were observed in Sharon Steel Run beyond the clay barriers located at the base of the Middle and East tributaries during the RI, the existing trench systems and clay barrier appear to be currently controlling tar migration at the surface. However, the existing collection trenches do not extend to the overburden aquifer areas mostly impacted with contaminants (e.g., in the vicinity of wells MW-4 and MW-5); therefore, this system is not currently optimum for the collection of impacted groundwater from these areas.

Further, it appears that impacted groundwater still discharges beyond these containment features, as evidenced by elevated concentrations of benzene, iron, and manganese detected in the surface water of the Unnamed Tributary #1 in the vicinity of the East Tributary. These collection trenches were not specifically designed to collect and contain all of the water flowing through the Site, but rather were designed to create a highly permeable channel for the overburden groundwater collection. Therefore, any water that is not contained by these trenches ultimately discharges to the stream.

Under this No Further Action alternative, operation of the groundwater collection and treatment system would continue for a period of 30 more years. The PRP has been operating this system since its construction in 2001. Monitoring performing maintenance services is required to achieve and maintain the effectiveness of the existing system. Operations and maintenance (O&M) activities include the periodic (monthly) inspection of sumps, pumps, and treatment equipment and related reporting; periodic (monthly) cleaning of pumps, sumps, process lines and treatment equipment to remove tar buildup, periodic (annual) change-out of carbon canisters when absorption capacity is exhausted; and monthly monitoring and payment for discharge of treated groundwater to the City of Fairmont sewer system.

The following is a discussion of the effectiveness, implementability, and cost of the No Further Action removal alternative:

Effectiveness:

The No Further Action alternative would include continued operation of the existing tar and groundwater seep collection and treatment system, and no other removal actions would be implemented. As discussed previously, this pump-and-treat system has demonstrated successful collection and treatment of site-related contaminants in groundwater, and has also likely reduced the quantity of contaminants discharging from the groundwater into Sharon Steel Run. However, the existing collection trenches have not been effective in collecting all groundwater in the overburden aquifer at the Site, as evidenced by the water quality impacts observed in Sharon Steel Run. The collection system also does not extend to the areas with the most contaminated groundwater; therefore, it is not optimal for the removal of the most contaminated groundwater at the Site.

Consequently, the continued operation of the existing groundwater collection and treatment system would not be effective in meeting the removal action objectives for groundwater - specifically:

- The contaminated groundwater would remain throughout the impacted area of the Site - this alternative does not prevent future exposure of workers or residents to contaminated groundwater.
- This alternative controls some of the migration of the contaminant plume, but contaminated groundwater would continue to discharge to Sharon Steel Run, thereby continuing to impact the surface water quality.
- There would be no restoration of the groundwater quality in either the overburden or bedrock aquifer under the TARS or AOARS scenarios, as this alternative does not address the source material, nor is its configuration optimal for the removal of the most highly contaminated groundwater in the main plume area.

Overall Protection of Public Health and the Environment - No

- Would not be protective of human health or the environment because it continues to allow discharge of contaminated groundwater to Sharon Steel Run. The existing unacceptable risk would continue to be presented to ecological receptors and future recreational users.
- Would not be protective of human health for future receptors (water supply use) as it would not result in the restoration of the groundwater quality either throughout the aquifer or in the Area of Attainment.
- The current unacceptable risk level posed to the Site associated with groundwater would remain for a long period of time.

Compliance with ARARs - No

- The existing collection and treatment program prior to discharge to the city sewer system currently complies with City of Fairmont Sewage Discharge Control requirements for industrial wastewater discharge.
- Partial containment of groundwater plume does not comply with potential state and federal ARARs because certain contaminants discharging from groundwater exceed WV in-stream water quality standards and EPA TMDL (iron and manganese).
- The existing collection and pumping scheme will not achieve EPA Safe Drinking Water Standards (MCLs) or WV groundwater quality standards in the shallow aquifer under the TARS, nor would it likely meet these standards under the under the AOARS.
- Groundwater does not achieve EPA's policy for groundwater restoration (TBC) for either the overburden or bedrock aquifer under either the TARS or AOARS scenarios. It also does not achieve WV Anti-Degradation Policy for protection of existing uses of state waters.

Long-Term Effectiveness and Permanence - POOR

- Long-term human health and environmental risks at the Site would remain the same as those identified in the baseline risk assessments - this alternative would continue to be unprotective.
- The overburden and bedrock aquifers at the Site would remain contaminated for the long-term.
- Contaminated groundwater discharge would be a continuing source of surface water contamination in Sharon Steel Run.
- The No Further Action alternative would not attain most of the long-term objectives for groundwater established within the scope of the removal actions (i.e., restoration or prevention of exposure or discharge); however, it does help control contaminant migration in the groundwater.
- Based on historical performance of the existing containment system, the long-term effectiveness of the current pump-and-treat system to collect and treat groundwater is proven to have some limited successes, as more than 9 million gallons of contaminated groundwater have been removed; however, the system does not offer sufficient containment of the groundwater contaminants.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment - FAIR

- This alternative utilizes engineering controls to reduce the mobility of contaminants in the groundwater (somewhat, but not sufficient containment of the groundwater). The alternative does use treatment technology to reduce the mobility and toxicity of contaminants in the treatment train comprised of on-site and off-site treatment of that same groundwater. No reduction of volume is realized through treatment. This alternative does not reduce toxicity of contaminants that remain in the aquifer at the site.

- This alternative partially achieves the goal of preventing further migration of the contaminant plume, as it controls some (but not all) discharge of contaminated groundwater to the surface water. Collection system configuration is not optimal to collect the most contaminated groundwater, thereby allowing it to migrate from the source areas to other areas beyond the collection system.

Short-Term Effectiveness - POOR

- This alternative would not achieve the PRGs for the overburden or bedrock groundwater considering the TARS or the AOARS within a short time frame. Therefore the short-term risks would not be reduced.
- Short-term risks posed to the community, the workers, or the environment would not be increased as a result of this alternative being further implemented since no new construction would be involved and existing O&M is well established.
- The risk of chemical exposure during removal operations is minimized through use of proper protective clothing and other standard operating procedures in accordance with 29 CFR 1910.120.

Implementability:

Technical Feasibility - GOOD

- There are no technical difficulties posed by the implementation of this alternative beyond maintaining the current system - the existing system has been operating with some degree of successful for nearly 7.5 years (though unacceptable risks continue to be presented by hazardous substances at the Site)
- Significant maintenance would be required to maintain effective collection at the sumps and maintain the unit treatment processes in the on-Site trailer.

Administrative Feasibility - FAIR

- There are no administrative difficulties posed by the continued discharge of the treated effluent to the POTW - all permits and discharge agreements are already in place. The on-site treatment system is successfully achieving the pre-treatment requirements for the POTW, and the volume of discharge is relatively small (average 3,500 gallons per day) compared to the POTW capacity (9 million gallons per day).

Availability of Services and Materials - GOOD

- The necessary resources and support are readily available to continue operations and maintenance of the collection and treatment system.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

There are no capital costs associated with this alternative as the existing collection and treatment system would be used. On-going O&M costs are estimated at $60,000 per year. For a period of 30 years, this equates to a present worth cost of $745,000.

3.2.3 Alternative GW3: Monitored Natural Attenuation

Under this alternative, monitored natural attenuation (MNA) would be the means of achieving PRGs in the groundwater at the Site in both the overburden and bedrock aquifers. MNA refers to the reliance on natural processes to achieve site-specific contamination removal objectives. This alternative would involve very detailed monitoring of groundwater quality for a period of 30 years to provide an on-going evaluation of the nature and extent of natural attenuation processes occurring at the Site. This alternative would also include an institutional control in accordance with the West Virginia Uniform Covenant Act § 22-22B to prevent future groundwater use at the Site until PRGs are attained.

Natural attenuation processes include a variety of physical, chemical, and/or biological processes that act without human intervention to reduce the mass or concentration, toxicity, mobility, or volume of contaminants in groundwater and soil. These in-situ processes primarily include biodegradation, dilution and dispersion, and sorption (U.S. EPA, 1999). Most of these processes involved in natural attenuation are operating at all contaminated sites, but the potential contribution of natural attenuation to achieving remediation goals varies in different situations. Each of these processes is described briefly below:

- **Biodegradation**: Natural bacteria that may be present in the soil and groundwater are capable of using some organic contaminants as their primary source of energy or food. When the microbes "feed", they degrade the chemicals into less complex compounds, and/or ultimately carbon dioxide and water (in case of aerobic processes). The Site contaminants in the groundwater susceptible to biodegradation include the petroleum hydrocarbons (e.g., BTEX) and some of the PAHs (including low molecular-weight PAHs such as naphthalene and 2-methylnaphthalene). However, the high molecular-weight PAHs (including groundwater COCs such as benzo(a)anthracene, benzo(b)fluoranthene, and benzo(k)fluoranthene) and metals are not susceptible to biodegradation.
- **Dilution/Dispersion**: As contaminants mix with clean groundwater over time, their concentrations may be reduced so low that the risk to human health and the environment would be minimal; however, these processes do not destroy contaminants. All of the contaminants (both organic and inorganic) in the groundwater at the Site are susceptible to dilution/dispersion processes, especially in the areas away from the major source areas.
- **Adsorption**: As contaminants move through soil and groundwater, chemicals can stick or sorb to soil particles. This process does not destroy the chemicals, but it can keep them from polluting groundwater and leaving the site. All of the Site contaminants, especially the high molecular-weight PAHs and inorganics, are susceptible to adsorption processes.

Each of these three processes are occurring in the dissolved phase to some degree at the Site in the overburden aquifer, and biodegradation is probably the primary process of the three; however, it is likely that only dilution/dispersion is the primary process occurring in the bedrock aquifer system.

With respect to biodegradation processes in the overburden aquifer, there is evidence that anaerobic biodegradation is occurring throughout the general area of impacted groundwater (see Figure 2-3 for description of general area of impacted ground water); however, the rate of biodegradation is likely slow given the presence of an on-going source of contamination (i.e., coal tar and high PAH concentrations in the subsurface). The evidence includes a combination of low dissolved oxygen (DO) concentrations, negative oxidation-reduction potential (ORP), the presence of dissolved methane (which is indicative of methanogenesis, an anaerobic degradation process), and high dissolved iron and manganese concentrations (which have resulted from changes in redox conditions that have allowed for more of these metals to dissolve from the soils into the groundwater). See Figure 3-2 for a summary of pH, DO, ORP, dissolved methane, sulfate, iron, and manganese data for the overburden aquifer wells for the April 2005 sampling event. Note the obvious difference in the water quality in the vicinity of well locations MW-8A and MW-13A as compared to the overburden aquifer area east of these locations. The overburden aquifer in the vicinity of MW-8A/MW-13A has little to no organic compounds present, and as a result the groundwater contains high concentrations of dissolved oxygen, positive ORP, very low dissolved methane, and substantially lower iron and manganese concentrations than overburden aquifer areas to the east.

With respect to dilution/dispersion processes in the overburden aquifer, it is not expected that much dilution or dispersion is occurring as the source area for the groundwater contamination is large and remains present. Consequently, continued recharge from precipitation likely continues to mobilize contaminants from the overlying soil source areas into the overburden groundwater rather than diluting or dispersing the contaminants. However, some dilution is likely occurring in the bedrock aquifers, as this aquifer appears to receive some or most of its recharge from areas adjacent to the Site - consequently, dilution and dispersion is a more likely process in the bedrock aquifer.

With respect to adsorption processes in the overburden aquifer, the overburden material includes various sand, silt, and clay lenses. It is likely that some sorption of groundwater contaminants is occurring; however, the overburden aquifer also contains the large source area, and the ability for the silt and clay lenses to sorb more contaminants is probably limited, as these layers already contain high concentrations of PAHs in some saturated areas.

Given the evidence that biodegradation is probably occurring at the Site, the MNA monitoring program would focus on gathering the necessary data to evaluate the nature and extent of this process. Monitoring would also track the migration of contaminants that are not degrading as well as "daughter products." Consideration would also be given to identifying which parameter(s) may be limiting the rate at which degradation is occurring. Potential for enhancing biodegradation by augmentation of rate limiting parameter would be evaluated.

Monitoring Program

Under this alternative, the groundwater monitoring program would include routine measurements of contaminants of concern, as well as an evaluation of geochemical and hydrologic parameters in both the overburden and bedrock aquifers, including:

- Progress toward contaminant removal objectives and indications of additional contaminant releases;
- Contaminant detections at the horizontal and vertical plume boundaries that may indicate plume expansion;
- Geochemical changes (e.g., redox conditions) indicative of possible changes in contaminant transformation rates; and
- Changes in groundwater flow rates or directions.

For evaluation purposes, it is assumed that there is sufficient bedrock monitoring well coverage existing throughout the Site (34 monitoring wells located throughout the four primary stratigraphic units [SU1, SU2, SU3, and SU4] - used to describe the bedrock lithologic units; see Section 4.4.2.2 of the RI report); however, additional overburden monitoring wells would be useful to provide additional monitoring points, especially in the area around the 2005 drum excavation area near the head of the West Tributary, as well as areas to the east and south. It is assumed that an additional 4 shallow monitoring wells would be installed in the overburden aquifer to provide expanded coverage (12 existing overburden well locations plus 4 new overburden monitoring locations). Groundwater samples would subsequently be collected semi-annually from all existing and newly installed monitoring wells (a total of 50 monitoring points) for an initial period of 5 years, followed by annual sampling for an additional 25 years. All samples would be analyzed for the Target Analyte List (TAL) inorganics and Target Compound List (TCL) organic compounds, natural attenuation parameters, including nitrate, sulfate, dissolved gases (e.g., methane, ethane, and ethene), and alkalinity, as well as field measurements for other water quality parameters such as pH, DO, iron, ORP, temperature, and conductivity.

The following is a discussion of the effectiveness, implementability, and cost of the MNA removal alternative:

Effectiveness:

The primary potential advantages of MNA are that it is less intrusive and disruptive, and it usually has lower contamination removal costs than other engineered methods. MNA requires long-term monitoring to assess natural attenuation processes and its effectiveness with respect to achieving removal objectives, but includes no other active components to reduce contamination mobility, toxicity, or volume. However, MNA works best where the source of pollution has been removed, and the biodegradation process, which is prominent at the Site, works primarily on low molecular-weight organic compounds (and not on the high molecular-weight PAHs), although changes in aquifer geochemistry resulting from natural processes can also indirectly affect inorganics.

Consequently, MNA as the sole remedy at the Site would not be effective in meeting most of the removal action objectives for groundwater - specifically:

- The contaminated groundwater in excess of PRGs would remain throughout the impacted area of the Site given its proximity to the source area; however, this alternative does provide, through institutional controls, the prevention of future exposure of workers or residents to contaminated groundwater.
- This alternative does not control the migration of the contaminant plume - contaminated groundwater would continue to discharge to Sharon Steel Run, thereby continuing to impact the surface water quality.

- There would be no restoration of the groundwater quality in either the overburden or bedrock aquifer under the TARS or AOARS scenarios in any reasonable time frame (the Site groundwater was probably first impacted by releases more than 50 years ago), as this alternative does not address the source material.

However, MNA may be appropriate as one component of the total remedy, either in conjunction with other active soil or groundwater remediation or as a follow-up measure. For example, the MNA may be specifically appropriate for any alternative that includes the WMA and AOARS scenario.

Overall Protection of Public Health and the Environment - No

- A comprehensive site-wide monitoring program would establish a sufficient database to determine if MNA is effective at controlling the groundwater plume. However, monitoring would not control the continued or future migration of contaminants from groundwater to surface water, thereby continuing to impact human health and the environment associated with Sharon Steel Run.
- Unacceptable concentrations of contaminants (e.g., VOCs, PAHs, and metals) in groundwater would remain for a long period of time. PRGs would not be expected to be met for a long period of time for some contaminants, and for others (such as high molecular-weight PAHs and metals not amiable to MNA), the PRGs may never be met.
- Institutional controls for groundwater use would be protective for future workers and residents.

Compliance with ARARs - No

- This alternative would not comply with chemical-specific groundwater ARARs since it is very unlikely that all PRGs would be met in the short or long term. Surface water TMDLs (TBC) as related to groundwater discharge would also not be met.
- MNA would not meet EPA Safe Drinking Water Standards (MCLs) or WV groundwater quality standards in the shallow aquifer under the TARS in the future unless paired with some active source removal action (such as soil removal/in-situ treatment). Attainment of quality standards is possible under the AOARS without any active source removal/containment action, however, time to attainment could be lengthy.
- This alternative would not meet the EPA policy for groundwater restoration (TBC) or meet WV Anti-Degradation Policy within a reasonable time frame (e.g., within 5 years) under either the TARS or AOARS scenarios.

Long-Term Effectiveness and Permanence - POOR

- Not likely effective in the long-term without source removal, as existing source would continue to impact groundwater quality. Not likely effective with high molecular-weight PAH contaminants or most metals.
- Long-term monitoring and on-going evaluation required to determine effectiveness of MNA - if MNA is determined not to be effective, other active removal activities may be required.
- Impacted groundwater would be a continuing source of downgradient groundwater and surface water contamination for a long period of time (e.g., > 5 years).
- Institutional controls can provide for permanent control of future groundwater use at the Site, but would only be protective for off-site users in combination with containment/prevention of groundwater migration.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment - POOR

- This alternative depends solely on natural attenuation to reduce the toxicity, mobility, or volume of contaminants in the overburden and bedrock groundwater. Process is occurring, but the rate is very slow.
- To the extent that the biodegradation component of the natural attenuation process is recognized as "in situ" treatment, this alternative does minimally satisfy the statutory preference for treatment to reduce contaminant toxicity, mobility, or volume.
- This alternative would not achieve the goal of preventing off-site migration of contaminants in the overburden groundwater until MNA meets PRGs.
- No substantial reduction in toxicity of most PAHs or metals in the short term through natural processes. Reduction of toxicity of certain readily biodegradable compounds (e.g., VOCs) probably would occur; however, risk reduction goals would not be met. Very little long-term reduction in toxicity of high molecular-weight PAHs would occur, as these compounds are not as susceptible to biodegradation processes.

Short-Term Effectiveness -POOR

- In general, short-term effectiveness of this alternative is low as the rate of natural processes responsible for eventual attenuation to achieve PRGs is very slow.
- Groundwater monitoring as part of this alternative would pose minimal risks to the community and the workers. Risk of chemical exposure during monitoring can be minimized through proper protective clothing and air monitoring. Workers would be required to have training in accordance with 29 CFR 1910.120.
- Implementation of this removal alternative, which can be immediate given the existing monitoring well network, would not increase the existing risks presented by the Site as very little intrusive work is required.

Implementability:

Technical Feasibility - GOOD

- There are no technical implementability concerns posed by this alternative since no substantial construction activity is involved beyond monitoring well installation. Groundwater monitoring can be easily implemented at the Site. Institutional controls can also be readily implemented at the Site.
- A monitoring program could easily be designed to track and confirm if this alternative is effective in reducing COC concentrations; however, the time frame to evaluate effectiveness is long in duration (i.e., many years).
- It is not technically feasible to utilize MNA to achieve PRGs for contaminants that are recalcitrant to biodegradation and dilution (high molecular-weight PAHs and metals).

Administrative Feasibility - FAIR

- No major regulatory permits are required to implement MNA. Some minor permitting required related to monitoring well installation.

- Institutional controls (e.g., to restrict or prevent the use of groundwater as a potable water source) can be implemented relatively easily with property owner cooperation since groundwater is currently not used as a potable water source in the area - more than 90% of Marion County (including nearly all of the City of Fairmont) reportedly has access to a municipal water supply source; therefore, groundwater use for potable supply in the area is not necessary.

Availability of Services and Materials - GOOD

- Necessary monitoring well installation contractors and supplies, as well as sampling resources and laboratory support are readily available to implement MNA.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Under this alternative, there would be capital costs associated with the installation of four new monitoring wells, as well as O&M costs for groundwater monitoring, as described previously. Detailed cost estimates, including assumption made, are provided in Appendix C. The costs for this alternative are summarized as follows:

Capital cost:	$90,000
Annual O&M costs:	$296,000 (first 5 years), $163,000 (final 25 years)
Present worth cost:	$3,204,000 (with a discount rate of 7% for 30 years)

3.2.4 Alternative GW4: Expansion of the Existing Groundwater Containment System

This alternative includes expansion of the existing groundwater containment and treatment features described in Alternative GW2 to enhance performance of the current containment systems to prevent site-related contaminants in groundwater from migrating off-site or into receiving surface waters. This alternative includes:

- Re-configuring the tar and seep collection system by extending and re-aligning French drains to better capture tar and contaminated groundwater
- Upgrade or replacement of existing groundwater treatment system to accommodate higher flow rate
- Institutional controls
- Long-term groundwater monitoring

As previously discussed under Alternative GW2, two existing trenches have served to collect both groundwater and mobile tar seeps at the Site since 2001. However, the trenches were originally designed as temporary features and site-related contaminants are still being detected in surface water samples from the Unnamed Tributary #1, most likely due to some of the groundwater migrating beyond these containment features toward this stream. The collector trenches do not currently extend to the areas with the highest concentrations of groundwater contamination (e.g., in the vicinity of wells MW-4A and MW-5A). Consequently, the current system configuration is not the most optimal for the containment and capture of the contaminants in the center of the plume.

To improve the performance of the current groundwater collection and containment system, a new collection trench would be constructed in the West Tributary, and the existing collection trenches in the Middle and East Tributaries would be extended to increase their area of influence. In addition, new collection sumps as well as new containment walls keyed-in to the underlying bedrock at the mouth of the East, Middle, and West Tributaries would be installed to further limit subsurface flow to the Unnamed Tributary #1 and Sharon Steel Run. Further, the existing oil/water separator and carbon filtration treatment system would also be upgraded/expanded to handle the additional flow. In addition, an alternative for the further treatment of site groundwater allowing for the direct discharge to Sharon Steel Run is also presented. The principal components in this alternative are shown in Figure 3-3 and discussed below. **Note that this design concept is presented to assess the feasibility of this alternative as well as develop cost estimates - the actual configuration of the system would be developed during the design phase of any future removal action.**

Groundwater Collection Trench Extension

Additional groundwater collection trenches would be situated in areas with highly contaminated groundwater to facilitate more efficient groundwater collection. Presently, the water in the overburden aquifer originating in the center (most contaminated) portion of the Site generally flows distances of up to 500 feet to the tributary areas where some of it is collected in the existing collector trenches. The primary objective of extending the trenches is to minimize the distance that contaminated groundwater must flow before being collected. This would help ensure more complete capture of the contaminated groundwater in the overburden aquifer, which would further deter the discharge of this contaminated groundwater to Sharon Steel Run.

A description of the expanded groundwater collection trench system follows, and is depicted on Figure 3-3:

- East Tributary - The existing collection trench in the East Tributary would be extended approximately 250 to 300 feet to the northwest to facilitate the collection of groundwater from the northeastern portion of the Site (including the area in the vicinity of monitoring well MW-5 with elevated VOCs in the subsurface soil). A new sump would also be installed at the western end of this collection system. After completion, the water in this trench will flow in two directions (based on the groundwater gradient and ultimate collection trench elevation)- part of it will flow toward the East Tributary collection sump, and part of it will flow toward the new sump on the western end.
- Middle Tributary - The Middle Tributary collection trench would be extended approximately 300 feet to the north and sloped to a new collection sump (rather than sloped toward the south as the current configuration) to limit the conveyance of additional water toward Sharon Steel Run. This extension would also capture groundwater in between the areas of wells MW-4 and MW-5, which are the most contaminated wells at the Site. Similar to the system described for the East Tributary, groundwater in this trench will flow in two directions as well.

- West Tributary - A new collection trench would be installed in the vicinity of the West Tributary - this collection trench would have two segments—one segment extending approximately 250 feet down the slope of the tributary to the south toward Sharon Steel Run, and one segment extending approximately 300 feet to the north across the main portion of the site. Each segment would be sloped in a different direction (one to the south/one to the north) to facilitate optimum groundwater collection. New collection sumps would be installed at either end of the collection trench. The new northern sump for the West Tributary would also serve as the discharge point of an extended collection trench in the Middle Tributary. This collection trench would capture groundwater in the area with a long history of waste operations (e.g., cullet washing) as well as address the likely groundwater contamination associated with drums previously disposed (and excavated in a 2005 removal action) near the head of the West Tributary.

Note that the orientation of the collector trench extensions is intended to provide for a collection system situated in the most contaminated portion of the overburden aquifer. In some cases these trench extensions are located perpendicular to the observed flow direction in the overburden aquifer, but in some cases (such as in the tributaries), the trenches are likely situated parallel to the observed aquifer flow direction. The saturated thickness of the overburden aquifer at the site is only 4 to 11 feet. Given this relatively thin aquifer thickness coupled with a relatively small groundwater yield component from the site (estimated to be only 3 to 5 gallons per minute), the collector system would have a very strong influence on the localized flow directions in the overburden aquifer. Consequently, the general orientation of the collection system would likely promote the capture of the most contaminated groundwater at the site.

With regard to the collection trench construction, the new trenches would be constructed using excavation techniques capable of ensuring placement of the collection pipe into the coarse sand unit that is situated at the base of the overburden. The collection pipe would be a 4-inch HDPE Schedule 80 perforated pipe placed horizontally at the bottom of the trench. The perforated pipe would be surrounded by a non-woven geotextile to minimize accumulation of sediments. The slope of the interceptor pipe extensions would be designed to maintain gravity flow to a sump that would be placed at the end of the new trench extensions. The sumps would be equipped with pumping equipment and controls to convey the collected groundwater to the treatment system.

Expanded Containment Structures

Alternative GW4 would also include the expansion of the bentonite dams that are situated at the mouth of the East and Middle Tributaries to prevent any subsurface flow into the Unnamed Tributary #1 and Sharon Steel Run. A similar structure would also be constructed at the mouth of the West Tributary. New bentonite dams or other containment structures would be placed across the entire width of these confluence areas to prevent groundwater discharge into the tributaries. The structures would be excavated and keyed-in to the bedrock (approximately 5 to 10 feet below grade) and extend to a depth of approximately 1 foot below grade. Any groundwater that would collect behind these containment structures would be collected in the collection sumps and pumped to the treatment plant.

Institutional Controls

An institutional control utilizing the Uniform Environmental Covenants Act would be required to prevent future groundwater use at the Site. An institutional control prohibiting other groundwater withdrawals in the immediate vicinity would also protect the integrity of the groundwater containment systems to ensure efficient operation and prevent exposure to hazardous substances.

Long-Term Monitoring

A groundwater monitoring network capable of tracking the effectiveness of this removal strategy would be established. For cost estimation purpose, it is assumed that in addition to the existing monitoring well network (17 locations - 46 wells), an additional 4 shallow monitoring wells would be installed in the overburden aquifer to provide expanded coverage (12 existing overburden well locations plus 4 new monitoring locations) to monitor the effectiveness of the expanded groundwater containment system alternative. It is assumed that semi-annual groundwater sampling of the existing 50 monitoring wells (46 existing plus 4 new) would occur for five years, and then annually thereafter for another 25 years (for a total monitoring period of 30 years). It is assumed that all samples would be analyzed for TAL inorganics and TCL organic compounds.

Existing Groundwater Treatment Plant Upgrade

The existing groundwater treatment system has a treatment train that consists of oil/water separation (including filter bags) and carbon filtration followed by discharge to the City of Fairmont sewer system via a manhole that is located adjacent to the Site. The existing unit is designed to work at a rate of approximately 5 gpm, and has treated an average of 2.5 gallons per minute since the start of operation in March 2001 (more than 9.3 million gallons of water treated through July 2008).

Implementation of this alternative requires an upgrade of the existing treatment system to increase its treatment capacity as well as provide for improved automated controls and monitoring. The proposed new treatment plant capacity would be 10 gpm, as this would be suitable given the estimated yield of the overburden aquifer at the Site (i.e., 3-5 gallons per minute).

Two options for treatment plant upgrade were evaluated as part of the EE/CA: Option A - Upgrade of existing plant for continued treated effluent discharge to the City of Fairmont Sewer System; and Option B - Upgrade of existing plant for treated effluent discharge directly to Sharon Steel Run. These options are discussed as follows:

- Option A - Upgrade of Existing Plant - Continued Discharge to City of Fairmont Sewer System - This upgrade to the existing treatment plant would include the increase in treatment capacity from 5 gpm to 10 gpm. Upgrades would include the installation of a larger carbon adsorption system to handle the increase in flow, as well as a new oil/water separator. Automated controls of plant operations (including real-time off-site monitoring and operation) and electrical systems would also be upgraded as necessary. A new structure to adequately house all treatment plant operations (beyond current trailer) would also be part of the existing plant upgrade.

  Long-term operations and maintenance of this system would include periodic removal and disposal of oil from the oil/water separator, periodic change-out of carbon units, and routine and preventative maintenance of pumps, controls, and other treatment plant infrastructure. It also includes the monitoring and payment for discharge to the City of Fairmont Wastewater Treatment Plant. For the purposes of the EE/CA, maintenance and operations of the plant are assumed to last 30 years.

- Option B - Upgrade of Existing Plant for On-Site Discharge - This option would require a completely new treatment plant that would be able to both treat organics and inorganics in the groundwater to allow for on-site discharge to some or all of the Site Tributaries or Sharon Steel Run at concentrations that meet WVPDES standards. Note that the ultimate design of such a conveyance (either a direct pipe to the tributaries or Sharon Steel Run, or a diffuse conveyance method (such as through wetlands) would be determined based on the ultimate remedy selected to address the removal objectives for contaminated soil (either capping, on-site treatment, etc.).

The objective of on-site discharge is to provide additional flow to the tributaries of Sharon Steel Run that would assist with meeting the removal objectives for surface water - specifically the goal to restore surface water drainage quantity and ecological functions associated with the surface water drainage areas. As discussed in Section 1.4.9 (Site Geology and Hydrogeology), groundwater discharging from the Site is estimated to contribute approximately 4% of the total base flow to Sharon Steel Run, or an estimated 3 to 6 gpm. Note that the entire Site (both surface water runoff and groundwater discharge combined) hydrologically contributes an estimated 7% (or ~ 11 gpm) of the average daily discharge of Sharon Steel Run (~167 gpm) for the period evaluated (1998-1999).

The existing treatment plant is only capable of treating organics (oil and VOC removal) via carbon adsorption, and could not be efficiently modified to include the necessary inorganic treatment train that would be required for on-site discharge. Inorganics in the overburden groundwater that are present at concentrations that would exceed WVPDES standards, and subsequently would require treatment include iron and manganese. Consequently, a new treatment plant would be required.

The new groundwater treatment train would include the following major components:

- Oil/water separator (for oil/tar removal);
- Equalization tank (to allow consistent influent flow;
- Metals Removal System - to include a rapid mix tank (to allow for initial mixing of treatment chemicals), flocculation tank (to allow for the chemical precipitation process to begin), and clarifying tanks (to remove suspended solids);
- Sludge Handling System (to handle and process solids collected from the metals removal system);
- pH adjustment tank (to adjust pH to proper level, if necessary, prior to final polishing)
- Pressure Filter System - to include a pressure filter feed tank (to allow for optimum operation of pressure filters) and pressure filter (to ensure that the carbon beds are not fouled from any solids remaining in the effluent; and
- Carbon Filtration (to remove any remaining organics).

An entirely new structure would be required to house the treatment system, and the system would likely require a full- or part-time operator to ensure proper operation. Long-term operations and maintenance of this system would include periodic removal and disposal of oil from the oil/water separator, removal and disposal of treatment plant sludges, purchase of chemicals for the metals removal and pH adjustment systems, periodic change-out of carbon units, periodic replacement of pressure filter units, and routine and preventative maintenance of pumps, tanks, controls, and other treatment plant infrastructure. Long-term operations would also require discharge monitoring (assumed monthly). For purposes of the EE/CA, maintenance and operations of the plant are assumed to last 30 years.

The following is a discussion of the effectiveness, implementability, and cost of this expanded containment removal alternative:

Effectiveness:

As discussed previously, although the existing pump-and-treat system employed at the Site has demonstrated successful collection and treatment of site-related contaminants in the groundwater and reduced contaminant discharge to Sharon Steel Run, it does not meet all of the primary removal action objectives related to preventing further migration of contaminants and discharge of contaminated groundwater to surface water.

On the contrary, an expanded groundwater collection and treatment system would meet most of the removal action objectives that the existing system cannot meet - specifically:

- The institutional controls included in this alternative would prevent future exposure of workers and residents to contaminated groundwater.
- The expanded collection system would prevent further migration of NAPLs and the contaminant plume, as well as prevent contaminated water from discharging to surface water.
- The treatment alternative with on-site discharge can help meet the surface water removal action objective to restore surface water drainage quantity.

There would likely be some restoration of groundwater quality in both the overburden and bedrock aquifers given the removal of the most contaminated groundwater in the center of the Site, however, this alternative by itself does not fully address the source material and therefore could not meet the TARS removal objectives. The upgraded trenches and sump recovery network could prevent further migration of NAPL and contaminated groundwater to the point that this alternative would meet the AOARS removal objectives.

Overall Protection of Public Health and the Environment - YES

- The upgraded NAPL and groundwater collection network would restore the groundwater quality in the Area of Attainment and meet removal objective.
- It would eliminate discharge of contaminated groundwater to Sharon Steel Run, which in turn would reduce risks to human health and the environment associated with surface water and prevent recontamination or sediment in the waterways.
- It would prohibit installation of groundwater wells within the WMA for potable uses through institutional controls. This would eliminate the potential exposure pathway until groundwater PRGs are attained.
- Long-term monitoring component provides on-going data to evaluate the effectiveness of the system to ensure protection of surface water receptors.

Compliance with ARARs - YES

- Extraction and treatment prior to discharge to the city sewer system currently complies with City of Fairmont Sewage Discharge Control requirements for industrial wastewater discharge.

Upgraded existing treatment plant (Option A) would also be expected to meet discharge requirements.

- Extraction and treatment prior to on-site discharge (Option B) would comply with West Virginia Water Pollution Control Act Requirements Governing Water Quality Standards.
- Containment of groundwater plume in shallow overburden aquifer complies with potential state and federal ARARs to prevent surface water degradation. Surface water quality in Sharon Steel Run would improve as a result.
- Although this alternative would ultimately improve groundwater quality in the overburden and potentially the bedrock aquifer, because of the lack of source removal/control under this alternative, it may not fully comply with EPA's policy for groundwater restoration (TBC) or the WV Anti-Degradation Policy for protection of existing uses of state waters in a reasonable time frame (i.e. <10 years) under the TARS scenario. However, this alternative would likely eventually meet all ARARs under the AOARS scenario if this scenario is coupled with a source control option (such as soil removal/treatment/containment). Note that this alternative may only be necessary for several years based on the performance of any source control option.

Long-Term Effectiveness and Permanence - FAIR

- Long-term human health and environmental risks at the Site would be reduced as it relates to surface water quality impacted by groundwater. Long-term human health risks for future groundwater users would be eliminated as a result of exposure pathway elimination (institutional controls - note however that institutional controls would only be protective in combination with containment/prevention of groundwater migration).
- The reductions in risk would be permanent as long as the collection and treatment systems are maintained. However, if the collection system and institutional controls are not maintained through the attainment of groundwater PRGs, risks can return.
- Based on the historical performance of the existing containment system, the long-term effectiveness of the current pump-and-treat system to collect and treat groundwater is sustainable, as more than 9 million gallons of contaminated groundwater have been collected and treated. An upgrade of the existing system with Publicly Owned Treatment Work (POTW) discharge or a new treatment system with on-site discharge is expected to be effective in the long-term.
- Although there would be an improvement in water quality over time, the overburden and bedrock aquifers would remain contaminated for the long-term since this alternative has no source removal component.
- Operations and maintenance would require further off-site treatment/disposal of effluent (Option A - POTW discharge), off-site treatment/disposal for sludges generated from on-site treatment (Option B - On-Site Discharge), and off-site treatment/disposal for recovered coal tar/oil (both Options A and B).
- Ultimately, the long-term effectiveness of this alternative would be dependent on the competent and consistent implementation of the system.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment - GOOD

- This alternative utilizes engineering controls to reduce the mobility of contaminants in the groundwater. The alternative does use treatment technology to reduce the mobility and toxicity of contaminants in the treatment train comprised of on-site and off-site treatment of that same groundwater. No reduction of volume is realized through treatment. This alternative does not reduce toxicity of contaminants that remain in the aquifer at the site.

- Volume of contaminants in surface water would be substantially reduced once groundwater discharge is eliminated.

Short-Term Effectiveness - GOOD

- This alternative would not achieve the PRGs for the overburden or bedrock groundwater in a relatively short timeframe (<1 year), although improvements could eventually be seen as the most contaminated water is removed from the center of the Site. However, given the remaining source, groundwater contamination would remain.
- This alternative could be implemented within 6 months to 1 year (including design and construction) - Option A (existing plant upgrade) would likely require a shorter implementation time frame than Option B (new treatment plant for on-site discharge).
- There would be no additional risks posed to the community, the workers, or the environment as a result of this alternative. The risk of chemical exposure during removal operations is minimized through the use of proper protective clothing and other standard operating procedures in accordance with 29 CFR 1910.120.

Implementability:

Technical Feasibility - GOOD

- There are no technical difficulties posed by the implementation of this alternative - the existing system has been operating with a certain degree of success for nearly 7.5 years. Utilizing engineering controls to implement hydraulic containment is a well understood process. The collection system expansion and treatment plant upgrade (Option A) or replacement (Option B) are routine design engineering and construction projects.

Administrative Feasibility - GOOD

- There are no complex administrative difficulties posed by this alternative. There is an existing permit for pretreatment and discharge (Option A) to the local POTW. The increased flows anticipated are relatively small and should not be an issue to the POTW. Institutional controls to prohibit are routinely implemented. A WVPDES permit (or equivalent for Option B) is also routinely obtained.

Availability of Services and Materials - GOOD

- Engineering design and contracting services and materials required for construction of an expanded containment system and treatment plant upgrade/replacement would be readily available for implementing this alternative.
- Necessary operations and maintenance support (including monitoring and laboratory support) are readily available. There are numerous permitted/licensed facilities available for off-site treatment/disposal of treatment residuals (oil and sludges).

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

There is capital cost associated with the installation of the sumps and a new collection trench, expansion of the existing trenches, and upgrades to the existing treatment facility (both Options A and B). O&M costs for groundwater monitoring and operation of the groundwater treatment plant would also be incurred. Detailed cost estimates, including assumptions, are provided in Appendix C. A summary of the capital and O&M costs for this alternative (for both treatment options) are as follows:

Option A - Upgraded Treatment Plant with POTW Discharge

Capital cost:	$1,114,000
Annual O&M costs:	$346,000 (first 5 years), $218,000 (last 25 years)
Present worth cost:	$5,073,000 (with a discount rate of 7% for 30 years)

Option B - Upgrade Treatment Plant with On-Site Discharge

Capital cost:	$2,014,000
Annual O&M costs:	$636,000 (first 5 years), $508,000 (last 25 years)
Present worth cost:	$10,542,000 (with a discount rate of 7% for 30 years)

3.2.5 Alternative GW5: In-situ Chemical Oxidation

This alternative involves the use of in-situ chemical oxidation (ISCO) technology to address groundwater contamination at the Site. The contaminated groundwater area proposed for in-situ chemical oxidation treatment is depicted in Figure 2-3 (approximately 360,000 square feet), and is co-incident with the area of impacted groundwater within the shallow overburden aquifer. In addition to this immediately impacted groundwater area, the entire impacted soil area (depicted in Figure 2-2), which acts as a continuing on-going source for groundwater contamination, would also be addressed. The entire area encompasses more than 650,000 square feet (~ 15 acres) to depths up to 40 feet below grade (>260,000 cubic yards). Long-term groundwater monitoring would also be a component of this alternative to evaluate effectiveness.

In-situ chemical oxidation has been demonstrated as a promising remediation technology, particularly useful for treatment of the dissolved fraction organic contaminants of concern (e.g., benzene, naphthalene, and other PAHs) identified in groundwater at the Site, although it would not be as applicable to the inorganic COCs. In many cases, this technology has been selected where bioremediation cannot be effective with respect to rate or extent due to contaminant characteristics and/or site conditions.

Most commonly used oxidants in ISCO include peroxide, permanganate, ozone, peroxone, and persulfate. These oxidants are known to offer the rapid and complete chemical destruction of many toxic organic chemicals, or to promote subsequent natural attenuation or bioremediation because of increased oxygen levels in the subsurface. Factors influencing potential application and limitations of these oxidants associated with ISCO, and their amenability to treat contaminants of concern in groundwater at the Site are generally described in Appendix D. For the purposes of this EE/CA, permanganate is the oxidant that is considered the most viable for this Site (primarily PAH contamination), and is used for the development of the cost estimate for this alternative.

Note that permanganate will not directly address the BTEX compounds in the soil and groundwater at the Site, but other oxidants are proven effective for these compounds. Therefore, a combination of oxidant methods would likely be required to address all Site COCs; the complete treatment process would ultimately be established during the design phase based on the results of bench-scale or pilot testing of the technology.

This alternative would require the installation of injectors or treatment trenches to accommodate the application of oxidant to the saturated treatment zone of approximately 650,000 square feet (15 acres) in total area and up to 40 feet deep. It is assumed that injectors or treatment trenches would be installed in parallel rows spaced approximately 25-50 feet apart. Oxidants would then be injected through each of these injectors or treatment trenches into the overburden treatment zone ensuring oxidant delivery to depths up to 40 feet, including the saturated thickness zone (ranging from 5-15 feet thick at the base of the overburden). Both shallow and deep soil mixing is another option that may be feasible in addition to or instead of injection points or treatment trenches for the application of the oxidant at the Site (especially in the areas with only shallow soil contamination). However, for cost estimating purposes, it is assumed that injectors will be used and that the potassium permanganate will be injected at a 3% solution concentration; it is also assumed that the average price for remediation grade $KMnO_4$ is \$1.80/lb. Other oxidants, if used for polishing to address the BTEX compounds, would be in the same general price range.

Conceptually, initial oxidant injections on the periphery of the treatment area would be performed. Subsequent injections in the middle of the treatment zone may transport contaminants into adjacent zones already containing oxidant. Ideally, this strategy would reduce the transport of contaminants from the source zone into uncontaminated areas. In addition, the natural oxidant demand, due to site unknowns such as aquifer heterogeneity and geochemistry, is assumed to be 5g/kg. The estimated time required for the implementation of this removal system is approximately 18-24 months (assumes up to 6 applications 3 to 4 months apart of both permanganate and other oxidants).

A groundwater monitoring network capable of tracking the effectiveness of this removal strategy would be established. For cost estimation purpose, it is assumed that in addition to the existing monitoring well network (17 locations - 46 wells), an additional 4 shallow monitoring wells would be installed in the overburden aquifer to provide expanded coverage (12 existing overburden well locations plus 4 new monitoring locations) to monitor the effectiveness of in-situ chemical oxidation alternative. It is assumed that semi-annual groundwater sampling of the existing 50 monitoring wells (46 existing plus 4 new) would occur for five years and then annually thereafter for another 25 years (for a total monitoring period of 30 years). It is assumed that all samples would be analyzed for TAL inorganics and TCL organic compounds.

In addition to the monitoring to evaluate the performance of this alternative, it is also assumed for cost estimating purposes that the existing groundwater collection and treatment system would continue to operate for five years (i.e., it assumes that the groundwater PRGs would be met within five years).

The following is a discussion of the effectiveness, implementability, and cost of the in-situ chemical oxidation removal alternative:

Effectiveness:

The in-situ chemical oxidation alternative could result in remediation of both the soil and groundwater at the site. Both the overburden aquifer (directly) and bedrock aquifer (indirectly) could be fully remediated using this technique - consequently, this alternative would meet the removal action objectives for groundwater - specifically:

- This alternative would destroy the most prevalent contaminants (organics) in the soil and groundwater thereby preventing further migration of the contaminant plume, including discharge of contaminants to the surface water. This alternative could also address inorganics given the changes in geochemistry in the aquifer as a result of the oxidation processes, which will result in decreases in inorganic concentrations.
- This alternative would eventually restore groundwater quality in the overburden (directly) and bedrock aquifers (indirectly as a result in changes to the overburden water quality) under both the TARS and AOARS.

However, some key environmental parameters at the site affecting the actual, in the field effectiveness of this alternative include the intrinsic natural oxidant demand (NOD) of the overburden sediments, the heterogeneous wastes, as well as the variable permeability of the overburden sediments. The oxidants injected are generally non-selective to both target contaminants and naturally occurring organic matter. Therefore, the presence of natural organic matter in the treatment zone could consume a large portion of the injected oxidants, substantially increasing the cost of this alternative beyond that estimated for the EE/CA. This is especially important for the BJS Site because of the high organic-rich silts and clays in the overburden related to the historic lacustrine depositional environment. In addition, these sediments are highly variable (sand, silt, clay, gravel sized sediments) - consequently, it will be difficult to design a delivery system in both the unsaturated and saturated portion of the overburden to ensure complete contact of oxidant with all impacted subsurface soil. Waste product comprised of high concentrations of PAHs (in the form of pitch, road tar, oils derived from coal tar, etc.) is present in chunks, seams or NAPL located at various locations throughout the soils contaminated with lower concentrations of organic COCs.

In addition, the immediate geochemical impact of injecting oxidants is to increase the oxidation state of the aquifer. Oxidation reactions change the solubility of many inorganic species, such as iron, manganese, arsenic, and sulfide, resulting in the precipitation of soluble minerals. Although chemical oxidation does not destroy the inorganics, it does change the aquifer chemistry affecting the mobility of the inorganics. In the case of permanganese-driven ISCO, MnO_2 (s), which is one of oxidation byproducts, would sorb numerous heavy metals including, but not limited to, Cd, Co, Cr, Cu, Fe, Ni, Pb, Hg and Zn. It is also known to be the primary electron acceptor for the oxidation of As^{3+} to the less soluble As^{5+}. Therefore, adsorption process of metals onto either manganese or iron oxides would immobilize those metals of concern and eventually restrict their transport in groundwater. The use of other oxidants would also change the geochemistry of the groundwater after application, including the increase in dissolved oxygen content, which can affect bioremediation.

Overall Protection of Public Health and the Environment - YES

- In ideal circumstances, the in-situ oxidation with permanganate would destroy organic COCs such as PAHs and 1,2-dibromo-3-chloropropane in groundwater (and soil) - other oxidants can destroy the BTEX compounds as well. Fully implemented, this alternative could completely eliminate risks to human health and the environment posed by the groundwater and subsurface soil and meet groundwater PRGs. Actual effectiveness would depend on the ability to deliver the adequate amount of oxidant to the wastes in situ.

- This alternative would eventually prevent future exposure to contaminated groundwater and discharge of contaminated groundwater to surface water. Existing NAPL and groundwater seep collection system may be required to prevent a flushing of hazardous substances to the stream until oxidation reactions are successful.
- Long-term monitoring would confirm effectiveness of in-situ oxidation in treating contaminants of concern and provide information regarding the decrease in contaminant concentrations with time.
- This alternative would restore groundwater quality in the overburden and bedrock aquifers under the TARS or AOARS scenarios in a reasonable time frame (i.e., <10 years).

Compliance with ARARs - YES

- If in-situ chemical oxidation can be effectively implemented in the field the alternative has the potential to reduce the concentration of organic contaminants to below the respective federal ARARs (MCLs). It would also be necessary to control/eliminate the source material located in unsaturated zones at the Site. Chemical oxidation may be capable of reducing the solubility of some inorganics COCs thereby achieving MCLs (primarily arsenic). Treatability studies would be necessary to confirm.
- In-situ chemical oxidation employed in this alternative would be implemented in a manner consistent with the requirements for the Underground Injection Control (UIC) program of the Safe Drinking Water Act (SDWA), administered in West Virginia by EPA.
- This alternative could ultimately result in restoration of the groundwater thereby complying with EPA's policy for groundwater restoration and the WV Anti-Degradation Policy within a reasonable time frame (e.g., <10 years) for both the TARS and AOARS scenarios.

Long-Term Effectiveness/Permanence - GOOD

- Destruction of organic contaminants is permanent and irreversible.
- Dissolved organic contaminants will be more readily degraded than NAPL, chunks or seams of product (coal tar derivatives) or COCs tightly sorbed to fine particles in formation soils. Rebounds will be anticipated and multiple applications would be utilized as necessary.
- Once the targeted (source) area is successfully treated, the long-term effectiveness of this alternative will be successful since groundwater would not become re-contaminated (i.e., source area remediated).
- Organic contaminant levels (e.g., PAHs) in groundwater would be significantly reduced over time.
- With changes in the aquifer chemistry resulting from in-situ chemical oxidation, naturally occurring dissolved minerals may be precipitated as metal oxides, which would further restrict their transport in the groundwater.
- Addition of certain oxidants may promote subsequent natural attenuation or bioremediation due to increased oxygen levels in the subsurface.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment - GOOD

- In-situ chemical oxidation would reduce toxicity of site-related organic contaminants in the dissolved phase of the overburden aquifer. On the molecular level, the oxidation degradation is permanent and non-reversible. After treatment with oxidant, concentrations of organic COCs groundwater would be expect to rebound as NAPL and tightly sorbed COCs mobilize to the water column. Successive treatment applications would incrementally destroy the persistent residual NAPL contaminants.
- Inorganics of concern in groundwater (e.g., Fe, Mn, and As) would be precipitated as metal oxides during oxidation reactions, and their mobility would be reduced dramatically. However, mobilization/ immobilization of other inorganics of concern such as cyanide, thallium, and vanadium during oxidation is largely unknown.

Short-Term Effectiveness - FAIR

- A common observation is that dissolved organic contaminant levels increase after injection events, followed by a permanent decrease as the contaminant mass is degraded and the aqueous phase reequilibrates with the saturated soil.
- This alternative would achieve PRGs for organic COCs within a relatively short timeframe (< 5 yrs); however it may not achieve PRGs for inorganics in groundwater in the same time period.
- Permanganate is a hazardous material and must be stored and handled in a safe manner. Oxidation is an exothermic reaction which has potential increase mobility of volatile organic compounds. Both potential hazards can be effectively managed.
- The risk to chemical exposure to site workers, the community or the environment during removal operations would be minimized through the use of proper protective clothing and other standard operating procedures in accordance with 29 CFR 1910.120.
- This alternative could be fully implemented within 2-3 years (including design, pilot testing, and construction).

Implementability:

Technical Feasibility - POOR

- This alternative employs a developing technology that has limited information from field applications. Therefore, bench- and pilot-scale treatability studies would be required to assess the potential significance of the environmental parameters and to gain insight on the feasibility of ISCO for the Site remediation.
- Further engineering judgment would be required during operation to determine the operational parameters because test conditions at bench-scale are significantly different from those at field-scale and do not fully represent field conditions.
- The physical properties such as high solubility and density (greater than water) of oxidants may allow for density-driven delivery and distribution of the oxidant to the overburden aquifer.
- Due to the non-selective reactivity of the oxidants, the presence of natural organic matter and minerals in the treatment zones could consume a large portion of the injected oxidants, substantially increasing the cost of this alternative.
- Due to the strength of the oxidants and large quantity of hazardous chemicals employed, this alternative does pose significant handling concerns, requiring stringent and costly personal protection equipment and controls.

- This alternative would likely require a large quantity of water (10-15 million gallons) to deliver the oxidant (permanganate) to the subsurface. This would require coordination with local water purveyors to ensure that the supply can be provided. If potable water can not be provided, it is possible that water from on-site groundwater sources, Sharon Steel Run, or the Monongahela River could also be utilized; however, that would require regulatory considerations and likely approval.

Administrative Feasibility - GOOD

- The injection of oxidants is regulated primarily by the UIC program of the Safe Drinking Water Act (SDWA), which is administered through EPA for West Virginia. ISCO with permanganate and other oxidants has been authorized in the past in West Virginia.
- There are no other administrative difficulties posed by this alternative.

Availability of Services and Materials - FAIR

- The engineering services and materials would be readily available for implementing this alternative, although there are a limited number of manufacturers or providers of ISCO services and chemicals, given the specialty nature of these services.
- Conventional construction techniques and equipment would be used for the installation of injection wells and treatment trenches.
- Necessary sampling resources and laboratory support are readily available.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumptions used, are provided in Appendix C. A summary of the capital and O&M costs for this alternative are as follows:

Capital costs:	$13,897,000
Annual O&M cost:	$356,000 (first five years) to $163,000 (last 25 years)
Present worth cost:	$17,257,000 (with a discount rate of 7% for 30 years)

3.2.6 Alternative GW6: In-situ Bioremediation

This alternative would involve the use of in-situ bioremediation to address contaminants in groundwater (and soil) at the Site. Bioremediation is a process that attempts to accelerate the natural biodegradation process by providing nutrients, electron acceptors, and/or competent degrading microorganisms that may otherwise be limiting the rapid conversion of organic contaminants to innocuous end products. In-situ bioremediation is the method of implementing such bioremediation in place without pumping water above ground for treatment or excavating the overlying soil.

Bioremediation can take place under both aerobic and anaerobic conditions. Aerobic processes require an oxygen source, and the end-products include carbon dioxide and water; whereas anaerobic processes are conducted in the absence of oxygen, and the end-products include methane, carbon dioxide, sulfide, hydrogen gas, and nitrogen gas. In-situ bioremediation has been used extensively to restore aquifers contaminated with petroleum hydrocarbons (e.g., BTEX) primarily in the aerobic condition because these fuel-related compounds, especially benzene, are known to biodegrade more rapidly under aerobic conditions.

Of the PAHs of concern at the Site, low molecular-weight PAHs (e.g., 2-methylnaphthalene and naphthalene) are soluble in water and generally biodegradable. However, high molecular-weight PAHs such as benzo(a)anthracene, benzo(b)fluoranthene, and benzo(k)fluoranthene, which are normally of most concern due to carcinogenic risks, are known to be recalcitrant to biodegradation, and their intermediate degradation products may still display toxicity and remain for substantial periods of time.

Collectively, anaerobic bioremediation may not offer significant benefit over natural attenuation with respect to degrading contaminants of concern at the Site. Therefore, this alternative focuses on aerobic bioremediation; however, aerobic bioremediation cannot address high molecular-weight PAHs and inorganics of concern at the Site, thereby resulting in difficulty in achieving PRGs with this alternative alone.

The concept of aerobic in-situ bioremediation depends largely upon the delivery of oxygen sources or electron acceptors (e.g., air, pure oxygen, hydrogen peroxide, and magnesium peroxide) and nutrients to the contaminated subsurface, typically by withdrawing groundwater, adding oxygen and nutrients, and re-injecting the enriched water. The injected water moves through the aquifer and stimulates the growth of native microorganisms, resulting in the degradation of contaminants. Oxygen injection of hydrogen peroxide, air sparging or oxygen diffusion may be another method to promote in-situ aerobic bioremediation.

The system would include injection wells, groundwater containment (i.e., existing and expanded groundwater collection trenches), and equipment for the addition and mixing of the nutrients and the oxygen sources. The area to be addressed with in-situ bioremediation is the same as that outlined in Figure 2-2, and encompasses the entire area of impacted soils and groundwater.

For costing purposes, it is estimated that approximately 100 injection points would be required to deliver nutrients and oxygen sources throughout the impacted area, based on highly variable permeability found in the overburden aquifer throughout the Site. Inorganic amendments (e.g., trace metals and nutrients) are first injected, followed by hydrogen peroxide solutions in the range of 100-500 mg/L. Groundwater would be pumped from the collection trenches (see Figure 3-3) to control the geochemical zones within the aquifer during this treatment. This system would require frequent manual inspection and operation to ensure the proper operation of the site (not a full-time operator, but on-site operations 1 to 2 days per week). The assumed duration for in-situ bioremediation is 5 years to assess its effectiveness in reducing concentrations of contaminants of concern and to determine its continuation as a remedy at the Site.

In addition to stimulating indigenous microbial populations to degrade organic contaminants, another approach ("bioaugmentation"), which includes the addition of microorganisms with specific metabolic capabilities, may also be feasible for this Site. Populations that are specialized in degrading specific compounds, especially for high-molecular-weight PAHs, are selected by enrichment culturing where microorganisms are exposed to increasing concentrations of a contaminant or mixture of contaminants. However, a treatability study would be required to fully explore the feasibility of this application.

The monitoring program described in Alternative GW3 (Monitored Natural Attenuation) would also be applicable to this alternative to monitor the effectiveness and progress of the in-situ bioremediation.

The following is a discussion of the effectiveness, implementability, and cost of the in-situ bioremediation removal alternative:

Effectiveness:

Overall Protection of Public Health and the Environment - NO

- Bioremediation would not degrade high molecular-weight carcinogenic PAHs (e.g., benzo[a]anthracene, benzo[b]fluoranthene, and benzo[k]fluoranthene) and inorganics identified as COCs at the Site. Therefore, this alternative would not meet the PRGs established for groundwater at the Site under TARS or AOARS scenarios, and not be protective of human health and the environment.
- This alternative would reduce the risks to human and environmental receptors by degrading BTEX and low molecular-weight PAHs in groundwater (and soil).
- Comprehensive site-wide monitoring would assess the effectiveness of bioremediation in treating BTEX and low molecular-weight PAHs.

Compliance with ARARs - NO

- Bioremediation would not restore groundwater quality under TARS or AOARS; therefore, it would not comply with state and federal ARARs as well as TBCs to reduce and eliminate the off-site risk to human health and the environment.
- This alternative would not comply with chemical-specific ARARs (e.g., for high molecular-weight PAHs and metals), but would likely achieve compliance faster than Alternative GW2.

  In-situ bioremediation employed in this alternative would be implemented in a manner that would comply with requirements for the Underground Injection Control (UIC) program of the Safe Drinking Water Act (SDWA).
- This alternative would contain the contaminated groundwater plume through the expanded collection system (GW4); however, it would not reduce levels of contamination associated with high molecular-weight PAHs. Therefore, it would not fully comply with EPA's policy for groundwater restoration (TBC) or the WV Anti-Degradation Policy for protection of existing uses of state waters in a reasonable timeframe (i.e., <10 years).

Long-Term Effectiveness/Permanence - POOR

- Long-term human and environmental risks at the Site would be reduced as this alternative would likely reduce groundwater contamination associated with BTEX and low molecular-weight PAHs.
- Risks due to BTEX levels in groundwater would be reduced over time, but the overall risks would not be reduced to levels that do not pose a risk to off-site receptors because of other COCs recalcitrant to bioremediation.
- Destruction of biodegradable organics (i.e., BTEX and low molecular-weight PAHs) through bioremediation is permanent and irreversible.

- In case of bioaugmentation, the introduced microorganisms could have a long-term adverse effect on the ecosystem.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment - FAIR

- In-situ bioremediation would reduce toxicity of BTEX and low molecular-weight PAHs in the overburden aquifer permanently; however, no significant reduction in toxicity, mobility, or volume of high molecular-weight PAHs and inorganics is expected with this alternative.
- This alternative would not meet the statutory preference of groundwater treatment for remedies since it cannot address high molecular-weight PAHs in both overburden and bedrock aquifers.

Short-Term Effectiveness - POOR

- This alternative cannot achieve PRGs for groundwater (and soil) in a short time frame.
- In-situ bioremediation would have a short-term effectiveness in removing BTEX and low molecular-weight PAHs in overburden groundwater (and soil) within the treatment zone; however, it would have limited short-term effectiveness in treating these organics in the bedrock aquifer.
- Potential short-term impacts to removal construction workers, the community, or the environment would be minimal under this alternative through a site-specific health and safety plan. Proper protective clothing and air monitoring would minimize risk of chemical exposure during drilling operations. Workers would be required to have training and medical examinations, in accordance with 29 CFR 1910.120.

Implementability:

Technical Feasibility - FAIR

- Treatability studies would be performed to determine the operational parameters for the in-situ bioremediation, but further engineering judgment would be required during operation.
- No routine maintenance is required after the injections are complete.

Administrative Feasibility - FAIR

- The injection of nutrients and oxygen sources is regulated primarily by the UIC program of the Safe Drinking Water Act (SDWA) by EPA in West Virginia.
- This alternative may have regulatory concerns and community acceptance regarding introducing nonindigenous microbes into the subsurface.

Availability of Services and Materials - GOOD

- Engineering services and materials are readily available for implementing this alternative.
- Conventional construction techniques and equipment would be used for the installation of injection wells.
- Necessary sampling resources and laboratory support are readily available.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumption used, are provided in Appendix C. A summary of the capital and O&M costs for this alternative are as follows:

Capital costs:	$1,760,000
Annual O&M cost:	$546,000 (first five years) - $163,000 (last 25 years)
Present worth cost:	$5,899,000 (with a discount rate of 7% for 30 years)

3.2.7 Summary of Groundwater Alternatives Retained for Comparative Analysis

Of the six alternatives evaluated in this section, only three will be retained for comparative analysis in Section 4.0:

Alternative GW1 - No Action
Alternative GW4 - Expansion of Existing Groundwater Containment System
Alternative GW5 - In-situ Chemical Oxidation

The following alternatives are screened out of the evaluation process for the following reasons:

- Alternative GW2 - No Further Action - This alternative is not retained because it does not meet the majority of the groundwater RAOs - specifically, it does not prevent future exposure of workers and residents to contaminated groundwater; it allows for continued migration of contaminated groundwater and discharge of contaminated groundwater to the surface water as the current groundwater collection and treatment system does not address all of the contaminated groundwater at the site; and it will not restore the aquifer in a reasonable time frame.
- Alternative GW3 - Monitored Natural Attenuation - This alternative is not retained for the same reasons provided for Alternative GW2 - it would not meet the majority of the groundwater RAOs.
- Alternative GW6 - In-Situ Bioremediation - This alternative is not retained because it is not considered effective for most of the PAHs located throughout the Site. Several of the COCs are PAHs. Although it is feasible for the ultimate degradation of BTEX and related compounds, bioremediation would not address the major PAH source in the soil or groundwater. Consequently, this alternative would also not meet the majority of the groundwater RAOs.

3.3 ON-SITE SEDIMENT ALTERNATIVES

The impacted on-site sediment medium includes those surficial sediments found primarily in Sharon Steel Run, Unnamed Tributary #1 and Unnamed Tributary #2, as well as the West, Middle, and East Tributaries. The primary COCs in the sediment are PAHs and a few heavy metals (i.e., lead, manganese, and mercury) that are present at concentrations in excess of their respective PRGs. As discussed in Section 2.3 (Determination of Removal Scope), the primary impact areas include: Sharon Steel Run/Unnamed Tributary #1, Unnamed Tributary #2, and the West Tributary. It is estimated that there are approximately 3,280 cubic yards (~ 5,000 tons) of on-site sediment to be addressed by the EE/CA, summarized as follows:

- Sharon Steel Run/Unnamed Tributary #1 - Approximately 1,500 linear feet of impacted area, with an estimated 280 cubic yards or nearly 450 tons of impacted sediment.
- Unnamed Tributary #2 - Approximately 2,250 linear feet of impacted area (including storm sewer segment), with an estimated 1,730 cubic yards or approximately 2,800 tons of impacted sediment.
- West Tributary - Approximately 200 linear feet of impacted area with an estimated 1,100 cubic yards or approximately 1,800 tons of impacted sediment.

The following alternatives have been identified for mitigation of risk presented by hazardous substances in the on-site sediment at the BJS Site:

Alternative OSS1: No Action
Alternative OSS2: Excavation and Off-Site Disposal/Treatment
Alternative OSS3: Excavation and On-Site Confinement
Alternative OSS4: Monitored Natural Recovery

These alternatives are discussed in the following sections.

3.3.1 Alternative OSS1: No Action

The No Action alternative (OSS1) does not utilize any technologies to reduce contaminant mobility, toxicity, or volume of contaminants in on-site sediment. Because no additional removal activities would be performed under the No Action alternative, long-term human health and environmental risk for the Site would remain the same as those identified in the baseline risk assessment. However, this alternative is considered in the detailed analysis for comparison purposes, as required by NCP.

The following is a discussion of the effectiveness, implementability, and cost of the No Action alternative for on-site sediments:

Effectiveness:

The No Action alternative would not directly attain any objectives established within the scope of the removal actions (i.e., prevent further migration of contaminated sediments to the Monongahela River; prevent exposure of contaminated sediments to receptors; and restore sediment quality to below risk levels and promote ecological function).

However, in the event that alternative OSS1 is paired with a removal action for soils which controls the continuing source of contaminated sediments to the waterways, natural attenuation over time may eventually reduce concentrations in the sediments to below PRGs in certain areas (such as the Sharon Steel Run/Unnamed Tributary #1). Nevertheless, the sediments in Unnamed Tributary #2 or the buried sediments in the West Tributary would not likely be as susceptible to natural attenuation since the contaminant load in these sediments is much higher than that found in Sharon Steel Run/Unnamed Tributary #1. Consequently, natural attenuation would not reduce concentrations of contaminants in these areas to levels below the PRGs.

Overall Protection of Public Health and the Environment - NO

- No removal actions would be taken as part of this alternative. Consequently the existing unacceptable risk to human health and the environment due to contaminated on-site sediment would remain. The No Action alternative would not be protective of the public health or the environment.

Compliance with ARARs - YES

- There are currently no ARARs establishing acceptable concentrations for contaminants in sediment at the Site. However, the human health risk assessment and the ecological risk assessment determined that the concentration of contaminants in the sediment do present an unacceptable risk to human health and the environment. The site-specific risk assessments are "To Be Considered" requirements.

Long-Term Effectiveness and Permanence - POOR

- Sediment contamination at the Site would not be removed or contained, so exposure to contamination would remain. This alternative does not meet removal action objectives for on-site sediment. However, if this alternative were paired with a soil removal action that reduced the quantity of contaminated sediment being added to the waterways (specifically Sharon Steel Run/Unnamed Tributary #1), contaminate concentrations would start to reduce, although it is unknown if it would ever reduce sufficiently to meet PRGs.

Reduction in Contaminant Toxicity, Mobility, or Volume through Treatment - POOR

- There would be no reduction in the volume, mobility, or toxicity of contamination with this alternative.

Short-Term Effectiveness- POOR

- There is no short-term effectiveness with this alternative. All unacceptable threats posed by contaminants would continue to be present.
- There would be no additional risks posed to the community, the workers, or the environment from this alternative beyond those currently determined from the baseline risk assessments.

Implementability:

Technical Feasibility - GOOD

- There are no technical difficulties posed by this alternative since no additional action would be taken.

Administrative Feasibility - GOOD

- No action would be taken.

Availability of Services and Materials - GOOD

- The necessary resources and support are readily available.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

There are no costs associated with this alternative.

3.3.2 Alternative OSS2: Excavation and Off-Site Disposal

This alternative consists of excavating the on-site sediment exceeding PRGs from the impacted areas and sending it off-site for disposal. This alternative would be best performed in conjunction with Alternative SO4, as discussed previously in Section 3.1.4. The total volume of impacted sediments in Sharon Steel Run/Unnamed Tributary #1, Unnamed Tributary #2, and the West Tributary is estimated to be approximately 3,280 cubic yards or 5,000 tons.

The sediment removal and restoration activities would involve a number of different technologies, based on the stream segment of interest as described below:

- Sharon Steel Run/Unnamed Tributary #1 - Most of the sediments in this approximate 1,500-foot stretch of waterway have been removed previously as part of prior removal actions - consequently, only small pockets and shallow deposits remain within the rocky substrate that characterizes this stream stretch. Sediments would be removed using high-capacity vacuum/guzzler recovery technology. A vacuum truck could be used since the entire stream segment is accessible via an access road. The surface water discharge would be diverted around the sediment section to be removed (upstream and downstream check dams), and the sediment subsequently removed to the bedrock subsurface. The sediments would ultimately be unloaded to an on-site staging area for dewatering prior to off-site disposal.
  Restoration of the Sharon Steel Run/Unnamed Tributary #1 would involve the placement of clean sediment and/or root wads into select areas where thick sediment deposits were removed, to enhance habitat restoration along this stretch of stream. Note that the key factor to restoration of this stream habitat is water quality improvement.
- Unnamed Tributary #2 - This feature has four separate components to be addressed - (1) the approximately 800-foot long segment adjacent to the Site; (2) the approximately 650-foot long segment downstream of the Site; (3) the approximately 400- to 500-foot long storm-water drainage pipe under the former Creative Labels property; and 4) the approximately 300-foot long segment on the steep slope from the storm-water drainage pipe outfall to the Monongahela River. Note that this tributary is normally dry and only contains flowing water during periods of high precipitation. Consequently, routine heavy equipment excavation techniques (backhoe/excavator with dump trucks) would be used on the segments immediately adjacent to and downstream of

the Site. Typical storm-water pipe cleaning equipment (i.e., high pressure hoses, scraping equipment, etc.) would be used to remove sediments from the storm-water pipe section. Finally, hand excavation coupled with the use of high-capacity vacuum/guzzler recovery technology (vacuum truck positioned either at the top or bottom of the steep stream section) would be used for the final segment of this tributary.
Restoration of this tributary, which is predominantly a storm-water drainage feature rather than an actual watercourse, would involve the placement of rip rap and revegetation to ensure that the feature operates properly as a drainage feature in the future. No additional habitat restoration of this section would be conducted.

- West Tributary - The impacted sediments in this tributary are currently covered with an access road. This tributary is currently dry except during periods of high precipitation (storm-water runoff only). Consequently, routine heavy equipment excavation techniques (backhoe/excavator with dump trucks) would be used on the West Tributary segment.
The ultimate restoration scheme of this tributary would be based upon the ultimate soil removal action selected. At a minimum, this tributary would be restored after sediment removal to its function as a drainage way from the Site uplands. The extent of restoration would depend on final land use selected for the Site.

For all areas, confirmation sampling would be required to evaluate the success of the removal measure (assume 1 confirmation sample collected per 50 feet of stream channel, or a total of 70 samples for the approximate 3500 feet of sediment removal area).

The following is a discussion of the effectiveness, implementability, and cost of the removal and off-site/disposal or treatment for on-site sediments:

Effectiveness:

Overall Protection of Public Health and the Environment - YES

- This alternative would remove the contaminated sediment, thereby protecting human health and the environment.

Compliance with ARARs - YES

- This alternative would be implemented in a manner that would comply with ARARs and TBCs that are directly or indirectly related to removal of contaminated on-site sediment and erosion controls. The TBCs include Fish and Wildlife Coordination Act - 16 U.S.C. §662 (requires coordination with various federal agencies to ensure that ecological resources are conserved during any work within waterways), Fish and Wildlife Conservation Act - 16 U.S.C. 2901-2911 (also requires conservation of non-game fish and wildlife during any work within waterways). Excavated material would be analyzed and disposed at an appropriately approved facility (WV and federal RCRA standards).

Long-Term Effectiveness and Permanence - GOOD

- Contaminated sediment in the Site streams would be removed and disposed of off-site. This would be an effective and permanent measure, providing that the streambed is not re-contaminated by additional sources of from other upgradient locations.

Reduction in Contaminant Toxicity, Mobility, or Volume through Treatment - FAIR

- Excavated material would be sampled and disposed in an appropriate manner. Existing sediment samples indicate that the contaminated sediments are not RCRA-characteristic, accordingly, the material would not require treatment prior to safe and legal disposal. Therefore, this alternative does not involve treatment, so there is no reduction in toxicity, mobility or volume of contaminants through treatment. Engineering controls employed at the offsite landfill would significantly reduce mobility of contaminants from on-site sediment.

Short-Term Effectiveness - GOOD

- Implementation of this alternative would not expose workers to any unacceptable risks. Workers would be required to have training and a medical examination in accordance with 29 CFR 1910.120. Additionally, workers would need to utilize protective clothing and other personal protective equipment as established in the site health and safety plan. Hazards to site workers relate to standard construction risks and would be addressed using standard safety practices.
- This alternative would be implemented in a manner that would not pose any additional risks to the community, the workers, or the environment.
- Full implementation of this alternative is estimated to take one month.

Implementability:

Technical Feasibility - GOOD

- There are no technical difficulties posed by this alternative. This alternative would utilize standard excavation and dewatering techniques that are well developed. The delineation of the extent of contamination is also fairly straightforward.
- Stream diversion is a well established technique.

Administrative Feasibility - GOOD

- Plan approval would be required prior to stream diversion, sediment excavation and the off-site shipment of the sediment. Engineering controls would be utilized to prevent adverse impacts to state waters.

Availability of Services and Materials - GOOD

- The necessary resources and support for sediment excavation, off-site disposal, and stream diversion are readily available.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumptions made, are provided in Appendix C. The O&M and capital costs for this alternative are summarized as follows:

Capital Cost:	$640,000
Annual O&M Cost:	$ 40,000
Total Present Worth Cost:	$805,000

3.3.3 Alternative OSS3: Excavation and On-Site Confinement

This alternative consists of consolidating the contaminated on-site sediment with contaminated soil on the Site for confinement, in conjunction with removal actions in other soil alternatives (i.e., Capping/Containment in Alternative SO5 or In-Situ Treatment in Alternative SO6). The sediment would be excavated from the various stream segments, spread to fill in low areas on the Site prior to the site either being capped or treated, as discussed in Sections 3.1.5 and 3.2.6, respectively. Approximately 3,280 cubic yards (5,000 tons) of impacted sediment would be excavated and consolidated within the Area of Contamination.

The following is a discussion of the effectiveness, implementability, and cost of the consolidation and on-site disposal or treatment for on-site sediments:

Effectiveness:

Overall Protection of Public Health and the Environment - YES

- This alternative would remove the contaminated sediment from the subject stream segments, thereby protecting human health and the environment.

Compliance with ARARs - YES

- This alternative would be implemented in a manner that would comply with ARARs and TBCs that are directly or indirectly related to removal of contaminated on-site sediment and erosion controls. The TBCs include Fish and Wildlife Coordination Act - 16 U.S.C. §662 (requires coordination with various federal agencies to ensure that ecological resources are conserved during any work within waterways), Fish and Wildlife Conservation Act - 16 U.S.C. 2901-2911 (also requires conservation of non-game fish and wildlife during any work within waterways).

Long-Term Effectiveness and Permanence - GOOD

- Sediment at the Site would be removed and contained or treated on-site, so this would be a very effective, permanent measure for contaminants in on-site sediment, providing that the streambed is not contaminated by additional sources of contamination, and integrity of an on-site confinement feature is maintained.

Reduction in Contaminant Toxicity, Mobility, or Volume through Treatment – FAIR/GOOD

- If paired with Soil Alternative SO5 (Capping/Containment) the alternative would not involve treatment, so there would be no reduction in contaminant toxicity, mobility or volume through treatment. Engineering controls employed at the Site would significantly reduce mobility of contaminants from on-site sediment.
- If paired with Soil Alternative SO6 the alternative would reduce contaminant toxicity, mobility and volume through treatment. The contaminant concentrations in on-site sediment are lower than the concentrations in soil. The implementability concerns discussed relating to the lack of access to the subsurface waste/soil and heterogeneity of material (e.g., NAPL, chunks and seams of waste) would not apply to the onsite sediment.

Short-Term Effectiveness - GOOD

- Consolidation of sediments would take one month; however, full implementation of this alternative, including all planning and on-site confinement, is estimated to take 1 to 1.5 years.
- Implementation of this alternative would not expose workers to any unacceptable risks. Workers would be required to have training and a medical examination in accordance with 29 CFR 1910.120. Additionally, workers would need to utilize protective clothing and other personal protective equipment as established in the site health and safety plan. Hazards to site workers relate to standard construction risks and would be addressed using standard safety practices.
- This alternative would be implemented in a manner that would not pose any additional risks to the community, the workers, or the environment from this alternative.

Implementability:

Technical Feasibility - GOOD

- There are no technical difficulties posed by this alternative. This alternative would utilize standard excavation techniques that are well developed.
- Stream diversion is a well established technique.
- Pre-design studies would be required to select oxidation reagent if this alternative is paired with SO6.

Administrative Feasibility - POOR

- Plan approval would be required prior to stream diversion, sediment excavation and on-site confinement of sediment.
- Site background information indicates that contaminants within the Sharon Steel Run sediments could have originated from former operations conducted upon either the Big John Salvage uplands or the Sharon Steel/Fairmont Coke Works facility. Historical effluent and stormwater draining both these properties flow to the Monongahela River via Sharon Steel Run. For various reasons, preliminary communications with the respective potentially responsible parties indicate that there are strong objections to consolidating the potentially co-mingled wastes on the uplands at the Big John Salvage site.

Availability of Services and Materials - GOOD

- The necessary resources and support for sediment excavation and stream diversion are readily available.
- On-site confinement portion of this alternative utilizes conventional construction techniques and equipment. Therefore, the engineering services and materials should be readily available for implementing this alternative.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumptions made, are provided in Appendix C. The O&M and capital costs (excavation only) for this alternative are summarized as follows:

Capital Cost:	$358,000
Annual O&M Cost:	$ 40,000
Total Present Worth Cost:	$523,000

3.3.4 Alternative OSS4: Monitored Natural Recovery

This alternative involves the use of naturally occurring physical, biological, and/or chemical mechanisms to reduce risk posed by the on-site sediments to human and or ecological receptors within a reasonable time frame. The activity performed generally consists of institutional controls to limit exposure and monitoring of sediment quality recovery while natural processes reduce the concentrations of chemicals of concern. This differs from the No Action alternative because it includes more active monitoring of the sediments over time as well as institutional controls to ensure that on-site impacted sediment areas are not disturbed.

Natural attenuation/recovery processes include a variety of physical, chemical, and biological processes that act without human intervention to reduce the toxicity, mobility or volume of contaminants. These processes would be most effective if coupled with active source removal (i.e., soil and groundwater).

The in-situ processes primarily include biodegradation, dilution and dispersion, and sorption. Of these, the main natural attenuation/recovery process that would occur in the sediment of the stream segment of interest (see Section 3.3.2) would be dilution/dispersion, which allows the contaminants and sediment being dispersed by water in the streams. This process would result in reducing the contamination in the stream sediments, but would have the negative impact of spreading the contamination to a further downstream area (i.e., into the Monongahela River or the ultimate sediment deposition location). Areas at or near the surface (< 1 feet) with relatively low concentrations of organic contaminants (no NAPL, chunks or seams or waste material) may also be degraded through aerobic biodegradation.

The primary potential advantage of monitored natural recovery (MNR) is that it is less disruptive and has lower implementation costs than other active engineered methods. The dilution/dispersion would ultimately result in concentrations that would not adversely impact human health or the environment. However, MNR can take a very long time to achieve target risk reduction goals. In addition, there is no guarantee that MNR would achieve the PRGs within a lifetime of this alternative, especially for the sediment in Unnamed Tributary #2 or the buried sediment in the West Tributary as described previously in Section 3.3.1. The MNR alternative would have a greater potential of success if paired with more aggressive excavation of high concentration areas and deep source areas. MNA may be successful as a "polishing" step utilized to achieve risk reduction in the lesser contaminated sediments.

This alternative would require long-term monitoring of the sediment and surface water quality within the subject on-site streams. For cost estimation purposes, it is assumed that five monitoring stations would be established for each tributary, and the sediment (as well as surface water to gather data for evaluating the surface water PRGs) at these stations would be sampled annually for full TCL/TAL analysis for 30 years. Sediment samples would also be subject to sediment toxicity tests. Semi-annual vegetation (or rip rap) and aquatic macroinvertebrate surveys would also be conducted for each tributary to monitor the ecological changes over time.

This alternative would also include the continued periodic maintenance of the retention basin to keep contaminated sediments from reaching the Monongahela River. It is assumed that an annual clean-out of this basin would be required to maintain the discharge pipes. Sediments excavated from this retention basin (estimated 100 tons/year) would be sampled and disposed in an appropriate off-site landfill. The duration of this annual maintenance would be 30 years for cost estimating purposes. Maintenance of the Site fencing (which also controls access to, and subsequently exposure to the on-site impacted sediment areas) would also be included in this alternative. Finally, institutional controls would be implemented as part of this alternative to prohibit the disturbance of sediments adjacent to the Site (such as those associated with Unnamed Tributary #2).

The following is a discussion of the effectiveness, implementability, and cost of the monitored natural recovery alternative:

Effectiveness:

Overall Protection of Public Health and the Environment - NO

- This alternative would not be protective of human health or the environment since the risks to human health or the environment due to on-site sediment at the Site would remain unacceptable for a long-term.
- A comprehensive monitoring program would determine if MNR is effective and contamination does not migrate off-site at concentrations which adversely impact human health and the environment.
- Current risk level posed to the Site would remain for a long period of time.
- A modified MNR option that included excavation of the high concentration areas coupled with MNR of the lower concentration areas near the surface may be effective as a polishing step.

Compliance with ARARs - YES

- There are currently no ARARs establishing acceptable concentrations for contaminants in sediment at the Site. However, the human health risk assessment and the ecological risk assessment determined that the concentration of contaminants in the sediment do present an unacceptable risk to human health and the environment. The site-specific risk assessments are "To Be Considered" requirements. It is unlikely that concentrations of primary COCs such as large molecule-weight PAHs or the metals (lead and mercury) in on-site sediment would be reduced substantially to meet PRGs by natural attenuation.

Long-Term Effectiveness and Permanence -POOR

- Sediment contamination at the Site would remain for a long-term due to the slow natural attenuation processes, so exposure to contamination would exist for the long-term. This alternative does not meet removal action objectives for on-site sediment. However, if this alternative were paired with a soil removal action which reduced the quantity of contaminated sediment being added to the waterways (specifically Sharon Steel Run/Unnamed Tributary #1), contaminate concentrations would start to reduce, although it is unknown if it would ever reduce sufficiently to meet PRGs. Targeted removal of hot spots and source areas (e.g., West tributary) would enhance its potential long-term effectiveness.
- Once attenuated, COCs identified for on-site sediment would not return provided that continuing sources are removed. Any contaminant mass degraded through biological or abiotic activity would be permanent.

Reduction in Contaminant Toxicity, Mobility, or Volume through Treatment - POOR

- This alternative depends solely on natural attenuation (primarily dilution/dispersion) to reduce the toxicity, mobility, or volume of contaminants in the sediment. Incremental biodegradation which is non-reversible, would also occur for amenable compounds such as low molecular-weight PAHs.

Short-Term Effectiveness - POOR

- This alternative would not achieve the PRGs established for on-site sediment within a short timeframe because several COCs are not readily biodegradable and flushing (for dispersion/dilution) of sediment would take time once the contamination sources are removed.
- Site monitoring as part of this alternative would not pose any additional risks to the community and the workers.
- Implementation of this alternative would not expose workers to any unacceptable risks. Workers would be required to have training and a medical examination in accordance with 29 CFR 1910.120. Additionally, workers would need to utilize protective clothing and other personal protective equipment as established in the site health and safety plan.

Implementability:

Technical Feasibility - FAIR

- There are strong doubts if this alternative would achieve the performance goals within a 30-year period, because there is no evidence that natural degradation is occurring at an appreciable rate. It is therefore considered to not be technically feasible unless coupled with targeted removal of hotspots and MNR as polishing step.

Administrative Feasibility - FAIR

- This alternative could be implemented immediately. No particular permits would be required. Institutional controls would be necessary to prevent human exposure to contaminated sediments on site.

Availability of Services and Materials - GOOD

- The necessary resources and support for sampling (TAL/TCL) are readily available.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumptions made, are provided in Appendix C. The O&M and capital costs for this alternative are summarized as follows:

Capital Cost:	$0
Annual O&M Cost:	$95,000
Total Present Worth Cost:	$1,179,000 (with a discount rate of 7% for 30 years)

3.3.5 Summary of On-Site Sediment Alternatives Retained for Comparative Analysis

Of the four alternatives evaluated in this section, only three will be retained for comparative analysis in Section 4.0:

Alternative OSS1 - No Action
Alternative OSS2 - Excavation and Off-Site Disposal/Treatment
Alternative OSS3 - Excavation and On-Site Confinement

The following alternatives are screened out of the evaluation process for the following reasons:

- Alternative OSS4 - Monitored Natural Recovery - This alternative is not retained because it does not meet any of the stream sediment RAOs - specifically, it does not prevent future migration of contaminated sediments to the Monongahela River, it does not prevent exposure of contaminated sediments to receptors, and does not restore sediment quality in a reasonable time frame (i.e., <10 years).

3.4 RIVER SEDIMENT ALTERNATIVES

As part of the RI, the Monongahela River was assessed to investigate the nature and extent of site-related sediment contamination in the river. This included depositional zone assessment and sediment sampling.

The initial assessment focused between river mile (RM) 126 and RM 124 (Sharon Steel Run discharges into the Monongahela River at river mile 125.25). Based on review of historical documents (e.g., aerial photographs and other previous evaluations), the Monongahela River was impacted by discharges from Sharon Steel Run, although the extent of the sediment contamination in the river related to the discharges from Sharon Steel Run has not been fully delineated.

Results of the RI indicate that the sediments of the Monongahela River within the study area range from 1 to 8+ feet in thickness, with most deposition occurring on the western side of the river between RM 124 and RM 126, primarily related to the influence of sediment introduced by Buffalo Creek.

The river sediment bed appears reasonably stable in most areas, although periods of high flow could result in the entrainment and transport of contaminated sediments. The black semi-solid deposits (BSD) that are the most obvious contributor to contaminated sediment at the confluence of the Monongahela River and downstream of Sharon Steel Run, reportedly forms an almost asphaltic surface up to 1 foot thick, which is well attached to the stream bottom and appears not to be subject to easy erosion, and does not support a healthy benthic environment. However, the BSD is likely being slowly eroded away by abrasion from coarser grain sediments and water action during periods of high flow, carrying the contaminants downstream in smaller particles.

The section of the river near the Site is used primarily for recreational purposes, although historically it has also been used for barge traffic (coal). The City of Fairmont redevelopment master plan includes building a marina and a water activity center on the Sharon Steel Fairmont Coke Works site to the east of and upstream of the BJS Site. This could create a magnet recreational area in the river, which could greatly increase traffic on the river. This development would increase the number of people potentially exposed to the river and river sediments in the future.

As described in Section 2.3 (Determination of Removal Scope) and based on the field findings, there are two types of impacted sediments in the Monongahela River near the Site that are specifically being considered as part of this EE/CA:

- Black semi-solid deposits (BSD) - Analytical results reported by Reilly (2005) for the BSD indicate that total PAH concentrations (>20,000 mg/kg) are well in excess of the total PAH PRG of 26 mg/kg. Consequently, all sediments with BSD are considered impacted. The estimated extent of this material, based on the Reilly dive inspections, ranges from 50 to 100 feet wide, extending from approximately 25-50 feet upstream to approximately 350 downstream from the Sharon Steel Run confluence. This equates to a total area of approximately 40,000 square feet (1 acre). The thickness of this material (and any impacted sediments underlying this material - note that the material itself was found to be up to 1 foot thick in sections) is estimated to range from 1 to 3 feet thick (maximum), so the volume of the BSD and related impacted sediments is estimated to be approximately 4,500 cubic yards or approximately 7,500 tons.
- Stained sediment deposits (SSD) - Analytical results from the April 2007 sample collected from location SD-07 (which was collected from the general area mapped as "stained" by Reilly in 2005) indicated a total PAH concentration of 1,289 mg/kg, which is well above the total PAH PRG of 26 mg/kg. Consequently, it is assumed that all shallow stained sediments are considered impacted. The estimated extent of this stained area, based on the Reilly dive inspections, is approximately 30 feet wide by more than 800 feet long (note the downstream extent has not been mapped). This equates to a total area of approximately 24,000 square feet. The thickness of this stained layer is unknown, but for estimation purposes would be considered to be up to 1 foot thick (or more), so the volume of SSD is approximately 900 cubic yards or 1,400 tons.

As stated previously in Section 2.3, the deep sediment deposits in the river will be further evaluated in the future as part of the final risk evaluation and record of decision (ROD) developed for this site.

The following alternatives have been identified to address the contaminated sediments located in the Monongahela River situated adjacent to the BJS Site:

Alternative RS1: No Action
Alternative RS2: Excavation and Off-Site Disposal/Treatment
Alternative RS3: Excavation and On-Site Confinement
Alternative RS4: Monitored Natural Recovery

These alternatives are discussed in the following sections.

Note that the two types of contaminated sediments (BSD and SSD) each carry a different level of risk (e.g., BSD carries the highest risk or highest PAH concentrations and the SSD carries lower PAH concentrations) - consequently, certain removal alternatives may be more feasible than others for the given sediment type. The sediment type is considered in the discussions in the following sections.

It should also be noted that no alternatives for sediment armoring or capping were considered for this Site. The highly variable nature of the flow of the Monongahela River in this mountainous area (e.g., occasionally high flows related to storm events) would likely result in the eventual erosion of any armoring or capping system, thereby re-exposing the contaminated sediments at some point in the future. Consequently, capping or related alternatives are not considered feasible for this stretch of the river.

Finally, it should be noted that the alternatives discussed in this section are predicated on the assumption that effective source control for the Site has been implemented to prevent the recontamination of the river sediments by site-related contaminants in the future.

3.4.1 Alternative RS1: No Action

In accordance with the NCP, the No Action alternative is considered for this Site. This alternative provides a baseline for comparing other alternatives. Because no removal activities would be implemented with this alternative, long-term human health and environmental risks for the Site would be the same as those identified in the baseline risk assessment. No treatment, engineering controls, or institutional controls would be implemented under this alternative.

The following is a discussion of the effectiveness, implementability, and cost of the No Action alternative for river sediment:

Effectiveness:

The No Action alternative would not directly attain any objectives established within the scope of the removal actions (i.e., remove industrial waste from the river bottom, prevent exposure to receptors, or restore sediment quality and promote ecological function).

However, in the event that the No Action alternative is paired with a removal action for soils and on-site sediments that controls the continuing source of contaminated sediments/water to the Monongahela River, natural attenuation over time may eventually reduce concentrations in the Monongahela River surficial sediments to below the reference PRG in certain areas (such as the areas far downstream from the Site), but would not likely reduce concentrations in the BSD or SSD areas to safe levels.

Overall Protection of Public Health and the Environment - NO

- No removal actions would be taken as part of this alternative. Therefore, this alternative is not protective of human health or the environment since the long-term risks to human health or the environment due to the contaminated sediment in the river would remain unacceptable or the same as those identified in the baseline risk assessment.

Compliance with ARARs - NO

- While there are no promulgated Federal or State contaminant specific cleanup standards for contaminated sediment, there are several ARARs which are relevant to impacted river sediments. This alternative does not comply with several relevant and appropriate regulations or policies, including the West Virginia Anti-Degradation Policy (requiring protection of existing uses of state waters); West Virginia Water Pollution Control Act - Requirements Governing Water Quality Standards.
- The West Virginia Anti-Degradation Policy within the West Virginia Water Pollution Control Act prohibits the discharge/disposal of industrial wastes into waters of the State. The regulation is relevant and appropriate when considering the mass of BSD exposed on the bottom of the Monongahela River. This alternative would not comply with the West Virginia Anti-Degradation Policy.

Long-Term Effectiveness and Permanence - POOR

- Sediment contamination in the river would not be removed or contained, so long-term exposure to contamination would remain.

Reduction in Contaminant Toxicity, Mobility, or Volume Through Treatment - POOR

- There would be no reduction in the volume, mobility, or toxicity of contamination with this alternative.

Short-Term Effectiveness - POOR

- Short-term effectiveness for this alternative would be poor - all unacceptable threats posed by the contaminants would continue to be present.

- There would be no additional risks posed to the community, the workers, or the environment from this alternative beyond that already determined by the baseline risk assessment.

Implementability:

Technical Feasibility - GOOD

- There are no technical difficulties posed by this alternative since no removal action would be taken.

Administrative Feasibility - POOR

- No administrative actions required.

Availability of Services and Materials - GOOD

- No services or materials required since no action is required.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

There are no costs associated with this alternative.

3.4.2 Alternative RS2: Excavation and Off-Site Disposal/Treatment

This alternative involves the excavation of BSD and highly contaminated sediment (SSD) from the Monongahela River and disposing of it in an off-site landfill or treating it off-site. It includes isolation of the excavation area to reduce/prevent erosion during removal activities; removal of the residual waste and sediment from the river; conveyance of impacted sediment for staging and dewatering; and sediment disposal/treatment as appropriate.

There are two sediment removal scenarios that may be applicable for the project based on the risk management approach selected (see below). When assessing the merit and extent of excavation of tar-derived material and contaminated sediment warranted from the River, it is necessary to consider: 1) the potential for resuspension and release of contaminants currently in the sediments, 2) the residual contamination that may remain at the surface of the river bottom after excavation activities, and the potential risks that are being abated verses the potential short term risks that may be presented through the excavation process.

- River Sediment Removal Option A - Removal of BSD only (includes ~40,000 square feet of riverbed subject to removal activities near the confluence of Sharon Steel Run and the Monongahela River - equates to ~4,500 cubic yards or ~7,500 tons of sediment removed.

  This option would result in the removal of the most highly contaminated sediments, which also continue to be an on-going source of contamination for sediments downstream, as the BSD and related sediments continue to slowly erode away and are redeposited in downstream areas. The removal of these sediments would likely result in a substantial improvement in the ecological health in the immediate area, as well as reduce the potential for human health exposure to contaminated sediments, as the BSD is situated in shallower water near the eastern bank of the river that is most accessible to recreational users.

- River Sediment Removal Option B - Removal of BSD and SSD only (includes the scope of Option A plus an additional ~24,000 square feet of riverbed subject to removal activities downstream from the BSD area - equates to an additional ~900 cubic yards or ~1,400 tons of sediment removed (or a total of ~5,400 cubic yards or ~8,900 tons).

  This option would result in the removal of all of the visibly contaminated sediments containing the highest concentrations (>100-500 mg/kg) of total PAHs from the river bottom. As this option encompasses a larger area and mass of sediment than Option A, it will subsequently provide an even greater improvement to the ecological health as well as a further reduction in the potential for human health exposure throughout the river area downstream of Sharon Steel Run confluence.

A sediment removal project must be well designed and implemented to achieve removal action objectives. Additional detailed site information must first be collected to accurately define the extent of sediment contamination and establish the boundaries for sediment removal both horizontally and vertically (i.e., defining the dredge prism). Projects designed to implement Option A (BSD removal, approximately 1.0 acre) and B (BSD and SSD removal, approximately 1.5 acres) would be easier to isolate using standard engineering controls. Options A and B involve a small work area, shallow water depths and close proximity to shore which would make it relatively easy to control any resuspension contaminated sediment and/or release of tar derivatives.

Excavation of submerged wastes and contaminated sediment inevitably re-suspends some small fraction of the contaminated sediments into the water column. If the engineering controls are successful at isolating the area, the stirred up sediments settle back to the bottom after the excavation phase is complete and create a thin layer of "residual" contamination that tends to contain COCs at concentrations approximately equal to the average concentration of the material removed. The project design can address the residual veneer layer by conducting successive "passes," hydraulic vacuum of this residual material, backfilling with a clean cover (such as 6 inches of sand and gravel), or allowing natural deposition of bed load moving downstream to cover the residual.

Note that the shallow presence of bedrock beneath the river will pose a challenge to complete sediment removal, as this will represent a very irregular surface from which to remove sediments. In addition, the sediment removal effort must consider effects of sediment removal to the existing waterway uses and infrastructure in the river, including impact on the City of Fairmont Wastewater Treatment Plant discharge, river navigation (by both recreational and commercial users), Sharon Steel Run discharge, and river habitat. Consequently, there would be an extensive planning and design effort required prior to the removal of any sediments from the Monongahela River.

Each river sediment removal scenario above would require that the contaminated sediments be isolated from the river to prevent the stirred up sediments from impacting areas downstream of the dredge area and the Site. River isolation techniques include sheet piling, earthen dams, cofferdams, inflatable dams, and floating sediment curtains. In addition to the river isolation, the handling of any sediment residuals that settle back to the bottom within the isolated area after the main dredging activities have been completed must also be considered. Additional removal of this residual sediment (through the use of a final pass approach, for example) and post excavation sediment monitoring may also be required to meet all the sediment removal objectives. Note that extensive capping of any residual sediment in this stretch of the Monongahela River would not typically be considered, as the river is erosional during periods of high flow and any cap material could simply be eroded downstream during high flow events. However, as a temporary means for added protection of aquatic receptors, the placement of a thin cap of material (6 inches) would prevent exposure to the veneer residual layer of contaminated sediments in the immediate post-excavation time period. For the purposes of cost estimating as part of the EE/CA, it is assumed that a 6-inch cover will be placed in the dredge areas at the completion of dredging activities.

Either sheet piling or floating sediment curtains are feasible for removal scenarios Options A and B, since the overall river area to be disturbed under these options is relatively small. Note that the ultimate selection of the isolation technique would be based on a more detailed evaluation of the river characteristics, including river velocity, hydrodynamics and bathymetry, and the subsequent dredge plan that will be required prior to any removal action. For the purposes of cost estimating as part of the EE/CA, sediment curtains are assumed to be the isolation method used.

Sediment removal from the river would likely involve several different techniques, based on the depth of water and nature of sediments. BSD and SSD were found in water depths ranging from less than 1 foot (along the shoreline) to more than 20 feet (center channel areas). In the shallow water portions of the river along the eastern bank, the sediment material consists of large rocks, whereas farther out into the deeper river channel the sediments consist mostly of gravel and coarse sand. Slackwater and slower velocity areas (such as the western bank downstream of the Buffalo Creek confluence) have a thin layer of coarse sediment underlain by a thick layer of homogeneous silt deposits. Consequently, different sediment removal techniques may be required based on the findings of additional pre-removal sediment characterization activities.

Near shore sediment removal, including shallow water (less than 2 or 3 feet) areas, areas with a large percentage of rocks, and the BSD area, would likely require the use of articulated mechanical removal techniques (e.g., backhoe design, clam-type enclosed buckets, hydraulic closing mechanisms, all supported by articulated fixed-arm) to be able to handle the variety of sediment types and shallow water constraints. This type of equipment can be loaded onto a barge or be used from shore-based positions, although the use of a shore-based position would require reworking of the riverbank to provide access to the sediments. Sediments removed with articulated mechanical removal techniques would likely be loaded onto another barge and floated downstream for further off-loading (there is an established barge loading station nearby downstream of the area that has been used historically for coal barge operations) and then transported to the Site for staging and dewatering. Alternatively, dewatering/solidification can also be done on the barges themselves using fixation polymers or other additives to solidify the sediments prior to off-loading. It is assumed that the BSD and probably most of the SSD in shallow water (less than 10-15 feet) could be removed using this removal method (~ 5,400 cubic yards or ~8,900 tons).

Areas with deeper water and regular type sediments (such as the SSD areas) can employ a floating barge with a cutterhead mounted on a hydraulic boom which can cut a swath through the contaminated sediment. The average water depth in the SSD area ranges from 10 to 15 feet, and the sediments to be removed in these areas would be approximately 1 foot thick (or more), although the exact thickness of the stained layer is currently unknown, but would not likely exceed 3 feet in thickness in most areas. The sediment (and related water) is then pumped via an intake tube to the shore and up to the main portion of the Site for staging and dewatering. Mechanical removal techniques could also be used for the deeper areas.

Regardless of the method used to remove the sediment, temporary storage of the contaminated sediments would be needed to dewater it prior to any upland disposal. Sediment dewatering/stabilization/solidification can be accomplished through the use of either additives/fixatives (applied directly to the sediments on the barges) or through the use of on-shore facilities set up specifically for dewatering purposes. Lined berm basins could be constructed at the Site to contain the dredged sediments to allow for the sediment to settle and dewater prior to off-site transport and disposal.

The size of the lined berms required for the project would ultimately depend on the sediment removal scenario selected, but could be rather large (up to five acres) depending on the method used for sediment removal and the quantity of sediment handled. For example, articulated mechanical removal techniques generate much less water than cutterhead removal techniques.

The water would then be pumped off and treated in an on-site treatment system (for example, solids removal, oil/water separation, carbon filtration) to ensure attainment with water quality standards prior to discharge to Sharon Steel Run. Should additional dewatering be required (after simple decanting), then additional methods may also be used, including geotextile tube dewatering (using filter fabric and chemical additives to promote dewatering) or mechanical dewatering (using filter press or centrifuge type equipment).

Once sufficiently dewatered or stabilized, the sediments would be characterized and transported off-site for proper treatment or disposal.

This alternative would include demonstration of attainment sediment sampling (for cost estimating purposes assume an attainment study costing $50,000 and $60,000, respectively for Options A and B) to verify that sediment removal activities have met the removal requirements as well as to provide a baseline condition for the sediment quality monitoring program to follow. This alternative would also require a detailed pre-sediment removal investigation to delineate in detail the extent of the BSD, stained sediments, and other contaminated sediments in the river to establish the dredge prism (i.e., three dimensional area designated for sediment removal).

Finally, a 5-year sediment quality monitoring program would also be part of this alternative to monitor the long term performance of this alternative. The scope of the monitoring program would be the same as that described in Section 3.4.4 (Monitored Natural Recovery), but would involve annual monitoring for a period of only 5 years. Ten monitoring stations would be established in the river and the sediment and surface water at these stations would be sampled annually for full TCL/TAL analysis. Sediment samples would also be subject to sediment toxicity tests. Annual biological testing, including fish and macroinvertebrate inventory assessment and sampling would also be conducted to monitor the changes in biota contaminant concentrations over time to monitor the effectiveness of the removal action.

The following is a discussion of the effectiveness, implementability, and cost of the river sediment removal and off-site treatment/disposal alternative:

Effectiveness:

Overall Protection of Public Health and the Environment - FAIR (Options A & B)

- This alternative would remove the contaminated sediment in the river, thereby protecting human health and the environment to various degrees depending on the ultimate removal option selected Option A and Option B would substantially reduce the potential impact, but some residual risk to human health and the environment would remain as other deep impacted sediments would remain. Options A and B would also eliminate the toxic BSD and most contaminated sediments so that monitored natural recovery may successfully reduce the concentrations of remaining COCs to levels protective of human health and the environment.

Compliance with ARARs - YES

- There are no promulgated federal or state contaminant specific cleanup standards for sediment, however, there are several ARARs that are relevant to impacted river sediments. This alternative would comply with several relevant and appropriate regulations and policies, including the West Virginia Anti-Degradation Policy (requiring protection of existing uses of state waters); West Virginia Water Pollution Control Act (regulates the discharge or deposit of wastes into state waters - such as contaminated sediments, as well as establishes surface water quality standards), Fish and Wildlife Coordination Act - 16 U.S.C. §662 (requires coordination with various federal agencies to ensure that ecological resources are conserved during any work within waterways), Fish and Wildlife Conservation Act - 16 U.S.C. 2901-2911 (also requires conservation of non-game fish and wildlife during any work within waterways), Rivers and Harbors Act (all sediment removal activities must be coordinated with the US Army Corps of Engineers), and WV and Federal RCRA standards (ensures proper waste handling and disposal at an approved facility).
- The West Virginia Anti-Degradation Policy within the West Virginia Water Pollution Control Act prohibits the discharge/disposal of industrial wastes into waters of the State. The regulation is relevant and appropriate when considering the mass of BSD exposed on the bottom of the Monongahela River. This alternative would comply with the West Virginia Anti-Degradation Policy.

Long-Term Effectiveness and Permanence - GOOD

- Excavation and off-site disposal of the tarry wastes and highly contaminated river sediment at the Site would be a long-term effective and permanent removal action. Once the thick mat of coal tar residue is removed from the river bottom there is no possibility that the habitat could become re-contaminated to that degree (20,000 mg/kg PAHs). However, source control actions on the upland portions of the site would be necessary to ensure that the riverbed is not re-contaminated. The BSD and contaminated sediments that are removed from the river would be sampled and disposed of in an appropriate manner. Any material determined to be RCRA-characteristic waste would be treated prior to disposal in an approved RCRA TSDF. Excavated material would be sent to disposal facilities in accordance the CERCLA Off-Site Rule. The level of sediment removal would vary, depending on the final sediment removal scenario selected (Options A or B). Options A and B would eliminate the toxic BSD and most contaminated sediments so that monitored natural recovery may successfully reduce the concentrations of remaining COCs to levels protective of human health and the environment. Low-molecular weight PAHs, such as naphthalene, are most amenable to natural degradation processes.

Reduction in Contaminant Toxicity, Mobility, or Volume through Treatment - FAIR

- This alternative would physically remove the contaminated river sediment, hence preventing future mobility of the contamination. A component of the most contaminated sediments (e.g., BSD and stained sediments) may require treatment prior to off-site disposal. Any treatment of excavated sediment, if required, would reduce toxicity and volume of contaminants. Off-site disposal would reduce mobility by placing the material in a regulated, engineered landfill. Water collected during dewatering operations would be treated in a water treatment facility. The water treatment process would reduce contaminant mobility and toxicity.

Short-Term Effectiveness - FAIR

- Engineering controls such as oil booms, silt curtains and/or sheet pile would be utilized to isolate the areas subject to excavation and prevent migration resuspended sediments from the area of contamination. The larger the area subject to excavation the more difficult the isolation task would be. A river sediment removal effort would temporarily stir up sediments from the river bottom and could pose short-term impacts to the existing waterways uses, river navigation, and river habitat. Routine monitoring would be conducted to optimize the isolation methods. Adequate planning and design effort would be (isolation of the excavation area) required to implement this alternative effectively.
- A site-specific health and safety plan would be implemented to protect workers from potential exposure to contaminated material removed from the River. Workers would be required to utilize protective clothing and other personal protective equipment. Engineering controls would be employed to protect the environment.
- It is estimated that implementation of this alternative could take 12-16 months, including all pre-removal studies (including additional river sediment contamination delineation studies), design, procurement, and removal action activities.

Implementability:

Technical Feasibility- GOOD

- Sediment removal activities are routinely and successfully performed utilizing standard equipment. The scope of Options A or B are so small that they resemble a pilot scale project for most sediment removal operations. The sediment volume is estimated at approximately 5,000 cubic yards of material. The area to be excavated is approximately 1 acre with target BSD/SSD 1-3 feet thick in shallow water near the shore. River isolation techniques such as sheet piling and sediment curtains could minimize migration of contaminants off-site, but these techniques would need to be carefully designed to minimize migration of contaminants off-site.
- Options A or B would require additional field sampling adequate to define the material to be removed and develop a dredge prism. An excavation bucket equipped with a GPS unit could be used to remove contaminated material. A post-excavation survey would demonstrate that the material was successfully removed to pre-determined elevations.
- Off-site disposal or treatment facilities that can accept contaminated sediments are available.
- Water generated during sediment dewatering would be collected and analyzed. The volume of water generated implementing Options A or B are relatively small. Depending on contaminant concentration in the decant water the level of treatment required, treated water would be either discharged to the river in accordance with a WVPDES permit or discharged to the City of Fairmont sewer system upon meeting appropriate pre-treatment standards developed by the City.

Administrative Feasibility - GOOD

- Acquisition of appropriate permits and/or discharge agreements will not be difficult provided that the discharge meets appropriate water quality parameters.
- Plan approval and permits would be required prior to isolating and dredging a section of the river.

Availability of Services and Materials - GOOD

- The necessary resources and support for installing a silt curtain, dredging the sediment, dewatering and disposing of it are readily available.
- There is sufficient capacity for sediment disposal/treatment at nearby facilities.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumptions made, are provided in Appendix C. The O&M and capital costs for this alternative are summarized as follows:

Option A - BSD Removal and Disposal Only (~4,500 cubic yards)

Capital Cost:	$3,192,000
Annual O&M Cost:	$150,000
Total Present Worth Cost:	$3,808,000

Option B - BSD/SSD Removal and Disposal Only (~5,400 cubic yards)

Capital Cost:	$4,440,000
Annual O&M Cost:	$150,000
Total Present Worth Cost:	$5,056,000

The cost was based on disposal of the sediment in a non-hazardous landfill.

3.4.3 Alternative RS3: Excavation and On-Site Confinement

This alternative would consist of the same removal activities as described in Alternative RS2, except for the on-site confinement instead of off-site disposal/treatment. This alternative would be implemented with Soil Alternative SO5 (Capping/Containment), or Alternative SO6 (Insitu Treatment - ISCO). The sediment would be excavated from the river and spread to fill in low areas on the Site prior to the site either being capped or solidified.

The following is a discussion of the effectiveness, implementability, and cost of the river sediment removal and on-site confinement/disposal alternative:

Effectiveness:

Overall Protection of Public Health and the Environment FAIR (Options A&B)

- This alternative would remove the contaminated sediment in the river, thereby protecting human health and the environment to various degrees depending on the ultimate removal option selected. Option A and Option B would substantially reduce the potential impact, but some residual risk to human health and the environment would remain. Options A and B would eliminate the toxic BSD and the most contaminated sediments so that monitored natural recovery may successfully reduce the concentrations of remaining COCs to levels protective of human health and the environment.

Compliance with ARARs - YES

- There are no promulgated federal or state contaminant specific cleanup standards for sediment, however, there are several ARARs that are relevant to impacted river sediments. This alternative would comply with several relevant and appropriate regulations and policies, including the West Virginia Anti-Degradation Policy (requiring protection of existing uses of state waters); West Virginia Water Pollution Control Act (regulates the discharge or deposit of wastes into state waters - such as contaminated sediments, as well as establishes surface water quality standards), Fish and Wildlife Coordination Act - 16 U.S.C. §662 (requires coordination with various federal agencies to ensure that ecological resources are conserved during any work within waterways), Fish and Wildlife Conservation Act - 16 U.S.C. 2901-2911 (also requires conservation of non-game fish and wildlife during any work within waterways), Rivers and Harbors Act (all sediment removal activities must be coordinated with the US Army Corps of Engineers). In the event that some of the excavated material is tested and determined to be RCRA-characteristic waste, the contaminated river sediments are within the Area of Contamination. Therefore the material could be consolidated on the upland portion of the site without invoking "placement" in the context of Land Ban.
- The West Virginia Anti-Degradation Policy within the West Virginia Water Pollution Control Act prohibits the discharge/disposal of industrial wastes into waters of the State. The regulation is relevant and appropriate when considering the mass of BSD exposed on the bottom of the Monongahela River. This alternative would comply with the West Virginia Anti-Degradation Policy.

Long-Term Effectiveness and Permanence - GOOD

- Excavation and off-site disposal of the tarry wastes and highly contaminated river sediment at the Site would be a long-term effective and permanent removal action. Once the thick mat of coal tar residue is removed from the river bottom there is no possibility that the habitat could become re-contaminated to that degree (20,000 mg/kg PAHs). However, source control actions on the upland portions of the site would be necessary to ensure that the riverbed is not re-contaminated. The BSD and contaminated sediments that are removed from the river would be sampled and disposed of in an appropriate manner. The level of sediment removal would vary, depending on the final sediment removal scenario selected (Options A or B). Options A and B would eliminate the toxic BSD and most contaminated sediments so that monitored natural recovery may successfully reduce the concentrations of remaining COCs to levels protective of human health and the environment. Low-molecular weight PAHs, such as naphthalene, are most amenable to natural degradation processes

Reduction in Contaminant Toxicity, Mobility, or Volume through Treatment – POOR/FAIR

- There would be no appreciable reduction of toxicity, mobility or volume through treatment unless coupled with alternative SO6 (ISCO). On-site confinement with capping would reduce mobility of contaminants in excavated sediment with the use of engineering controls. On-site confinement with in-situ treatment (solidification/stabilization) would reduce mobility of inorganic COCs in the river sediment, but would have marginal effect in reducing mobility of organic COCs that were not otherwise degraded. Alternatively, in-situ treatment using ISCO would reduce mobility of organic COCs, but have limited effect in reducing the mobility of the inorganic COCs.

Short-Term Effectiveness - FAIR

- Engineering controls such as oil booms, silt curtains and/or sheet pile would be utilized to isolate the areas subject to excavation and prevent migration resuspended sediments from the area of contamination. The larger the area subject to excavation the more difficult the isolation task would be. A river sediment removal effort would temporarily stir up sediments from the river bottom and could pose short-term impacts to the existing waterways uses, river navigation, and river habitat. Routine monitoring would be conducted to optimize the isolation methods. Adequate planning and design effort would be (isolation of the excavation area) required to implement this alternative effectively.
- Standard engineering controls would be utilized for dust suppression as excavated contaminants were dewatered/dried and on-site graded as appropriate either as a base layer for a multi-layered cap or treatment by ISCO.
- A site-specific health and safety plan would be implemented to protect workers from potential exposure to contaminated material removed from the River. Workers would be required to utilize protective clothing and other personal protective equipment. Engineering controls would be employed to protect the environment.
- The short-term effectiveness would be fair because the benefit of contaminant removal would be balanced by some entrainment of chemicals of concern into the river.
- It is estimated that implementation of this alternative could take 12-16 months, including all pre-removal studies (including additional river sediment contamination delineation studies), design, procurement, and removal action activities. It is estimated that sediment excavation portion of this alternative would take six months. On-site capping or in-situ treatment of excavated sediment would take an additional 1 to 1.5 years.

Implementability:

Technical Feasibility - GOOD

- Sediment removal activities are routinely and successfully performed utilizing standard equipment. The scope of Options A or B are so small that they resemble a pilot scale project for most sediment removal operations. The sediment volume is estimated at approximately 5,000 cubic yards of material. The area to be excavated is approximately 1 acre with target BSD/SSD 1-3 feet thick in shallow water near the shore. River isolation techniques such as sheet piling and sediment curtains could minimize migration of contaminants off-site. but these techniques need to be carefully designed to minimize migration of contaminants off-site.
- Options A or B would require additional field sampling adequate to define the material to be removed and develop a dredge prism. An excavation bucket equipped with a GPS unit could be

used to remove contaminated material. A post-excavation survey would demonstrate that the material was successfully removed to pre-determined elevations.

- Excavated material could be readily transported for consolidation on the upland portion of the site and graded prior to cap construction or stockpiled to await ISCO.
- Water generated during sediment dewatering would be collected and analyzed. The volume of water generated implementing Options A or B are relatively small. Depending on contaminant concentration in the decant water the level of treatment required, treated water would be either discharged to the river in accordance with a WVPDES permit or discharged to the City of Fairmont sewer system upon meeting appropriate pre-treatment standards developed by the City.

Administrative Feasibility - POOR

- Acquisition of appropriate permits and/or discharge agreements will not be difficult provided that the discharge meets appropriate water quality parameters.
- Plan approval and permits would be required prior to isolating and dredging a section of the river.
- Site background information indicates that contaminants within the Monongahela River sediments could have originated from former operations conducted upon either the Big John Salvage uplands or the Sharon Steel/Fairmont Coke Works facility. Historical effluent and stormwater draining both these properties flow to the Monongahela River via Sharon Steel Run. For various reasons, preliminary communications with the respective potentially responsible parties indicate that there are strong objections to consolidating the potentially co-mingled wastes on the uplands at the Big John Salvage site.

Availability of Services and Materials - GOOD

- The necessary resources and support for installing a silt curtain, dredging the sediment, and placing it on-site are readily available.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumptions made, are provided in Appendix C. The O&M and capital costs for this alternative are summarized as follows:

Option A - BSD Removal and On-Site Confinement Only (~4,500 cubic yards)

Capital Cost:	$2,786,000
Annual O&M Cost:	$150,000
Total Present Worth Cost:	$3,402,000

Option B - BSD/SSD Removal and On-Site Confinement Only (~5,400 cubic yards)

Capital Cost:	$3,953,000
Annual O&M Cost:	$150,000
Total Present Worth Cost:	$4,569,000

3.4.4 Alternative RS4: Monitored Natural Recovery

This alternative involves the use of naturally occurring physical, biological, and/or chemical mechanisms to reduce risk to human and/or ecological receptors, and the prevention of contact with contaminated sediments through implementation of institutional controls. Monitored natural recovery (MNR) relies on dispersion through erosion or isolation and natural sedimentation for mixing of contaminants, and thereby reducing exposure. Institutional controls for the river bottom (to control future sediment disturbance) such as easements for utilities, fishing advisories, mooring restrictions, and waterway use restrictions would be included to minimize the potential for unacceptable exposure to contaminated sediments. MNR is non-invasive and has a relatively low implementation cost. The cost for implementation would be derived from monitoring, institutional controls, and public education.

In the context of this site, the potential for MNR may be best evaluated separately for the BSD and perhaps SSD vs. the sediments with elevated but relatively low concentrations of COCs. The BSD is a one acre mass of coal tar derivatives measured to be comprised of more than 20,000 mg/kg PAHs. If the BSD remains on the river bottom it will likely remain an ecological dead zone source of PAH contamination to downstream locations and receptors for many decades.

An important first step to MNR is source control. This would prevent additional sediment accumulation and allow the Monongahela River sediments to reach the site removal objectives in a reasonable time frame (e.g., within 10-20 years). This would consist of controlling the on-site sediment and groundwater to prevent the continued migration of contamination into the river from the Big John and Sharon Steel sites. Therefore, source control is an essential component to successfully implement this alternative.

In general, natural burial through sedimentation can be used with contaminated sediments to reduce risks. The findings of the RI indicate that the sediments in the deeper channel areas are comprised mostly of coarse sand and gravel; with coal pieces making up a large portion of the sediment in the area. Sediments in depositional areas are comprised primarily of silt and clay, with some fine sand. In addition, interlayered beds of fine and coarse grain material were observed, indicating a variable depositional setting on this section of the river, ranging from high velocity to low velocity depositional episodes. The findings of the RI also indicate that natural burial is occurring in the river, although the sediment dynamics of this river are always changing, and even though some contaminated sediments are currently buried, it is uncertain that these cover sediments would remain in place in the future. Indeed, there is a strong possibility that the current of the river would carry the sediment further downstream in the future.

It is unclear what would happen with the BSD. The BSD forms a layer approximately 3-12 inches thick along the bed of the river, and does not seem to be highly erodible, or degradable. There is likely some erosion when it is scoured by sediment and water action during higher flow periods, but this is not likely to remove the BSD within a reasonable timeframe.

As part of evaluating MNR as a contaminant removal alternative for the Monongahela River, the following site conditions would be assessed: is the expected human exposure low and/or can it be reasonably controlled by institutional controls; is the sediment bed reasonably stable and likely to remain so; is the sediment resistant to resuspension (e.g., cohesive or well-armoured sediment); are the contaminant concentrations in biota and in the biologically active zone of sediment moving toward risk-based goals (PRGs) on their own.

Institutional controls would be essential to limiting human exposure to the contaminated sediment at the site. This would prohibit river facility development as well as river dredging in the impacted area of the river. The current redevelopment plans for the adjacent Sharon Steel site includes a water park and a marina - institutional controls that would limit the human exposure to the contaminated sediments or prevent sediment disturbance associated with this development could be difficult to implement.

In addition to institutional controls, a biological and chemical monitoring plan is an important component of this alternative to measure and evaluate the changes in sediment contaminant levels and the associated biological response. For cost estimating purpose, it was assumed that this alternative would require long-term monitoring of the sediment and surface water quality of the river for a period of 30 years. Ten monitoring stations would be established in the river, and the sediment and surface-water at these stations would be sampled annually for full TCL/TAL analysis. Sediment samples would also be subject to sediment toxicity tests. Annual biological testing, including fish and macroinvertebrate inventory assessment and sampling, would also be conducted to monitor the changes in biota contaminant concentrations over time.

The following is a discussion of the effectiveness, implementability, and cost of the river sediment monitored natural attenuation alternative:

Effectiveness:

Overall Protection of Public Health and the Environment - NO

- Institutional controls, which is the primary component of this alternative to prevent human access to the Site, is not considered feasible due to development plans in the area, so this would not be protective of human health and the environment.
- There would be minimal reduction in the risk or increase in protectiveness of human health and the environment in the long-term. The only risk reduction comes from the long-term degradation of contaminants and through migration of contaminated sediment off-site. The BSD is not believed to be readily degradable or likely to erode significantly.
- The current risk level posed by contaminated river sediment at the Site would remain for a long period of time.
- MNR could be potentially effective if considered as a component of an alternative including removal of the BSD and highly contaminated sediments.

Compliance with ARARs - NO

- While there are no promulgated federal or state contaminant specific cleanup standards for sediment, there are several ARARs that are relevant to impacted river sediments. The West Virginia Anti-Degradation Policy within the West Virginia Water Pollution Control Act prohibits the discharge/disposal of industrial wastes into waters of the State. The regulation is relevant and appropriate when considering the mass of BSD exposed on the bottom of the Monongahela River. This alternative would not comply with the West Virginia Anti-Degradation Policy.

Long-Term Effectiveness and Permanence - POOR

- Long-term monitoring would be required to measure progress of MNR, document its effectiveness and project the time necessary to achieve acceptable risk range.
- The sediment and the BSD at the Site would remain contaminated for the long-term, potentially forever if it is not removed by erosion and natural methods. The BSD is toxic to aquatic life.
- Long-term effectiveness of this alternative would be poor because it is unlikely that the river sediment with BSD can be attenuated by natural means.

Reduction in Contaminant Toxicity, Mobility, or Volume through Treatment - POOR

- This alternative depends solely on MNR to reduce the toxicity, mobility, or volume of contaminants in the sediment. There would be marginal reduction in toxicity and volume of organic COCs such as low molecular-weight PAHs through biodegradation; however, most organic COCs are recalcitrant to biodegradation. In consideration of the initial COC concentrations in the BSD, the potential rate of degradation is insignificantly small to achieve appreciable risk reduction within several decades. Therefore, this alternative cannot reduce toxicity, mobility, or volume of contaminants in the river sediments unless coupled with hot-spot removal (e.g., BSD removal). If the BSD is allowed to continually erode, the volume of contaminated sediment may increase even as the mass of coal tar residue is dispersed through the habitat.

Short-Term Effectiveness - POOR

- Given the period of time that has passed since the initial discharges that contaminated the sediments (35 to 80 years ago) the time frame required to meet performance goals would likely be much longer. Contaminant levels in the sediments associated with the source areas are still very high.
- This alternative would require 30 years or longer of monitoring for full TCL/TAL, including COCs identified for the river sediments.
- Site monitoring as part of this alternative would pose minimal risks to the community and the workers.
- Risk of chemical exposure during monitoring would be minimized through proper training, protective clothing and air monitoring in accordance with 29 CFR 1910.120. The current site-specific health and safety plan would be maintained.

Implementability:

Technical Feasibility - POOR

- The technical feasibility of utilizing naturally occurring biota to degrade the BSD to less toxic components and ultimately achieve concentrations which are protective to human health and the environment would be very poor. .

Administrative Feasibility - POOR

- There would be administrative difficulties to implement this alternative because the institutional controls required would be in conflict with the local redevelopment master plan for the region.

Availability of Services and Materials - GOOD

- Necessary sampling resources and laboratory support are readily available.

State Acceptance

- State acceptance would be evaluated after release of the EE/CA and review of public comments.

Community Acceptance

- Community acceptance would be evaluated after release of the EE/CA and review of public comments.

Cost:

Detailed cost estimates, including assumptions made, are provided in Appendix C. The O&M and capital costs for this alternative are summarized as follows:

Capital Cost:	$42,000
Annual O&M Cost:	$150,000
Total Present Worth Cost:	$1,904,000 (with a discount rate of 7% for 30 years)

3.4.5 Summary of River Sediment Alternatives Retained for Comparative Analysis

Of the four alternatives evaluated in this section, all four will be retained for comparative analysis in Section 4.0:

Alternative RS1 - No Action
Alternative RS2 - Excavation and Off-Site Disposal/Treatment
Alternative RS3 - Excavation and On-Site Confinement
Alternative RS4 - Monitored Natural Recovery

4.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

In contrast to the preceding analysis in which each alternative was analyzed independently without considering other alternatives, a comparative analysis is conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criterion. The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so that the key tradeoffs can be identified.

4.1 SOIL ALTERNATIVES

The removal action alternatives retained for comparative analysis for contaminated soil at the Site include No Action (SO1); Capping and Containment (SO5), and in-situ chemical oxidation (SO6). These alternatives were compared against their effectiveness, implementability, and cost below.

Effectiveness

Alternative SO1 (No Action), if implemented, would not meet the soil RAOs or be protective of public health and the environment.

The various capping and containment alternatives (SO5 - Option A - RCRA Subtitle D Cap; Option B - Expanded RCRA Subtitle D Cap; and Option C - Subtitle D Cap with Asphalt Cover) are proven remedies and would be effective in meeting all of the soil RAOs – note that the actual capping method and detail would be selected during the design process. The capping and containment alternatives also offer compliance with the ARARs, provide good long-term and short-term effectiveness, and are permanent measures, although they will require a long-term operations and maintenance component to maintain their effectiveness. The SO5 alternative does not include treatment, but would help to reduce the mobility of contaminants in the soil by limiting surface erosion as well as limiting the further leaching of contaminants in the unsaturated zone to the groundwater. This alternative would not reduce any of the toxicity or volume of contaminants in the soil – all soil contamination would remain in place, although the cap would eliminate the current and future pathway soil exposure routes for human health and ecological receptors.

All three of the cover options evaluated are equally effective in addressing the soil RAOs, and are also equally protective of public health and the environment. The differences in design would accommodate different future site land use. Given that this alternative eliminates all potential exposure pathways, it would be more protective than alternative SO6, which may not be fully effective in treating all the contamination in the soil at the Site.

Alternative SO6 (In-situ Chemical Oxidation) could also be effective in meeting all of the soil RAOs if successfully implemented, and would also address most of the groundwater RAOs as well, although this alternative would not address the inorganic COCs in the soil or groundwater. The main advantage of this alternative over SO5 is that it reduces the toxicity, volume, and mobility of the soil contaminants through treatment. However, as discussed in Section 4.2, there are some Site-specific conditions that could affect the overall effectiveness of this alternative, including the natural oxidant demand (NOD) of the overburden sediments (the NOD of the sediments is likely high because of the silt and clay and related high organic carbon fraction), as well as the variable permeability of the overburden sediments. Consequently, it may be very difficult to deliver oxidants to all source areas in the subsurface and subsequently treat all of the contaminants in the subsurface to the PRGs. Although this alternative would reduce the risk posed by the Site, some level of risk may remain for any untreated areas of the Site. See Section 4.2 for additional discussion about the overall effectiveness of in-situ chemical oxidation at the Site.

Neither of the soil alternatives poses any substantial risks to the community or unacceptable risks to the site workers during construction activities. The in-situ chemical oxidation alternative does require additional worker protection measures given the handling hazards of the oxidants.

Implementability

SO1 can be implemented immediately. Alternatives SO5 and SO6 each require an extensive design component (including additional pre-design studies), but could be implemented relatively quickly. Alternatives SO5 and SO6 could be implemented within an 18-24 and 24-36 month time period, respectively.

However, the design for SO5 would require a determination of future land use prior to design initiation, which could extend the ultimate time frame for implementation. The future land-use determination is a critical element in the SO5 design, as it could affect design decisions about the overall area to be capped, type of cap, and how the steep slope areas adjacent to Sharon Steel Run would ultimately be addressed.

Alternative SO6 would require extensive bench-scale and pilot testing, as well as more detailed site investigations to delineate the horizontal and vertical extent of contamination to gather the necessary data to design an effective system, especially since contaminant concentrations are heterogeneous and multiple oxidants may be required. The technical feasibility of successfully implementing this alternative is unknown.

There are no reliability concerns with capping and containment, as RCRA Subtitle D caps have proven their performance at hundreds of sites throughout the United States. However, the in-situ chemical oxidation alternative may have some reliability concerns related to full applicability at this Site as it relates to the implementation of oxidant delivery and ensuring contact with all subsurface contamination. In addition, given the various types of contaminants at the site, more than one type of oxidant will be required to address all contaminant types, and this further complicates the implementation of this alternative. Finally, the application of in-situ chemical oxidation for the primary Site contaminants (tar and PAHs) has not often been demonstrated on such a large scale.

Both SO5 and SO6 are proven technologies, and there are various vendors and suppliers available to implement the removal action, although there are probably more vendors and suppliers available for capping and containment remedies versus in-situ chemical oxidation remedies. They are also both feasible administratively with respect to permitting considerations and regulatory oversight. However, SO5 has a better probability of success than SO6 given the less complicated application of the capping and containment technology.

Cost

The capital, annual O&M, and present worth costs for each soil alternative are summarized below:

Alternative	Cost		
	Capital	Annual O&M	Total (Present Worth)
SO1 (No Action)	$0	$0	$0
SO5 (Capping/ Containment)	Option A $6,211,000 Option B $7,307,000 Option C $7,401,000	Option A $75,000 Option B $75,000 Option C $75,000	Option A $7,142,000 Option B $8,238,000 Option C $8,332,000
SO6 (Chemical Oxidation)	$13,897,000	$70,000	$14,766,000

The lowest present worth cost is for No Action (SO1), followed by the typical Subtitle D Cap (Option A), expanded Subtitle D Cap (Option B), and Subtitle D Asphalt Cap (Option C). In-situ Chemical Oxidation (SO6) is the highest present worth analysis cost. For reference, the other soil alternatives that were not retained for comparative analysis had substantially higher present worth costs (Alternative SO3: Excavation and On-Site Thermal Treatment -$94,633,000 and Alternative SO4: Excavation and Off-Site Disposal $49,985,000.

In general, there is a good degree of confidence in the cost estimated for the various capping and containment options with respect to known Site conditions. The future land-use considerations and related design requirements would affect the ultimate cost of the cap system. For example, if larger structures are planned for the Site, the subgrade preparation would require more effort than if the Site were to remain open space, resulting in more cost. In addition, since the primary goal of the cap is to prevent exposure and reduce infiltration, a less costly alternative to a typical RCRA Subtitle D cap (such as a compacted soil cap or a geomembrane cap with less cover soil requirement) is also feasible at this Site, should this ARAR be waived or interpreted in a different way.

Further, the cost estimate is based on an approximately 18-acre capping system. It is possible that based on additional site studies, perimeter areas that only contain surface soil contamination (and not deep subsurface soil contamination) could be excavated and consolidated into the most contaminated center portion of the Site or disposed off-site, thereby reducing the total area to be capped/contained. The cost estimate is based on the worst-case scenario (18 acres), but the actual area to be capped could be up to 20% less. The capping system for the steep slope area adjacent to Sharon Steel Run also poses a design challenge as well. The cost estimate of a capping system for this steep slope area has uncertainty due to the requirement to address long-term tar seeps emanating from this area.

As discussed further in Section 4.2 below, the cost estimate developed for the in-situ chemical oxidation SO6 alternative has a much higher degree of uncertainty. The overall cost of this alternative could be substantially higher than that presented based on actual Site conditions discovered in the field. For example, high natural oxidant demand would require additional oxidant, substantially increasing the cost. In addition, the cost of oxidant delivery could be higher should soil mixing be required versus the use of injection points. See the additional discussion under Section 4.2 regarding the cost uncertainty for this alternative.

The benefit of this in-situ chemical oxidation alternative is that it has the potential to address both the soil and groundwater RAOs. Consequently, based on the current cost estimate, it may be viewed just as cost effective as a combination of capping (SO5) and expanded groundwater collection and treatment (GW4). However, the uncertainty regarding the full-scale implementation of this technology to the Site and the potential for cost escalation should be considered as part of the cost evaluation. Continued groundwater collection and treatment may be necessary if the chemical oxidation is less effective than anticipated.

4.2 GROUNDWATER ALTERNATIVES

The removal action alternatives retained for comparative analysis for groundwater includes No Action (GW1); Expansion of the Existing Groundwater Containment System (GW4), and in-situ chemical oxidation (GW5). These alternatives were compared against their effectiveness, implementability, and cost below.

Effectiveness

Alternative GW1 (No Action) is not effective with respect to any of the evaluation criteria, and will not meet any of the groundwater RAOs or ARARs relevant to water quality, restoration, and anti-degradation.

Alternative GW4 (Expansion of Existing System), however, would be effective in meeting most (but not all) of the removal action objectives that the existing groundwater collection system cannot meet with respect to the additional use of institutional controls, prevention of further migration of the contaminant plume, and improvement of surface water quality. The expanded system would be more effective and efficient in the collection and treatment of contaminated groundwater at the Site. However, although there would likely be some restoration of groundwater quality in both the overburden and bedrock aquifers under the TARS or AOARS given the removal of the most contaminated groundwater in the center of the Site, this alternative by itself does not fully address the source material. This alternative would not be fully effective in meeting the TARS removal action objective without being coupled with a source removal measure (such as SO6 - In-situ Chemical Oxidation). However, this alternative would likely meet the AOARS removal action objective if coupled with any of the active soil alternatives (SO5 or SO6). This alternative could meet groundwater quality and restoration anti-degradation ARARs for the area of attainment scenario, but would also need a groundwater quality standard variance (as per WV 47 CSR 57) for the groundwater underlying the WMA.

The continued off-site discharge of treated groundwater (Option A) would not address one of the surface water RAOs (restoration of surface water drainage quantity). The on-site discharge of treated groundwater (Option B) would contribute to the improvement of base flow conditions in the Site waterways; however, the total volume of groundwater discharge from the Site would comprise less than five percent of the base flow of Sharon Steel Run.

Alternative GW5 (In-situ Chemical Oxidation) would also be effective in meeting most of the removal action objectives, although continuance of the existing groundwater collection and treatment system would be required for a period of time until removal actions objectives are fully attained.. The in-situ chemical oxidation alternative could result in remediation of both the soil and groundwater at the site – both the overburden aquifer (directly) and bedrock aquifer (indirectly) could be fully remediated using this technique, although this alternative would not directly address inorganics. However, some key environmental parameters at the site affecting the overall effectiveness of this alternative include the intrinsic natural oxidant demand of the overburden soil as well as the variable permeability of the overburden soil. The oxidants injected are generally non-selective to both target contaminants and naturally occurring organic matter. Therefore, the presence of natural organic matter in the treatment zone could consume a large portion of the injected oxidants, substantially increasing the cost of this alternative beyond that estimated for the EE/CA.

This is especially important for the Site because of the high organic-rich silts and clays in the overburden related to the historic lacustrine depositional environment. In addition, these sediments are highly variable (sand, silt, clay, gravel sized sediments); consequently, it will be difficult to design a delivery system in both the unsaturated and saturated portion of the overburden to ensure complete contact of oxidant with all impacted subsurface soil.

Neither of these alternatives poses any substantial risks to the community, or unacceptable risks to the site workers during construction activities, although the in-situ chemical oxidation alternative does require additional worker protection measures given the handling hazards of the oxidants.

Implementability

All three alternatives can be implemented immediately, although alternatives GW4 and GW5 each require extensive design components. Further, any design and implementation plan will have to account for the long term management of the tar seeps which periodically occur on the slopes. In addition, GW5 will also require extensive pilot testing to gather the necessary data to design an effective system. There are no reliability concerns with GW4, as the existing groundwater collection and treatment system has proven its performance over the years.

However, the in-situ chemical oxidation alternative may have some reliability concerns related to full applicability at this Site as it relates to the implementation of oxidant delivery and ensuring contact with all subsurface contamination. In addition, given the various types of contaminants at the site, more than one type of oxidant will be required to address all contaminant types; this further complicates the implementation of this alternative. Finally, the application of in-situ chemical oxidation for these contaminant types (tar and heavy weight PAHs) has not often been demonstrated on such a large scale.

Both GW4 and GW5 are proven technologies, and there are various vendors and suppliers available to implement the removal action, although there are fewer vendors and suppliers available for the implementation of the GW5 alternative (as compared to the GW4 alternative). They are also both feasible administratively with respect to permitting considerations and regulatory oversight.

Cost

The capital, annual O&M, and present worth costs for each groundwater alternative are summarized below:

Alternative	Cost		
	Capital	Annual O&M	Total (Present Worth)
GW1 (No Action)	$0	$0	$0
GW4 (Expanded Collection System)	Option A $1,114,000 Option B $2,608,000	Option A $218,00 - $346,000 Option B $508,000 - $636,000	Option A $5,073,000 Option B $10,542,000
GW5 (Chemical Oxidation)	$13,897,000	$356,000 (first five years) $163,000 (last 25 years)	$17,257,000

The lowest present worth cost is for No Action (GW1), followed by the Expansion of the Existing Treatment System (GW3 - Option A (off-site treatment) then Option B (on-site treatment). In-situ Chemical Oxidation (GW5) has the highest present worth analysis cost.

In general, there is a high degree of confidence in the cost estimated for collection, treatment and sewer disposal of groundwater, which is an improvement on the existing system currently employed at the Site. However, there is more variability with the on-site discharge cost estimate, as the groundwater quality could change over time requiring either more or less treatment effort to meet water quality requirements of any on-site discharge; therefore, the long-term operation and maintenance cost could be more or less than that assumed. Overall, differing site conditions identified during pre-design studies (as compared to the current site assumptions) would not substantially affect the cost of this alternative.

The cost estimate developed for the in-situ chemical oxidation GW5 alternative includes a variety of assumptions about the Site that may be different than actual Site conditions. For example, the natural oxidant demand for on-site soils has not yet been measured and could be greater than that assumed in the cost estimate; a higher NOD would require the use of more oxidant, thereby increasing the overall cost. Further, although the general nature and extent of subsurface contamination has been delineated in the areal extent, the vertical extent has not been fully verified. Consequently, the actual volume of impacted soil may be greater than that currently assumed – this too could increase the total cost of this alternative. Therefore, the actual cost of this alternative could be substantially higher than that currently estimated based on the results of more detailed site investigations. This cost uncertainty should be considered as part of the overall evaluation of this alternative.

4.3 ON-SITE SEDIMENT ALTERNATIVES

The removal action alternatives retained for comparative analysis for addressing sediments in the on-site streams and drainage ways include: No Action (OSS1); Excavation and Off-Site Removal (OSS2), Excavation and On-Site Confinement (OSS3), and Monitored Natural Recovery (OSS4). These alternatives were compared against their effectiveness, implementability, and cost below.

Effectiveness

Alternative OSS1 (No Action), if implemented, would not meet the stream sediment RAOs or be protective of public health and the environment. Further, the monitored natural recovery alternative (OSS4) would also not meet the sediment RAOs or be protective of public health and the environment, although OSS4 would provide important data to evaluate the on-going risk to public health and the environment posed by the stream sediments.

The two removal alternatives (OSS2 and OSS3) are exactly the same in their overall effectiveness as they share many common elements, and both meet all of the stream sediment RAOs. Both alternatives would be protective of public health and the environment, meet ARARs, provide good long-term and short-term effectiveness, and are permanent measures for addressing the risk posed by stream sediments (presuming that the sediments are not recontaminated by Site activities). These alternatives remove the contaminated sediments, but rely on either on-site or off-site containment to address the contamination; there is no reduction in the toxicity or volume through treatment. Mobility of contaminants in the sediments is eliminated by complete removal of the contaminated sediments. Both alternatives can reduce all sediment contaminant concentrations remaining in the streambed after removal to below PRGs.

The only difference between these two alternatives is the management of the removed sediments — off-site disposal versus on-site confinement. The on-site confinement alternative offers an advantage in that it eliminates any issues associated with transport to an off-site location (such as the impact of using a large number of trucks [an estimated 250 truckloads of sediment would be transported], tarping, unacceptable moisture content, etc.). However, this alternative is only feasible if the soil capping and containment alternative (SO5) is selected for the main portion of the Site. The off-site disposal option offers the advantage of being placed in a fully engineered Subtitle D compliant landfill with both cap and liner systems. Further, as the contaminant concentrations in the sediments are expected to be relatively low, the disposed material could also provide a beneficial reuse as an alternative daily cover for the off-site landfill.

None of these alternatives pose any substantial risks to the community, or unacceptable risks to the site workers during construction activities, although the sediment removal actions do require additional worker protection measures given the hazards of working in areas along highways (in the vicinity of Unnamed Tributary #2) or around steep slopes (along Sharon Steel Run).

Implementability

All four alternatives can be implemented immediately. Alternatives OSS2 and OSS3 each require a thorough planning effort, including additional characterization in some areas to specifically define the extent of contamination. The off-site disposal alternative would require disposal facility coordination whereas the on-site confinement alternative would have to be coordinated with the design and implementation of the SO5 capping alternative. Both alternatives would be coordinated with the main site soil activities to ensure that the sediments are not recontaminated by future Site activities.

There are no reliability concerns with excavation and disposal type alternatives to address the sediment RAOs at this Site. They have been used successfully in the past to address sediment contamination in Sharon Steel Run and its tributaries. This is the most common removal technique employed throughout the United States. The removal of the residual sediments from Sharon Steel Run could pose some challenges, as the sediment quantities along the rocky bottom in the upper reaches are minimal, and typical excavation techniques (such as the use of excavators) will not likely be effective - alternative methods, such as the use of vacuum trucks or hand excavation, may be required. Streambed restoration techniques are also reliable and commonly employed. Alternatives OSS2 and OSS3 could be implemented within a 1-2 month time period, excluding planning time and restoration efforts.

Although the procedures employed for collecting the sediment quality data necessary for evaluation of monitored natural recovery are very reliable, the monitored natural recovery alternative by itself is not a reliable technology for addressing the sediment RAOs within a reasonable time frame.

Various vendors, suppliers and contractors are readily available to implement the stream sediment removal action. In addition, there are a variety of non-hazardous disposal sites in the region that have the capacity and capabilities to receive wastes similar to the contaminated sediments. Both excavation alternatives are feasible administratively with respect to permitting considerations and regulatory oversight. Both excavation alternatives have a high probability of success with respect to implementation.

Cost

The capital, annual O&M, and present worth costs for each on-site sediment alternative are summarized below:

Alternative	Cost		
	Capital	Annual O&M	Total (Present Worth)
OSS1 (No Action)	$0	$0	$0
OSS2 (Excavation and Off-Site Disposal)	$640,000	$40,000	$805,000
OSS3 (Excavation and On-Site Confinement)	$358,000	$40,000	$523,000
OSS4 (Monitored Natural Recovery)	$0	$95,000	$1,179,000

The lowest present worth cost is for No Action (OSS1), followed by the Excavation and On-Site Confinement (OSS3) and Excavation and Off-Site Disposal (OSS2). Monitored natural recovery (OSS4) is the highest present worth analysis cost.

In general, there is a high degree of confidence in the cost estimated for the two excavation alternatives with respect to known Site conditions (i.e., quantity of sediment to be removed is generally known and would not be subject to a large increase in volume based on unknown conditions). Only the disposal costs associated with the off-site disposal alternative is subject to some variability or volatility on the upside based on transport costs and tipping fees (both of which can be tied to fuel costs).

There is also a high degree of confidence in the cost estimated for the monitored natural recovery alternative.

4.4 RIVER SEDIMENT ALTERNATIVES

The removal action alternatives retained for comparative analysis for addressing sediments in the Monongahela River include: No Action (RS1); Excavation and Off-Site Removal (RS2), Excavation and On-Site Confinement (RS3), and Monitored Natural Recovery (RS4). These alternatives were compared against their effectiveness, implementability, and cost below.

Effectiveness

Alternative RS1 (No Action), if selected, would not meet the Monongahela River sediment RAOs nor be protective of public health and the environment. Further, the monitored natural recovery alternative (RS4) would also not meet the sediment RAOs by itself or be protective of public health and the environment, although RS4 would provide very important data to evaluate the on-going risk to public health and environment posed by the sediments in the Monongahela River.

The two removal alternatives (RS2 and RS3) are exactly the same in their overall effectiveness, and both can meet all of the Monongahela River sediment RAOs. However, depending on the degree of sediment removal, the ultimate protectiveness to public health and the environment would vary.

Removal of the BSD/SSD would meet the river sediment RAOs, and result in an immediate improvement to sediment quality in the river, substantially reducing the overall contaminant load remaining in the river sediments. Lesser levels of sediment removal (i.e., removal of the BSD only) would not meet the river sediment RAOs. However, residual PAH contamination would remain in the river sediment (as the removal alternatives only address the most contaminated sediments). The extent of residual PAH contamination post removal action is unknown, but the risks of residual contaminants would ultimately be further evaluated in the future as part of the final risk evaluation and record of decision (ROD) developed for this Site.

Both sediment removal alternatives would be implemented in a manner that meets ARARs (depending on the degree of sediment removal), provide both long-term and short-term effectiveness, and are permanent measures for addressing the risk posed by river sediments (presuming that the sediments are not recontaminated by Site or other non-Site activities in the upstream watershed).

These alternatives remove some or all of the contaminated sediments, but rely on either on-site or off-site containment to address the management of the contamination; there is no reduction in the toxicity or volume through treatment. Mobility of contaminants in the sediments is wholly or partially eliminated by removal of the contaminated sediments based on the degree of removal. Both alternatives can reduce all sediment contaminant concentrations remaining in the river bottom after removal, again depending on the degree of sediment removal.

Similar to the on-site stream sediment alternatives, the only difference between the two excavation alternatives is the management of the removed sediments – off-site disposal versus on-site confinement. The on-site confinement alternative offers an advantage over off-site disposal in that it eliminates any issues associated with transport to an off-site location. Although trucks could be used to transport the estimated quantity of contaminated sediment associated with the BSD and SSD removal option (~8,900 tons, or nearly 450-500 truckloads), river barges could also be used. However, the on-site confinement alternative is only feasible if the soil capping and containment alternative (SO5) is selected for the Site soil.

With respect to short-term risks to the community and site workers, special safety precautions would have to be implemented to protect community users of the river and removal workers during the sediment removal effort. The river traffic would have to be controlled to reduce navigation hazards, and additional worker protection measures would be required to address the general hazards of working on the river.

Implementability

Alternatives RSI (No Action) and RS4 (Monitored Natural Recovery) would begin immediately because no physical action is required. Alternatives RS2 and RS3 each require a thorough initial planning effort, including additional detailed characterization of the river sediments to specifically define the extent of contamination to be removed and coordination with the US Army Corps of Engineers (who is responsible for this section of the Monongahela River) with respect to navigation. The project team would need to coordinate with river barge operators that use the river for commerce.

There are many challenges associated with environmental dredging. This section of the Monongahela River offers several challenges with respect to technical implementation of any sediment removal action, including limited river bank access for equipment (it is heavily forested with steep slopes near the Site); shallow water in certain sections, which could preclude the use of certain sediment removal techniques; fast river currents with the potential for flash flooding along this section of the river; variable sediment types (ranging from fine grained silts to large rocks); and large elevation differences between the river and the main Site (approximately 130 feet above river level). Although not impractical, it will require extensive planning and design to implement any sediment removal action – further, the larger the extent of sediment removal , the more extensive the planning and design will become. Containment and control of suspended sediments and residual deposition is another key factor to be controlled during the implementation of the dredging work.

Both sediment removal alternatives could require the development of sediment dewatering facilities to accommodate the dewatering of the sediments prior to off-site transport or on-site confinement. The degree of dewatering will likely be higher for the off-site disposal alternative to minimize the cost of water weight disposal. Alternatively, stabilization/solidification of the sediments using various chemicals (polymers, fly ash, etc.) is another alternative that is available to minimize the dewatering requirements. The feasibility of this could only be determined as part of the planning and design phase of the project.

There are no reliability concerns with excavation and disposal type alternatives to address the river sediment RAOs at this Site. River dredging is a common method used to remove sediment accumulations from rivers, and has been successfully employed to remove contaminated sediments from dozens of large rivers throughout the United States. Alternatives RS2 and RS3 could be implemented within a 2-4 month time period, excluding planning time.

Although the data collection techniques used to gather the information for the monitored natural recovery alternative (RS4) are very reliable, the alternative by itself is not a reliable technology for addressing the river sediment RAOs within a reasonable time frame.

Specialty contractors are usually required for large river sediment removal projects – there are many available in the eastern United States; however, their availability may be limited at any given time depending on other dredging project commitments. There are a variety of non-hazardous disposal sites available in the region that have the capacity and capabilities to receive moderate quantities of wastes similar to the contaminated sediments, but may not be feasible for the disposal of large quantities (>50,000 tons). Disposal sites for large quantities of contaminated sediments are available nationwide, but would require transport coordination, likely using a combination of barge and rail.

Both excavation alternatives are feasible administratively with respect to permitting considerations and regulatory oversight. Further, both river sediment excavation alternatives have a high probability of success with respect to implementation.

Cost

The capital, annual O&M, and present worth costs for each river sediment alternative are summarized below:

Alternative	Cost		
	Capital	Annual O&M	Total (Present Worth)
RS1 (No Action)	$0	$0	$0
RS2 (Excavation and Off-Site Disposal)	Option A $3,192,000 Option B $4,440,000	Option A $150,000 Option B $150,000	Option A $3,808,000 Option B $5,056,000
RS3 (Excavation and On-Site Confinement)	Option A $2,786,000 Option B $3,402,000	Option A $150,000 Option B $150,000	Option A $3,953,000 Option B $4,569,000
RS4 (Monitored Natural Recovery)	$42,000	$150,000	$1,904,000

The lowest present worth cost is for No Action (RS1), followed by the various excavation and on-site confinement options (RS3) and excavation and off-site disposal (RS2). Monitored natural recovery (RS4) is in the middle range of costs.

There is a high degree of confidence in the cost estimated for the monitored natural recovery alternative. However, there is a moderate degree of uncertainty associated with the cost estimate provided for the sediment removal alternatives as it relates to the quantities of sediments to be removed as well as the cost to remove and handle the sediments prior to off-site disposal or confinement.

As indicated previously, the lateral and vertical extent of BSD and SSD has not been fully delineated, although the likely quantities of the most highly contaminated sediments are probably captured in the quantities used for the cost estimate.

With respect to the cost for removing and handling the sediments, as discussed previously, this section of the Monongahela River poses challenges for the use of typical river dredging equipment and turbidity controls because of a combination of river access, water depth, water velocity, and proximity of dewatering area constraints. A combination of sediment removal techniques may be used based on the sediment types present (ranging from fine silts, sands, and gravel that are suitable for cutterhead techniques to rocky areas that are suitable for articulated mechanical removal techniques). Given the uncertainty of how this sediment removal action would actually be implemented, the actual costs could be substantially higher (up to 20-50% higher or more) than that presented in the cost estimate for the EE/CA.

Further, depending on the type of sediment removal technique employed, the cost for sediment handling and dewatering may be higher or lower than that included in the cost estimate. All of these factors should be considered when evaluating the costs of the excavation alternatives.

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5.0 RECOMMENDED REMOVAL ACTION ALTERNATIVES

The recommended removal action alternatives for the site are as follows:

5.1 SOIL

The recommended removal action to address the soil RAOs is Alternative SO5 - Capping/Containment. This alternative would address all of the soil RAO's including:

- Prevention of future exposure to human and ecological receptors to contaminated soil through the construction of a barrier;
- Elimination of infiltration of precipitation into the soil through construction of a relatively impermeable barrier, thereby reducing the potential for continued leaching of contaminants in the vadose zone to the groundwater; and
- Elimination of contaminated soil erosion and surface water runoff through construction of a barrier.

This soil removal alternative could also incorporate the sediments to be removed from the on-site waterways and Monongahela River (as discussed below).

The actual extent and configuration of the cap included as part of this alternative would be selected during design. Additional pre-design studies would ultimately establish the size of the cap (18 acres or less); as well as address how the steep slope area with on-going tar seeps will be managed. Select excavation and on-site or off-site disposal of hot spot areas around the perimeter of the Site could further reduce the cap size. The future land use of the site would also influence the selection of the cap profile (i.e., typical RCRA Subtitle D cap, expanded cap, asphalt cap, or other alternative cap that is protective to human health and the environment)

Innovative storm-water management features will be considered to restore the base flow to the waterways adjacent to the Site to enhance overall ecological restoration for the Site. Storm-water management features such as retention basins (permanent wet ponds with capacity to store and discharge storm water), detention basins (dry ponds with the capacity to store and discharge storm water), and infiltration basins placed in unimpacted soil areas outside the cap could be used to enhance the base flow conditions of the Site waterways. These design features would assist in meeting surface water RAOs related to restoration of surface water quality and quantity.

Further, the overall cost of the design and construction of the cap can potentially be reduced through the use of alternative capping materials (such as biosolids, compost, recycled ground glass as a replacement for part of the topsoil), use of alternative capping approaches (such as phytostabilization for the areas on the north side of Sharon Steel Run), and the use of native plants (which would reduce the maintenance interval on the final cap system).

The present worth cost of the various capping scenarios developed for this alternative ranges from $7,142,000 to $8,332,000.

5.2 GROUNDWATER

The recommended removal action to address the groundwater RAOs is Alternative GW4 - Expansion of Existing Groundwater Containment System - Option A - Upgrade of Existing Plant and Continued Discharge to the City of Fairmont Sewer System. This alternative will address all of the risk-related groundwater RAO's, including:

- Prevention of further migration of the contaminant plume and groundwater discharge to the surface water via an expanded groundwater collection and containment system; and
- Prevention of future exposure to workers and residents to contaminated groundwater through institutional controls.

This alternative also helps to address several surface water RAOs, including the mitigation of contaminated surface water discharge and restoration of surface water quality through a reduction in contaminated groundwater discharge to the surface water.

This alternative will not meet the total area groundwater restoration RAO; however, GW4 can achieve groundwater performance standards within the area of attainment within a reasonable time frame (i.e., <10 years). The expansion of the groundwater collection system will allow for more contaminant mass to be removed from the groundwater than the current system. Expanded groundwater collection will slowly contribute to the restoration of the aquifer, but attainment of the groundwater PRGs would take many years to accomplish.

Restoration of the groundwater in the overburden aquifer would only be possible through the removal or treatment of the large volume of contaminated soils which is a continuing source of the groundwater contamination - however, major contaminated soil complete source removal or treatment is not the recommended removal action to address the soil RAOs (see above). However, the capping/containment removal action for the soil will ultimately reduce the infiltration of precipitation through the contaminated soil in the unsaturated zone, thereby reducing some of the source that contributes to groundwater contamination at the Site.

Consequently, the establishment of a Waste Management Area (WMA) is recommended for the overburden aquifer areas as well as the bedrock aquifer. In general, the bedrock aquifer has not been substantially impacted by organic contaminants to date, although it contains some inorganics at concentrations in excess of groundwater PRGs related to changes in aquifer geochemistry caused by the contamination in the overburden aquifer. Continued monitoring of the adjacent overburden and bedrock aquifer areas would be used to confirm the effectiveness of the expanded groundwater containment system for controlling groundwater migration and meeting performance standards in the area of attainment.

The continued discharge of treated groundwater to the City of Fairmont Sewer System is recommended over an on-site treatment and discharge approach because of operational and cost considerations. Given the relatively small volume of groundwater discharge to the Sharon Steel Run system from the Site (3-6 gallons per minute on average), it would be more feasible to design innovative storm-water management features for base flow improvement as part of the soil capping and containment removal action rather than treat and discharge this small volume of groundwater using an on-site system. The use of detention basins, retention basins, and infiltration basins in unimpacted portions of the site to manage storm water would be a more effective way to improve base flow conditions in the area waterways.

The present worth analysis cost for this alternative is $5,073,000.

5.3 ON-SITE SEDIMENT

The recommended removal action to address the on-site sediment RAOs is Alternative OSS3 - Excavation and On-Site Confinement. This alternative will address all of the on-site sediment RAOs, including:

- Prevention of further migration of the on-site contaminated sediments to the Monongahela River, as they will be consolidated and confined beneath a cap;
- Prevention of future exposure of human and ecological receptors to contaminated sediments as they will be removed and confined; and
- Restoration of sediment quality to acceptable human health/ecological risk levels through removal and the promotion of ecological function through restoration actions conducted as part of sediment removal activities.

Approximately 3,300 cubic yards of sediments would be removed from the on-site waterways using various means, and then placed on the main part of the Site for dewatering (with collection and treatment of decant water), consolidation with the on-site soil stockpile and Monongahela River sediments, and amendment (if necessary for stabilization/solidification) prior to incorporation into the foundation layer for the soil cap. Restoration efforts in the waterways will also be monitored for a period of five years after the completion of removal activities.

The present worth cost for this alternative is $523,000.

5.4 MONONGAHELA RIVER SEDIMENT

The recommended removal action to address the Monongahela River sediment RAOs is Alternative RS2 - Excavation and Off-Site Disposal/Treatment (Removal Option B) to address the bottom solid deposits (BSD) and stained sediment deposits (SSD).

This alternative will address most of the Monongahela River sediment RAOs, including:

- Removal of the BSD from the river bottom, thereby uncovering smothered benthic habitat and eliminating a source of continued contaminant migration to other parts of the river;
- Prevention of exposure by receptors to the most contaminated sediments (BSD and SSD) through removal and off-site disposal/treatment of these highly contaminated sediments; and
- Restoration of sediment quality through the removal and off-site disposal of highly contaminated sediments to promote improved ecological function of the waterway.

Approximately 5,400 cubic yards of BSD and SSD impacted sediments would be removed from the Monongahela River using various means, and then would be temporarily staged on the main part of the Site for dewatering (with collection and treatment of decant water) and amendment (if necessary for stabilization/solidification) prior to off-site disposal/treatment.

The removal of the most contaminated sediments in the Monongahela River, coupled with the elimination of further sediment transport from the Site through the construction of an on-site cap, better containment of seeps, and the removal of on-site sediments, should reduce the COC concentration and mass enough to allow natural attenuation processes to begin to reduce the exposure to safe levels over time. This section of river should begin to restore itself in the future once the most contaminated sediments are removed. Annual monitoring for an initial period of 5 years will be used to assess the restoration of the Monongahela River sediments upon completion of the other removal actions. The risks of residual contaminants in the river sediments after the completion of the removal action will ultimately be further evaluated in the future as part of the final risk evaluation and record of decision (ROD) developed for this Site.

The present worth cost for this alternative is $5,056,000.

5.5 SUMMARY

The total estimated cost for all of these removal actions is as follows:

Groundwater - Alternative GW4		$5,073,000
Soil - Alternative SO5		$7,142,000 to $8,332,000
On-Site Sediments - Alternative OSS3		$523,000
Monongahela River Sediments - Alternatives RS2 (Option B) and RS4		$5,056,000
	Total	$17,794,000 to $18,984,000

It is estimated that the full implementation of these alternatives would take 24 to 36 months, including all design and initial construction elements. For cost estimating purposes, groundwater monitoring is assumed to be conducted over a period of 30 years, whereas initial stream and sediment restoration monitoring is assumed to be conducted over a period of 5 years.

Tables

TABLES

TABLE 2-1
SUMMARY OF KEY ARARs FOR BIG JOHN SALVAGE REMOVAL ALTERNATIVES

Except where noted, the following are ARARs for all alternatives except No-Action.

ARAR OR TBC	LEGAL CITATION	CLASSIFICATION	SUMMARY OF REQUIREMENT	FURTHER SPECIFICATION AND/OR DETAILS REGARDING ARARs IN THE CONTEXT OF REMEDIATION
Chemical Specific				
Safe Drinking Water Act: Maximum Contaminant Levels and Maximum Contaminant Level Goals	42 USC § 300(g-1); 40 CFR §§ 141.11-13; 40 CFR §§ 141.50-51	Relevant and Appropriate	MCLs are enforceable standards for public drinking water supply systems which have at least 15 service connections or are used by at least 25 persons. MCLGs are non-enforceable health-based goals for similar systems. These requirements are not directly applicable since ground water in the vicinity of the Site is not used as a private drinking water supply. However, under the circumstances of this Site, MCLs and MCLGs are relevant and appropriate requirements which were considered in establishing ground water cleanup levels.	EPA regulation establishes that, where relevant and appropriate, MCLGs set at levels above zero will be attained at CERCLA sites and that, where the MCLG is set at zero, the MCL will be attained. The MCLs/non-zero MCLGs will be met in ground water within the "area of attainment." The more stringent of the Federal or State MCLGs/MCLs will be attained.
WV Requirements Governing Groundwater Standards	WV 46 CSR 12-3.1 to 3.5.a and Appendix A	Relevant and Appropriate		
WV Requirements Governing [Surface] Water Quality Standards	WV 47 CSR 2-3.2(a)-(f), 4.1, 4.1(a) and 4.1(b), 6, 7.1.(c) and Appendix E	Relevant and Appropriate	It regulates the discharge or deposit of sewage, industrial wastes and other wastes into the waters of the state, and establishes water quality standards for the waters of the State standing or flowing over the surface of the State.	Relevant and appropriate to any alternative which includes discharge of contaminants to Sharon Steel Run and the Monongahela River. The regulation requires that the water quality be protective of the respective State-designated use(s) and cites both quantitative and narrative standards which must be met in-stream. Appendix E lists contaminant-specific concentrations which must be met in-stream to be protective. The

ARAR OR TBC	LEGAL CITATION	CLASSIFICATION	SUMMARY OF REQUIREMENT	FURTHER SPECIFICATION AND/OR DETAILS REGARDING ARARS IN THE CONTEXT OF REMEDIATION
(Continued from previous page)				regulation includes an anti-degradation policy provision (47 CSR 2-4) which is relevant and appropriate to the industrial wastes referred to as black semi-solid deposit (BSD) covering a portion of the bottom of the river. The BSD presents an unacceptable risk to human health and the environment.
Action Specific				
Clean Water Act: National Discharge Elimination System Requirements	40 CFR § 123.25, incorporating sections of §122	Relevant and Appropriate	These are enforceable standards for direct discharge of pollutants to surface waters of the United States.	Alternative GW4-Option B would include a point source discharge. Any point source discharge to the unnamed tributary or Monongahela River would meet the substantive requirements of this regulation. Any alternative which includes discharging water to the Fairmont POTW will include pretreatment to meet POTW's pretreatment standards No permits shall be required for on-site discharges.
WV National Pollutant Discharge Elimination System (NPDES) Program	WV 47 CSR 10-3 to 10-8 and 10-11 to 10-14	Applicable	These are standards for discharging pollutants into surface waters of the State including provisions requiring that appropriate pre-treatment standards be met if the discharge will be directed to a POTW	
Iron and Manganese TMDLs for the Unnamed Tributary at Sharon Steel Run, West Virginia U.S. EPA, Region 3, September 2001	No legal citation	TBC	EPA established TMDLs for the on-site streams for the protection of the Monongahela River.	Note that EPA-established TMDLs are neither promulgated as rules, nor enforceable, and, therefore, are not ARARs. However, even if a TMDL is not an ARAR, it was considered in setting protective cleanup levels. Storm water management plan will consider potential for increasing clean runoff to Sharon Steel Run.
WV Air Pollution Control Act	WV 45 CSR 4-3	Relevant and Appropriate	Regulations to prevent and control the discharge of air pollutants into the open air which causes or contributes to an objectionable odor or odors	The cleanup will be conducted in a manner which complies with the substantive requirement of this regulation.

ARAR OR TBC	LEGAL CITATION	CLASSIFICATION	SUMMARY OF REQUIREMENT	FURTHER SPECIFICATION AND/OR DETAILS REGARDING ARARs IN THE CONTEXT OF REMEDIATION
WV Air Pollution Control Act	WV 45 CSR 25-4.3	Relevant and Appropriate	Facilities shall be designed, constructed, maintained and operated in a manner to minimize unplanned releases of hazardous constituents to the air.	During excavation, thermal or chemical oxidation, capping, and other activities, measures will be employed to prevent unplanned releases of hazardous constituents, including fugitive air emissions.
RCRA Subtitle D, Municipal Solid Waste Landfills	40 CFR 258.12, 23, 26, 40(a)(1), 40(c), and 40(d), 51, 53, 60 and 61	Relevant and Appropriate	Establishes requirements for municipal solid waste landfills, including wetlands, landfill gas management, storm water run-on/run-off, ground water monitoring and analysis, closure requirements, and post-closure requirements.	These regulations are relevant and appropriate to the design, construction and maintenance of the cap constructed to reduce the potential for migration of contaminants to the ground water or Monongahela River. This regulation would be insufficient to adequately contain wastes or contaminated soils which are determined to be RCRA characteristic wastes.
WV Hazardous Waste Management Rule	WV 33 CSR 20.8.1	Relevant and Appropriate	Regulates treatment, storage and disposal of hazardous waste for protection of the public health and safety and the environment. Incorporates by reference federal law on treatment, land filling, and disposal of hazardous waste (40 CFR 265 subsections listed below).	Alternatives including containment with a multi-layer cap will be designed and constructed to minimize infiltration of precipitation by having a low permeability, promote drainage and minimize erosion of cover over the long term.
RCRA Requirements for Landfill Caps	40 CFR 265.19 40 CFR 265.111 40 CFR 265.310(a)	Relevant and Appropriate	Requirements for landfill cap performance and post-closure maintenance. Design and construct to minimize maintenance necessary to control, minimize or eliminate escape of hazardous constituents to ground water or surface water.	

ARAR or TBC	Legal Citation	Classification	Summary of Requirement	Further Specification and/or Details Regarding ARARs in the Context of Remediation
WV Hazardous Waste Management Rule	WV 33 CSR 20	Relevant and Appropriate	Regulates generation, treatment, storage and disposal of hazardous waste for protection of the public health and safety and the environment. Incorporates by referenced federal law on thermal treatment, land filling, and disposal of hazardous waste.	Could apply if the capping option is selected for the contaminated soil.
WV Groundwater Protection Regulations	WV 47 CSR 58-4.2 to 4.8	Relevant and Appropriate	Establish requirements for groundwater protection.	Site cleanup and construction activities will be conducted in manner that prevents release of hazardous substances to the groundwater.
West Virginia Uniform Environmental Covenants Act	WV Code Chapter 22, Article 22B	TBC	Procedures for implementing environmentally based institutional controls	Land use restrictions will be implemented prohibiting residential use of property and installation of drinking water wells within the waste management area
Occupational Safety and Health Act (OSHA)	29 CFR 1910.120	Applicable	Establishes health and safety requirements for workers on hazardous waste sites and construction sites.	These regulations apply to site workers who have a reasonable potential for exposure to hazardous substances while on the site.
EPA Soil Screening Levels (SSLs) Guidance and Generic Levels EPA 540-R-96-018	No legal citation	TBC	Guidance that provides a methodology to calculate risk-based, site-specific SSLs for contaminants in soil that may be used to identify areas needing further investigation. Also provides generic SSLs for a number of soil contaminants.	This guidance document was considered during the development of soil-to-groundwater clean-up levels and preliminary remediation goals (PRGs).
Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments, EPA/530-SW-89-047, July 1989	No legal citation	TBC	Establishes guidance for appropriate design and construction of landfill covers.	This guidance document is relevant to alternatives including a multi-layer cap to contain hazardous substances located in the surface and subsurface soil.

ARAR OR TBC	LEGAL CITATION	CLASSIFICATION	SUMMARY OF REQUIREMENT	FURTHER SPECIFICATION AND/OR DETAILS REGARDING ARARS IN THE CONTEXT OF REMEDIATION
Location Specific				
Federal Protection of Wetlands Executive Order	Executive Order 11990	TBC	Requires the federal agencies to minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands.	Cleanup will be conducted in a manner which minimizes loss or degradation of wetland areas. Design will consider potential for increasing the flow of clean water in waterways.
Fish and Wildlife Coordination Act	16 U.S.C. § 662	Relevant and Appropriate	If waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or otherwise controlled or modified for any purpose, by any department or agency of the United States, consultation with the United States Fish and Wildlife Service is required, with a view to the conservation of wildlife resources.	EPA will continue to consult with USFWS and consider reasonable steps to minimize any adverse impact to wildlife resources during any contaminated sludge removal from the bottom of the Monongahela River
Rivers and Harbors Act	Section 10, 33 USC § 403	Applicable	Requires coordination and approval of the Army Corps of Engineers to excavate, fill or alter any navigable waterway	EPA will coordinate with US Army Corps to meet any substantive requirements deemed appropriate during the removal of tarry wastes from the river bottom.

TABLE 2-2
PROPOSED PRELIMINARY REMOVAL GOAL SUMMARY - ALL MEDIA
BIG JOHN SALVAGE/HOULT ROAD SITE
ENGINEERING EVALUATION/COST ANALYSIS

CHEMICAL OF CONCERN	PROPOSED PRG FOR EE/CA	BASIS FOR PRG SELECTION
SOIL (mg/kg)		
Arsenic	20	Protection of Industrial Uses
Total benzo(a)pyrene (BAP) equivalents	4.6	Protection of Industrial Uses
Total PAHs	26	Protection of Ecological Receptors
Naphthalene	10	Proteciton of Industrial Uses/Soil to Groundwater
Copper	35	Protection of Ecological Receptors
Mercury	1	Protection of Ecological Receptors
Zinc	95	Protection of Ecological Receptors
Benzene	0.03	Soil to Groundwater
1,2-Dibromo-3-chloropropane	0.02	Soil to Groundwater
2-Methylnaphthalene	1	Soil to Groundwater
SEDIMENT - ON-SITE (mg/kg)		
Total BAP equivalents	0.4	Protection of Recreational Uses
Total PAHs	26	Protection of Ecological Receptors
Lead	130	Protection of Ecological Receptors
Mercury	1	Protection of Ecological Receptors
Cadmium	1	Protection of Ecological Receptors
SURFACE WATER - ON-SITE (ug/L)		
Benzo(a)anthracene	0.2/GOAL - 0.02 (1)	Protection of Recreational Uses
Benzo(a)pyrene	0.03/GOAL - 0.02 (1)	Protection of Recreational Uses
Benzo(b)fluoranthene	0.5/GOAL - 0.02 (1)	Protection of Recreational Uses
Dibenzo(a,h)anthracene	0.01/GOAL - 0.02 (1)	Protection of Recreational Uses
Indeno(1,2,3-cd)pyrene	0.06/GOAL - 0.02 (1)	Protection of Recreational Uses
Fluoranthene	370	Protection of Ecological Receptors
Naphthalene	11	Protection of Ecological Receptors
Pyrene	0.06	Protection of Ecological Receptors
Benzene	51	Protection of Ecological Receptors
Aluminum	750	Protection of Ecological Receptors
Barium	40	Protection of Ecological Receptors
Cyanide	5	Protection of Ecological Receptors
Cadmium	0.8 - 1.1	Protection of Ecological Receptors
Iron	1500	Protection of Ecological Receptors
Lead	4.5 - 8.4	Protection of Ecological Receptors
Mercury	2.4	Protection of Ecological Receptors
Manganese	1000	Protection of Ecological Receptors

TABLE 2-2
PROPOSED PRELIMINARY REMOVAL GOAL SUMMARY - ALL MEDIA
BIG JOHN SALVAGE/HOULT ROAD SITE
ENGINEERING EVALUATION/COST ANALYSIS

CHEMICAL OF CONCERN	PROPOSED PRG FOR EE/CA	BASIS FOR PRG SELECTION
GROUNDWATER (ug/L)		
1,2-Dibromo-3-chloropropane	**0.2/GOAL - 0.03 (3)**	**Protection of Future Residential Uses**
2-Methylnaphthalene	**27**	**Protection of Future Residential Uses**
Benzo(a)anthracene	**0.2/GOAL - 0.005 (2)**	**Protection of Future Residential Uses**
Benzo(b)fluoranthene	**0.3/GOAL - 0.003 (2)**	**Protection of Future Residential Uses**
Benzo(k)fluoranthene	**0.5/GOAL - 0.03 (2)**	**Protection of Future Residential Uses**
Benzo(a)pyrene (and total BAP equivalents)	**0.2/GOAL - 0.0009 (3)**	**Protection of Future Residential Uses**
Naphthalene	**62**	**Protection of Future Residential Uses**
Benzene	**5**	**Protection of Future Residential Uses**
Arsenic	**10/GOAL - 0.09 (3)**	**Protection of Future Residential Uses**
Iron	**2300**	**Protection of Future Residential Uses**
Manganese	**270**	**Protection of Future Residential Uses**
Thallium	**2/GOAL - 0.6 (3)**	**Protection of Future Residential Uses**
Cyanide	**200**	**Protection of Future Residential Uses**
Vanadium	**12**	**Protection of Future Residential Uses**
MONONGAHELA RIVER SEDIMENT (mg/kg)		
Black Semi-Solid Deposit (BSD)	**COMPLETE REMOVAL**	**Risk reduction - Human Health/Environment**
Visually Stained Sediments	**COMPLETE REMOVAL**	**Risk reduction - Human Health/Environment**
Total BAP equivalents	**0.4 - GOAL (4)**	**Protection of Recreational Uses**
Total PAHs	**26 - GOAL (4)**	**Protection of Ecological Receptors**

(1) First value presented is typical detection limit available from routine analytical methods. Second value is ultimate goal based on meeting West Virginia AWQC standards for protection of ecological receptors.

(2) First value presented is typical detection limit available from routine analytical methods. Second value is ultimate goal based on meeting human health risk goals (cancer risk = 1E-05, or HI = 1.0)

(3) First value presented is the maximum contaminant level (MCL). Second value is ultimate goal based on meeting human health risk goals (cancer risk = 1E-05, or HI = 1.0)

(4) Value presented is for reference only - this value represents a potential goal for protection of human health and environment in river sediments to be considered in the future after completion of any non-time critical removal action and final risk evaluation of river sediments.

TABLE 2-3
REMOVAL PERFORMANCE STANDARDS
BIG JOHN SALVAGE/HOULT ROAD SITE

CHEMICAL OF CONCERN	REMOVAL PERFORMANCE STANDARDS	BASIS FOR REMOVAL PERFORMANCE STANDARD SELECTION
SOIL (mg/kg)		
Arsenic	20	*Protection of Industrial Uses*
Total benzo(a)pyrene (BAP) equivalents	4.6	Protection of Industrial Uses
Total PAHs	26	Protection of Ecological Receptors
Naphthalene	10	Proteciton of Industrial Uses/Soil to Groundwater
Copper	35	Protection of Ecological Receptors
Mercury	1	Protection of Ecological Receptors
Zinc	95	Protection of Ecological Receptors
Benzene	0.03	Soil to Groundwater
1,2-Dibromo-3-chloropropane	0.02	Soil to Groundwater
2-Methylnaphthalene	1	Soil to Groundwater
SEDIMENT - ON-SITE (mg/kg)		
Total BAP equivalents	0.4	Protection of Recreational Uses
Total PAHs	26	Protection of Ecological Receptors
Lead	130	Protection of Ecological Receptors
Mercury	1	Protection of Ecological Receptors
Cadmium	1	Protection of Ecological Receptors
SURFACE WATER - ON-SITE (ug/L)		
Benzo(a)anthracene	0.2/GOAL - 0.02 (1)	Protection of Recreational Uses
Benzo(a)pyrene	0.03/GOAL - 0.02 (1)	Protection of Recreational Uses
Benzo(b)fluoranthene	0.5/GOAL - 0.02 (1)	Protection of Recreational Uses
Dibenzo(a,h)anthracene	0.02	Protection of Recreational Uses
Indeno(1,2,3-cd)pyrene	0.06/GOAL - 0.02 (1)	Protection of Recreational Uses
Fluoranthene	370	Protection of Ecological Receptors
Naphthalene	11	Protection of Ecological Receptors
Pyrene	0.06	Protection of Ecological Receptors
Benzene	51	Protection of Ecological Receptors
Aluminum	750	Protection of Ecological Receptors
Barium	40	Protection of Ecological Receptors
Cyanide	5	Protection of Ecological Receptors
Cadmium	0.8 - 1.1	Protection of Ecological Receptors
Iron	1500	Protection of Ecological Receptors
Lead	4.5 - 8.4	Protection of Ecological Receptors
Mercury	2.4	Protection of Ecological Receptors
Manganese	1000	Protection of Ecological Receptors

TABLE 2-3
REMOVAL PERFORMANCE STANDARDS
BIG JOHN SALVAGE/HOULT ROAD SITE

CHEMICAL OF CONCERN	REMOVAL PERFORMANCE STANDARDS	BASIS FOR REMOVAL PERFORMANCE STANDARD SELECTION
GROUNDWATER (ug/L)*		
1,2-Dibromo-3-chloropropane	**0.2 (3)**	**Protection of Future Residential Uses**
2-Methylnaphthalene	**27**	**Protection of Future Residential Uses**
Benzo(a)anthracene	**0.2/GOAL - 0.005 (2)**	**Protection of Future Residential Uses**
Benzo(b)fluoranthene	**0.3/GOAL - 0.003 (2)**	**Protection of Future Residential Uses**
Benzo(k)fluoranthene	**0.5/GOAL - 0.03 (2)**	**Protection of Future Residential Uses**
Benzo(a)pyrene (and total BAP equivalents)	**0.2 (3)**	**Protection of Future Residential Uses**
Naphthalene	**62**	**Protection of Future Residential Uses**
Benzene	**5**	**Protection of Future Residential Uses**
Arsenic	**10 (3)**	**Protection of Future Residential Uses**
Iron	**2300**	**Protection of Future Residential Uses**
Manganese	**270**	**Protection of Future Residential Uses**
Thallium	**2 (3)**	**Protection of Future Residential Uses**
Cyanide	**200**	**Protection of Future Residential Uses**
Vanadium	**12**	**Protection of Future Residential Uses**
MONONGAHELA RIVER SEDIMENT (mg/kg)		
Black Semi-Solid Deposit (BSD)	COMPLETE REMOVAL	**Risk reduction - Human Health/Environment**
Visually Stained Sediments	REMOVAL (4)	**Risk reduction - Human Health/Environment**

(1) First value presented is typical detection limit available from routine analytical methods. Second value is ultimate goal based on meeting West Virginia AWQC standards for protection of ecological receptors.

(2) First value presented is typical detection limit available from routine analytical methods. Second value is ultimate goal based on meeting human health risk goals (cancer risk = 1E-05; or HI = 1.0)

(3) Value presented is the maximum contaminant level (MCL).

(4) Complete removal or isolate post-excavation residual with earthen material

* The groundwater performance standards apply to the "area of attainment."

Figures

FIGURES

Figure 1-1

General Location Map

Big John Salvage - Hoult Road Site

Fairmont, West Virginia

NOT TO SCALE

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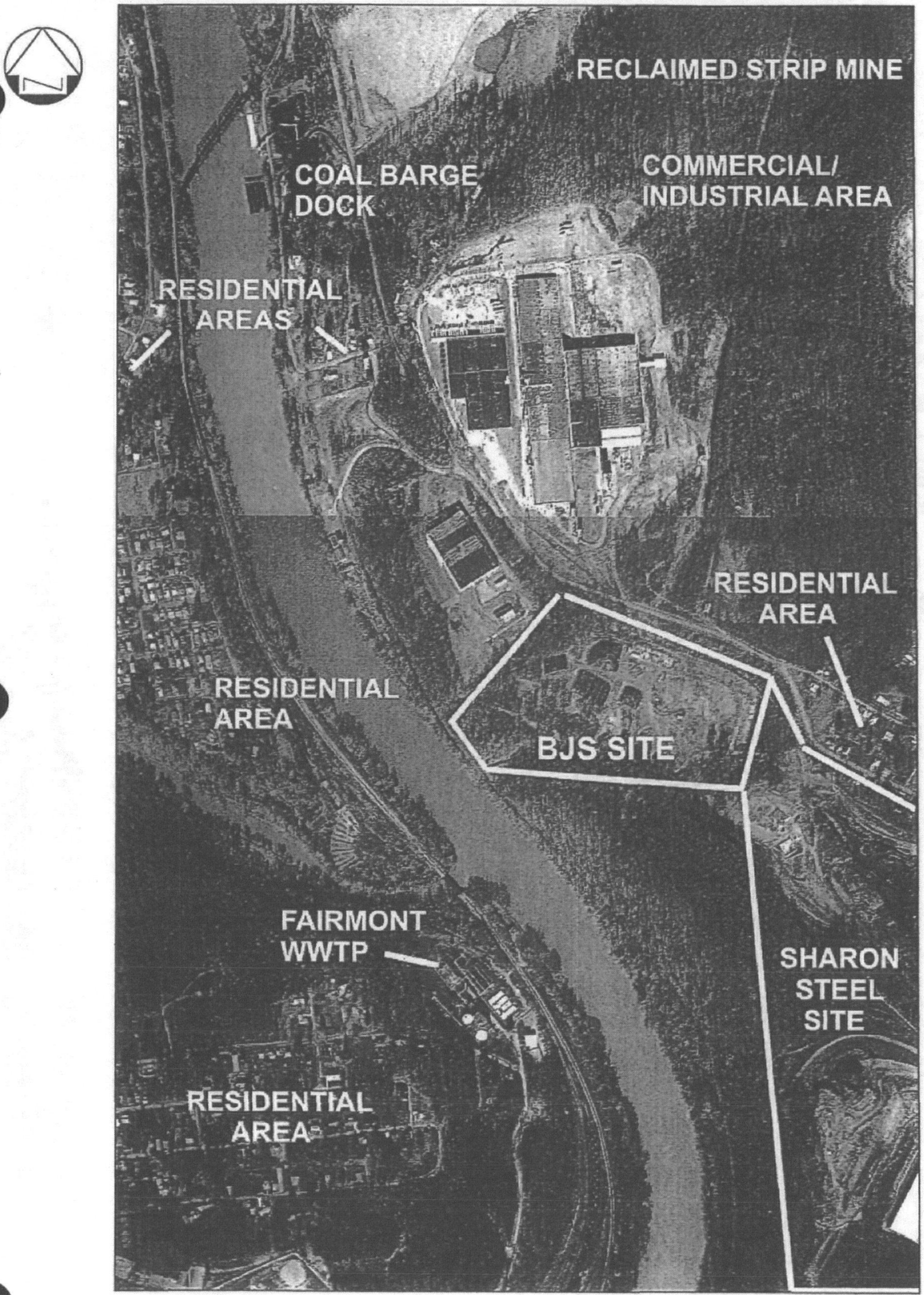

Figure 1-2

March 2005 - Aerial Photograph
Big John Salvage - Hoult Road Site
Fairmont, West Virginia

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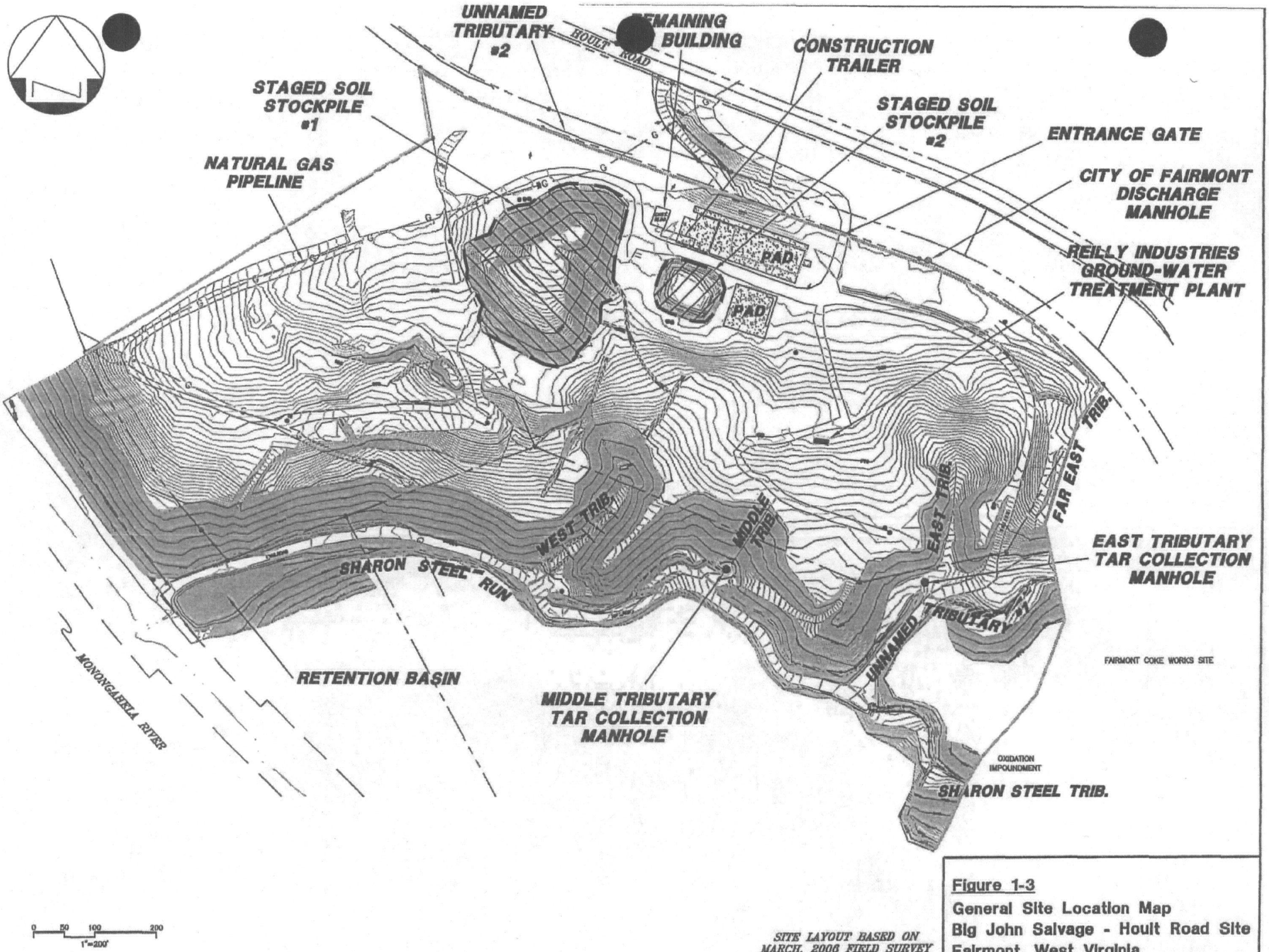

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

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Figure 1-3

General Site Location Map
Big John Salvage - Hoult Road Site
Fairmont, West Virginia

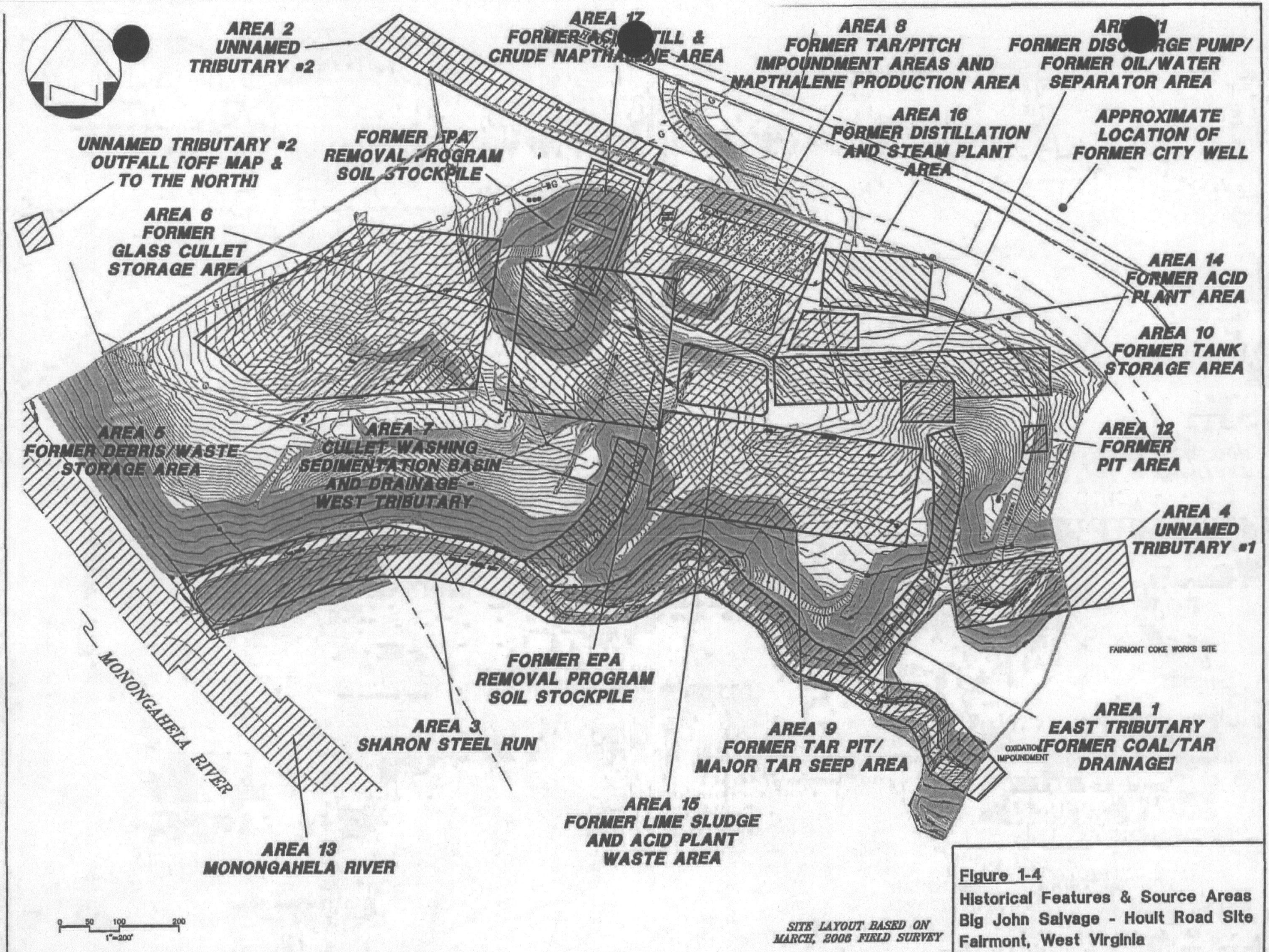

Figure 1-4

Historical Features & Source Areas
Big John Salvage - Hoult Road Site
Fairmont, West Virginia

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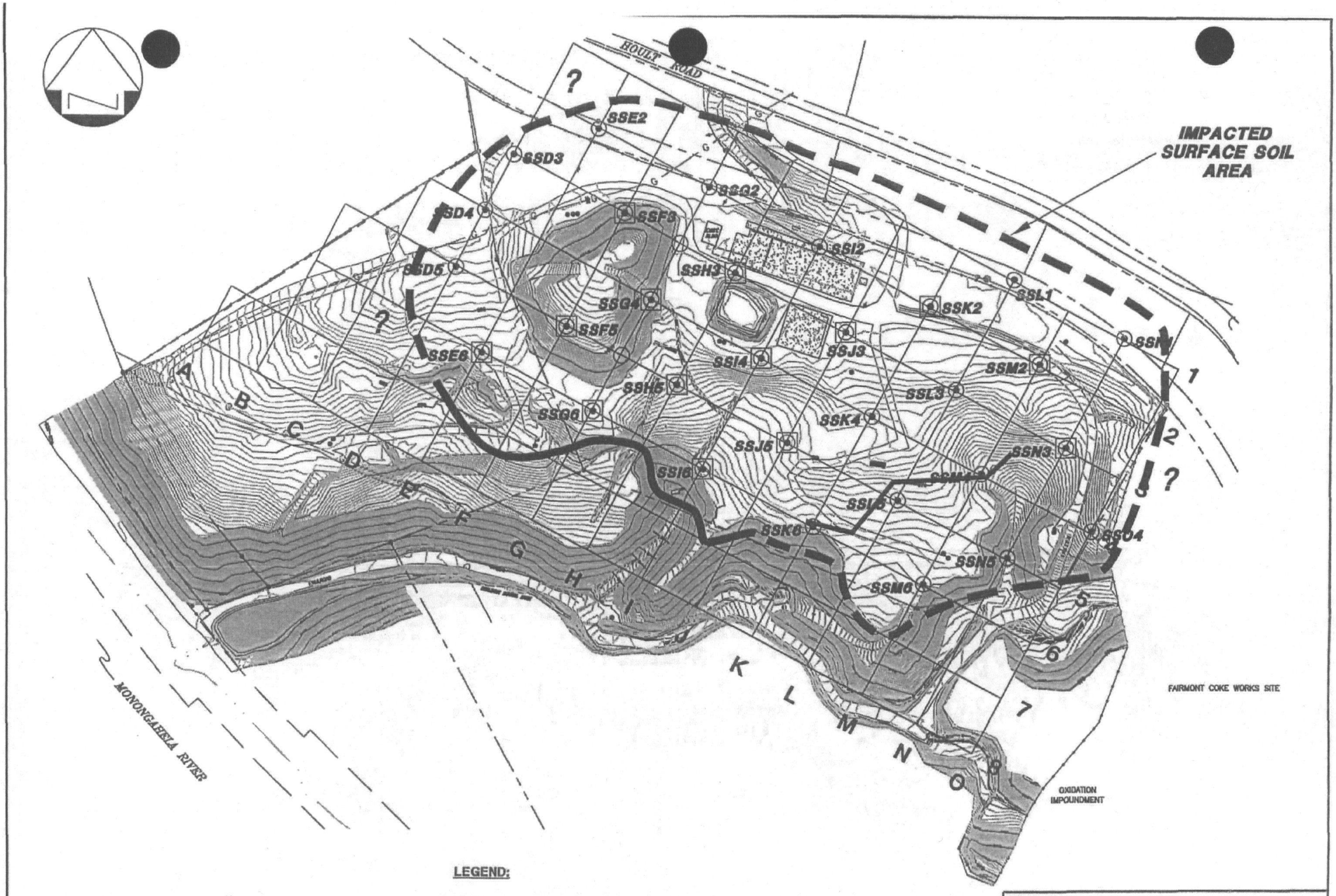


LEGEND:

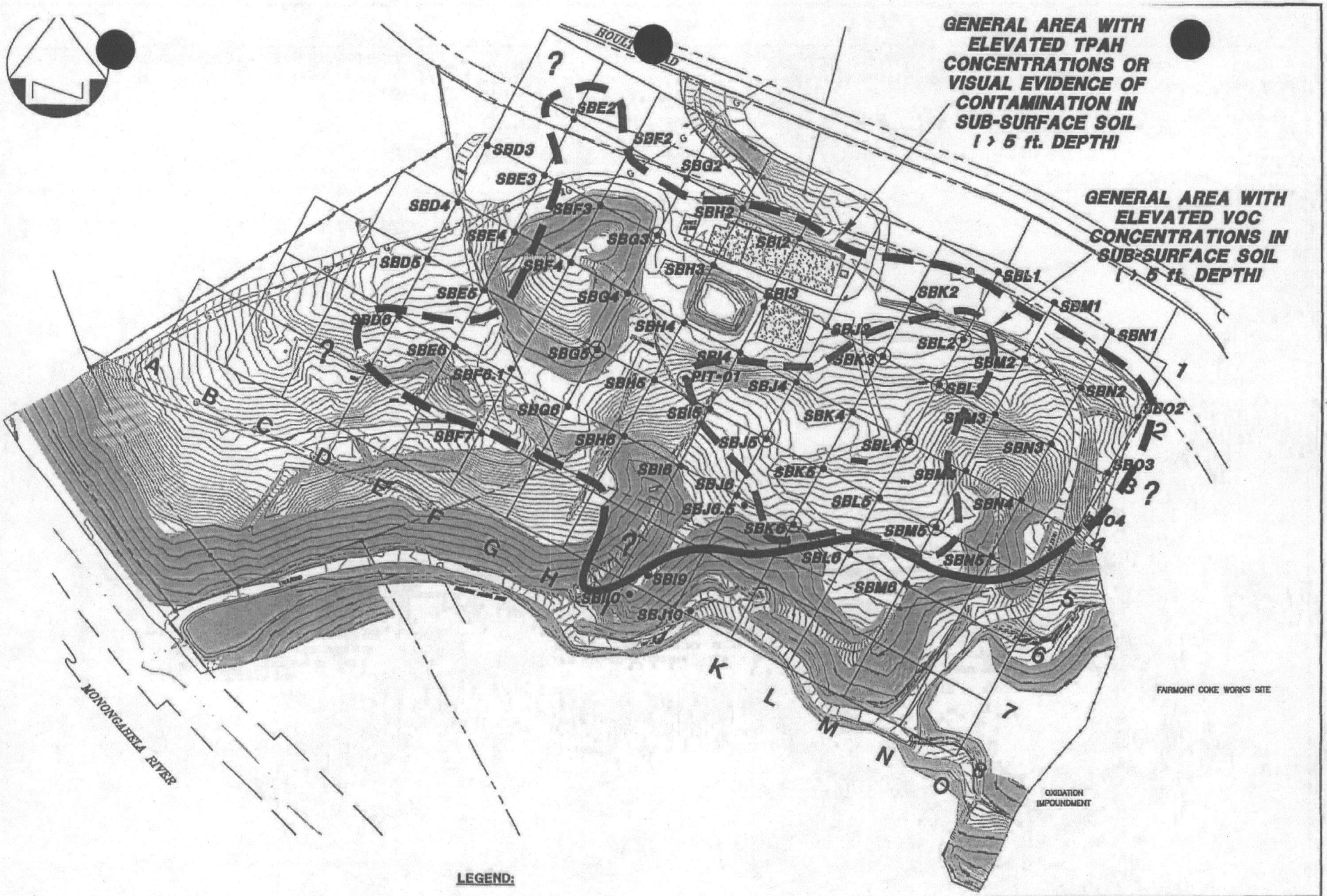
SSD3 ⊙ EXISTING ON-SITE SURFACE SOIL SAMPLE LOCATIONS (30 locations – 200 ft. Grid)

SSD6 ▣ LOCATIONS DISTURBED AFTER APRIL 2005, BY EARTH-MOVING ACTIVITIES

0 50 100 200
1"=200'

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 2-1
Impacted Surface Soil Area Location Map
Big John Salvage - Hoult Road Site
Fairmont, West Virginia



LEGEND:

SBD3 ● EXISTING SUBSURFACE SOIL BORING LOCATIONS (APRIL, 2005) (62 locations – 100 ft. Grid)

SBK3 ⦿ ELEVATED CONCENTRATION LEVELS

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

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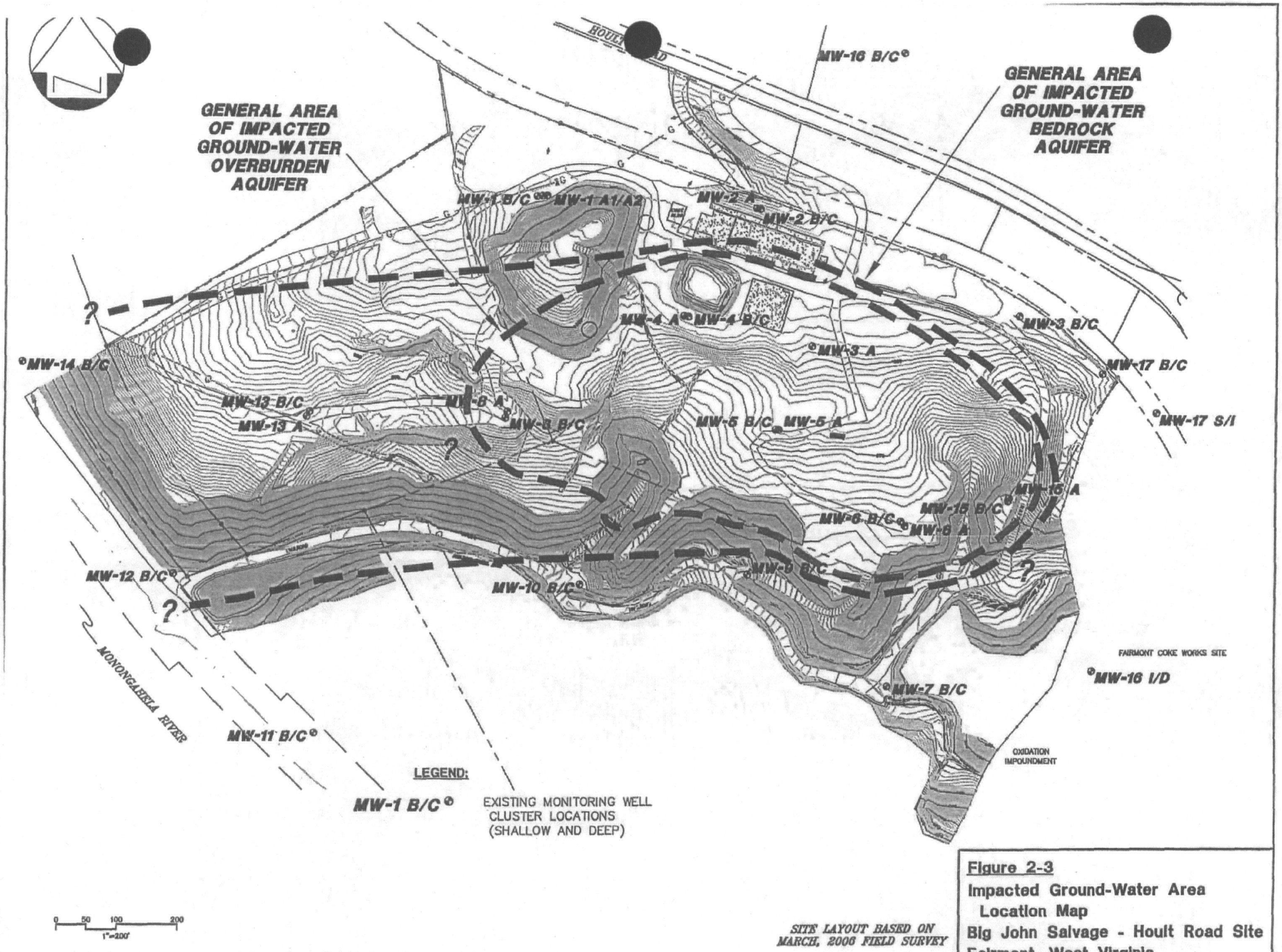
Figure 2-2

Impacted Sub-Surface Soil Area Location Map

Big John Salvage - Hoult Road Site

Fairmont, West Virginia



SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 2-3
Impacted Ground-Water Area Location Map
Big John Salvage - Hoult Road Site
Fairmont, West Virginia

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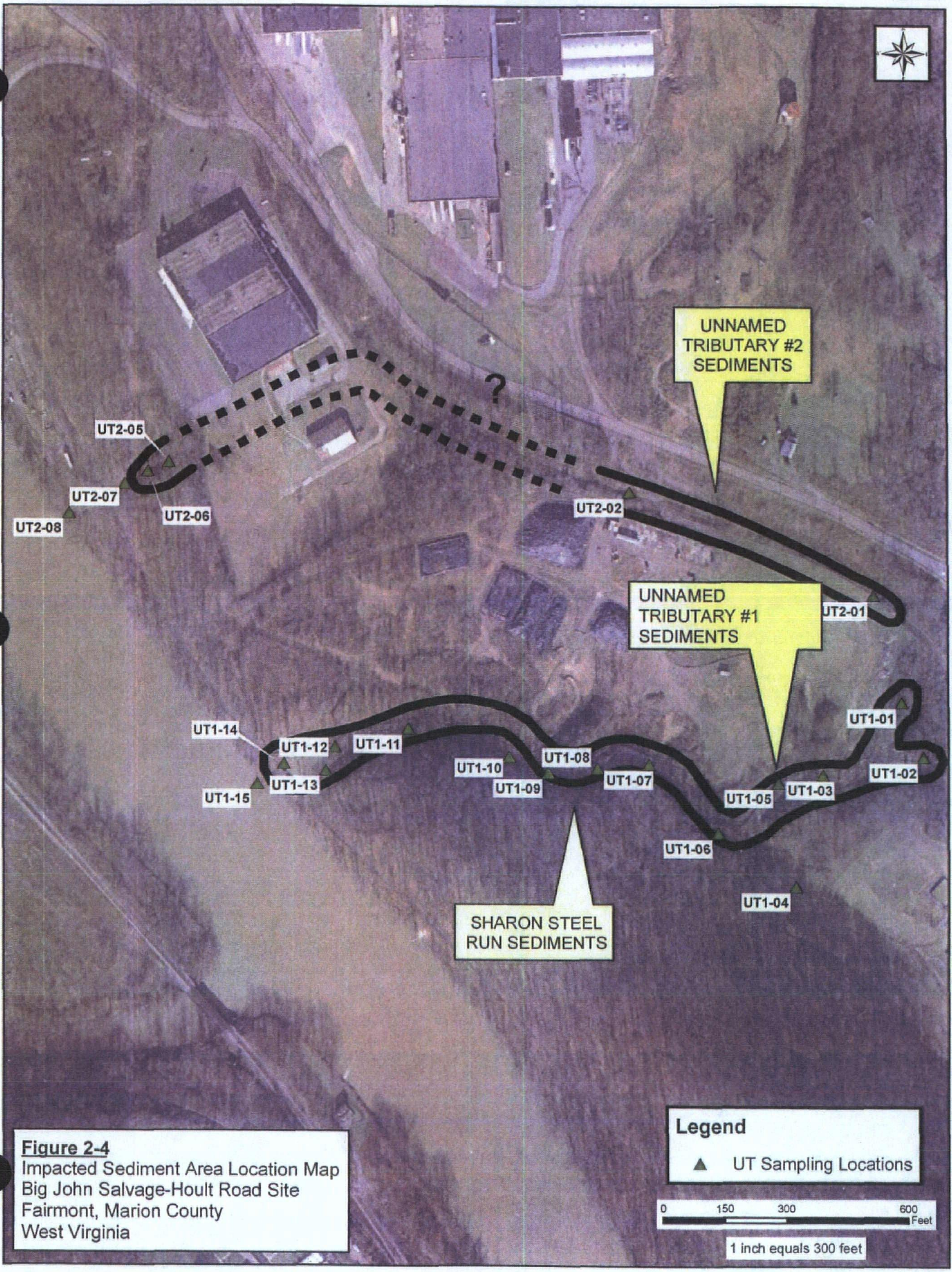

Figure 2-4
Impacted Sediment Area Location Map
Big John Salvage-Hoult Road Site
Fairmont, Marion County
West Virginia

N:\Projects\T47121 Big John Salvage RI-FS\Data\GIS\Maps\Figure 4-9 Impacted Sediment Area.mxd

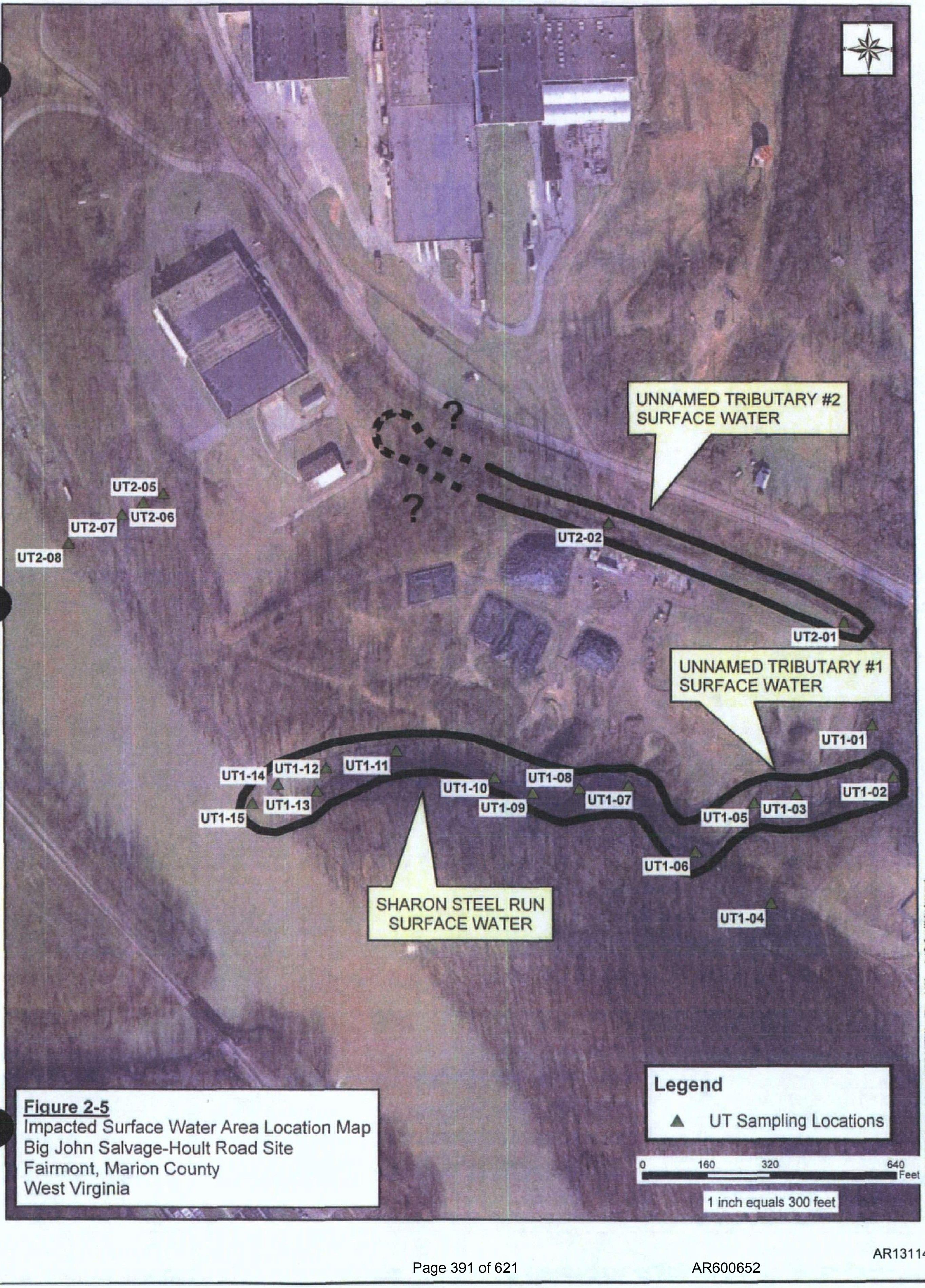

Figure 2-5
Impacted Surface Water Area Location Map
Big John Salvage-Hoult Road Site
Fairmont, Marion County
West Virginia

N:\Projects\TD00001T47121 Big John Salvage RI-FS\Data\GIS\Maps\Figure 4-12 Impacted Surface Water Area.mxd

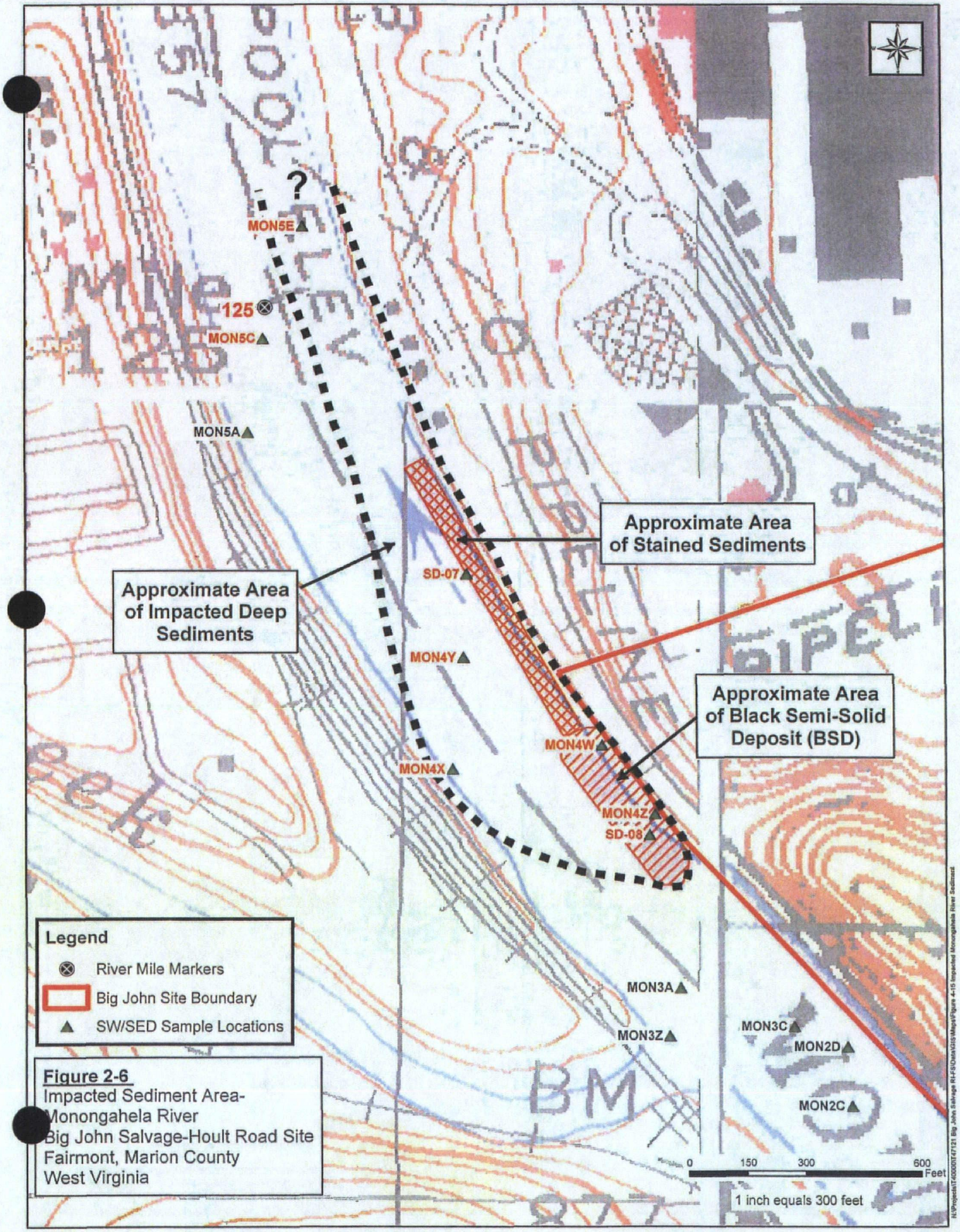

Figure 2-6
Impacted Sediment Area-
Monongahela River
Big John Salvage-Hoult Road Site
Fairmont, Marion County
West Virginia

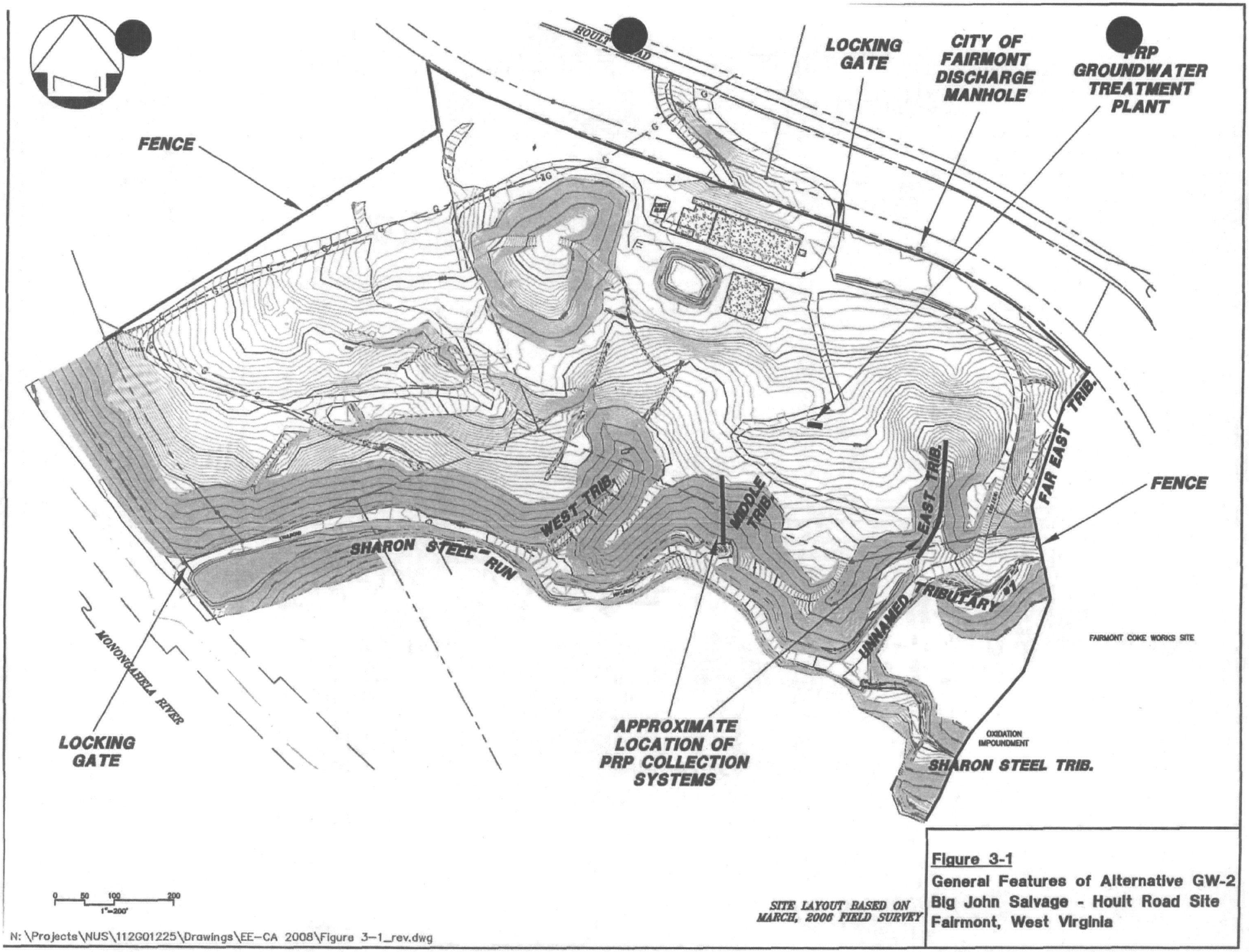

Figure 3-1

General Features of Alternative GW-2
Big John Salvage - Hoult Road Site
Fairmont, West Virginia

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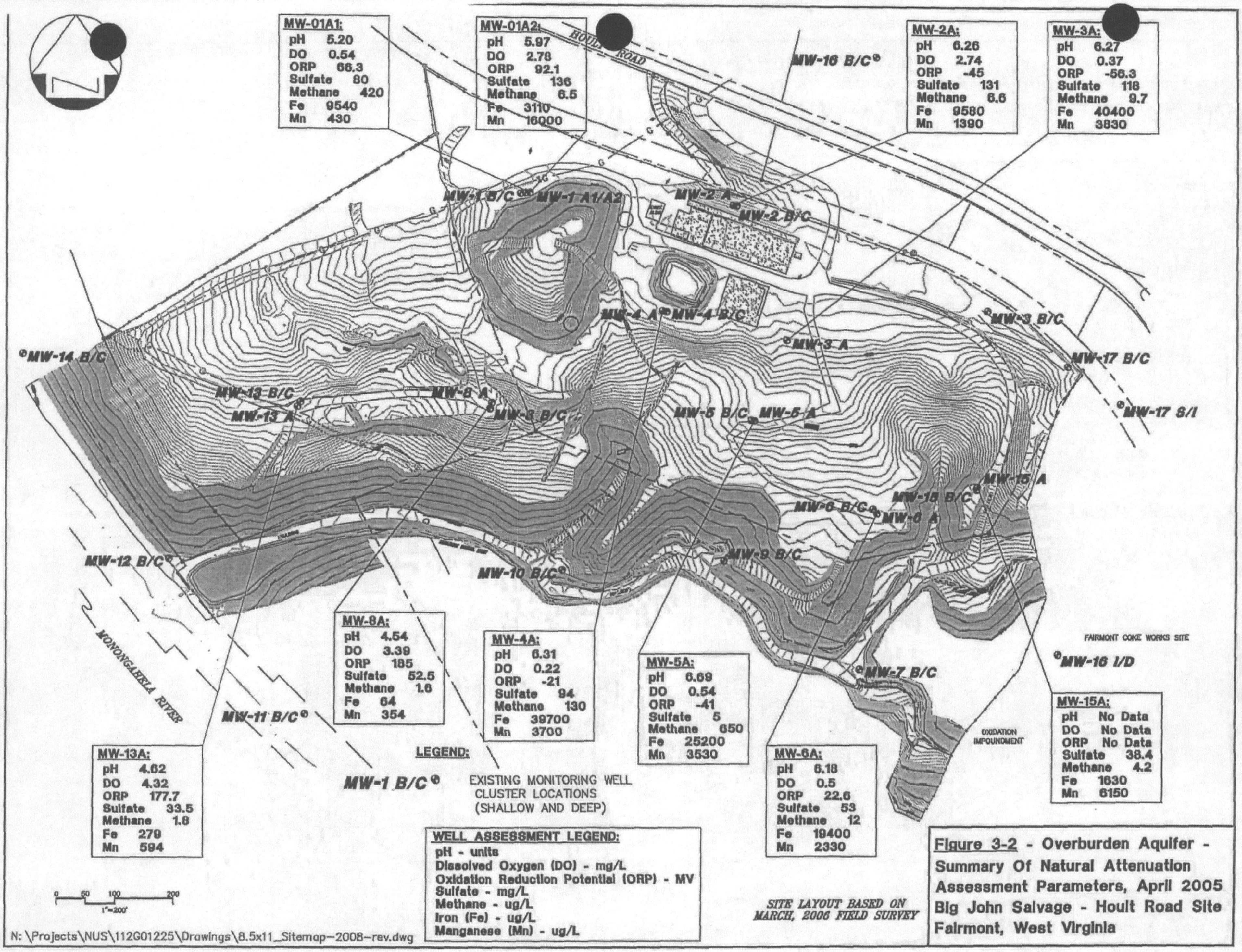

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DO 0.54
ORP 66.3
Sulfate 80
Methane 420
Fe 9540
Mn 430

MW-01A2:
pH 5.97
DO 2.78
ORP 92.1
Sulfate 136
Methane 6.5
Fe 3110
Mn 16000

MW-2A:
pH 6.26
DO 2.74
ORP -45
Sulfate 131
Methane 6.6
Fe 9580
Mn 1390

MW-3A:
pH 6.27
DO 0.37
ORP -56.3
Sulfate 118
Methane 9.7
Fe 40400
Mn 3830

MW-8A:
pH 4.54
DO 3.39
ORP 185
Sulfate 52.5
Methane 1.6
Fe 64
Mn 354

MW-4A:
pH 6.31
DO 0.22
ORP -21
Sulfate 94
Methane 130
Fe 39700
Mn 3700

MW-5A:
pH 6.69
DO 0.54
ORP -41
Sulfate 5
Methane 650
Fe 25200
Mn 3530

MW-15A:
pH No Data
DO No Data
ORP No Data
Sulfate 38.4
Methane 4.2
Fe 1630
Mn 6150

MW-13A:
pH 4.62
DO 4.32
ORP 177.7
Sulfate 33.5
Methane 1.8
Fe 279
Mn 594

MW-6A:
pH 6.18
DO 0.5
ORP 22.6
Sulfate 53
Methane 12
Fe 19400
Mn 2330

LEGEND:

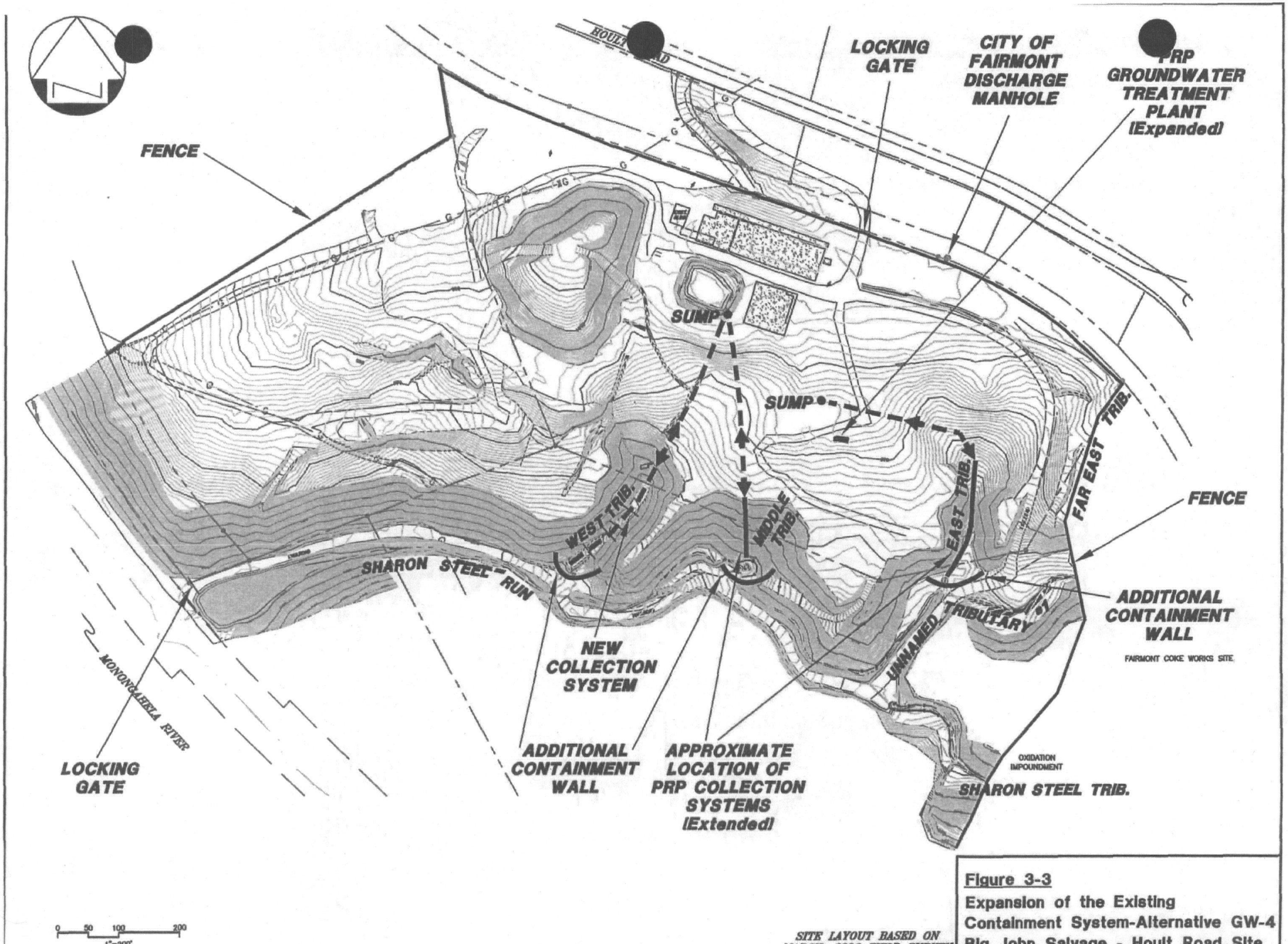
MW-1 B/C ⊕ EXISTING MONITORING WELL CLUSTER LOCATIONS (SHALLOW AND DEEP)

WELL ASSESSMENT LEGEND:
pH - units
Dissolved Oxygen (DO) - mg/L
Oxidation Reduction Potential (ORP) - MV
Sulfate - mg/L
Methane - ug/L
Iron (Fe) - ug/L
Manganese (Mn) - ug/L

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 3-2 - Overburden Aquifer - Summary Of Natural Attenuation Assessment Parameters, April 2005
Big John Salvage - Hoult Road Site
Fairmont, West Virginia

N: \Projects\NUS\112G01225\Drawings\8.5x11_Sitemap-2008-rev.dwg



SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 3-3

Expansion of the Existing Containment System-Alternative GW-4
Big John Salvage - Hoult Road Site
Fairmont, West Virginia

N: \Projects\NUS\112G01225\Drawings\EE-CA 2008\Figure 3-3_rev.dwg

Appendix A

APPENDIX A

Geology/Hydrogeology Excerpt from the June 2007 Draft Final RI

(with BTEX concentrations detected at greater than 70 mg/kg), but PAHs are the most widespread contaminant detected at the Site, with the highest concentrations found near the center of the Site. Very low concentrations of some pesticides were detected in a few subsurface soil samples; however, no PCB Arochlors were detected in any of the subsurface soil samples.

There is a wide variety of inorganics present in the subsurface soil. Twelve inorganics present in the subsurface soil were identified as COPCs for human health based on the exceedance of HHSVs, and most metals were also present at concentrations in excess of ESVs. With a few exceptions (mercury and the area in the vicinity of the head of the West Tributary), most heavy metals are randomly distributed throughout the Site with no apparent pattern observed in the extent of detection. Mercury was detected in several borings in the vicinity of the former cullet processing area, and high concentrations of numerous heavy metals (lead, arsenic, cadmium, mercury, nickel) were found in borings near the top of the West Tributary in the vicinity of the 2005 drum excavation area. Both of these areas are likely indicative of localized hot spots of contamination.

Finally, none of the five visually contaminated samples submitted for waste characterization exhibited RCRA hazardous waste characteristics, and the waste, which is mostly soil, has very little heat value (<454 Btu/lb), indicating that it would have very little value as a recycled fuel supplement. In the absence of a listed waste classification of the material, most of the contaminated soil at the Site would not likely be considered a hazardous waste. However, there are likely hot spots of soil and waste present (such as in the drum excavation area) that do have sufficiently high concentrations of VOCs and SVOCs that could be classified as RCRA hazardous for disposal or treatment purposes.

See Figure 4-2 for an illustration of the general delineation of the area with impacted subsurface soil at the Site.

4.4 GEOLOGIC/HYDROGEOLOGIC ASSESSMENT

A general summary of the regional geology and hydrogeology of the study area is presented in Section 2. The geology and hydrogeology of the site were investigated using various methods including rock coring, down-hole geophysical logging of newly installed wells, review of relevant geologic and hydrogeologic information (including that available for the adjacent Sharon Steel Site - See Appendix 4H - Supplemental Geologic Information), and evaluation of water level and water quality data collected during this RI, all of which are discussed in the following sections.

4.4.1 Site Geology

The information in this section is supplemented by the following figures, tables, and appendices:

Figure 4-3	Site Geology Cross Section Location map
Figure 4-4A	Overburden Cross Section - OA-OA'
Figure 4-4B	Overburden Cross Section - OB-OB'
Figure 4-4C	Overburden Cross Section - OC-OC'
Figure 4-4D	Overburden Cross Section - OD-OD'
Figure 4-4E	Isopach Thickness Map of the Sand Layer at the Base of the Overburden
Figure 4-4F	Top of Basal Sand Layer Elevation - Overburden Unit
Figure 4-5	Site Bedrock Stratigraphic Cross Section (General)
Figure 4-6A-B	Bedrock Geology Cross Sections (various)

Table 4-18	Summary of On-Site Geologic Section
Table 4-19	Summary of Bedrock Monitoring Well Units
Appendix 3A	Site Geophysics Report
Appendix 3D	Soil Boring Logs
Appendix 3E	Shallow Well Logs
Appendix 3F	Rock Core Logs
Appendix 3G	Downhole Geophysical Logs
Appendix 4H	Supplemental Geologic Information

There are two distinct geologic units at the site - the overburden unit and the bedrock unit. Discussions for each of these units are presented in the following sections.

4.4.1.1 Site Stratigraphy - Overburden

As discussed briefly in Section 2.0, the BJS Site is situated on a historic river terrace that was formed by a previous meander of the Monongahela River (see Figure 2-6). The bedrock beneath the BJS Site is covered by a veneer of up to 40 feet of unconsolidated glacio-fluvial or lacustrine sediments, ranging in texture from clay to sand, which is mostly silty and of relatively low permeability. These sediments are thickest beneath the central portion of the BJS Site.

The source of the sediments is either historic alluvial deposits during the ancient Monongahela River flow through this meander, or the result of lacustrine deposits that resulted from ancient Lake Monongahela, which was formed during the last Ice Age approximately 20,000 years ago. Damming and draining of the glacial lake occurred numerous times, resulting in a complex, interbedded sequence of lacustrine deposits in certain areas of northern West Virginia, including the Fairmont area. These sediments are generally found between elevations of 900-1080 feet above sea level (Fonner & Messina, 1981).

The results of a geophysical survey of the BJS Site conducted for EPA during removal actions by Enviroscan (Enviroscan, 2003 - see Appendix 3A) indicated that there are three layers at the BJS site: a surficial layer (comprised of unconsolidated sediments); highly weathered rock; and bedrock. The depth to the inferred bedrock layer ranges from approximately 15 feet to depths of around 40 feet, with an average depth of 20-25 feet. This general interpretation was confirmed by the extensive test boring program conducted during the RI. Fluvial sediments generally occur atop relatively unweathered bedrock, as any weathered soils were removed by erosion prior to deposition of the sediments.

General stratigraphic cross-sections illustrating the nature and extent of the unconsolidated overburden sediments are shown on Figures 4-4A through 4-4D. Cross-section reference lines are presented on Figure 4-3.

The unconsolidated sediments predominantly consist of silts and clay, with minor sand lenses throughout the unit. In addition, a relatively well defined and somewhat continuous sandy unit (i.e., sand and silty sand) was found at the base of the overburden unit throughout most of the site (see Figures 4-4A through 4-4D). This sand unit ranges in thickness from 0 to 20 feet, and is generally thickest in the center of the site. An isopleth thickness map of this sand unit is illustrated on Figure 4-4E, and the elevation of the top of this basal sandy unit is depicted on Figure 4-4F. Figure 4-4F illustrates that the sandy unit is mounded in the center of the site.

Note that based on the depictions of the soil boring locations on the cross-sections, the direct push soil boring method often met with refusal in stiff silts and clays at depths 5 to 10 feet above the actual bedrock interface. Consequently, the extent of contamination in the subsurface soil at depths in excess of 20 to 25 feet in the overburden remains a data gap at some locations.

4.4.1.2 Site Stratigraphy - Bedrock

The geology of the study area includes the rocks of the lower members of the Pittsburgh Formation of the Monongahela Group and the Casselman Formation of the Conemaugh Group. Both formations consist of cyclically repeating beds of calcareous shale, shaley limestone and sandstone, with periodic coal beds. The geologic section found beneath the BJS Site is summarized in Table 4-18, and the stratigraphy is presented graphically on Figure 4.5. The combination of rock cores completed at locations MW-16 and MW-12 provided hard rock information for nearly 260 feet of continuous stratigraphic section at the Site. Based on a review of the core logs, the Site stratigraphy can be differentiated into 15 major lithologic units, as illustrated on Figure 4-5 and summarized on Table 4-18.

The oldest and bottom member of the Pittsburgh Formation is the Pittsburgh Coal. As illustrated on Figure 2-5, this coal resource has been mined extensively in the area, including areas immediately to the north of the BJS Site across Hoult Road, and in areas to the north and west. Based on the mine maps, the Pittsburgh Coal was mined under a portion of the former Creative Labels property to the west of the Site, less than 500 feet to the west. The Pittsburgh Coal is also being mined on the adjacent Sharon Steel Site as part of the on-going remediation effort.

Only a small portion of the Pittsburgh Formation (Figure 4-5 - lithologic units 1 and 2) is within the boundaries of the current BJS Site. The Upper Pittsburgh sandstone and shales (lithologic unit 1) are present just below the surface north of Hoult Road, and the Pittsburgh Coal (lithologic unit 2) was presumably encountered in well location MW-16 at a depth of approximately 55 feet below grade, as the rock core completed at that location indicated the presence of coal. In addition, during the air rotary drilling of the MW-16 borehole, no drill cuttings or water returned to the surface during drilling operations. Presumably the cuttings and water filled in a portion of the mine void at this location. This well was also observed to be "smoking" on a cool morning prior to being completed - the air emanating from the borehole was condensing in the cool air, causing a "smoking effect." A noticeable flow of air could also be felt at this borehole prior to well completion.

As a result of the historic meander of the Monongahela River, the Pittsburgh Coal unit and other overlying Pittsburgh Formation rocks were eroded away from the area immediately underlying the site. Consequently, the portion of the Site south of Hoult Road is underlain by the Casselman Formation. The Casselman Formation has been reported to be about 220 feet thick in the area (Fonner & Messina, 1981). As illustrated on Table 4-18 and Figure 4-5, most of the bedrock underlying the site are shales, with minor interbedded sandstones and limestones.

The Casselman Formation is comprised of various members, including the Lower Pittsburgh sandstone and shales, Little Pittsburgh coal, Connellsville sandstone, Clarksburg limestone and red shale, Morgantown sandstone, Elk Lick coal, Elk Lick limestone, West Milford coal, Birmingham red shale, and Grafton sandstone. None of these members are reported to be sufficiently persistent to serve as key horizons throughout the outcrop area in this portion of West Virginia - consequently, the individual members are not differentiated in this report. However, given the reported thickness of the Casselman Formation in the area (~220 feet), many of these units are likely present within the stratigraphic section of interest for the Site.

The bedrock beneath the BJS site dips gradually to the northwest (N50°W) at about 60 feet per 1000 feet (about 300 feet per mile) as shown in Figure 2-5, which shows the structure contour for the Pittsburgh Coal, which has been mapped and mined extensively in the area. The beds are relatively flat lying at the site, and there are no major geologic structures (such as anticlines, synclines, or faults) identified in the immediate area of the Site, although the rocks are dipping toward the axis of a syncline situated approximately 2.5 miles northwest of the Site.

A systematic set of fractures occurs throughout the Pennsylvanian coals of West Virginia's Appalachian plateau. The pattern of fractures is similar across broad areas. In the vicinity of the BJS Site, the dominant fracture set is nearly vertical (perpendicular to the bedrock) and trends about N50°W; that is, in the same direction as the dip of the bedrock. Similarly, extensive systematic vertical fractures in the shale units have also been observed, generally with similar strikes, reported as about N80°E. (Kulander et al, 1980).

Borehole geophysical logging performed during the RI identified multiple fractures throughout all the strata penetrated by each borehole. Some of these were apparently bedding plane partings, but many were identified as high angle fractures or joints. The spacing between the rock openings was rarely more than 2 feet apart. In addition, recent fracturing associated with settlement above coal mines has been identified as another potential vertical pathway through the consolidated rocks (Hobba, 1981). Some mining has occurred in the areas north and west of the BJS Site.

Site-specific bedrock cross-sections illustrating the nature of the site geology are depicted on Figures 4-6A and 4-6B. See Figure 4-3 for the orientation of the cross-section reference lines.

In summary, the site is underlain by two major geologic units—unconsolidated sediments and sedimentary bedrock. The unconsolidated sediments are glacio-fluvial or lacustrine in nature, and range in texture from clay to sand, although most of the sediments are silts and clays with relative low permeability. They are up to 40 feet thick in the center portion of the Site, although the typical thickness is 20-25 feet across the Site. A prevalent sand unit is found at the base of the unconsolidated sediment section, and ranges in thickness from 0 to 20 feet, with the thickest section found in the center portion of the site.

The underlying bedrock includes the rocks of the lower members of the Pittsburgh Formation of the Monongahela Group and the Casselman Formation of the Conemaugh Group. Both formations consist of cyclically repeating beds of calcareous shale, shaley limestone and sandstone, with periodic coal beds. The majority of the Site is underlain by the Casselman Formation, and most of the rocks underlying the Site are shales, with minor interbedded sandstones and limestones.

4.4.2 Site Hydrogeology

The information in this section is supplemented by the following figures and tables:

Figure 4-3	Site Geology Cross Section Location map
Figure 4-4A	Overburden Cross Section - OA-OA'
Figure 4-4B	Overburden Cross Section - OB-OB'
Figure 4-4C	Overburden Cross Section - OC-OC'
Figure 4-4D	Overburden Cross Section - OD-OD'
Figure 4-4E	Isopach Thickness Map - Overburden Basal Sand Layer
Figure 4-4F	Top of Overburden Basal Sand Layer Elevation
Figure 4-5	Site Bedrock Stratigraphic Cross Section (General)
Figure 4-6A-B	Bedrock Geology Cross Sections (various)
Figure 4-7	General Ground-Water Flow Direction - Overburden Aquifer
Figure 4-8A-D	General Ground-Water Flow Direction - Bedrock Aquifer
Table 4-20	Monitoring Well Water Level Data

Ground water is present at the site in both the unconsolidated overburden sediments, as well as the bedrock. These two units are discussed further in the following sections:

4.4.2.1 Overburden Aquifer

The saturated unconsolidated sediments form the overburden aquifer at the Site. Ground water was encountered in most of the 60+ boreholes that were completed throughout the Site. The saturated thickness in the overburden ranges from 4 to 11 feet, as measured in the overburden monitoring wells (MW1-A1, MW1-A2, MW-2A, MW-3A, MW4A, MW-5A, MW6A, MW-8A, MW-13A, and MW-15A). See Table 4-20 for water level measurement data for the study period. Note that for the purposes of discussion, the data from the September 2005 measurement event are used, as these are the most recent complete set of water level data available. (Note that not all wells were measured in the November 2005 measurement event, which is also presented on Table 4-20).

The extent of this aquifer is bounded on the north, southwest, and south side of the Site by several notable features, including the slope break on the northern side of the Site (Hoult Road), the slope break leading to Sharon Steel Run on the southern side of the Site (note that most of the steep slope consists of weathered rock), and the slope break leading to the Monongahela River on the southwestern side of the Site (again, this slope consists of weathered rock). The unconsolidated material has been eroded away near the southern and western slope breaks and is thinnest in these areas. The overburden aquifer is not bounded to the east of the Site, as it is reported to be present underlying the entire Sharon Steel Site (see Appendix 4H for cross-sections for the adjacent Sharon Steel Site). The overburden aquifer is also not bounded to the northwest (toward the former Creative Labels site), although this area eventually slopes to the Monongahela River. The overburden aquifer also includes the unconsolidated sediments in the West and East Tributaries, which are seasonally wet.

The overburden aquifer receives recharge from a combination of sources, including precipitation that falls directly on the Site, surface water runoff from Hoult Road and other topographically high areas north and northeast of the Site, and upward flow from the underlying bedrock aquifer.

Discharge from the overburden aquifer is primarily by gravity flow to the main site drainage features, including the West Tributary, Mid Tributary, and East Tributary, as well as the Far East Tributary. Flow in these tributaries subsequently discharges to Sharon Steel Run; ground-water discharge appears to provide the baseflow for this stream. The overburden aquifer may also discharge through seeps in the valley walls adjacent to Sharon Steel Run to the south, or along the valley wall adjacent to the Monongahela River to the west. There may also be surface discharge of seeps from perched areas at the Site. One ground-water seep was observed originating at the land surface at a location south of well location MW-4 during a site visit in June 2006. The source of this seep is not known, but could be related to ground-water mounding in the large soil stockpile, which was located approximately 100 feet west of the seep location.

The following are additional observations about the hydrogeology of the overburden aquifer:

- The unconsolidated sediments predominantly consist of silts and clay, with minor sand lenses throughout the unit. This silt and clay can cause localized perched water conditions, as well as preferential flow paths. For example, well MW-1A1 is screened in a perched layer at a depth of approximately 20 feet. This well indicated a saturated thickness of 14 feet in this layer in September 2005, with a water level approximately 8 feet below the surface. However, the immediately adjacent overburden well, which is screened from 30 to 40 feet below the surface, indicated only 6 feet of saturated zone on the same date. This example illustrates the variability of the sediments, and the affect on ground-water flow within this unit.

- There is a prevalent sandy unit (sand and silty sand) at the base of the overburden aquifer which ranges in thickness from 0 to 20 feet, with the thickest section found in the center of the site (well MW-8A had the thickest section measured, at 22.73 feet). Most of the saturated thickness within the overburden aquifer is within this basal sandy unit.

- With the exception of the perched zone associated with well MW-1A1 and the off-site overburden wells MW-17S and 17I, the elevation of the ground water in the overburden aquifer on the Site ranged from 949-954 feet MSL during the September 2005 measurement event, with the highest elevations measured in the western portion of the Site (MW-13A), and the lowest elevation measured in the eastern portion of the Site near the East Tributary (MW-15A).

  With regard to location MW-17, although not measured during the September 2005 event, the elevation of ground water at this overburden well location was well over 980 feet MSL in April 2005 (note that the general water levels were approximately 1 foot higher in April 2005). This elevation is similar to that found in MW-1A1 (~980 feet MSL). The cluster well at location MW-17 also further demonstrates the variability of the overburden aquifer in the area. The shallow well at this location (MW-17S screened from 5-15 feet below grade) monitors a perched zone, and the deeper well monitors the base of the overburden (MW-17I screened from 26-31 feet below grade). However, the deeper overburden at this location is confined, and the water level elevation measured in the deep well (984.70 feet MSL) is higher than the water level elevation measured in the shallow well (983.33 feet MSL).

- The yield of the on-site overburden wells ranged from <0.25 gallons per minute (gpm) to nearly 2 gpm, indicating that the permeability of this aquifer is highly variable. Horizontal flow of ground water in the overburden aquifer can follow preferred pathways in the subsurface, typically following more permeable units (i.e., sand lenses) to lower gradient areas. The distribution of some of the visually contaminated subsurface soils provides further evidence of the flow of liquids through preferred pathways (see Appendix 4F - Subsurface Soil Data Summary). For example, along the I soil boring transect, borings I-3, I-4, and I-6 all show discrete contaminated zones well below the surface, including bottom intervals, some of which are defined as sand units. Given the preferred pathways, the existing monitoring well network may not be connected to all of the conduits of ground-water flow in the overburden aquifer at the Site.

- The existing ground-water/tar recovery system at the Site (french drain type structures location in the Middle Tributary and East Tributary) continue to collect tar and contaminated ground water discharging from the overburden aquifer. During the period March 2001 through December 2006, approximately 7,183,000 gallons of water had been treated through the system, but there is no record of the volume of tar recovered from the system (email correspondence from Doug Taylor, consultant to PRP, dated December 22, 2006). However, no major tar areas were encountered in the subsurface during the RI, nor were any tar seeps observed in the vicinity of the East Tributary or Sharon Steel Run, indicating that the existing collection system appears to controlling tar migration to the surface. Based on the variability and heterogeneity of the overburden sediments, it is likely that the locations selected for borings and wells did not intersect some of the preferred pathways in the aquifer conveying the most contaminated ground water and tar.

- The overburden aquifer is likely not providing much recharge to the bedrock aquifer in the central and eastern portion of the Site, as the bedrock aquifer potentiometric levels in this area indicate a generally upward flow into the overburden in this area. The bedrock aquifer potentiometric surface is higher than the overburden potentiometric surface throughout the center of the Site. Further, deep bedrock wells at locations MW-2 and MW-3 are artesian. However, direct recharge to the bedrock aquifer is more likely in the western portion of the Site, where bedrock aquifer potentiometric surfaces are well below the overburden/bedrock interface. Further, based on the boring and well drilling information, the unconsolidated sediments have been deposited on generally unweathered bedrock surfaces as a result of the formation of the terrace by the ancient Monongahela River. Most of the center portion of the Site is underlain by competent shale and sandstone, which offers only limited potential for recharge of water into the underlying bedrock through open fractures and joints.

- Figure 4-7 is a depiction of the general flow direction inferred from the water levels measured in the overburden aquifer in September 2005. The flow direction is variable at the Site, but generally is toward the south and east toward the main drainage tributaries (West Tributary, Middle Tributary, and East Tributary). Ground-water flow direction in the overburden aquifer in the cross-sectional view is presented on Figures 4-4A through 4-4D.

- The existing PRP operated ground-water collection system at the Site, which consists of french drains (i.e., pipes installed within an excavation, and the excavation backfilled with stone) installed in the Middle and East Tributaries, probably has a major influence on the nature and direction of ground-water flow in the overburden aquifer in these areas. In addition, a clay barrier (installed to a depth of approximately 15 feet by EPA in November 2002 because of the extensive coal tar in the subsurface in this area) may also have an influence on the flow of water in the overburden in this area during high water conditions. However, this barrier was probably not constructed to a sufficient depth to completely restrict flow in this area, as the base of the overburden ranges from 20 to 30 feet below grade in this area. The approximate locations of the collection system, as well as the clay barrier wall installed by EPA, is also shown on Figure 4-7.

In summary, the saturated unconsolidated sediments form the overburden aquifer at the Site. The unconsolidated sediments predominantly consist of silts and clay, with minor sand lenses throughout the unit. The saturated thickness in the overburden ranges from 4 to 11 feet, as measured in the 10 overburden monitoring wells. The yield for wells in this aquifer is generally less than 1 or 2 gallons per minute. The overburden aquifer receives recharge from a combination of sources, including precipitation that falls directly on the Site, surface water runoff from Hoult Road and other topographically high areas north and northeast of the Site, and upward flow from the underlying bedrock aquifer.

Discharge from the overburden aquifer is primarily by gravity flow to the main site drainage features, including the West Tributary, Mid Tributary, and East Tributary, as well as the Far East Tributary. Flow in these tributaries subsequently discharges to Sharon Steel Run; ground-water discharge, both from the overburden and bedrock, appears to provide the baseflow for this stream.

The silt and clay fraction in the overburden aquifer can cause localized perched water conditions, as well as preferential flow paths. Horizontal flow of ground water in the overburden aquifer can follow preferred pathways in the subsurface, typically following more permeable units (i.e., sand lenses) to lower gradient areas. The distribution of some of the visually contaminated subsurface soils provides further evidence of the flow of liquids through preferred pathways.

The existing ground-water/tar recovery system at the Site (french drain type structures location in the Middle Tributary and East Tributary) continue to collect tar and contaminated ground water discharging from the overburden aquifer. However, no major tar areas were encountered in the subsurface during the RI. Based on the variability and heterogeneity of the overburden sediments, it is likely that the locations selected for borings and wells did not intersect some of the preferred pathways in the aquifer conveying the most contaminated ground water and tar.

The overburden aquifer is likely not providing much recharge to the bedrock aquifer in the central and eastern portion of the Site, as the bedrock aquifer potentiometric levels in this area indicate a generally upward flow into the overburden in this area. The bedrock aquifer potentiometric surface is higher than the overburden potentiometric surface throughout the center of the Site. Consequently, it appears unlikely that contaminants in the overburden ground water will substantially impact the underlying bedrock aquifer, which to date, is relatively free of contamination.

The general flow direction in the overburden aquifer is variable, but is generally toward the south and east toward the main drainage tributaries (West Tributary, Middle Tributary, and East Tributary). The existing PRP operated ground-water collection system installed in the Middle and East Tributaries probably has a major influence on the nature and direction of ground-water flow in the overburden aquifer in these areas.

4.4.2.2 Bedrock Aquifer

For discussion purposes, the bedrock aquifer will sometimes be discussed with the terms shallow and deep. The monitoring wells were given a designation of "B" (shallow bedrock) and "C" (deep bedrock) in the field to differentiate their placement at a given location. The "shallow" bedrock wells were completed within the first major water bearing zone, generally within 20-40 feet of the top of bedrock. "Deeper" bedrock wells were generally screened 50-100 feet below the top of the bedrock. However, given the elevation differences at the Site, some shallow bedrock "B" wells correlate with deep bedrock "C" wells in certain locations, and conversely, some deep bedrock "C" wells correlate with some shallow bedrock "B" wells in certain locations. Consequently, these "B" and "C" designations for shallow and deep bedrock are not functional for discussing the overall bedrock aquifer at the Site.

Alternatively, the bedrock aquifer above 890 feet MSL will be considered "shallow bedrock," and the bedrock aquifer below 890 feet MSL will be considered "deep bedrock." This elevation was selected based on the average elevation of Sharon Steel Run, which is an important hydrogeologic feature as this tributary receives discharge from both the overburden and bedrock aquifers. The elevation of this tributary ranges from ~930 feet at the upper reaches to 857 feet at the Monongahela River confluence. The 890 foot MSL elevation is considered an average elevation of Sharon Steel Run at the site.

Further, for the purposes of the hydrogeologic discussion, the bedrock lithologic units have been further grouped into the following stratigraphic units:

- **Stratigraphic Unit 1 (SU1)** - Lithologic units 4 through 8 (various shales, sandstones, and a limestone bed with data from 5 wells – MW-1B, 2B, 3B, 8B, and 16B)
- **Stratigraphic Unit 2 (SU2)** - Lithologic units 9 and 10 (gray shale and major limestone bed with data from 8 wells – MW-1C, 2C, 4B, 5B, 13B, 14B, 16C, and 17B)
- **Stratigraphic Unit 3 (SU3)** - Lithologic unit 11(thick section of gray calcareous shales with data from 14 wells MW-3C, 4C, 5C, 6B, 7B, 8C, 9B, 10B, 11B, 12B, 13C, 14C, 15B, 15C)
- **Stratigraphic Unit 4 (SU4)** - Lithologic units 12 through 15 (major limestone bed and underlying interbedded shales with data from 7 wells – MW6C, 7C, 9C, 10C, 11C, 12C, 17C)

This differentiation is based on a combination of the distribution of the well screens across the stratigraphic section and the general hydrogeologic properties of the bedrock units. No wells are screened within lithologic units 1 through 3, so they are not included in the designation. Table 4-19 summarizes the stratigraphic and lithologic designations for the bedrock wells at the Site. These units are also depicted on Figure 4-6A and 4-6B (Bedrock Aquifer cross-sections).

The following are general observations about the hydrogeology of the bedrock aquifer at the Site:

- The ground water in the bedrock aquifer is moving primarily along fractures in the rock. Although there is some primary porosity reported for the sandstone units of the Conemaugh group, it is the secondary porosity associated with fracture and joint openings and bedding plane partings in the bedrock that is the primary ground-water flow control mechanism.

- Water-yielding zones encountered during drilling were found randomly distributed through all lithologies. The borehole yields encountered during drilling ranged from approximately 1 gpm (MW-11, MW-17) to more than 50 gpm (MW-1). Some of the highest yielding zones occurred in the limestone and shale intervals, and some of the lowest yields were from sandstone units.

  The highest interval yields (10-30 gpm) were found associated with SU2. The highest yields were generally encountered above the limestone unit of SU2 from the center of the Site and in areas to the west. On the contrary, this unit was not as productive in the eastern portion of the Site, where notable yields were observed in the shaly units underlying the limestone. The likely reason for the low productivity in the east is because this particular unit outcrops under the overburden in the area to the east (in the vicinity of MW-15), and a sufficient quantity of water has probably not yet accumulated in this unit in the east to be as productive.

- Based on a review of the geophysical logs and rock cores, it appears that the majority of the fractures in the rock are related to bedding plane partings, although some vertical joints and fractures were identified. Further, many of the joints have been identified as cemented or mineralized. No dissolution openings were identified in the limestone cores. Consequently, it appears that most of the ground-water flow at the Site is along bedding plane fractures and partings, with some vertical integration of units through joints and fractures.

- Layers of unfractured shale and claystone can behave as aquitards, impeding the vertical flow of water. This condition results in both perched water tables, which discharge through hillside springs (some of which can be observed occasionally along the rock outcrops in the Sharon Steel Run valley, or confined aquifer conditions). While unfractured claystones and shales can seriously impede the vertical movement of water in the bedrock, the properties of these confining layers vary laterally as they become coarser textured, pinch out, or contact vertical fractures. The less permeable rocks beneath the BJS Site probably do act, at least locally, as aquitards, impeding the vertical migration of water. However, the results of borehole geophysical logs and rock cores indicate that fractures occur throughout the rock at intervals of no more than two feet vertically.

- In general, the potentiometric levels in SU2 are higher than those found in SU1 over most of the Site. This indicates that SU2 is a confined unit across most of the Site. Further, potentiometric levels in SU3 are also higher than SU1, SU2, and SU4 levels in the eastern portion of the Site, but are less than the SU2 levels in the western portion of the Site (see Figures 4-6A and 4-6B for bedrock cross-section depiction of potentiometric surfaces, and Figures 4-8A through 4-8D for an areal representation of the potentiometric levels).

- Some of the bedrock wells situated along the northern border of the Site, including MW-3B (SU1), MW-2C (SU2), MW-17B (SU2), and MW-3C (SU3), are artesian (i.e., flowing above the land surface). Given the regional geology strike and dip, these beds would be expected to outcrop directly to the southeast of the Site; however, given the terrace erosion to the east, these beds are missing from the section immediately updip of the BJS Site. Consequently, the confining pressure found in those units must be related to areas situated north of the Site, where these units do exist in the subcrop. The area north of the Site is a hill with a maximum elevation of 1200 feet MSL, which is approximately 210 feet higher than the general elevation of the center of the Site. The reason for the artesian condition in SU1, SU2, and SU3 in this area is unknown, but the condition probably does affect ground-water flow directions at the Site (see flow direction discussion below).

- The wells located along Sharon Steel Run (MW-7, MW-9, and MW-10) are all artesian, indicating that Sharon Steel Run is a discharge point for the bedrock aquifer in this area. Note that the shallow bedrock wells at MW-7 and MW-9 are situated only 20-30 feet below grade at these locations.

- The water levels in the bedrock wells screened in SU3 along the Monongahela River have a potentiometric surface that is nearly equal to the normal pool elevation of the river, which is approximately 857 feet. This would suggest that the river and SU3 are hydrologically connected, and it is also possible that the Monongahela River may provide recharge to this unit.

- The ground-water flow direction in the bedrock aquifer is influenced by several factors, including: (1) the regional hydrologic gradient (toward the northwest, which is downdip and in line with orientation of the Monongahela River (regional ground-water discharge point); (2) the local hydrologic gradient (toward the southwest, parallel to Sharon Steel Run (a known local ground-water discharge point); and (3) the hydrostatic head to the north, which could result in a southerly influence. Consequently, the ground-water flow direction in the bedrock aquifer has several components, the result of which is a general flow direction to the west/southwest (see Figures 4-8A through 4-8D for a general depiction of flow).

- The bedrock hydrogeology to the north and northwest of the Site is strongly influenced by the underground coal mining in the area. The mine void created in the Pittsburgh Coal unit acts as a major conduit for ground-water flow in the area. The abandoned mines are slowly filling with water, and some of the mines in the immediate vicinity of the Site (including those immediately across the Monongahela River under Buffalo Creek) have already fully flooded. This unique feature means that the ground water on the mountainside north of the Site would likely never drain toward the BJS Site, but rather would intersect the mine void and flow directly to the northwest following the dipping mine void.

In summary, the ground water in the bedrock aquifer is moving primarily along fractures in the rock. Although there is some primary porosity reported for the sandstone units of the Conemaugh group, it is the secondary porosity associated with fracture and joint openings and bedding plane partings in the bedrock that is the primary ground-water flow control mechanism. It appears that the majority of the fractures in the rock are related to bedding plane partings, although some vertical joints and fractures were identified. Consequently, most of the ground-water flow at the Site is along bedding plane fractures and partings, with some vertical integration of units through joints and fractures.

Water-yielding zones encountered during drilling were found randomly distributed through all lithologies. The borehole yields encountered during drilling ranged from approximately 1 gpm (MW-11, MW-17) to more than 50 gpm (MW-1). Some of the highest yielding zones occurred in the limestone and shale intervals, and some of the lowest yields were from sandstone units.

Layers of unfractured shale and claystone can behave as aquitards, impeding the vertical flow of water. This condition results in both perched water tables, which discharge through hillside springs (some of

which can be observed occasionally along the rock outcrops in the Sharon Steel Run valley, or confined aquifer conditions). In general, the potentiometric levels in deeper rock units are higher than those found in shallower rock units, indicating that the deeper rock units are confined across most of the Site, with bedrock aquifer recharge areas to the east, and discharge areas to the west.

The wells located along Sharon Steel Run (MW-7, MW-9, and MW-10) are all artesian, indicating that Sharon Steel Run is a discharge point for the bedrock aquifer in this area. Note that the shallow bedrock wells at MW-7 and MW-9 are situated only 20-30 feet below grade at these locations.

The water levels in the bedrock wells situated along the Monongahela River have a potentiometric surface that is nearly equal to the normal pool elevation of the river, which is approximately 857 feet. This would suggest that the river and underlying rocks are hydrologically connected, and it is also possible that the Monongahela River may provide recharge to these rocks.

The ground-water flow direction in the bedrock aquifer is influenced by several factors, including: (1) the regional hydrologic gradient (toward the northwest, which is downdip and in line with orientation of the Monongahela River (regional ground-water discharge point); (2) the local hydrologic gradient (toward the southwest, parallel to Sharon Steel Run (a known local ground-water discharge point); and (3) the hydrostatic head to the north, which could result in a southerly influence. Consequently, the ground-water flow direction in the bedrock aquifer has several components, the result of which is a general flow direction to the west/southwest.

4.4.3 Ground-Water Quality

The discussion of the ground-water quality at the Site will be divided into two sections—overburden aquifer water quality, and bedrock aquifer water quality.

4.4.3.1 Overburden Aquifer Water Quality

The results of the overburden water quality assessment are summarized below. Data were collected from 11 locations (MW-1 (wells A1 and A2); MW-2A, MW-3A, MW-4A, MW-5A, MW-6A, MW-8A, MW-13A, MW-15A, and MW-17 (wells 17S and 17I). The information in this section is supplemented by the following figures, tables, and appendices:

Figure 3-5	Monitoring Well Location Map
Figure 4-9	Summary of Organic Ground-Water Detections - Overburden Aquifer - April 2005
Figure 4-9A	Summary of VOC Ground-Water Detections - Overburden Aquifer - April 2005
Figure 4-9B	Summary of PAH Ground-Water Detections - Overburden Aquifer - April 2005
Figure 4-10	Summary of Organic Ground-Water Detections - Overburden Aquifer - July 2005
Figure 4-10A	Summary of VOC Ground-Water Detections - Overburden Aquifer - July 2005
Figure 4-10B-E	Summary of VOC Ground-Water Detections - Overburden Aquifer - July 2005 (various cross sections)
Figure 4-10F	Summary of PAH Ground-Water Detections - Overburden Aquifer - July 2005
Figure 4-10G-J	Summary of PAH Ground-Water Detections - Overburden Aquifer - July 2005 (various cross sections)

Figure 4-11	Impacted Ground-Water Area Location Map - Overburden Aquifer
Table 4-21	Summary of Organic Detections - Overburden Aquifer - April and July 2005
Table 4-22	Summary of Inorganic Detections - Overburden Aquifer - April and July 2005

HHRA Table 2-2 - Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Ground Water
SLERA Table 3-6 - Summary of Chemicals Detected in Overburden Ground Water from Wells near Ecological Habitats

Appendix 3E	Shallow Monitoring Well Logs
Appendix 3H	Ground-Water Sampling Logs

Results of Organic Analyses of Overburden Wells - Frequency and Magnitude of Detected Analytes

Organic compounds (mostly VOCs and PAHs) were detected in the overburden aquifer at five locations (MW-4, MW-5, MW-6, MW-8, and MW-15) during both rounds of sampling, and at an additional location (MW-3) during the July 2005 sampling event (See Figures 4-9 and 4-10 for the general distribution of organic compound detection in the overburden aquifer for April and July 2005, respectively. See other related Figure 4-9 and 4-10 series figures for a more detailed depiction of the total VOC and total PAH concentrations in the overburden ground water in both the areal and cross-section views). The nature of contaminants in the overburden ground water are similar to those found in the subsurface soil.

General observations about the organic detections in the overburden aquifer include:

- The most commonly encountered VOCs in overburden ground water are BTEX compounds, and the most commonly detected compounds are xylene and ethylbenzene. Detections are similar between April and July sampling events in terms of numbers of detections; however, the detections in July 2005 are generally higher than those found in April 2005, although within the same order of magnitude.

- The largest VOC detections were found in well MW-4A, for which the April and July 2005 detections are very similar (ethylbenzene (130-140 ug/L) and xylenes (330-430 ug/L). MW-5A also has detections of BTEX, but at levels 20 percent less than those detected at MW-4A. Finally, BTEX was also found in well MW-15A. Methylene chloride was encountered in four overburden wells for April 2005 (only), and detections were at very low levels (1J up/L). See Table 4-21 for additional organic concentration and distribution details.

- PAHs are the most commonly encountered SVOCs in overburden ground water. Naphthalene is the most common PAH detected in the ground water. In terms of TSVOC (mostly PAHs), July 2005 TSVOC detections are 3,400 and 850 ug/L for MW-4A and MW-5A, respectively, Overburden wells with detectable SVOCs in either April or July 2005 include MW-3A,MW-6A, MW-8A, and MW-15A. 2-Methyl naphthalene is the second most commonly encountered PAH (six detections in April, two detections in July). MW-04A and MW-05A have the highest July 2005 detections for this compound compared to other overburden wells (410 ug/L and 31J ug/L, respectively). See Table 4-21 for additional organic concentration and distribution details.

- Eleven organic compounds are present in the overburden aquifer at concentrations in excess of HHSVs, including benzene, ethylbenzene, and xylenes, and a variety of SVOCs (naphthalene, 2-methylnaphthalene, other PAHs, pentachlorophenol (one detection at well MW-8A), carbazole (three detections only), and other random SVOCs. Sixteen organic compounds are present in the overburden aquifer at concentrations in excess of ESVs as well.

- There were no detections for PCBs or pesticides in overburden wells.

- There was no light or dense non-aqueous phase liquids (LNAPL or DNAPL) observed in any of the overburden monitoring wells. However, certain wells had a strong odor, including wells MW-4A and MW-5A, which is consistent with the contamination detected in those wells.

- The overall nature and extent of organic contaminants in the overburden aquifer is the result of historic operations at the Site. The extent of contamination in the overburden aquifer is generally well defined in the center portion of the Site (as the overburden aquifer is limited in its presence at the Site). However, based on supplemental field observations and data (such as the contamination observed in the drum excavation area and the detections of benzene in the surface water near the East Tributary [see discussion in Section 4.5]), there are likely gaps in the monitoring, especially within the overburden aquifer discharge areas in the vicinity of the East Tributary and West Tributary.

Results of Inorganic Analyses of Overburden Wells - Frequency and Magnitude of Detected Analytes

General observations about the nature and extent of inorganics in the overburden aquifer include:

- The overburden ground water contains a wide variety of inorganics in both the total and dissolved fraction; however, there appear to be no atypical inorganic detections or unusually high or anomalous concentrations that are widespread across the Site (see Table 4-22). The inorganics are widely distributed with no apparent pattern observed in the extent of detection for any given analyte. Further, there is no major differences noted between the dissolved and total fraction concentrations of inorganics, indicating that the wells were generally well developed with limited turbidity.

- The most commonly detected inorganics present in the total or dissolved fraction at concentrations frequently in excess of HHSVs in the overburden aquifer include: arsenic, barium, chromium, iron, lead, manganese, nickel, and vanadium. A total of 12 inorganics are present at concentrations that exceed the HHSVs. Concentrations of all heavy metals (24 analytes) detected in the overburden ground water in the total fraction are also in excess of the ESV in almost every overburden well. Note that the ESV used for ground water screening is that used for surface water screening as well.

- Mercury, which is identified as a COC for surface and subsurface soil, is not present in the overburden ground water in total or dissolve fraction at concentrations in excess of the HHSV, but is present at concentrations in excess of the ESV.

In summary, organic compounds (predominantly BTEX and naphthalene) are present in the overburden aquifer in the central portion of the Site in areas consistent with historical operations. The types of contaminants found in the overburden ground water are consistent with those detected in the subsurface

soil. The highest BTEX concentrations detected were nearly 0.5 mg/l, and the highest total PAH concentrations detected were more than 3 mg/l. However, no LNAPL or DNAPL were observed in any of the monitoring wells. The extent of organic contamination in the overburden is generally well defined; however, there are likely monitoring gaps in the vicinity of the East Tributary and West Tributary, given other RI data which suggest overburden aquifer contamination in these areas.

The overburden ground water also contains a wide variety of inorganics in both the total and dissolved fraction, which are widely distributed with no apparent pattern observed in the extent of detection for any given analyte. No unusually high or anomalous concentrations that are widespread across the Site were observed. However, concentrations of 12 inorganics exceed HHSV criteria, and most heavy metal concentrations detected exceed ESV criteria.

See Figure 4-11 for an illustration of the general delineation of the area of impacted ground water in the overburden at the Site.

4.4.3.2 Bedrock Aquifer Water Quality

The results of the bedrock water quality assessment are summarized below. Data were collected from 17 locations encompassing 34 wells (MW-1B/C ; MW-2B/C, MW-3B/C, MW-4B/C, MW-5B/C, MW6-B/C, MW-7B/C, MW-8B/C, MW-9B/C, MW-10B/C, MW-11B/C, MW-12B/C, MW-13B/C, MW-14B/C, MW-15B/C, MW-16B/C, and MW-17B/C. The information in this section is supplemented by the following figures, tables, and appendices:

Figure 3-5	Monitoring Well Location Map
Table 4-23	Summary of Organic Detections - "B" Wells in Bedrock Aquifer - April and July 2005
Table 4-24	Summary of Organic Detections - "C" Wells in Bedrock Aquifer - April and July 2005
Table 4-25	Summary of Inorganic Detections - "B" Wells in Bedrock Aquifer - April and July 2005
Table 4-26	Summary of Inorganic Detections - "C" Wells in Bedrock Aquifer - April and July 2005
Table 4-27	Summary of Natural Attenuation Parameter Results

HHRA Table 2-2 - Occurrence, Distribution, and Selection of Chemicals of Potential Concern - Ground Water
SLERA Table 3-5 - Summary of Chemicals Detected in Ground Water from Wells near Ecological Habitats

Appendix 3H	Ground-Water Sampling Logs

Note that the bedrock well data in the tables have been segregated for the "B" wells (i.e., the designation for the shallow bedrock well at a given location) and "C" wells (i.e., the designation for the deep bedrock well at a given location) simply for the purpose of data presentation, and do not reflect some hydrogeologic differentiation between the wells. All of the bedrock well data will be described together in the following sections, as the bedrock aquifer at the Site is considered a single hydrogeologic unit for the purposes of this RI.

Results of Organic Analyses of Bedrock Wells - Frequency and Magnitude of Detected Analytes

Only low level detections of organic compounds were infrequently detected in several of the bedrock monitoring wells (see Tables 4-21 ("B" Wells) and 4-22 ("C" Wells). The compounds detected were similar to those found in the overburden aquifer. Otherwise, the bedrock aquifer at the Site appears to be generally unimpacted by organic compounds. General observations about the organic detections in the bedrock aquifer include:

- Low concentrations of VOCs were detected only in the following bedrock wells:

  MW-5B (BTEX ~4 J ug/l - April 2005, and xylene (7J ug/l - July 2005)
  MW-5C (xylene - 5J ug/l - July 2005)
  MW-6C (xylene - 1J ug/l - July 2005)
  MW-13C (toluene - 2J ug/l and xylene - 1J ug/l - July 2005)
  MW-17C (benzene - 1J ug/l - July 2005)

- Low concentrations of acenapthene were detected in wells MW-5B (2J ug/l - April 2005) and MW-12B (1J ug/l - July 2005), and naphthalene was also detected in well MW-5B (6J ug/l - April 2005). No other PAHs were detected in the bedrock aquifer wells.

- Based on the site hydrogeology, which suggests that most of the flow in the bedrock aquifer of the site is along bedding planes, the contaminants detected in well MW-5B would have originated in areas to the east (in the vicinity of MW-15 or even farther to the east), where the rocks within the screen interval of MW-5B appear to outcrop beneath the overburden. The saturated thickness of overburden in the area of MW-15 is the thinnest at the site (averaging only 2 to 4 feet during the period of the study) - consequently, it is possible that contaminants could have entered the bedrock aquifer directly in this area.

- Bis(2-ethylhexyl)phthalate was detected at six bedrock well locations, with an anomalous concentration of 460 ug/l detected in MW-8B in July 2005, although this compound was non-detect at this location in the April 2005 sampling event. Well MW-15B had detections of this compound in both sampling events. The remainder of the detections of this compound were single-event detections. In addition to this compound, low concentrations (2J-4J up/l) of butylbenzylphthalate and di-n-butyl phthalate were also detected in well MW-13B in the July 2005 sampling event. The bis(2-ethylhexyl) phthalate was found at concentrations in excess of the HHSV.

- One pesticide (P,P-DDT) was detected in well MW-10C (0.13 ug/l - July 2005) and MW-14B (0.11 ug/l - July 2005). No other pesticides or PCBs were detected in the bedrock aquifer wells.

- Although there is no evidence of organic compounds in the ground water collected from the wells at location MW-17, a "petroleum type" odor was observed during the initial drilling of this well. A slight odor was initially noticed at a depth of ~60 feet, but it became noticeably stronger at ~110 feet, and some black "floating" material was observed on the drilling water coming out of the hole at a depth of ~125 feet. Note that this borehole was open from a depth of approximately 22 feet below grade at this location during drilling. Consequently, given the use of air rotary drilling techniques, the odor could have originated from any section of the open borehole. A slight "petroleum" type odor and similar black "floating" material on the return water was also observed during the drilling of the bedrock well at location MW-15.

Results of Inorganic Analyses of Bedrock Wells - Frequency and Magnitude of Detected Analytes

General observations about the nature and extent of inorganics in the bedrock aquifer include:

- Similar to the overburden, the bedrock ground water contains a wide variety of inorganics in both the total and dissolved fraction; however, there appear to be no atypical inorganic detections or unusually high or anomalous concentrations that are widespread across the Site (see Tables 4-23 and 4-24). The inorganics are widely distributed with no apparent pattern observed in the extent of detection for any given analyte. The nature and distribution of inorganics is mostly related to the type of rock (i.e., shale, sandstone, or limestone) in which the well is screened. Further, there is no major differences noted between the dissolved and total fraction concentrations of inorganics, indicating that the wells were generally well developed with limited turbidity.

- The most commonly detected inorganics present at concentrations in the total or dissolved fraction frequently in excess of HHSVs in the bedrock aquifer include: iron, manganese, lead and vanadium. The remainder of the analytes detected in excess of HHSVs are low frequency random detections. A total of 10 inorganics are present at concentrations that exceed the HHSVs. Further, concentrations of 12 heavy metals detected in the bedrock aquifer are also in excess of the ESV in many of the bedrock wells. Note that the ESV used for ground water screening is that used for surface water.

In summary, only low level detections of VOCs and SVOCs were infrequently detected in several of the bedrock monitoring wells. The compounds detected (BTEX type compounds and naphthalene) were similar to those found in the overburden aquifer. Otherwise, the bedrock aquifer at the Site appears to be generally unimpacted by organic compounds.

The bedrock ground water contains a wide variety of inorganics in the dissolved and total fraction, which are widely distributed with no apparent pattern observed in the extent of detection for any given analyte. No unusually high or anomalous concentrations that are widespread across the Site were observed. The nature and distribution of the inorganics are primarily related to the various rock types underlying the Site (i.e., shale, sandstone, limestone). However, concentrations of 10 inorganics exceed HHSV criteria, and 12 inorganics exceed ESV criteria.

Natural Attenuation Assessment

Ground-water samples were collected during the April 2005 sampling event and submitted for analysis of natural attenuation parameters to provide data for the evaluation of remedial alternatives in the feasibility study related to natural attenuation and bioremediation of the ground water. The natural attenuation parameters analyzed included nitrate, sulfate, dissolved gases (methane, ethane, and ethene), and alkalinity (see Table 4-27). Information about other parameters and analytes, including dissolved oxygen, iron, oxidation/reduction potential (Eh), temperature, and conductivity have also been collected during the RI for use in the evaluation of natural attenuation alternatives during the feasibility study (FS).

General observations about the nature and extent of dissolved gases and other analytes of interest for the evaluation of natural attenuation processes in the ground water include:

- Dissolved methane is found in both the overburden and bedrock aquifer at concentrations ranging from non-detect to 650 ug/l. The presence of methane indicates that methanogenesis (an anaerobic biodegradation process) is occurring in some locations. The highest concentration of dissolved methane was found in well MW-5A (650 ug/l), which is not unexpected given the concentrations of contaminants found at this location. On the contrary, the concentration detected in well MW-4A (the most highly contaminated) was only 130 ug/l. Other wells with high concentrations of dissolved methane (>300 ug/l) include MW-01A1, MW-06C, MW-09B, MW-10B, MW-10C, and MW-15C.

- Sulfate concentrations ranged from 5 mg/l to 444 mg/l (see Table 4-27). Sulfate concentrations are used as an indicator of anaerobic degradation, and low sulfate concentrations are often indicative of active degradation processes. The lowest concentration was detected in well MW-5A (5 mg/l), which combined with the methane concentration, indicates that anaerobic degradation is occurring in this area. On the contrary, the sulfate concentration measured in well MW-4A was 94 mg/l - combined with the methane concentration observation for this well, it appears that the conditions in the subsurface at MW-4A are not as conducive to anaerobic degradation of the contaminants as they are at location MW-5A.

In summary, a cursory review of the data collected for evaluation of natural attenuation processes at the Site indicate that anaerobic degradation appears to be occurring in the vicinity of well MW-05A (the well with the second highest concentration of organic compounds). However, it appears that the conditions in the subsurface in the vicinity of well MW-4A (the well with the highest concentrations of organic compounds) are not nearly as conducive to anaerobic degradation as those found near well MW-5A. Note that a more detailed assessment of the natural attenuation potential for the Site will be conducted as part of the FS remedial alternatives evaluation.

4.5 SURFACE WATER/SEDIMENT ASSESSMENT

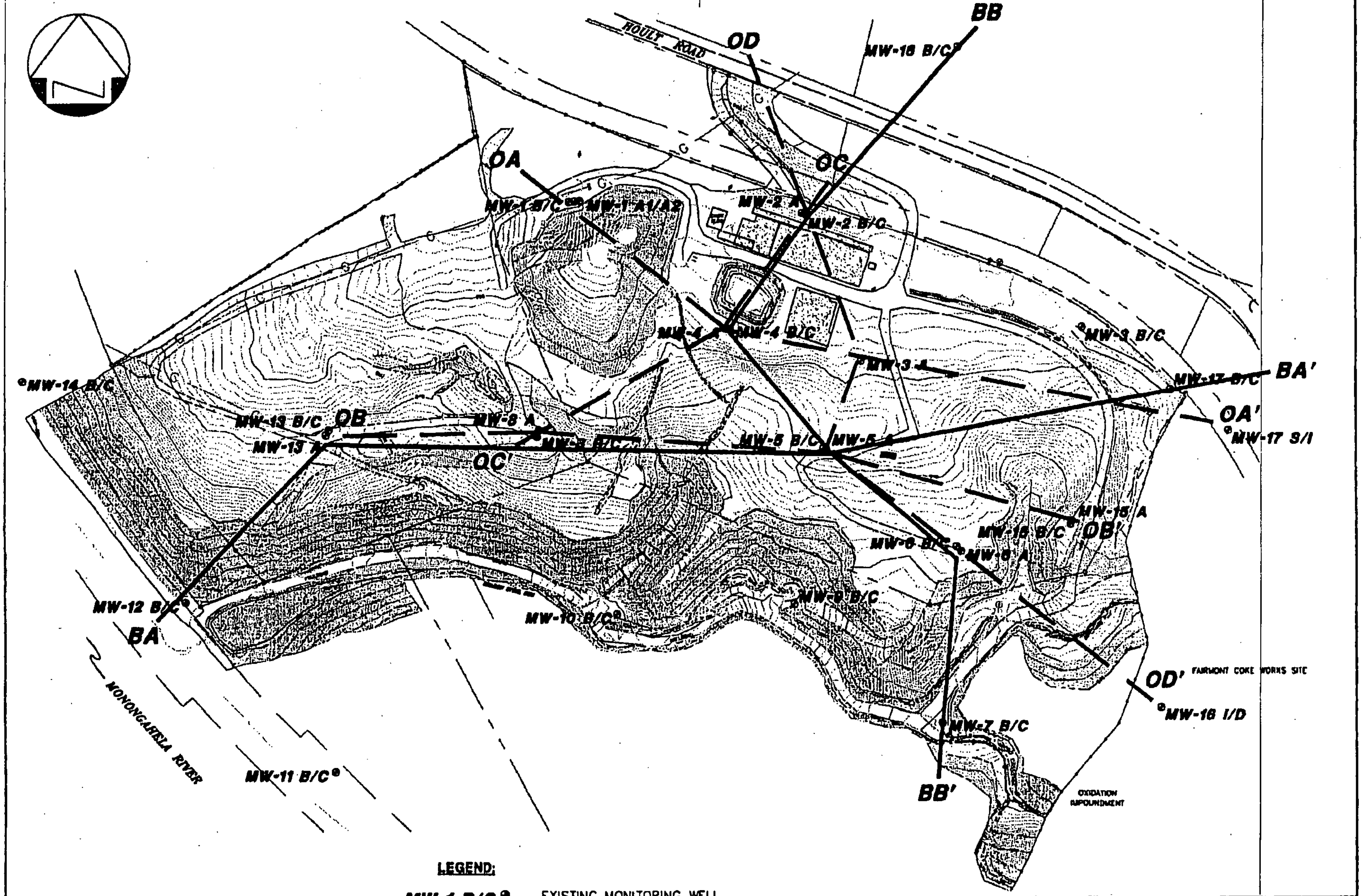
4.5.1 Surface Water Assessment

The results of the surface water assessment for on-site and off-site streams (i.e., not including the Monongahela River) are summarized below. Data were collected from:

- Fifteen (15) locations that are part of the Sharon Steel Run drainage system (which drains the majority of the Site);
- Eight (8) locations (both on-site and off-site) that are part of Unnamed Tributary #2 (which drains the northern portion of the Site); and
- Four (4) off-site locations that drain areas both hydrologically isolated and far upgradient of the Site, in areas which have not been subject to industrial land use activities (considered to be background locations).

The information in this section is supplemented by the following figures, tables, and appendices:

Figure 3-6	On-Site Surface Water/Sediment Location Map
Figure 3-7	Off-Site Surface Water/Sediment Location Map
Figure 4-12	Impacted Surface Water Area Location Map



LEGEND:

MW-1 B/C® EXISTING MONITORING WELL CLUSTER LOCATIONS (SHALLOW AND DEEP)

BA ——— **BA'** BEDROCK CROSS SECTION LINE

OA — — **OA'** OVERBURDEN CROSS SECTION LINE

0 40 80 160
1"=80'

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 4-3
Site Geology Cross Section Location Map
Big John Salvage - Hoult Road Site
Fairmont, West Virginia

N:\Projects\T0000\t47121\8.5x11_Sitemap-2006-rev.dwg

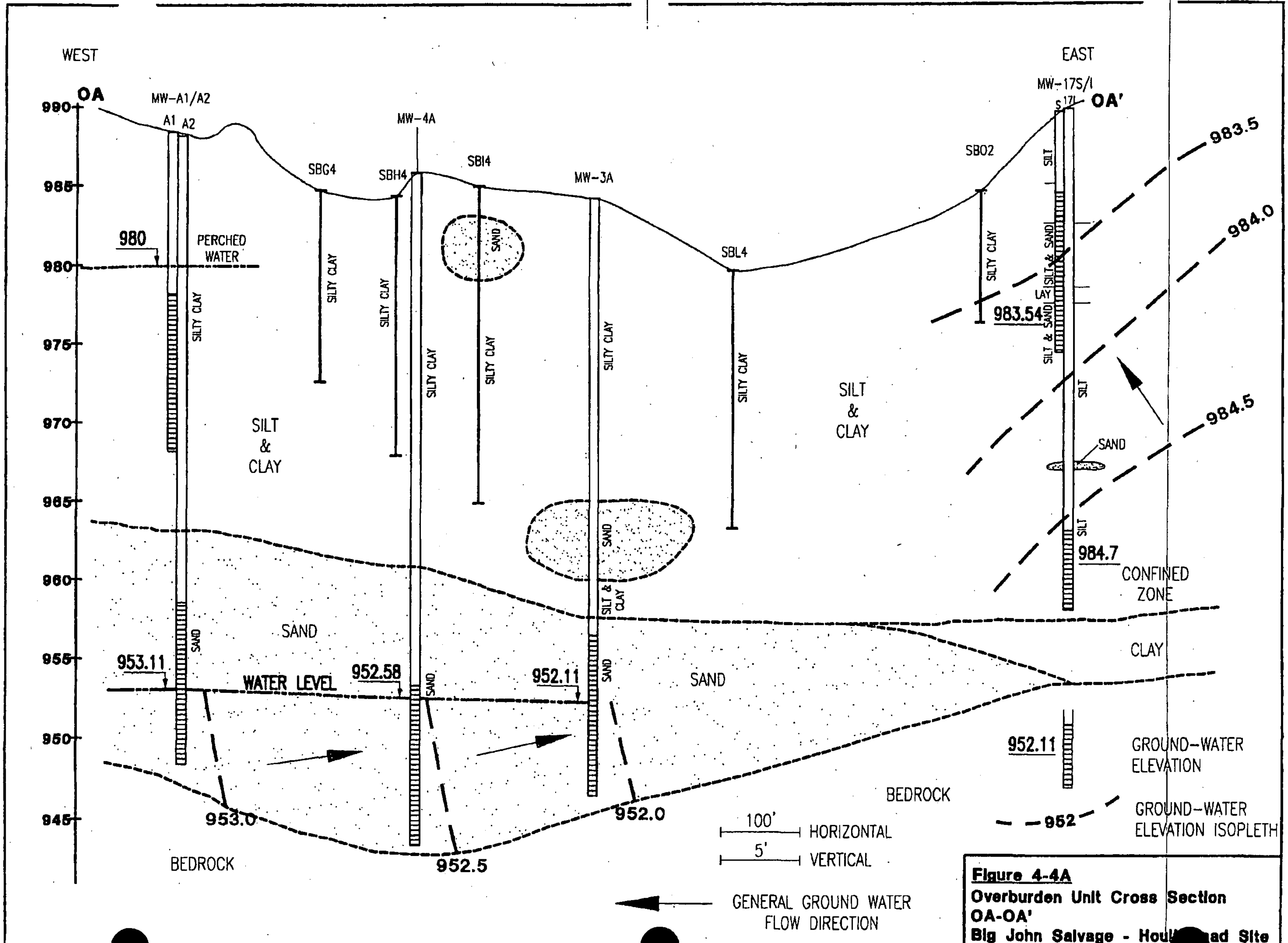


Figure 4-4A
Overburden Unit Cross Section
OA-OA'
Big John Salvage - Hou[illegible]ad Site
Fairmont, West Virginia

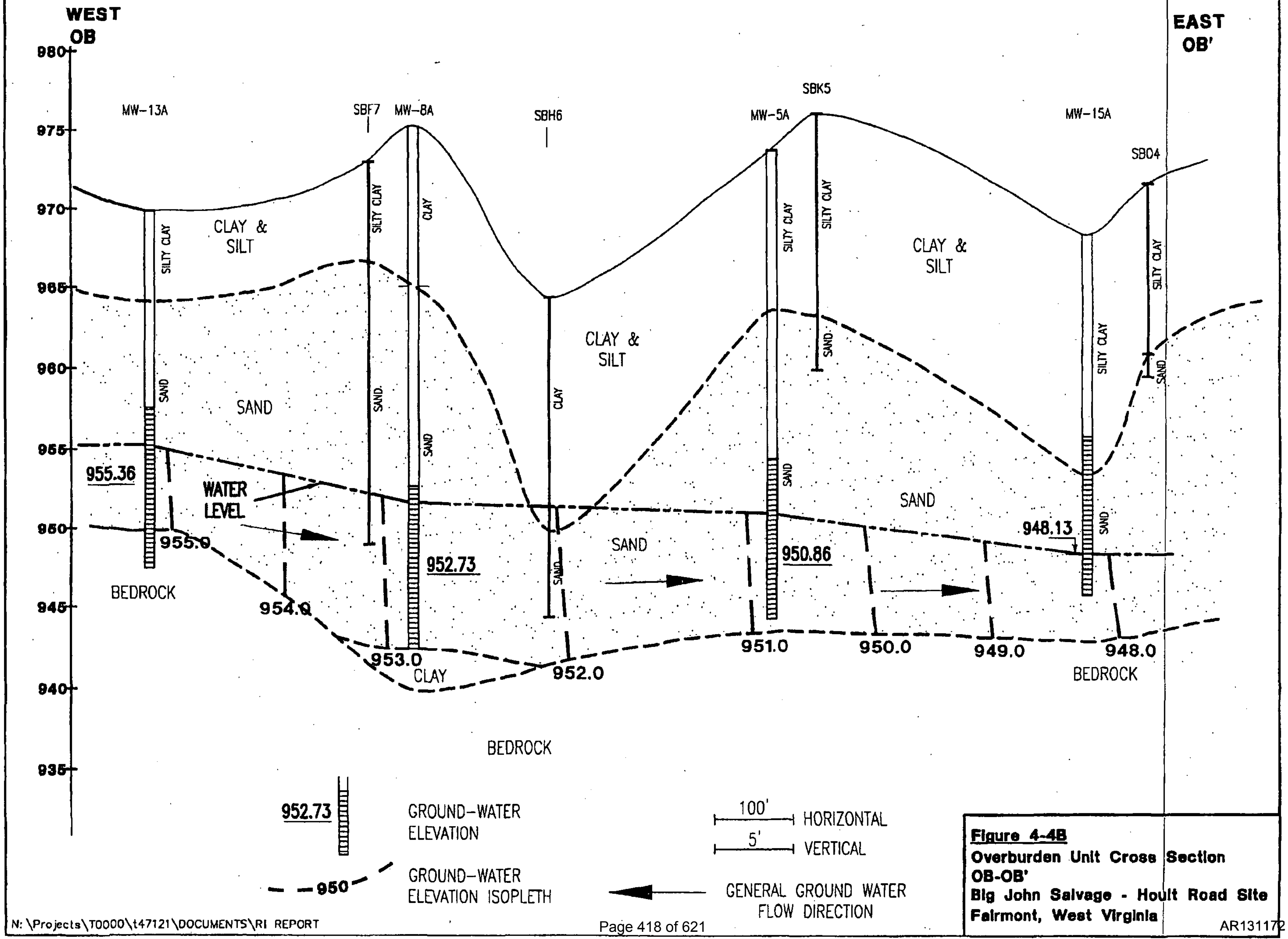


Figure 4-4B
Overburden Unit Cross Section OB-OB'
Big John Salvage - Hoult Road Site
Fairmont, West Virginia

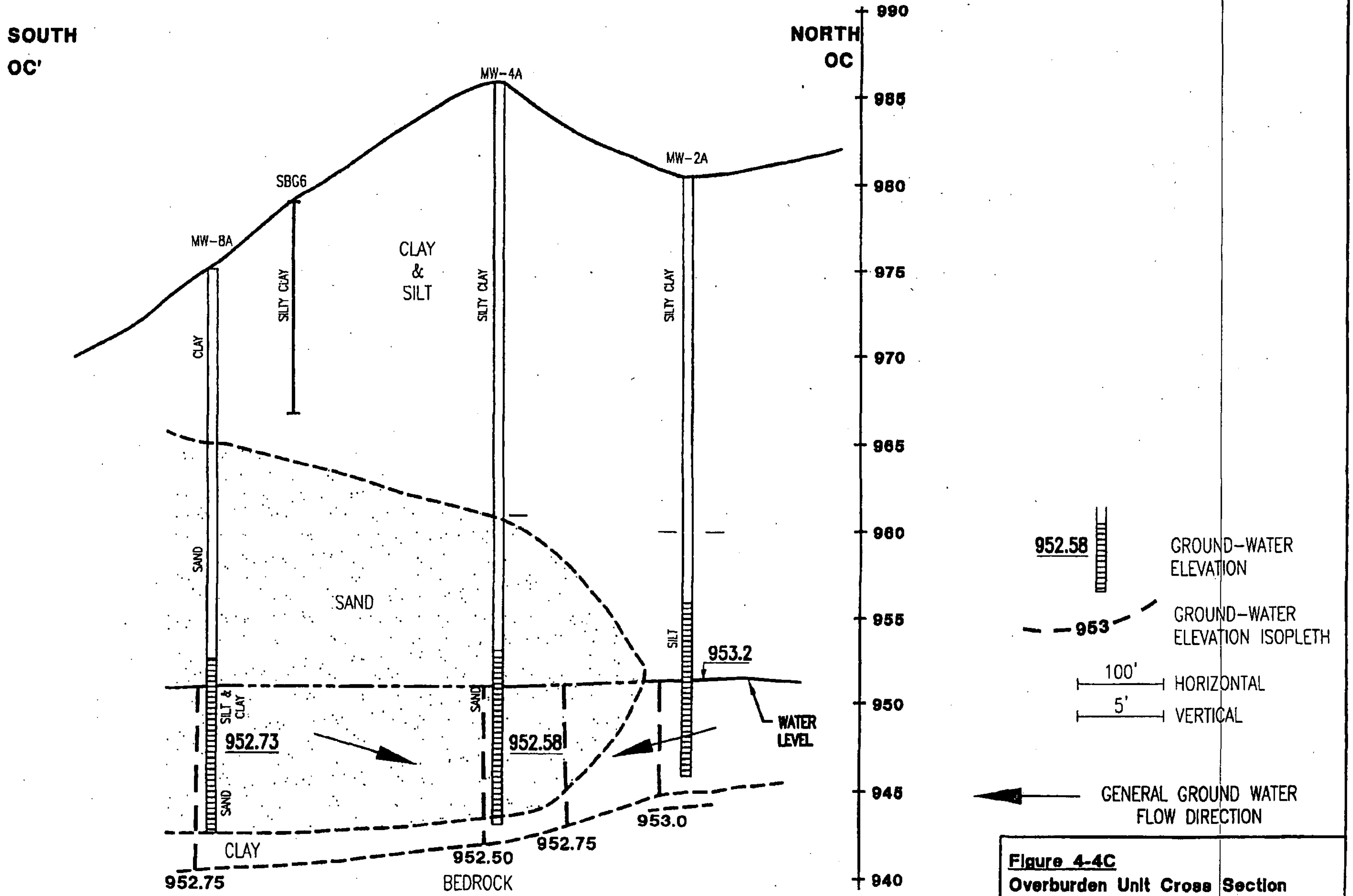


Figure 4-4C

Overburden Unit Cross Section OC-OC'

Big John Salvage - Hou[illegible]ead Site

Fairmont, West Virginia

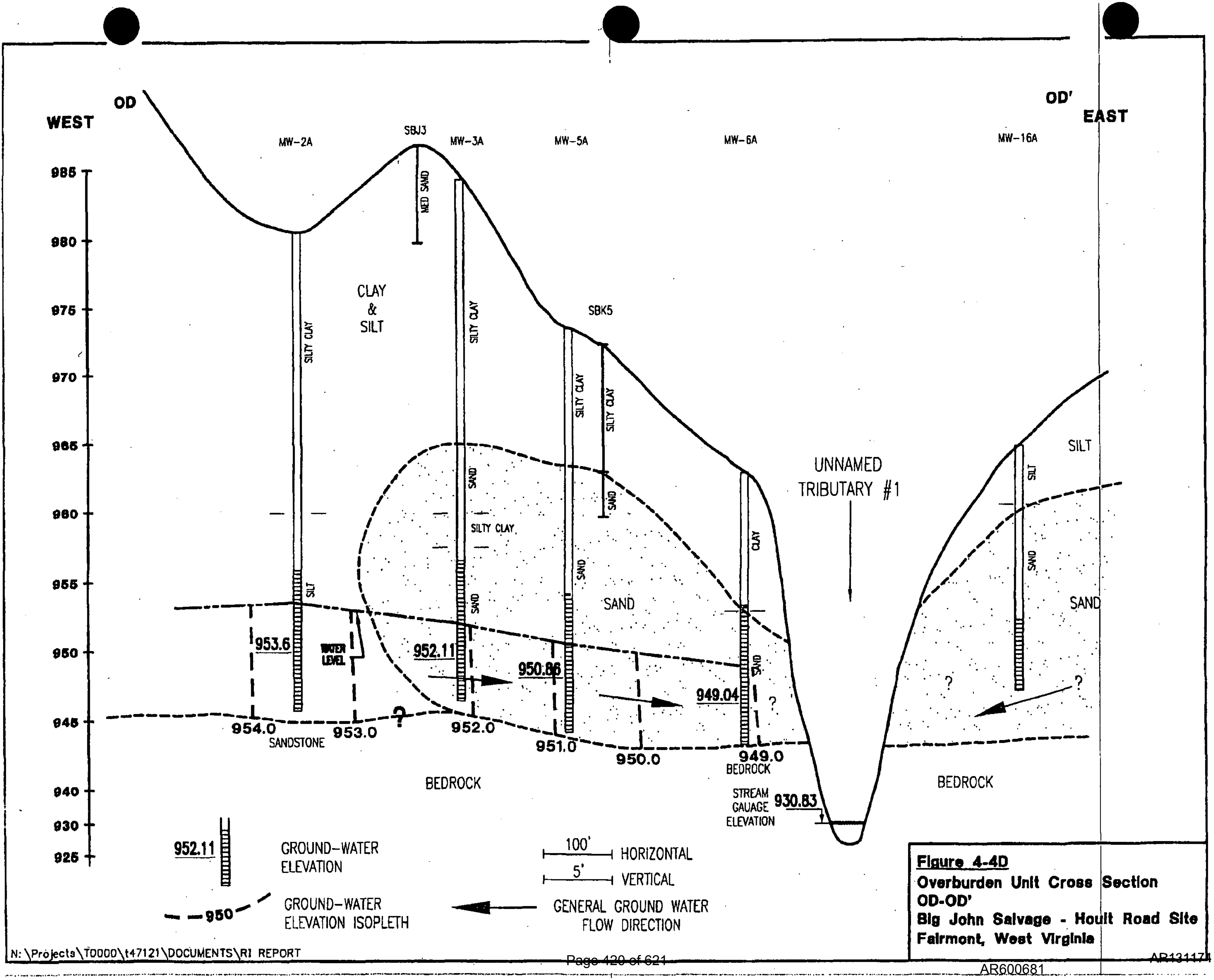
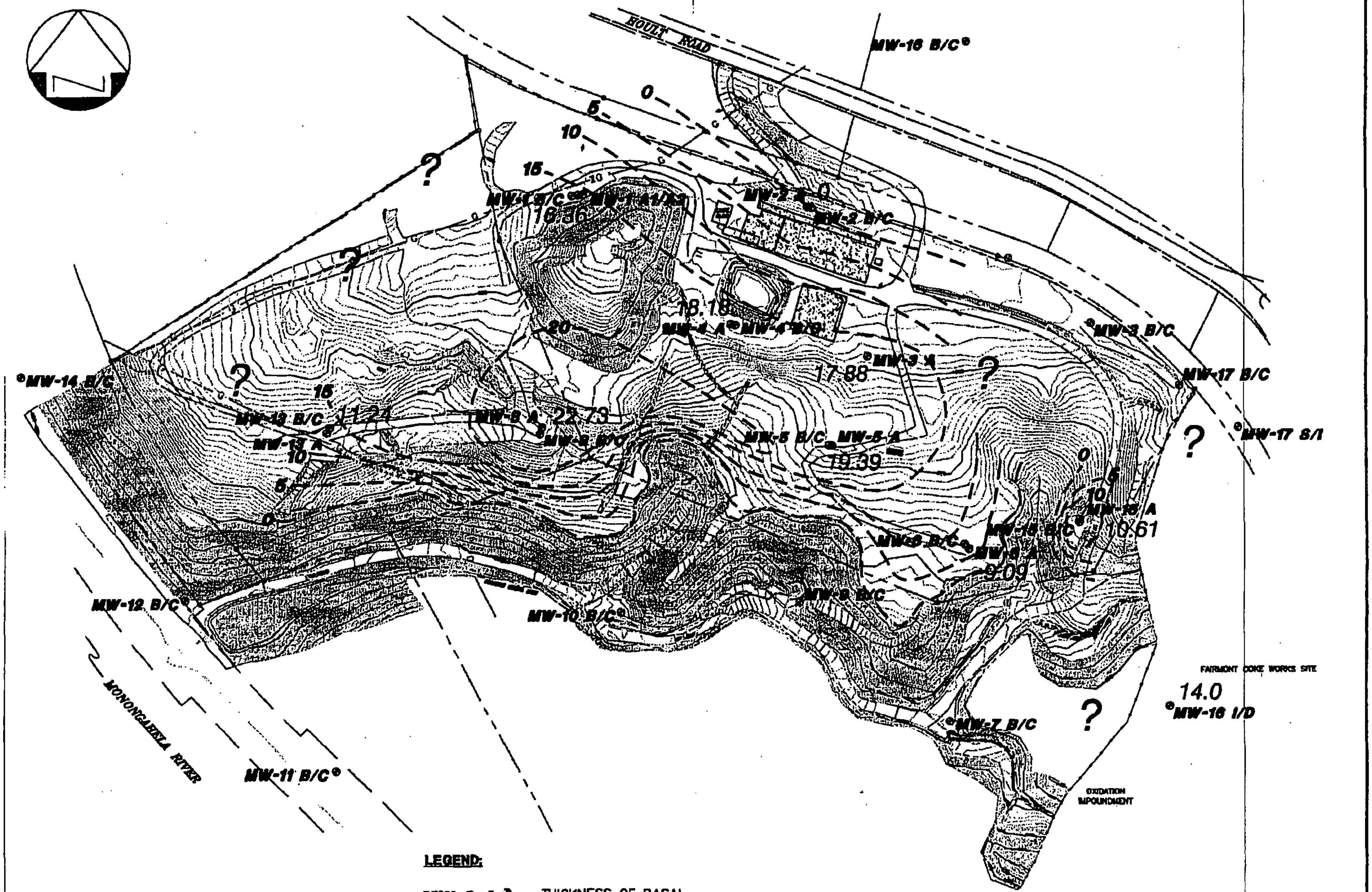


Figure 4-4D
Overburden Unit Cross Section OD-OD'
Big John Salvage - Hoult Road Site
Fairmont, West Virginia



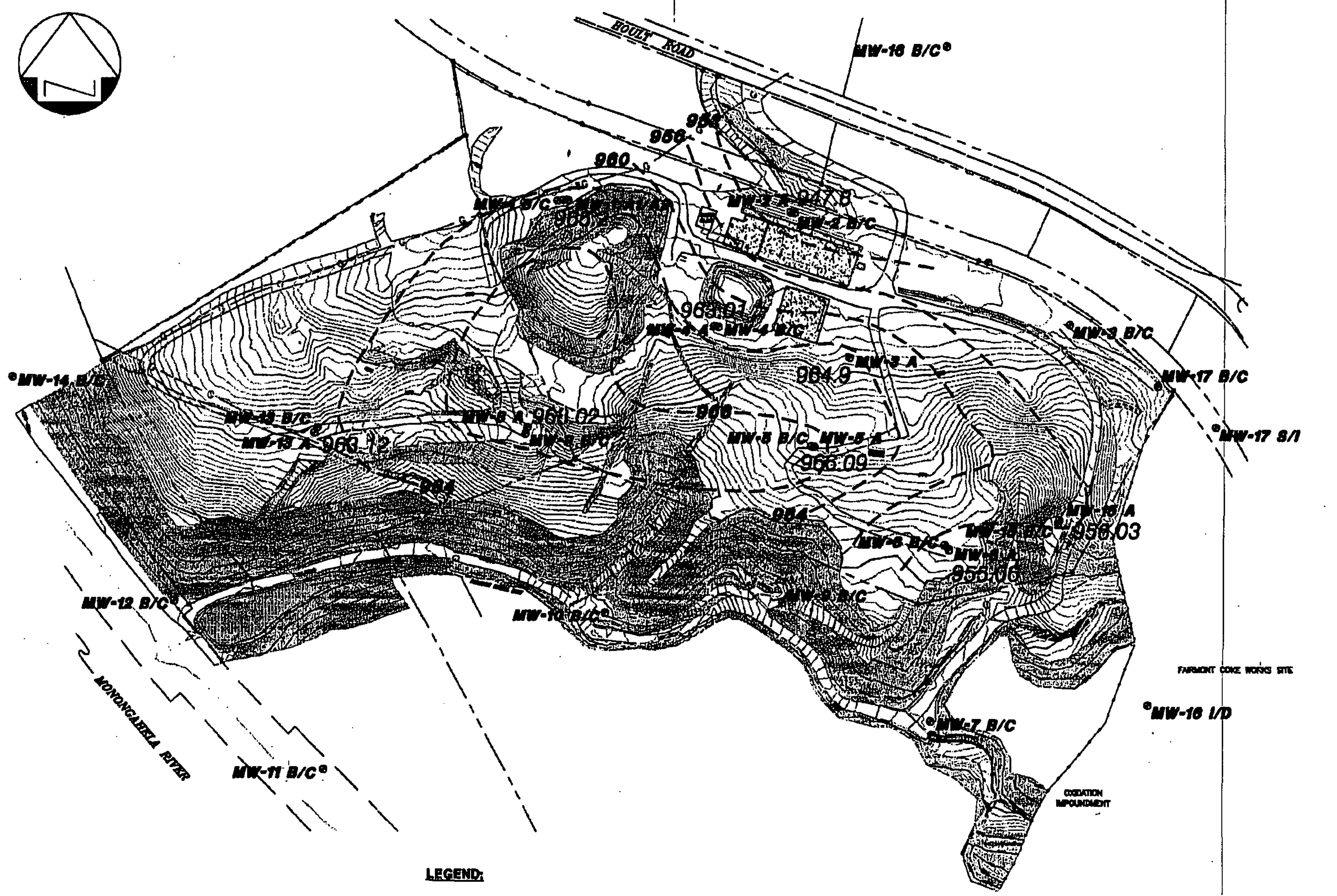
LEGEND:

MW-6 A ● 9.09	THICKNESS OF BASAL SAND LAYER
— — 20 — —	SAND LAYER THICKNESS ISOPLETH

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 4-4E

Isopach Thickness Map of the Sand Layer at the Base of Overburden Big John Salvage - Houl[illegible]ad Site Fairmont, West Virginia



LEGEND:

- -966- -	TOP OF BASAL SAND LAYER ELEVATION ISOPLETH

0 40 80 160
1"=80'

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 4-4F

Top of the Sand Layer Elevation Map

Big John Salvage - Hoult Road Site
Fairmont, West Virginia

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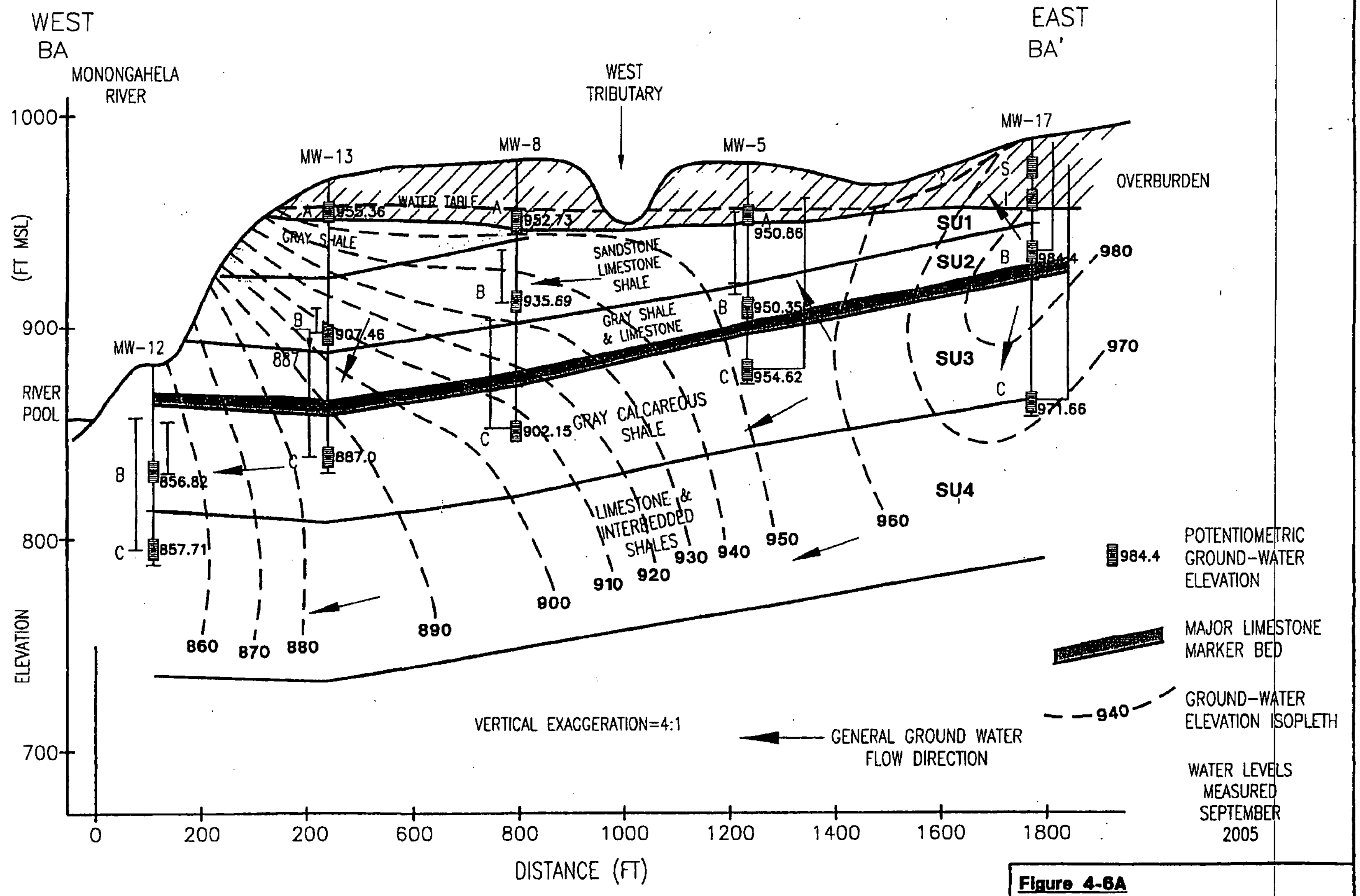
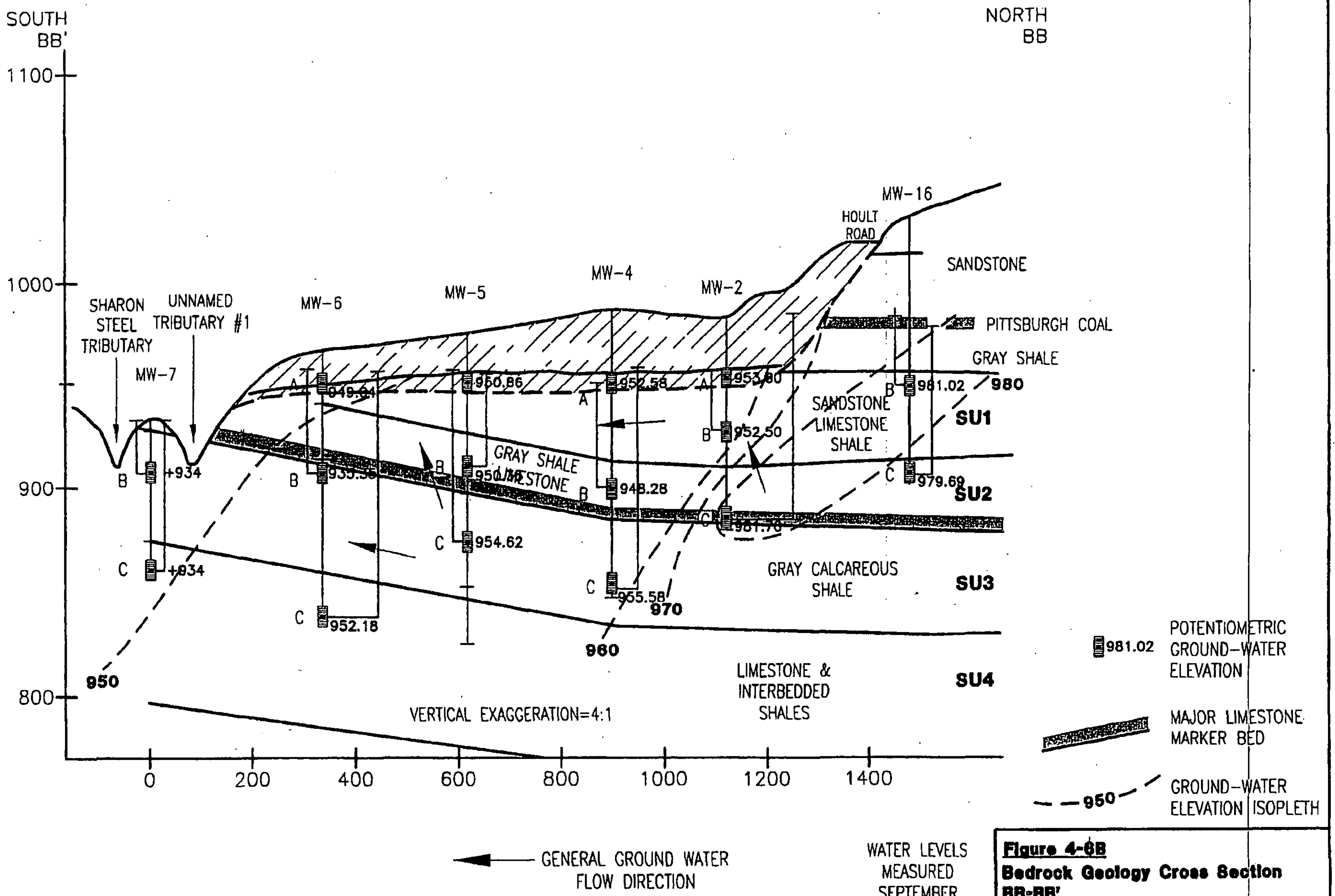


Figure 4-6A
Bedrock Geology Cross Section BA-BA'
Big John Salvage - Hoult Road Site
Fairmont, West Virginia



WATER LEVELS MEASURED SEPTEMBER 2005

Figure 4-6B
Bedrock Geology Cross Section BB-BB'
Big John Salvage - Hoult Road Site
Fairmont, West Virginia

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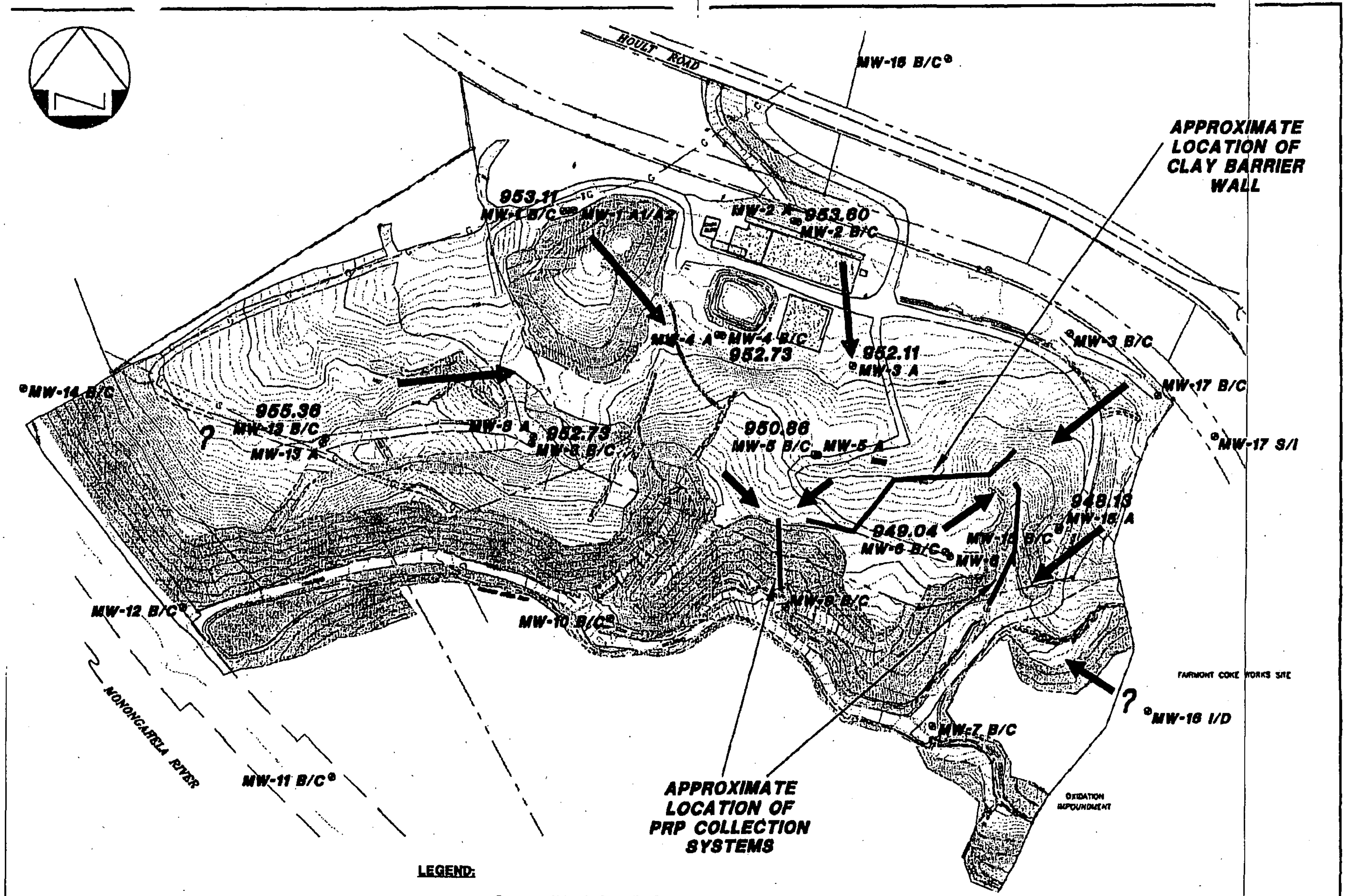

LEGEND:

MW-1 B/C ® 953.11	OVERBURDEN WELLS - SEPTEMBER, 2005 WATER LEVELS/POTENTIOMETRIC
⟵	GENERAL FLOW DIRECTION

0 40 80 160

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 4-7

General Ground-Water Flow Direction - Overburden Aquifer

Big John Salvage - Hoult [illegible] Site

Fairmont, West Virginia

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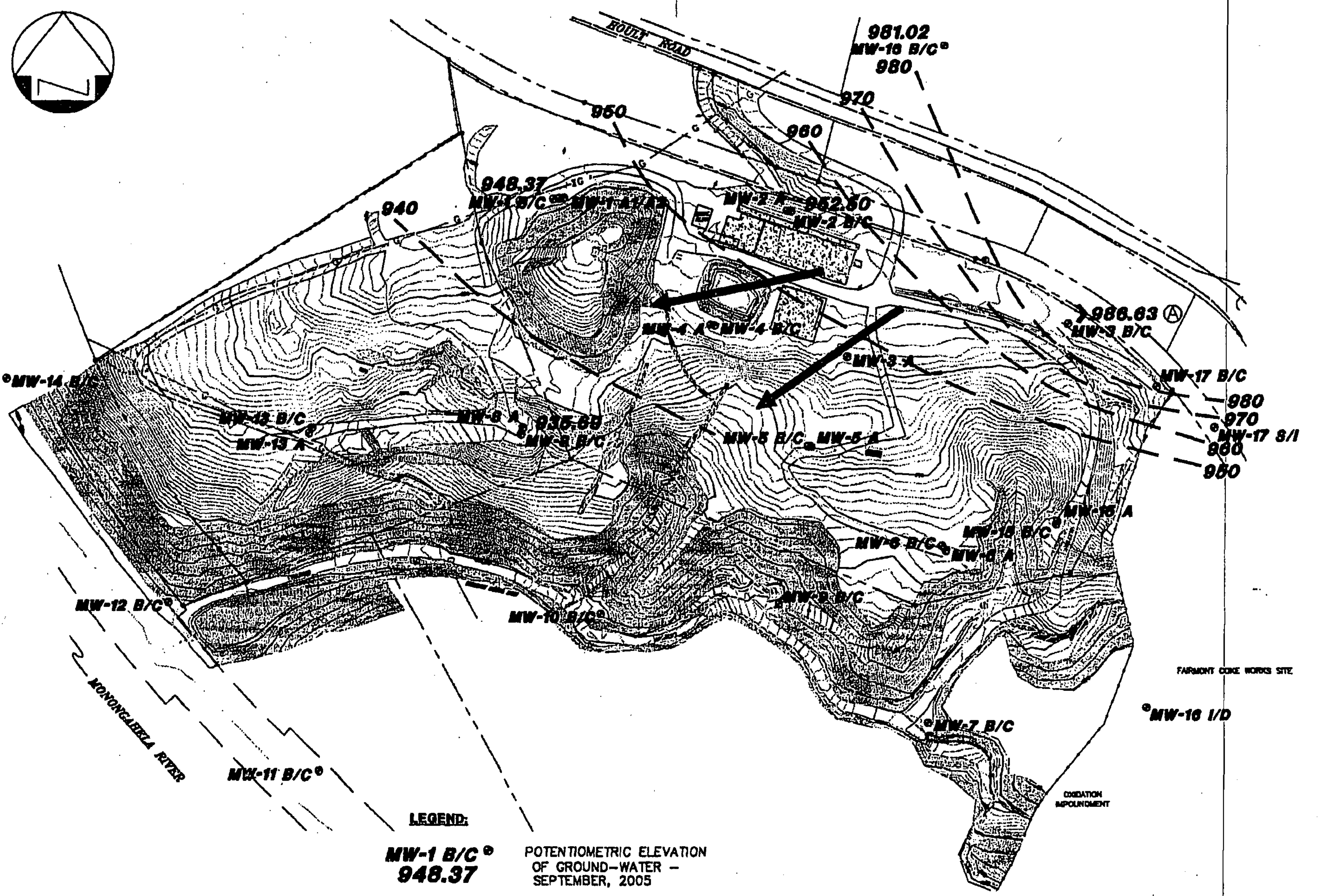

LEGEND:

MW-1 B/C 948.37	POTENTIOMETRIC ELEVATION OF GROUND-WATER – SEPTEMBER, 2005
Ⓐ	DENOTES ARTESIAN
⟵	GENERAL FLOW DIRECTION
940 — — —	GROUND-WATER ELEVATION ISOPLETH

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 4-8A

General Ground-Water Flow Direction - Stratigraphic Unit 1

Big John Salvage - Hoult Road Site

Fairmont, West Virginia

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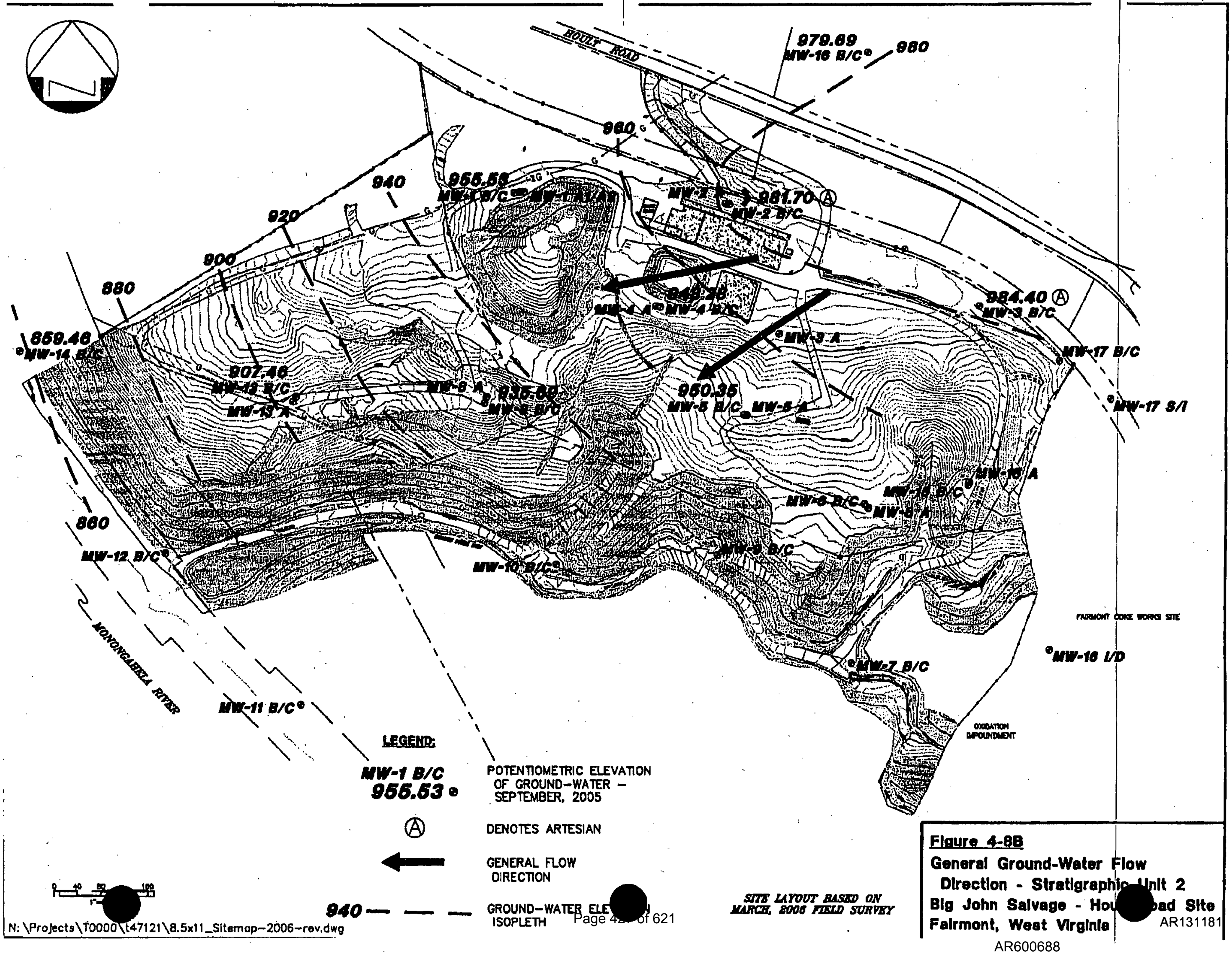
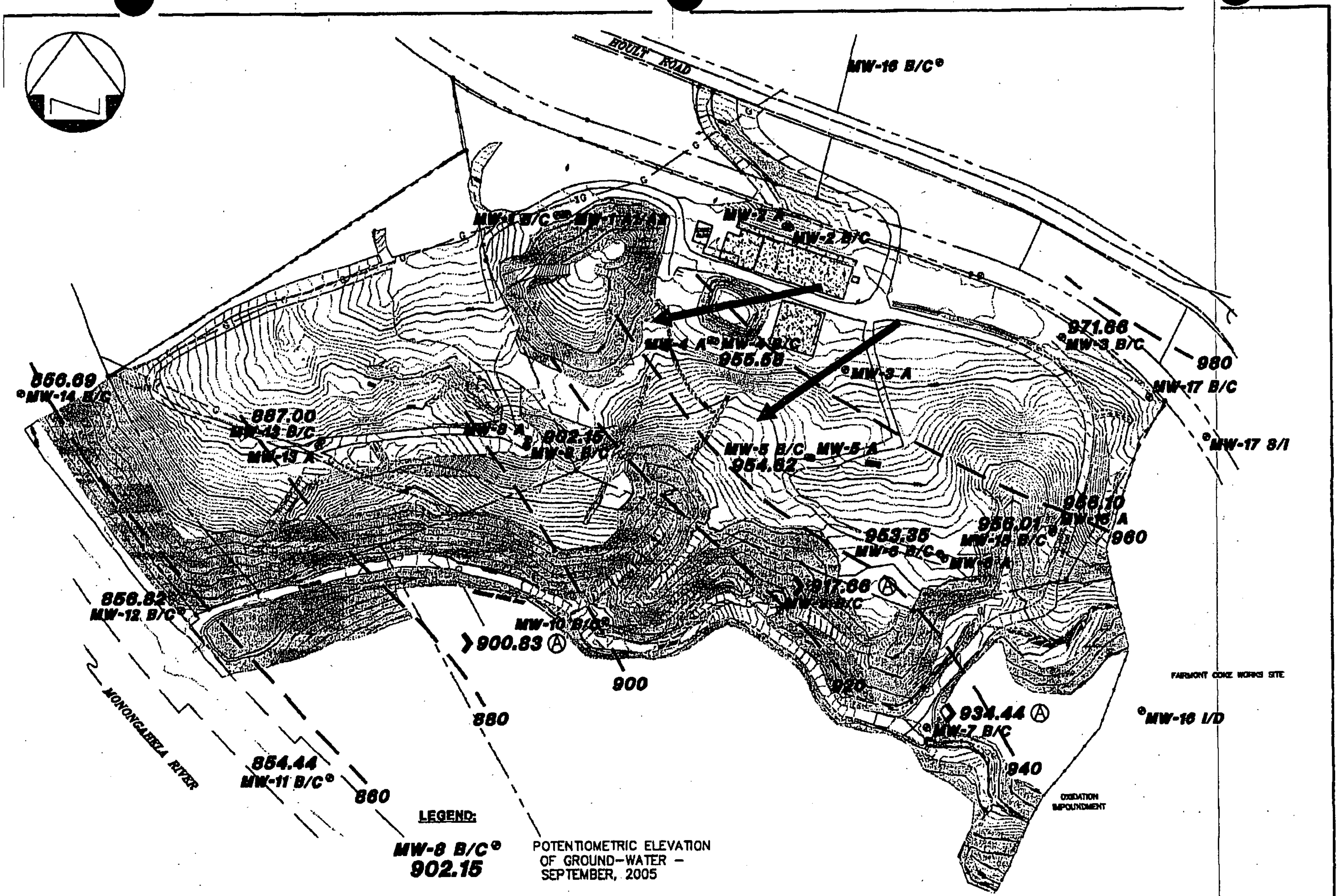


Figure 4-8B

General Ground-Water Flow Direction - Stratigraphic Unit 2
Big John Salvage - Hou[illegible]oad Site
Fairmont, West Virginia



LEGEND:

MW-8 B/C ⊕ 902.15	POTENTIOMETRIC ELEVATION OF GROUND-WATER – SEPTEMBER, 2005
Ⓐ	DENOTES ARTESIAN
←	GENERAL FLOW DIRECTION
940 — — —	GROUND-WATER ELEVATION ISOPLETH

0 40 80 160
1"=80'

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 4-8C

General Ground-Water Flow Direction - Stratigraphic Unit 3

Big John Salvage - Hoult Road Site

Fairmont, West Virginia

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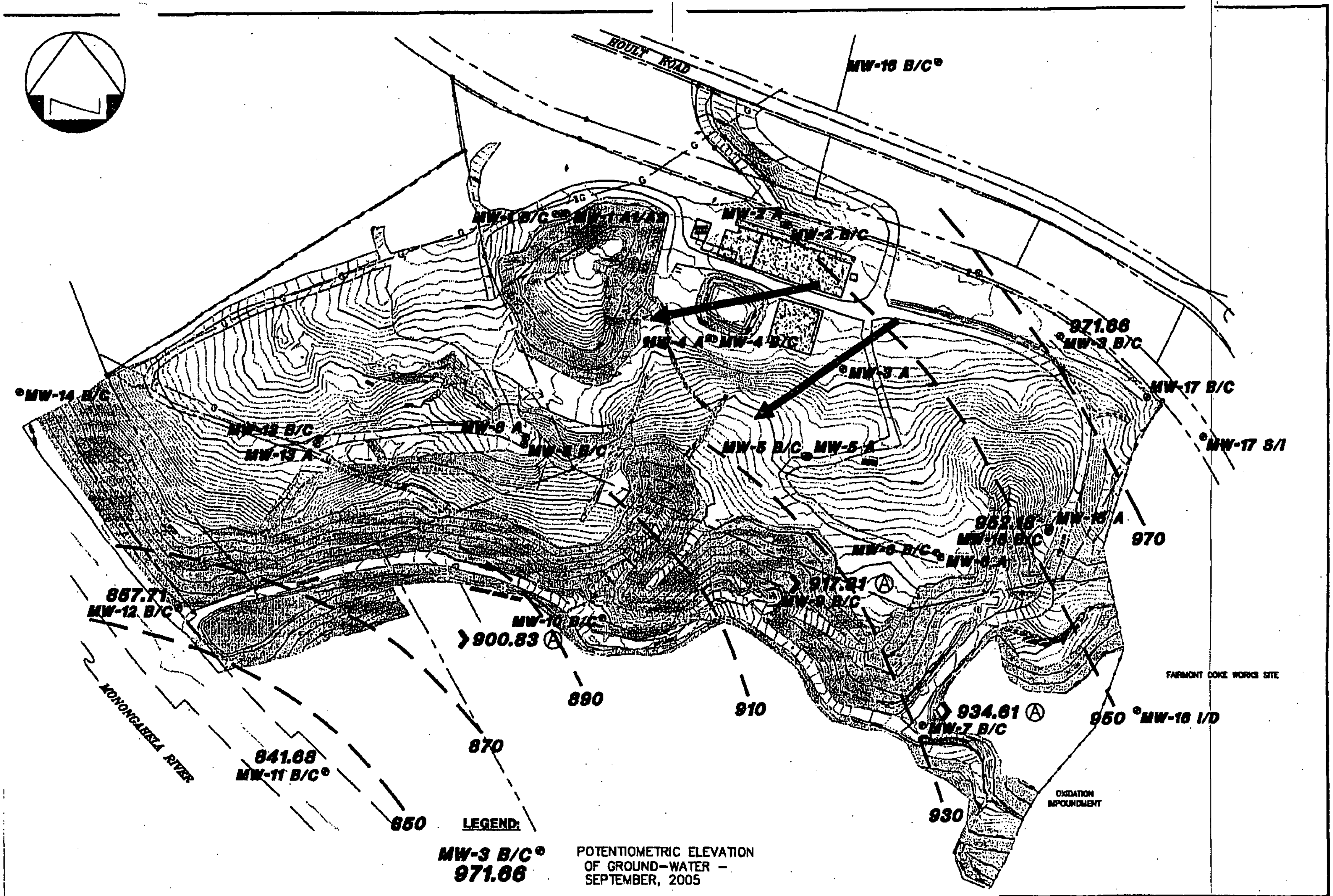

LEGEND:

MW-3 B/C
971.66 POTENTIOMETRIC ELEVATION OF GROUND-WATER – SEPTEMBER, 2005

Ⓐ DENOTES ARTESIAN

← GENERAL FLOW DIRECTION

930 — — — GROUND-WAT[illegible]EVATION ISOPLETH

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 4-8D

General Ground-Water Flow Direction - Stratigraphic Unit 4
Big John Salvage - Hou[illegible]ad Site
Fairmont, West Virginia

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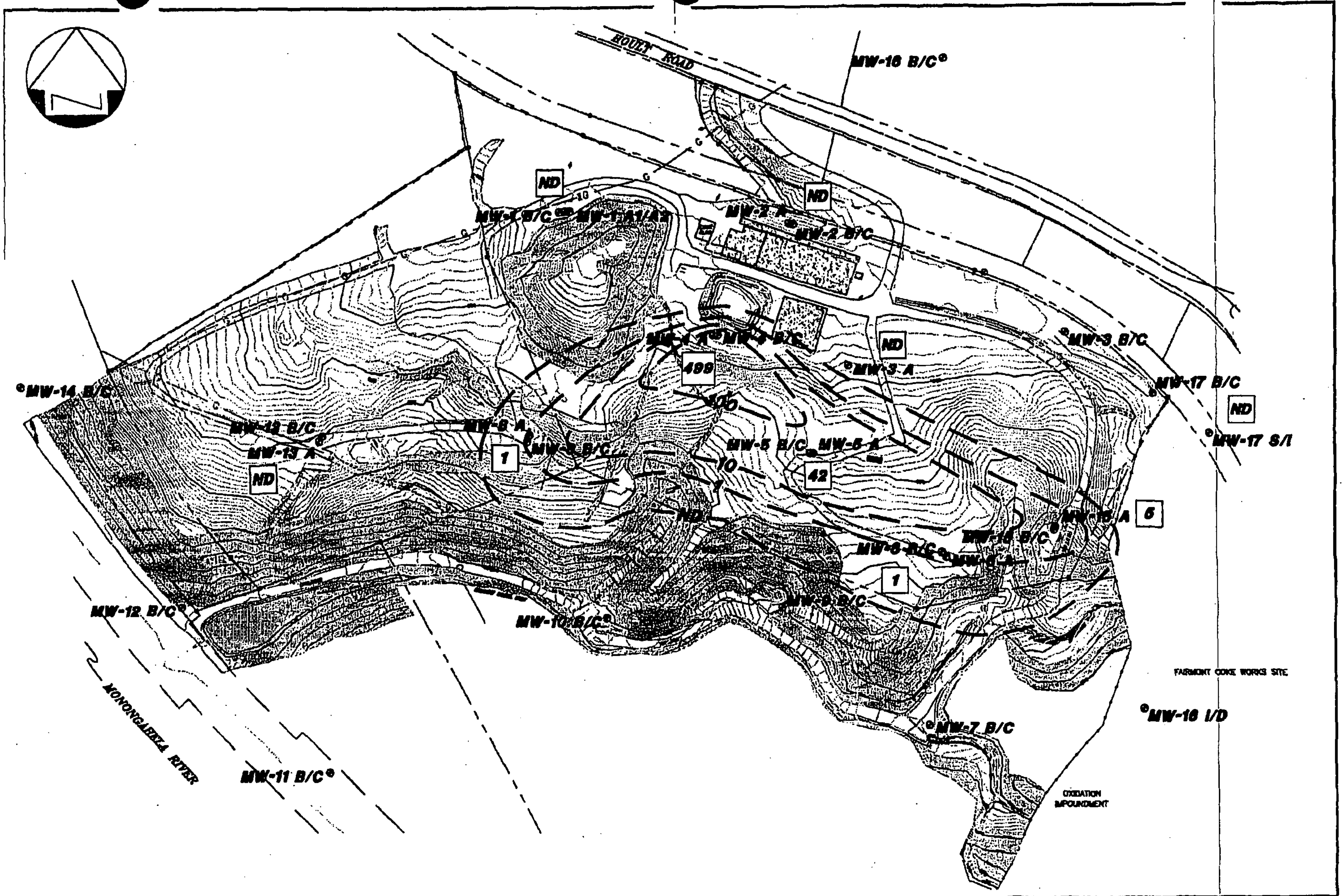

499	TOTAL VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATION (ug/L)
- -100- -	CONCENTRATION ISOPLETH

0 40 80 160
1"=80'

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 4-9A

Summary of VOC Ground-Water Detections - Overburden Aquifer - April, 2005

Big John Salvage - Hoult Road Site
Fairmont, West Virginia

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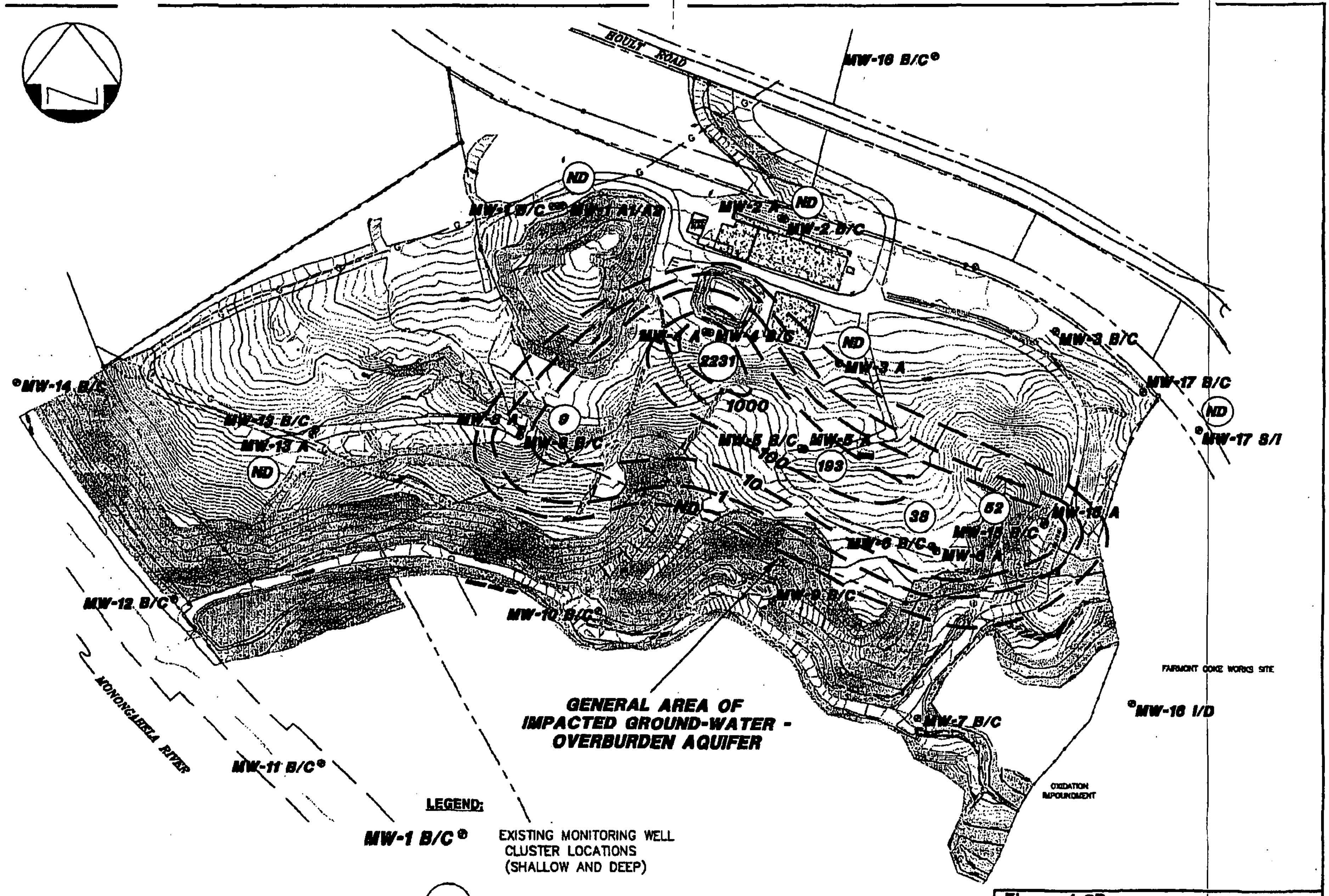


GENERAL AREA OF IMPACTED GROUND-WATER - OVERBURDEN AQUIFER

LEGEND:

MW-1 B/C ⊕	EXISTING MONITORING WELL CLUSTER LOCATIONS (SHALLOW AND DEEP)
(2231)	TOTAL PAH CONCENTRATION (ug/L)
– – 100 – –	CONCENTRATION ISOPLETH

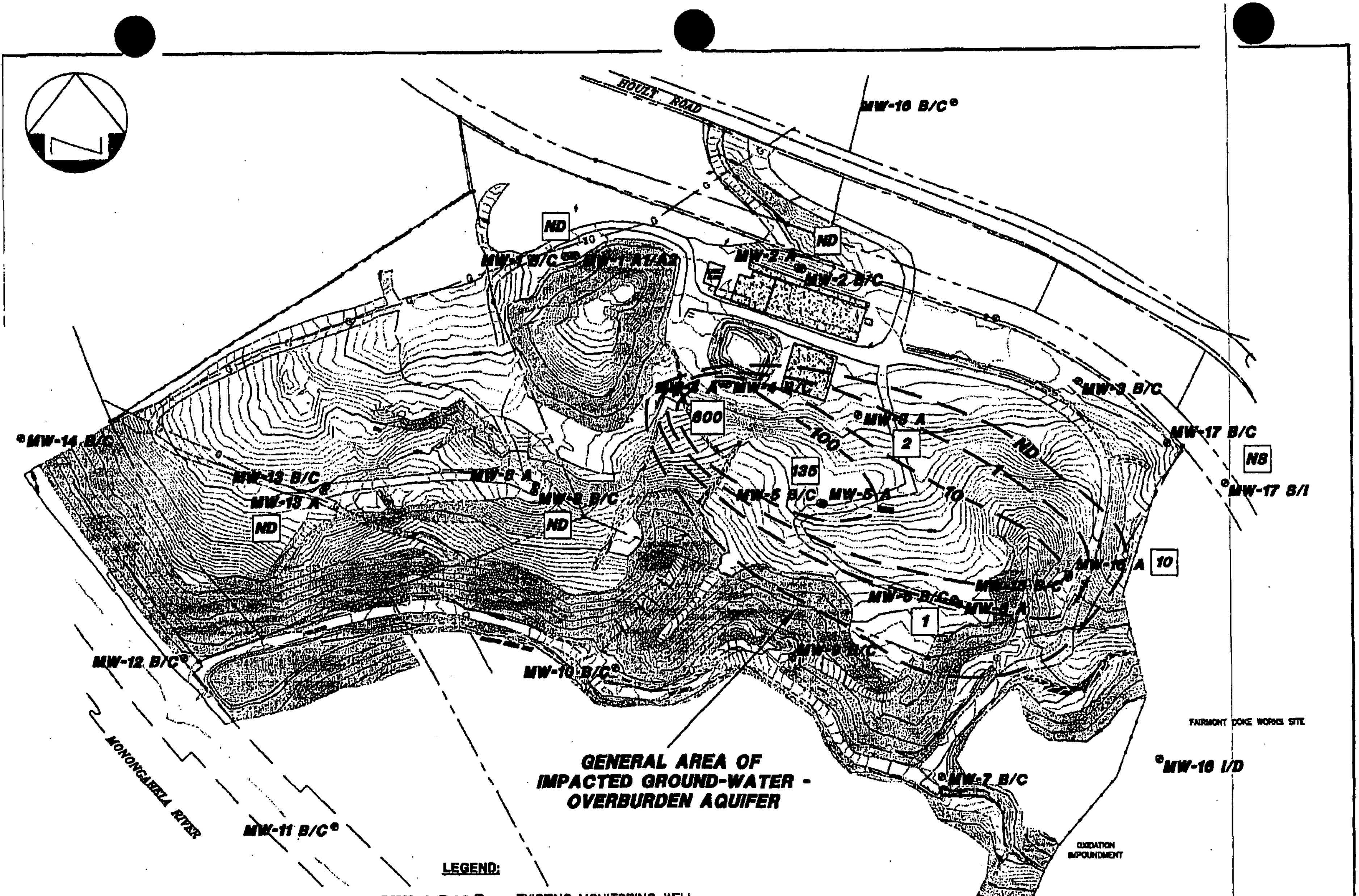
SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 4-9B

Summary of PAH Ground-Water Detections - Overburden Aquifer - April, 2005

Big John Salvage - Hou[illegible]ad Site

Fairmont, West Virginia



LEGEND:

MW-1 B/C®	EXISTING MONITORING WELL CLUSTER LOCATIONS. (SHALLOW AND DEEP)
600	TOTAL VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATION (ug/L)
- -100- -	CONCENTRATION ISOPLETH

0 40 80 160
1"=80'

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 4-10A
Summary of VOC Ground-Water Detections - Overburden Aquifer - July, 2005
Big John Salvage - Hoult Road Site
Fairmont, West Virginia

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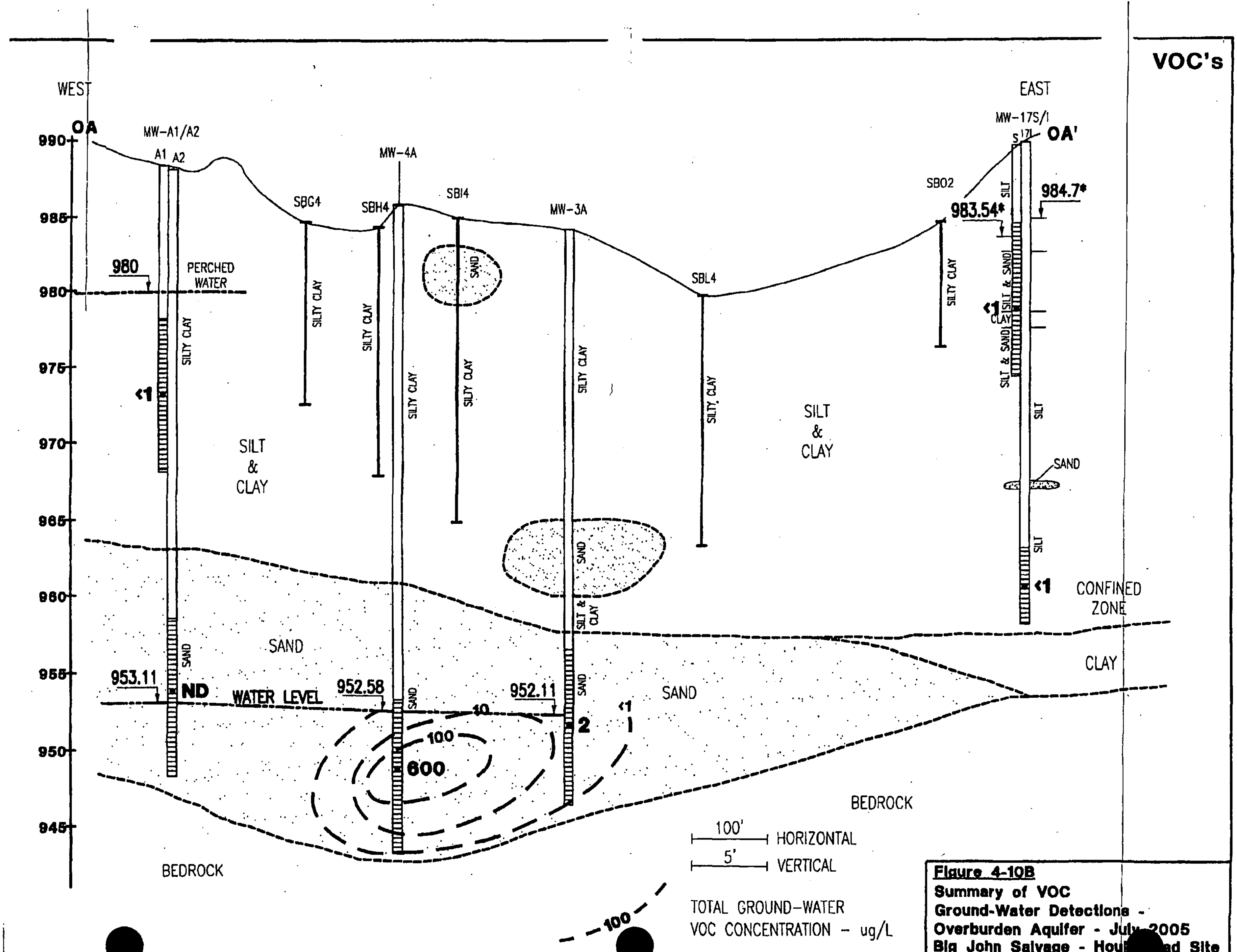

Figure 4-10B

Summary of VOC Ground-Water Detections - Overburden Aquifer - July 2005
Big John Salvage - Hou[illegible]ad Site
Fairmont, West Virginia

AR131187

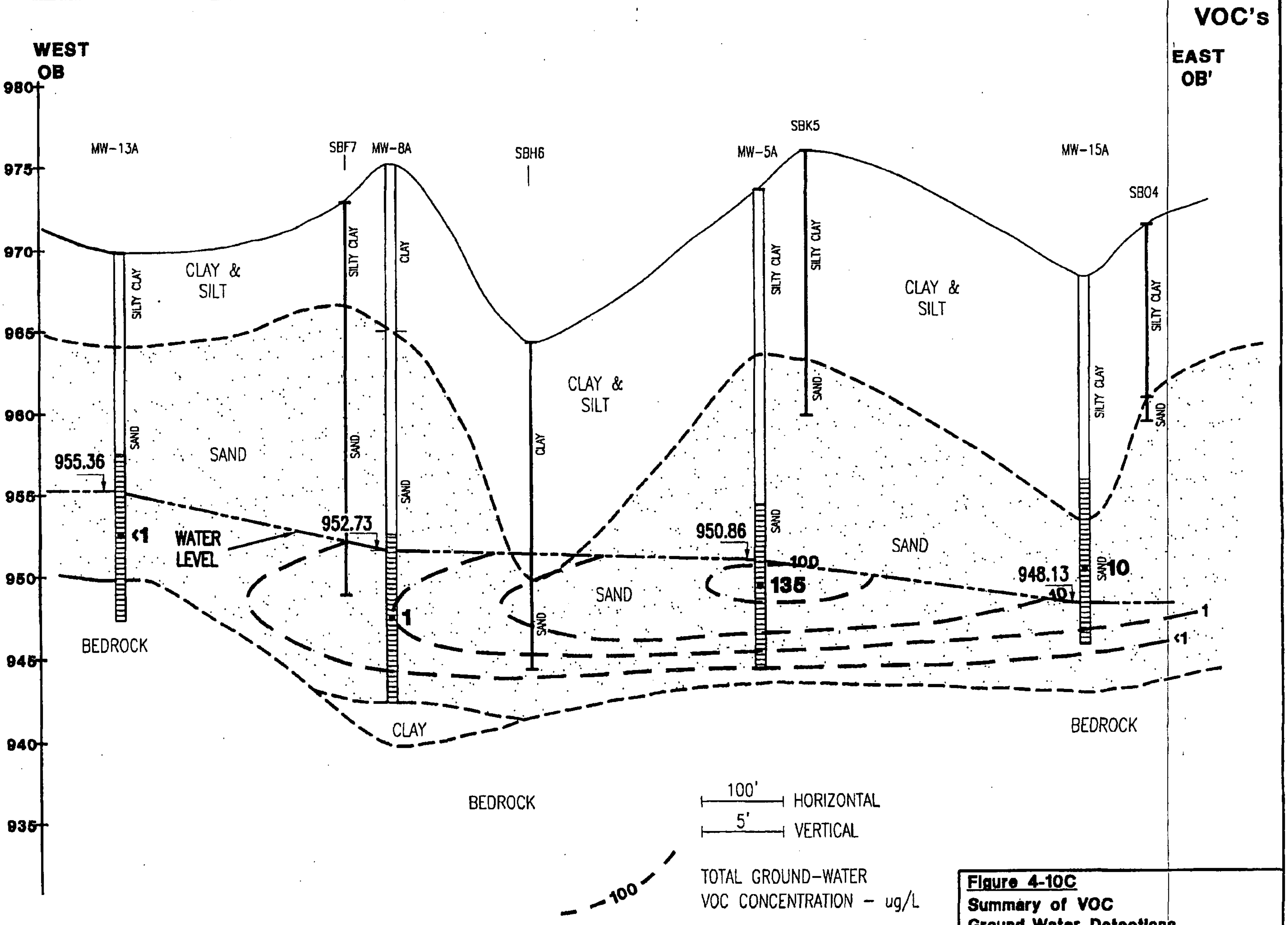

Figure 4-10C

Summary of VOC Ground-Water Detections - Overburden Aquifer - July 2005 Big John Salvage - Hoult Road Site Fairmont, West Virginia

VOC's

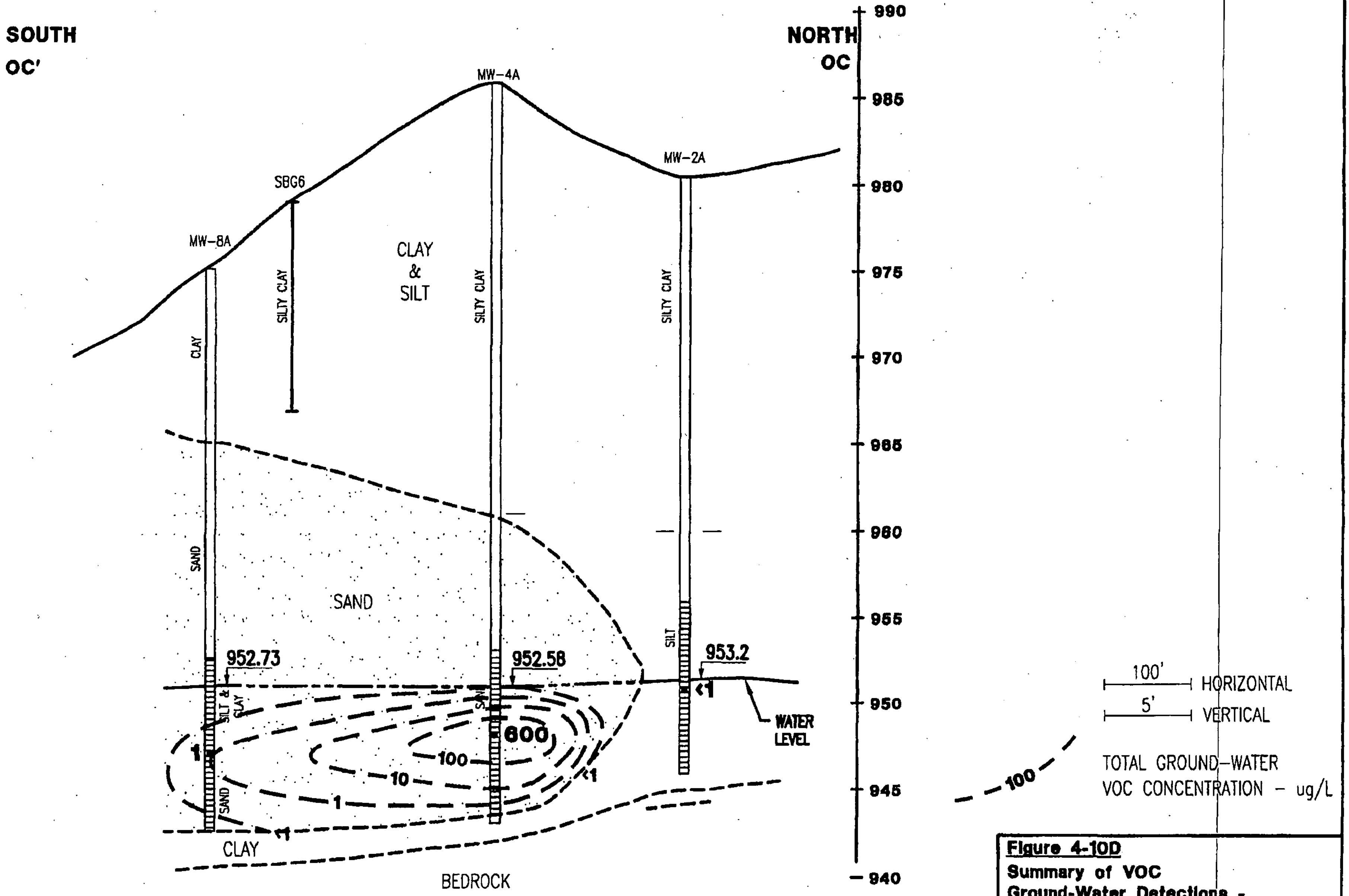

Figure 4-10D

Summary of VOC Ground-Water Detections - Overburden Aquifer - July 2005
Big John Salvage - Hou[illegible]ad Site
Fairmont, West Virginia

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VOC's

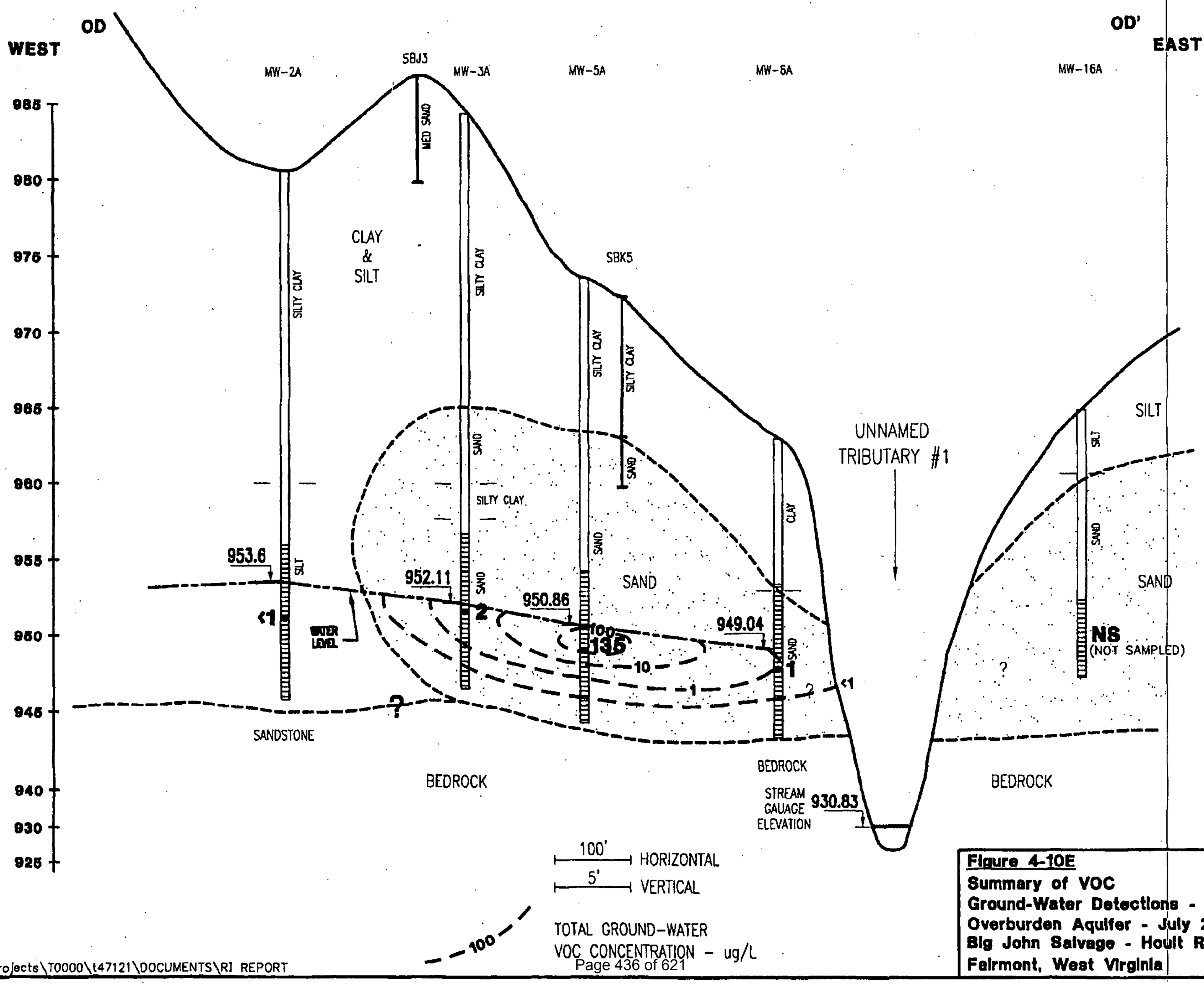
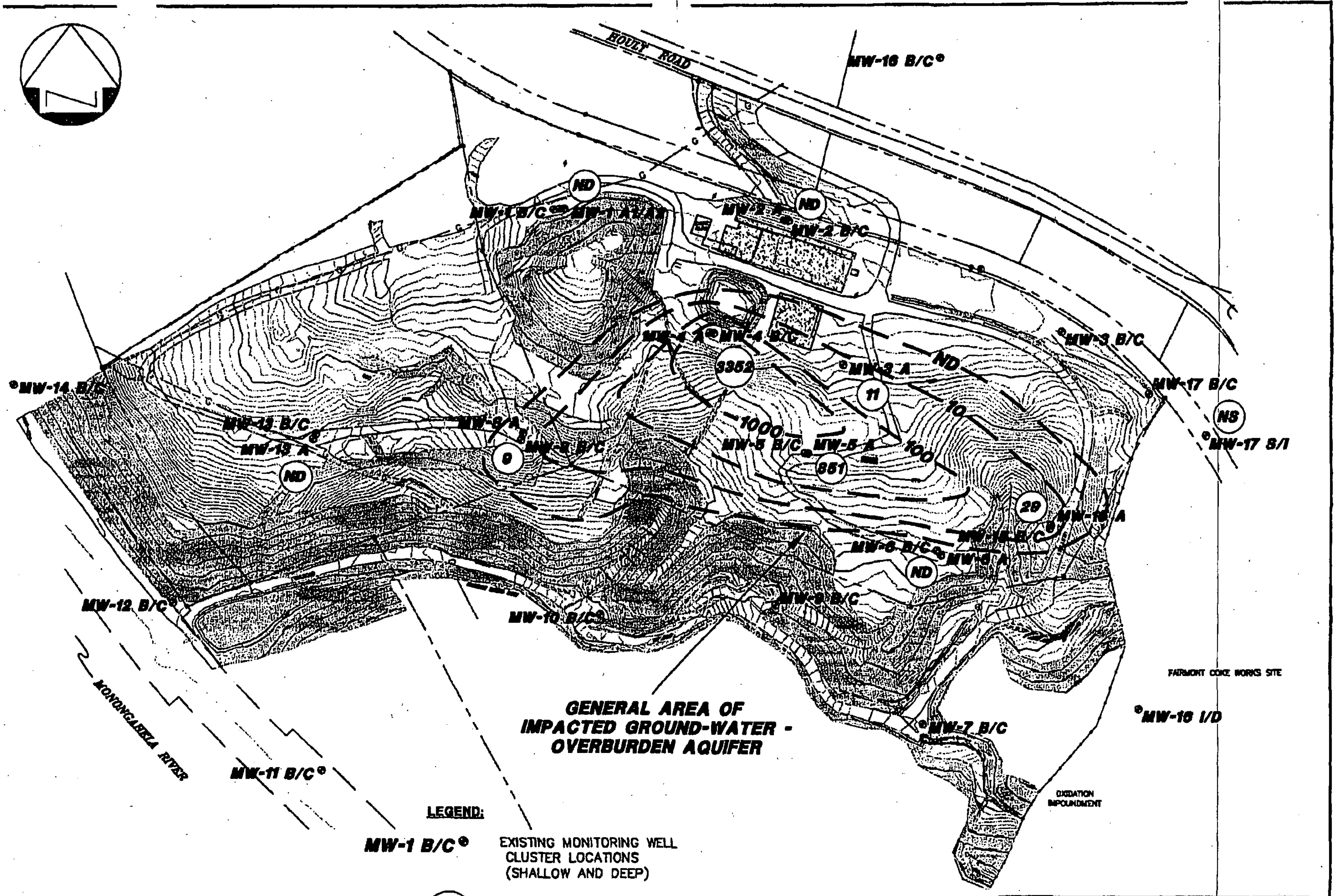


Figure 4-10E

Summary of VOC Ground-Water Detections - Overburden Aquifer - July 2005

Big John Salvage - Hoult Road Site

Fairmont, West Virginia



LEGEND:

MW-1 B/C⊕	EXISTING MONITORING WELL CLUSTER LOCATIONS (SHALLOW AND DEEP)
3352	TOTAL PAH CONCENTRATION (ug/L)
- -100- -	CONCENTRATION ISOPLETH

0 40 80 160
1"=80'

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

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Figure 4-10F

Summary of PAH Ground-Water Detections - Overburden Aquifer - July, 2005

Big John Salvage - Houl[illegible]ad Site
Fairmont, West Virginia

PAH's

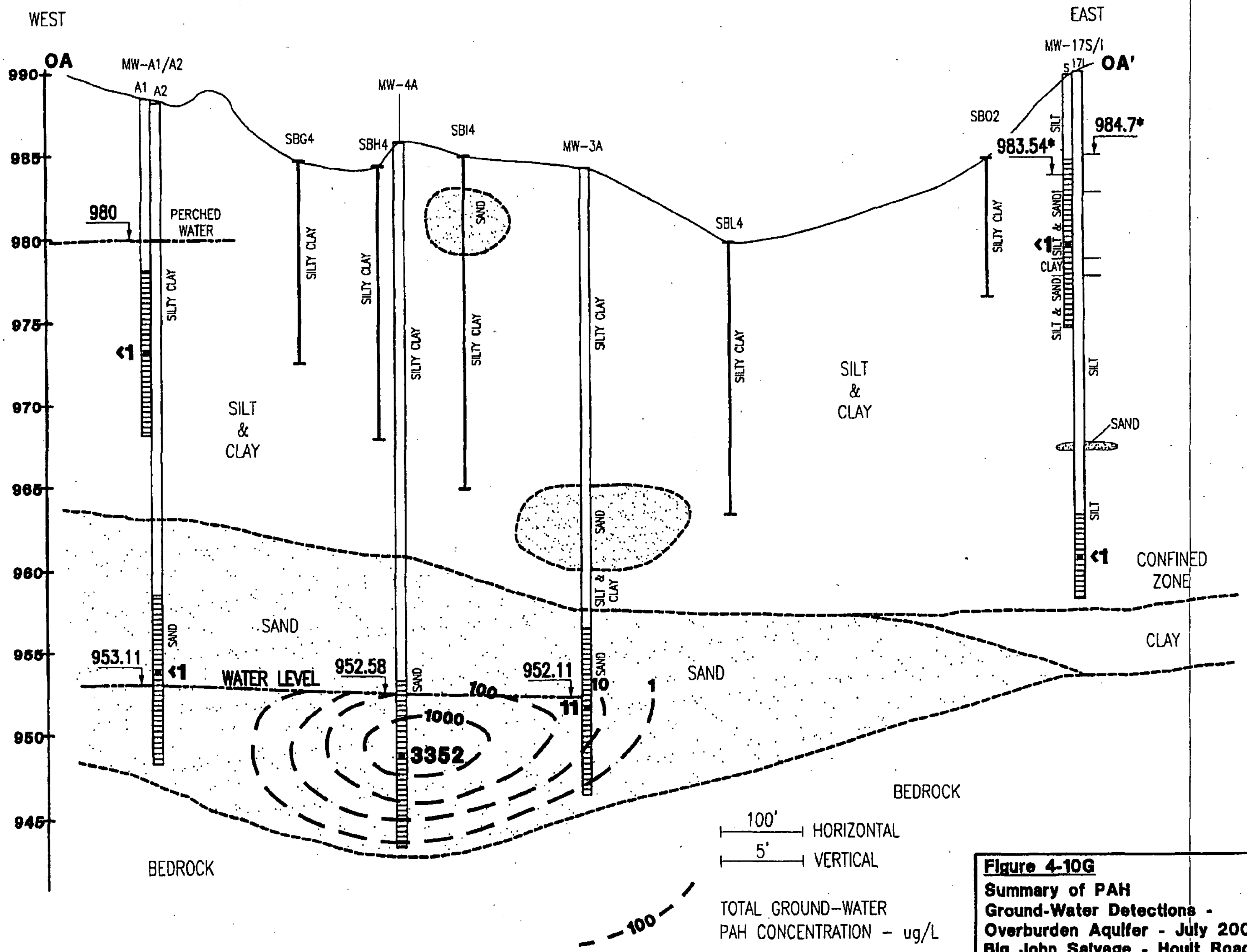


Figure 4-10G

Summary of PAH Ground-Water Detections - Overburden Aquifer - July 2005

Big John Salvage - Hoult Road Site

Fairmont, West Virginia

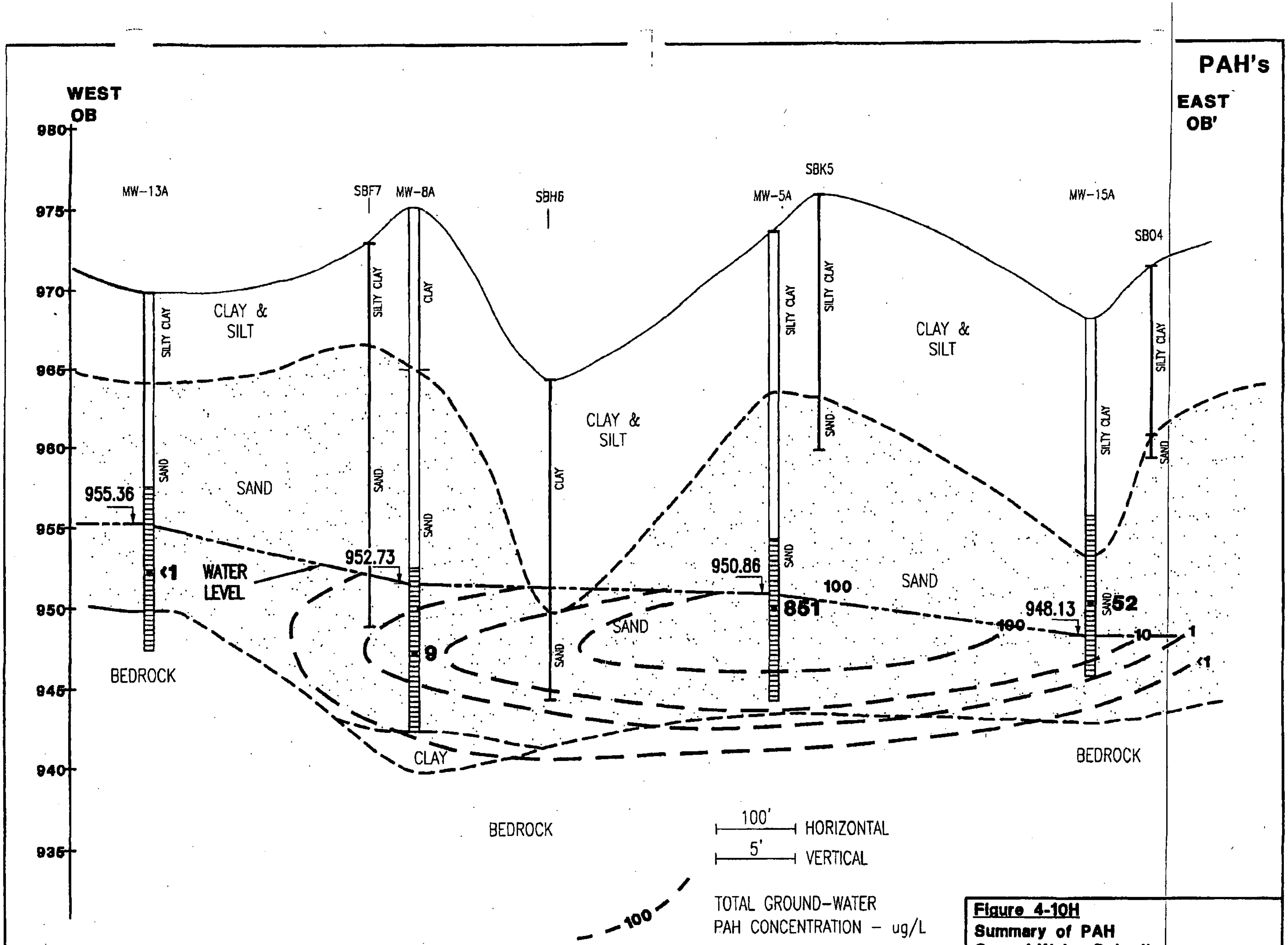


Figure 4-10H

Summary of PAH Ground-Water Detections - Overburden Aquifer - Ju[illegible] 2005

Big John Salvage - Hou[illegible]oad Site

Fairmont, West Virginia

PAH's

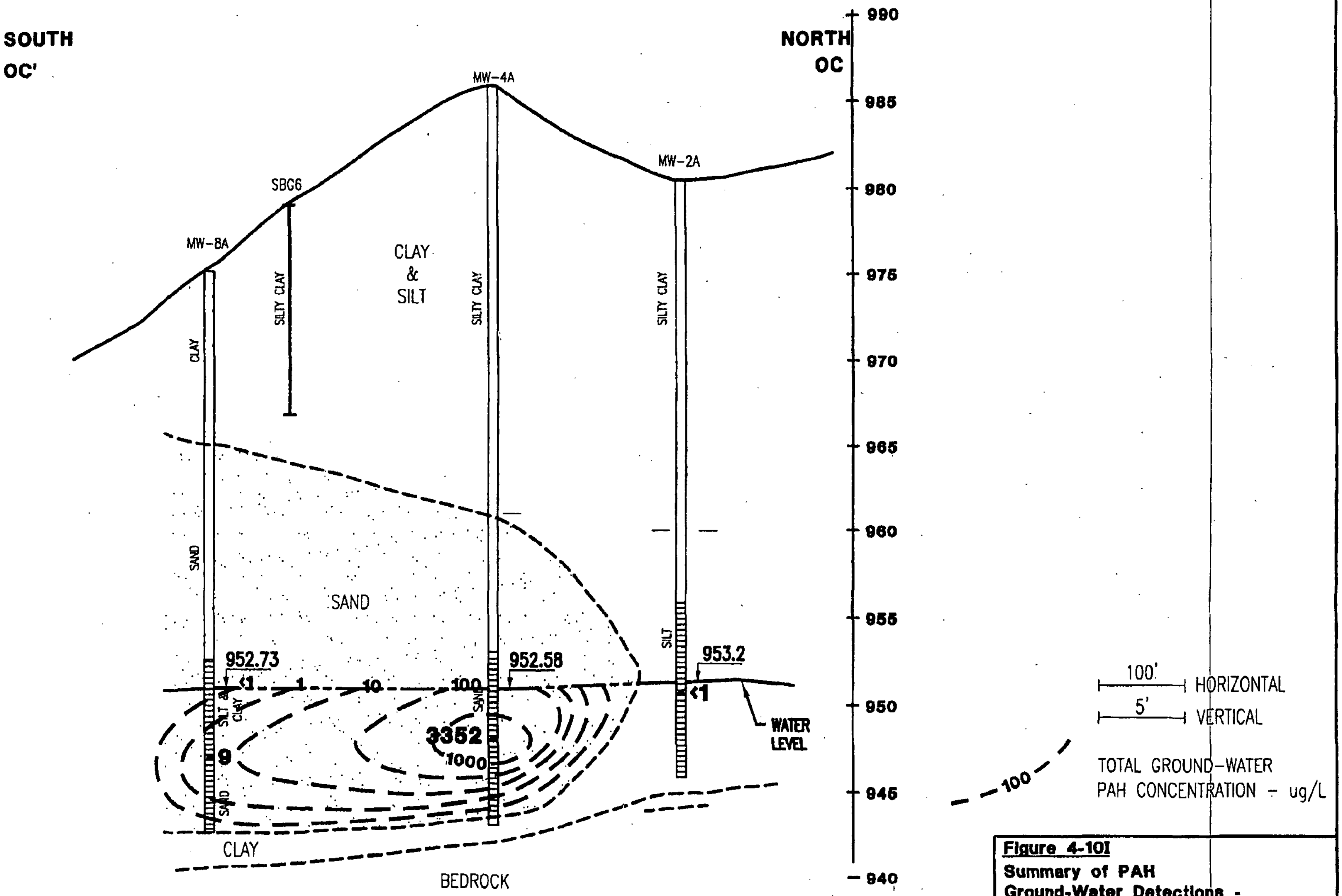


Figure 4-10I

Summary of PAH Ground-Water Detections - Overburden Aquifer - July 2005
Big John Salvage - Hoult Road Site
Fairmont, West Virginia

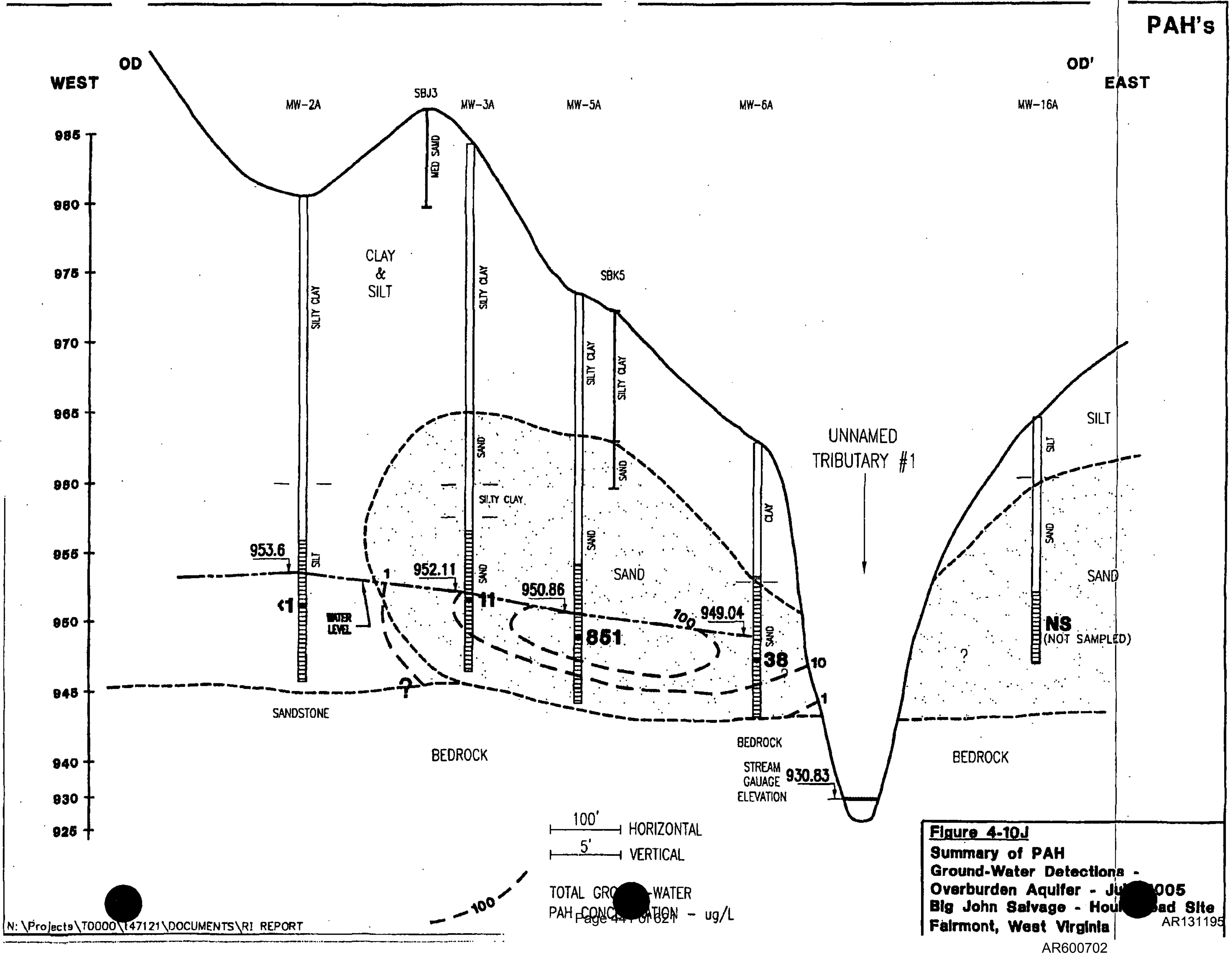
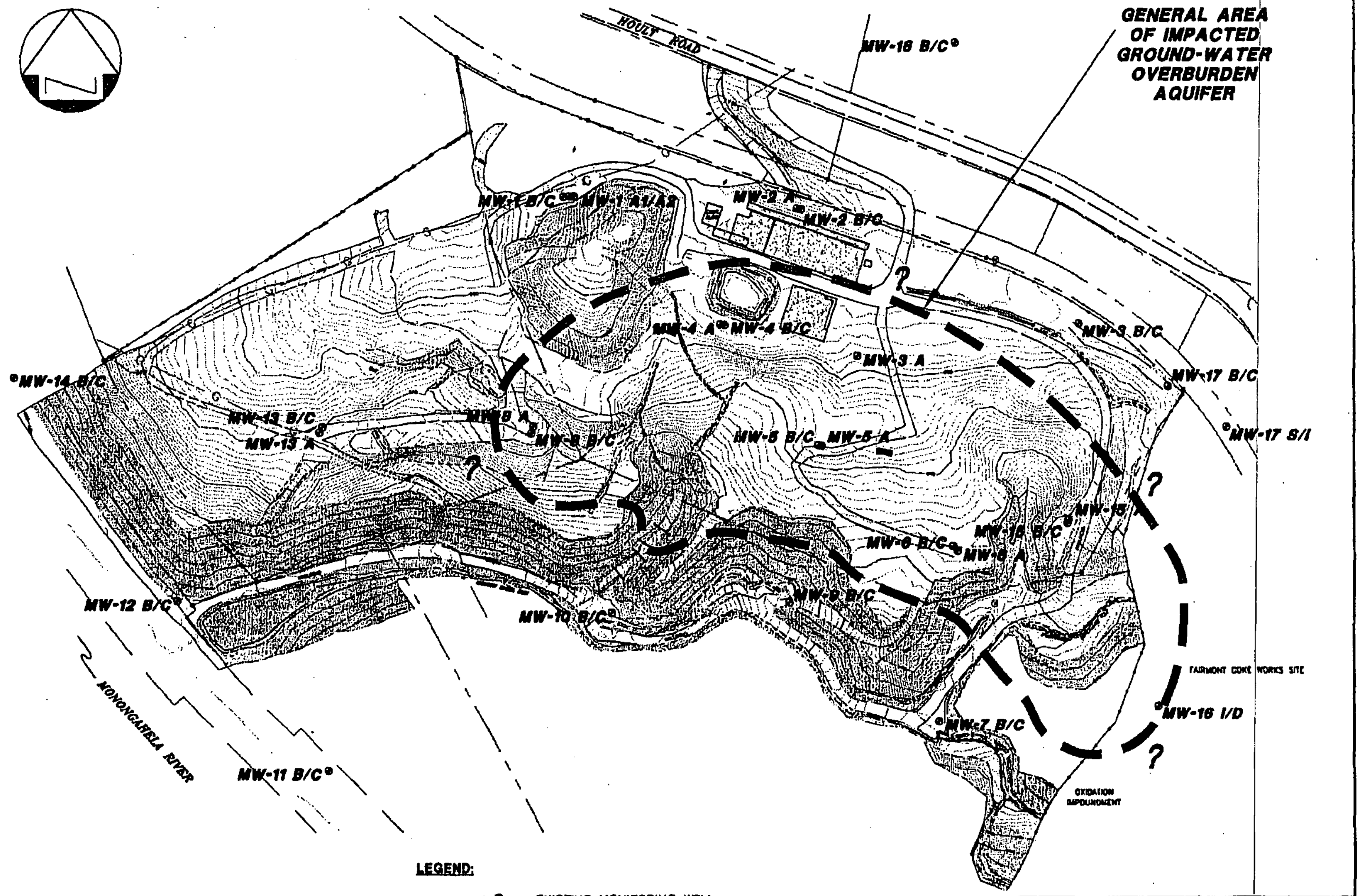


Figure 4-10J

Summary of PAH Ground-Water Detections - Overburden Aquifer - Ju[illegible]005

Big John Salvage - Hou[illegible]ad Site

Fairmont, West Virginia



LEGEND:

MW-1 B/C ®	EXISTING MONITORING WELL CLUSTER LOCATIONS (SHALLOW AND DEEP)
	BEDROCK CROSS-SECTION LINE
	OVERBURDEN CROSS-SECTION LINE

0 40 80 160
1"=80'

SITE LAYOUT BASED ON MARCH, 2006 FIELD SURVEY

Figure 4-11
Impacted Ground-Water Area Location Map - Overburden Aquifer
Big John Salvage - Hoult Road Site
Fairmont, West Virginia

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Appendix B

APPENDIX B

Preliminary Removal Goal (PRG) Development Summary

PRELIMINARY REMOVAL GOALS

This appendix provides a summary of the development of the Preliminary Removal Goals (PRGs) developed for the Big John Salvage Site. PRGs are medium-specific contaminant concentrations that are protective of human health and/or the environment given the possibility of exposures to anticipated human or ecological receptors. PRGs can be risk-based, that is, based on site-specific assumptions of receptor activity patterns and cumulative toxicity for the mixture of chemicals present at a site. Alternatively, PRGs may also be based on ARARs, which are chemical-specific regulatory standards for protectiveness that take into account protection of human health or ecological concerns in a generic manner across various settings. In some cases, ARARs can be based on ideal goals or practical technology controls feasible to implement in a public or broad scale scenario, as opposed to what should be considered based purely on site-specific risk objectives. Finally, PRGs may also be based upon background concentrations in situations where the background concentrations are higher than the applicable risk-based value or ARARs.

For the BJS Site, the PRG development included a detailed review of the human health risk and ecological risk assessments prepared for the site in 2007, a review of the ARARs, and consideration for background concentrations for the media and contaminants of interest. Draft PRGs were submitted to EPA initially for initial review in late September 2008, and the approach and values were revised and submitted again for EPA review in November 2008. Based on EPA comments received from the November 2008 submission, the approach and values were revised once again in February 2009. Another version of the PRGs was developed in March 2009 based on the result of additional subsequent discussion with EPA regarding the February 2009. The current version of the PRGs included in this document is based on the final EPA comments received from the March 2009 submission as well as a preliminary July 2009 submission.

The attached table (Proposed PRG Summary – All Media) is a detailed summary of this compilation from the various review cycles, and forms the basis for the PRGs provided in Table 2-2 of the EE/CA.

Supporting documentation which provides additional information/rationale for the development of these PRGs is provided in the following attachments to this Appendix for reference –

- Appendix B – Attachment 1 – Risk Based Rationale for the Selection of the PRGs (originally prepared in September 2008 – this document was the original basis for the development of the PRGs, but does not reflect all the changes and revisions that have subsequently been made to the current July 2009 version of the Proposed PRG Summary – All Media Table. It is provided as a general reference only, and should not be viewed as the complete technical support documentation for the final July 2009 Proposed PRG Summary – All Media Table.
- Appendix B – Attachment 2 – Preliminary Removal Goals Update – February 2009 (prepared in response to EPA comments regarding the November 2008 revision to the PRG table
- Appendix B – Attachment 3 – Lines of Evidence Discussion Supporting the Selection of the Total PAH Sediment PRG (26 mg/kg)

PROPOSED PRELIMINARY REM[illegible]L GOAL SUMMARY - ALL MEDIA
BIG JOHN SALVAGE/HOULT ROAD SITE
ENGINEERING EVALUATION/COST ANALYSIS

Chemical of Concern	HHRA Risk-Based PRG Concentration For Cumulative Risk = 1E-5 Risk or HI = 1 or EPA Region III Tox Provided Values (a)	Basis for HHRA PRG: CA = Cancer or NC = Non-Cancer	Ecological Risk PRG	Basis for Ecological Risk PRG:	OTHER CONSIDER-ATIONS - MCLs, AWQC, TMDLs, SCREENING VALUES, B-GROUND, ETC.	PROPOSED PRG FOR EE/CA	Cancer Risk or HQ at a Concentration Equal to PRG	RATIONALE FOR PROPOSED PRG SELECTION
SOIL								
PATHWAY: Direct Contact								
	mg/kg		mg/kg		mg/kg	mg/kg		
Arsenic	4 (residential)(a) 20 (industrial)(a)	CA	no unacceptable ecological risk	–	–	20	RME risk: 1.0E-5 (industrial)	The PRG selected for arsenic is based on the expected future land-use scenario (industrial). Note that the arithmetic mean on-site arsenic concentration in surface soil (0-5 feet) is 15.87 mg/kg. The mean on-site arsenic concentration for all soil (shallow and deep) is 14.38 mg/kg.
Benzo(a)anthracene	0.4 (residential)(a) 6 (industrial)(a)	CA	0.44	MV	18/1.1 (ECO SSL) soil invertebrates/ mammalian	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Benzo(a)pyrene	0.15 (residential)(a) 2.5 (industrial)(a)	CA	0.42	MV	18/1.1 (ECO SSL) soil invertebrates/ mammalian	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Benzo(b)fluoranthene	0.4 (residential)(a) 6 (industrial)(a)	CA	0.41	MV	18/1.1 (ECO SSL) soil invertebrates/ mammalian	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Dibenzo(a,h)anthracene	0.04 (residential)(a) 0.6 (industrial)(a)	CA	–	–	18/1.1 (ECO SSL) soil invertebrates/ mammalian	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Indeno(1,2,3-cd)pyrene	0.4 (residential)(a) 6 (industrial)(a)	CA			18/1.1 (ECO SSL) soil invertebrates/ mammalian	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.

PROPOSED PRELIMINARY REMOVAL GOAL SUMMARY - ALL MEDIA
BIG JOHN SALVAGE/HOULT ROAD SITE
ENGINEERING EVALUATION/COST ANALYSIS

Chemical of Concern	HHRA Risk-Based PRG Concentration For Cumulative Risk = 1E-5 Risk or HI = 1 or EPA Region III Tox Provided Values (a)	Basis for HHRA PRG: CA = Cancer or NC = Non-Cancer	Ecological Risk PRG	Basis for Ecological Risk PRG:	OTHER CONSIDER-ATIONS - MCLs, AWQC, TMDLs, SCREENING VALUES, B-GROUND, ETC.	PROPOSED PRG FOR EE/CA	Cancer Risk or HQ at a Concentration Equal to PRG	RATIONALE FOR PROPOSED PRG SELECTION
Total BAP equivalents***	0.12 (residential) 2.3 (industrial)	CA	0.41	–	18/1.1 (ECO SSL) soil invertebrates/ mammalian	**4.6 (BAP equivalent)**	**RME risk: 3.1E-4 (residential) 1.8E-5 (industrial)**	The PRG of 4.6 mg/kg Benzo(a)Pyrene equivalent is based on the evaluation of various background considerations, including a comparison of pristine background conditions, off-site (but nearby locations), and the soil cleanup BAP equivalent value selected for the adjacent Fairmont Coke/Sharon Steel Superfund Site.
Total PAHs	n/a	-			NOAEC - 44.5 ECO SSL - 18/1.1 Background - 11	**26**		Total PAH value of 26 mg/kg (including both carcinogenic and non-carcinogenic PAHs) is based on the site-specific, weight of evidence derived PRG for total PAHs in sediments for protection of ecological receptors.This PRG is considered appropriate given that the site soils are the primary source of sediments to the adjacent streams. This PRG would be protective of ecological receptors if most Eco SSLs are considered, but not if site specific ecological risk calculations are considered (which calculates PRGs in the range of less than 1 mg/kg for high molecular weight PAHs). This PRG would also be protective to some PAHs with respect to the soil to groundwater pathway, but it would exceed some EPA SGSSL goals for certain carcinogenic PAHs.
Acenaphthene	no unacceptable human health risk	–	0.56	MV	29/100 (ECO SSL) - soil invertebrates/ mammalian	**NO ANALYTE SPECIFIC PRG PROPOSED**		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Acenaphthylene	no unacceptable human health risk	–	0.56	MV	29/100 (ECO SSL) - soil invertebrates/ mammalian	**NO ANALYTE SPECIFIC PRG PROPOSED**		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Anthracene	no unacceptable human health risk	–	0.52	MV	29/100 (ECO SSL) - soil invertebrates/ mammalian	**NO ANALYTE SPECIFIC PRG PROPOSED**		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Benzo(g,h,i)perylene	no unacceptable human health risk	–	0.38	MV	29/100 (ECO SSL) - soil invertebrates/ mammalian	**NO ANALYTE SPECIFIC PRG PROPOSED**		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.

PROPOSED PRELIMINARY REM[illegible]L GOAL SUMMARY - ALL MEDIA
BIG JOHN SALVAGE/HOULT ROAD SITE
ENGINEERING EVALUATION/COST ANALYSIS

Chemical of Concern	HHRA Risk-Based PRG Concentration For Cumulative Risk = 1E-5 Risk or HI = 1 or EPA Region III Tox Provided Values (a)	Basis for HHRA PRG: CA = Cancer or NC = Non-Cancer	Ecological Risk PRG	Basis for Ecological Risk PRG:	OTHER CONSIDER-ATIONS - MCLs, AWQC, TMDLs, SCREENING VALUES, B-GROUND, ETC.	PROPOSED PRG FOR EE/CA	Cancer Risk or HQ at a Concentration Equal to PRG	RATIONALE FOR PROPOSED PRG SELECTION
Benzo(k)fluoranthene	no unacceptable human health risk	–	0.41	MV	29/100 (ECO SSL) - soil invertebrates/ mammalian	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Carbazole	no unacceptable human health risk	–	–	–	29/100 (ECO SSL) - soil invertebrates/ mammalian	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Chrysene	no unacceptable human health risk	–	0.44	MV	18/1.1 (ECO SSL) soil invertebrates/ mammalian	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Dibenzofuran	no unacceptable human health risk	–	–	–	29/100 (ECO SSL) - soil invertebrates/ mammalian	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Fluoranthene	no unacceptable human health risk	–	0.48	MV	29/100 (ECO SSL) - soil invertebrates/ mammalian	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Fluorene	no unacceptable human health risk	–	0.54	MV	29/100 (ECO SSL) - soil invertebrates/ mammalian	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Naphthalene	no unacceptable human health risk	NC	–	–	29/100 (ECO SSL) - soil invertebrates/ mammalian	10	HQ=1 (industrial)	Human Health Risk Calculation selected as PRG based on the protection of human receptors associated with vapor intrusion pathway, primarily industrial users. This PRG also adequately addresses the soil to groundwater pathway (Area of Attainment Restoration Scenario) as well as the ecological receptors, but would not meet the Total Aquifer Restoration Scenario goal of 4 mg/kg.
Phenanthrene	no unacceptable human health risk	–	0.52	MV	29/100 (ECO SSL) - soil invertebrates/ mammalian	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.

PROPOSED PRELIMINARY REMOVAL GOAL SUMMARY - ALL MEDIA
BIG JOHN SALVAGE/HOULT ROAD SITE
ENGINEERING EVALUATION/COST ANALYSIS

Chemical of Concern	HHRA Risk-Based PRG Concentration For Cumulative Risk = 1E-5 Risk or HI = 1 or EPA Region III Tox Provided Values (a)	Basis for HHRA PRG: CA = Cancer or NC = Non-Cancer	Ecological Risk PRG	Basis for Ecological Risk PRG:	OTHER CONSIDER-ATIONS - MCLs, AWQC, TMDLs, SCREENING VALUES, B-GROUND, ETC.	PROPOSED PRG FOR EE/CA	Cancer Risk or HQ at a Concentration Equal to PRG	RATIONALE FOR PROPOSED PRG SELECTION
Pyrene	no unacceptable human health risk	–	0.48	MV	29/100 (ECO SSL) - soil invertebrates/ mammalian	**NO ANALYTE SPECIFIC PRG PROPOSED**		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Copper	no unacceptable human health risk	--	–	–	70 (ECO SSL) 11-64 (range in off site "background" soils 12 samples - mean 35.73)	**35**		Background value selected as the PRG based on protection of ecological receptors. It should be noted that although the ECO SSL value is 70 mg/kg, the ECO SSL guidance documents clearly states that the screening values should not be used as PRGs. Therefore, it is more appropriate to use the background concentration to be protective of ecological receptors. Note that the on-site average concentration for copper in soil is 37.6 mg/kg.
Mercury	no unacceptable human health risk	--	0.005 - 0.07	Range of Wildlife calculated PRGs - avaian herbivores, mammalian and avian vermivores	0.06 - 3.4 (range in off-site "background" soils 12 samples - mean 0.86) 12 (SQG)	**1**		Mean background concentration of mercury from off-site samples selected for PRG. This PRG is higher than ecological PRGs calculated for protection of wildlife, but is less than Canadian Soil Quality Criteria which are based on protection of plants and soil invertebrates
Zinc	no unacceptable human health risk	–	–	–	120 (ECO SSL) 36 - 176 (range in off-site "background" soils 12 samples - mean 94.41)	**95**		Background value selected as the PRG based on protection of ecological receptors. It should be noted that although the ECO SSL value is 120 mg/kg, the ECO SSL guidance documents clearly states that the screening values should not be used as PRGs. Therefore, it is more appropriate to use the background concentration to be protective of ecological receptors. Note that the on-site average concentration for zinc in soil is 68.3 mg/kg.

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PATHWAY: Vapor Intrusion to Indoor Air								
Naphthalene	0.25 (residential) 10 (industrial)	NC	–	–	170 (EPA SSL-generic)	10	HQ of 1 (industrial)	Human Health Risk Calculation selected as PRG based on the protection of human receptors associated with vapor intrusion pathway, primarily industrial users. This PRG also adequately addresses the soil to groundwater pathway (Area of Attainment Restoration Scenario) as well as the ecological receptors, but would not meet the Total Aquifer Restoration Scenario goal of 4 mg/kg.
Benzene	0.2 (residential) no unacceptable industrial risk	CA	–	–	0.8 (EPA SSL-generic)	0.03	1.8E-6 (residential)	PRG is the EPA SGSSL (soil to ground water SSL), which is selected for protection of ground water to meet aquifer restoration goals (Area of Attainment Restoration Scenario). This PRG will also be protective of the vapor intrusion pathway. However, this PRG will not be fully protective under the Total Aquifer Restoration Scenario.
PATHWAY: Soil to Groundwater								
Naphthalene	--	--	–	--	4 (TARS) 84(AOARS) EPA SGSSL (generic)	10	HQ of 1 (industrial)	Human Health Risk Calculation selected as PRG based on the protection of human receptors associated with vapor intrusion pathway, primarily industrial users. This PRG also adequately addresses the soil to groundwater pathway (Area of Attainment Restoration Scenario) as well as the ecological receptors, but would not meet the Total Aquifer Restoration Scenario goal of 4 mg/kg.
Benzene	–	–	–	–	0.002 (TARS) 0.03 (AOARS) EPA SGSSL (generic)	0.03		PRG is the EPA SGSSL (soil to ground water SSL), which is selected for protection of ground water to meet aquifer restoration goals (Area of Attainment Restoration Scenario). This PRG will also be protective of the vapor intrusion pathway. However, this PRG will not be fully protective under the Total Aquifer Restoration Scenario.
1,2-Dibromo-3-chloropropane	–	–	–	--	0.001 (TARS) 0.020 (AOARS) EPA SGSSL (calculated)	0.02		PRG is the EPA SGSSL (soil to ground water SSL), which is selected for protection of ground water to meet aquifer restoration goals (Area of Attainment Restoration Scenario). However, this PRG will not be fully protective under the Total Aquifer Restoration Scenario.
2-Methylnaphthalene	–	–	–	–	0.5 (TARS) 1 (AOARS) EPA SGSSL (calculated)	1		PRG is the EPA SGSSL (soil to ground water SSL), which is selected for protection of ground water to meet aquifer restoration goals (Area of Attainment Restoration Scenario). However, this PRG will not be fully protective under the Total Aquifer Restoration Scenario.
Benzo(a)anthracene	--	–	–	–	0.08 (TARS) 2 (AOARS) EPA SGSSL (generic)	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs. This concentration exceeds Area of Attainment Restoration Scenario goal value for this COC related to restoration of groundwater.

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Benzo(b)fluoranthene	–	–	–	–	0.2 (TARS) 5 (AOARS) EPA SGSSL (generic)	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs. This concentration exceeds Area of Attainment Restoration Scenario goal value for this COC related to restoration of groundwater.
Benzo(k)fluoranthene	–	–	–	–	2 (TARS) 49 (AOARS) EPA SGSSL (generic)	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Total BAP equivalents***	–	–	–	–	0.4 (TARS) 8 (AOARS) EPA SGSSL (generic)	4.6 (BAP equivalent)	RME risk: 3.1E-4 (residential) 1.8E-5 (industrial)	Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs. This concentration exceeds Area of Attainment Restoration Scenario goal value for this COC related to restoration of groundwater.
Arsenic	–	–	–	–	1 (TARS) 29 (AOARS) EPA SGSSL (generic)	20	RME risk: 1.0E-5 (industrial)	The PRG selected for arsenic is based on the expected future land-use scenario (industrial). Note that the arithmetic mean on-site arsenic concentration in surface soil (0-5 feet) is 15.87 mg/kg. The mean on-site arsenic concentration for all soil (shallow and deep) is 14.38 mg/kg.
Iron	–	–	–	–	–	NO SOIL PRG PROPOSED		No soil PRG proposed for this inorganic. Restoration of ground water is likely to require changes in hydrogeochemistry or fixation of inorganic in matrix rather than the removal of the actual mass of inorganics from the subsurface.
Manganese	–	–	–	–	–	NO SOIL PRG PROPOSED		No soil PRG proposed for this inorganic. Restoration of ground water is likely to require changes in hydrogeochemistry or fixation of inorganic in matrix rather than the removal of the actual mass of inorganics from the subsurface.
Thallium	–	–	–	–	0.04 (TARS) 0.7(AOARS) EPA SGSSL (generic)	NO SOIL PRG PROPOSED		No soil PRG proposed for this inorganic. Restoration of ground water is likely to require changes in hydrogeochemistry or fixation of inorganic in matrix rather than the removal of the actual mass of inorganics from the subsurface.

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Cyanide	–	–	–	–	2 (TARS) 40 (AOARS) EPA SGSSL (generic)	NO SOIL PRG PROPOSED		No soil PRG proposed for this inorganic. Restoration of ground water is likely to require changes in hydrogeochemistry or fixation of inorganic in matrix rather than the removal of the actual mass of inorganics from the subsurface.
Vanadium	–	–	–	–	300 (TARS) 6000 (AOARS) EPA SGSSL (generic)	NO SOIL PRG PROPOSED		No soil PRG proposed for this inorganic. Restoration of ground water is likely to require changes in hydrogeochemistry or fixation of inorganic in matrix rather than the removal of the actual mass of inorganics from the subsurface.

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SEDIMENT - ON-SITE								
	mg/kg		mg/kg		mg/kg	mg/kg		
Benzo(a)anthracene	0.65 (a)	CA	see total PAH determination	–	–	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Benzo(a)pyrene	0.2 (a)	CA	see total PAH determination	–	–	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Benzo(b)fluoranthene	0.65 (a)	CA	see total PAH determination	–	–	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Dibenzo(a,h)anthracene	0.065 (a)	CA	see total PAH determination	–	–	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Indeno(1,2,3-cd)pyrene	0.41	CA	see total PAH determination	–	–	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.

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Total BAP equivalents***	0.20	CA	--	--	0.4 (background mean BAP equivalent calculated for Mon river sediments) 4.6 (on-site soil PRG)	**0.4**	**2E-5 (RME) - residential**	The on-site sediment PRG is based on background - note that the Monongahela River background value for BAP equivalent was used as there was a very limited background data set available (4 samples only) for small drainages in the area. This PRG is protective to both human health and ecological receptors for carcinogenic PAHs. Note that a residential exposure scenario was selected for the sediments as the exposure scenario includes a recreational child and the sediment dermal adherence is much greater than soil.
Total PAHs	--	--	44.5	NOAEC	26 (BTAG)	**26**		This PRG is proposed to address the on-site sediments in Sharon Steel Run and related tributaries, as well as Unnamed Tributary #2. This PRG is based on the site specific weight of evidence PRG for total PAHs for protection of ecological receptors. Note that napthalene is considered part of the total PAH suite of analytes for this purpose.
Napthalene	no unacceptable human health risk	--	no site specific ERA determination	--	--	**NO ANALYTE SPECIFIC PRG PROPOSED**		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Lead	no unacceptable human health risk	--	no site specific ERA determination		36 (EPAFSSV) 8.2 - 39.0 (background range in sediments - 4 samples only - mean 10.75) 21 - 257 (range in off-site soils 12 samples - mean 133.1)	**130**		Mean concentration of lead collected in off-site soil samples (both pristine and adjacent to the site - 12 sample data set) is basis for PRG. Background samples collected from pristine sediment location contained very low concentrations of lead. On-site surface soil samples (from which most of the site sediments are derived) had mean concentration of lead of 173.2 mg/kg (32 samples).

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Mercury	no unacceptable human health risk	–	no site specific ERA determination	–	0.2 (EPAFSSV) 0.1 (background concentration detected in sediments - 4 samples only - mean 0.1) 0.06 - 3.4 (range in off-site soils 12 samples - mean 0.86)	1		Mean concentration of mercury collected in off-site soil samples (both pristine and adjacent to the site - 12 sample data set) is basis for the PRG. Background samples collected from pristine sediment location contained very low concentrations of mercury. On-site surface soil samples (from which most of the site sediments are derived) had a mean concentration of 34 mg/kg (32 samples)
Cadmium	no unacceptable human health risk	–	no site specific ERA determination	–	0.99 (EPAFSSV) 0.1 (background concentration detected in sediments - 4 samples only - mean 0.1) 0.22 - 1.4 (range in off-site soils 12 samples - mean 0.9)	1		Mean concentration of cadmium collected in off-site soil samples (both pristine and adjacent to the site - 12 sample data set) is basis for the PRG. Background samples collected from pristine sediment location contained very low concentrations of cadmium. On-site surface soil samples (from which most of the site sediments are derived) had a mean concentration of 2.60 mg/kg (32 samples)

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MONONGAHELA RIVER SEDIMENT								
	mg/kg		mg/kg		mg/kg	mg/kg		
Benzo(a)anthracene	2 (a)	CA	see total PAH determination	–	–	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Benzo(a)pyrene	0.2 (a)	CA	see total PAH determination	–		NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Benzo(b)fluoranthene	0.41	CA	see total PAH determination	–	–	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Dibenzo(a,h)anthracene	0.041	CA	see total PAH determination	–	–	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Indeno(1,2,3-cd)pyrene	0.41	CA	see total PAH determination	–	–	NO ANALYTE SPECIFIC PRG PROPOSED		Combined single PAH PRG is proposed instead of separate PRGs for each PAH. Total PAH PRG would include both carcinogenic and non-carcinogenic PAHs.
Total BAP equivalents***	0.20	CA	–	–	0.4 (background mean BAP equivalent calculated for river sediments) 6 (background mean total PAH detected in river sediments)	0.4 or 1.0 or 2.0	2E-5 (RME) or 5E-5 (RME) or 1E-4 (RME)	The river sediment PRG choices are based on protection of human health, and the ultimate PRG selected will be based on EPA determination of an acceptable risk level. These PRGs are *protective to ecological receptors for carcinogenic PAHs* - see total PAH values for ecological protection for both carcinogenic and non-carcinogenic PAHs. Note that total risk (including all COCs) would be slightly higher considering risks associated with background levels of arsenic.

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Total PAHs	–	–	44.5	NOAEC	26 (BTAG)	6 or 12 or 20		This PRG is proposed to address the river sediments which are not defined as BSD or stained sediments. This PRG is based on the projected value of total PAH that is extrapolated from the BAP equivalent PRG selected as most appropriate. BAP equivalent concentrations comprise approximately 8% of total PAH concentrations found in the background samples - consequently, BAP equivalent concentrations associated with 0.4, 1, and 2 mg/kg are somewhat propoportional, on average, to total PAH concentrations of 6, 12, and 20 mg/kg, respectively. Note that napthalene is considered part of the total PAH suite of analytes. Any of this potential PRGs are protective of human health and ecological receptors.
Black Semi-Solid Deposit (BSD)	–	–	–	–	–	COMPLETE REMOVAL		This PRG is proposed to address the bottom solid deposit material that is present in the river bottom, which has been found to contain very high concentrations (>20,000 mg/kg) of PAHs.
Visually Stained Sediments	–	–	–	–	–	COMPLETE REMOVAL		This PRG is proposed to address the stained sediments which are present in the river bottom, which have been found to contain high concentrations (>1000 mg/kg) of PAHs.

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SURFACE WATER - SHARON STEEL RUN AND OTHER ON-SITE WATERWAYS								
	ug/L		ug/l		ug/l	ug/l		
Benzo(a)anthracene	0.06	CA	no site specific ERA determination	–	0.02 (WVAWQC)	**0.20**	**7.2E-06**	Method Detection Limit (MDL) from Method EPA 525.2 (organic contaminants in drinking water -lowest detection limit available) selected for PRG because calculated human health risk PRG value is less than what can be measured with current laboratory methods. However, AWQC value is the analytical goal
Benzo(a)pyrene	0.003	CA	no site specific ERA determination	–	0.02 (WVAWQC)	**0.03**	**1.8E-05**	Method Detection Limit (MDL) from Method EPA 525.2 (organic contaminants in drinking water -lowest detection limit available) selected for PRG because calculated human health risk PRG value is less than what can be measured with current laboratory methods. However, AWQC value is the analytical goal
Benzo(b)fluoranthene	0.03	CA	no site specific ERA determination	–	0.02 (WVAWQC)	**0.5**	**3.1E-05**	Method Detection Limit (MDL) from Method EPA 525.2 (organic contaminants in drinking water -lowest detection limit available) selected for PRG because calculated human health risk PRG value is less than what can be measured with current laboratory methods. However, AWQC value is the analytical goal
Dibenzo(a,h)anthracene	0.002	CA	no site specific ERA determination	–	0.02 (WVAWQC)	**0.01**	**9.7E-06**	Method Detection Limit (MDL) from Method EPA 525.2 (organic contaminants in drinking water -lowest detection limit available) selected for PRG because calculated human health risk PRG value is less than what can be measured with current laboratory methods. However, AWQC value is the analytical goal
Indeno(1,2,3-cd)pyrene	0.03	CA	no site specific ERA determination	–	0.02 (WVAWQC)	**0.06**	**3.8E-06**	Method Detection Limit (MDL) from Method EPA 525.2 (organic contaminants in drinking water -lowest detection limit available) selected for PRG because calculated human health risk PRG value is less than what can be measured with current laboratory methods. However, AWQC value is the analytical goal
Total BAP equivalents***	0.01	CA	–	–	–	**0.03**	**2.1E-05**	Method Detection Limit (MDL) from Method EPA 525.2 (organic contaminants in drinking water -lowest detection limit available) selected for PRG because calculated human health risk PRG value is less than what can be measured with current laboratory methods. However, AWQC value is the analytical goal
Fluoranthene	no unacceptable human health risk	–	no site specific ERA determination	–	370 (WVAWQC)	**370**		West Virginia AWQC for protection of human health (recreational users) selected as PRG
Naphthalene	no unacceptable human health risk	–	no site specific ERA determination	–	1.1 (EPAFWSV) 11 (LOEC)	**11**		EPA Region 3 Freshwater Screening Value benchmark selected as PRG based on the LOEC screening value (note that 1.1 ug/l is based on the NOEC)

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Pyrene	no unacceptable human health risk	–	no site specific ERA determination	–	0.025 (EPAFWSV)	**0.06**		Method Detection Limit (MDL) from Method EPA 525.2 (organic contaminants in drinking water -lowest detection limit available) selected for PRG because EPAFSV value is less than what can be measured with current lab methods
Benzene	no unacceptable human health risk	–	no site specific ERA determination	–	51 (WVAWQC)	**51**		West Virginia AWQC for protection of human health (recreational users) selected as PRG
Aluminum	no unacceptable human health risk	–	no site specific ERA determination	–	750 (WVAWQC)	**750**		West Virginia AWQC for protection of aquatic life selected as PRG
Barium	no unacceptable human health risk	–	no site specific ERA determination	–	4 (EPAFWSV) 40 (LOEC)	**40**		EPA Region 3 Freshwater Screening Value benchmark selected as PRG based on the LOEC screening value (note that 4 ug/l is based on the NOEC)
Cyanide	no unacceptable human health risk		no site specific ERA determination		5 (WVAWQC)	**5**		West Virginia AWQC for protection of aquatic life selected as PRG
Cadmium	no unacceptable human health risk	–	no site specific ERA determination	–	0.25 (EPAFWSV) 0.8 - 1.1 (WV AWQC)	**0.8 - 1.1**		West Virginia AWQC for protection of aquatic life selected as PRG. Note that actual value is based on calculation derived using site-specific hardness data - on-site surface water sample hardness ranged from 172 - 310 mg/l, which calculates a cadmium PRG value ranging from 0.8 - 1.1 ug/l. Actual PRG will be based on site hardness data collected at time of removal action
Iron	no unacceptable human health risk	–	no site specific ERA determination	–	1500 (TMDL)	**1500**		TMDL selected as PRG
Lead	no unacceptable human health risk	–	no site specific ERA determination	–	2.5 (EPAFWSV) 4.5 - 8.4 (WVAWQC)	**4.5 - 8.4**		West Virginia AWQC for protection of aquatic life selected as PRG. Note that actual value is based on calculation derived using site-specific hardness data - on-site surface water sample hardness ranged from 172 - 310 mg/l, which calculates a lead PRG value ranging from 4.5 - 8.4 ug/l. Actual PRG will be based on site hardness data collected at time of removal action
Mercury	no unacceptable human health risk	–	no site specific ERA determination	–	2.4 (WV AWQC)	**2.4**		West Virginia AWQC for protection of aquatic life selected as PRG
Manganese	no unacceptable human health risk	NC	44.5	NOAEC	1000 (TMDL)	**1000**		TMDL selected as PRG

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BIG JOHN SALVAGE/HOULT ROAD SITE
ENGINEERING EVALUATION/COST ANALYSIS

Chemical of Concern	HHRA Risk-Based PRG Concentration For Cumulative Risk = 1E-5 Risk or HI = 1 or EPA Region III Tox Provided Values (a)	Basis for HHRA PRG: CA = Cancer or NC = Non-Cancer	Ecological Risk PRG	Basis for Ecological Risk PRG:	OTHER CONSIDER-ATIONS - MCLs, AWQC, TMDLs, SCREENING VALUES, B-GROUND, ETC.	PROPOSED PRG FOR EE/CA	Cancer Risk or HQ at a Concentration Equal to PRG	RATIONALE FOR PROPOSED PRG SELECTION
GROUNDWATER								
	ug/L		ug/L		ug/l	ug/l		
1,2-Dibromo-3-chloropropane	0.03 (residential) 1.0 (industrial)	CA	–	–	0.2 (MCL)	**0.2 GOAL - 0.03**	**1.5E-5 (residential) 9.8E-7 (industrial)**	MCL selected as primary PRG, although the goal of 0.03 ug/l is also provided for residential receptor protection. Note that MCLG is zero.
2-Methylnaphthalene	27 (residential) no unacceptable industrial risk	NC	–	–	–	**27**	**HQ of 1 (residential)**	Human health risk PRG selected based on tap water ingestion for most sensitive future receptor
Benzo(a)anthracene	0.005 (residential) no unacceptable industrial risk	CA	–	–	–	**0.2 GOAL - 0.005**	**8.7E-5 (residential)**	Method Detection Limit (MDL) from Method EPA 525.2 (organic contaminants in drinking water) selected for PRG because calculated human health risk PRG value is less than what can be measured with current readily available laboratory methods. Goal is best available analytical detection limit.
Benzo(b)fluoranthene	0.003 (residential) no unacceptable industrial risk	CA	–	–	–	**0.3 GOAL - 0.003**	**2.2E-4 (residential)**	Method Detection Limit (MDL) from Method EPA 525.2 (organic contaminants in drinking water) selected for PRG because calculated human health risk PRG value is less than what can be measured with current readily available laboratory methods. Goal is best available analytical detection limit.
Benzo(k)fluoranthene	0.03 (residential) no unacceptable industrial risk	CA	–	–	–	**0.5 GOAL - 0.03**	**3.6E-5 (residential)**	Method Detection Limit (MDL) from Method EPA 525.2 (organic contaminants in drinking water) selected for PRG because calculated human health risk PRG value is less than what can be measured with current readily available laboratory methods. Goal is best available analytical detection limit.
Total BAP equivalents***	0.0009 (residential) no unacceptable industrial risk	CA	–	–	0.2 (MCL)	**0.2 GOAL - 0.0009**	**1.3E-3 (residential)**	MCL selected as PRG for the total of all carcinognenic PAHs (MCL basis is for benzo(a)pyrene), although a goal of 0.0009 ug/l is also provided for residential receptor protection. Note that MCLG is zero
Naphthalene	62 (residential) no unacceptable industrial risk	NC	–	–	–	**62**	**HQ of 1 (residential)**	Human health risk PRG selected based on showering for residential receptor
Benzene	no unacceptable human health risk	–	–	–	5 (MCL)	**5**		MCL selected as PRG. Contaminant concentration does not present a human health risk concern, but exceeds MCL - PRG considered to meet aquifer restoration goal

PROPOSED PRELIMINARY REMOVAL GOAL SUMMARY - ALL MEDIA
BIG JOHN SALVAGE/HOULT ROAD SITE
ENGINEERING EVALUATION/COST ANALYSIS

Chemical of Concern	HHRA Risk-Based PRG Concentration For Cumulative Risk = 1E-5 Risk or HI = 1 or EPA Region III Tox Provided Values (a)	Basis for HHRA PRG: CA = Cancer or NC = Non-Cancer	Ecological Risk PRG	Basis for Ecological Risk PRG:	OTHER CONSIDER-ATIONS - MCLs, AWQC, TMDLs, SCREENING VALUES, B-GROUND, ETC.	PROPOSED PRG FOR EE/CA	Cancer Risk or HQ at a Concentration Equal to PRG	RATIONALE FOR PROPOSED PRG SELECTION
Arsenic	0.09 (residential) 1.0 (industrial)	CA	–	–	10 (MCL)	10 GOAL - 0.09	2.2E-4 (residential) 5.2E-5 (industrial)	MCL selected as PRG, although a goal of 0.09 ug/l is also provided for residential receptor protection. Note that MCLG is zero
Iron	2300 (residential)(a) 15300 (industrial)	NC	–	–	–	2300	HQ of 1.0 (residential) 0.08 (industrial)	Human health risk PRG selected based on tap water ingestion for most sensitive future receptor
Manganese	270 (residential) 2040 (industrial)	NC	–	–	–	270	HQ of 1 (residential) 0.1 (industrial)	Human health risk PRG selected based on tap water ingestion for most sensitive future receptor
Thallium	0.58 (residential) 3.8 (industrial)	NC	–	–	2 (MCL)	2 GOAL - 0.6	HQ of 1.7 (residential) 0.3 (industrial)	MCL selected as PRG, atlhough a goal of 0.6 ug/l is also provided for residential receptor protection. Note that MCLG is 0.5 ug/l
Cyanide	no unacceptable human health risk				200 (MCL)	200		MCL selected as PRG. Contaminant concentration does not present a human health risk concern, but exceeds MCL - PRG considered to meet aquifer restoration goal
Vanadium	12 (residential) no unacceptable industrial risk	NC	–	–	–	12	HQ of 1 (residential)	Human health risk PRG selected based on tap water ingestion for most sensitive future receptor

Note that all mean concentrations presented are arithmetic mean concentrations

ACRONYMS

AOARS = Area of Attainment Aquifer Restoration Scenario (assumes dilution attenation factor for SSL = 20)
WVAWQC = West Virginia Ambient Water Quality Criteria
BTAG = Value calculated by EPA Region 3 BTAG Group
CA = Cancer Risk
Eco SSL - Ecological Soil Screening Levels
EPAFSSV = EPA Region 3 Freshwater Sediment Screening Value
EPAFWSV = EPA Region 3 Freshwater Screening Value
EPASGSSL = EPA Soil to Groundwater Soil Screening Level
LOEC = Lowest Observed Effect Concentration
MCL = Maximum Contaminant Limit (Safe Drinking Water Act)
MV= Mammalian vermivores
NC = Non-Cancer Risk
NOEC = No Observed Effect Concentration
SQC = Canadian Soil Quality Criteria (for ecological receptors)
TARS = Total Aquifer Restoration Scenario (assumes dilution attenuation factor for SSL = 1)
TMDL = Total Maximum Daily Load

Appendix B – Attachment 1 – RISK BASED RATIONALE FOR THE SELECTION OF PRGS

Basis for Human Health Risk-Based PRGs

In general, EPA has defined acceptable human health risks for carcinogens as within the range of 10^{-4} to 10^{-6} excess lifetime cancer risk, and for non-carcinogens as a hazard index (HI) of less than 1.0. Various uncertainties associated with the HHRA are discussed in detail in the HHRA report submitted under separate cover (Tetra Tech, 2007). The risk-based PRG concentrations presented in Tables 1 through 6 do not account for detection limits, technical feasibility, or costs. However, they represent a line of evidence for the risk management process that can form the basis for selection of ultimate clean-up levels.

The HHRA determined which chemicals were risk drivers for various environmental media (e.g., sediment, surface water, soil, and groundwater) and considered potentially exposed receptors (e.g., adult and child residents, child and adult recreational users, industrial workers, and construction workers) for each exposure point (on-site soil or groundwater plume, the Monongahela River shallow or deep sediment, and on-site surface water and sediment). Exposure point concentrations (EPCs) were developed in the HHRA to represent the reasonable maximum exposure to each substance found within each medium and associated with an exposure point location or pathway.

Associated with each EPC is an estimated cancer risk and non-cancer hazard quotient (HQ). The RAGS D Table 7s and 10s presented in the HHRA show the individual EPCs and cancer risks for each substance, the cumulative risk from all contaminants of potential concern (COPCs), the non-cancer HQ for each substance, and the total hazard index (HI), which is the total of non-cancer HQ's affecting the same target organ. These values provide a basis for developing PRGs.

In Tables 1 through 6, the HHRA calculated EPCs and risks are listed only for the risk driver chemicals of concern (COCs) that represent the major contributors to unacceptable risk for the human receptors exposed to each medium and area of interest (residential and industrial receptors for soil and groundwater and recreational receptor for surface water and sediment). PRGs were developed based on these receptor scenarios, considering the residential receptor as the most sensitive receptor for soil and groundwater, while the industrial receptor is considered to be associated with a more practical future land use at the site.

For each exposure medium, a target risk goal was proposed for the total risk or hazard from exposure to all chemicals. In Tables 1 through 6, the overall cumulative risk goals were proposed as a HI of 1 for noncarcinogenic toxicity for any medium, or as medium-specific cumulative cancer risk goals of 2×10^{-5} for sediment, 1×10^{-5} for surface water, 4×10^{-5} for soil, and 1×10^{-5} for groundwater. The overall cumulative risk goal was then subdivided into allowable contributions to risk from each substance, based on either cancer risk levels or non-cancer HIs that, when added together, achieve the overall requirement for not exceeding the acceptable risk range.

Exposures to COCs may be associated with cancer or non-cancer toxicity (or in some cases both types of risk). When the more sensitive toxicity endpoint for a particular COC was based on non-cancer hazards, then the chemical-specific PRG was based on an overall target HI goal of 1.0 divided by the number (N) of risk driver chemicals contributing to non-cancer risk to the same target organ, so that the summation of all HQs affecting the same target organ would not exceed a total HI of 1.

The equation used to calculate non-cancer risk-based PRGs in Tables 1 through 6 is as follows:

$$\text{Non-Cancer Risk-Based PRG (ug/L or mg/kg)} = (\text{EPC in HHRA}) \times \frac{(\text{Target HI Goal}/N)}{(\text{Child HQ from HHRA})}$$

For many COCs, cancer risks rather than noncancer hazards represent the more sensitive endpoint for protection of human health. Target cancer risk goals were developed for each applicable COC in Tables 1 through 6, starting with selecting an overall total cancer risk goal that ranged between 1E-5 and 4E-5 for media-wide risk, and then apportioning a fraction of this risk goal as the allowed contribution from each risk driver chemical. In deriving groundwater and surface water PRGs, chemical-specific cancer risk goals were apportioned equally among all substances; in other words, the total risk goal was divided by N, the number of contributors. The following equation was used to calculate these cancer risk-based PRGs:

Human health risk-based PRGs, EPCs, and receptor risks at concentrations equal to the PRG or the EPC are presented in Table 1 for sediment. Sediment COCs are applicable to both on-site exposure and exposure to Monongahela River deep sediment. Monongahela River shallow sediment estimated cancer risks fell within the target risk range; therefore, COCs for river shallow sediment were not necessary to apply for protection of human health, although similar PAH compounds were detected as with deep sediments (dibenz(a,h)anthracene and indeno(1,2,3-cd)pyrene). Exposure assumptions were applicable to a recreational receptor and are based on

48 days/year of sediment contact and an incidental ingestion rate of 100 mg/day for an adult and 200 mg/day for a child.

$$\text{Cancer Risk - Based PRG (ug/L or mg/kg)} = (\text{EPC in HHRA}) \times \frac{(\text{Target Cancer Risk Goal}/N)}{(\text{Lifetime Cancer Risk from HHRA})}$$

In developing PRGs, the overall cumulative risk goal does not always have to be subdivided into equal cancer risk contributions for each COC, as other fractions can be selected that subdivide the target allowable risk among contributors and still achieve the same total level of protectiveness expressed as cumulative risk. Therefore, for soil and onsite sediment, BAP was allowed a target risk of one-half of the overall cumulative cancer risk goal, while the remaining "N" additional carcinogenic COCs were each allowed to contribute towards an individual cancer risk of up to 1/N x 1/2 x the overall cumulative cancer risk goal.

Table 2 presents human health risk-based PRGs, EPCs, and receptor risks at concentrations equal to the PRG or the EPC for on-site surface water exposure. Exposure assumptions were applicable to a recreational receptor and are based on 48 days/year of surface water contact and an incidental ingestion rate of 0.1 L/day for an adult or a child.

Table 3 and Table 4 present risk-based PRGs, EPCs, and risks at concentrations equal to the PRG or the EPC for residential soil and groundwater exposure, respectively. Non-cancer hazards are based on a child resident and cancer risks are based on a lifetime resident. Table 5 and Table 6 present analogous PRGs for industrial receptors. The industrial use scenario assumes adult workers would be exposed to media containing COCs less often compared to residential receptors, which allows higher concentrations of COCs to remain safely, compared to PRGs established in the same media for residential receptors.

For certain substances, such as arsenic, both cancer and non-cancer toxicity factors are available. In this case, the PRG should be set equal to the smaller of the two estimated values, so that neither cancer risk nor non-cancer risk would exceed the allowable risk range.

Ecological PRGs for Soil

Tables 9-1 through 9-4 from the 2007 BERA present the chemicals that were retained as COCs in soil based on risks to ecological receptors. This section describes the development of PRGs for the COCs for two primary groups of ecological receptors: (1) plants and soil invertebrates, and (2) mammals (herbivores and vermivores) and birds (vermivores).

Sixteen PAHs, carbazole, dibenzofuran, copper, mercury, zinc, methoxychlor, and cyanide were retained as COCs based on risks to plants and soil invertebrates. These chemicals were retained as COCs because they were detected at concentrations that exceeded screening levels and were detected at concentrations greater than background concentrations. No site-specific plant or invertebrate toxicity tests were conducted so a further refinement based on site-specific toxicity test data could not be conducted.

In June 2007, EPA issued the Ecological Soil Screening Level (Eco SSL) document for PAHs, which contained soil screening levels for soil invertebrates and mammalians (EPA, 2007a). The low molecular weight (LMW) and high molecular weight (HMW) PAH Eco SSLs for soil invertebrates are 29 mg/kg and 18 mg/kg, respectively, and for mammalians are 100 and 1.1 mg/kg, respectively . These Eco SSL values are to be applied to each individual PAH, not as a group of PAHs. Although a PAH Eco SSL was not derived for plants, one of the studies provided in the text of the Eco SSL document for plants utilized mixed PAHs for the toxicity study. This study provided a lowest observed adverse effects concentration (LOAEC) of 100 mg/kg. Other studies listed for plants in the Eco SSL document are for anthracene, a low molecular weight (LMW) PAH. All of the studies provide EC_{50}s (concentration which effects fifty percent of the test organisms) and LC_{50}s, where lethality occurred in fifty percent of the test organisms. Most of the EC_{50}s and LC_{50}s were greater than 1000 mg/kg, with others ranging from 30 to 720 mg/kg. Also, the ORNL plant benchmark for acenaphthene is 20 mg/kg (Efroymson et al., 1997a). Similar results were found for benzo(a)pyrene in the Canadian Soil Quality Guideline (EC, 1999) which provided no observed adverse effects concentrations (NOAECs) for plants ranging from 4400 mg/kg to 17500 mg/kg. Therefore, it appears that the Eco SSLs for soil invertebrates is more conservative than toxicity levels for plants. Although Eco SSLs are not available for carbazole or dibenzofuran, the Eco SSLs for LMW PAHs are used as a surrogate for these parameters because they have less than four aromatic rings.

Copper and zinc have Eco SSLs for plants and soil invertebrates (EPA, 2007b and EPA, 2007c). For copper, the plant Eco SSL (70 mg/kg) is lower than the invertebrate value while for zinc the invertebrate Eco SSL (120 mg/kg) is lower than the plant value. Eco SSLs have not been developed for cyanide or mercury but Canadian Soil Quality Guidelines (SQGs) based on plants and invertebrates are available for both parameters. The Canadian SQGs for cyanide and mercury are 0.9 mg/kg (EC, 1999a) and 12 mg/kg (EC, 1999b), respectively. No other screening levels were available for methoxychlor other than the Region 3 screening level of 0.1 mg/kg.

The EPA Eco SSL document states that "Eco-SSLs are not designed to be used as cleanup levels and the EPA emphasizes that it would be inappropriate to adopt or modify the intended use of these Eco-SSLs as national cleanup standards." However, because of a lack of site-specific toxicity data for the site, the Eco SSLs (and the Canadian SQG) are considered for use as the PRGs, except as described below for cyanide, zinc, and methoxychlor.

PRGs should not be set at levels below background, so the next step was to determine whether the Eco SSLs (or Canadian SQG) were less than site-specific background concentrations. Background concentrations were available for metals and cyanide in surface soil at the site. Copper, mercury, zinc, and cyanide were detected in background surface soil samples at concentrations ranging from 11.3 to 64.2 mg/kg (for copper), 0.06 to 1.4 mg/kg (for mercury) 38.6 to 176 mg/kg (for zinc), and 65 to 0.86 mg/kg (for cyanide). Only the maximum background concentration for zinc is greater than its Eco SSL so the PRG for zinc is set at the maximum background concentration.

The Canadian SQG for cyanide is less than the Region 3 screening level used to select COCs in the ERA (1.33 mg/kg), which is based on risks to wildlife. The Canadian SQG for cyanide is based on free cyanide, but the soil samples were analyzed for total cyanide so there is considerable uncertainty in using the SQG as the PRG for the site. Cyanide was only retained as a COC in soil in the emergent wetland. The source of the cyanides in that area is not known because the cyanide levels in the wetland were much greater than they were in the surface soil. There are many natural sources of cyanide including various species of bacteria, algae, fungi, and higher plants that form and excrete cyanide (Eisler, 1991), some of which could be responsible for the elevated levels of cyanide in the wetland. Because of the uncertainties in the form of cyanide at the site, the apparent lack of a source of cyanide in the wetland, it is not appropriate to develop a PRG for cyanide at the site.

There is also a lot of uncertainty in the screening level for methoxychlor, because it is based on a 96-hr lethal concentration 50 for sow bugs for 4,4'-DDT (EPA, 1995), not on toxicity data for methoxyclor. Methoxyclor was only retained as a COC in soil in the Forested Uplands area. However, the central tendency exposure (CTE) hazard quotient (HQ) for methoxychlor was only 1.12. The, CTE HQs for other parameters in that area were much greater indicating that although methoxyclor was a COC for the site, it is not considered a risk driver. Because of that and because of the uncertainties in the screening level, it is not appropriate to develop a PRG for methoxyclor at the site.

The PRGs for wildlife were calculated using the same food chain model that was used to calculate risks in the ERA. The parameters in the equation were rearranged to solve for the soil concentration, which is the PRG. Table 7 presents the equation and parameters that were used to calculate the PRGs. PRGs were only calculated for PAHs and mercury because these were the only chemicals that were COCs for wildlife in the ERA. For mercury, however, the calculated PRG is less than the maximum background concentration of 1.4 mg/kg. Therefore, the PRG for mercury is set at the maximum background concentration.

In summary, PRGs were developed for 16 PAHs, carbazole, dibenzofuran, copper, mercury and zinc. PRGs were not developed for cyanide or methoxyclor for reasons discussed above. Table 8 presents the PRGs for surface soil for both receptor groups (plants/soil invertebrates and wildlife) and the overall PRG which is the lower of the two PRGs.

Ecological PRGs for Aquatic Habitat

Tables 9-5 and 9-6 from the 2007 BERA present the chemicals that were retained as COCs in sediment, surface water, and porewater based on risks to ecological receptors. Chemicals were retained as COCs for the following receptors: (1) benthic invertebrates exposed to chemicals in sediment or porewater, (2) fish exposed to chemicals in sediment or surface water, (3) aquatic invertebrates exposed to chemicals in surface water, (4) insectivorous birds exposed to chemicals in benthic invertebrates, and (5) piscivorous mammals and birds exposed to chemicals in fish.

Although chemicals were retained as COCs for various receptors in various media, PRGs were only developed for risks to benthic invertebrates exposed to chemicals in the sediment. The following section describes why PRGs were not developed for the other receptors and media, followed by how PRGs were developed for benthic invertebrates.

Risks to fish and aquatic invertebrates from chemicals in surface water were determined by comparing measured chemical concentrations in surface water to water quality criteria and other evaluations as described in the ERA. Based on these evaluations, chemicals were retained as COCs in surface water only for future populations of aquatic organisms in Sharon Steel Run and its tributaries; no chemicals were retained as COCs in surface water for the Monongahela River.

As discussed in Section 2.4.2.1 of the EE/CA, Sharon Steel Run and its tributaries have been highly disturbed by previous sediment removal activities, as well as road and earthwork associated with other on-site activities. The streams themselves are relatively small (less than 3 feet wide of flowing water) and shallow (most areas are less than 6 inches deep) and flow across a muddy and silty substrate. The water in varies in turbidity, and has been observed to range from extremely muddy and turbid to relatively clear and colorless. Because of these disturbances and the turbidity of the water, there is very little aquatic habitat currently provided. Therefore, Sharon Steel Run is not currently considered as an ecological habitat of concern in this risk assessment and was only evaluated as a potential future habitat in the ERA. For these reasons, and because PRGs are rarely developed for surface water, ecological PRGs were specifically not developed for surface water at this site.

The objective of the porewater evaluation was to determine whether benthic invertebrates were at risks from chemicals in the groundwater as it discharges through the sediment. As discussed in the ERA, there are many uncertainties in using porewater by itself to evaluate risks to benthic invertebrates so the porewater data was used in a lines of evidence approach to determine whether benthic invertebrates were being impacted. The conclusion of the ERA was that benthic invertebrates were being impacted in part, because several chemicals were detected in porewater at concentrations that exceeded surface water criteria. However, PRGs were not developed for chemicals in porewater for the following reasons:

(1) Porewater cannot be remediated and there is a lot of uncertainty in developing PRGs for groundwater that protect porewater.
(2) The risks to benthic invertebrates were determined using other lines of evidence such as the sediment toxicity testing and the benthic community survey. Therefore, the porewater evaluation comprised only a small portion of the overall line of evidence.
(3) Most chemicals in the porewater are expected to settle out and accumulate in the sediment, so PRGs developed for sediment should address potential impacts from porewater.

Prior to conducting any type of remedial action for the sediment, however, the potential impacts of groundwater discharging through the sediment needs to be determined so that the sediment does not become recontaminated.

PAHs and a few metals were retained were retained as COCs for wildlife. However, PRGs were not developed for wildlife for several reasons. Risks to wildlife in Sharon Steel Run and its tributaries are based on future wildlife communities because of the poor habitat currently at the site. For that reason, PRGs will not be developed for wildlife in this area.

In the Monongahela River, risks to insectivorous birds from PAHs were calculated using PAH concentrations in clams collected in the Monongahela River. Risks to piscivorous birds and mammals from mercury were based on mercury levels in small fish collected in the Monongahela River. The risks from PAHs are primarily high because the toxicity reference value for PAHs is very low (0.22 mg/kgBW-day). The new Eco SSL document for PAHs (EPA, 2007a) indicates that not enough toxicity data were available to develop a TRV for birds. However, Appendix Tables 5-1 and 5-2 in that document present the available no observed adverse effects levels (NOAELs) and lowest observed adverse effects levels (LOAELs) for LMW PAHs and HMW PAHs, respectively. The NOAELs in these studies for LMW PAHs and HMW PAHs were 1,653 mg/kgBW-day and 2 mg/kgBW-day. If these NOAELs were used in the food chain model, all HQ would be less than or just slightly greater than 1.0 for the CTE scenario. If the LOAELs were used, all HQs would be less than 1.0. Also, the clam samples were only able to be collected at two locations (SD-06 and SD-07) and less than 10 grams of tissue were collected at each location. The greatest PAH concentrations were found in the clams collected at SD-07, which was close to the site, while low levels were found in the clams collected at SD-06. The AUF for the sandpiper (the insectivorous bird used in the food chain model) was 50 percent assuming that they only spend half of the year at the site because they are migratory.

Sediment PRGs for risks to benthic invertebrates were determined using the sediment toxicity test data and the benthic community data. A 42-day *Hyalella azteca* test was conducted with sediment samples collected from the Monongahela River. The tests were performed to measure the effects of the sediment samples on *H. azteca* (freshwater amphipod). The test endpoints were survival, growth (weight and length), and reproduction. Based on the results of the test, sediment samples collected from Station 7 (BJ-SD-07 and its duplicate BJ-SD-07D) both caused significant mortality to *H. azteca* after 28-days of exposure. Survival in all other samples was greater than 80 percent. These two sediment samples were the only samples that demonstrated a significant effect. The remaining test sediment samples did not cause significant mortality, or reductions in weight, length, or reproduction. Sample location BJ-SD-07, along with some other locations, also had negative effects for the metrics used to evaluate the results of a benthic community survey.

Chemical analysis of the test sediment samples collected from the Monongahela River indicated that samples BJ-SD-07 and its duplicate BJ-SD-07D had the highest reported concentrations of Total PAHs (3,084 mg/kg and 116 mg/kg, respectively). Concentrations of the metals were similar in all sediment samples. This data suggests that the low survival in sediment samples BJ-SD-07 and BJ-SD-07D is likely related to the high concentrations of PAHs detected in these samples. The greatest total PAH concentration in the samples with an acceptable survival (BJ-SD-08) was 44.5 mg/kg. Therefore, the NOAEC PRG is 44.5 mg/kg and the LOAEC PRG is 116 mg/kg (see Table 9).

The concentrations of metals were similar in all sediment samples collected for the sediment toxicity test so a strong dose-response relationship could not be established based on the toxicity testing results. Therefore, it is unknown whether or not metal concentrations are associated with sediment toxicity so PRGs could not be developed for metals in sediment.

ARARs, Human Health Risk, and Ecological Candidate PRGs Compared

In the preceding sections, candidate PRGs were developed for soil based on human health and ecological risk; sediment based on human health and ecological risk; surface water based on human health risk; and groundwater based on human health risk. To this list, EPA Federal Maximum Contaminant Levels (MCLs) should also be considered as ARARs that may be appropriate to include in the selection process for deciding on a final controlling PRG for each COC that is protective for all potential scenarios and receptors, both human and ecological.

Table 10 presents the candidate sediment PRGs for COCs determined by estimated human health risk or ecological risk. For each substance, the proposed controlling PRG is usually recommended to be the smaller of the two ecological risk-based PRG or human health risk-based PRG. However, in the case of sediment, the ecological PRG is formulated for total PAHs, without regard to which substance is included. In contrast, the human health-based PRGs are formulated only for PAHs that exhibit carcinogenicity, and exhibit numeric values that vary according to relative cancer potency. Technically, these two types of PRGs cannot be directly compared because they are based on different components. However, practically speaking, it should be noted that overall, the ecological risk-based PRG for total PAHs (44.5 mg/kg) is of a much greater magnitude than the sum of the human health risk-based PRGs for carcinogenic PAHs.

A summary of proposed PRGs for sediment COCs determined by estimated ecological and human health risks was presented on the summary table at the beginning of Appendix B (Summary Table – All Media). This table includes a column titled, "Cancer Risk or HQ at a Concentration Equal to PRG", which illustrates the estimated human health risk assuming a concentration equal to the proposed PRG. In the Summary Table – All Media, the sediment total PAHs PRG is proposed as 26 mg/kg based on the site specific ecological PRG developed by Region III BTAG based on site-specific weight-of-evidence calculations (See Attachment 3). This value is more conservative than the 44.5 mg/kg site-specific ecological risk assessment PRG. When human health risks are considered, the acceptability of the proposed 26 mg/kg PRG can be conservatively evaluated with respect to the BAP equivalent concentration. This is a very conservative assumption since only two PAHs (BAP and dibenz(a,h)anthracene) have a toxicity equivalent factor of 1, and all other PAHs exhibit relative cancer potencies one-tenth or less compared to BAP. At a concentration of 26 m/kg BAP equivalents, this PRG corresponds to a lifetime carcinogenic risk of 1.3E-03 under the reasonable maximum risk (RME) exposure scenario. Given that this represents an unacceptable risk, a value of 0.4 mg/kg BAP equivalents is instead proposed to provide for an acceptable risk in the sediments. Note that total risk (including all COCs) would be slightly higher considering risks associated with background levels of arsenic.

Table 11 presents the candidate surface water PRGs for COCs determined by estimated human health risk, which comprise only PAH compounds. These surface water PRGs are impractical for actual verification sampling due to detection limits for available analytical methods. Therefore, the Summary Table- All Media lists the method detection limit for the PAH COCs in surface water as a practical alternative that represents a verifiable concentration for the proposed PRGs. The risk at the proposed PRGs is shown to be within the acceptable risk range of 1E-6 to 1E-4.

While no ecological PRGs were derived for the carcinogenic PAHs listed in Table 11 for surface water, the Summary Table – All Media shows that manganese was selected as a COC with a proposed PRG based only upon ecological considerations.

Table 12 presents the candidate soil PRGs for COCs determined by either estimated human health risk or ecological risk based on the original PRG development.. For non-carcinogenic PAHs and for metals, there were no human health-based risk drivers, so the proposed controlling PRGs for naphthalene, copper, and zinc were selected based on ecological considerations.

With respect to the soil PRGs for PAHs, the human health derived PRG is based on a total benzo(a)pyrene (B(a)P) equivalent value of 4.6 mg/kg, which is the PRG value established for the adjacent Fairmont Coke Works/Sharon Steel Superfund site. This value also falls within the expected range of background values that could be applied at the Big John Salvage site.

With respect to a soil PRG for total PAHs protective of ecological receptors, the value of 26 mg/kg (which is the same as the sediment total PAH PRG) is also proposed for the soil. Note that the 4.6 mg/kg B(a)P equivalent concentration in surface soils would be approximately equal to a total PAH concentration of 31 mg/kg using the relative proportions of each PAH. Based on the ratio High to Low Molecular Weight PAHs (HMW/LMW) in soils, this 26 mg/kg concentration is at or below benchmarks for soil invertebrates and below effects levels for LMW PAHs for mammals. This PRG will also prevent soil transport from recontaminating the tributaries. This total PAH soil PRG is above effects levels for HMW PAHs for mammals (5.49 mg/kg – note that the total PAH background level for the site is approximately 11 mg/kg). However, several measures can be taken to ensure protection of all ecological receptors. Specifically, the contaminated surface soil that extends beyond contaminated subsurface soils will be excavated and consolidated under the cap, and these excavated areas will be backfilled with clean soils, and the area not being capped will be spatially-limited. The total PAH value of 26 mg/kg will essentially be a "not to exceed concentration" and, given the fact that the residual total PAHs available to ecological receptors will be spatially limited due to the aforementioned consolidation and capping, the anticipated average surface soil concentration will not likely exceed the background concentration (11 mg/kg), or even the 5.5 mg/kg with the use of clean fill, which is approximately the most sensitive PRG for HMW PAHs for mammals.

The Summary Table – All Media indicates that, aside from PAHs, the only other soil COCs associated with ecological risk were 3 metals, although none of these substances were human health soil COCs. Eco SSLs were proposed for copper and zinc. In addition, a PRG value of 1 mg/kg was proposed for mercury. The mean background concentration of mercury from off-site samples was selected for the mercury PRG. This PRG is higher than ecological PRGs calculated for protection of wildlife, but is less than Canadian Soil Quality Criteria which are based on protection of plants and soil invertebrates.

Table 13 presents the candidate groundwater PRGs. The human health risk-based PRGs are compared to EPA Federal MCLs. In the Summary Table – All Media, for the carcinogenic PAHs groundwater COCs, the human health risk-based PRGs are lower than analytical detection limits using available methods. Therefore, the MCL for benzo(a)pyrene was selected as the proposed groundwater PRG for carcinogenic PAHs. However, the risk at the proposed PRG is estimated as 1.3E-3, which exceeds the risk management goal range of 1E-04 to 1E-06. For other groundwater COCs, the MCLs were proposed as PRGs, including 1,2-dibromo-3-chloropropane, benzene, arsenic, and thallium, although goals in addition to the MCLs are also provided for 1,2-dibromo-3-chloropropane, arsenic, and thallium as the respective MCLs for these compounds exceed the risk management goals for the Site.

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TABLE 1
HUMAN HEALTH RISK-BASED PRGS FOR SEDIMENT FOR LIFETIME VISITOR/RESIDENT RECEPTORS
BIG JOHN SALVAGE/HOULT ROAD SITE

Onsite Sediment PRGs	Exposure Point Concentration (EPC) in HHRA (mg/kg)	Lifetime Cancer Risk in HHRA From Concentration Equal to EPC	Lifetime Cancer Risk for Concentration Equal to the PRG Shown**	Risk-Based PRG Concentration That Achieves Cancer Risk Goal (mg/kg)
Benzo(a)anthracene	18.2	8.65E-05	3.1E-06	0.65
Benzo(a)pyrene	20.9	9.93E-04	9.5E-06	0.2
Benzo(b)fluoranthene	19.1	9.08E-05	3.1E-06	0.65
Dibenzo(a,h)anthracene	9.60	4.56E-04	3.1E-06	0.065
		TOTAL RISK	1.9E-05	

** Risk goals selected so BAP contributes 1/2 and 3 other PAHs contribute 1/6 fraction to a target risk <= 2E-5.

Assumptions: 48 days per year of sediment contact, ingestion of 100 and 200 mg/day for an adult/child.

Deep River Sediment PRGs	Exposure Point Concentration (EPC) in HHRA (mg/kg)	Lifetime Cancer Risk in HHRA From Concentration Equal to EPC	Lifetime Cancer Risk for Concentration Equal to the PRG Shown**	Risk-Based PRG Concentration That Achieves Cancer Risk Goal (mg/kg)
Benzo(a)anthracene	12.9	6.29E-05	9.8E-06	2.0
Benzo(a)pyrene	8.2	4.00E-04	9.8E-06	0.2
		TOTAL RISK	2.0E-05	

** Risk goals selected so each of 2 PAHs contribute 1/2 towards a total target risk of <= 2E-5.

Note: The assessment determined there are no COCs for sediment based on noncancer hazards.

Assumptions: 48 days per year of sediment contact, ingestion of 100 and 200 mg/day for an adult/child.

TABLE 2
HUMAN HEALTH RISK-BASED PRGS FOR SURFACE WATER FOR LIFETIME RECREATIONAL USER
BIG JOHN SALVAGE/HOULT ROAD SITE

Surface Water PRGs	Exposure Point Concentration in HHRA Based on 95% UCL (ug/L)	Lifetime Cancer Risk in HHRA From Concentration Equal to EPC	Lifetime Cancer Risk for Concentration Equal to the PRG Shown**	Risk-Based PRG Concentration That Achieves Cancer Risk Goal (ug/l)
Benzo(a)anthracene	10.6	3.79E-04	2.1E-06	0.06
Benzo(a)pyrene	12.1	7.21E-03	1.8E-06	0.003
Benzo(b)fluoranthene	11.6	7.13E-04	1.8E-06	0.03
Dibenzo(a,h)anthracene	5.2	5.06E-03	1.9E-06	0.002
Indeno(1,2,3-cd)pyrene	6.8	4.32E-04	1.9E-06	0.03
		TOTAL RISK	9.6E-06	

** Risk goals selected so each of 5 PAHs contribute 1/5 towards a total target risk of <= 1E-5.

Note: The assessment determined there are no COCs for surface water based on noncancer hazards.
Assumptions: 48 days/yr. of surface water contact, incidental ingestion of 0.1 L/day for an adult/child

TABLE 3
HUMAN HEALTH RISK-BASED PRGS FOR RESIDENTIAL EXPOSURE TO SOIL
BIG JOHN SALVAGE/HOULT ROAD SITE

Soil PRGs - Noncancer Risk Consideration	Exposure Point Concentration (EPC) in HHRA (mg/kg)	Child HQ Estimated in HHRA From Concentration Equal to EPC	Adult HQ Estimated in HHRA From Concentration Equal to EPC	Child HQ Estimated for Concentration Equal to the PRG Shown*	Adult HQ Estimated for Concentration Equal to the PRG Shown*	PRG That Achieves HI and Cancer Risk Goals* (mg/kg)	Target Organs
PATHWAY: Direct Contact with Soil unless otherwise noted							
Arsenic	1.58E+01	0.73	0.081	0.2	0.02	4	Skin, vascular system
Naphthalene (oral/dermal contact only)	5.45E+01	0.048	0.006	0.0002	0.00003	0.3	Body weight
Naphthalene (vapor intrusion pathway only)	5.45E+01	253	90	1.2	0.4	0.3	Nasal effects
Benzene (noncancer hazards primarily from vapor intrusion pathway)	5.70E-01	0.69	0.25	0.2	0.09	0.2	Blood, immune system
		Total HI for Nasal		1.2	0.4		
		Total HI for Body Weight		0.0002	0.00003		
		Total HI for Skin and Vascular		0.2	0.02		
		Total HI for Blood and Immune		0.2	0.09		

* HQ at the stated PRG, which considers applicable cancer risks and/or target organ-specific HIs <= 1.0.
(There were no target organs in common among soil COCs, so the target HQ is 1.0 for each COC.)
Assumptions: 350 days per year of soil contact, ingestion of 100 and 200 mg/day for an adult/child.

Soil PRGs - Cancer Risk Consideration	Exposure Point Concentration (EPC) in HHRA (mg/kg)	Lifetime Cancer Risk in HHRA From Concentration Equal to EPC	Lifetime Cancer Risk for Concentration Equal to the PRG Shown**	Risk-Based PRG Concentration That Achieves Cancer Risk Goal (mg/kg)
PATHWAY: Direct Contact with Soil unless otherwise noted				
Arsenic	1.58E+01	4.06E-05	1.0E-05	4
Benzo(a)anthracene	3.16E+01	2.14E-04	2.7E-06	0.4
Benzo(a)pyrene	3.32E+01	2.25E-03	1.0E-05	0.15
Benzo(b)fluoranthene	2.84E+01	1.92E-04	2.7E-06	0.4
Dibenzo(a,h)anthracene	5.32E+00	3.61E-04	2.7E-06	0.04
Indeno(1,2,3-cd)pyrene	1.46E+01	9.89E-05	2.7E-06	0.4
Benzene (primarily vapor intrusion pathway)	5.70E-01	3.37E-05	1.2E-05	0.2
		TOTAL RISK	4.3E-05	

** Risk goals selected so BAP, benzene, and arsenic each contribute 1/4, and 4 other PAHs contribute 1/16 fraction to a total target risk <= 4E-5.
Assumptions: 350 days per year of soil contact, ingestion of 100 and 200 mg/day for an adult/child.

TABLE 4
HUMAN HEALTH RISK-BASED PRGS FOR GROUNDWATER, TAP WATER USE BY RESIDENTS
BIG JOHN SALVAGE/HOULT ROAD SITE

Groundwater PRGs - Noncancer Risk Consideration	Exposure Point Concentration (EPC) In HHRA (ug/l)	Child HQ Estimated in HHRA at Concentration Equal to EPC	Adult HQ Estimated in HHRA at Concentration Equal to EPC	Child HQ Estimated for Concentration Equal to the PRG Shown*	Adult HQ Estimated for Concentration Equal to the PRG Shown*	PRG That Achieves HI and Cancer Risk Goals* (ug/l)	Target Organs
1,2-Dibromo-3-chloropropane	5.1	–	0.52	–	0.003	0.03	Reproductive
2-Methylnaphthalene	41.6	1.54	0.64	1.0	0.4	27	Respiratory system
Naphthalene (oral/dermal)	362	1.87	0.79	0.3	0.1	62	Body weight
Naphthalene (inhalation)	362	–	5.87	–	1.0	62	Nasal
Arsenic	8.9	1.91	0.82	0.02	0.008	0.09	Skin, vascular system
Iron	25498	5.47	2.34	0.5	0.2	2300	GI tract, blood, liver
Manganese	9999	37.2	15.5	1.0	0.4	270	CNS
Thallium	12.6	10.8	4.63	0.4	0.2	0.5	Liver
Vanadium	6.9	0.55	0.23	1.0	0.4	12.5	Kidney
		Total HI for Reproductive		–	0.003		
		Total HI for Respiratory		1.0	0.4		
		Total HI for Nasal		–	1.0		
		Total HI for Body Weight		0.3	0.1		
		Total HI for Skin and Vascular		0.02	0.008		
		Total HI for GI Tract and Blood		0.5	0.2		
		Total HI for Liver		0.9	0.4		
		Total HI for CNS		1.0	0.4		
		Total HI for Kidney		1.0	0.4		

* HQ at the stated PRG, which considers applicable cancer risks and/or target organ-specific HIs <= 1.0.
(Only iron and thallium exhibit a target organ in common, so the target HQ is 0.5 for these elements and 1.0 for other COCs.)

Assumptions: 350 days per year of tap water contact, ingestion of 1 and 2 L/day for an adult/child, plus daily showering exposure for adults.

Groundwater PRGs - Cancer Risk Consideration	Exposure Point Concentration (EPC) in HHRA (ug/l)	Lifetime Cancer Risk In HHRA From Concentration Equal to EPC	Lifetime Cancer Risk for Concentration Equal to the PRG Shown*	Risk-Based PRG Concentration That Achieves Cancer Risk Goal (ug/l)
1,2-Dibromo-3-chloropropane	5.1	3.91E-04	2.3E-06	0.03
Benzo(a)anthracene	1.0	4.36E-04	2.2E-06	0.005
Benzo(b)fluoranthene	2.0	1.46E-03	2.2E-06	0.003
Benzo(k)fluoranthene	1.0	7.28E-05	2.2E-06	0.03
Arsenic	8.9	2.00E-04	2.0E-06	0.09
		TOTAL RISK	1.1E-05	

** Individual cancer risks formulated so that each of 5 COCs contribute 1/5 fraction to the total target risk of 1E-5.

Assumptions: 350 days per year of tap water contact, ingestion of 1 and 2 L/day for an adult/child, plus daily showering exposure for adults.

TABLE 5
RISK-BASED PRELIMINARY REMEDIATION GOALS FOR SOIL, INDUSTRIAL WORKER
BIG JOHN SALVAGE/HOULT ROAD SITE

Soil PRGs - Noncancer Risk Consideration	Exposure Point Concentration (EPC) in HHRA (mg/kg)	Worker HQ Estimated in HHRA From Concentration Equal to EPC	Worker HQ Estimated for Concentration Equal to the PRG Shown*	PRG That Achieves HI and Cancer Risk Goals* (mg/kg)	Target Organs
PATHWAY: Direct Contact with Soil unless otherwise noted					
Arsenic	1.58E+01	0.06	0.07	20	Skin, vascular system
Naphthalene (oral/dermal contact only)	5.45E+01	0.004	0.0008	10	Body weight
Naphthalene (vapor intrusion pathway only)	5.45E+01	5.8	1.1	10	Nasal effects
Benzene (noncancer hazards primarily from vapor intrusion pathway)	5.70E-01	0.03	0.1	2.5	Blood, immune
	Total HI for Nasal		1.1		
	Total HI for Body Weight		0.0008		
	Total HI for Skin and Vascular		0.07		
	Total HI for Blood and Immune		0.1		

* HQ at the stated PRG, which considers applicable cancer risks and/or target organ-specific HIs <= 1.0. (There were no target organs in common among soil COCs, so the target HQ is 1.0 for each COC.)

Assumptions: 225 days per year of soil contact, ingestion of 100 mg/day for an adult worker.

Soil PRGs - Cancer Risk Consideration	Exposure Point Concentration (EPC) in HHRA (mg/kg)	Worker Cancer Risk in HHRA From Concentration Equal to EPC	Worker Cancer Risk for Concentration Equal to the PRG Shown**	Risk-Based PRG Concentration That Achieves Cancer Risk Goal (mg/kg)
PATHWAY: Direct Contact with Soil unless otherwise noted				
Arsenic	1.58E+01	8.93E-06	1.1E-05	20
Benzo(a)anthracene	3.16E+01	1.35E-05	2.6E-06	6
Benzo(a)pyrene	3.32E+01	1.42E-04	1.1E-05	2.5
Benzo(b)fluoranthene	2.84E+01	1.21E-05	2.6E-06	6
Dibenzo(a,h)anthracene	5.32E+00	2.27E-05	2.6E-06	0.6
Indeno(1,2,3-cd)pyrene	1.46E+01	6.23E-06	2.6E-06	6
Benzene (primarily vapor intrusion pathway)	5.70E-01	2.34E-06	1.0E-05	2.5
		TOTAL RISK	4.2E-05	

** Risk goals selected so BAP, benzene, and arsenic each contribute 1/4, and 4 other PAHs each contribute 1/16 fraction to a total target risk <= 4E-5.

Assumptions: 225 days per year of soil contact, ingestion of 100 mg/day for an adult worker.

TABLE 7

CALCULATION OF WILDLIFE ECOLOGICAL PRELIMINARY REMEDIATION GOALS IN SOIL
BIG JOHN SALVAGE - HOULT ROAD SITE
FAIRMONT, WEST VIRGINIA

Parameter	LOAELs (mg/kg-day)		Soil to Earthworm Biotransfer Factor	Soil to Plant Biotransfer Factor	Preliminary Remediation Goals$^{(1)}$		
	Mammal	Bird			American Woodcock (mg/kg)	Short-Tailed Shrew (mg/kg)	Meadow Vole (mg/kg)
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	10	0.22	0.67	NA	0.564	NA	NA
Acenaphthylene	10	0.22	0.67	NA	0.564	NA	NA
Anthracene	10	0.22	0.74	NA	0.518	23	NA
Benzo(a)anthracene	10	0.22	0.89	NA	0.442	19	NA
Benzo(a)pyrene	10	0.22	0.95	NA	0.417	18	NA
Benzo(b)fluoranthene	10	0.22	0.97	NA	0.412	18	NA
Benzo(g,h,i)perylene	10	0.22	1.05	NA	0.383	16	NA
Benzo(k)fluoranthene	10	0.22	0.97	NA	0.412	18	NA
Chrysene	10	0.22	0.89	NA	0.442	19.07	NA
Dibenz(a,h)anthracene	10	0.22	1.05	NA	0.384	16	NA
Fluoranthene	10	0.22	0.81	NA	0.479	21	NA
Fluorene	10	0.22	0.70	NA	0.542	24	NA
Phenanthrene	10	0.22	0.74	NA	0.518	23	NA
Pyrene	10	0.22	0.81	NA	0.479	21	NA
Metals							
Mercury	0.025	0.064	8.50	0.069	0.01530	0.00523	1

NOAEL - No Observed Adverse Effects Level
EEQ - Ecological Effects Quotient = 1.0
BTF - Biotransfer Factor
NA - Not applicable because chemical was not retained as a COC in soil for that receptor.

(1) - The Preliminary Remediation Goals were calculated using the following equation:

$$PRG = \frac{NOAEL*EEQ}{((BTF*If)+(Is))*AUF}$$

Exposure Inputs	American Woodcock	Short-Tailed Shrew	Meadow Vole	Units
Soil Ingestion Rate (Is)	0.104	0.024	0.024	kg
Food Ingestion Rate (If)	0.770	0.560	0.325	kg/day
Area Use Factor (AUF)	0.629	1	1	unitless

TABLE 8

SUMMARY OF ECOLOGICAL PRELIMINARY REMEDIATION GOALS IN SOIL
BIG JOHN SALVAGE - HOULT ROAD SITE
FAIRMONT, WEST VIRGINIA

Constituent of Concern	Plants & Soil Invertebrates		Wildlife PRGs (mg/kg)(1)			Lowest PRG (mg/kg)
	PRG (mg/kg)	Source	Avian Herbivores	Mammalian Vermivores	Avian Vermivores	
Semivolatile Organic Compounds						
Acenaphthene	29	Eco SSL*	NA	0.56	NA	0.56
Acenaphthylene	29	Eco SSL*	NA	0.56	NA	0.56
Anthracene	29	Eco SSL*	NA	0.52	23	0.52
Benzo(a)anthracene	18	Eco SSL*	NA	0.44	19	0.44
Benzo(a)pyrene	18	Eco SSL*	NA	0.42	18	0.42
Benzo(b)fluoranthene	18	Eco SSL*	NA	0.41	18	0.41
Benzo(g,h,i)perylene	18	Eco SSL*	NA	0.38	16	0.38
Benzo(k)fluoranthene	18	Eco SSL*	NA	0.41	18	0.41
Carbazole	29	Eco SSL*	NA	NA	NA	NA
Chrysene	18	Eco SSL*	NA	0.44	19	0.44
Dibenzo(a,h)anthracene	18	Eco SSL*	NA	NA	NA	NA
Dibenzofuran	29	Eco SSL*	NA	NA	NA	NA
Fluoranthene	29	Eco SSL*	NA	0.48	21	0.48
Fluorene	29	Eco SSL*	NA	0.54	24	0.54
Indeno(1,2,3-cd)pyrene	18	Eco SSL*	NA	NA	NA	18
Naphthalene	29	Eco SSL*	NA	NA	NA	29
Phenanthrene	29	Eco SSL*	NA	0.52	23	0.52
Pyrene	18	Eco SSL*	NA	0.48	21	0.48
Metals						
Copper	70	Eco SSL**	NA	NA	NA	
Mercury	12	SQG	0.0688	0.02	0.005	1.4(2)
Zinc	176	Max Bkg	NA	NA	NA	
Other						
Cyanide	NC	NC	NA	NA	NA	NC
Methoxychlor	NC	NC	NA	NA	NA	NC

Eco SSL* - Ecological Soil Screening Level based on risks to invertebrates
Eco SSL** - Ecological Soil Screening Level based on risks to plants
Max Bkg - maximum background concentration
SQG - Canadian Soil Quality Guideline
PRG - Preliminary remediation goal

NA - Not applicable because chemical was not a COC for that receptor.
NC - Not calculated for reasons presented in the text.

1 - The calculations of the wildlife PRGs are presented in Table 5.
2 - The PRG for mercury is the maximum background concentration.

TABLE 9

SUMMARY OF ECOLOGICAL PRELIMINARY REMEDIATION GOALS IN SEDIMENT
BIG JOHN SALVAGE - HOULT ROAD SITE
FAIRMONT, WEST VIRGINIA

Constituent of Concern	NOAEC PRG (mg/kg)	LOAEC PRG (mg/kg)
Semivolatile Organic Compounds		
Total PAHs	44.5	116

NOAEC - No observed adverse effects concentration
LOAEC - Lowest observed adverse effects concentration
PRG - Preliminary remediation goal

TABLE 10
HUMAN HEALTH RISK AND ECOLOGICAL CANDIDATE PRGS FOR SEDIMENT
BIG JOHN SALVAGE/HOULT ROAD SITE

PRGs for Onsite Sediment	HHRA Risk-Based PRG Concentration For Cumulative Risk mg/kg	Basis for HHRA PRG: CA = Cancer or NC = Non-Cancer	Ecological Risk PRG mg/kg	Basis for Ecological Risk PRG: NOAEC or LOAEC	Comments
Benzo(a)anthracene	0.65	CA	–	–	
Benzo(a)pyrene	0.2	CA	–	–	
Benzo(b)fluoranthene	0.65	CA	–	–	
Dibenzo(a,h)anthracene	0.065	CA	–	–	
Total PAHs	–	–	44.5	NOAEC	also consider a LOAEC of 116 m/kg

NOAEC - No observed adverse effects concentration
LOAEC - Lowest observed adverse effects concentration

PRGs for Deep River Sediment	HHRA Risk-Based PRG Concentration For Cumulative Risk mg/kg	Basis for HHRA PRG: CA = Cancer or NC = Non-Cancer	Ecological Risk PRG mg/kg	Basis for Ecological Risk PRG: NOAEC or LOAEC	Comments
Benzo(a)anthracene	2	CA	–	–	
Benzo(a)pyrene	0.2	CA	–	–	
Total PAHs	–	–	44.5	NOAEC	also consider a LOAEC of 116 m/kg

NOAEC - No observed adverse effects concentration
LOAEC - Lowest observed adverse effects concentration

TABLE 11
HUMAN HEALTH RISK-BASED CANDIDATE PRGS FOR SURFACE WATER
BIG JOHN SALVAGE/HOULT ROAD SITE

Surface Water PRGs	HHRA Risk-Based PRG Concentration For Cumulative Risk = 1E-5 Risk or HI = 1	Basis for HHRA PRG: CA = Cancer or NC = Non-Cancer
	ug/L	
Benzo(a)anthracene	0.06	CA
Benzo(a)pyrene	0.003	CA
Benzo(b)fluoranthene	0.03	CA
Dibenzo(a,h)anthracene	0.002	CA
Indeno(1,2,3-cd)pyrene	0.03	CA

Ecological PRGs were not developed for surface water or porewater for the reasons stated in the accompanying text.

TABLE 12
HUMAN HEALTH RISK AND ECOLOGICAL CANDIDATE PRGS FOR FOR SOIL
BIG JOHN SALVAGE/HOULT ROAD SITE

Soil PRGs	Residential Risk-Based PRG Concentration	Industrial Risk-Based PRG Concentration	Basis for HHRA PRGs: CA = Cancer or NC = Non-Cancer	Ecological Risk PRG	Basis for Ecological Risk PRG: MV = Mammalian Vermivores	Comments
PATHWAY: Direct Contact with Soil	**mg/kg**	**mg/kg**		**mg/kg**		
Arsenic	4	20	CA	–	–	
Benzo(a)anthracene	0.4	6	CA	0.44	MV	ECO based on wildlife PRG
Benzo(a)pyrene	0.15	2.5	CA	0.42	MV	ECO based on wildlife PRG
Benzo(b)fluoranthene	0.4	6	CA	0.41	MV	ECO based on wildlife PRG
Dibenzo(a,h)anthracene	0.04	0.6	CA	–	–	
Indeno(1,2,3-cd)pyrene	0.4	6	CA	18	Eco SSL	ECO based on risk to invertebrates
Acenaphthene	–	–	–	0.56	MV	ECO based on wildlife PRG
Acenaphthylene	–	–	–	0.56	MV	ECO based on wildlife PRG
Anthracene	–	–	–	0.52	MV	ECO based on wildlife PRG
Benzo(g,h,i)perylene	–	–	–	0.38	MV	ECO based on wildlife PRG
Benzo(k)fluoranthene	–	–	–	0.41	MV	ECO based on wildlife PRG
Chrysene	–	–	–	0.44	MV	ECO based on wildlife PRG
Fluoranthene	–	–	–	0.48	MV	ECO based on wildlife PRG
Fluorene	–	–	–	0.54	MV	ECO based on wildlife PRG
Naphthalene	–	–	–	29	Eco SSL	ECO based on risk to invertebrates
Phenanthrene	–	–	–	0.52	MV	ECO based on wildlife PRG
Pyrene	–	–	–	0.48	MV	ECO based on wildlife PRG
Mercury	–	–	–	1.4	max background	max background exceeds Eco PRGs
PATHWAY: Vapor Intrusion to Indoor Air	**(mg/kg PRG concentration in soil)**					
Naphthalene	0.3	10	NC	–	–	
Benzene	0.2	2.5	CA	–	–	

TABLE 13
FEDERAL MCLS AND HUMAN HEALTH RISK-BASED CANDIDATE PRGS FOR FOR GROUNDWATER
BIG JOHN SALVAGE/HOULT ROAD SITE

Groundwater PRGs	Residential Risk-Based PRG Concentration For Cancer Risk = 1E-5 Risk or HI = 1	Industrial Risk Based PRG Concentration For Cancer Risk = 1E-5 Risk or HI = 1	Basis for HHRA PRG: CA = Cancer or NC = Non-Cancer	FEDERAL MAXIMUM CONTAMINANT LEVEL (MCL)	Comments
	ug/L	ug/L		ug/L	
1,2-Dibromo-3-chloropropane	0.03	0.4	CA	0.2	MCLG is zero.
2-Methylnaphthalene	27	400	NC	–	
Benzo(a)anthracene	0.005	1	CA	0.2 as BAP TEQ*	
Benzo(b)fluoranthene	0.003	1	CA	0.2 as BAP TEQ*	
Benzo(k)fluoranthene	0.03	10	CA	0.2 as BAP TEQ*	
Benzene	–	–	–	5	
Cyanide	–	–	–	200	
Naphthalene	62	2000	NC	–	
Arsenic	0.09	0.5	CA	10	MCLG is zero.
Iron	2300	15000	NC	–	may be greater than background
Manganese	270	2000	NC	–	may be greater than background
Thallium	0.5	4	NC	2	MCLG is 0.5. May exceed background
Vanadium	12.5	100	NC	–	may be greater than background

* Benzo(a)Pyrene (BAP) Toxicity Equivalent (TEQ) is the sum of each carcinogenic PAH concentration multiplied by relative potency to BAP.

MCLs are from EPA website: http://www.epa.gov/safewater/contaminants/index.html

Appendix B – Attachment 2 – PRELIMINARY REMOVAL GOALS (PRG) UPDATE – FEBRUARY 2009

Preliminary Removal Goals (PRG) Update – Big John Salvage Site

Attached is the updated PRG Table which addresses the various comments provided by EPA in the January 22, 2009 comment letter regarding the version of the Big John Salvage Site Engineering Evaluation/Cost Analysis submitted in November 2008.

The major revisions include new proposed PRGs for PAHs to address both human health and ecological risks. Other revisions include a further explanation of the derivation of background values which are proposed in the table.

In addition to the revised table, the following analysis is also provided for your consideration as it relates to the development of the PRGs to provide additional information to the risk managers as they decided on the final PRGs to be included in the final EE/CA.

***Monongahela River (MR) Sediments* –**

A background analysis was conducted for the sediment data collected from the Monongahela River during April 2005 – this data set, which includes data from 56 separate locations, was chosen because it is the most complete data set available for the river sediments. It includes samples collected from 19 shallow and deep sediment cores obtained from 8 different locations upstream from the Sharon Steel Run (SSR) confluence, and 37 shallow and deep sediment cores obtained from 13 different locations downstream from the SSR confluence.

Note that only the Target Compound List (TCL) PAH data collected from the sediment cores was used for this analysis, and not the target PAH data collected from the sediment cores, as the TCL data is more comparable to other historic and subsequent data collected for the river sediments.

Background MR Sediment Concentrations

Total PAH concentrations detected in the 19 upstream samples (determined to be background to any discharge from SSR) from both shallow (within 1 foot of the river bottom) and deep sediments (maximum of 5 feet below the river bottom) ranged from non detect (with an approximate quantitation limits ranging from ~ 300 – 550 ug/kg) to 18,170 ug/kg, with an arithmetic mean concentration of 3,782 ug/kg. However, using a background determination approach which assigns a value of one-half of the quantitation limit for all samples with non-detect analytes (based on Region III guidance and consistent with the other background evaluation conducted in the human health risk assessment for the Big John Salvage Site), the arithmetic mean concentration of total PAHs in the upstream sediments is calculated to be 6118 ug/kg.

Consequently, a value of 6 mg/kg is assumed as the background total PAH concentration in the Monongahela River sediments in this area.

Benzo(a)pyrene Equivalent Concentration Contribution to Total PAH Concentration in MR Sediment

The contribution of carcinogenic PAHs to the total PAH mass in the river sediments was also investigated. Note that for this evaluation, only actual analyte detections quantified were used in the calculation – i.e., non detects were not used nor were one-half of the quantitation limit used as proxy values in the calculation for this simple assessment.

The benzo(a)pyrene (B(a)P) equivalent concentrations were calculated for each background sample, and this total was divided by the total PAH concentration for each background sample to determine the range of contribution of carcinogenic PAHs to the total PAH concentrations detected.

For the entire reach of the MR investigated, the B(a)P equivalent concentrations constitute 0 to ~27% of the total PAH concentrations detected – for all 56 samples, the average B(a)P equivalent concentration constitute approximately 7.3% of the total PAH concentration detected.

The upstream samples had a range of B(a)P equivalent concentrations constituting 0-14% of the total PAH concentrations detected, with an average of 6%, whereas the downstream samples had a range of B(a)P equivalent concentrations constituting 0-27% of the total PAH concentrations detected, with an average of nearly 8% (7.8%).

Consequently, given an calculated background concentration of 6 mg/kg for PAHs, the estimated B(a)P equivalent fraction of this background concentration would range from non detect to 0.84 mg/kg, or an average of approximately 0.4 mg/kg.

Human Health Protectiveness Level of Ecological Risk Based PRG for Sediments

EPA Region 3 BTAG calculated a PRG for river sediments of 26 mg/kg for total PAHs based on the protection of ecological receptors. Based on the evaluation presented above of the contribution of the carcinogenic PAHs to total PAHs concentrations in the river sediments, this would equate, on average, to a B(a)P equivalent concentration of approximately 2.1 mg/kg (assuming 8% contribution of B(a)P equivalent to total PAH concentration), which would represent a cancer risk of approximately 1E-4 under the RME. Note that the actual risk would be slightly higher considering risks associated with the background levels of arsenic in the river sediment if they are considered.

The following table provides a summary B(a)P equivalent ranges for the various river sediment combinations that can be considered as part of the PRG development:

	Estimated Background Total PAH Concentration (mg/kg)	Range of B(a)P Equivalent Concentration Contribution(%)	Average B(a)P Equivalent Concentration Contribution (%)	Estimated Background B(a)P Equivalent Concentration (mg/kg)
Mon River Sediment Background Data Set	**6**	**0-14**	**8**	**0.4**
EPA Region III BTAG Eco Risk PRG (protective of ecological receptors)	**26**	**0-14**	**8**	**2.1**

The EPA Region 3 BTAG proposed PRG for total PAHs for sediments (26 mg/kg) would result in a human health risk slightly in excess of 1E-4, which is the risk associated with a B(a)P equivalent concentration of 2.1 mg/kg. Note that a total PAH value associated with a B(a)P equivalent concentration of 0.2 mg/kg (which is the 1E-5 risk value) would be approximately 2.5 mg/kg of total PAH, which is less than the background concentration of the river sediment.

Consequently, a final river sediment PRG for total PAHs somewhere between 6 and 24 mg/kg is the most applicable PRG that would be both protective of both human health and the environment. Note that the final number would be based on the final risk management goal selected – the background value (6 mg/kg) would represent a starting risk value of 2E-5, a value of 12 mg/kg would represent a risk value of 5E-5, etc.

On-Site Soil

The background analysis for total PAH concentrations was revisited to address EPA concerns regarding the use of the nearby off-site sample data set for the development of background soil concentrations.

A background analysis was conducted for the both the distant off-site surface soil data set (a three sample data set), as well as a combination of the distant off-site and nearby off-site data set.

Background Soil Concentrations

Distant Off-Site Sample Data Set - Total PAH concentrations detected in the three samples collected from pristine locations distant from the site ranged from non detect in two of the samples (with an approximate quantitation limits ranging from ~ 400-450 ug/kg) to 2420 ug/kg in the third sample, with an arithmetic mean concentration of 806 ug/kg (~ 1 mg/kg) of total PAH detections.

However, using a background determination approach which assigns a value of one-half of the quantitation limit for all samples with non-detect analytes (based on Region III guidance and consistent with the other background evaluation conducted in the human health risk assessment for the Big John Salvage Site), the arithmetic mean concentration of total PAHs in the distant off-site soil samples is calculated to be 4097 ug/kg.

Note that even though no detections were found in these two samples above quantitation limits, these samples are assigned approximate values of ~4000 ug/kg using the ½ detection limit proxy approach. This is an important assumption.

Consequently, a value of 4 mg/kg is assumed as the pristine background total PAH concentration in the general area.

Nearby Off-Site Sample Data Set – The nearby off-site sample data set is comprised of 9 samples (7 samples and two duplicates) collected from 7 locations situated adjacent to the Big John Site (but off-site and upgradient hydro logically – consequently these areas could not be impacted by surface water runoff or actual site related waste handling activities, however, are likely impacted by aerial deposition from historic industrial activities either from the Big John Site or other nearby sites).

Total PAH concentrations detected in these samples ranged from non detect to 178,000 ug/kg, with an arithmetic mean concentration of approximately 43 mg/kg. Note that this average is largely skewed by two adjacent samples with high concentrations (178 mg/kg and 139 mg/kg) – if these samples were removed from the data set, the average would be approximately 10 mg/kg (5 location data set). Also note that the two high concentration samples were collected adjacent to a non-detect sample, so they likely represent a contaminant source area rather than an over reaching depositional background.

Assigning ½ quantitation limit proxy values to non-detects, the arithmetic mean total PAH concentration of nearby off-site soils would be approximately 56 mg/kg (7 location data set), or approximately 11 mg/kg for the data set with the two biased high sample points removed (5 location data set).

Benzo(a)pyrene Equivalent Concentration Contribution to Total PAH Concentration in Soil

Using the same approach explained previously, the off-site background soil sample data set indicated B(a)P equivalent concentrations constitute 10 to ~17% of the total PAH concentrations detected in soil samples – the average B(a)P equivalent concentration constitutes approximately 15% of the total PAH concentrations detected in the off-site soil.

For reference, note that the on-site surface soil samples (32 sample data set) had a range of B(a)P equivalent concentrations constituting ~ 0-14% of the total PAH concentrations detected, with an average of nearly 12%, whereas the on-site subsurface soil samples (41 sample data set) also had a range of B(a)P equivalent concentrations constituting 0-15% of the total PAH concentrations detected, but with an average of slightly over 7% (7.23%). This indicates that a the lighter weight PAH (non-cancer) fraction is more present in the subsurface as compared to the surface – consequently the carcinogenic PAHs make up less of the total PAH concentration at depth. To be conservative, the off-site background percentage will be considered.

The following table provides a summary B(a)P equivalent ranges for the various off-site soil background combinations that can be considered as part of the PRG development:

	Estimated Mean Background Total PAH Concentration (mg/kg)	Range of B(a)P Equivalent Concentration Contribution(%)	Average B(a)P Equivalent Concentration Contribution (%)	Estimated Mean Background B(a)P Equivalent Concentration (mg/kg)
Pristine Background Data Set	4	10-17	15	0.6
Nearby Off-Site Background Data Set	11-56	10-17	15	1.6-8.4
Blended Pristine/Nearby Off-Site Background Data Set	8-41	10-17	15	1.2-6.15
Fairmont Coke/Sharon Steel	n/a	n/a	n/a	4.6

Consequently, there are various values that could be selected for consideration as background for the on-site soils ranging from 0.6 to 8.4 mg/kg B(a)P equivalent concentrations. However, to be consistent for the other removal action on-going at the adjacent site, and given the potential for similar future land use applications at the adjacent sites, the 4.6 mg/kg B(a)P equivalent is probably the most appropriate PRG for the Big John Salvage site as well, and falls within the expected range of background values that could be applied at this site.

Note that the 4.6 mg/kg B(a)P equivalent concentration in surface soils would be approximately equal to a total PAH concentration of 31 mg/kg using the relative proportions of each PAH.

Appendix B – Attachment 3 – LINES OF EVIDENCE DISCUSSION SUPPORTING THE SELECTION OF THE TOTAL PAH SEDIMENT PRG (26 mg/kg)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

July 2, 2009

SUBJECT: Lines of Evidence for Sediment PAH PRG Derivation; Big John Salvage - Hoult Road Site, Fairmont, West Virginia

FROM: Bruce R. Pluta, Coordinator
Biological Technical Assistance Group

TO: Eric Newman (3HS23)
DE, VA, WV Remedial Branch

In response to your request, representatives of the BTAG have prepared the following discussion describing the lines of evidence used to derive the PRG for PAHs in sediment

The risk assessment objective is to use multiple lines of evidence to evaluate risk to ecological receptors and, if unacceptable risk is present, to derive a site-specific PRG. The lines of evidence for the sediments include sediment concentrations, laboratory toxicity testing, a benthic macroinvertebrate survey, mussel tissue concentrations, and fish tissue histopathology. These lines of evidence were used to derive the PAH PRG for sediments.

The results of the bioassay with *H. azteca* confirm that toxicity is the most severe at the location with the highest concentration of PAHs (SD07). However, other species of benthic macroinvertebrates (BMI) are known to be more sensitive than this test organism. For this reason, benthic macroinvertebrate surveys were also performed in the river. Negative effects were observed on BMI metrics at SD08, SD03, and SD07.

Efforts were made to collect crayfish and mussels in multiple locations in the river. However, crayfish were not found and mussel populations appear to be severely limited, effects that may be attributable in part to the PAH contamination. Even with only two mussel samples, it is clear that the PAHs are bioavailable as the mussels accumulated PAHs. As mussels are filter feeders, this observation documents that PAHs are released into the water column from the sediment deposits. Thus, the asphaltic nature of the deposit does not provide complete containment of the PAH contamination necessary to prevent exposure.

PAHs are not bioaccumulative in fish tissue. Fish tissue histopathology served as both an indirect measure of fish exposure to PAHs in the river and evidence of PAH-induced cellular alterations. Results indicated that the fish are exposed and affected by PAHs in the river. As fish are mobile, it is not possible to associate this effect with a particular location. However, research on PAH effects in bullheads indicates that tumors are associated with sediment PAH concentrations exceeding 25 ppm (Pinkney, A.E. and J.C. Harshbarger. 2005. Tumor prevalence in brown bullheads (*Ameiurus nebulosus*) from the South River, Anne Arundel County, Maryland. http://www.fws.gov/chesapeakebay/pdf/CBFO-C0504.pdf).

Using the weight of evidence approach, PRGs are selected within the range of the lowest adverse effect concentration and the highest concentration with no adverse effect across the measurement endpoints. In this case, adverse effects were observed at 7.24 ppm, but no effects were observed as high as 13.87. The lowest adverse effect level above all no effect concentrations was 25.68. Considering all of the evidence cumulatively, 26 ppm total PAHs was selected as PRG for sediments.

Thank you for the opportunity to provide continuing support on this project. Please contact Kathy Patnode at 304-234-0238 or me at x-2380 if you have any questions.

APPENDIX C

EE/CA Cost Summary Tables

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

Alternative GW1 - No Action

Item No.	Description	Units	Unit Cost	No. Units	Total Cost
100	**Capital Cost**				
101	Removal of Existing Treatment Works	EA	$10,000.00	1	$10,000
	Construction Cost Subtotal				**$10,000**
	Contingency on construction capital costs	%	25		$2,500
	Design & permitting	%	15		$1,500
	Construction management	%	10		$1,000
Total Construction Cost					**$15,000**
200	**Annual O&M Costs**				
201	Analytical Cost	EA	$0.00	0	$0
202	Labor to collect samples	Event	$0.00	0	$0
203	Data analysis and report preparation	EA	$0.00	0	$0
204	Project management, technical support, etc.	Annual	$0.00	0	$0
205	Routine Maintenance	Annual	$0.00	0	$0
	Total Annual O&M Costs				**$0**
Present Worth Cost of Annual O&M Costs (7% discount rate for 30 years)					$0
Total Present Worth Cost with a Discount Rate of 7% (30 Year Operation)					**$15,000**

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Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

Alternative GW2 - No Further Action

Item No.	Description	Units	Unit Cost	No. Units	Total Cost
100	**Capital Cost**				
101	None	EA	$0.00	0	$0
	Construction Cost Subtotal				**$0**
	Contingency on construction capital costs	%	25		$0
	Design & permitting	%	15		$0
	Construction management	%	10		$0
Total Construction Cost					**$0**
200	**Annual O&M Costs**				
201	Sampling, Analysis, and report preparation	Month	$1,300.00	12	$15,600
202	Project management, technical support, etc.	Month	$2,000.00	12	$24,000
203	Discharge Costs	Annual	$7,000.00	1	$7,000
204	Electric Cost	Annual	$3,000.00	1	$3,000
205	Routine Maintenance (including annual carbon change out)	Annual	$10,000.00	1	$10,000
	Total Annual O&M Costs				**$60,000**
Present Worth Cost of Annual O&M Costs (7% discount rate for 30 years)					$745,000
Total Present Worth Cost with a Discount Rate of 7% (30 Year Operation)					**$745,000**

Alternative GW3 - Monitored Natural Attenuation

Item No.	Description	Units	Unit Cost	No. Units	Total Cost
100	**Capital Cost**				
101	Planning, Project Plans, Development of MNA Scheme	EA	$30,000.00	1	$30,000
101	Monitoring Well Installation (4 new wells)	EA	$30,000.00	1	$30,000
	Construction Cost Subtotal				**$60,000**
	Contingency on construction capital costs	%	25		$15,000
	Design & permitting	%	15		$9,000
	Construction management	%	10		$6,000
Total Construction Cost					**$90,000**
200	**Annual O&M Costs (First 5 Years)**				
201	Analytical Cost (50 wells per event, 2 events per year)	EA	$100,000.00	2	$200,000
202	Labor to collect samples (2 people, 4 wells /day, 240 hours/event at $75/hour)	Event	$18,000.00	2	$36,000
203	Data analysis and report preparation	EA	$15,000.00	2	$30,000
204	Project management, technical support, etc.	Annual	$20,000.00	1	$20,000
205	Supplies/Equipment	Annual	$10,000.00	1	$10,000
	Total Annual O&M Costs				**$296,000**
Present Worth Cost of Annual O&M Costs (7% discount rate for 5 years)					$1,214,000
300	**Annual O&M Costs (Last 25 Years)**				
301	Analytical Cost (50 wells per event, 1 event per year)	EA	$100,000.00	1	$100,000
302	Labor to collect samples (2 people, 4 wells /day, 240 hours/event at $75/hour)	Event	$18,000.00	1	$18,000
303	Data analysis and report preparation	EA	$15,000.00	1	$15,000
304	Project management, technical support, etc.	Annual	$20,000.00	1	$20,000
305	Supplies/Equipment	Annual	$10,000.00	1	$10,000
	Total Annual O&M Costs				**$163,000**
Present Worth Cost of Annual O&M Costs (7% discount rate for 25 years)					$1,900,000
Total Present Worth Cost with a Discount Rate of 7% (30 Year Operation)					**$3,204,000**

Alternative GW4 - Expansion of Existing Groundwater Containment System - Option A - Discharge to POTW

Item No.	Description	Units	Unit Cost	No. Units	Total Cost
100	**Capital Cost**				
	Groundwater Collection Trenches				
101	Mobilization/Trenching Support/New Containment Walls	EA	$100,000.00	1	$100,000
102	Trench Installation - directional drilling medium soil for 6 inch casing, up to 40' deep	LF	$65.00	1,200	$78,000
103	Perforated PVC pipe, 4" diameter includes installation	LF	$40.00	1,200	$48,000
104	Geotextile/drainage fabric (130 mil)	SY	$20.00	140	$2,800
105	Gravel (general purpose)	CY	$50.00	20	$1,000
105	40' x 36" diameter reinforced concrete pipe wet well for lift station	EA	$60,000.00	2	$120,000
106	Submersible well pump, with pressure control, 4-10 gpm, 4" discharge	EA	$3,000.00	2	$6,000
107	Product recovery pump, deep depths (>20'), 6gpm, controls	EA	$10,000.00	2	$20,000
108	Detection systems, water level sensor, float switch, incl. 50' cable, excl. wires & conduit	EA	$5,000.00	2	$10,000
109	Electrical power and controls	LS	$50,000.00	1	$50,000
110	Monitoring Well Installation	LS	$50,000.00	1	$50,000
	Trenching/piping to the GW treatment Plant				
110	Excavating. Trench, medium soil, 1' to 2' deep, excluding sheeting or dewatering	LF	$20.00	400	$8,000
111	Backfill with excavated material	CY	$15.00	60	$900
112	2" PVC double-wall piping	LF	$95.00	400	$38,000
	Groundwater Treatment Plant				
113	Demolition of existing units, preparation	LS	$10,000.00	1	$10,000
114	Upgrade of building unit, oil water separator, carbon unit, controls	LS	$200,000.00	1	$200,000
	Capital Cost Subtotal				**$742,700**
	Contingency On Construction Capital Costs	%	25		$185,675
	Remedial Design & Permitting	%	15		$111,405
	Construction Management	%	10		$74,270
Total Capital Cost					**$1,114,000**
200	**Annual O&M Costs (first 5 years)**				
201	Analytical Cost (50 wells per event, 2 events per year)	EA	$100,000.00	2	$200,000
202	Labor to collect samples (2 people, 4 wells /day, 240 hours/event at $75/hour)	Event	$18,000.00	2	$36,000
203	Data analysis and report preparation	EA	$10,000.00	2	$20,000
204	Project management, technical support, etc.	Annual	$30,000.00	1	$30,000
206	Routine Maintenance	Annual	$60,000.00	1	$60,000
	Total Annual O&M Costs				**$346,000**
Present Worth Cost of Annual O&M Costs (7% discount rate for 5 years)					$1,419,000

Alternative GW4 - Expansion of Existing Groundwater Containment System - Option A - Discharge to POTW

Item No.	Description	Units	Unit Cost	No. Units	Total Cost
200	**Annual O&M Costs (for remaining 25 years)**				
201	Analytical Cost (50 wells per event, 1 event per year)	EA	$100,000.00	1	$100,000
202	Labor to collect samples (2 people, 4 wells /day, 240 hours/event at $75/hour)	Event	$18,000.00	1	$18,000
203	Data analysis and report preparation	EA	$10,000.00	1	$10,000
204	Project management, technical support, etc.	Annual	$30,000.00	1	$30,000
206	Routine Maintenance	Annual	$60,000.00	1	$60,000
	Total Annual O&M Costs				**$218,000**
Present Worth Cost of Annual O&M Costs (7% discount rate for 25 years)					$2,540,000
Total Present Worth Cost with a Discount Rate of 7% (30 Year Operation)					**$5,073,000**

Alternative GW4 - Expansion of Existing Groundwater Containment System - Option B - On-Site Discharge

Item No.	Description	Units	Unit Cost	No. Units	Total Cost
100	**Capital Cost**				
	Groundwater Collection Trenches				
101	Mobilization/Trenching Support/New Containment Walls	EA	$100,000.00	1	$100,000
102	Trench Installation - directional drilling medium soil for 6 inch casing, up to 40' deep	LF	$65.00	1,200	$78,000
103	Perforated PVC pipe, 4" diameter includes installation	LF	$40.00	1,200	$48,000
104	Geotextile/drainage fabric (130 mil)	SY	$20.00	140	$2,800
105	Gravel (general purpose)	CY	$50.00	20	$1,000
105	40' x 36" diameter reinforced concrete pipe wet well for lift station	EA	$60,000.00	2	$120,000
106	Submergible well pump, with pressure control, 4-10 gpm, 4" discharge	EA	$3,000.00	2	$6,000
107	Product recovery pump, deep depths (>20'), 6gpm, controls	EA	$10,000.00	2	$20,000
108	Detection systems, water level sensor, float switch, incl. 50' cable, excl. wires & conduit	EA	$5,000.00	2	$10,000
109	Electrical power and controls	LS	$50,000.00	1	$50,000
110	Monitoring Well Installation	LS	$50,000.00	1	$50,000
	Trenching/piping to the GW treatment Plant				
110	Excavating. Trench, medium soil, 1' to 2' deep, excluding sheeting or dewatering	LF	$20.00	400	$8,000
111	Backfill with excavated material	CY	$15.00	60	$900
112	2" PVC double-wall piping	LF	$95.00	400	$38,000
	Groundwater Treatment Plant				
113	Demolition of existing units, preparation	LS	$10,000.00	1	$10,000
114	Construction of new 10-gpm treatment plant for on-site discharge	LS	$800,000.00	1	$800,000
	Capital Cost Subtotal				**$1,342,700**
	Contingency On Construction Capital Costs	%	25		$335,675
	Remedial Design & Permitting	%	15		$201,405
	Construction Management	%	10		$134,270
Total Capital Cost					**$2,014,000**
200	**Annual O&M Costs (first 5 years)**				
201	Groundwater Analytical Cost (50 wells per event, 2 events per year)	EA	$100,000.00	2	$200,000
202	Labor to collect samples (2 people, 4 wells /day, 240 hours/event at $75/hour)	Event	$18,000.00	2	$36,000
203	Data analysis and report preparation	EA	$10,000.00	2	$20,000
204	Project management, technical support, etc.	Annual	$30,000.00	1	$30,000
206	Routine Maintenance (includes daily staffing of treatment plant, carbon and sludge disposal, electricity, effluent monitoring, etc.)	Annual	$350,000.00	1	$350,000
	Total Annual O&M Costs				**$636,000**
Present Worth Cost of Annual O&M Costs (7% discount rate for 5 years)					$2,608,000

Item No.	Description	Units	Unit Cost	No. Units	Total Cost
200	**Annual O&M Costs (second 25 years)**				
201	Groundwater Analytical Cost (50 wells per event, 1 event per year)	EA	$100,000.00	1	$100,000
202	Labor to collect samples (2 people, 4 wells /day, 240 hours/event at $75/hour)	Event	$18,000.00	1	$18,000
203	Data analysis and report preparation	EA	$10,000.00	1	$10,000
204	Project management, technical support, etc.	Annual	$30,000.00	1	$30,000
206	Routine Maintenance (includes daily staffing of treatment plant, carbon and sludge disposal, electricity, effluent monitoring, etc.)	Annual	$350,000.00	1	$350,000
	Total Annual O&M Costs				**$508,000**
Present Worth Cost of Annual O&M Costs (7% discount rate for 25 years)					$5,920,000
Total Present Worth Cost with a Discount Rate of 7% (30 Year Operation)					**$10,542,000**

Alternative GW5 - In-Situ Chemical Oxidation

Item No.	Description	Units	Unit Cost	No. Units	Total Cost
100	**Capital Cost**				
	In-Situ Oxidation System				
101	Construction equipment mobilization demobilization (drill rigs and injection equipment)	LS	$50,000	1	$50,000
102	Submittals (HASP, QAPP, etc.)	LS	$15,000	1	$15,000
103	Temporary facilities, trailers, signs, etc.	LS	$20,000	1	$20,000
104	PPE/Monitoring	LS	$15,000	1	$15,000
105	Construction of injection points, including decontamination, disposal of drill cuttings, analyzers, and grout.	EA	$1,500	500	$750,000
106	Oxidant procurement and transportation	LB	$1.80	4,000,000	$7,200,000
107	Chemical mixing system; two 10,000 gallon tanks on slab, piping	LS	$60,000	1	$60,000
108	Oxidant injection pump	LS	$15,000	2	$30,000
109	Permit for chemical injection	LS	$10,000	1	$10,000
110	Water Supply for mixing up oxidant prior to injection	1000 gal	$6	13,000	$74,750
111	Personnel for installation of injection points and injection events (assume 2 personnel periodically for a period of up to two years for all injection events)	EA	$75.00	10,000	$750,000
112	Bench-scale Test	EA	$20,000.00	3	$60,000
113	Pilot-scale Test	EA	$100,000.00	1	$100,000
114	Performance Testing	EA	$100,000.00	1	$100,000
115	Monitoring Well Installation	EA	$30,000.00	1	$30,000
	Capital Cost Subtotal				**$9,264,750**
	Contingency On Construction Capital Costs	%	25		$2,316,188
	Remedial Design & Permitting	%	15		$1,389,713
	Construction Management	%	10		$926,475
Total Capital Cost					**$13,897,000**
200	**Annual O&M Costs (First 5 Years)**				
201	Analytical Cost (50 wells per event, 2 events per year)	EA	$100,000.00	2	$200,000
202	Labor to collect samples (2 people, 4 wells /day, 240 hours/event at $75/hour)	Event	$18,000.00	2	$36,000
203	Data analysis and report preparation	EA	$15,000.00	2	$30,000
204	Project management, technical support, etc.	Annual	$20,000.00	1	$20,000
205	Supplies/Equipment	Annual	$10,000.00	1	$10,000
206	Existing Groundwater Collection & Treatment O&M Costs	Annual	$60,000.00	1	$60,000
	Total Annual O&M Costs				**$356,000**
Present Worth Cost of Annual O&M Costs (7% discount rate for 5 years)					$1,460,000
300	**Annual O&M Costs (Last 25 Years)**				
301	Analytical Cost (50 wells per event, 1 event per year)	EA	$100,000.00	1	$100,000
302	Labor to collect samples (2 people, 4 wells /day, 240 hours/event at $75/hour)	Event	$18,000.00	1	$18,000
303	Data analysis and report preparation	EA	$15,000.00	1	$15,000
304	Project management, technical support, etc.	Annual	$20,000.00	1	$20,000
305	Supplies/Equipment	Annual	$10,000.00	1	$10,000
	Total Annual O&M Costs				**$163,000**
Present Worth Cost of Annual O&M Costs (7% discount rate for 25 years)					$1,900,000
Total Present Worth Cost with a Discount Rate of 7% (30 Year Operation)					**$17,257,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

Alternative GW6 - In-Situ Bioremediation

Item No.	Description	Units	Unit Cost	No. Units	Total Cost
100	**Capital Cost**				
	In-Situ Bioremediation System				
101	Water storage tanks, ground level, 5,000 gallons	EA	$7,500	1	$7,500
102	Direct push rig, truck mounted, non-hydraulic, including labor, sampling, and decontamination	Day	$1,500	12	$18,000
103	Mobilize/demobilize direct push rig and crew	Day	$800	2	$1,600
104	L-103 light petroleum biocultures, per pail	LB	$40	10,000	$400,000
105	Bionutrients, 50 lb bag	EA	$100	50	$5,000
106	Hydrogen peroxide, 50% solution, 500 lb drums	EA	$1,500	10	$15,000
109	Construction of injection points	EA	$1,500.00	100	$150,000
107	Bench-scale Test	EA	$20,000	2	$40,000
108	Pilot-scale Test	EA	$100,000.00	1	$100,000
	In-Situ Bioremediation System Subtotal				**$737,100**
	Groundwater Collection Trenches				
101	Mobilization/Trenching Support/New Containment Walls	EA	$100,000.00	1	$100,000
102	Trench Installation - directional drilling medium soil for 6 inch casing, up to 40' deep	LF	$65.00	1,200	$78,000
103	Perforated PVC pipe, 4" diameter includes installation	LF	$40.00	1,200	$48,000
104	Geotextile/drainage fabric (130 mil)	SY	$20.00	140	$2,800
105	Gravel (general purpose)	CY	$50.00	20	$1,000
105	40' x 36" diameter reinforced concrete pipe wet well for lift station	EA	$60,000.00	2	$120,000
106	Submergible well pump, with pressure control, 4-10 gpm, 4" discharge	EA	$3,000.00	2	$6,000
107	Product recovery pump, deep depths (>20'), 6gpm, controls	EA	$10,000.00	2	$20,000
108	Detection systems, water level sensor, float switch, incl. 50' cable, excl. wires & conduit	EA	$5,000.00	2	$10,000
109	Electrical power and controls	LS	$50,000.00	1	$50,000
111	Monitoring Well Installation	EA	$50,000.00	1	$50,000
	Containment Cost Subtotal				**$435,800**
	Capital Cost Subtotal				**$1,172,900**
	Contingency on construction capital costs	%	25		$293,225
	Design & permitting	%	15		$175,935
	Construction management	%	10		$117,290
Total Capital Cost					**$1,760,000**
200	**Annual O&M Cost - First 5 years**				
201	Analytical Cost (50 wells per event, 2 events per year)	EA	$100,000.00	2	$200,000
202	Labor to collect samples (2 people, 4 wells /day, 240 hours/event at $75/hour)	Event	$18,000.00	2	$36,000
203	Data analysis and report preparation	EA	$15,000.00	2	$30,000
204	Project management, technical support, etc.	Annual	$30,000.00	1	$30,000
205	Injection and Extraction System Operation	Annual	$250,000.00	1	$250,000
Total Annual O&M Cost - first 5 years					**$546,000**
Present Worth Cost of Annual O&M Costs (7% discount rate for 5 years)					$2,239,000

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Alternative GW6 - In-Situ Bioremediation

Item No.	Description	Units	Unit Cost	No. Units	Total Cost
300	**Annual O&M Cost - Second 25 years**				
301	Analytical Cost (50 wells per event, 1 event per year)	EA	$100,000.00	1	$100,000
302	Labor to collect samples (2 people, 4 wells /day, 240 hours/event at $75/hour)	Event	$18,000.00	1	$18,000
303	Data analysis and report preparation	EA	$15,000.00	1	$15,000
304	Project management, technical support, etc.	Annual	$30,000.00	1	$30,000
Total Annual O&M Cost - Second 25 years					**$163,000**
Present Worth Cost of Annual O&M Costs (7% discount rate for 25 years)					$1,900,000
Total Present Worth Cost with a Discount Rate of 7% (30 Year Operation)					**$5,899,000**

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Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

Soil Alternative SO1 - No Action					
	Description	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Capital Costs					
	No implementation				$0
Capital Cost Subtotal					**$0**
	Contingency	%	25		$0
	Remedial design, project & construction management	%	15		$0
Total Capital Cost					**$0**
Annual O&M Cost					
	No O&M Costs				$0
					$0
					$0
					$0
Total Annual O&M Cost					**$0**
Present Worth of Annual O&M Costs (7% discount rate for 30 years)					$0
Total Present Worth of Alternative					**$0**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

Soil Alternative SO2 - No Further Action				
Description	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Capital Costs				
No implementation				$0
Capital Cost Subtotal				**$0**
Contingency	%	25		$0
Remedial design, project & construction management	%	15		$0
Total Capital Cost				**$0**
Annual O&M Cost				
Fence maintenance (semi-annual)	1	LS	$5,000	$5,000
Visual inspections (semi-annual)	2	EA	$5,000	$10,000
Site Maintenance (Erosion and sediment control, etc.)	1	LS	$20,000	$20,000
Administrative/Management	1	LS	$25,000	$25,000
Total Annual O&M Cost				**$60,000**
Present Worth of Annual O&M Costs (7% discount rate for 30 years)				$745,000
Total Present Worth of Alternative				**$745,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

Soil Alternative SO3 - Excavation and On-Site Thermal Treatment					
	Description	**Quantity**	**Unit**	**Unit Cost**	**Cost**
100					
101	Mobilization/Demobilization	1	LS	$50,000	$50,000
102	Temporary facilities, trailers, signs, ...	1	LS	$20,000	$20,000
103	Project Plans	1	LS	$25,000	$25,000
104	Submittals (Work Plan, HASP, QAPP, ...)	1	LS	$10,000	$10,000
105	Clearing	15	acre	$2,000	$30,000
106	Soil Excavation (4 CY hydraulic excavator)	312,000	CY	$10	$3,120,000
107	Mob/demob on-site thermal desorption units	2	LS	$570,000	$1,140,000
108	Thermal desorption of soil	505,000	ton	$110	$55,550,000
109	Air samples (stack testing prior to soil treatment, and confirmatory during treatment, analyzed for TPH and VOCs)	75	EA	$424	$31,800
110	Air samples (perimeter monitoring analyzed for TPH and VOCs)	96	EA	$424	$40,704
111	New Power line for thermal desorption units (3 phase, run 1000 feet from the main)	1	LS	$25,000	$25,000
112	Soil Samples (confirmation (attainment) and performance testing samples)	1,000	EA	$300	$300,000
113	Erosion Control at site during excavation, grading	1	LS	$250,000	$250,000
114	Backfilling of treated soil (spread and compacted in 6" layers, sprayed with water, with density testing)	312,000	CY	$4	$1,248,000
115	6" layer of topsoil for vegetation support (6 inch thick layer in 18 acres)	12,100	CY	$25	$302,500
116	Vegetative Cover (Seeding/Mulch)	15	Acre	$2,200	$33,000
	Construction Cost Subtotal (Rounded Up)				**$62,177,000**
	Contingency on Construction Capital Costs		%	25	$15,544,250
	Remedial Design & Permitting		%	15	$9,326,550
	Construction Management		%	11	$6,839,470
Total Construction Cost (Rounded Up)					**$93,888,000**
Annual O&M Cost					
	Fence maintenance (semi-annual)	1	LS	$5,000	$5,000
	Visual inspections (semi-annual)	2	EA	$5,000	$10,000
	Site Maintenance (Erosion control, etc.)	1	LS	$20,000	$20,000
	Administrative/Management	1	LS	$25,000	$25,000
	Annual O&M Cost				**$60,000**
Present Worth of Annual O&M Costs (7% discount rate for 30 years)					**$745,000**
Total Present Worth of Alternative (Rounded up)					**$94,633,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

Soil Alternative SO4 - Excavation and Off-Site Disposal

	Description	Quantity	Unit	Unit Cost	Cost
100					
101	Mobilization/Demobilization	1	LS	$50,000	$50,000
102	Temporary facilities, trailers, signs, etc.	1	LS	$20,000	$20,000
103	Project Plans	1	LS	$25,000	$25,000
104	Submittals (Work Plan, HASP, QAPP, etc.)	1	LS	$10,000	$10,000
105	Clearing	15	acre	$2,000	$30,000
106	Soil Excavation	312,000	CY	$10	$3,120,000
107	Soil incineration for fuel value (includes shipping soil to Clarion, PA for use -assume 3 years worth of material)	71,100	TON	$70	$4,977,000
108	Soil reuse as landfill cap material (excavated by 2 CY front end loader, includes trucking soil to landfill, assume landfill is within 30 miles, $58/CY for tipping fee)	268,000	CY	$82	$22,091,240
109	Soil Samples (confirmation (attainment) and performance testing samples)	1,500	EA	$300	$450,000
110	Erosion Control at site during excavation, grading	1	LS	$250,000	$250,000
111	Soil for backfilling some of the excavated area, brought on from off-site, spread in 6" lifts, graded and compacted	50000	CY	$25	$1,250,000
112	6" layer of topsoil for vegetation support (6 inch thick layer in 15 acres)	12100	CY	$25	$302,500
113	Vegetative Cover (Seeding/Mulch)	15	Acre	$2,200	$33,000
					$0
	Construction Cost Subtotal (Rounded Up)				**$32,609,000**
	Contingency on Construction Capital Costs		%	25	$8,152,250
	Remedial Design & Permitting		%	15	$4,891,350
	Construction Management		%	11	$3,586,990
Total Construction Cost (Rounded Up)					**$49,240,000**
Annual O&M Cost					
	Fence maintenance (semi-annual)	1	LS	$5,000	$5,000
	Visual inspections (semi-annual)	2	EA	$5,000	$10,000
	Site Maintenance (Erosion and sediment control, e	1	LS	$20,000	$20,000
	Administrative/Management	1	LS	$25,000	$25,000
	Annual O&M Cost				**$60,000**
Present Worth of Annual O&M Costs (7% discount rate for 30 years)					**$745,000**
Total Present Worth of Alternative					**$49,985,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

Alternative SO5 - Capping/Containment - Option A - Regular Subtitle D Cap					
	Description	**Quantity**	**Unit**	**Unit Cost**	**Cost**
100	**Site Preparation**				
101	Mobilization/Demobilization	1	LS	$100,000	$100,000
102	Temporary facilities, trailers, signs, ...	1	LS	$20,000	$20,000
103	Sediment and Erosion Controls	1	LS	$55,000	$55,000
104	Project Plans	1	LS	$25,000	$25,000
105	Clearing	18	Acre	$4,000	$72,000
106	General Site Regrading	100,000	CY	$6	$600,000
107	Segregation of surface wastes/off-site disposal	1,500	CY	$82	$123,000
200	**Landfill Cap**				
201	Vegetative Cover (Seeding/Mulch)	18	Acre	$2,200	$39,600
202	6" Topsoil (Erosion control layer, delivered and compacted)	18	Acre	$19,000	$342,000
203	18" Cover Soil Layer (18" over 18 acres, delivered and compacted')	43,560	CY	$25	$1,088,999
204	40 mil LDPE Geomembrane, installed	87,000	SY	$5.00	$435,000
205	Geocomposite Drainage Layer	87,000	SY	$6.75	$587,250
300	**Other Costs**				
301	H&S and PPE	1	LS	$25,000	$25,000
302	Landscapping (Trees, shrubs on east perimeter)	1	LS	$75,000	$75,000
303	Balance of Work (Stormwater Management features, retaining walls, etc.)	1	LS	$500,000	$500,000
400	**Institutional Controls**	1	LS	$25,000	$25,000
	Construction Cost Subtotal (Rounded Up)				**$4,113,000**
	Contingency on Construction Capital Costs		%	25	$1,028,250
	Remedial Design & Permitting		%	15	$616,950
	Construction Management		%	11	$452,430
Total Construction Cost (Rounded Up)					**$6,211,000**
500	**Annual O&M Cost (30 Years)**				
501	Fence maintenance	1	LS	$5,000	$5,000
502	Visual Inspections (Quarterly)	4	LS	$5,000	$20,000
503	Site Maintenance (Pavement repair, etc.)	1	LS	$25,000	$25,000
504	Administrative/Management	1	LS	$25,000	$25,000
	Total Annual O&M Cost				**$75,000**
Present Worth of Annual O&M Costs (7% discount rate for 30 years, rounded up)					**$931,000**
Total Present Worth of Alternative					**$7,142,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

Alternative SO5 - Capping/Containment - Option B - Expanded Subtitle D Cap					
	Description	**Quantity**	**Unit**	**Unit Cost**	**Cost**
100	**Site Preparation**				
101	Mobilization/Demobilization	1	LS	$100,000	$100,000
102	Temporary facilities, trailers, signs, ...	1	LS	$20,000	$20,000
103	Sediment and Erosion Controls	1	LS	$55,000	$55,000
104	Project Plans	1	LS	$25,000	$25,000
105	Clearing	18	Acre	$4,000	$72,000
106	General Site Regrading	100,000	CY	$6	$600,000
107	Segregation of surface wastes/off-site disposal	1,500	CY	$82	$123,000
200	**Landfill Cap**				
201	Vegetative Cover (Seeding/Mulch)	18	Acre	$2,200	$39,600
202	6" Topsoil (Erosion control layer, delivered and compacted)	18	Acre	$19,000	$342,000
203	18" Cover Soil Layer (18" over 18 acres, delivered and compacted')	43,560	CY	$25	$1,088,999
204	12" Additional Soil Cover, delivered and compacted	29,040	CY	$25	$725,999
205	40 mil LDPE Geomembrane, installed	87,000	SY	$5.00	$435,000
206	Geocomposite Drainage Layer	87,000	SY	$6.75	$587,250
300	**Other Costs**				
301	H&S and PPE	1	LS	$25,000	$25,000
302	Landscapping (Trees, shrubs on east perimeter)	1	LS	$75,000	$75,000
303	Balance of Work (Stormwater Management features, retaining walls, etc.)	1	LS	$500,000	$500,000
400	**Institutional Controls**	1	LS	$25,000	$25,000
	Construction Cost Subtotal (Rounded Up)				**$4,839,000**
	Contingency on Construction Capital Costs		%	25	$1,209,750
	Remedial Design & Permitting		%	15	$725,850
	Construction Management		%	11	$532,290
Total Construction Cost (Rounded Up)					**$7,307,000**
500	**Annual O&M Cost (30 Years)**				
501	Fence maintenance	1	LS	$5,000	$5,000
502	Visual Inspections (Quarterly)	4	LS	$5,000	$20,000
503	Site Maintenance (Pavement repair, etc.)	1	LS	$25,000	$25,000
504	Administrative/Management	1	LS	$25,000	$25,000
	Total Annual O&M Cost				**$75,000**
Present Worth of Annual O&M Costs (7% discount rate for 30 years, rounded up)					**$931,000**
Total Present Worth of Alternative					**$8,238,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

Alternative SO5 - Capping/Containment - Option C - Subtitle D Cap with Asphalt					
	Description	**Quantity**	**Unit**	**Unit Cost**	**Cost**
100	**Site Preparation**				
101	Mobilization/Demobilization	1	LS	$100,000	$100,000
102	Temporary facilities, trailers, signs, ...	1	LS	$20,000	$20,000
103	Sediment and Erosion Controls	1	LS	$55,000	$55,000
104	Project Plans	1	LS	$25,000	$25,000
105	Clearing	18	Acre	$4,000	$72,000
106	General Site Regrading	100,000	CY	$6	$600,000
107	Segregation of surface wastes/off-site disposal	1,500	CY	$82	$123,000
200	**Landfill Cap**				
201	40 mil LDPE Geomembrane, installed	87,000	SY	$5.00	$435,000
202	Geocomposite Drainage Layer	87,000	SY	$6.75	$587,250
203	Gravel pad for asphalt (crushed 3/4" stone, compacted, 8 inches thick, delivered 10 miles)	87,000	SY	$15	$1,305,000
204	Asphalt Cap (3 inches thick, compacted, delivered 10 miles)	87,000	SY	$11	$953,520
300	**Other Costs**				
301	H&S and PPE	1	LS	$25,000	$25,000
302	Landscapping (Trees, shrubs on east perimeter)	1	LS	$75,000	$75,000
303	Balance of Work (Stormwater Management features, retaining walls, etc.)	1	LS	$500,000	$500,000
400	**Institutional Controls**	1	LS	$25,000	$25,000
	Construction Cost Subtotal (Rounded Up)				**$4,901,000**
	Contingency on Construction Capital Costs		%	25	$1,225,250
	Remedial Design & Permitting		%	15	$735,150
	Construction Management		%	11	$539,110
Total Construction Cost (Rounded Up)					**$7,401,000**
500	**Annual O&M Cost (30 Years)**				
501	Fence maintenance	1	LS	$5,000	$5,000
502	Visual Inspections (Quarterly)	4	LS	$5,000	$20,000
503	Site Maintenance (Pavement repair, etc.)	1	LS	$25,000	$25,000
504	Administrative/Management	1	LS	$25,000	$25,000
	Total Annual O&M Cost				**$75,000**
Present Worth of Annual O&M Costs (7% discount rate for 30 years, rounded up)					**$931,000**
Total Present Worth of Alternative					**$8,332,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

Alternative SO6 - Chemical Oxidation

Item No.	Description	Units	Unit Cost	No. Units	Total Cost
100	**Capital Cost**				
	In-Situ Oxidation System				
101	Construction equipment mobilization demobilization (drill rigs and injection equipment)	LS	$50,000	1	$50,000
102	Submittals (HASP, QAPP, etc.)	LS	$15,000	1	$15,000
103	Temporary facilities, trailers, signs, etc.	LS	$20,000	1	$20,000
104	PPE/Monitoring	LS	$15,000	1	$15,000
105	Construction of injection points, including decontamination, disposal of drill cuttings, analyzers, and grout.	EA	$1,500	500	$750,000
106	Oxidant procurement and transportation	LB	$1.80	4,000,000	$7,200,000
107	Chemical mixing system; two 10,000 gallon tanks on slab, piping	LS	$60,000	1	$60,000
108	Oxidant injection pump	LS	$15,000	2	$30,000
109	Permit for chemical injection	LS	$10,000	1	$10,000
110	Water Supply for mixing up oxidant prior to injection	1000 gal	$6	13,000	$74,750
111	Personnel for installation of injection points and injection events (assume 2 personnel periodically for a period of up to two years for all injection events)	EA	$75.00	10,000	$750,000
112	Bench-scale Test	EA	$20,000.00	3	$60,000
113	Pilot-scale Test	EA	$100,000.00	1	$100,000
114	Performance Testing	EA	$100,000.00	1	$100,000
115	Monitoring Well Installation	EA	$30,000.00	1	$30,0[illegible]
	Capital Cost Subtotal				**$9,264,7[illegible]**
	Contingency On Construction Capital Costs	%	25		$2,316,188
	Remedial Design & Permitting	%	15		$1,389,713
	Construction Management	%	10		$926,475
Total Capital Cost					**$13,897,000**
200	**Annual O&M Costs**				
601	Fence maintenance	1	LS	$5,000	$5,000
602	Visual Inspections (Quarterly)	4	LS	$5,000	$20,000
603	Site Maintenance (Erosion control, etc.)	1	LS	$20,000	$20,000
604	Reporting/Administrative/Management	1	LS	$25,000	$25,000
	Total Annual O&M Costs				**$70,000**
Present Worth Cost of Annual O&M Costs (7% discount rate for 30 years)					$869,000
Total Present Worth Cost with a Discount Rate of 7% (30 Year Operation)					**$14,766,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

Alternative SO7 - Soil Stabilization/Solidification					
	Description	**Quantity**	**Unit**	**Unit Cost**	**Cost**
100	**Site Preparation and Oxidant Procurement**				
101	Temporary facilities, trailers, signs, ...	1	LS	$15,000	$15,000
102	Project Plans and Permits	1	LS	$20,000	$20,000
200	**On-Site Soil Stabilization**				
201	Stabilization equipment mobilization	1	LS	$5,000	$5,000
202	Cement for chemical fixation and stabilization	99,700	Ton	$83	$8,275,100
203	Stabilization equipment operation (including labor, equipment rental)	18	Month	$260,000	$4,680,000
204	Diesel fuel (for the operation of the mixing equipment)	538,000	Gal	$5	$2,690,000
205	Pre-Mixing Data Analysis and Final Mixing Design	1	LS	$50,000	$50,000
	Construction Cost Subtotal (Rounded Up)				**$15,736,000**
	Contingency on Construction Capital Costs		%	25	$3,934,000
	Remedial Design & Permitting		%	10	$1,573,600
	Construction Management		%	11	$1,730,960
Total Construction Cost (Rounded Up)					**$22,975,000**
600	**Annual O&M Cost (30 Years)**				
601	Fence maintenance	1	LS	$5,000	$5,000
602	Visual Inspections (Quarterly)	4	LS	$5,000	$20,000
603	Site Maintenance (Erosion control, etc.)	1	LS	$18,000	$18,000
604	Reporting/Administrative/Management	1	LS	$10,000	$10,000
605	Soil samples (including labor)	8	EA	$900	$7,200
	Total Annual O&M Cost (Rounded)				**$60,000**
Present Worth of Annual O&M Costs (7% discount rate for 30 years, rounded up)					**$745,000**
Total Present Worth of Alternative					**$23,720,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

On-Site Sediment Alternative 1 - No Action				
Description	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Capital Costs				
No implementation				$0
Capital Cost Subtotal				**$0**
Contingency	%	25		$0
Remedial design, project & construction management	%	15		$0
Total Capital Cost				**$0**
Annual O&M Cost				
No implementation				$0
Total Annual O&M Cost				**$0**
Present Worth of Annual O&M Costs (7% discount rate for 30 years)				$0
Total Present Worth of Alternative				**$0**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

On-Site Sediment Alternative 2 - Excavation and off-site disposal/treatment

	Description	Quantity	Unit	Unit Cost	Cost
Capital Costs					
100	**Sediment Excavation and Disposal**				
101	Site Isolation/Restoration	1	LS	$75,000	$75,000
102	Additional soil sampling for delineation of contamination	30	EA	$300	$9,000
103	Soil sampling (crew of 2, 4 days)	80	HR	$75	$6,000
104	Mobilize/demobile contractor	1	LS	$10,000	$10,000
105	Sediment excavation	3,280	CY	$10	$32,800
106	Sediment Dewatering, including temporary drying facility, water teatment (minimal expected)	3,280	CY	$10	$32,800
107	Soil reuse as landfill cap material (excavated by 2 CY front end loader, includes trucking soil to landfill, assume landfill is within 30 miles, $58/CY for tipping fee)	3,280	CY	$82	$270,370
108	Soil Samples (1 confirmatory samples per 100 CY excavated)	70	EA	$300	$21,000
Capital Cost Subtotal					**$456,970**
	Contingency	%	25		$114,243
	Remedial design, project & construction management	%	15		$68,546
Total Capital Cost					**$640,000**
Annual O&M Cost					
	Annual Stream Restoration Monitoring				$40,000
Total Annual O&M Cost					**$40,000**
Present Worth of Annual O&M Costs (7% discount rate for 5 years)					$165,000
Total Present Worth of Alternative					**$805,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

On-Site Sediment Alternative 3 - Excavation and On-Site Confinement					
	Description	Quantity	Unit	Unit Cost	Cost
Capital Costs					
100	**Sediment Excavation and Disposal**				
101	Site Isolation/ Restoration	1	LS	$75,000	$75,000
102	Additional soil sampling for delineation of contamination	30	EA	$300	$9,000
103	Soil sampling (crew of 2, 4 days)	80	HR	$75	$6,000
104	Mobilize/demobile contractor	1	LS	$10,000	$10,000
105	Sediment excavation	3,280	CY	$10	$32,800
106	Sediment Dewatering, including temporary drying facility, water teatment (minimal expected)	3,280	CY	$10	$32,800
107	Sediment hauling to disposal location (includes loading into truck,haul less than 1 mile on site)	3,280	CY	$15	$49,200
108	Site regrading of excavated sediment into low-lying areas prior to capping/solidification	3,280	CY	$6	$19,680
109	Soil Samples (1 confirmatory samples per 100 CY excavated)	70	EA	$300	$21,000
Capital Cost Subtotal					**$255,480**
	Contingency	%	25		$63,870
	Remedial design, project & construction management	%	15		$38,322
Total Capital Cost					**$358,000**
Annual O&M Cost					
	Annual Stream Restoration Monitoring				$40,000
Total Annual O&M Cost					**$40,000**
Present Worth of Annual O&M Costs (7% discount rate for 5 years)					$165,000
Total Present Worth of Alternative					**$523,000**

On-Site Sediment Alternative 4 - Monitored Natural Recovery					
	Description	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Capital Costs					
100	**No Implementation**				**$0**
Capital Cost Subtotal					**$0**
	Contingency	%	$25		$0
	Remedial design, project & construction management	%	$15		$0
Total Capital Cost					**$0**
Annual O&M Cost					
201	Sediment and surface water sampling (one crew of 2, 3 days)	60	HR	$75	$4,500
202	Sediment analysis (5 locations, once per year, TCL/TAL analysis)	5	EA	$2,000	$10,000
203	Surface water analysis (5 locations, once per year, TCL/TAL analysis)	5	EA	$2,000	$10,000
204	Annual vegetation/macroinvertabrae inventory/tox tests/report	1	EA	$50,000	$50,000
205	Sediment removal contractor mob/demob	1	LS	$5,000	$5,000
206	Sediment removal from retention basin, offsite disposal	100	CY	$150	$15,000
Total Annual O&M Cost					**$95,000**
Present Worth of Annual O&M Costs (7% discount rate for 30 years)					$1,179,000
Total Present Worth of Alternative					**$1,179,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

River Sediment Alternative 1 - No Action				
Description	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Capital Costs				
No implementation				$0
Capital Cost Subtotal				**$0**
Contingency	%	25		$0
Remedial design, project & construction management	%	15		$0
Total Capital Cost				**$0**
Annual O&M Cost				
No implementation				$0
Total Annual O&M Cost				**$0**
Present Worth of Annual O&M Costs (7% discount rate for 30 years)				$0
Total Present Worth of Alternative				**$0**

River Sediment Alternative 2 - Excavation and off-site disposal/treatment - Option A (BSD Only)					
				Unit	
	Description	**Quantity**	**Unit**	**Cost**	**Cost**
Capital Costs					
100	**Sediment Excavation and Disposal**				
101	Site Isolation/ Dewatering (installation of floating sediment curtain around site, and repairing as needed, installed once on each half of the river)	1	EA	$300,000	$300,000
102	Additional sediment sampling for delineation of contamination	1	EA	$300,000	$300,000
103	Mobilize/demobile contractors (including initial site prep, construction of on-site facilities, etc.)	1	LS	$500,000	$500,000
104	Sediment dredging and pumping to shore	4,500	CY	$75	$337,500
105	Sediment Dewatering, including temporary drying facility, water treatment jor fixation	4,500	CY	$75	$337,500
106	Soil reuse as landfill cap material (excavated by 2 CY front end loader, includes trucking soil to landfill, assume landfill is within 30 miles, $58/CY for tipping fee)	4,500	CY	$82	$370,935
107	Disposal Characterization Sampling (1 confirmatory samples per 100 CY excavated)	45	EA	$300	$13,500
108	River Sediment Capping Material including Placement	1,000	CY	$70	$70,000
109	Attainment Sampling Study	1	EA	$50,000	$50,000
Capital Cost Subtotal					**$2,279,435**
	Contingency	%	25		$569,859
	Remedial design, project & construction management	%	15		$341,915
Total Capital Cost					**$3,192,000**
Annual O&M Cost					
201	Sediment and surface water sampling (one crew of 2, 3 days + planning& coordination)	1	EA	$30,000	$30,000
202	Sediment analysis (10 locations, once per year, TCL/TAL analysis)	10	EA	$2,000	$20,000
203	Surface water analysis (10 locations, once per year, TCL/TAL analysis)	10	EA	$2,000	$20,000
204	Annual vegetation/macroinvertabrae inventory/tox tests/report	1	EA	$80,000	$80,000
Total Annual O&M Cost					**$150,000**
Present Worth of Annual O&M Costs (7% discount rate for 5 years)					$616,000
Total Present Worth of Alternative					**$3,808,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

River Sediment Alternative 2 - Excavation and off-site disposal/treatment - Option B (BSD/SSD)

	Description	Quantity	Unit	Unit Cost	Cost
Capital Costs					
100	**Sediment Excavation and Disposal**				
101	Site Isolation/ Dewatering (installation of floating sediment curtain around site, and repairing as needed, installed several times to address long reach of river)	3	EA	$300,000	$900,000
102	Additional sediment sampling for delineation of contamination	1	EA	$300,000	$300,000
103	Mobilize/demobile contractors (including initial site prep, construction of on-site facilities, etc.)	1	LS	$500,000	$500,000
104	Sediment dredging and pumping to shore	5,400	CY	$75	$405,000
105	Sediment Dewatering, including temporary drying facility, water treatment	5,400	CY	$75	$405,000
106	Soil reuse as landfill cap material (excavated by 2 CY front end loader, includes trucking soil to landfill, assume landfill is within 30 miles, $58/CY for tipping fee)	5,400	CY	$82	$445,122
107	Disposal Characterization Sampling (1 confirmatory samples per 100 CY excavated)	54	EA	$300	$16,200
108	River Sediment Capping Material including Placement	2,000	CY	$70	$140,000
109	Attainment Sampling Study	1	EA	$60,000	$60,000
Capital Cost Subtotal					**$3,171,322**
	Contingency	%	25		$792,831
	Remedial design, project & construction management	%	15		$475,698
Total Capital Cost					**$4,440,000**
Annual O&M Cost					
201	Sediment and surface water sampling (one crew of 2, 3 days + planning& coordination)	1	EA	$30,000	$30,000
202	Sediment analysis (10 locations, once per year, TCL/TAL analysis)	10	EA	$2,000	$20,000
203	Surface water analysis (10 locations, once per year, TCL/TAL analysis)	10	EA	$2,000	$20,000
204	Annual vegetation/macroinvertabrae inventory/tox tests/report	1	EA	$80,000	$80,000
Total Annual O&M Cost					**$150,000**
Present Worth of Annual O&M Costs (7% discount rate for 5 years)					$616,000
Total Present Worth of Alternative					**$5,056,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

River Sediment Alternative 3 - Excavation and On-Site Confinement - Option A (BSD Only)					
	Description	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Capital Costs					
100	**Sediment Excavation and Disposal**				
101	Site Isolation/ Dewatering (installation of floating sediment curtain around site, and repairing as needed, installed once on each half of the river)	1	EA	$300,000	$300,000
102	Additional sediment sampling for delineation of contamination	1	EA	$300,000	$300,000
103	Mobilize/demobile contractors (including initial site prep, construction of on-site facilities, etc.)	1	LS	$500,000	$500,000
104	Sediment dredging and pumping to shore	4,500	CY	$75	$337,500
105	Sediment Dewatering, including temporary drying facility, water treatment	4,500	CY	$75	$337,500
106	Sediment hauling to disposal location (includes loading into truck,haul less than 1 mile on site)	4,500	CY	$15	$67,500
107	Site regrading of excavated sediment into low-lying areas prior to capping/solidification	4,500	CY	$6	$27,000
108	River Sediment Capping Material including Placement	1,000	CY	$70	$70,000
109	Attainment Sampling Study	1	EA	$50,000	$50,000
Capital Cost Subtotal					**$1,989,500**
	Contingency	%	25		$497,375
	Remedial design, project & construction management	%	15		$298,425
Total Capital Cost					**$2,786,000**
Annual O&M Cost					
201	Sediment and surface water sampling (one crew of 2, 3 days + planning& coordination)	1	EA	$30,000	$30,000
202	Sediment analysis (10 locations, once per year, TCL/TAL analysis)	10	EA	$2,000	$20,000
203	Surface water analysis (10 locations, once per year, TCL/TAL analysis)	10	EA	$2,000	$20,000
204	Annual vegetation/macroinvertabrae inventory/tox tests/report	1	EA	$80,000	$80,000
Total Annual O&M Cost					**$150,000**
Present Worth of Annual O&M Costs (7% discount rate for 5 years)					$616,000
Total Present Worth of Alternative					**$3,402,000**

River Sediment Alternative 3 - Excavation and On-Site Confinement - Option B (BSD/SSD)					
				Unit	
	Description	Quantity	Unit	Cost	Cost
Capital Costs					
100	**Sediment Excavation and Disposal**				
101	Site Isolation/ Dewatering (installation of floating sediment curtain around site, and repairing as needed, installed several times on the river)	3	EA	$300,000	$900,000
102	Additional sediment sampling for delineation of contamination	1	EA	$300,000	$300,000
103	Mobilize/demobile contractors (including initial site prep, construction of on-site facilities, etc.)	1	LS	$500,000	$500,000
104	Sediment dredging and pumping to shore	5,400	CY	$75	$405,000
105	Sediment Dewatering, including temporary drying facility, water treatment	5,400	CY	$75	$405,000
106	Sediment hauling to disposal location (includes loading into truck,haul less than 1 mile on site)	5,400	CY	$15	$81,000
107	Site regrading of excavated sediment into low-lying areas prior to capping/solidification	5,400	CY	$6	$32,400
108	River Sediment Capping Material including Placement	2,000	CY	$70	$140,000
109	Attainment Sampling Study	1	EA	$60,000	$60,000
Capital Cost Subtotal					**$2,823,400**
	Contingency	%	25		$705,850
	Remedial design, project & construction management	%	15		$423,510
Total Capital Cost					**$3,953,000**
Annual O&M Cost					
201	Sediment and surface water sampling (one crew of 2, 3 days + planning& coordination)	1	EA	$30,000	$30,000
202	Sediment analysis (10 locations, once per year, TCL/TAL analysis)	10	EA	$2,000	$20,000
203	Surface water analysis (10 locations, once per year, TCL/TAL analysis)	10	EA	$2,000	$20,000
204	Annual vegetation/macroinvertabrae inventory/tox tests/report	1	EA	$80,000	$80,000
Total Annual O&M Cost					**$150,000**
Present Worth of Annual O&M Costs (7% discount rate for 5 years)					$616,000
Total Present Worth of Alternative					**$4,569,000**

Big John Salvage - Hoult Road Site
Cost Estimate of Removal Alternatives

River Sediment Alternative 4 - Monitored Natural Attenuation					
	Description	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Capital Costs					
100	Institutional controls (deed and mooring restrictions)	1	LS	$10,000	$10,000
101	Public education	1	LS	$20,000	$20,000
Capital Cost Subtotal					**$30,000**
	Contingency	%	$25		$7,500
	Remedial design, project & construction management	%	$15		$4,500
Total Capital Cost					**$42,000**
Annual O&M Cost					
201	Sediment and surface water sampling (one crew of 2, 3 days + planning& coordination)	1	EA	$30,000	$30,000
202	Sediment analysis (10 locations, once per year, TCL/TAL analysis)	10	EA	$2,000	$20,000
203	Surface water analysis (10 locations, once per year, TCL/TAL analysis)	10	EA	$2,000	$20,000
204	Annual vegetation/macroinvertabrae inventory/tox tests/report	1	EA	$80,000	$80,000
Total Annual O&M Cost					**$150,000**
Present Worth of Annual O&M Costs (7% discount rate for 30 years)					$1,862,000
Total Present Worth of Alternative					**$1,904,000**

Appendix D

APPENDIX D

Supplemental In-Situ Chemical Oxidation Information

APPENDIX D

SUPPLEMENTAL INSITU-CHEMICAL OXIDATION INFORMATION FOR THE BIG JOHN SALVAGE HOULT ROAD SITE

The following is a discussion of the various common oxidants available for in-situ chemical oxidation applications that may be feasible for the Big John Salvage Site, as well as a general discussion of the oxidant that is most feasible for application at the Site. Oxidants discussed in this Appendix include permanganate, peroxide, ozone, peroxone, and persulfate.

Key Environmental Considerations

The key environmental parameters affecting effectiveness of this alternative include pH, intrinsic natural organic matter (NOM) and minerals, alkalinity, and permeability. The oxidants injected are generally non-selective to both target contaminants and NOM. Therefore, the presence of natural organic matter in the contaminated zone could consume a large portion of the injected oxidants, increasing the cost of this alternative. This is especially important for the BJS Site because of the high organic-rich silts and clays in the overburden related to the lacustrine depositional environment as well as reduced inorganic species (e.g., iron and manganese). Bench- and pilot-scale treatability studies would be required to fully assess the potential significance of these parameters and to gain insight on the feasibility of ISCO for the Site remediation.

Common Oxidants

Permanganate

Potassium permanganate ($KMnO_4$) has been used for the treatment of wastewater for many decades because it can oxidize many wastewater constituents, including phenol and other taste/odor-producing compounds. Therefore, permanganate-based ISCO is more fully developed than any other oxidants. Potassium permanganate is available as a powder that must be mixed with water before injection and is soluble up to 60 grams per liter (g/L) or 6%. The reaction of permanganate with organic compounds produces manganese dioxide (MnO_2), carbon dioxide, and intermediate compounds. Permanganate is effective in oxidizing a wide range of organic compounds, including alkenes, aromatics (except benzene), PAHs, and and phenolic compounds. Permanganate reactions are effective over a wide pH range from 3.5 to 12. Moreover, permanganate is more stable and persistent in the subsurface (e.g., for months), and easier to handle than peroxide and ozone. Visual confirmation of permanganate presence in the groundwater samples is possible due to the characteristic purple color of the oxidant.

The potential limitation with permanganate is that MnO_2 particles generated during the reaction may reduce permeability in the aquifer system. Naturally-occurring dissolved metals such as iron and manganese, which are abundant at the BJS site, would also precipitate as metal oxides at pH above 3.5; therefore, could reduce permeability. In addition, benzene, which is among the organic COCs in the overburden aquifer at the Site, is reported to be recalcitrant to permanganate oxidation (Sperry and Cookson, 2002; Brown, 2003; and ITRC, 2005).

Peroxide

Hydrogen peroxide (H_2O_2) is used directly or in the presence of native or supplemental ferrous iron (Fe^{2+}) to form Fenton's Reagent, which produces very reactive hydroxyl radicals (OH•). This strong, non-specific oxidant can rapidly degrade a variety of organic compounds. Fenton's Reagent oxidation is most effective under acidic pH (e.g., pH 2 to 4), and becomes ineffective under moderate to strongly alkaline conditions, although there are modifications to the Fentons reaction that will work in a wide range of pH conditions. Of COCs in the overburden aquifer at the BJS Site, benzene and some PAHs are amenable with this oxidant. However, oxidized compounds without double bonds (e.g., 1,2-bibromo-3-chloropropane) are recalcitrant to oxidation with hydroxyl radical. Moreover, PAHs such as 2-methylnaphthalene, acenaphthene (COC for soil), and naphthalene are known to be recalcitrant to the peroxide oxidation (ITRC, 2005).

Injection of peroxide at low concentrations (1 to 10%) would reduce peroxide scavenging (i.e., reactions with other non-target species), increase the volume of oxidant solution injected, and result in lower temperaures at the injection well head. At most sites where Fenton oxidation was carried out, typical concentrations of ferrous iron required in the subsurface have generally been at 20 to 100 mg/L. The presence of naturally occurring high iron concentrations at the site would ultimately affect the dosing requirements for the Fenton reaction, especially the quantity of iron salts typically required to optimize the reaction.

Major concerns with this oxidant are the handling of a large quantity of hazardous reactive chemicals, excessive heat, and pressure buildup. Therefore, special safety measures are required during the delivery processes. Oxygen gas produced in saturated porous media during ISCO can cause significant reductions in permeability, and in turn the flow of ground water and the injected reagent through the targeted treatment zone. The resulting pressure buildup could also transport contaminated groundwater beyond the treatment area. Moreover, an abundance of iron and manganese at the Site would lead to excessive non-productive decomposition of peroxide, and limit the persistence of peroxide to a short period (minutes to hours). Furthermore, Fenton oxidation is more effective under acidic conditions than in the neutral pH range. Therefore, mobility of metals could be significantly enhanced under acidic conditions. This technology is usually accompanied with a vacuum extraction system to control potential VOC emissions during Fenton oxidation.

Ozone

Ozone is a strong gaseous oxidant that is sparingly soluble in water, and upon reaction does not leave a residual (e.g., MnO_2 particles) other than oxygen. Ozone gas can quickly oxidize contaminants by direct contact or through the formation of hydroxyl radicals. Ozone has been used to treat many organic contaminants (including BTEX) in groundwater, but in much more limited field applications than permanganate- and Fenton-driven oxidation. Similar to peroxide, ozone reactions are most effective under acidic conditions. The oxidation reaction proceeds extremely fast. In general, ozone is reported to be effective in degrading PAHs and benzene; however, does not react effectively with 1,2-dibromo-3-chloropropane due to no free C=C bond (ITRC, 2005).

Due to ozone's high reactivity and instability, ozone (gas) must be generated on-site. An electrical generator with air or pure oxygen is used to produce ozone in concentrations of about 1% or 4 to 10%, respectively. Due to its similarity, air sparging has been used as a primary method to deliver ozone in the subsurface below the water table. Close spacing of injection wells and compression of ozone gas are required due to the poor radius of influence or the short transport distance, especially in the saturated zone. Soil vapor extraction is commonly used to capture fugitive VOC emissions in the unsaturated zone and to enhance the radius of influence of ozone during ozone injection.

In-situ ozonation would be effective in treating many contaminants in the unsaturated zone, but its effectiveness in the saturated zone would be limited due to the short transport distance. Therefore, ozone gas injected in the subsurface may not fully contact and treat contaminants in the overburden aquifer at the Site.

Peroxone

The peroxone process is based on the use of ozone in conjunction with hydrogen peroxide to produce highly reactive hydroxyl radicals which would oxidize organic COCs at the Site in both soil and groundwater. Peroxone has also been used as a disinfectant in water treatment plants since it does not produce measurable disinfectant residual. Its effectiveness in treating organics is similar to effectiveness of Fenton's Reagent because it also relies on hydroxyl radicals (OH•); therefore, benzene and some PAHs are amenable to this oxidant, but 2-methylnaphthalene, acenaphthalene, naphthalene, and 1,2-bibromo-3-chloropropane are recalcitrant to peroxine oxidation.

Oxidation of compounds by peroxone occurs due to two reactions: (1) direct oxidation by ozone and (2) indirect oxidation by hydroxyl radicals produced by the decomposition of ozone. In the peroxone process, the added peroxide reduces direct oxidation potential by ozone due to accelerated ozone decomposition. However, indirect oxidation by hydroxyl radicals greatly outweighs the reduction in direct ozone oxidation because the hydroxyl radical has higher oxidation potential, resulting in more effective net oxidation than ozone alone. The peroxide:ozone dose ratio used at the previous demonstration sites was reported to be 0.5 to 0.6. However, the optimum ratio should be determined for site-specific conditions (e.g., target compounds, concentrations, natural soil demand, etc.) during the design phase.

As with peroxide alone, pH and alkalinity play a major role in peroxone effectiveness, and its effectiveness in treating several PAHs of concern in groundwater and soil is reported to be recalcitrant (ITRC, 2005). Prior to the application of peroxone at the Site, lowering the alkalinity and pH may be necessary. However, this could cause mobilization of some pH-sensitive metals during treatment and other environmental impact. Special precautions would be made for handling bulk quantities of hydrogen peroxide and ozone.

Persulfate

Persulfate ion ($S_2O_8^{2-}$) is a strong oxidant capable of oxidizing many organic contaminants (e.g., benzene and PAHs) to carbon dioxide and other mineral products. ISCO with persulfate has mainly been investigated at bench-scale levels, but is in rapid development. Persulfate reacts with organic compounds primarily by the sulfate radical (SO_4^{-}•) which can be generated in solution by several mechanisms, including:

1. Heat or ultraviolet (UV) radiation: heat activation can be accomplished at temperature in the range of 20 to 60°C. Steam heating has been used as a practical means to provide persulfate activation for in-situ application.

2. Chelating agent: sulfate radical can also be generated by chelated metals such as iron ethylenediaminetetraacetic acid (FeEDTA). Metal complex activation of persulfate has been effective in treating aromatics and chlorinated ethenes.

3. Alkaline pH: Sodium hydroxide is commonly used to adjust the initial pH of the injection solution in the range of 11 to 12.5. The alkaline conditions are neutralized during treatment by the generation of

hydrogen sulfate ions. Therefore, pH of the treatment zones should be monitored periodically and a base should be added if necessary.

Persulfate (as $Na_2S_2O_8$) is very soluble in water (up to 40%) and its density is greater than water. In contrast to the hydroxyl radical, the sulfate radical generated by persulfate is relatively stable (weeks), especially at low concentrations (1 to 10 percent), suggesting that the natural oxidant demand for persulfate is relatively low. These properties allow for density-driven delivery and distribution of persulfate to the subsurface without solubility and persistence limitations, commonly encountered with other oxidants. This reagent is similar to permanganate with respect to safety and handling issues.

Persulfate would oxidize benzene, while permanganate does not. However, persulfate is the newest form of oxidant currently being used for ISCO. Therefore, there is limited information available upon which to design successful ISCO system.

Preliminary Evaluation of the Oxidants for In-Situ Chemical Oxidation at the BJS Site

In addition to the reactivity of a particular oxidant with contaminants of concern, the persistence in the subsurface was considered another important factor in selecting the oxidant for the Site since this affects the contact time and the delivery of the oxidant to targeted zone in the subsurface. Peroxide-driven ISCO (i.e., Fenton's Reagent and peroxone) was eliminated for further consideration because of excessive heat, pressure buildup resulting from large quantities of oxygen gas released during the oxidation reactions, short persistence, and low pH requirement. Ozone is not considered further due to its low pH requirement and, more importantly, its instability, short transport distance, and potential fugitive volatile emissions. Persulfate is also eliminated because of its limited field-scale application.

For the EE/CA purpose, permanganate is recommended as the oxidant to be considered for use at the Site. This oxidant is stable and its persistence in the subsurface would allow the oxidant to be delivered to the targeted zones.

Despite its limited effectiveness (long reaction time) in treating benzene, permanganate offers several potential advantages over the other oxidants: 1) permanganate can be transported longer distance than the other oxidants; 2) permanganate oxidation would be effective over the pH range normally found in ground water; 3) permanganate is more stable and persistent in the subsurface than the other oxidants; 4) permanganate oxidation would produce MnO_2 (s) that behaves as a sorbent for many metals of concern and restrict their transport to ground water; and 5) permanganate-driven ISCO is more developed than the other oxidants-driven ISCO.