TETRA TECH

December 30, 2014

Mr. Eric Amadi
c/o Ms. Victoria Stovall
Wisconsin Department of Natural Resources Southeast Region
2300 North Martin Luther King Jr Drive
Milwaukee, WI 53212

RE: Remedial Action Options Report
Former Koppers Tar Plant and Wabash Alloys Site
9100 South 5th Avenue, Oak Creek, WI 53154
FID #: 241379050; BRRTS #: 02-41-553761
Connell VPLE BRRTS #: 06-41-560068
Beazer VPLE BRRTS #: 06-41-561509

City of Oak Creek Utility Corridor Lot 1
9170 South 5th Avenue, Oak Creek, WI 53154
FID #: 341074470; BRRTS #: 02-41-561425
Beazer VPLE BRRTS #: 06-41-561426

Dear Mr. Amadi:

On behalf of Beazer and Connell, Tetra Tech is submitting the enclosed Remedial Action Options Report for your review. Three copies of the report are enclosed.

Connell has determined that the site would be considered a Type C site under the One Cleanup Program Memorandum of Agreement (MOA), PUB-RR-786, dated November 2014. Connell requests WDNR's concurrence on this site classification and the resulting coordinated review and approval process with USEPA. Once Connell receives WDNR's concurrence, a letter will be sent to the USEPA Region 5 PCB Coordinator and the Regional Administrator (with cc to the WDNR project manager) requesting a TSCA coordinated approval, to be led by WDNR, in accordance with the MOA.

Please do not hesitate to contact us should you have any questions or require additional information.

Sincerely,

Tetra Tech, Inc.

Michael R. Noel, P.G.
Vice President, Principal Hydrogeologist

Encl.: Report

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Mike Kellogg, Connell Aluminum Properties (via email)
Julie Zimdars, NRT (via email)
Larry Haskin, Haskin & Karls (via email)
Kathryn Huibregtse, Environ (via email)

REMEDIAL ACTION OPTIONS REPORT

FORMER KOPPERS TAR PLANT
AND WABASH ALLOYS SITE
Oak Creek, WI
FID # 241379050
BRRTS # 02-41-553761
Connell VPLE BRRTS # 06-41-560058
Beazer VPLE BRRTS # 06-41-561509

CITY OF OAK CREEK UTILITY CORRIDOR LOT 1
FID # 341074470
BRRTS # 02-41-561425
Beazer VPLE BRRTS # 06-41-561426

Prepared for:

Connell Aluminum Properties, LLC
One International Place
Boston, MA 02110

Beazer East, Inc.
c/o Three Rivers Management, Inc.
One Oxford Center, Suite 3000
Pittsburgh, PA 15219

Prepared by:

Natural Resource Technologies, Inc.
234 W. Florida Street, Fifth Floor
Milwaukee, Wisconsin 53204

Tetra Tech, Inc.
175 N. Corporate Drive, Suite 100
Brookfield, WI 53045

December, 2014

CERTIFICATION

"I, Julie A. Zimdars, hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A−E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A−E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."

_______________________________ December 30, 2014

Julie A. Zimdars, P.E. Date

Senior Engineer

"I, Michael R. Noel, hereby certify that I am a scientist as that term is defined in s. NR 712.03 (3), Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."

_______________________________ December 30, 2014

Michael R. Noel, P.G. Date

Vice President, Principal Hydrogeologist

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1.0 EXECUTIVE SUMMARY

This NR 722 remedial action options report (RAOR) was prepared for the Former Koppers Tar Plant and Wabash Alloys site (Site) located in the City of Oak Creek, Milwaukee County, Wisconsin, on the western shore of Lake Michigan. The responsible parties are Beazer East Inc. (Beazer) and Connell Aluminum Properties, LLC (Connell). This report was completed to satisfy the Voluntary Party Liability Exemption (VPLE) program needs by addressing all areas of concern (AOCs) identified in the January 14, 2014 Site Investigation Report.

Connell's Voluntary Party Liability Exemption (VPLE) property includes the 20-acre parcel (Wabash Parcel) owned by Connell. Beazer has two VPLE properties including the Wabash Parcel and a 2-acre portion of the utility corridor (City Parcel) owned by the City of Oak Creek. Investigation and remediation of environmental impacts related to the coal tar distillation operations that occurred on both parcels from 1917-1960 is being conducted by Beazer. Investigation and remediation of environmental impacts related to the secondary aluminum smelting operations that occurred on the Wabash Parcel only from 1968-2001 is being conducted by Connell.

The purpose of the evaluation process described in this RAOR is to determine which remedial action option constitutes the most appropriate technology or combination of technologies to restore the environment, to the extent practicable, within a reasonable period of time and to minimize harmful effects to the air, land, or waters of the state, to address the exposure pathways of concern, and effectively and efficiently address the source of the environmental impact.

Based upon the site conditions, Remedial Action Objectives (RAOs) were developed for the following media and constituents at the Site:

- Soil Impacted by VOCs and PAHs
  - Prevent direct contact with soil exceeding direct contact RCLs.
  - Prevent leaching of contaminants that may result in groundwater contamination in excess of groundwater RCLs.
- Soil Impacted by PCBs and Metals
  - Prevent direct contact with soil exceeding direct contact RCLs.
  - Prevent leaching of contaminants that may result in groundwater contamination in excess of groundwater RCLs.
- Potentially Mobile Tar
  - Prevent potentially mobile tar from seeping to the ground surface or daylighting along the ravine bluff.
- Groundwater
  - Prevent potential potable use of impacted groundwater.
  - Restore groundwater to NR140 RCLs to the extent technically and economically feasible.
- Utility Trenches
  - Mitigate impacted groundwater migration that may be occurring along preferential pathways created by utility conduits and trenches.

- Vapor Intrusion
  - Prevent vapor intrusion from impacted soil and groundwater into potential future occupied structures.
- Ecological/Wetlands
  - Minimize wetland area disturbance. Wetlands are prevalent in the eastern portion of the Wabash Parcel and disturbance of the wetlands is undesirable.

Based on the development and screening of general response actions and remedial technologies, remedial alternatives were developed for detailed evaluation. This evaluation included one site wide alternative (SW-1); four remedial alternatives for soil (S-1, S-2, S-3 and S-4); three remedial alternatives each for potentially mobile tar (MT-1, MT-2 and MT-3), groundwater (GW-1, GW-2 and GW-3), and utility trenches (UT-1, UT-2 and UT-3); and one remedial alternative for vapor intrusion (VI-1). The final remedy for the former tar plant operations includes one alternative from each medium and the former aluminum smelter includes a remedial alternative for soil. The alternatives evaluated included:

Site Wide Alternative:
- SW-1: Institutional Controls

Surface Soil VOC & PAH Alternatives:
- S-1: Soil Barrier
- S-2: Impermeable Cover

Soil PCBs & Metals Alternatives:
- S-3: Soil Barrier
- S-4: Soil Excavation with Off-site Disposal

Potentially Mobile Tar Alternatives:
- PMT-1A: Solidification (0-4 Ft)
- PMT-1B: Solidification (Total Depth)
- PMT-2: Impermeable Cover (0-4 Ft)
- PMT-3A: Excavation (0-4 Ft) with Off-Site Disposal
- PMT-3B: Excavation (Total Depth) with Off-Site Disposal

Groundwater Alternatives:
- GW-1: Monitored Plume Stability (MPS)
- GW-2: In-Situ Treatment
- GW-3: Extraction with Treatment

Utility Trench Alternatives:
- UT-1: Trench Plug
- UT-2: In-Situ Treatment
- UT-3: Extraction with Treatment

Vapor Intrusion Alternative:

- VI-1: Institutional Controls

The recommended combination of alternatives for Site remediation includes:

Site Wide:

- Alternative SW-1: Institutional Controls

Former Tar Plant Operations:

- Alternative S-1: Soil Barrier
- Alternative PMT-2.1: Impermeable Cover (Non-Wetland Tar Areas)
- Alternative PMT-3A.1: Excavation (0-4 Ft) with Off-Site Disposal (Wetland Tar Areas)
- Alternative GW-1: Monitored Plume Stability
- Alternative UT-1: Trench Plugs
- Alternative VI-1: Institutional Control

Former Aluminum Smelter:

- Alternative S-3: Soil Barrier
- Alternative S-4: Soil Excavation with Off-Site Disposal

2.0 BACKGROUND

2.1 General Information

This NR 722 Remedial Action Options Report (RAOR) evaluates remedial action options for the Former Koppers Tar Plant and Wabash Alloys site (Site) located in the City of Oak Creek, Milwaukee County, Wisconsin, on the western shore of Lake Michigan. The responsible parties include Beazer East Inc. (Beazer) and Connell Aluminum Properties, LLC (Connell). Investigation and remediation of environmental impacts related to the coal tar distillation operations that occurred on both parcels from 1917-1960 is being conducted by Beazer. Investigation and remediation of environmental impacts related to the secondary aluminum smelting operations that occurred on the Wabash Parcel only from 1968-2001 is being conducted by Connell. Refer to the definitions in section 2.1.7 for a description of property and parcel terms used throughout the report.

2.1.1 Project Title and Report Purpose

Remedial Action Options Report
Former Koppers Tar Plant and Wabash Alloys Site
FID #: 241379050
BRRTS#: 02-41-553761
Connell VPLE BRRTS#: 06-41-560058
Beazer VPLE BRRTS#: 06-41-561509

City of Oak Creek Utility Corridor Lot 1
FID # 341074470
BRRTS # 02-41-561425
Beazer VPLE BRRTS # 06-41-561426

2.1.2 Current Property Owners

Former Wabash Alloys Site:
Connell Aluminum Properties, LLC
Project Contact: Mr. Mike Kellogg
(919) 744-7522

City Utility Corridor Parcel:
City of Oak Creek
Project Contact: Mr. Larry Haskins
(414) 762-5105

2.1.3 Consultants

For Connell:
Natural Resource Technology, Inc. (NRT)
234 W. Florida Street, Fifth Floor
Milwaukee, Wisconsin 53204
Contact: Julie Zimdars, P.E.
(414) 837-3564

For Beazer:
Tetra Tech, Inc.
175 N. Corporate Drive, Suite 100
Brookfield, WI 53045
Contact: Michael Noel, P.G.
(262) 792-1282

2.1.4 Site Location, Zoning and Land Use

The Former Koppers Tar Plant and Wabash Alloys Site is located on the east side of 5th Avenue, south of E. Depot Road and west of Lake Michigan. The Site is comprised of two parcels:

- Former Koppers Tar Plant and Wabash Alloys (Wabash Parcel):

SW ¼ of the NW ¼, and the NW ¼ of the SW ¼
Section 24, T5N, R22E
9100 South 5th Avenue
Oak Creek, Milwaukee County, Wisconsin
Current Zoning: Agricultural
Previous Land Use: Industrial
Future Expected Land Use: Non-Residential

- City of Oak Creek Utility Corridor Lot 1 (City Parcel):

NW ¼ of the SW ¼
Section 24, T5N, R22E
9170 South 5th Avenue
Oak Creek, Milwaukee County, Wisconsin
Current Zoning: Institutional
Current and Future Expected Land Use: Restricted Access Utility Corridor

2.1.5 Location map

Figure 1 shows the general Site location within Milwaukee County. Figure 2 shows the subject parcel and property boundaries.

2.1.6 Geographic Position of Properties

The Wisconsin Trans Mercator (WTM) coordinates (meters) that define the approximate parcel corners, as determined from the WDNR Bureau of Remediation and Re-development web site are as follows:

Wabash Parcel

- Northwest Corner – 695,330; 269,610
- Southwest Corner – 695,330; 269,425
- Southeast Corner – 696,060; 269,535
- Northeast Corner – 696,046; 269,585

City Parcel

- Northwest Corner – 695,330; 269,425
- Southwest Corner – 695,330; 269,395
- Southeast Corner – 695,627; 269,395
- Northeast Corner – 695,656; 269,425

2.1.7 Definitions

- *Wabash Parcel* – Connell-owned 20-acre parcel where the Wabash Alloys facility operated and a majority of the Koppers plant historically operated.

- *City Parcel* – A 2-acre portion (Lot 1) of the Utility Corridor Property owned by the City of Oak Creek where a small portion of the Koppers plant historically operated.
- *Utility Corridor Property* - The entire City-owned property from 5th Avenue to Lake Michigan.
- *Connell VPLE property* – Wabash Parcel
- *Beazer VPLE properties* – Wabash and City Parcels
- *Site* - Includes both the Wabash Parcel and the City Parcel. Where it is important to distinguish environmental impacts located on a VPLE property from that located off of, or migrated from, the VPLE property for either Connell or Beazer, references to the Wabash Parcel, City Parcel, or Utility Corridor Property are used. These parcel and property boundaries are clearly identified on all figures. Throughout this ROAR, use of the terms “off-site” and “on-site” were avoided to reduce confusion.

2.2 Site Regulatory Status

The Site is regulated under the Voluntary Party Liability Exemption (VPLE) program. Connell’s VPLE property includes the 20-acre parcel (Wabash Parcel) owned by Connell. Beazer has two VPLE properties including the Wabash Parcel and a 2-acre portion of the utility corridor (City Parcel) owned by the City of Oak Creek.

2.3 Summary of Geologic and Hydrogeologic Characteristics

The uppermost unit across much of the Site is comprised of silty clay and clay fill materials that typically ranges between 5 to 10 feet thick but is up to 15 feet thick in some locations. The fill materials are more granular in some areas. Beneath the fill, the native unconsolidated materials in the Site vicinity consist of silty clay glacial sediments belonging to the Oak Creek and New Berlin Formations that extend to a depth of approximately 190 feet bgs, which, in turn, are underlain by Silurian dolomite. The depth to groundwater ranges from 1-3 feet bgs along the northern property line to as much as 12 feet bgs in the Utility Corridor. Groundwater flow at the water table generally mimics topography and is to the south toward the Utility Corridor and then turns east toward Lake Michigan. Deeper groundwater flow (50 feet bgs) is generally to the east toward the lake. The hydraulic conductivity averages 3.9E-04 cm/sec for the fill and/or fractured clay till and 3.4E-06 cm/sec for the unfractured clay till. For the shallow ground water, calculated flow velocities range between 5 to 100 feet per year. The lower annual flow velocity correlates better to observed groundwater plume maps. For the deep groundwater, the calculated groundwater flow velocity is less than one foot per year.

2.4 Summary of Nature and Extent of Environmental Impacts

Constituents of potential concern (COPCs) associated with the former coal tar plant include benzene, toluene, ethylbenzene, xylene, trimethylbenzenes (BTEXTM) and polyaromatic hydrocarbons (PAHs). Primary source areas occur in the vicinity of the former tar plant lagoon/ponds, tank farm and truck loading area. The lateral extent of impacted soil and groundwater from Site source areas has been defined except for a small area to the south of the City parcel where access has not yet been granted. Non-industrial direct contact RCLs are exceeded for one or more compounds (primarily benzo(a)pyrene) across most of the Site. The protection of groundwater RCL in vadose zone soils is exceeded for PAH compounds (benzo(a)pyrene primarily and naphthalene in limited areas). Leaching of these relatively insoluble compounds does not contribute materially to the magnitude of groundwater impacts in areas of tar. DNAPL tar has been observed in Site monitoring wells with maximum product thickness observations ranging from 0.2 to 5.5 feet. Mobility/recoverability testing found that the amount of product that was able to be removed was minimal (< a few gallons) and after purging the product level recovery was very slow. The lack of accumulating DNAPL in several wells within the soil tar delineation areas and the low return of product to wells after bailing suggests that most of the DNAPL in the delineated area is immobile and not recoverable. Despite the long term (80+ years) presence of tar below the water table, the horizontal and vertical extent of the dissolved groundwater plume is nearly coincident with the residual tar source areas. The lack of horizontal and vertical migration of impacted groundwater is due to the low permeability of the native clay till. The maximum vertical extent of impacted soil and groundwater is less than 30 feet.

COPCs associated with the former aluminum smelter include PCBs, arsenic, mercury, lead and nickel, although arsenic is the only metal detected above the direct contact RCL on a frequent basis. Primary PCB source areas occur in the raw scrap storage yard area on the east side of the facility. In this area, PCB concentrations are greatest in the upper 3 feet and decrease with depth. Isolated source areas also exist in the low area between the railroad tracks, the southeast side of the building and in an isolated unknown source/spill to the east. These areas exhibit slightly deeper PCB impacts below 3 feet to approximately 5-8 feet, where fill was placed on top of the impacted soil. The lateral and vertical extent of PCB-impacted soil has been defined. Although the groundwater protection pathway is exceeded for total PCBs, this pathway is not of concern as evidenced by the lack of PCBs in the groundwater. As described in the SI report, areas exist on the property where there is also no unacceptable direct contact risk, and therefore no action is necessary in these areas. Three isolated shallow wells (MW-806, MW-111 and MW-106) exceed the NR140 Enforcement Standard (ES) for different metals including arsenic, barium, and nickel; however, no piezometers exceed the ES for metals. Metals concentrations have decreased from the June to September 2013 round. The initial higher metals concentrations in the wells appear to correlate with higher turbidity.

2.5 PCB-Contaminated Concrete Slab Removal

As part of the soil remedial action and per City requirements, the remaining building concrete and exterior slabs will be removed and disposed in accordance with an approved USEPA and/or WDNR plan. Re-use of clean concrete materials as fill material (i.e. less than 1 mg/kg total PCBs) is planned, assuming regulatory approval can be obtained for this. Clean concrete materials are expected to include:

- Currently stockpiled building wall materials previously sampled and documented as less than 1 mg/kg total PCBs
- Previously sampled and documented areas of the building slab that are less than 1 mg/kg total PCBs
- Below grade concrete foundations
- Outside concrete slabs or “flatworks” slabs that are less than 1 mg/kg total PCBs

Costs for the slab removal are not included in the remedial option cost estimates.

3.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

3.1 Overview

The purpose of this section is to identify site-specific Remedial Action Objectives (RAOs), General Response Actions (GRAs), and specific technologies that may be appropriate for the identified RAOs and GRAs for the Site. After development of the RAOs and GRAs, the identified remedial technologies are screened to eliminate those that are inappropriate for inclusion in specific integrated alternatives. The technologies identified that satisfy the RAO criteria and appear acceptable as components of final remedial actions will be retained for further evaluation and potential inclusion in remedial alternatives developed for the Site.

3.2 Remedial Action Objectives

Based upon the Site conditions, RAOs were developed for the following media and COPCs at the Site:

3.2.1 Soil Impacted by VOCs and PAHs

- Prevent direct contact with soil exceeding direct contact RCLs.
- Prevent leaching of contaminants that may result in groundwater contamination in excess of groundwater RCLs.

3.2.2 Soil Impacted by PCBs and Metals

- Prevent direct contact with soil exceeding direct contact RCLs.
- Prevent leaching of contaminants that may result in groundwater contamination in excess of groundwater RCLs.

3.2.3 Potentially Mobile Tar

- Prevent potentially mobile tar from seeping to the ground surface or daylighting along the ravine bluff.

3.2.4 Groundwater

- Prevent potential potable use of impacted groundwater.
- Restore groundwater to NR140 RCLs to the extent technically and economically feasible.

3.2.5 Utility Trenches

- Mitigate impacted groundwater migration that may be occurring along preferential pathways created by utility conduits and trenches.

3.2.6 Vapor Intrusion

- Prevent vapor intrusion from impacted soil and groundwater into potential future occupied structures.

3.2.7 Ecological/Wetlands

- Minimize wetland area disturbance. Wetlands are prevalent in the eastern portion of the Wabash Parcel and disturbance of the wetlands is undesirable.

3.3 General Response Actions

The remedial action options evaluation process involves the development of general response actions, followed by identification, screening, and selection of remedial technologies. The general response actions are broad classes of actions or remedies that will satisfy the remediation goals. Available technologies and process options that correspond to the general response actions are identified and screened in sections 3.4 and 3.5. The following general response actions have been identified

- Institutional controls, which involve the creation and implementation of responsibilities for restricting public and environmental contact with Site COPCs.
- Containment, which involves physical restrictions on Site COPC mobility and water infiltration.
- Removal, which involves the direct physical removal of impacted media or source areas.
- Treatment, which involves on-site and/or off-site measures to reduce toxicity, mobility, and volume of the impacted materials.
- Discharge or Disposal, which involves measures to relocate impacted materials in such a way as to reduce their interaction with the public and the environment.

3.4 Identification of Technologies and Process Options

Tables 1A and 1B list the potential treatment technologies and corresponding process options for environmental media or migration/exposure pathway. The technologies and process options listed in these tables were selected based on the fate and transport characteristics of the chemicals of concern identified in each medium and on the applicability of a given technology or process option to a specific medium.

3.5 Initial Screening of Technologies and Process Options

An initial screening of remedial technologies was conducted to identify remedial action options for further evaluation that are reasonably likely to be feasible for the Site based on the COPCs present, media affected and Site characteristics. Tables 1A and 1B describe the process options and applicable areas of concern, and summarize the technology screening process for the options. A description of each process option is included in the table to provide an understanding of each option and to assist in the evaluation of its technical effectiveness and implementability. The screening comments address the technical feasibility and the ability of a given process option to serve its intended purpose. The screening comments include a statement as to whether each process option was determined to be potentially applicable or was rejected. The technologies and process options that cannot be effectively implemented at the Site were screened out using the most current Site information such as COPC types and concentrations and Site characteristics. The evaluation of the process options based on technical effectiveness and implementability, and cost is summarized in Table 1A and 1B. Those process options that were retained after the evaluation were used in the development of the remedial alternatives presented in Section 4.0.

3.6 Retained Technologies and Process Options for Site Wide Application

3.6.1 Institutional Controls

Institutional controls to be applied Site wide in conjunction with other selected alternatives include the following:

- Access restrictions limiting future use of the Wabash parcel to non-residential uses and establishing a post-closure plan for managing residual soil that may be excavated and/or removed in the future.
- A soil management plan establishing a continuing obligation for the Site outlining the procedures and requirements for management of any future soil disturbance or excavation at the Site.
- Land use restrictions to prevent installation of drinking water wells at the Site and other areas of impacted groundwater to prevent the use of impacted groundwater as source of drinking water.
- Controls to maintain undisturbed wetland areas.
- Requirements to install groundwater migration barriers along future utility trenches that may be installed below the water table at the Site and in other areas of impacted groundwater. The required barrier would typically include construction of an impermeable clay or bentonite dike around the exterior of the utility pipe to block potential migration along the utility trench.
- Requirements to install vapor mitigation systems for any potential future occupied structures constructed at the Site and over other areas of residual soil and impacted groundwater that have the potential for volatilization.

3.7 Retained Technologies and Process Options for Soil Impacted by VOCs and PAHs

Table 1A provides a list of retained technologies and process options for soil impacted by VOCs and PAHs. The following sections describe the retained technologies and process options in greater detail. Technologies and process options from the retained list were used to assemble the alternatives in Section 4.0.

3.7.1 No Action

The no action option was carried forward as potentially applicable for soils that exceed the protection of groundwater standard for the following reasons:

- The native clay till provides attenuation of constituent leaching from shallow vadose zone soils.
- The only VOC to exceed the groundwater protection standard was benzene in 2 of 61 samples.
- Several PAH compounds exceed the groundwater protection standard, however, the contribution to groundwater impacts from leaching is considered minimal compared to existing groundwater impacts and does not materially affect the stability of the plume.
- Areas of greatest impact in the vadose zone are addressed below under the potentially mobile tar options.
- Minimize wetland area disturbance.

A separate alternative was not developed for the "No Action" option, but its application was used in evaluating engineered barrier alternatives (S-1 and S-2).

3.7.2 Engineered Barrier

Potentially applicable engineered barriers include a 24-inch thick soil cover to prevent direct contact, an impermeable cover constructed of compacted clay or geomembranes to prevent direct contact and be protective of groundwater, and asphalt or concrete barriers that either exist (e.g. road along utility corridor) or that may be constructed as part of any future redevelopment activities that would also serve to prevent direct contact and be protective of groundwater. Engineered barriers do not actively reduce source area concentrations, but work to minimize or prevent direct contact exposure to the affected soils and leaching to groundwater. A maintenance plan would also be required after the barrier is installed to inspect and repair damage to the barrier.

3.8 Retained Technologies and Process Options for Soil Impacted by PCBs and Metals

Table 1B provides a list of retained technologies and process options for soil impacted by PCBs and metals. The following sections describe the retained technologies and process options in greater detail. Technologies and process options from the retained list were used to assemble the alternatives in Section 4.0.

3.8.1 No Action

The no action option was considered as potentially applicable for soils that exceed the protection of groundwater standard but have very low level PCB concentrations found in portions of the Wabash Parcel. Since the primary constituents of concern (PCBs) for this remedial action are hydrophobic and have low mobility as evidenced by the groundwater results, the groundwater pathway is not of concern. The focus will be to address the direct contact pathway. Because minimizing disturbance to the wetlands is also a RAO, the no action process option should be considered.

A separate alternative was not developed for the "No Action" option, but its application was used in evaluating and determining extent of the engineered barrier alternative (S-3). As described in the SI report, areas on the property exist where there is no unacceptable direct contact risk. Therefore, no action is necessary in these areas and they are not included in the soil barrier extent shown on Figure 8. In the east/wetland area, an NR 720 averaging analysis showed the PCB and arsenic soil concentrations in the 0-2 ft interval will not pose an unacceptable direct contact risk and will serve as a natural soil cover to residual impacts below.

3.8.2 Engineered Barrier

An engineered barrier is proposed over the designated affected soil that would remain in-place. The purpose of the barrier is to function as a soil performance standard as outlined in NR 720.08(3). Potentially applicable engineered barriers include a 24-inch thick soil barrier to prevent direct contact over areas containing PCBs and metals concentrations above direct contact levels and also to minimize the potential for leaching to groundwater. Engineered barriers do not actively reduce source area concentrations, but work to minimize or prevent direct contact exposure to COPCs. A maintenance plan would also be required after the barrier is installed to inspect and repair damage to the barrier.

The barrier for covering the PCB affected soil is proposed to be consistent with the USEPA TSCA 40 C.F.R. § 761.61(a)(4)(i)(A), which states that cleanup levels for bulk PCB remediation waste for high occupancy areas where bulk PCB remediation waste remains at concentrations less than or equal 10 mg/kg shall be covered with a barrier cover meeting the requirements of 761.61 (a)(7) and (a)(8).

3.8.3 Excavation

This process option includes excavation of PCB-contaminated soils for off-site disposal. Excavations would be backfilled with segregated soils with PCBs concentrations less than or equal to 10 mg/kg PCBs, site concrete containing PCB concentrations less than or equal to 1 mg/kg PCBs, or clean imported fill, as necessary. Excavation limits will be based on 10 mg/kg total PCBs soil performance standard, which is equivalent to the 40 C.F.R. § 761.61(a)(4)(i)(A) cleanup level for high occupancy areas with a cover/barrier as discussed below.

3.8.4 Disposal

This process option includes disposal of PCB concentrations identified to be greater than or equal to 50 mg/kg PCBs to a TSCA certified landfill and PCB concentrations less than 50 mg/kg to a local special waste landfill approved for PCB soil disposal at these concentrations.

3.9 Retained Technologies and Process Options for Potentially Mobile Tar

Table 1A provides a list of retained technologies and process options for potentially mobile tar. The following sections describe the retained technologies and process options in greater detail. The retained technologies and process options are assembled into alternatives in Section 4.0.

3.9.1 No Action

The no action option was carried forward as potentially applicable for areas of deeper tar that have no potential for seepage to the ground surface.

3.9.2 Solidification

This process option consists of mixing soils with binding agents to solidify soil and reduce tar mobility to prevent seepage of tar to the ground surface. Solidification would also reduce the leachability of COPCs from the soil. Mixing can be accomplished in-situ using excavators, large diameter (5-foot) augers or mechanical mixers to blend in potential binding agents such as Portland cement, blast furnace slag, fly ash, cement kiln dust, or bentonite.

3.9.3 Engineered Barrier

This process option would include an impermeable cover constructed of compacted clay or geomembranes to serve as a barrier and prevent seepage of tar to the ground surface. This would be applicable to areas of observed potentially mobile tar within surface soils (0-4 feet bgs). Potentially mobile tar below a depth of 4 feet does not have the potential for seepage to the ground surface.

3.9.4 Slurry wall

This process option is a non-structural vertical cutoff wall constructed to prevent the horizontal movement of tar. This would be applicable to areas of observed tar that have the potential to seep out along the ravine slope. The slurry trench installation method uses an engineered fluid (normally consisting of some mixture of clay and water) to hold open the sidewalls of an excavation thereby permitting the excavation of deep and narrow trenches without the need for other conventional excavation support systems. A shallow trench drain may need to be installed adjacent to and upgradient of the slurry wall to prevent mounding of groundwater behind the wall.

3.9.5 Excavation

This process option consists of excavating impacted tar soils for off-site disposal or on-site consolidation. Excavated areas would require backfilling with clean fill.

3.9.6 Disposal

This process option includes the disposal of excavated tar soils into a solid waste landfill.
Based on the TCLP analysis of the soil indicating that the soil is non-hazardous, off-site disposal would likely be to an approved landfill.

3.9.7 Consolidation

This process option would include on-site consolidation of tar soils to reduce the footprint of the impacted area. This option would be used in conjunction with other options such as engineered barriers or solidification.

3.10 Retained Technologies and Process Options for Groundwater

Table 1A provides a list of retained technologies and process options for groundwater. The following sections describe the retained technologies and process options in greater detail. The retained technologies and process options are assembled into alternatives in Section 4.0.

3.10.1 Groundwater Monitoring

This process option includes routine monitoring of groundwater to ensure the dissolved phase groundwater plume is not migrating or expanding. At least two years of quarterly sampling data would be required to demonstrate the stability of the groundwater plume.

3.10.2 Slurry Wall

This process option is a non-structural vertical cutoff wall constructed to prevent the horizontal movement of impacted groundwater. A shallow trench drain may need to be installed adjacent to and upgradient of the slurry wall to prevent mounding of groundwater behind the wall.

3.10.3 Aerobic Treatment Curtain

This process option involves the in-situ treatment of impacted groundwater as it passes through an aerobic treatment curtain (ATC) where aerobic biodegradation of VOCs and PAHs takes place along with VOC volatilization. This option could be used independently but more likely in conjunction with a slurry wall that would funnel groundwater through an ATC gate.

3.10.4 Groundwater Interception Trench

This process option includes constructing a trench backfilled with gravel to intercept the dissolved phase groundwater plume. Intercepted groundwater that collects in the trench would be extracted for subsequent treatment and discharge.

3.10.5 On-Site Treatment

This process option includes the on-site treatment of extracted groundwater. Applicable treatment technologies include air stripping and/or granular activated carbon with subsequent discharge.

3.10.6 Discharge

This process option includes the discharge of collected and treated water to the storm sewer under a WPDES permit or to the Milwaukee Metropolitan Sewerage District (MMSD) sanitary sewer.

3.11 Retained Technologies and Process Options for Utility Trenches

Table 1A provides a list of retained technologies and process options for the utility trenches. The following sections describe the retained technologies and process options in greater detail. The retained technologies and process options are assembled into alternatives in Section 4.0.

3.11.1 No Action

This process option is potentially applicable if further investigation and monitoring demonstrate that COPC concentrations and/or migration potential are low enough that no further or minimal action is needed to prevent COPC migration.

3.11.2 Low Permeability Trench Plugs

This process option would include construction of a low permeability plug around the exterior of the utility pipe to block impacted groundwater migration along the utility trench. The plug could be constructed of compacted clay or a low permeability flowable fill. Approval and coordination with the Oak Creek Sewer and Water Utility and other utility companies would be required to ensure no damage would occur to existing infrastructure.

3.11.3 Groundwater Extraction

This process option includes extracting groundwater from wells or a permeable trench installed along utility trenches and within or at the downgradient extent of impacted groundwater. Extracted groundwater would require subsequent treatment and discharge.

3.11.4 On-Site Treatment

This process option includes the on-site treatment of extracted groundwater. Potentially applicable treatment technologies include air stripping and/or granular activated carbon with subsequent discharge.

3.11.5 Aerobic Treatment Curtain

This process option involves the in-situ treatment of groundwater as it passes through an ATC where aerobic biodegradation of VOCs and PAHs takes place along with VOC volatilization. This option would include construction of air sparge wells within utility trenches and within or at the downgradient extent of impacted groundwater that would be used to introduce air to the groundwater to aerobically degrade COPCs. Approval and coordination with the Oak Creek Sewer and Water Utility and other utility companies would be required to ensure no damage would occur to existing infrastructure.

3.11.6 Discharge

This process option includes the discharge of collected and treated water to the storm sewer under a WPDES permit or to the Milwaukee Metropolitan Sewerage District (MMSD) sanitary sewer.

3.12 Retained Technologies and Process Options for Vapor Intrusion

Table 1A provides a list of retained technologies and process options for vapor intrusion. The following sections describe the retained technologies and process options in greater detail. The retained technologies and process options are assembled into alternatives in Section 4.0.

3.12.1 Institutional Controls

As stated in section 3.6.1, Site wide institutional controls to be applied in conjunction with other remedial alternatives include requirements to install vapor mitigation systems for any potential future occupied structures constructed at the Site and over other areas of impacted residual soil and groundwater that have the potential for volatilization.

4.0 DEVELOPMENT AND ANALYSIS OF REMEDIAL ALTERNATIVES

4.1 Introduction

This section presents a more detailed description and analysis of the remedial alternatives selected for further evaluation as part of the initial screening presented in Section 3.0. The analysis assesses each remedial alternative against a set of evaluation criteria outlined in NR722. This evaluation process was used to determine which remedial action option constitutes the most appropriate technology or combination of technologies to restore the environment, to the extent practicable, within a reasonable period of time and to minimize harmful effects to the air, land, or waters of the state, to address the exposure pathways of concern, and effectively and efficiently address the source of the environmental impact.

4.2 Evaluation Criteria

In accordance NR722, the evaluation included an assessment and comparison of the technical and economic feasibility of various options.

4.2.1 Technical Feasibility

The technical feasibility of each remedial action option was evaluated based on long- and short-term effectiveness, implementability, and restoration time frame as summarized below:

- Long-term effectiveness
  - Degree to which the toxicity, mobility and volume of the contamination is expected to be reduced;
  - Degree to which a remedial action option, if implemented, will protect public health, safety, and welfare and the environment over time.
- Short-term effectiveness
  - Considers adverse impacts on public health, safety, or welfare or the environment that may be posed during the construction and implementation period.
- Implementability
  - Technical feasibility of constructing and implementing the remedial action option at the Site given the type of contaminants and hydrogeologic conditions present;
  - Availability of materials, equipment, technologies, and services needed to conduct the remedial action option;
  - Potential difficulties and constraints associated with on-site construction or off-site disposal and treatment;
  - Difficulties associated with monitoring the effectiveness of the remedial action option;
  - Administrative feasibility of the remedial action option, including activities and time needed to obtain any necessary licenses, permits or approvals;
  - Presence of any federal or state, threatened or endangered species;
  - Technical feasibility of recycling, treatment, engineering controls or disposal;
  - Technical feasibility of naturally occurring biodegradation at the site or facility, if responsible parties evaluate this option;
  - Redevelopment potential of the site once the remedy has been implemented;
  - Reduction of greenhouse gases consistent with federal or state climate action policies.

- Restoration time frame, taking into account
  - Proximity of contamination to receptors;
  - Presence of sensitive receptors;
  - Presence of threatened or endangered species or habitats, as defined by state and federal law;
  - Current and potential use of the aquifer, including proximity to private and public water supplies and surface water bodies;
  - Magnitude, mobility and toxicity of the contamination;
  - Geologic and hydrogeologic conditions;
  - Effectiveness, reliability, and enforceability of continuing obligations;
  - Naturally occurring biodegradation processes at the site;
  - Degradation potential of the compounds.

4.2.2 Economic Feasibility

The economic feasibility of each remedial action option was evaluated using the following criteria:

- Capital costs, including both direct and indirect costs;
- Initial costs, including design and testing costs;
- Annual operation and maintenance costs;
- Total present worth of the costs;
- Costs associated with potential future liability.

4.3 Description and Evaluation of Remedial Alternatives

This section describes the development of the preliminary remedial action options. Remedial alternatives have been developed for each media or migration/exposure pathway separately to reduce the number of possible permutations of site-wide remedial alternatives. One alternative for each medium should be implemented at the site to provide the most adequate degree of protection to human health and the environment and attainment of the Remedial Action Objectives.

One site wide remedial alternative (SW-1); four remedial alternatives for soil (S-1, S-2, S-3 and S-4); three remedial alternatives each for potentially mobile tar (PMT-1, PMT-2 and PMT-3); groundwater (GW-1, GW-2 and GW-3); and utility trenches (UT-1, UT-2 and UT-3) and one remedial alternative for vapor intrusion (VI-1) have been assembled from the technologies and process options that were retained from the technology screening process. The final remedy will include one from each medium for the former tar plant operations and for the former aluminum smelting operations. The alternatives evaluated include:

Site Wide Alternative:

- SW-1: Institutional Controls

Surface Soil VOC & PAH Alternatives:

- S-1: Soil Barrier
- S-2: Impermeable Cover

Soil PCBs & Metals Alternatives:

- S-3: Soil Barrier
- S-4: Excavation with Off-site Disposal

Potentially Mobile Tar Alternatives:

- PMT-1A: Solidification (0-4 Ft)
- PMT-1B: Solidification (Total Depth)
- PMT-2: Impermeable Cover (0-4 Ft)
- PMT-3A: Excavation (0-4 Ft) with Off-Site Disposal
- PMT-3B: Excavation (Total Depth) with Off-Site Disposal

Groundwater Alternatives:

- GW-1: Monitored Plume Stability (MPS)
- GW-2: In-Situ Treatment
- GW-3: Extraction with Treatment

Utility Trench Alternatives:

- UT-1: Trench Plug
- UT-2: In-Situ Treatment
- UT-3: Extraction with Treatment

Vapor Intrusion Alternative:

- VI-1: Institutional Controls

4.3.1 Alternative SW-1: Site Wide Institutional Controls

4.3.1.1 Description

This alternative would include institutional controls for the following:

- Access restrictions limiting future site use of the Wabash parcel to non-residential uses and establishing a post-closure plan for managing residual soil that may be excavated and/or removed in the future.
- A soil management plan establishing a continuing obligation for the Site outlining the procedures and requirements for management of any future soil disturbance or excavation at the Site.
- Land use restrictions to prevent installation of drinking water wells at the Site and other areas of impacted groundwater to prevent the use of impacted groundwater as source of drinking water.
- Controls to maintain undisturbed wetland areas.
- Requirements to install groundwater migration barriers along future utility trenches that would be installed below the water table at the Site and in other areas of contaminated groundwater. The required barrier would typically include construction of an impermeable clay or bentonite dike around the exterior of the utility pipe to block potential migration along the utility trench.

- Requirements to install vapor mitigation systems for any potential future occupied structures constructed at the Site and over other areas of residual soil and impacted groundwater that have the potential for volatilization.

4.3.1.2 Detailed Evaluation

Long-term effectiveness

This alternative does not reduce the toxicity, mobility or volume of COPCs, however:

- Limiting land use to non-residential decreases potential exposure opportunities to more sensitive populations.
- Procedures and requirements for management of any future soil disturbance or excavation at the Site decreases potential exposure to Site workers.
- Putting a restriction on groundwater use eliminates potential exposure to impacted drinking water and is therefore protective of public health, safety, and welfare.
- Placing a deed restriction on the property to require the installation of groundwater migration barriers along future utilities constructed through areas of affected groundwater eliminates the creation of possible migration pathway and is therefore protective of public health, safety, and welfare.
- Placing a deed restriction on the property to require the installation of a vapor mitigation system beneath the construction of an occupied structure is protective of public health, safety, and welfare by eliminating the potential vapor intrusion pathway.

Short-term effectiveness

There would be no adverse impacts on public health, safety, or welfare or the environment by implementing this institutional control.

Implementability

The current owner of the Wabash Parcel (Connell) intends to place deed restrictions on the property to restrict groundwater use, limit future land use to non-residential, require the installation of groundwater migration barriers along future utilities, and to require the installation of a vapor mitigation system beneath the construction of an occupied structure. The utility corridor property is currently zoned institutional and will remain a utility corridor and access for the Oak Creek Sewer and Water Utility's water intake facility.

Restoration Time Frame

The continuing obligation of a deed restriction is effective, reliable and enforceable.

Economic Feasibility

Appendix SW-1 presents a detailed cost analysis for Alternative SW-1. In summary, capital costs including legal and administrative are estimated to be $25,000 for institutional controls. There are no additional OM&M costs associated with Alternative SW-1.

4.3.2 Alternative S-1: Soil Barrier for PAHs

4.3.2.1 Description

This alternative includes a soil cover to eliminate direct contact with PAHs (primarily benzo(a)pyrene) that exceed the non-industrial direct contact residual contaminant level (0.02

mg/kg). The dermal contact barrier would be comprised of a 2-foot thickness of clean soil placed over the area of impacted soil that exceeds direct contact RCLs. The soil cover would be graded for proper control of storm water run-off. The upper 3 to 6 inches of the 2-foot cover would be comprised of top soil with established vegetation to prevent erosion and deterioration of the cover. Figure 3 shows the area of the dermal contact barrier over affected areas of the Site. The paved road in the utility corridor serves as a component of the dermal contact barrier. The surface area of the soil cover for the combined Wabash and City Parcels is approximately 910,115 square feet or approximately 21 acres. The volume of soil needed for a 2-foot thick cover would be 67,415 cubic yards (yds^3). This alternative does not include a barrier over affected wetlands soils, which are addressed below under remedial alternatives for potentially mobile tar.

Continuing obligations for the dermal cover would include regular inspections and a maintenance program, including the regular repair and/or replacement of any eroded or deteriorated areas, to ensure its long-term effectiveness. The maintenance plan would prohibit activities that may disturb the dermal cover or change the condition of the cover without prior written WDNR approval. Additionally, note that Alternative SW-1 includes a soil management plan establishing a continuing obligation for the Site outlining the procedures and requirements for management of any future soil disturbance or excavation at the Site.

4.3.2.2 Detailed Evaluation

Long-term effectiveness

Placing a dermal contact barrier over the soils with benzo(a)pyrene) concentrations that exceed the direct contact residual contaminant level does not lessen toxicity or volume of COPCs, but it does mitigate mobility. The cover reduces the mobility of constituents in the soil by eliminating potentially impacted runoff. The vegetated soil layer also reduces the amount of infiltration through evapotranspiration which in turn reduces the production of leachate.

This alternative would be protective of public health, safety and welfare and the environment. The covering of impacted soil would reduce risk to public health by direct contact and soil ingestion.

Short-term effectiveness

Short-term risks to the community associated with implementation of the remedy involve health and safety risks to those living around the Site. Community impacts include increased dust/exhaust, noise and traffic congestion from construction and truck traffic. These can be controlled through conventional health and safety measures as well as controlling daily working hours and days of operation. Risks to on-site workers include inhalation of dust and direct contact with impacted soils during excavation and grading activities. These are easily controlled through conventional dust control and health and safety measures.

Short term risks to the environment include potential release of COPCs through off-site run-off during excavation and grading activities. These can be controlled through readily available erosion/sedimentation control features such as silt fences. Short-term risks to the environment also include disruption of animal habitat through necessary clearing of brush and trees and construction of a cover over the impacted soil area. Disruptive activities would be limited when possible, and would take place only during implementation of the remedy. The dermal cover would be revegetated providing healthy wildlife habitats.

Implementability
This alternative is technically straight forward to construct and was recently completed for the former DuPont property to the south of the Site. The equipment and services needed to construct the dermal barrier are readily available, but there may be some difficulty in obtaining the quantity of required imported soil (over 65,000 cubic yards). Imported soil will need to be sampled and approved by WDNR prior to bringing on Site. The soil cover will need to be properly graded to promote directed stormwater runoff. Future redevelopment over the soil cover would need to comply with the cover maintenance requirements and soil management plan.

Restoration Time Frame
The construction of the dermal contact barrier could be completed in a few months providing a restored surface soil environment that is protective of public health and the environment. Continuing obligations for the property owner would include maintenance of the barrier and adherence to a soil management plan which are effective, reliable and enforceable institutional controls.

Economic Feasibility
Appendix S-1 presents a detailed cost analysis for Alternative S-1. In summary, capital costs including engineering and contingency are estimated to be $2,919,916 for the land use restrictions and dermal contact barrier. OM&M costs are estimated at a 30-year net present value (NPV) of $24,940 for a total cost estimate of $2,944,856 for Alternative S-1.

4.3.3 Alternative S-2: Impermeable Cover for PAHs and VOCs

4.3.3.1 Description
This alternative is the same as Alternative S-1 except the engineered barrier would be constructed of an impermeable cover that would not only serve as a dermal contact barrier but would also limit infiltration and thereby minimize the leaching of COPCs in soil to groundwater. The impermeable cover would be comprised of a geomembrane infiltration barrier. It is assumed that a soil barrier layer beneath the geomembrane would not be needed if the surface soil being covered is properly graded and free of objects that could penetrate the geomembrane. A 2-foot thick soil cover would be placed over the geomembrane infiltration barrier to provide rooting depth for vegetation and to protect the geomembrane layer from freeze-thaw damage and other environmental effects. The dimensions of the impermeable cover would be the same as those for the dermal cover and is shown in Figure 3.

4.3.3.2 Detailed Evaluation
Long-term effectiveness
Placing an impermeable cover over the impacted soils does not lessen toxicity or volume of COPCs, but it does mitigate their mobility. The cover reduces the mobility of COPCs in the soil by eliminating potentially impacted runoff. The cover also eliminates infiltration and the production of leachate.

This alternative would be protective of public health, safety and welfare and the environment. The covering of the impacted soil would reduce risk to public health by direct contact and soil ingestion.

Short-term effectiveness
Short-term risks to the community associated with implementation of the remedy involve health and safety risks to those living around the Site. Community impacts include increased dust/exhaust, noise and traffic congestion from construction and truck traffic. These can be controlled through conventional health and safety measures as well as controlling daily working hours and days of operation. Risks to on-site workers include inhalation of dust and direct contact with impacted soils during excavation and grading activities. These are easily controlled through conventional dust control and health and safety measures.

Short term risks to the environment include potential release of COPCs through off-site run-off during excavation and grading activities. These can be controlled through readily available erosion/sedimentation control features such as silt fences. Short-term risks to the environment also include disruption of animal habitat through necessary clearing of brush and trees and construction of a cover over the impacted soil area. Disruptive activities would be limited when possible, and would take place only during implementation of the remedy. The impermeable cover would be revegetated providing healthy habitats for wildlife.

Implementability
This alternative is technically straight forward to construct. Installation of a geomembrane requires contractors to properly install the geomembrane according to manufacturer's instructions. The equipment and services needed to construct the impermeable cover are readily available, but there may be some difficulty in obtaining the quantity of required imported soil (over 65,000 cubic yards). Imported soil will need to be sampled and approved by WDNR prior to bringing on site. The soil cover will need to be properly graded to promote directed stormwater runoff. Future redevelopment over the impermeable cover would need to comply with the cover maintenance requirements and soil management plan.

Restoration Time Frame
The construction of an impermeable cover could be completed in a few months providing a restored surface soil environment that is protective of public health and the environment. Continuing obligations for the property owner would include maintenance of the cover and adherence to a soil management plan which are effective, reliable and enforceable institutional controls.

Economic Feasibility
Appendix S-2 presents a detailed cost analysis for Alternative S-2. In summary, capital costs including engineering and contingency are estimated to be $6,086,369 for the land use restrictions and impermeable cover. OM&M costs are estimated at a 30-year NPV of $24,940 for a total cost estimate of $6,111,309 for Alternative S-2.

4.3.4 Alternative S-3: Soil Barrier for PCBs and Metals

4.3.4.1 Description

This alternative includes two soil barriers, one designed for PCBs and one designed for arsenic only, to eliminate the direct contact pathway. Both soil barriers would be 2-foot thick. The dermal contact barrier for arsenic would be comprised of a 2-foot thickness of clean general fill soil placed over the area of impacted soil that exceeds the arsenic direct contact RCL. The cover for PCBs would be comprised of 10-inches of low permeability soil meeting the requirements of CFR 761.61, placed over the area of impacted soil that exceeds PCB direct contact RCLs followed by 14 inches of clean general fill. The soil covers would be graded for proper control of storm water run-off. The upper 3 to 6 inches of the 2-foot covers would be comprised of top soil with established vegetation to prevent erosion and deterioration of the covers. Figure 8 shows the areas of the two specific barriers over affected areas of the Site. The barriers do not extend over the wetlands. The surface area of the soil cover is approximately 519,400 square feet or approximately 12 acres. The volume of low permeability soil needed for the 10-inch thick cover would be 15,400 cubic yards (cy) and the volume of general clean soil needed to complete the cover over PCB and metals would be 23,200 cy, which is a total of 38,600 cubic yards.

For the west/former building area, a barrier is included for the following:

- Soil with PCB concentrations greater than the non-industrial direct contact RCL and less than or equal to 10 mg/kg total PCBs in the 0-4 ft interval.
- Soil with arsenic above the WDNR background level of 8 mg/kg in the 0-4 ft interval.
- All reused/recycled concrete materials used as fill material.

For the east/wetland area, a barrier is included for the following:

- Select soil with elevated PCB levels but less than or equal to 10 mg/kg total PCBs in the 0-4 ft interval, targeting elevated impacts in the 0-2 ft interval.
- Select soil with arsenic above the WDNR background levels of 8 mg/kg in the 0-4 ft interval, targeting elevated impacts in the 0-2 ft interval.

4.3.4.2 Detailed Evaluation

Long-term effectiveness

Placing a cover over the impacted soils does not lessen toxicity or volume of COPCs, but it does mitigate constituent mobility. The cover reduces the mobility of COPCs in the soil by eliminating runoff. The vegetated soil layer also reduces the amount of infiltration through evapotranspiration which in turn reduces the production of leachate. The 10-inch low permeability soils part of the cover also reduces infiltration and the production of leachate.

This alternative would be protective of public health, safety and welfare and the environment. The barrier over the impacted soil would reduce risk to public health by direct contact and soil ingestion.

Short-term effectiveness

Short-term risks to the community associated with implementation of the remedy involve health and safety risks to those living around the Site. Community impacts include increased dust/exhaust, noise and traffic congestion from construction and truck traffic. These can be controlled through conventional health and safety measures as well as controlling daily working hours and days of operation. Risks to on-site workers include inhalation of dust and direct contact with impacted soils during excavation and grading activities. These are easily controlled through conventional dust control and health and safety measures.

Short term risks to the environment include potential release of constituents through off-site run-off during excavation and grading activities. These can be controlled through readily available erosion/sedimentation control features such as silt fences. Short-term risks to the environment also include disruption of animal habitat through necessary clearing of brush and trees and construction of a cover over the impacted soil area. Disruptive activities would be limited when possible, and would take place only during implementation of the remedy. The cover would be revegetated providing healthy habitats for wildlife.

Implementability

This alternative is technically straight forward to construct and was recently completed for the former DuPont property to the south. The equipment and services needed to construct the covers are readily available, but there may be some difficulty in obtaining the quantity of required imported soil (over 38,000 cubic yards). Imported soil will need to be sampled and approved by WDNR prior to bringing on Site. The soil cover will need to be properly graded to promote directed stormwater runoff. Future redevelopment over the soil cover would need to comply with the cover maintenance requirements, regulatory requirements, and soil management plan.

Restoration Time Frame

The construction of the covers could be completed in a few months providing a restored surface soil environment that is protective of public health and the environment. Continuing obligations for the property owner would include maintenance of the barrier and adherence to a soil management plan which are effective, reliable and enforceable institutional controls.

Economic Feasibility

Appendix S-3 presents a detailed cost analysis for Alternative S-3. In summary, capital costs including engineering and contingency are estimated to be $1,753,413 for the soil barrier option. OM&M costs are estimated at a 30-year NPV of $24,940 for a total cost estimate of $1,778,353 for Alternative S-3.

4.3.5 Alternative S-4: Excavation and Offsite Disposal for PCBs and Metals

4.3.5.1 Description

This alternative consists of excavation of soil with concentrations greater than 10 mg/kg PCBs at any depth. Excavation areas are shown on Figure 9. It is anticipated that soil with concentrations less than or equal to 10 mg/kg PCBs and which are overlying soils with concentrations greater than 10 mg/kg will be excavated and segregated for use as backfill. Excavated soil segregation would be conducted using a 2-inch vertical buffer using equipment to verify this accuracy (i.e. using either Global Positioning System [GPS] equipment or typical surveying equipment which is expected to be capable of segregating the soil within this tolerance).

The 2-inch vertical buffer includes:

- For locations where concentrations greater than 50 mg/kg PCBs exists at the surface, the buffer includes soil 2 inches below the greater than 50 mg/kg PCB layer.
- For locations where concentrations greater than 50 mg/kg PCBs exists in a layer below the surface, the buffer includes soil 2 inches above and 2 inches below the greater than 50 mg/kg PCB layer.
- For locations that only contain soil with concentrations of less than 50 mg/kg PCBs, the 2 inch vertical buffer criteria will also be used to better ensure the soil intended for re-use onsite will be less than or equal to 10 mg/kg.

Soil would be segregate into three different concentrations during excavation including:

- Excavated soil with concentrations greater than 50 mg/kg PCBs will be segregated and disposed at a TSCA-licensed landfill out-of-state.
- Excavated soil with concentrations less than 50 mg/kg PCBs but greater than 10 mg/kg PCBs will be segregated and disposed at a landfill approved for special waste disposal in southeast Wisconsin.
- Excavated soil with concentrations less than or equal to 10 mg/kg PCBs will be segregated and stockpiled on-site in approximate 100 to 300 cubic yard piles. In accordance with NR 718, the soil piles will undergo additional analyses to confirm that the material is less than or equal to 10 mg/kg PCBs and no potentially mobile tar is observed prior to re-use as backfill in the excavation areas.

As part of the S-4 alternative, if potentially mobile tar is observed seeping into any of the excavations, a field decision will be made, depending on the extent and amount of seepage, to either excavate or solidify the tar materials prior to backfilling the excavations.

Additional clean backfill may be imported to complete the backfilling of excavation areas, as necessary. The estimated volume of soil with concentrations greater than or equal to 50 mg/kg PCBs is 1,500 cubic yards and the estimated volume of soil with concentrations greater than 10 mg/kg, but less than 50 mg/kg PCBs is 5,000 cubic yards. Disturbed wetland areas would be mitigated using off-site mitigation credits or an in-lieu fee program.

4.3.5.2 Detailed Evaluation

Long-term effectiveness

Excavation and offsite disposal of the impacted soils would reduce the mass and mobility of COPCs in soil. Off-site disposal would not reduce the mass or toxicity of COPCs removed from the Site, but would reduce the mass and toxicity remaining at the Site.

The removal and off-site disposal of PCB-contaminated surface soil would eliminate the risk to public health by direct contact and soil ingestion. The removal and off-site disposal of impacted soil eliminates the production of leachate from the constituents contained in the removed soil.

Short-term effectiveness

Short-term risks to the community associated with implementation of the remedy involve health and safety risks to those living around the Site. Community impacts included increased dust/exhaust, noise and traffic congestion from construction and truck traffic. These can be controlled through conventional health and safety measures as well as controlling daily working hours and days of operation. Risks to on-site workers include inhalation of dust and vapor and direct contact with impacted soils during excavation activities. These are easily controlled through conventional dust and odor control and health and safety measures.

Short term risks to the environment include potential release of constituents through off-site run-off during excavation activities. These can be controlled through readily available erosion/sedimentation control features such as silt fences. Short-term risks to the environment also include disruption of animal habitat through necessary clearing of brush in the excavation area. Disruptive activities would be limited when possible, and would take place only during implementation of the remedy. The excavations would be backfilled with clean soil and revegetated providing healthy habitats free for wildlife.

Implementablity

This alternative is technically straight forward to implement. The material, equipment, and services needed to excavate, haul, and backfill soils are readily available. Imported soil will need to be sampled and approved by WDNR prior to bring on site. The backfilled areas will need to be properly graded to promote directed stormwater runoff. Disturbed wetland areas would be mitigated using off-site mitigation credits or an in-lieu fee program.

Restoration Time Frame

The soil excavation and backfilling could be completed in a few months providing a restored surface soil environment that is protective of public health and the environment.

Economic Feasibility

A detailed cost analysis for Alternative S-4 is provided in Appendix S-4. In summary, capital costs including engineering and contingency are estimated to be $1,924,656 for excavation and off-site disposal of soil containing soil concentrations greater than 10 mg/kg PCBs. There are no additional OM&M costs associated with Alternative S-4.

4.3.6 Alternative PMT-1A: Solidification (0-4 Ft)

4.3.6.1 Description

This alternative consists of mixing soils with binding agents to solidify soil and reduce tar mobility to prevent seepage of tar to the ground surface and to reduce leachability of VOCs and PAHs from the tar to groundwater. Solidification would be applied to areas of observed potentially mobile tar within the upper 4 feet of surface soil. The general locations of the areas to be solidified are shown on Figure 4 and for the most part coincide with the locations of former tar plant ponds/lagoons (AOC-B4, AOC-B5 and AOC-B6). The total volume of soil to be solidified under this alternative is approximately 9,700 yds^3. Mixing would be accomplished in-situ using mechanical mixers to blend in binding agent(s) such as Portland cement and potentially bentonite. Bench-scale testing would be performed to establish the proper proportion of binding agent(s) necessary to achieve specified strength and permeability criteria to be identified through the remedial design process. Strength criteria for solidification projects commonly ranges from 25-50 psi and permeability criteria typically range from $1x10^{-5}$ to $1x10^{-6}$ cm/sec. Disturbed wetland areas would be mitigated using off-site mitigation credits or an in-lieu fee program. Mixing to be conducted in the vicinity of buried utilities would require approval and coordination with the City of Oak Creek Water and Sewer Utility and other utility companies.

4.3.6.2 Detailed Evaluation

Long-term effectiveness

Solidification of the impacted materials does not lessen the toxicity or volume of COPCs or tar , but it does mitigate their mobility. Solidification eliminates the potential for tar seepage to the ground surface, reduces the mobility of COPCs in the soil by eliminating potentially impacted runoff, and also eliminates infiltration and the production of leachate.

This alternative would be protective of public health, safety and welfare and the environment. The solidification of the impacted soil and tar would reduce risk to public health by direct contact and soil ingestion and eliminate the generation of leachate from COPCs or tar contained in the solidified surface soil. It also would eliminate the potential for tar seepage to the ground surface.

Short-term effectiveness

Short-term risks to the community associated with implementation of the remedy involve health and safety risks to those living around the Site. Community impacts include increased dust/exhaust, noise and traffic congestion from construction and truck traffic. These can be controlled through conventional health and safety measures as well as controlling daily working hours and days of operation. Risks to on-site workers include inhalation of dust and vapors and direct contact with impacted soils during soil mixing activities. These are easily controlled through conventional dust and odor control and health and safety measures.

Short term risks to the environment include potential release of vapors and impacted sediments through off-site run-off during mixing activities. Conducting solidification is a wet process that may mitigate the release of vapors and erosion/sedimentation control features such as silt fences can control any potential off-site run-off. Short-term risks to the environment also include disruption of animal habitat through necessary clearing of brush in the solidification area. Disruptive activities would be limited when possible, and would take place only during implementation of the remedy. The solidified areas would be revegetated providing healthy habitats for wildlife.

Implementability

This alternative is somewhat more challenging technically but relatively straight forward to implement. Soil mixing in the vicinity of buried utilities would be more difficult. Bench testing would be performed to establish the proper proportion of binding agent(s). The material, equipment, and services needed for soil mixing are readily available. The solidified areas will need to be properly graded to promote directed stormwater runoff and revegetated. Future redevelopment over the solidified areas would need to comply with specified maintenance requirements, regulatory requirements, and soil management plan. Disturbed wetland areas would be mitigated using off-site mitigation credits or an in-lieu fee program. Obtaining regulatory approval for solidification may be an obstacle for implementation in wetland areas.

Restoration Time Frame
The soil solidification could be completed in a few months providing a restored surface soil environment that is protective of public health and the environment.

Economic Feasibility
Appendix PMT-1A presents a detailed cost analysis for Alternative PMT-1A. In summary, capital costs including engineering and contingency are estimated to be $1,146,063 for the solidification of surface soil (0-4 feet) containing potentially mobile tar. There are no OM&M costs associated with Alternative PMT-1A.

4.3.7 Alternative PMT-1B: Solidification (Total Depth)

4.3.7.1 Description

This alternative consists of mixing soils with binding agents to solidify soil and reduce tar mobility to prevent seepage of tar to the ground surface and to reduce leachability of VOCs and PAHs from the tar to groundwater. Solidification would be applied to the full lateral and vertical extent of observed potentially mobile tar. The general locations of the areas to be solidified are shown on Figure 5 and for the most part coincide with the locations of former tar plant ponds/lagoons (AOC-B4, AOC-B5 and AOC-B6). The total volume of soil to be solidified under this alternative is approximately 90,000 yds^3. Mixing would be accomplished in-situ using mechanical mixers to blend in binding agents such as Portland cement and potentially bentonite. Bench-scale testing would be performed to establish the proper proportion of binding agent(s) necessary to achieve specified strength and permeability criteria to be identified through the remedial design process. Strength criteria for solidification projects commonly ranges from 25-50 psi and permeability criteria typically range from $1x10^{-5}$ to $1x10^{-6}$ cm/sec. Disturbed wetland areas would be mitigated using off-site mitigation credits or an in-lieu fee program. Mixing to be conducted in the vicinity of buried utilities would require approval and coordination with the City of Oak Creek Water and Sewer Utility and other utility companies.

4.3.7.2 Detailed Evaluation

Long-term effectiveness
Solidification of the soils containing potentially mobile tar does not lessen toxicity or volume of COPCs or tar but it does mitigate their mobility. Solidification eliminates the potential for tar seepage to the ground surface, reduces the mobility of COPCs in the soil by eliminating potentially impacted runoff, and also eliminates production of leachate from residual tar above and below the water table.

This alternative would be protective of public health, safety and welfare and the environment. The solidification of the impacted soil and potentially mobile tar would reduce risk to public health by direct contact and soil ingestion and eliminate the generation of leachate from COPCs contained in the solidified soil. It also would eliminate the potential for tar seepage to the ground surface.

Short-term effectiveness

Short-term risks to the community associated with implementation of the remedy involve health and safety risks to those living around the Site. Community impacts include increased dust/exhaust, noise and traffic congestion from construction and truck traffic. These can be controlled through conventional health and safety measures as well as controlling daily working hours and days of operation. Risks to on-site workers include inhalation of dust and vapors and direct contact with impacted soils during soil mixing activities. These are easily controlled through conventional dust and odor control and health and safety measures.

Short term risks to the environment include potential release of vapors and impacted sediments through off-site run-off during mixing activities. Conducting solidification as a wet process that may mitigate the release of vapors and erosion/sedimentation control features such as silt fences can control any potential off-site run-off. Short-term risks to the environment also include disruption of animal habitat through necessary clearing of brush in the solidification area. Disruptive activities would be limited when possible, and would take place only during implementation of the remedy. The solidified areas would be revegetated providing healthy habitats for wildlife.

Implementability

This alternative is a technically challenging but relatively straight forward to implement. Soil mixing in the vicinity of buried utilities would be more difficult. Bench testing would be performed to establish the proper proportion of binding agent. The material, equipment, and services needed for soil mixing are readily available. The solidified areas will need to be properly graded to promote directed stormwater runoff and revegetated. Future redevelopment over the solidified areas would need to comply with specified maintenance requirements, regulatory requirements, and soil management plan. Disturbed wetland areas would be mitigated using off-site mitigation credits or an in-lieu fee program. Obtaining regulatory approval for solidification may be an obstacle for implementation in wetland areas.

Restoration Time Frame

The soil solidification could be completed in one construction season providing a restored surface soil environment that is protective of public health and the environment.

Economic Feasibility

Appendix PMT-1B presents a detailed cost analysis for Alternative PMT-1B. In summary, capital costs including engineering and contingency are estimated to be $12,577,950 for the solidification of surface and subsurface soil containing potentially mobile tar. There are no OM&M costs associated with Alternative PMT-1B.

4.3.8 Alternative PMT-2: Impermeable Cover (0-4 Ft)

4.3.8.1 Description

This alternative consists of installing an impermeable cover over the areas of surface soil indicating potentially mobile tar to prevent seepage of tar to the ground surface. The general locations of the areas of potentially mobile tar in the surface soils (0-4 feet bgs) are shown on Figure 4 and for the most part coincide with the locations of former tar plant ponds/lagoons

(AOC-B4, AOC-B5 and AOC-B6). The engineered barrier would be comprised of a geomembrane barrier with an overlying 2-foot thick soil cover to provide rooting depth for vegetation and to protect the geomembrane layer from freeze-thaw damage and other environmental effects. Covered wetland areas would be mitigated using off-site mitigation credits or an in-lieu fee program. For the cost estimate it was assumed that this alternative would include the cost of the geomembrane installation component of the cover as part of the dermal cover alternative (S-1). A variation of this alternative excludes the covering in the wetland area (AOC-B6 and part of AOC-B5) and addressing this area using the excavation alternative (PMT-3A).

4.3.8.2 Detailed Evaluation

Long-term effectiveness

Containment of the impacted surface soils and potentially mobile tar does not lessen toxicity or volume of COPCs, but it does mitigate their mobility. Containment eliminates the potential for tar seepage to the ground surface, reduces the mobility of COPCs in the soil by eliminating potentially impacted runoff, and also eliminates infiltration and the production of leachate.

This alternative would be protective of public health, safety and welfare and the environment. The containment of the impacted soil and tar would reduce risk to public health by direct contact and soil ingestion and eliminate the generation of leachate from COPCs contained in the surface soil. It also would eliminate the potential for tar seepage to the ground surface.

Short-term effectiveness

Short-term risks to the community associated with implementation of the remedy involve health and safety risks to those living around the Site. Community impacts include increased dust/exhaust, noise and traffic congestion from construction and truck traffic. These can be controlled through conventional health and safety measures as well as controlling daily working hours and days of operation. Risks to on-site workers include inhalation of dust and vapor and direct contact with impacted soils during grading and covering activities. These are easily controlled through conventional dust and odor control and health and safety measures.

Short term risks to the environment include potential release of COPCs through off-site run-off during grading activities. These can be controlled through readily available erosion/sedimentation control features such as silt fences. Short-term risks to the environment also include disruption of animal habitat through necessary clearing of brush in the excavation area. Disruptive activities would be limited when possible, and would take place only during implementation of the remedy.

Implementability

This alternative is technically straight forward to implement. Installation of a geomembrane is a specialty service, requiring experienced contractors to properly install the geomembrane according to manufacturer's instructions. Future redevelopment over the cover would need to comply with the cover maintenance requirements and soil management plan. Covered wetland areas would be mitigated using off-site mitigation credits or an in-lieu fee program. Obtaining regulatory approval for covering may be an obstacle for implementation in wetland areas.

Restoration Time Frame

The covering could be completed in a few weeks providing a restored surface soil environment that is protective of public health and the environment.

Economic Feasibility

Appendix PMT-2 presents a detailed cost analysis for Alternative PMT-2 with and without covering the wetland area (AOC-B5/AOC-B6). In summary, capital costs including engineering and contingency for the engineered barrier over areas with potentially mobile tar in the surface soil are estimated to be $486,544 for all areas (PMT-2) and $401,723 if covering wetland areas are excluded (PMT-2.1). This alternative could be implemented independently or in conjunction with Alternative S-1. There are no additional OM&M costs associated with Alternative PMT-2.

4.3.9 Alternative PMT-3A: Excavation (0-4 Ft) with Off-Site Landfill Disposal

4.3.9.1 Description

This alternative consists of excavation and off-site disposal of soils in areas indicating potentially mobile tar within the upper 4 feet of surface soil to prevent seepage of tar to the ground surface. The general locations of the areas of potentially mobile tar in the surface soils (0-4 feet bgs) are shown on Figure 4 and for the most part coincide with the locations of former tar plant ponds/lagoons (AOC-B4, AOC-B5 and AOC-B6). The total amount of soil to be excavated and landfilled under this alternative is approximately 14,500 tons. Based on the TCLP analysis of the soil indicating that the soil is non-hazardous, off-site disposal would be to an approved sanitary landfill. Excavated areas would require backfilling with clean fill. Disturbed wetland areas would be mitigated using off-site mitigation credits or an in-lieu fee program. Soil excavation in the vicinity of buried utilities would require approval and coordination with the City of Oak Creek Water and Sewer Utility and other utility companies. For the cost estimate it was assumed that this alternative would utilize the additional soil cover including topsoil and revegetation of alternative S-1. A variation of this alternative includes only excavation in the wetland area (AOC-B6 and part of AOC-B5) to be used in conjunction with the covering of the other non-wetland areas using Alternative PMT-2.

4.3.9.2 Detailed Evaluation

Long-term effectiveness

This remedy would reduce the mobility of COPCs and potentially mobile tar through removal of wastes for off-site disposal. Off-site disposal would not reduce the volume or toxicity of COPCs removed from the Site.

This alternative would be protective of public health, safety and welfare and the environment. The removal and off-site disposal of impacted surface soil and tar would eliminate the risk to public health by direct contact and soil ingestion. The removal and off-site disposal of tar in the surface soil eliminates the potential for tar seepage to the ground surface, reduces the mobility of COPCs in the soil by eliminating potentially impacted runoff, and also eliminates infiltration and the production of leachate from the COPCs contained in the removed surface soil.

Short-term effectiveness

Short-term risks to the community associated with implementation of the remedy involve health and safety risks to those living around the Site. Community impacts include increased dust/exhaust, noise and traffic congestion from construction and truck traffic. These can be controlled through conventional health and safety measures as well as controlling daily working hours and days of operation. Risks to on-site workers include inhalation of dust and vapor and direct contact with impacted soils during excavation and grading activities. These are easily controlled through conventional dust and odor control and health and safety measures.

Short term risks to the environment include potential release of COPCs through off-site run-off during excavation and grading activities. These can be controlled through readily available erosion/sedimentation control features such as silt fences. Short-term risks to the environment also include disruption of animal habitat through necessary clearing of brush in the excavation area. Disruptive activities would be limited when possible, and would take place only during implementation of the remedy. The excavations would be backfilled with clean soil and revegetated providing healthy habitats for wildlife.

Implementability

This alternative is technically straight forward to implement. The material, equipment, and services needed to excavate, haul and backfill soils are readily available. Imported soil will need to be sampled and approved by WDNR prior to bringing on Site. The backfilled areas will need to be properly graded to promote directed stormwater runoff. Disturbed wetland areas would be mitigated using off-site mitigation credits or an in-lieu fee program. Regulatory approval will be required for excavation in the wetland areas.

Restoration Time Frame

The soil excavation and backfilling could be completed in a few months providing a restored surface soil environment that is protective of public health and the environment.

Economic Feasibility

Appendix PMT-3A presents a detailed cost analysis for Alternative PMT-3A with and without the excavation of the non-wetland areas. In summary, capital costs including engineering and contingency for the excavation and disposal of surface soil containing potentially mobile tar are estimated to be $1,463,688 for all areas (PMT-3A) and $328,006 for wetland areas only (PMT-3A.1) (AOC-B5/AOC-B6). There are no additional OM&M costs associated with Alternative PMT-3A.

4.3.10 Alternative PMT-3B: Excavation (Total Depth) with Off-Site Landfill Disposal

4.3.10.1 Description

This alternative consists of excavation and off-site disposal of the full lateral and vertical extent of soils indicating potentially mobile tar to eliminate the source of tar seepage and impacts to groundwater. The general locations of the areas to be excavated are shown on Figure 5. The total amount of soil to be excavated and landfilled under this alternative is approximately 90,000 cubic yards (135,000 tons). Based on the TCLP analysis of the soil indicating that the soil is non-hazardous, off-site disposal would be to an approved sanitary landfill. Excavated areas would require backfilling with clean fill. Disturbed wetland areas would be mitigated using off-site mitigation credits or an in-lieu fee program. Soil excavation in the vicinity of buried utilities would require approval and coordination with the City of Oak Creek Water and Sewer Utility and other utility companies.

4.3.10.2 Detailed Evaluation

Long-term effectiveness

This remedy would reduce the mobility of COPCS in soil and potentially mobile tar through removal of the material for off-site disposal. Off-site disposal would not reduce the volume or toxicity of constituents removed from the Site.

This alternative would be protective of public health, safety and welfare and the environment. The removal and off-site disposal of impacted surface soil and tar would eliminate the risk to public health by direct contact and soil ingestion. The removal and off-site disposal of tar in the surface soil eliminates the potential for tar seepage to the ground surface, reduces the mobility of COPCs in the soil by eliminating potentially impacted runoff, and also eliminates the production of leachate from the COPCs contained in the removed surface soil.

Short-term effectiveness

Short-term risks to the community associated with implementation of the remedy involve health and safety risks to those living around the Site. Community impacts include increased dust/exhaust, noise and traffic congestion from construction and truck traffic. These can be controlled through conventional health and safety measures as well as controlling daily working hours and days of operation. Risks to on-site workers include inhalation of dust and vapor and direct contact with impacted soils during excavation and grading activities. These are easily controlled through conventional dust and odor control and health and safety measures.

Short term risks to the environment include potential release of COPCs through off-site run-off during excavation and grading activities. These can be controlled through readily available erosion/sedimentation control features such as silt fences. Short-term risks to the environment also include disruption of animal habitat through necessary clearing of brush in the excavation area. Disruptive activities would be limited when possible, and would take place only during implementation of the remedy. The excavations would be backfilled with clean soil and revegetated providing healthy habitats for wildlife.

Implementability

This alternative is technically straight forward to implement. The equipment and services needed to excavate, haul and dispose of soils are readily available, but there may be some difficulty in obtaining the quantity of required imported soil (90,000 cubic yards) to backfill the excavations. Imported soil will need to be sampled and approved by WDNR prior to bringing on Site. The backfilled areas will need to be properly graded to promote directed stormwater runoff. Disturbed wetland areas would be mitigated using off-site mitigation credits or an in-lieu fee program. Regulatory approval will be required for excavation in the wetland areas.

Restoration Time Frame
The soil excavation and backfilling could be completed in one construction season providing a restored surface soil environment that is protective of public health and the environment.

Economic Feasibility
Appendix PMT-3B presents a detailed cost analysis for Alternative PMT-3B. In summary, capital costs including engineering and contingency are estimated to be $12,671,450 for the excavation and disposal of surface and subsurface soil containing potentially mobile tar. There are no additional OM&M costs associated with Alternative PMT-3B.

4.3.11 Alternative GW-1: Monitored Plume Stability (MPS)

4.3.11.1 Description
This alternative includes implementing a groundwater monitoring program to demonstrate that the dissolved phase groundwater plume is stable and not migrating. The monitoring well network would include a number of water table wells along the plume front, a few within the plume and a couple upgradient background locations. A few locations would include deeper nested wells to monitor the base of the plume. The network is assumed to include 12 shallow and 4 deep wells that would be sampled and analyzed for VOCs and PAHs quarterly for a period of two years. It is assumed that 4 shallow and 1 deep well will be installed to supplement the existing well network.

4.3.11.2 Detailed Evaluation
Long-term effectiveness
This alternative does not reduce the toxicity, mobility and volume of the COPCs in the groundwater. Groundwater monitoring to ensure that the dissolved phase plume is stable and not migrating would be protective of public health and the environment.

Short-term effectiveness
There are no adverse impacts on public health, safety, or welfare or the environment that may be posed during the construction and implementation period. Risks to on-site workers include inhalation of dust and vapor and direct contact with impacted soils and water during well installation and sampling activities. These are easily controlled through conventional health and safety measures.

Implementability
This alternative is technically straight forward to construct and implement. The material, equipment, and services needed to construct and sample groundwater monitoring wells are readily available. Natural attenuation of the dissolved phase groundwater plume is technically feasible considering the age of the plume and the limited horizontal and vertical extent of migration to date. Redevelopment potential of the Site would not be impeded once the remedy has been implemented.

Restoration Time Frame
While the more mobile VOC and PAH compounds are naturally biodegradable, groundwater restoration would take a long period of time. However, the low soil permeability and resultant

slow groundwater travel times are such that the plume front appears to be stabilized by natural biodegradation processes. Groundwater monitoring would be used to evaluate and demonstrate that natural attenuation is taking place and that the dissolved phase plume is stable and not migrating. There are no receptors or current users of the aquifer or surface water in proximity to the impacted groundwater and future groundwater use restrictions would ensure that remains the case. The continuing obligation of groundwater use restriction is effective, reliable and enforceable.

Economic Feasibility

Appendix GW-1 presents a detailed cost analysis for Alternative GW-1. It is expected that plume stability will be able to be confirmed within a two- year time period. In summary, capital costs including engineering and contingency are estimated to be $41,250 for groundwater use restrictions and monitoring well installation/repair. OM&M costs are estimated at $60,000 for two years for a total cost estimate of $101,250 for Alternative GW-1.

4.3.12 Alternative GW-2: In-Situ Treatment

4.3.12.1 Description

This alternative includes the groundwater monitoring as in Alternative GW-1 with the addition of an in-situ groundwater treatment system using the funnel and gate technology. The funnel and gate system would include a slurry wall installed along the leading edge of the dissolved phase groundwater plume that would be used to direct the flow of groundwater through treatment gates using aerobic treatment curtains (ATCs). The portion of the plume within the utility corridor would be addressed under the UT alternatives. A conceptual layout of the funnel and gate system is shown in Figure 6. The approximately 1,000-foot long slurry wall would extend to a depth of 25 feet bgs. The location, number and width of treatment gates would need to be determined through groundwater modeling to ensure the funnel captures the plume, that groundwater mounding does not occur behind the wall and that adequate retention time occurs within the gate to degrade the COPCs. Groundwater may be recirculated within the ATC where oxygen and nutrients are added to enhance the growth of indigenous microbes that naturally degrade VOCs and PAHs.

4.3.12.2 Detailed Evaluation

Long-term effectiveness

This alternative reduces constituent mobility by funneling impacted groundwater through an in-situ treatment system. The toxicity and volume of COPCs in groundwater that pass through the in-situ treatment system would be reduced through biodegradation.

Control and treatment of the dissolved phase groundwater plume is protective of public health, safety, and welfare and the environment. Groundwater monitoring to ensure that the dissolved phase plume is controlled and not migrating would also be protective of public health and the environment.

Short-term effectiveness

Short-term risks to the community associated with implementation of the remedy involve health and safety risks to those living around the Site. Community impacts include increased dust/exhaust, noise and traffic congestion from construction and truck traffic. These can be controlled through conventional health and safety measures as well as controlling daily working hours and days of operation. Risks to on-site workers include inhalation of dust and vapor and direct contact with impacted soils during construction of the slurry wall and treatment gates. These are easily controlled through conventional dust and odor control and health and safety measures.

Short term risks to the environment include potential release of COPCs through off-site run-off during construction activities. These can be controlled through readily available erosion/sedimentation control features such as silt fences.

Implementability
This alternative is a bit more challenging technically to implement. Construction of the slurry wall portion is relatively straightforward. The critical part of the alternative is the design of the treatment gate to ensure that the funnel and gate system works hydraulically and that the treatment gate is effective in treating the impacted groundwater. The location, number and width of treatment gates would need to be determined through groundwater modeling to ensure the funnel captures the plume, that groundwater mounding does not occur behind the wall and that adequate retention time occurs within the gate to degrade the constituents.

The material, equipment, and services needed to construct the funnel and gate system are readily available. Aerobic biodegradation of the VOCs and PAHs in the dissolved phase groundwater plume is technically feasible. Redevelopment potential of the Site would not be impeded once the remedy has been implemented. Placing a groundwater use restriction on the property is administratively feasible and straight forward.

Restoration Time Frame
While the impacted groundwater that passes through the in-situ treatment system would be restored, groundwater restoration of the entire plume would take a long period of time due to the low soil permeability and resultant slow groundwater travel times. There are no receptors or current users of the aquifer or surface water in proximity to the dissolved phase groundwater plume and future groundwater use restrictions would ensure that remains the case. The continuing obligation of groundwater use restriction is effective, reliable and enforceable.

Economic Feasibility
Appendix GW-2 presents a detailed cost analysis for Alternative GW-2. In summary, capital costs including engineering and contingency are estimated to be $822,388 for groundwater use restrictions and funnel and gate construction. OM&M costs are estimated at a 30-year NPV of $1,371,700 for a total cost estimate of $2,194,088 for Alternative GW-2.

4.3.13 Alternative GW-3: Pump and Treat

4.3.13.1 Description
This alternative is the same as Alternative GW-2, except instead of a funnel and gate treatment system, a groundwater collection trench would be installed along the same alignment (Figure 6) to intercept the dissolved phase groundwater plume for extraction and treatment through a

granular activated carbon (GAC) treatment system. The trench would be 25 feet deep and be sloped to a central sump location where groundwater extraction would occur. The GAC treatment system would be housed in an aboveground building. Treated water would be discharged to the storm sewer under a WPDES permit.

4.3.13.2 Detailed Evaluation

Long-term effectiveness

This alternative reduces constituent mobility by intercepting impacted groundwater and treating the collected groundwater through an above ground treatment system. The toxicity and volume of COPCs in groundwater that are collected and treated would be ultimately be reduced when the spent carbon units are sent off-site for regeneration.

Control and treatment of the dissolved phase groundwater plume is protective of public health, safety, and welfare and the environment. Groundwater monitoring to ensure that the dissolved phase groundwater plume is controlled and not migrating would also be protective of public health and the environment.

Short-term effectiveness

Short-term risks to the community associated with implementation of the remedy involve health and safety risks to those living around the Site. Community impacts include increased dust/exhaust, noise and traffic congestion from construction and truck traffic. These can be controlled through conventional health and safety measures as well as controlling daily working hours and days of operation. Risks to on-site workers include inhalation of dust and vapor and direct contact with impacted soils during construction of the collection trench and treatment system. These are easily controlled through conventional dust and odor control and health and safety measures.

Short term risks to the environment include potential release of COPCs through off-site run-off during construction activities. These can be controlled through readily available erosion/sedimentation control features such as silt fences.

Implementability

This alternative is technically straight forward to implement. The material, equipment, and services needed to construct the trench and treatment system are readily available. Treatment of the VOCs and PAHs in the extracted groundwater is technically feasible with granular activated carbon. Redevelopment potential of the Site would not be impeded once the remedy has been implemented.

Restoration Time Frame

While the impacted groundwater that is collected and treated would be restored, groundwater restoration of the entire plume would take a long period of time due to the low soil permeability and resultant slow groundwater travel times. There are no receptors or current users of the aquifer or surface water in proximity to the impacted groundwater plume and future groundwater use restrictions would ensure that remains the case. The continuing obligation of groundwater use restriction is effective, reliable and enforceable.

Economic Feasibility

Appendix GW-3 presents a detailed cost analysis for Alternative GW-3. In summary, capital costs including engineering, legal, administrative and contingency are estimated to be $763,606 for groundwater use restrictions and collection trench and treatment system construction. OM&M costs are estimated at a 30-year NPV of $1,371,700 for a total cost estimate of $2,135,306 for Alternative GW-3.

4.3.14 Alternative UT-1: Trench Plugs

4.3.14.1 Description

This alternative includes installing a low permeability trench plug using flowable fill along existing utilities that may currently serve as preferential pathways for impacted groundwater migration. The trench plugs would be placed within the utility corridor and across the two raw water lines and storm sewer at the downgradient end of the zone of impacted groundwater (Figure 7). The trench plug would be installed by excavating and exposing the buried utility lines so that the low permeability trench plug can be emplaced. Excavation work would be done with a combination of standard excavation equipment, vacuum excavation with an air knife, and shoring. The work would require the approval and coordination with the Oak Creek Sewer and Water Utility and other utility companies to ensure no damage would occur to existing infrastructure.

4.3.14.2 Detailed Evaluation

Long-term effectiveness

Trench plugs placed along buried utilities would not lessen toxicity or volume of COPCs, but they would mitigate constituent mobility along potential groundwater migration pathways. This alternative would be protective of public health, safety and welfare and the environment by eliminating constituent migration along potential preferential pathways.

Short-term effectiveness

There would be little to no short-term risks to the community associated with implementation of this remedy. Risks to on-site workers include inhalation of dust and vapor and direct contact with impacted soils and groundwater during excavation around the trench and construction of the trench plug around the utilities. These are easily controlled through conventional health and safety measures.

Short term risks to the environment include potential release of COPCs through surface run-off during construction. These can be controlled through readily available spill containment/control features.

Implementability

This alternative is technically challenging and would require the approval and coordination with the Oak Creek Sewer and Water Utility and other utility companies to ensure no damage would occur to existing infrastructure. The material, equipment, and services needed for installing a trench plug are readily available.

Restoration Time Frame
The construction of the trench plug could be completed in a few weeks and eliminate a potential preferential migration pathway that is protective of public health and the environment.

Economic Feasibility
Appendix UT-1 presents a detailed cost analysis for Alternative UT-1. In summary, capital costs including engineering and contingency are estimated to be $125,950 for the institutional controls and trench plug construction. There are no additional OM&M costs associated with Alternative UT-1.

4.3.15 Alternative UT-2: In-Situ Treatment

4.3.15.1 Description
This alternative would include an in-situ groundwater treatment system installed across the utilities in the utility corridor that may be serving as preferential migration pathways for impacted groundwater. The location of the in-situ treatment system is shown in Figure 7. The in-situ treatment would be similar to that of Alternative GW-2 and include the injection of oxygen and nutrients into an interception trench to enhance the growth of indigenous microbes that naturally degrade VOCs and PAHs.

4.3.15.2 Detailed Evaluation
Long-term effectiveness
The toxicity, mobility and volume of COPCs in groundwater that pass through the in-situ treatment system would be reduced through biodegradation. Control and treatment of impacted groundwater potentially migrating along this preferential pathway is protective of public health, safety, and welfare and the environment.

Short-term effectiveness
There would be little to no short-term risks to the community associated with implementation of this remedy. Risks to on-site workers include inhalation of dust and vapor and direct contact with impacted soils and groundwater during construction of the trench around the utilities. These are easily controlled through conventional dust and odor control and health and safety measures.

Short term risks to the environment include potential release of COPCs through off-site run-off during construction activities. These can be controlled through readily available erosion/sedimentation control features such as silt fences.

Implementability
This alternative is technically challenging and would require the approval and coordination with the Oak Creek Sewer and Water Utility and other utility companies to ensure no damage would occur to existing infrastructure. The material, equipment, and services needed for trenching around utilities and installing the treatment system are readily available. Aerobic biodegradation of the VOCs and PAHs in the treated groundwater is technically feasible.

Restoration Time Frame

Installation of the in-situ treatment system could be completed in a few weeks and would be protective of public health and the environment by restoring groundwater migrating along this preferential pathway. The continuing obligation of a deed restriction is effective, reliable and enforceable.

Economic Feasibility

Appendix UT-2 presents a detailed cost analysis for Alternative UT-2. In summary, capital costs including engineering and contingency are estimated to be $229,075 for institutional controls and in-situ treatment system construction. OM&M costs are estimated at a 30-year NPV of $623,500 for a total cost estimate of $852,575 for Alternative UT-2.

4.3.16 Alternative UT-3: Extraction with Treatment

4.3.16.1 Description

This alternative is the same as Alternative UT-2, except instead of an in-situ treatment system, groundwater would be extracted from an interception trench and treated using a granular activated carbon (GAC) treatment system. The trench location would be the same as that for Alternative UT-2 (Figure 7) The GAC treatment system would be housed in an aboveground building. Treated water would be discharged to the storm sewer under a WPDES permit.

4.3.16.2 Detailed Evaluation

Long-term effectiveness

This alternative reduces COPC mobility by intercepting impacted groundwater and treating the collected groundwater through an above ground treatment system. The toxicity and volume of dissolved phase constituents in groundwater that are collected and treated would be ultimately be reduced when the spent carbon units are sent off-site for regeneration. Control and treatment of impacted groundwater potentially migrating along this preferential pathway is protective of public health, safety, and welfare and the environment.

Short-term effectiveness

There would be little to no short-term risks to the community associated with implementation of this remedy. Risks to on-site workers include inhalation of dust and vapor and direct contact with impacted soils and groundwater during construction of the trench around the utilities. These are easily controlled through conventional dust and odor control and health and safety measures.

Short term risks to the environment include potential release of COPCs through off-site run-off during construction activities. These can be controlled through readily available erosion/sedimentation control features such as silt fences.

Implementability

This alternative is technically challenging and would require the approval and coordination with the Oak Creek Sewer and Water Utility and other utility companies to ensure no damage would occur to existing infrastructure. The material, equipment, and services needed for trenching around utilities and installing the treatment system are readily available. Carbon treatment of the VOCs and PAHs in the dissolved phase groundwater plume is technically feasible.

Restoration Time Frame
The installation of the collection and treatment system could be completed in a few weeks and would be protective of public health and the environment by restoring groundwater potentially migrating along this preferential pathway.

Economic Feasibility
Appendix UT-3 presents a detailed cost analysis for Alternative UT-3. In summary, capital costs including engineering, legal, administrative and contingency are estimated to be $229,075 for institutional controls and collection trench and treatment system construction. OM&M costs are estimated at a 30-year NPV of $623,500 for a total cost estimate of $852,575 for Alternative UT-3.

4.3.17 Alternative VI-1: Institutional Controls
See the description and detailed evaluation for Site wide institutional controls under section 4.3.1

5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section presents a comparison of the alternatives for each media/pathway. Table 2 presents a summary of these comparisons by using an assessment index of high, medium or low for the technical criteria: long-term effectiveness, short-term effectiveness and implementability. The selection of the assessment indices was based primarily on engineering judgment and on past experience. Alternative SW-1 (Site wide Institutional Controls) will be implemented Site wide in conjunction with all selected alternatives and is not included in the comparative analysis.

5.1 Comparative Analysis of Surface Soil Alternatives for VOCs and PAHs

Long-term effectiveness

Neither soil alternatives S-1 or S-2 lessen the toxicity or volume of COPCs, but both mitigate constituent mobility by eliminating potentially impacted runoff. Alternative S-2 would provide a greater reduction in infiltration and the production of leachate compared to Alternative S-1, however, the reduction in constituent flux would not make a significant material difference in the groundwater plume considering the low mass of leachable COPCs in the unsaturated zone compared to the mass in the saturated zone. Both alternatives would be protective of public health, safety and welfare and the environment by reducing risk to public health by direct contact and soil ingestion.

Short-term effectiveness

The adverse impacts on public health, safety or welfare or the environment that may be posed during the construction and implementation period for both alternatives is about the same. There would be slightly more noise and traffic congestion from construction and truck traffic with Alternative S-2 as the cover installation would require more time and materials to construct.

Implementability

There is more availability of the materials, equipment, and services required for implementation of Alternative S-1 than for Alternative S-2 which would require specialty services for proper installation of the geomembrane component of the cover. Otherwise all other aspects for these two alternatives are the same.

Restoration Time Frame

The restoration timeframe is nearly the same for both alternatives. There may be slightly less leachate generation with Alternative S-2 but not enough difference to be of material consequence.

Economic Feasibility

Total estimated costs for Alternative S-1 ($2,944,856) are significantly lower than costs for Alternative S-2 ($6,111,309).

5.2 Comparative Analysis of Soil Alternatives for PCBs and Metals

Long-term effectiveness

Both soil alternatives S-3 and S-4 mitigate COPC mobility by eliminating potentially impacted runoff, but soil alternative S-4 lessens the toxicity and volume of constituents on-site. Alternative S-4 would provide the greatest reduction in the toxicity, mobility and volume of COPCs at the Site through excavation, although the toxicity and volume of constituents are not absolutely reduced, but relocated to an off-site disposal facility. Alternative S-4 would be the most protective of public health, safety and welfare and the environment as the impacted soil would have a direct contact cover; whereas Alternative S-4 would remove concentrations above 10 mg/kg PCBs but would leave soil with concentrations above direct contact RCLs exposed to the public. Overall, both alternatives would be protective of public health, safety and welfare and the environment by reducing risk to public health by direct contact and soil ingestion. Neither alternative would meet the regulatory requirements of PCB-impacted soil for a high occupancy area by itself.

Short-term effectiveness

During the implementation period, Alternative S-4 would have the most adverse impact on the community living around the site due to increased dust/exhaust, noise and traffic congestion from construction and truck traffic hauling cover soils to the site. For on-site workers, Alternative S-4 would have a higher potential for direct contact with impacted soils compared to the other alternative, but with health and safety measures the impact differential between the two alternatives can be neutralized. Short-term risks to the environment from potential release of impacted sediment run-off during implementation is probably greatest with Alternative S-4 but these can be controlled through readily available erosion/sedimentation control features such as silt fences.

Implementablity

Alternative S-4 would be the most difficult to implement of the two alternatives as it involves segregating soils containing PCBs with a high level of accuracy. However, both alternatives are relatively straight forward approaches and are often combined into a final remedy.

Restoration Time Frame

Both alternatives would take approximately the same amount of time to provide a restored surface soil condition that is protective of public health and the environment.

Economic Feasibility

Total estimated costs for Alternative S-4 ($1,924,656) are higher than costs for Alternative S-3 (1,778,353).

5.3 Comparative Analysis of Potentially Mobile Tar Alternatives

Alternatives PMT-1, PMT-2 and PMT-3 were carried forward to address the remedial action objective of preventing tar seeps to the ground surface. It is believed that this objective can be met by remediating the surface soil interval (0-4 ft) as provided by Alternatives PMT-1A, PMT-2 and PMT-3A. Alternatives PMT-1B and PMT-3B remediate not only surface soil but also subsurface soil to the full depth of observed potentially mobile tar. While these alternatives (PMT-1B and PMT-3B) exceed what is needed to achieve the remedial objective of preventing tar seeps, they were evaluated for comparison because of the more complete source control they provide. Therefore, the comparison of the alternatives below is divided into two subsections: subsection 5.3.1 compares the three alternatives that adequately address the tar seep objective (PMT-1A, PMT-2 and PMT-3A) while subsection 5.3.2 compares the other two alternatives that go beyond achieving the tar seep objective by addressing the full depth of observed potentially mobile tar (PMT-1B and PMT-3B).

5.3.1 Alternatives for Preventing Surface Seeps of Potentially Mobile Tar (PMT-1A, PMT-2, and PMT-3A)

Long-term effectiveness
Alternative PMT-3A would provide the greatest reduction in the toxicity, mobility and volume of COPCs at the Site through excavation, although the toxicity and volume of constituents are not absolutely reduced, but relocated to an off-site disposal facility. Alternative PMT-3A would also be the most protective of public health, safety and welfare and the environment as the tar would be removed from the Site and placed in a licensed landfill. Alternative PMT-1A (solidification) would provide a slightly greater reduction in constituent mobility compared to Alternative PMT-2 (engineered barrier) but not enough to be of material consequence in terms of being more protective of public health, safety, and welfare and the environment.

Short-term effectiveness
During the implementation period, Alternative PMT-3 would have the most adverse impact on the community living around the Site due to increased dust/exhaust, noise and traffic congestion from construction and truck traffic hauling excavated materials off-site. For on-site workers, Alternative PMT-1A would likely generate more dust and vapors and may have a higher potential for direct contact with impacted soils compared to the other alternatives, but with conventional dust and odor control and health and safety measures the impact differential between the three alternatives can be neutralized. Short-term risks to the environment from potential release of vapors and potentially impacted sediment run-off during implementation is probably greatest with Alternative PMT-1A, but conducting solidification as a wet process that may mitigate the release of vapors and erosion/sedimentation control features such as silt fences can control run-off.

Implementability
Obtaining regulatory approval for either solidification (PMT-1A) or covering (PMT-2) may be an obstacle for implementation in wetland areas. From a technical perspective, alternative PMT-1A would be the most difficult to implement of the three alternatives as it involves selecting and adequately mixing in the proper binding agent(s) to solidify the soil.

Restoration Time Frame
All three alternatives would take approximately the same amount of time to provide a restored surface soil condition that is protective of public health and the environment.

Economic Feasibility

The lowest cost alternative is PMT-2 at $486.544 while Alternative PMT-3A has the highest estimated cost at $1,463,688.

5.3.2 Alternatives for Full Depth of Observed Potentially Mobile Tar (PMT-1B and PMT-3B)

Long-term effectiveness

Alternative PMT-3B (excavation – total depth) would provide the greatest reduction in the toxicity, mobility and volume of COPCs at the Site through excavation, although the toxicity and volume of constituents are not absolutely reduced, but relocated to an off-site disposal facility. Alternative PMT-3B would also be the most protective of public health, safety and welfare and the environment as the tar would be removed from the Site and placed in a licensed landfill.

Short-term effectiveness

During the implementation period, Alternative PMT-3B would have the most adverse impact on the community living around the Site due to increased dust/exhaust, noise and traffic congestion from construction and truck traffic hauling excavated materials off-site. For on-site workers, Alternative PMT-1B would likely generate more dust and vapors and may have a higher potential for direct contact with impacted soils compared to alternative PMT-3B, but with conventional dust and odor control and health and safety measures the impact differential between the two alternatives can be neutralized. Short-term risks to the environment from the potential release of vapors and potentially impacted sediment run-off during implementation is probably greatest with Alternative PMT-1B, but conducting solidification as a wet process that may mitigate the release of vapors and erosion/sedimentation control features such as silt fences can control run-off..

Implementability

Alternative PMT-1B would be the most difficult to implement as it involves selecting and adequately mixing in the proper binding agent(s) to solidify the soil. Excavation and off-site disposal (PMT-3B) would technically be the most routine and straightforward alternative to implement, although it would require a large amount of imported soil to backfill the excavations.

Restoration Time Frame

Both alternatives would take approximately the same amount of time to provide a restored soil condition that is protective of public health and the environment.

Economic Feasibility

Total estimated costs for Alternative PMT-1B ($12,577,950) are slightly lower than costs for Alternative PMT-3B ($12,671,450).

5.4 Comparative Analysis of Groundwater Alternatives

Long-term effectiveness

Alternative GW-1 provides no reduction in the toxicity and volume of the dissolved phase constituents in groundwater. Alternatives GW-2 and GW-3 provide some reduction in toxicity and volume of COPCs but given the low constituent flux into/through these treatment systems, the reduction would not be materially significant compared to Alternative GW-1. The same is true regarding constituent mobility. Alternative GW-1 provides no reduction in mobility, but due to the nature of the clay materials at the Site and their corresponding low groundwater velocities the mobility of COPCs is so low to begin with that the reduction in mobility provided by Alternatives GW-2 and GW-3 is not materially significant compared to Alternative GW-1. As a result, the three alternatives are equally protective of public health, safety and welfare and the environment.

Short-term effectiveness
As there is no construction involved, Alternative GW-1 would have the least impact on public health, safety and welfare and the environment during implementation. For Alternatives GW-2 and GW-3, the impacts to the community from increased dust/exhaust, noise and traffic congestion from construction and truck traffic, the risks to on-site workers from inhalation of dust and vapor and direct contact with impacted soils, and the risks to the environment from potential release of constituents through off-site run-off during construction are about the same. These are easily controlled through conventional dust and odor control, erosion/sedimentation control, and health and safety measures.

Implementability
Alternative GW-1 (MPS) would be the easiest to implement as no construction is involved. Natural attenuation of the dissolved phase groundwater plume is technically feasible, especially when considering the age of the plume and the limited horizontal and vertical extent of migration to date. Alternative GW-2 would be the most technically challenging to design making sure the system works hydraulically while providing adequate treatment. Aboveground treatment of VOCs and PAHs with granular activated carbon (GW-3) is more technically feasible than in-situ aerobic biodegradation (GW-2).

Restoration Time Frame
Groundwater restoration of the entire plume would take a long period of time for all three alternatives due to the low soil permeability and resultant slow groundwater travel times. There are no receptors or current users of the aquifer or surface water in proximity to the dissolved phase plume and future groundwater use restrictions would ensure that remains the case.

Economic Feasibility
The lowest cost alternative is GW-1 at $101,250. Alternative GW-2 has the highest estimated cost at $2,194,088 followed closely by Alternative GW-3 at $2,135,306.

5.5 Comparative Analysis of Utility Trench Alternatives

Long-term effectiveness
Alternative UT-1 would provide no reduction in the toxicity and volume of the constituents in the groundwater. Alternatives UT-2 and UT-3 would provide some reduction in toxicity and volume of constituents but given the low flux into/through these treatment systems, the reduction would not be materially significant compared to Alternative UT-1. All three alternatives would provide an equivalent reduction in COPC mobility along the preferential pathway of buried utilities. As a result, the three alternatives are equally protective of public health, safety and welfare and the environment.

Short-term effectiveness
There would be little to no impact to the community during implementation of any of the three alternatives. Risks to on-site workers are comparable for all three alternatives and are easily controlled through conventional health and safety measures. Short term risks to the environment are also comparable between the alternatives and are controlled through readily available spill containment/control and erosion/sedimentation control features.

Implementability
All three alternatives are technically challenging and would require the approval and coordination with the Oak Creek Sewer and Water Utility and other utility companies to ensure no damage would occur to existing infrastructure during construction. For the alternatives that include treatment, aboveground treatment of VOCs and PAHs with granular activated carbon (UT-3) is more technically feasible than in-situ aerobic biodegradation (UT-2).

Restoration Time Frame
All three alternatives could be completed in similar time frames and provide elimination/control of the preferential migration pathway.

Economic Feasibility
The lowest cost alternative is UT-1 at $125,950. Alternatives UT-2 and UT-3 have a higher estimated cost at $852,575.

5.6 Comparative Analysis of Vapor Intrusion Alternatives

There is only one alternative for this media/pathway and therefore no comparison is provided.

6.0 SELECTED REMEDY AND SUSTAINABILITY EVALUATION

6.1 Site Wide Institutional Controls

The site wide institutional controls alternative (SW-1) was selected to be used in combination with all other selected alternatives.

6.2 Selected Remedy for Tar Plant Residuals

The recommended combination of alternatives for Site remediation of the former tar plant residuals includes the following:

- **Alternative S-1: Soil Barrier (PAHs)**
  The soil barrier alternative (S-1) was selected because it meets the direct contact remedial action objective for surface soil and provides the same level of direct contact protection as the impermeable cover alternative (S-2) at nearly half the cost. Although the impermeable cover (S-2) would provide a slightly greater reduction in infiltration and the production of leachate, the reduction in constituent flux would not make a significant material difference in the dissolved phase groundwater plume considering the low mass of leachable constituents in the unsaturated zone compared to the constituent mass in the saturated zone.

  It should be noted that there is some overlap with the soil barrier alternative (S-3) for the aluminum smelter residuals described in Section 6.2 below. The limit of the barrier for PCBs falls entirely within the limit of the soil barrier (S-1) for the former tar plant and comprises approximately 55% of the surface area of the dermal cover. As the barrier for PCBs includes 10 inches of low permeability clay soil, it serves as an impermeable cover for that portion of the Site. The design and implementation of these alternatives would be integrated.

- **Alternative PMT-2.1: Impermeable Cover (Non-Wetland Tar)**
  The impermeable cover alternative in <u>non-wetland areas</u> (PMT-2.1) was selected for potentially mobile tar because it was the lowest cost alternative that meets the remedial action objective of preventing seepage of tar to the ground surface. The other alternatives that include solidification (PMT-1) or excavation with off-site disposal (PMT-3) go beyond what is required to meet the remedial action objective and they do so at a significantly greater cost.

  As noted above, there is some overlap with the alternatives for the aluminum smelter residuals described in Section 6.2 below. The soil barrier alternative for PCBs (S-3) includes 10 inches of low permeability clay soil that meets the engineered barrier requirements of Alternative PMT-2 and comprises approximately 60% of the surface area of the Alternative PMT-2 engineered barrier. In addition, the soil excavation and disposal alternative (S-4) includes approximately 15% of the surface area of the Alternative PMT-2 engineered barrier. The design and implementation of these alternatives would be integrated. Also note that if potentially mobile tar is observed seeping into any of the excavations being implemented as part of alternative S-4, a field decision will be made, depending on the extent and amount of seepage, to conduct a limited implementation of either alternative PMT-1 (solidification) or alternative PMT-3(excavation) on the tar materials prior to backfilling the excavations.

- **Alternative PMT-3A: Excavation (0-4 Ft) with Off-Site Disposal (Wetland Tar)**
  The soil excavation and off-site disposal alternative for potentially mobile tar in wetland areas only was selected as the only alternative for addressing the impacted wetlands as it would be difficult to get regulatory approval for covering or solidifying the soils within the wetlands.

- **Alternative GW-1: Monitored Plume Stability**
  The MPS alternative (GW-1) was selected for groundwater based on the limited plume migration that has occurred to date due to the extremely tight nature of glacial till and with groundwater use restrictions in place this alternative is protective of public health. The other active groundwater alternatives (GW-2 and GW-3) do not restore groundwater any quicker and are significantly more costly.

- **Alternative UT-1: Trench Plugs**
  The trench plug alternative (UT-1) was selected because it meets the remedial action objective of preventing impacted groundwater migration along preferential pathways at the lowest cost.

- **Alternative VI-1: Institutional Control**
  This was the only alternative considered for this potential future pathway and is protective of public health, safety and welfare.

6.3 Selected Remedy for Aluminum Smelter Residuals

The recommended combination of remedial options for soil remediation of the former aluminum smelter includes:

- **Alternative S-3: Soil Barrier (PCBs & Metals)**
- **Alternative S-4: Soil Excavation and Disposal (PCBs)**

These alternatives were selected because together they meet the direct contact remedial action objective for soil by removing soil concentrations greater than 10 mg/kg PCBs, provide a barrier to soil concentrations exceeding PCB and metal direct contact RCLs, and minimizes disturbance to the wetland. Institutional controls would also be implemented for land use restriction, and implementation of a soil management plan and cover maintenance plan.

6.4 Proposed Schedule for Implementation

The schedule for implementation will be provided in the remedial design report.

6.5 Estimated Cost

The estimated cost for the selected remedy is as follows:

Alternative	Description	Capital Cost	NPV O&M Cost	Total Cost
SW-1	Site-Wide Institutional Controls	$ 25,000	$ -	$ 25,000
S-1& S-3	Combined Soil Barriers (PAH, PCB, As)	$ 2,941,091	$ 24,940	$ 2,966,031
S-4	Soil Excavation and Disposal (PCB)	$ 1,924,656	$ -	$ 1,924,656
PMT-2.1	Impermeable Cover (Non-Wetland Areas)	$ 401,723	$ -	$ 401,723
PMT-3A.1	Excavation and Disposal (Wetland Areas)	$ 328,006	$ -	$ 328,006
GW-1	Monitored Plume Stability	$ 41,250	$ 60,000	$ 101,250
UT-1	Trench Plug	$ 125,950	$ -	$ 125,950
	Total Remedy Cost	$ 5,787,676	$ 84,940	$ 5,872,616

6.6 Compliance Timeframe

For most media, compliance will be achieved with the completion of cover, barriers and trench plug installations and concrete and soil removal/disposal. For the groundwater remedy it is assumed that closure will be requested once a demonstration is made that the groundwater plume is stable.

6.7 Performance Evaluation

The cover will be inspected for erosion and tar seeps on an annual basis and maintained on an as needed basis. Groundwater monitoring will be performed on a quarterly basis initially and will continue until an MPS demonstration has been completed and closure is received.

6.8 Management of Treatment Residuals

Soils excavated during installation of the trench plug will be disposed of at an approved solid waste landfill. Excavated PCB impacted soils will be disposed of at an approved solid waste landfill for PCB concentrations below 50 mg/kg and at a licensed TSCA landfill for PCB concentrations greater than or equal to 50 mg/kg. Purge water generated from groundwater monitoring events will be containerized and disposed of at an approved facility.

6.9 Redevelopment Considerations Concerning Remedial Design

The City of Oak Creek is actively pursuing opportunities to revitalize approximately 250 acres of former industrial waterfront sites along the shore of Lake Michigan. The Site is located within the proposed area for redevelopment, which is located east of South 5th Avenue and is bounded by Milwaukee County’s Bender Park on the south and the Metropolitan Milwaukee Sewerage District (MMSD) South Shore Water Reclamation Facility on the north. Conceptual plans for this area, called Lake Vista, are outlined in the Lakefront Redevelopment Action Plan (Plan), dated October 11, 2011. The Plan includes continued use of the City Utility property; park lands in the east that will allow public access along the upper bluff of Lake Michigan; and mixed use with multi-family residential, retail, commercial and light industrial throughout the remainder of the 250 acres. All of Lake Vista will be served with City sewer and water and other private utilities. Although specific redevelopment activities have been occurring within several parcels of Lake Vista, only limited design and engineering details in the beginning stages are currently available for most of the redevelopment components within the Site.

Beazer and Connell are cognizant of the City's Lake Vista redevelopment initiative and will work with the City during the remedial design phase for this Site to evaluate and incorporate design aspects, to the extent practical and foreseeable, for enabling construction of future, specific public infrastructure needs (e.g., altering cover or backfill in specific locations for future roadways and/or utilities) of the City related to the long term development plans for the Lake Vista area, including the installation and maintenance of such public infrastructure needs.

6.10 Cover Maintenance and Soil Management Plan

As noted in Section 6.1 above, Alternative SW-1 – Site-wide Institutional Controls is a component of the overall selected Site remedy. A detailed description of Alternative SW-1 is provided in Section 4.3.1.1. A soil cover maintenance and contaminated soil management plan are components of the Alternative SW-1. As part of the remedial design, the soil cover maintenance and contaminated soil management plan will be prepared to address long term cover maintenance requirements as well as soil management requirements during future redevelopment of the site. The plan will include:

- a map showing the location of the extent and type of residual contamination and soil cover boundaries;
- a brief description of the type, depth and location of residual contamination;
- a description of the maintenance actions required for maximizing effectiveness of the soil cover;
- the requirements for sampling, handling and disposal of contaminated soils generated during underground excavation and trenching;
- requirements for imported backfill sampling; and
- requirements for reconstruction of the existing cover in disturbed areas.

6.11 Sustainability Evaluation

A sustainability evaluation will be performed for the selected remedy using EPA's Spreadsheets for Environmental Footprint Analysis (SEFA). The results will be included in the remedial design report.

7.0 REFERENCES

Natural Resource Technology, Inc. and Tetra Tech, Inc., 2014. *Site Investigation Report, Former Koppers Tar Plant and Wabash Alloys Site, Oak Creek, WI*, January, 2014.

ENVIRONMENTAL MEDIA OR MIGRATION/EXPOSURE PATHWAY	REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPES	PROCESS OPTIONS	AREA OF CONCERN	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING SUMMARY
SURFACE SOIL VOCs & PAH	PREVENT DIRECT CONTACT WITH SOIL EXCEEDING DIRECT CONTACT RCLs PREVENT LEACHING OF CONTAMINANTS THAT MAY RESULT IN GROUNDWATER CONTAMINATION IN EXCESS OF GROUNDWATER RCLs	NO ACTION	NOT APPLICABLE	NONE	VADOSE ZONE SOIL EXCEEDING PROTECTION OF GROUNDWATER RCLs	NO ACTION	LEACHING POTENTIAL OF VADOSE ZONE CONTAMINANTS IS MINIMAL COMPARED TO EXISTING WATER QUALITY	NO IMPLEMENTATION REQUIRED	NONE	POTENTIALLY APPLICABLE
		CONTAINMENT	ENGINEERED BARRIER	SOIL COVER	SURFACE SOIL EXCEEDING DIRECT CONTACT RCLs	PLACE 24" THICK SOIL COVER AS CONTAMINANT BARRIER	EFFECTIVE TO PREVENT DIRECT EXPOSURE	EASILY IMPLEMENTED	MODERATE CAPITAL, LOW O&M	POTENTIALLY APPLICABLE
				IMPERMEABLE COVER	VADOSE ZONE SOIL EXCEEDING PROTECTION OF GROUNDWATER RCLs	CONSTRUCT BARRIER COMPRISED OF COMPACTED CLAY OR GEOSYNTHETIC MATERIALS	EFFECTIVE TO PREVENT DIRECT EXPOSURE AND PREVENT INFILTRATION OF PRECIPITATION	EASILY IMPLEMENTED	HIGH CAPITAL, MODERATE O&M	POTENTIALLY APPLICABLE
				ASPHALT/CONCRETE	VADOSE ZONE SOIL EXCEEDING PROTECTION OF GROUNDWATER RCLs AND/OR SURFACE SOIL EXCEEDING DIRECT CONTACT RCLs	USE EXISITNG (CITY PARCEL) AND/OR FUTURE ASPHALT/CONCRETE SURFACES AS CONTAMINANT BARRIER	EFFECTIVE TO PREVENT DIRECT EXPOSURE AND PREVENT INFILTRATION OF PRECIPITATION	EASILY IMPLEMENTED IN AREAS OF ROAD, PARKING LOTS, BUILDINGS	NO ADDITIONAL CAPITAL IF COMPONENT OF REDEVELOPMENT, LOW O&M	POTENTIALLY APPLICABLE
		INSTITUTIONAL ACTIONS	ACCESS RESTRICTIONS	RESIDENTIAL USE RESTRICTION	AREAS OF INSTALLED BARRIER	RESTRICTS FUTURE LAND USE TO NON-RESIDENTIAL	EFFECTIVE IN ELIMINATING POTENTIAL SENSITIVE RECEPTOR EXPOSURE	EASILY IMPLEMENTED	LOW COST	POTENTIALLY APPLICABLE
				SOIL MANAGEMENT PLAN	AREAS OF INSTALLED BARRIER	PLAN FOR MANAGEMENT OF CONTAMINATED SOIL IF BARRIER IS REMOVED AND/OR SOILS ARE EXCAVATED	EFFECTIVE IN MANAGING EXPOSURE IF/WHEN COVERED AREAS ARE BREACHED	EASILY IMPLEMENTED	NO CAPITAL, LOW O&M	POTENTIALLY APPLICABLE
		REMOVAL	EXCAVATION	EXCAVATION WITH OFF-SITE DISPOSAL	SURFACE SOIL EXCEEDING DIRECT CONTACT RCLs	EXCAVATION OF CONTAMINATED SURFACE SOIL	EFFECTIVE FOR SURFACE SOIL REMOVED, BUT NOT FOR SUBSURFACE SOIL LEFT IN PLACE	NOT PRACTICAL WITHOUT ALSO REMOVING CONTAMINATED SUBSURFACE SOIL	HIGH CAPITAL, NO O&M	NOT APPLICABLE
		DISPOSAL	OFF-SITE	SOLID WASTE LANDFILL	EXCAVATED SOILS	DISPOSAL OF EXCAVATED SOIL AT OFF-SITE LANDFILL	EFFECTIVE FOR EXCAVATED SOIL DISPOSAL	NOT APPLICABLE BECAUSE EXCAVATION OPTION NOT CARRIED FORWARD	HIGH CAPITAL, LOW O&M	NOT APPLICABLE
		TREATMENT	PHYSICAL	SOIL VAPOR EXTRACTION	VADOSE ZONE SOIL EXCEEDING PROTECTION OF GROUNDWATER RCLs	INSTALL SOIL VAPOR EXTRACTION WELLS WITHIN VADOSE ZONE TO REMOVE CONTAMINANTS	EFFECTIVE FOR VOCS BUT NOT FOR TAR AND PAH COMPOUNDS; ALSO NOT EFFECTIVE IN LOW PERMEABILITY SOIL	EASILY IMPLEMENTED	MODERATE CAPITAL, HIGH O&M	NOT APPLICABLE
POTENTIALLY MOBILE TAR	PREVENT POTENTIALLY MOBILE TAR FROM SEEPING TO THE GROUND SURFACE OR DAYLIGHTING ALONG THE RAVINE BLUFF	NO ACTION	NOT APPLICABLE	NONE	AREAS OF OBSERVED POTENTIALLY MOBILE TAR	NO ACTION	TAR MAY BE STABLE ENOUGH THAT NO FURTHER OR MINIMAL ACTION IS NEEDED TO PREVENTAGE SEEPAGE	NO IMPLEMENTATION REQUIRED	NONE	POTENTIALLY APPLICABLE
		TREATMENT	PHYSICAL	SOLIDIFICATION	AREAS OF OBSERVED POTENTIALLY MOBILE TAR	MIX BINDING AGENTS INTO POTENTIALLY MOBILE TAR TO SOLIDIFY AND REDUCE MOBILITY	EFFECTIVE IN REDUCING TAR MOBILITY AND LEACHABILITY	EASILY IMPLEMENTED FOR SHALLOW SOIL, MORE DIFFICULT TO IMPLEMENT WITH DEPTH	MODERATE TO HIGH CAPITAL, NO O&M	POTENTIALLY APPLICABLE
			CHEMICAL	OXIDATION	AREAS OF OBSERVED POTENTIALLY MOBILE TAR	MIX OXIDANTS INTO POTENTIALLY MOBILE TAR TO OXIDIZE AND DESTROY	NOT EFFECTIVE FOR TAR, MAY ACTUALLY INCREASE MOBILITY	MODERATELY DIFFICULT TO IMPLEMENT	MODERATE CAPITAL, MODERATE O&M	NOT APPLICABLE
			THERMAL	ELECTRICAL RESISTANCE HEATING	AREAS OF OBSERVED POTENTIALLY MOBILE TAR	INSTALL ELECTRODES TO HEAT SOIL AND VAPORIZE TAR FOR VAPOR EXTRACTION	NOT EFFECTIVE FOR TAR AND PAH COMPOUNDS	MODERATELY DIFFICULT TO IMPLEMENT	HIGH CAPITAL	NOT APPLICABLE
		CONTAINMENT	PHYSICAL BARRIER	IMPERMEABLE COVER	AREAS OF OBSERVED POTENTIALLY MOBILE TAR IN SURFACE SOIL (0-4')	CONSTRUCT BARRIER COMPRISED OF COMPACTED CLAY OR GEOSYNTHETIC MATERIALS	EFFECTIVE IN PREVENTING SEEPAGE TO THE SURFACE	EASILY IMPLEMENTED	HIGH CAPITAL, MODERATE O&M	POTENTIALLY APPLICABLE
				SLURRY WALL	AREAS OF OBSERVED POTENTIALLY MOBILE TAR NEAR RAVINE SLOPE	CONSTRUCT TRENCH BACKFILLED WITH SOIL AND/OR CEMENT BENTONITE SLURRY	EFFECTIVE IN PREVENTING HORIZONTAL MIGRATION	MODERATELY DIFFICULT TO IMPLEMENT	MODERATE CAPITAL, NO O&M	POTENTIALLY APPLICABLE
			HYDRAULIC BARRIER	FLOW DIVERSION DRAIN	AREAS OF OBSERVED POTENTIALLY MOBILE TAR	CONSTRUCT A DRAIN IN CONJUNCTION WITH PHYSICAL BARRIER TO AVOID MOUNDING	EFFECTIVE IN PREVENTING MOUNDING BEHIND PHYSICAL BARRIER	EASILY IMPLEMENTED	MODERATE CAPITAL, LOW O&M	POTENTIALLY APPLICABLE
		REMOVAL	EXCAVATION	EXCAVATION WITH OFF-SITE DISPOSAL	AREAS OF OBSERVED POTENTIALLY MOBILE TAR	EXCAVATION OF POTENTIALLY MOBILE TAR	EFFECTIVE IN ELIMINATING TAR MOBILITY AND LEACHABILITY	EASILY IMPLEMENTED FOR SHALLOW SOIL, MORE DIFFICULT TO WITH DEPTH AND AROUND UTILITIES	HIGH CAPITAL, NO O&M	POTENTIALLY APPLICABLE
		DISPOSAL	OFF-SITE	SOLID WASTE LANDFILL	EXCAVATED SOILS	DISPOSAL OF EXCAVATED SOIL AT OFF-SITE LANDFILL	EFFECTIVE FOR EXCAVATED SOIL DISPOSAL	EASILY IMPLEMENTED	HIGH CAPITAL, LOW O&M	POTENTIALLY APPLICABLE
		CONSOLIDATION	ON-SITE	ON-SITE	AREAS OF OBSERVED POTENTIALLY MOBILE TAR	CONSOLIDATE POTENTIALLY MOBILE TAR RESIDUALS TO REDUCE ON-SITE FOOTPRINT	EFFECTIVE FOR REDUCING FOOTPRINT IF USED IN CONJUNCTION WITH OTHER OPTIONS	EASILY IMPLEMENTED	MODERATE CAPITAL, NO O&M	POTENTIALLY APPLICABLE

ENVIRONMENTAL MEDIA OR MIGRATION/EXPOSURE PATHWAY	REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPES	PROCESS OPTIONS	AREA OF CONCERN	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING SUMMARY
GROUNDWATER	PREVENT POTENTIAL POTABLE USE OF IMPACTED GROUNDWATER RESTORE GROUNDWATER TO NR140 RCLs TO THE EXTENT TECHNICALLY AND ECONOMICALLY FEASIBLE	INSTITUTIONAL ACTIONS	ACCESS RESTRICTIONS	DEED RESTRICTIONS	SITE WIDE	IMPLEMENT LEGAL MECHANISM TO ENFORCE LAND USE RESTRICTIONS TO PREVENT INSTALLATION OF DRINKING WATER WELLS IN/NEAR IMPACTED GROUNDWATER	PREVENTS THE USE OF IMPACTED OF IMPACTED GROUNDWATER AS SOURCE OF DRINKING WATER	EASILY IMPLEMENTED	LOW COST	POTENTIALLY APPLICABLE
		MONITORING	GROUNDWATER MONITORING WELLS	GROUNDWATER MONITORING	SITE WIDE	CONDUCT ROUTINE MONITORING OF GROUNDWATER TO ENSURE CONTAMINANT PLUME IS NOT MIGRATING/EXPANDING	USEFUL FOR DOCUMENTING CONDITIONS, DOES NOT ACTIVELY REMEDIATE BUT MAY DEMONSTRATE THAT THERE IS NO NEED FOR ACTIVE REMEDY	EASILY IMPLEMENTED	LOW COST	POTENTIALLY APPLICABLE
		CONTAINMENT	PHYSICAL BARRIER	SLURRY WALL	DOWNGRADIENT PLUME BOUNDARY	CONSTRUCT TRENCH BACKFILLED WITH SOIL AND/OR CEMENT BENTONITE SLURRY	EFFECTIVE IN CONTAINING GROUNDWATER CONTAMINATION	MODERATELY DIFFICULT TO IMPLEMENT	MODERATE CAPITAL, NO O&M	POTENTIALLY APPLICABLE
			HYDRAULIC BARRIER	FLOW DIVERSION DRAIN	DOWNGRADIENT PLUME BOUNDARY	CONSTRUCT A DRAIN IN CONJUNCTION WITH PHYSICAL BARRIER TO AVOID MOUNDING	EFFECTIVE IN PREVENTING MOUNDING BEHIND PHYSICAL BARRIER	EASILY IMPLEMENTED	MODERATE CAPITAL, LOW O&M	POTENTIALLY APPLICABLE
			REACTIVE BARRIER	AEROBIC TREATMENT CURTAIN	DOWNGRADIENT PLUME BOUNDARY	INSTALL AN AIR CURTAIN TO AEROBICALLY BREAKDOWN CONTAMINANTS AS WATER PASSES THROUGH BARRIER	EFFECTIVE IN AEROBIC BIODEGRADTION OF VOCS AND PAHS ALONG WITH VOC VOLATILIZATION	MODERATELY DIFFICULT TO IMPLEMENT	MODERATE CAPITAL, LOW O&M	POTENTIALLY APPLICABLE
		REMOVAL	GROUNDWATER EXTRACTION	EXTRACTION WELLS	DOWNGRADIENT PLUME BOUNDARY	INSTALL EXTRACTION WELLS WITHIN PLUME TO RECOVER IMPACTED GROUNDWATER FOR TREATMENT	LOW PERMEABILTY OF SOIL WOULD REQUIRE CLOSELY SPACED WELLS DUE TO SMALL RADIUS OF INFLUENCE AND THEREFORE NOT PRACTICAL	EASILY IMPLEMENTED	MODERATE CAPITAL, LOW O&M	NOT APPLICABLE
				INTERCEPTION TRENCH	DOWNGRADIENT PLUME BOUNDARY	CONSTRUCT INTERCEPTION TRENCH AT PLUME BOUNDARY TO RECOVER IMPACTED GROUNDWATER FOR TREATMENT	EFFECTIVE IN COLLECTING IMPACTED GROUNDWATER FOR SUBSEQUENT TREATMENT	MODERATELY DIFFICULT TO IMPLEMENT	MODERATE CAPITAL, LOW O&M	POTENTIALLY APPLICABLE
		TREATMENT	ABOVE GRADE TREATMENT	ON-SITE TREATMENT PLANT	DOWNGRADIENT PLUME BOUNDARY	PASS WATER THROUGH AN ON-SITE TREATMENT PLANT TO TREAT IMPACTS UTILIZING MULTIPLE TECHNOLOGIES (I.E. AIR-STRIPPING, CARBON ADSORPTION ETC.)	EFFECTIVE IN TREATING VOCS AND PAHS	EASILY IMPLEMENTED	MODERATE CAPITAL, MODERATE O&M	POTENTIALLY APPLICABLE
		DISCHARGE	OFF-SITE	FORCE MAIN TO POTW	DOWNGRADIENT PLUME BOUNDARY	IMPACTED GROUNDWATER TREATED AT POTW	EFFECTIVE IN TREATING VOCS AND PAHS	EASILY IMPLEMENTED	LOW CAPITAL, MODERATE O&M	POTENTIALLY APPLICABLE
			ON-SITE	STORM SEWER TO LAKE	DOWNGRADIENT PLUME BOUNDARY	TREATED GROUNDWATER DISCHARGED TO SURFACE WATER	EFFECTIVE MEANS OF HANDLING TREATED WATER	EASILY IMPLEMENTED	LOW CAPITAL, LOW O&M	POTENTIALLY APPLICABLE

ENVIRONMENTAL MEDIA OR MIGRATION/EXPOSURE PATHWAY	REMEDIAL ACTION OBJECTIVES	GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY TYPES	PROCESS OPTIONS	AREA OF CONCERN	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING SUMMARY
UTILITY TRENCHES	MITIGATE IMPACTED GROUNDWATER MIGRATION THAT MAY BE OCCURRING ALONG PREFERENTIAL PATHWAYS CREATED BY UTILITY CONDUITS AND TRENCHES	NO ACTION	NOT APPLICABLE	NONE	EXISTING UTILITIES IN AREAS OF IMPACTED GROUNDWATER	NO ACTION	CONTAMINANT LEVELS AND/OR MIGRATION POTENTIAL LOW ENOUGH THAT NO FURTHER OR MINIMAL ACTION IS NEEDED TO PREVENT MIGRATION	NO IMPLEMENTATION REQUIRED	NONE	POTENTIALLY APPLICABLE
		INSTITUTIONAL ACTIONS	ACCESS RESTRICTION	DEED RESTRICTION	FUTURE UTILITY TRENCHES IN AREAS OF IMPACTED GROUNDWATER	IMPLEMENT LEGAL MECHANISM TO ENFORCE REQUIREMENT TO INSTALL MIGRATION BARRIERS ALONG FUTURE UTILITY TRENCH	PREVENTS CONSTRUCTION OF UTILITIES WITHOUT INCLUDING MIGRATION BARRIER	EASILY IMPLEMENTED	LOW COST	POTENTIALLY APPLICABLE
		CONTAINMENT	PHYSICAL BARRIER	JET GROUTING	EXISTING UTILITIES IN AREAS OF IMPACTED GROUNDWATER	JET GROUT ALONG EXTERIOR OF UTILITY TO ELIMINATE PREFERRENTIAL PATHWAY	EFFECTIVE IN ELIMINATING GROUNDWATER MIGRATION PATHWAY	NEED TO CONTROL INJECTION PRESSURE TO PREVENT DAMAGE TO PIPE MAKING IT MODERATELY DIFFICULT TO IMPLEMENT	MODERATE CAPITAL, NO O&M	NOT APPLICABLE
				TRENCH PLUG	EXISTING UTILITIES IN AREAS OF IMPACTED GROUNDWATER	INSTALL LOW PERMEABILITY PLUG ACROSS UTILITIES DOWNGRDIENT OF PLUME TO BLOCK MIGRATION PATHWAY	EFFECTIVE IN BLOCKING PATHWAY, MAY REQUIRE COLLECTION OF GROUNDWATER TO PREVENT MOUNDING	EASILY IMPLEMENTED	LOW CAPITAL, LOW O&M	POTENTIALLY APPLICABLE
				SEWER RELINING	EXISTING STORM SEWERS IN AREAS OF IMPACTED GROUNDWATER	LINE STORM SEWER TO PREVENT INFILTRATION OF CONTAMINATED GROUNDWATER	EFFECTIVE IN PREVENTING INFILTRATION OF GROUNDWATER INTO SEWER	MODERATELY DIFFICULT TO IMPLEMENT DUE TO SIZE OF STORM SEWER	MODERATE CAPITAL, NO O&M	NOT APPLICABLE
		REMOVAL	GROUNDWATER EXTRACTION	EXTRACTION WELLS	EXISTING UTILITIES IN AREAS OF IMPACTED GROUNDWATER	INSTALL EXTRACTION WELLS ALONG UTILITIES WITHIN PLUME TO RECOVER IMPACTED GROUNDWATER FOR TREATMENT	EFFECTIVE IN COLLECTING IMPACTED GROUNDWATER FOR SUBSEQUENT TREATMENT	EASILY IMPLEMENTED	LOW CAPITAL, LOW O&M	POTENTIALLY APPLICABLE
				TRENCH	EXISTING UTILITIES IN AREAS OF IMPACTED GROUNDWATER	INSTALL COLLECTION TRENCH ACROSS UTILITIES WITHIN PLUME TO RECOVER IMPACTED GROUNDWATER FOR TREATMENT	EFFECTIVE IN COLLECTING IMPACTED GROUNDWATER FOR SUBSEQUENT TREATMENT	MODERATELY DIFFICULT TO IMPLEMENT	MODERATE CAPITAL, LOW O&M	POTENTIALLY APPLICABLE
		TREATMENT	ABOVE GRADE TREATMENT	ON-SITE TREATMENT PLANT	EXISTING UTILITIES IN AREAS OF IMPACTED GROUNDWATER	PASS WATER THROUGH AN ON-SITE TREATMENT PLANT TO TREAT IMPACTS UTILIZING MULTIPLE TECHNOLOGIES (I.E. AIR-STRIPPING, CARBON ADSORPTION ETC.)	EFFECTIVE IN TREATING VOCS AND PAHS	EASILY IMPLEMENTED	MODERATE CAPITAL, MODERATE O&M	POTENTIALLY APPLICABLE
			IN-SITU TREATMENT	AEROBIC TREATMENT CURTAIN	EXISTING UTILITIES IN AREAS OF IMPACTED GROUNDWATER	INSTALL AIR SPARGE WELLS TO AEROBICALLY BREAKDOWN CONTAMINANTS	EFFECTIVE IN AEROBIC BIODEGRADTION OF VOCS AND PAHS ALONG WITH VOC VOLATILIZATION	EASILY IMPLEMENTED	LOW CAPITAL, LOW O&M	POTENTIALLY APPLICABLE
		DISCHARGE	OFF-SITE	FORCE MAIN TO POTW	EXISTING UTILITIES IN AREAS OF IMPACTED GROUNDWATER	IMPACTED GROUNDWATER TREATED AT POTW	EFFECTIVE IN TREATING VOCS AND PAHS	EASILY IMPLEMENTED	LOW CAPITAL, MODERATE O&M	POTENTIALLY APPLICABLE
			ON-SITE	STORM SEWER TO SURFACE WATER	EXISTING UTILITIES IN AREAS OF IMPACTED GROUNDWATER	TREATED GROUNDWATER DISCHARGED TO SURFACE WATER	EFFECTIVE MEANS OF HANDLING TREATED WATER	EASILY IMPLEMENTED	LOW CAPITAL, LOW O&M	POTENTIALLY APPLICABLE
VAPOR INTRUSION	PREVENT VAPOR INTRUSION FROM IMPACTED SOIL AND GROUNDWATER INTO POTENTIAL FUTURE OCCUPIED STRUCTURES	INSTITUTIONAL ACTIONS	ACCESS RESTRICTIONS	DEED RESTRICTIONS	SITE WIDE	IMPLEMENT LEGAL MECHANISM TO ENFORCE REQUIREMENT FOR VAPOR MITIGATION SYSTEMS FOR ANY POTENTIAL FUTURE OCCUPIED STRUCTURES	PREVENTS CONSTRUCTION OF OCCUPIED STRUCTURES WITHOUT INCLUDING VAPOR MITIGATION SYSTEM	EASILY IMPLEMENTED	LOW COST	POTENTIALLY APPLICABLE
		TREATMENT	PHYSICAL	SOIL VAPOR EXTRACTION	AREAS OF RESIDUAL SOIL AND/OR GROUNDWATER CONTAMINANTS HAVE THE POTENTIAL TO RELEASE CONTAMINANT VAPORS AT LEVELS ABOVE SCREENING CRITERIA	INSTALL SOIL VAPOR EXTRACTION WELLS WITHIN VADOSE ZONE TO PREVENT VAPOR INTRUSION INTO FUTURE OCCUPIED STRUCTURES	EFFECTIVE FOR VOCS BUT NOT EFFECTIVE IN LOW PERMEABILITY SOIL	EASILY IMPLEMENTED	MODERATE CAPITAL, HIGH O&M	NOT APPLICABLE

(green) RETAINED FOR USE IN REMEDIAL ALTERNATIVES

(orange) ELIMINATED FROM CONSIDERATION

Table 1B. Screening of General Response Actions and Remedial Technologies - ALUMINUM SMELTER

Remedial Action Options Report
Former Wabash Alloys Facility
Oak Creek, Wisconsin

Environmental Media or Migration/Exposure Pathway	Remedial Action Objectives	General Response Actions	Remedial Technology Types	Process Options	Area of Concern	Description	Effectiveness	Implementability	Cost	Screening Summary	Reason for Exclusion
Soil PCBs & Metals	• Prevent Direct Contact with Soil Exceeding Direct Contact RCLs • Prevent Leaching of Contaminants that may result in Groundwater Contamination in Excess of Groundwater RCLs	No Action	Not Applicable	None	Vadose Zone Soil Exceeding Protection of Groundwater RCLs	No Action	Leaching potential of Vadose Zone Contaminants is minimal	No Implementation Required	None	Potentially Applicable	--
		Containment	Engineered Barriers	Soil Barrier	Surface Soil Exceeding Direct Contact RCLs	Place 24" Thick Soil as Containment Cover	Effective to Prevent Direct Exposure	Easily Implemented	Moderate Capital, Low O&M	Potentially Applicable	--
				Soil Barrier for PCBs per CFR 761.61	PCB Soil Exceeding Direct Contact RCLs and Vadose Zone Soil Exceeding Protection of Groundwater RCLs	Construct Barrier Comprised of 10 inches low permeability Clay and 14 inches of Soil Material	Effective to Prevent Direct Exposure and Minimize Infiltration of Precipitation	Easily Implemented	Moderate-High Capital, Low O&M	Potentially Applicable	--
				Asphalt/Concrete	Vadose Zone Soil Exceeding Protection of Groundwater RCLs and/or Surface Soil exceeding Direct Contact RCLs	Use Existing and/or Future Asphalt/Concrete Surfaces as Contaminant Barrier	Effective to Prevent Direct Exposure and Minimize Infiltration of Precipitation	Easily Implemented in Areas of Road, Parking Lots, Buildings	No Additional Capital if Component of Redevelopment, Low O&M	Not Applicable	Existing Building Concrete and Exterior Slabs to be Removed - City Requirement, Future Redevelopment Unknown
		Institutional Controls	Access Restrictions	Residential Use Restriction	Areas of Installed Barrier	Restricts Future Land Use To Non-Residential	Effective in Eliminating Potential Sensitive Receptor Exposure	Easily Implemented	Low Cost	Potentially Applicable	--
				Soil Management Plan	Areas of Installed Barrier	Plan for Management of Contaminated Soil if Barrier is Removed and/or Soils are Excavated	Effective in Managing Exposure if/when Capped Areas are Breached	Easily Implemented	No Capital, Low O&M	Potentially Applicable	--
		Removal	Excavation	Excavation with Off-site Disposal	Surface Soil Exceeding Direct Contact RCLs	Excavation of Contaminated Soil	Effective to Prevent Direct Exposure	Easily Implemented for Shallow Soil, More Difficult to Implement with Depth	Moderate to High Capital, No O&M	Potentially Applicable	--

Retained for Use in Remedial Alternatives (green)

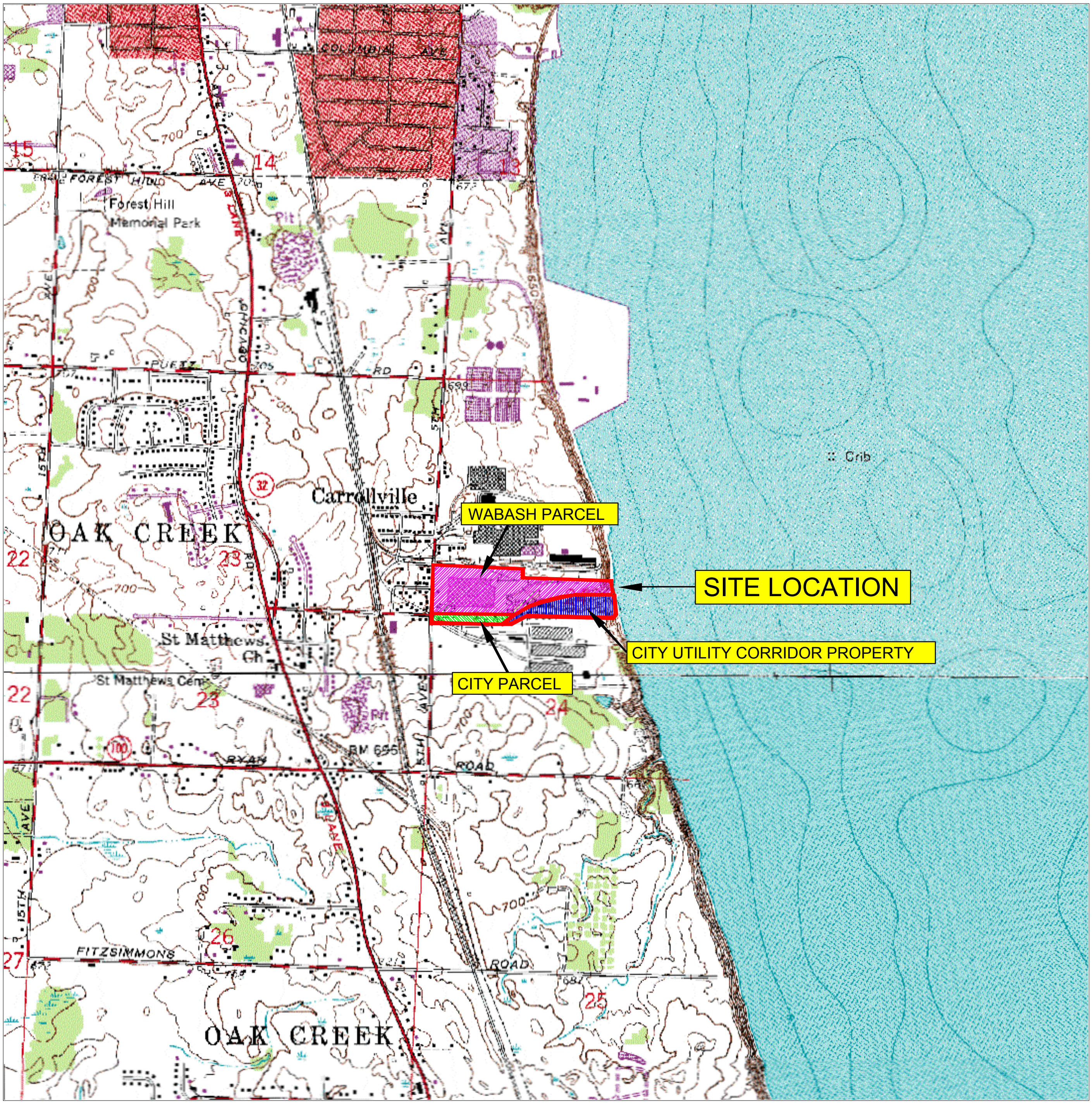
Eliminated from Consideration (orange)

O-RJG 5/16/14 C-JAZ 9/14

Table 2. Summary of Remedial Alternatives

ID	Description	Long-Term Effectiveness	Short-Term Effectiveness	Implementability	Restoration Timeframe	Capital Cost	NPV O&M Cost (1)	Total Cost	Recommended Alternative
Site-Wide Institutional Control									
SW-1	Institutional Control	High	High	High	Short	$ 25,000	$ -	$ 25,000	X
Surface Soil VOC & PAH									
S-1	Soil Cover	Medium	High	High	Short	$ 2,919,916	$ 24,940	$ 2,944,856	X (2)
S-2	Impermeable Cover	High	High	Medium	Short	$ 6,086,369	$ 24,940	$ 6,111,309	
Soil PCBs & Metals									
S-3	Soil Barrier (3)	High	High	High	Short	$ 1,753,413	$ 24,940	$ 1,778,353	X (2)
S-4	Soil Excavation with Off-site Disposal (3) (4)	High	High	Medium	Short	$ 1,924,656	$ -	$ 1,924,656	X
Potentially Mobile Tar (5)									
PMT-1A	In-Situ Soil Stabilization (0-4')	Medium	Medium	Medium	Medium	$ 1,146,063	$ -	$ 1,146,063	
PMT-1B	In-Situ Soil Stabilization (Total Depth)	High	Medium	Low	Short	$ 12,577,950	$ -	$ 12,577,950	
PMT-2	Engineered Barrier	Medium	High	High	Medium	$ 486,544	$ -	$ 486,544	
PMT-2.1	Engineered Barrier (Excluding Wetland Areas)	Medium	High	High	Medium	$ 401,723	$ -	$ 401,723	X
PMT-3A	Excavation & Landfill (0-4')	Medium	Medium	Medium	Medium	$ 1,463,688	$ -	$ 1,463,688	
PMT-3A.1	Excavation & Landfill (0-4') (Wetland Areas Only)	Medium	Medium	Medium	Medium	$ 328,006	$ -	$ 328,006	X
PMT-3B	Excavation & Landfill (Total Depth)	High	Medium	Low	Short	$ 12,671,450	$ -	$ 12,671,450	
Groundwater									
GW-1	Monitored Plume Stability	Medium	High	High	Long	$ 41,250	$ 60,000	$ 101,250	X
GW-2	Funnel & Gate	High	Medium	Medium	Long	$ 822,388	$ 1,371,700	$ 2,194,088	
GW-3	Pump & Treat	High	Medium	Medium	Long	$ 763,606	$ 1,371,700	$ 2,135,306	
Utility Trench Pathway									
UT-1	Trench Plug	Medium	High	Medium	Medium	$ 125,950	$ -	$ 125,950	X
UT-2	In-Situ Treatment	High	High	Medium	Medium	$ 229,075	$ 623,500	$ 852,575	
UT-3	Pump & Treat	High	High	Medium	Medium	$ 229,075	$ 623,500	$ 852,575	
Vapor Intrusion									
VI-1	Institutional Control (Included under SW-1)	High	High	High	Short	$ -	$ -	$ -	X

Notes:
(1) Assumes a discount rate of 1.235%
(2) Because of overlap in cover systems for Alternatives S-1 and S-3, the combined cost of $2,966,031 is less than the sum of the two
(3) Alternative S-3 to be implemented in conjunction with S-4 (soil excavation to cleanup level of 10 mg/kg total PCBs)
(4) During implementation of Alternative S-4, potentially mobile tar observed seeping into excavations will be excavated or solidified prior to backfilling.
(5) Solidified, covered or excavated wetland areas will be mitigated using off-site mitigation credits or in-lieu fee program



National Geodetic Vertical Datum of 1929
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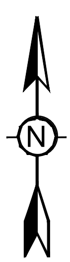
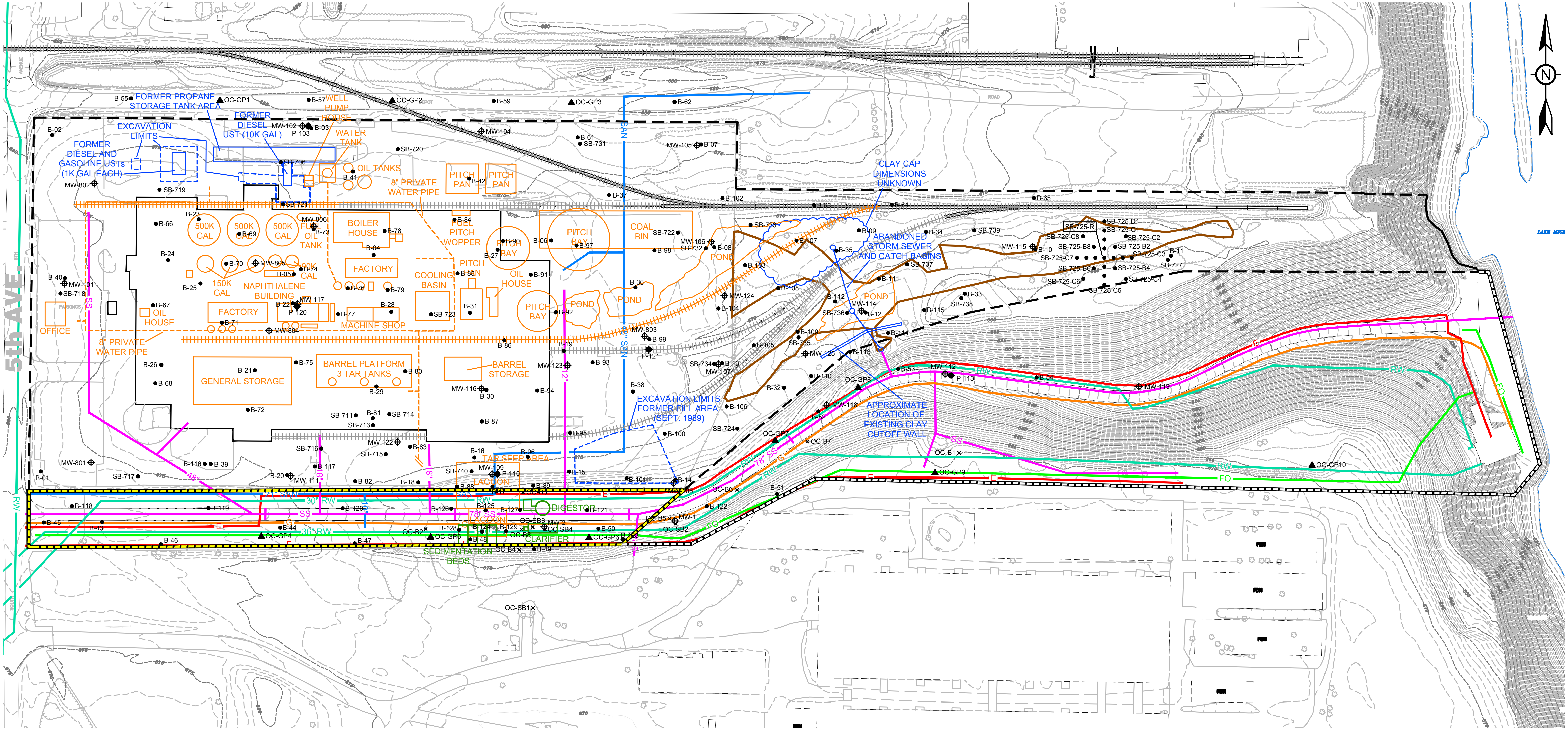


FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE OAK CREEK, WISCONSIN	DATE:	12/27/13	
	DESIGNED:	HJW	
SITE LOCATION and LOCAL TOPOGRAPHY	CHECKED:	DLM	
	APPROVED:	DLM	
	DRAWN:	HJW	
	PROJ.: 117-2201323		
TETRA TECH	Figure 1		

Base map from U.S.G.S. 7.5' SOUTH MILWAUKEE, WISCONSIN and RACINE NORTH, WISCONSIN topographic quadrangle map.

S:\CAD\BEAZER\WABASH\NEW COMBINED INVESTIGATION\10-28-13\FIG 1.DWG



EXPLANATION

MW-101	WATER TABLE WELL
P-103	NESTED PIEZOMETER
B-01	SOIL BORING
OC-SB1	SOIL BORING (CITY OF OAK CREEK)
OC-GP1	GEOPROBE (CITY OF OAK CREEK)
	APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
	APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
	FORMER TAR PLANT STRUCTURES
	PAST REMEDIAL ACTIVITIES
	FORMER WASTEWATER TREATMENT PLANT STRUCTURES
	APPROXIMATE WETLAND BOUNDARY
	APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
E	ELECTRICAL
G	NATURAL GAS
RW	RAW WATER
SAN	SANITARY
SS	STORM SEWER
FO	FIBER OPTIC

0 160 320

SCALE IN FEET

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE

SITE LAYOUT

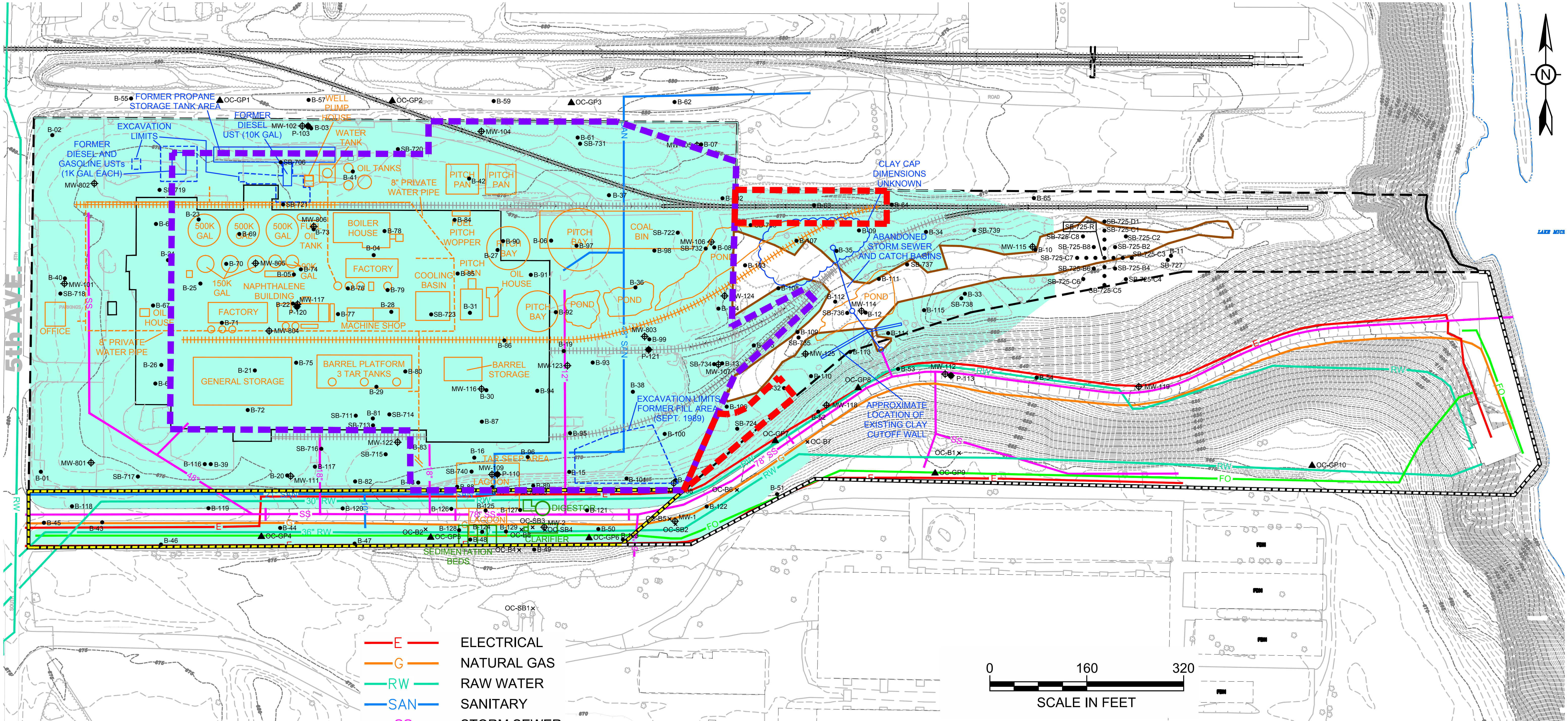
LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	HJW
PROJECT	117-2201323
DATE	11/7/14

FIGURE: 2

S:\CAD\BEAZER\WABASH\NEW COMBINED INVESTIGATION\SITE LAYOUT REVISED 11-7-2014.DWG



E	ELECTRICAL
G	NATURAL GAS
RW	RAW WATER
SAN	SANITARY
SS	STORM SEWER
FO	FIBER OPTIC

EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- PROPOSED LIMITS OF COVER FOR PCBs AND ARSENIC - 10" CLAY, 14" GENERAL FILL/ROOTING ZONE (497,162 FT.^{2})
- PROPOSED LIMITS OF COVER FOR ARSENIC ONLY - 24" GENERAL FILL/ROOTING ZONE (22,257 FT.^{2})
- PROPOSED LIMIT OF DERMAL COVER FOR PAHs - 24" GENERAL FILL/ROOTING ZONE (910,114 FT.^{2}) (PCB/ARSENIC COVER WOULD SERVE AS DERMAL COVER IN THOSE AREAS)

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
PAH SOIL BARRIER (ALTERNATIVES S-1 AND S-2)

LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN	FIGURE: 3
DRAFTED	HJW	
PROJECT	117-2201323	
DATE	11/10/14	

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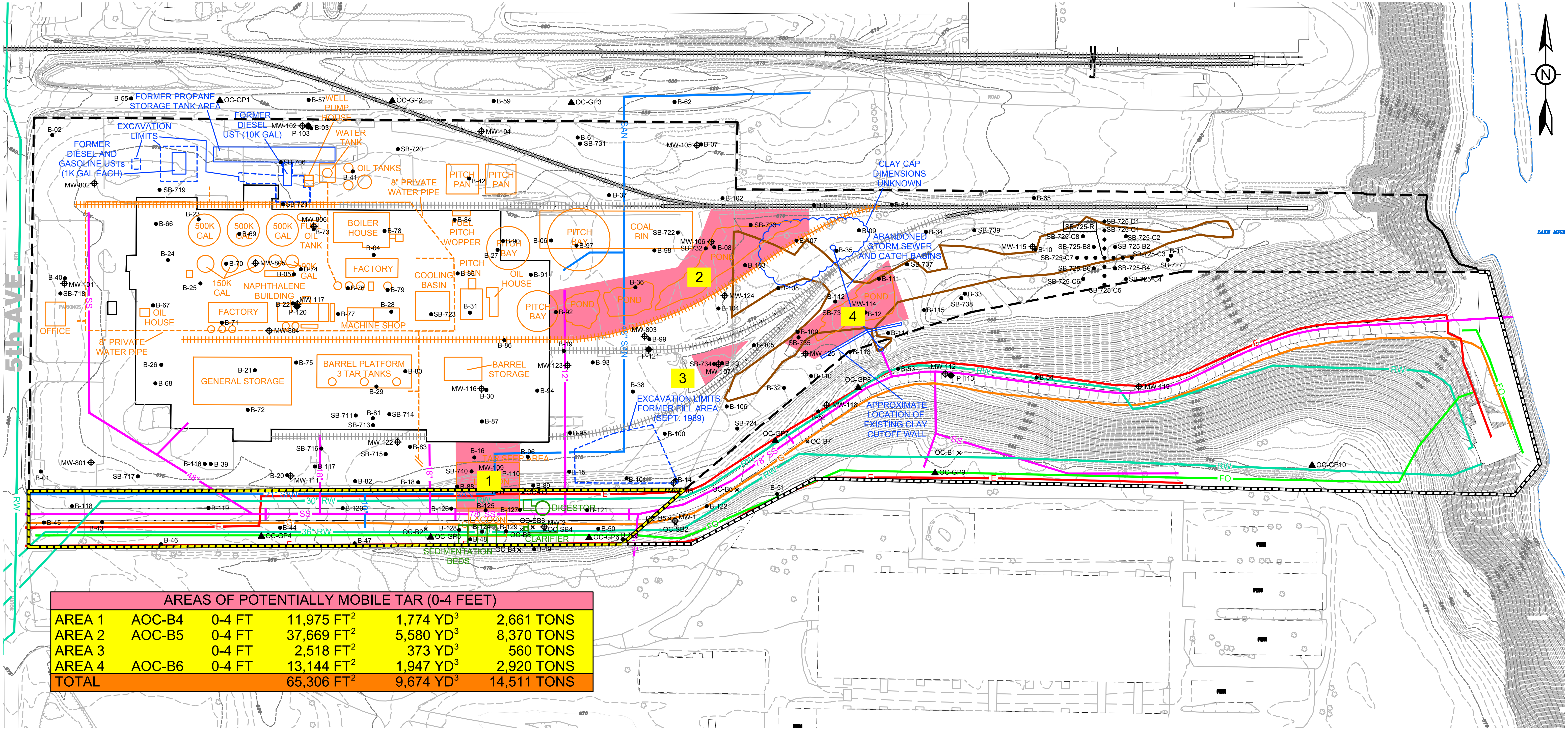

AREAS OF POTENTIALLY MOBILE TAR (0-4 FEET)					
AREA 1	AOC-B4	0-4 FT	11,975 FT^2	1,774 YD^3	2,661 TONS
AREA 2	AOC-B5	0-4 FT	37,669 FT^2	5,580 YD^3	8,370 TONS
AREA 3		0-4 FT	2,518 FT^2	373 YD^3	560 TONS
AREA 4	AOC-B6	0-4 FT	13,144 FT^2	1,947 YD^3	2,920 TONS
TOTAL			65,306 FT^2	9,674 YD^3	14,511 TONS

EXPLANATION

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- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- E — ELECTRICAL
- G — NATURAL GAS
- RW — RAW WATER
- SAN — SANITARY
- SS — STORM SEWER
- FO — FIBER OPTIC
- AREAS OF POTENTIALLY MOBILE TAR (0-4 FEET)

0 160 320

SCALE IN FEET

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
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4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE

POTENTIALLY MOBILE TAR 0-4 FT (ALTERNATIVES PMT-1A, PMT-2, AND PMT-3A)

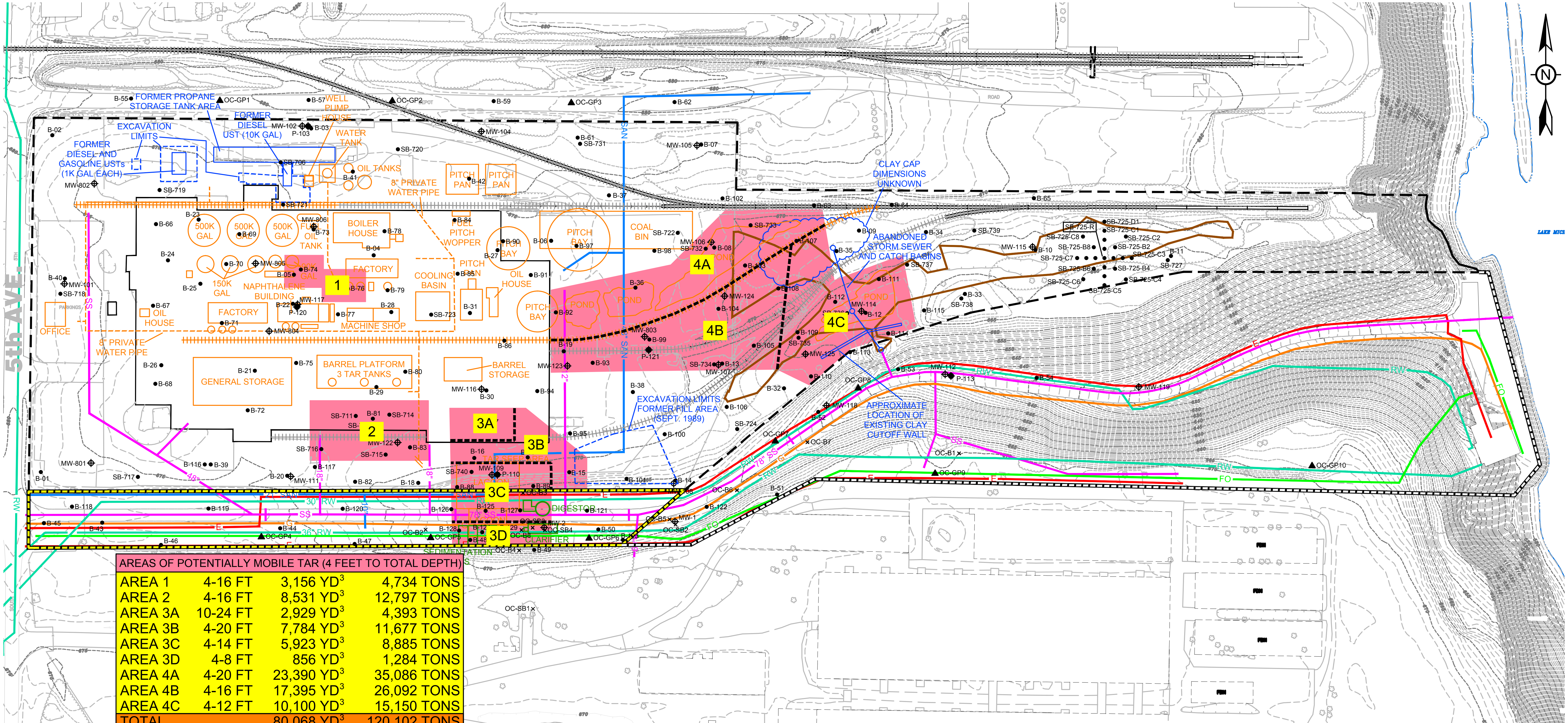
LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	HJW
PROJECT	117-2201323
DATE	11/10/14

FIGURE: 4

S:\CAD\BEAZER\WABASH\RAO REPORT\10-2-14\TAR COVER - SOLIDIFY REVISED.DWG



AREAS OF POTENTIALLY MOBILE TAR (4 FEET TO TOTAL DEPTH)			
AREA 1	4-16 FT	3,156 YD^3	4,734 TONS
AREA 2	4-16 FT	8,531 YD^3	12,797 TONS
AREA 3A	10-24 FT	2,929 YD^3	4,393 TONS
AREA 3B	4-20 FT	7,784 YD^3	11,677 TONS
AREA 3C	4-14 FT	5,923 YD^3	8,885 TONS
AREA 3D	4-8 FT	856 YD^3	1,284 TONS
AREA 4A	4-20 FT	23,390 YD^3	35,086 TONS
AREA 4B	4-16 FT	17,395 YD^3	26,092 TONS
AREA 4C	4-12 FT	10,100 YD^3	15,150 TONS
TOTAL		80,068 YD^3	120,102 TONS

EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- E — ELECTRICAL
- G — NATURAL GAS
- RW — RAW WATER
- SAN — SANITARY
- SS — STORM SEWER
- FO — FIBER OPTIC
- AREAS OF POTENTIALLY MOBILE TAR (4 FEET TO TOTAL DEPTH)

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE

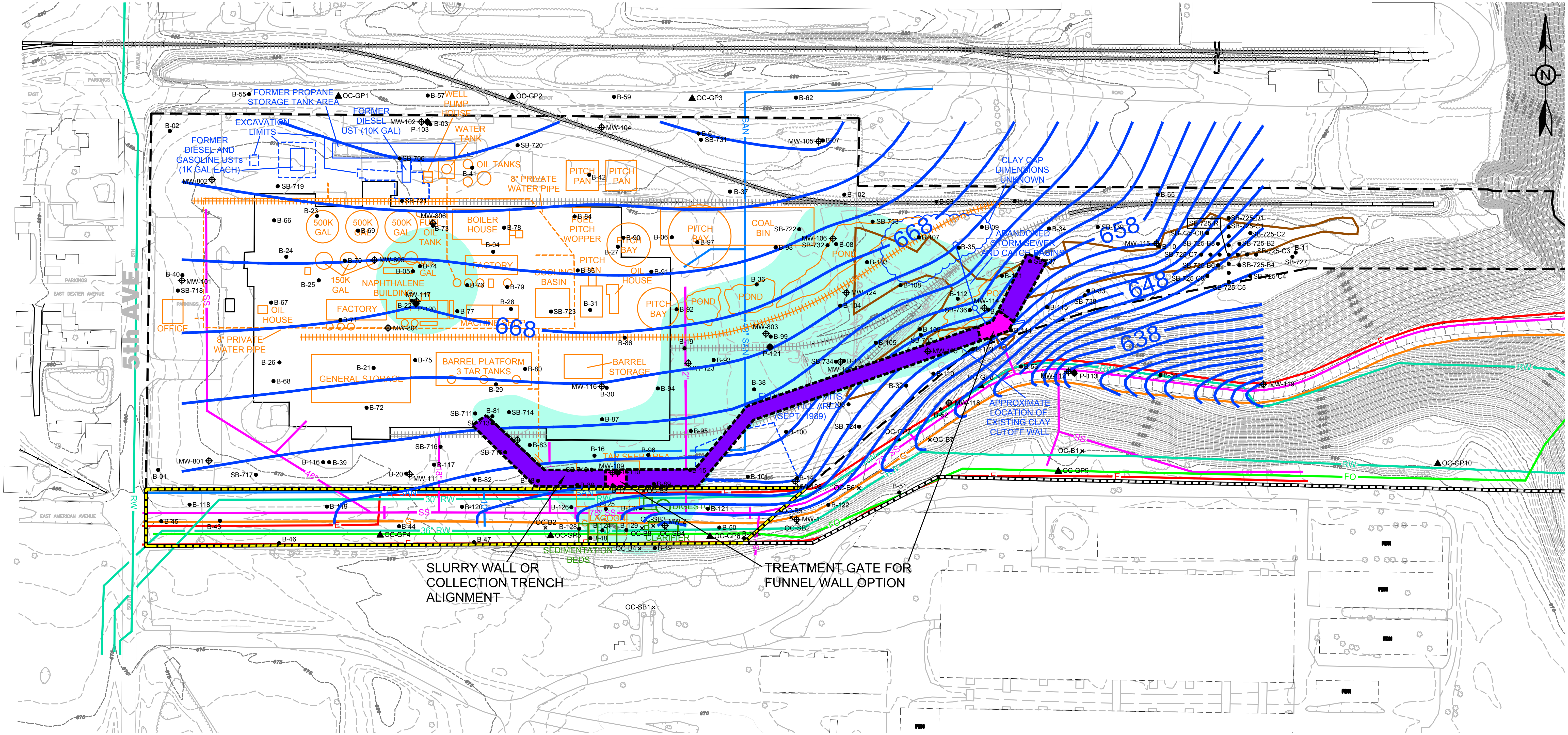
POTENTIALLY MOBILE TAR 4 FT TO TOTAL DEPTH (ALTERNATIVES PMT-1B AND PMT-3B)

LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN	FIGURE:
DRAFTED	HJW	5
PROJECT	117-2201323	
DATE	11/10/14	

S:\CAD\BEAZER\WABASH\RAO REPORT\10-2-14\MOBILE TAR EXCAVATION OR SOLIDIFICATION REVISED.DWG



EXPLANATION

MW-101	WATER TABLE WELL
P-103	NESTED PIEZOMETER
B-01	SOIL BORING
OC-SB1	SOIL BORING (CITY OF OAK CREEK)
OC-GP1	GEOPROBE (CITY OF OAK CREEK)
— — —	APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
	APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
	FORMER TAR PLANT STRUCTURES
	PAST REMEDIAL ACTIVITIES
	FORMER WASTEWATER TREATMENT PLANT STRUCTURES
	APPROXIMATE WETLAND BOUNDARY
	APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
—658—	SHALLOW WATER TABLE CONTOUR
—E—	ELECTRICAL
—G—	NATURAL GAS
—RW—	RAW WATER
—SAN—	SANITARY
—SS—	STORM SEWER
—FO—	FIBER OPTIC
	APPROXIMATE AREA OF GROUNDWATER THAT EXCEEDS ENFORCEMENT STANDARD

0 160 320
SCALE IN FEET

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE GROUNDWATER PLUME (ALTERNATIVES GW-1, GW-2, AND GW-3)

LOCATION: OAK CREEK, WISCONSIN

TETRATECH

CHECKED	MRN	FIGURE:
DRAFTED	HJW	6
PROJECT	117-2201323	
DATE	11/7/14	

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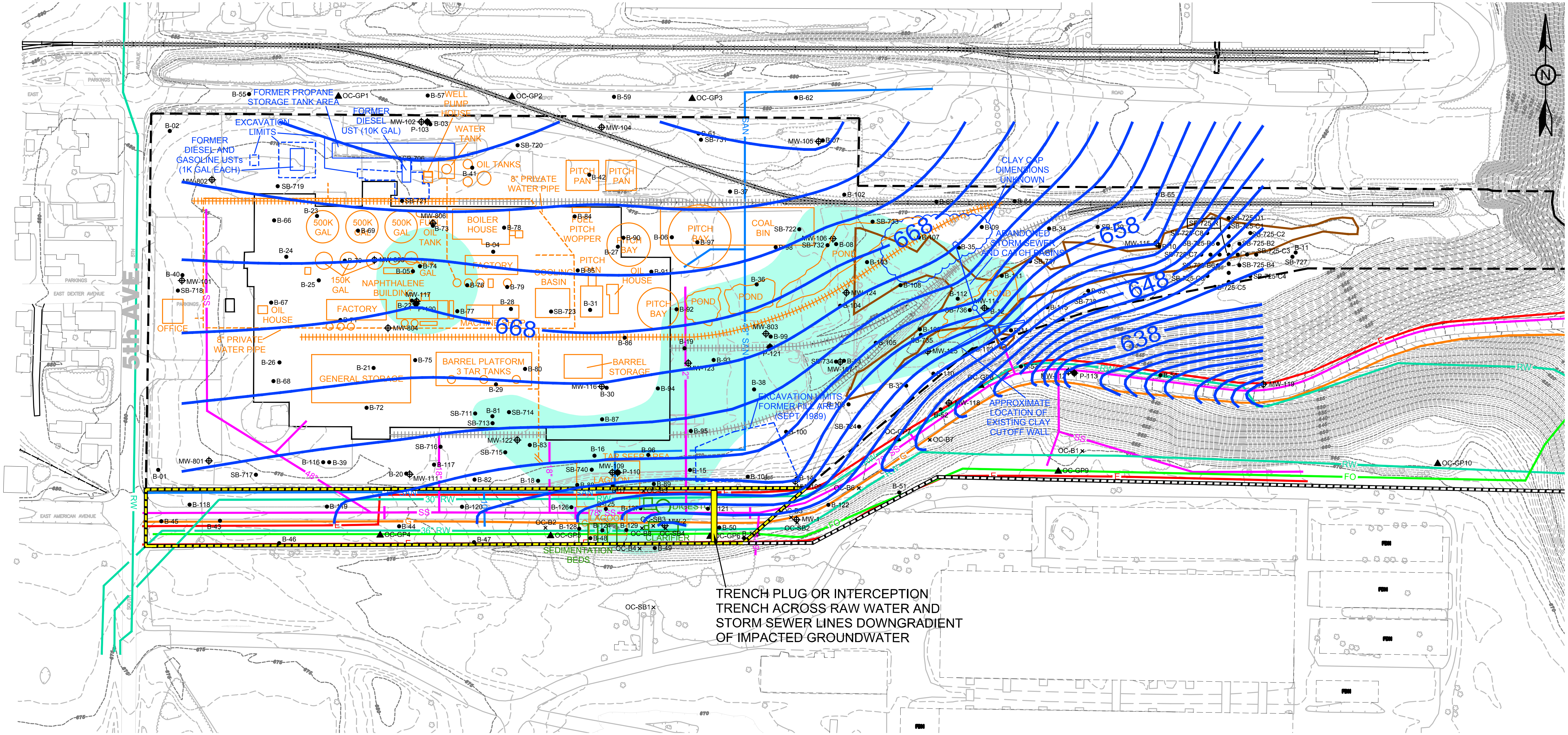


EXPLANATION

MW-101	WATER TABLE WELL
P-103	NESTED PIEZOMETER
B-01	SOIL BORING
OC-SB1	SOIL BORING (CITY OF OAK CREEK)
OC-GP1	GEOPROBE (CITY OF OAK CREEK)
— — —	APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
(yellow dashed)	APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
(orange square/circle)	FORMER TAR PLANT STRUCTURES
(blue dashed)	PAST REMEDIAL ACTIVITIES
(green square/circle)	FORMER WASTEWATER TREATMENT PLANT STRUCTURES
(brown line)	APPROXIMATE WETLAND BOUNDARY
(hatched line)	APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
—658—	SHALLOW WATER TABLE CONTOUR
—E—	ELECTRICAL
—G—	NATURAL GAS
—RW—	RAW WATER
—SAN—	SANITARY
—SS—	STORM SEWER
—FO—	FIBER OPTIC
(shaded area)	APPROXIMATE AREA OF GROUNDWATER THAT EXCEEDS ENFORCEMENT STANDARD

0 160 320

SCALE IN FEET

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

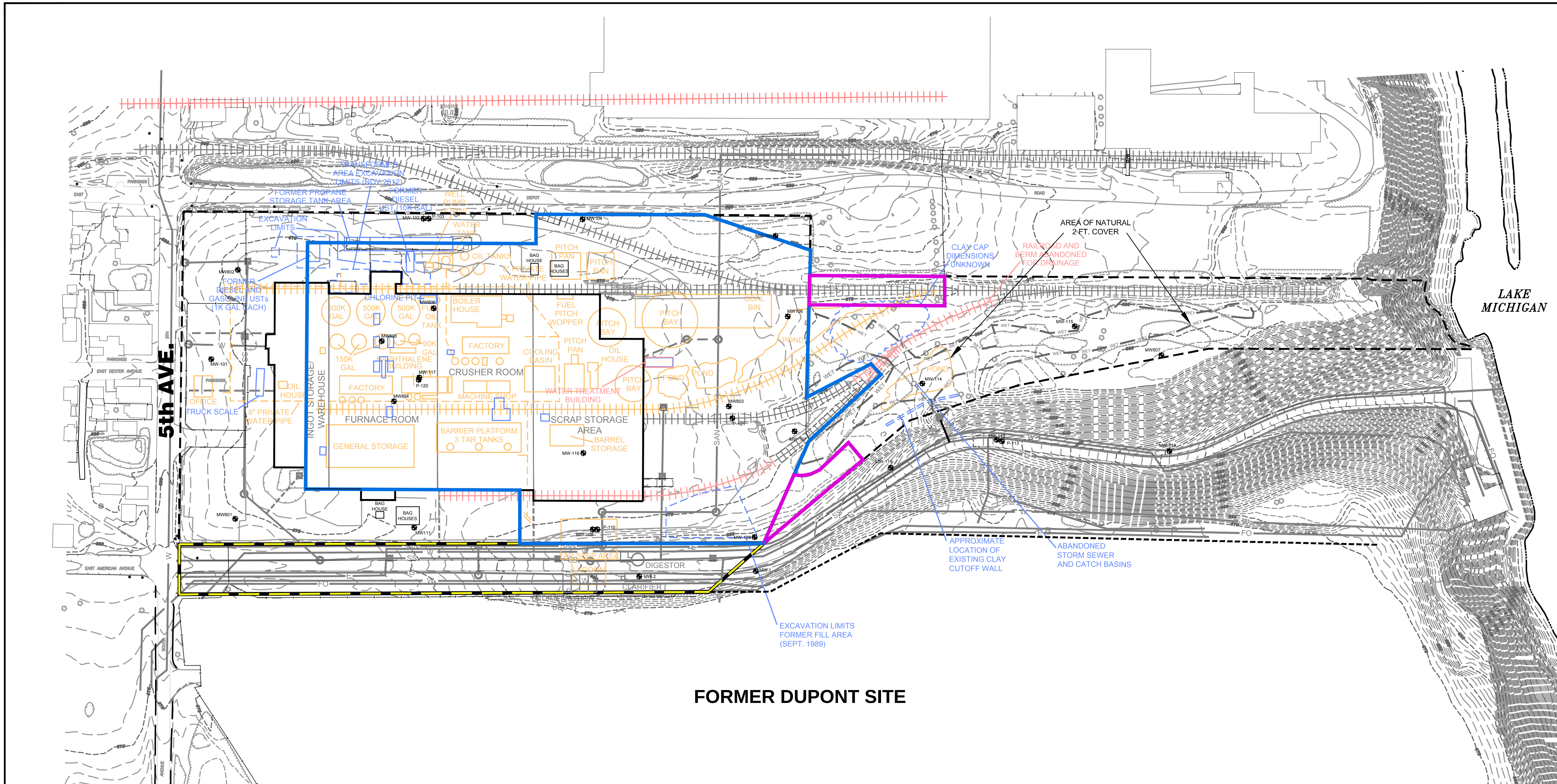
TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE UTILITY MIGRATION PATHWAYS (ALTERNATIVES UT-1, UT-2, AND UT-3)

LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN	FIGURE:
DRAFTED	HJW	7
PROJECT	117-2201323	
DATE	11/7/14	

S:\CAD\BEAZER\WABASH\RAO REPORT\JET GROUT REVISION1.DWG



- WABASH PARCEL PROPERTY BOUNDARY (CONNELL AND BEAZER VPLE)
- CITY PARCEL PROPERTY BOUNDARY (BEAZER VPLE)
- UTILITY CORRIDOR PROPERTY BOUNDARY
- WET — WETLAND BOUNDARY
- RAILROAD RAIL LINE
- SAN — SANITARY
- ABANDONED SANITARY
- SS — STORM SEWER
- ASSUMED STORM SEWER
- G — NATURAL GAS
- W — WATER MAIN
- E — ELECTRICAL
- FO — FIBER OPTIC
- MANHOLE
- INLET/CATCH BASIN
- EXISTING MONITORING WELL/PIEZOMETER
- PROPOSED LIMITS OF BARRIER FOR PCBs AND ARSENIC - 10" CLAY, 14" GENERAL FILL/ROOTING ZONE
- PROPOSED LIMITS OF BARRIER FOR ARSENIC ONLY - 24" GENERAL FILL/ROOTING ZONE
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER PITS OR TANKS, WABASH
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- ABANDONED STRUCTURE

NOTES:

1. BARRIER LIMITS ARE APPROXIMATE AND MAY BE REVISED DURING REMEDIAL DESIGN.

SOURCE NOTES:

1. TETRA TECH FIGURE 14, EXTENT OF SOIL EXCEEDING INDUSTRIAL DIRECT CONTACT RCL, DATED 2/16/12, 4436D-REVISED-OAK CREEK.DWG.
2. TETRA TECH FIGURE 11, PROPOSED INVESTIGATION/SAMPLING LOCATIONS, DATED 11/20/12, FIGURE 11 - PROPOSED INVESTIGATION-SAMPLING LOCATIONS.DWG.
3. TETRA TECH FIGURE 1, SITE LAYOUT, DATED 06/07/13, SITE LAYOUT.DWG.
4. WETLAND BOUNDARY DELINEATED BY HEY & ASSOCIATES AND FIELD LOCATED BY NATURAL RESOURCE TECHNOLOGY, INC. JUNE 2013

N

0 100 200

SCALE IN FEET

DRAWN BY: RLH DATE: 09/24/14
CHECKED BY: RJG DATE: 09/24/14
APPROVED BY: JAZ DATE: 11/11/14
DRAWING NO: FIG C1_2095-62-B08 Alt S-3
REFERENCE: .

PCB AND ARSENIC SOIL BARRIER (ALTERNATIVE S-3)

REMEDIAL ACTION OPTIONS REPORT
FORMER WABASH ALLOYS
9100 SOUTH 5TH AVENUE
OAK CREEK, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
2095/6.2

FIGURE NO.
8

Nov 12, 2014 7:28pm PLOTTED BY: ddudo SAVED BY: ddudo Y:\ACAData\Projects\20\2095\6-2\FIG C1_2095-62-B08 Alt S-3.dwg Layout1
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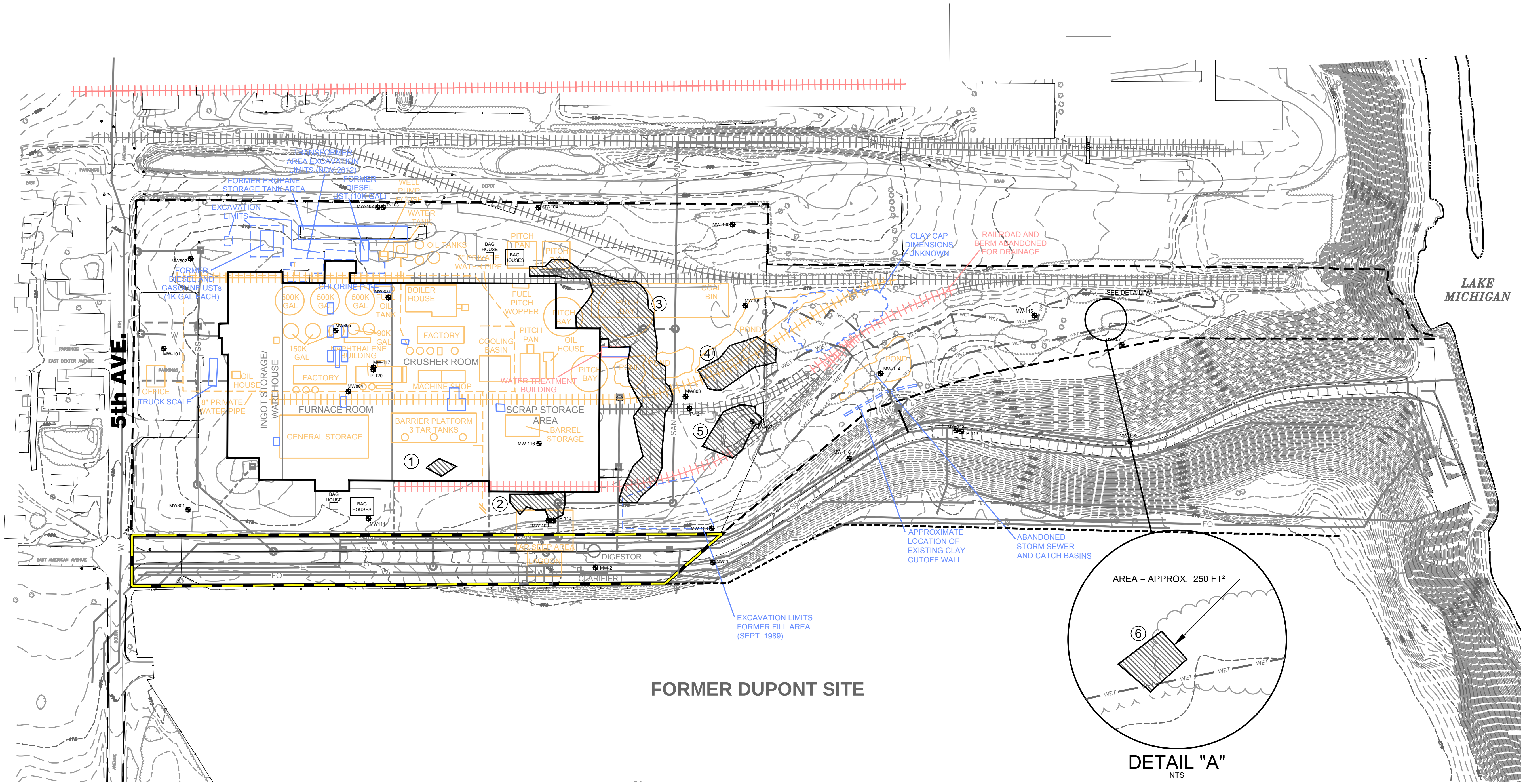

(dashed heavy line)	WABASH PARCEL PROPERTY BOUNDARY (CONNELL AND BEAZER VPLE)
(yellow/black line)	CITY PARCEL PROPERTY BOUNDARY (BEAZER VPLE)
(dashed line)	UTILITY CORRIDOR PROPERTY BOUNDARY
WET	WETLAND BOUNDARY
(hatched line)	RAILROAD RAIL LINE
SAN	SANITARY
(dashed)	ABANDONED SANITARY
SS	STORM SEWER
(dashed)	ASSUMED STORM SEWER
G	NATURAL GAS
W	WATER MAIN
E	ELECTRICAL
FO	FIBER OPTIC
(circle)	MANHOLE
(square)	INLET/CATCH BASIN
(dot)	EXISTING MONITORING WELL/PIEZOMETER
(hatched box)	PROPOSED PCB EXCAVATION AREA BOUNDARY, APPROXIMATE
(orange box/circle)	FORMER TAR PLANT STRUCTURES
(blue dashed box)	PAST REMEDIAL ACTIVITIES
(blue box)	FORMER PITS OR TANKS, WABASH
(grey box/circle)	FORMER WASTEWATER TREATMENT PLANT STRUCTURES
(red box)	ABANDONED STRUCTURE

NOTES:

1. EXCAVATION AREAS ARE APPROXIMATE AND MAY BE REVISED DURING REMEDIAL DESIGN.

EXCAVATION AREAS:

1. AREA = 909.5 SQ. FT.
2. AREA = 3382.0 SQ. FT.
3. AREA = 31918.4 SQ. FT.
4. AREA = 7201.5 SQ. FT.
5. AREA = 6044.3 SQ. FT.
6. AREA = 250.0 SQ. FT.

SOURCE NOTES:

1. TETRA TECH FIGURE 14, EXTENT OF SOIL EXCEEDING INDUSTRIAL DIRECT CONTACT RCL, DATED 2/16/12, 4436D-REVISED-OAK CREEK.DWG.
2. TETRA TECH FIGURE 11, PROPOSED INVESTIGATION/SAMPLING LOCATIONS, DATED 11/20/12, FIGURE 11 - PROPOSED INVESTIGATION-SAMPLING LOCATIONS.DWG.
3. TETRA TECH FIGURE 1, SITE LAYOUT, DATED 06/07/13, SITE LAYOUT.DWG.
4. WETLAND BOUNDARY DELINEATED BY HEY & ASSOCIATES AND FIELD LOCATED BY NATURAL RESOURCE TECHNOLOGY, INC. JUNE 2013

N

0 100 200

SCALE IN FEET

PCB SOIL EXCAVATION AND DISPOSAL (ALTERNATIVE S-4)

REMEDIAL ACTION OPTIONS REPORT
FORMER WABASH ALLOYS
9100 SOUTH 5TH AVENUE
OAK CREEK, WISCONSIN

DRAWN BY: DMD DATE: 10/24/14
CHECKED BY: JAZ DATE: 10/24/14
APPROVED BY: JAZ DATE: 11/11/14
DRAWING NO: FIG C2_2095-62-B09 Alt S-4
REFERENCE: .

NATURAL RESOURCE TECHNOLOGY

PROJECT NO. 2095/6.2

FIGURE NO. 9

Nov 12, 2014 7:33pm PLOTTED BY: ddudo SAVED BY: ddudo
Y:\ACAData\Projects\20\2095\6-2\FIG C2_2095-62-B09 Alt S-4.dwg Layout1
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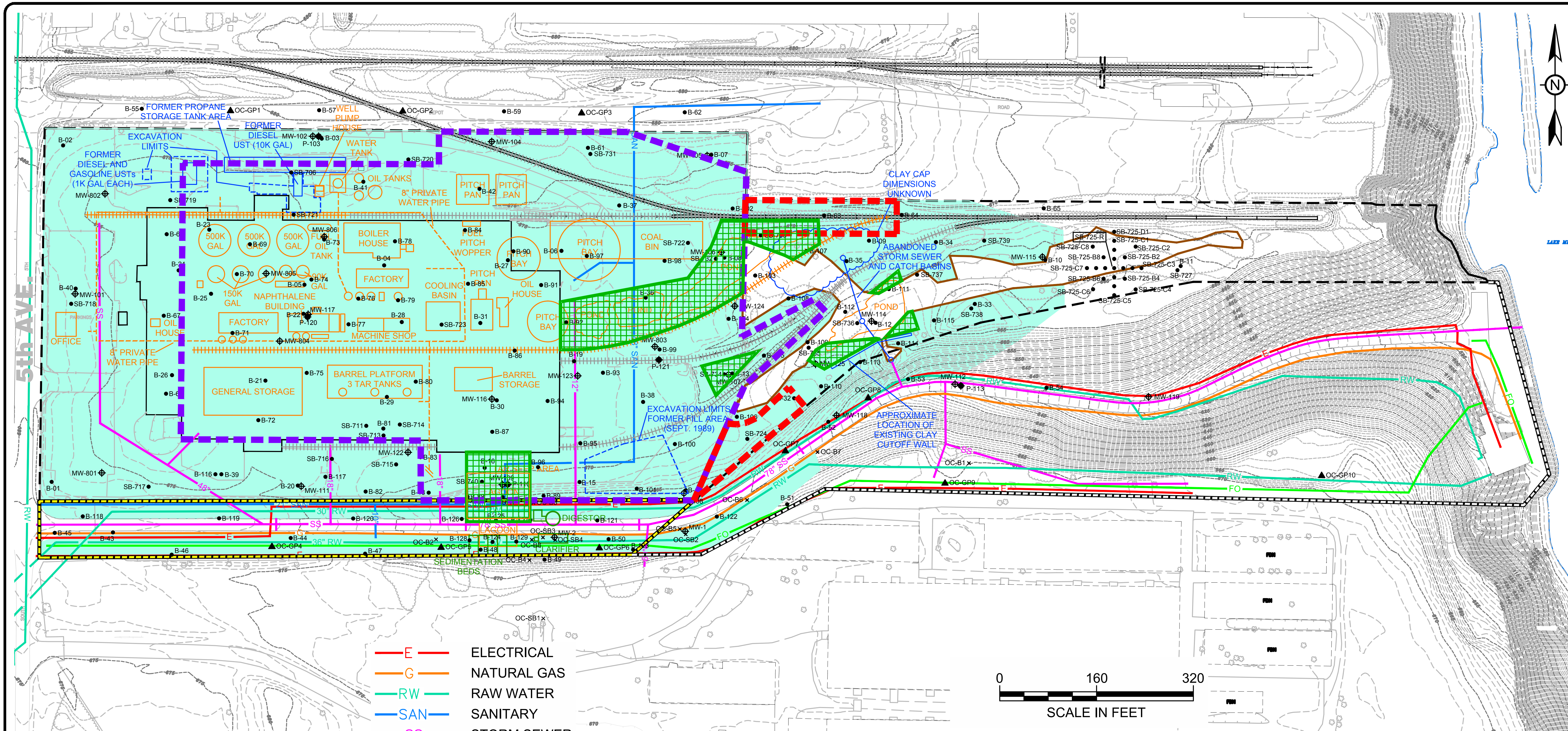


EXPLANATION

MW-101	WATER TABLE WELL
P-103	NESTED PIEZOMETER
B-01	SOIL BORING
× OC-SB1	SOIL BORING (CITY OF OAK CREEK)
▲OC-GP1	GEOPROBE (CITY OF OAK CREEK)
— — —	APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
(yellow/black line)	APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
—E—	ELECTRICAL
—G—	NATURAL GAS
—RW—	RAW WATER
—SAN—	SANITARY
—SS—	STORM SEWER
—FO—	FIBER OPTIC
(orange square/circle)	FORMER TAR PLANT STRUCTURES
(blue dashed box)	PAST REMEDIAL ACTIVITIES
(green square/circle)	FORMER WASTEWATER TREATMENT PLANT STRUCTURES
(brown line)	APPROXIMATE WETLAND BOUNDARY
(hatched line)	APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
(green grid)	GEOMEMBRANE
(purple dashed box)	PROPOSED LIMITS OF COVER FOR PCBs AND ARSENIC - 10" CLAY, 14" GENERAL FILL/ROOTING ZONE (497,162 FT.^{2})
(red dashed box)	PROPOSED LIMITS OF COVER FOR ARSENIC ONLY - 24" GENERAL FILL/ROOTING ZONE (22,257 FT.^{2})
(cyan fill)	PROPOSED LIMIT OF DERMAL COVER FOR PAHs - 24" GENERAL FILL/ROOTING ZONE (910,114 FT.^{2}) (PCB/ARSENIC COVER WOULD SERVE AS DERMAL COVER IN THOSE AREAS)

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

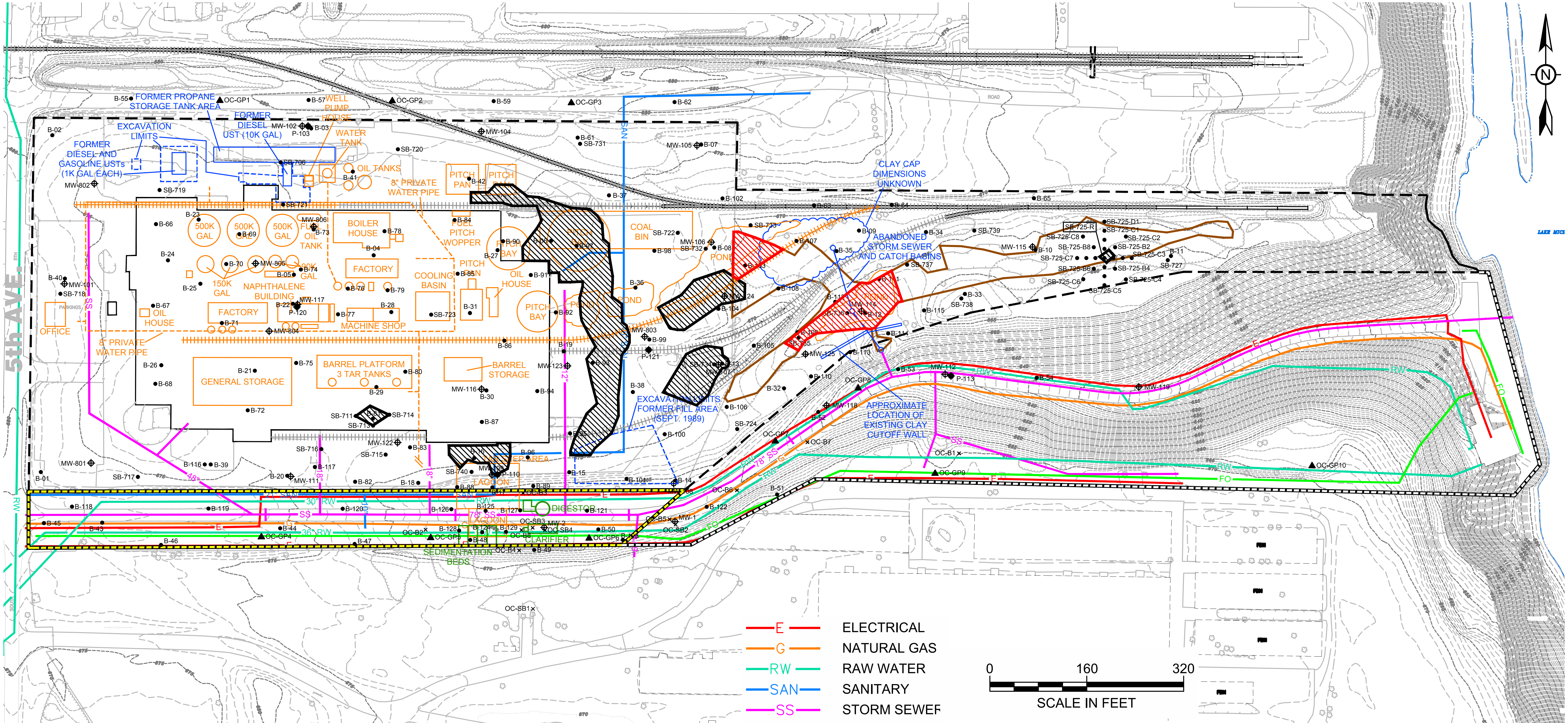
TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
COMBINED SOIL BARRIER (ALTERNATIVES S-1, PMT-2.1, AND S-3)

LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	HJW
PROJECT	117-2201323
DATE	11/10/14
FIGURE:	10

S:\CAD\BEAZER\WABASH\RAO REPORT\10-2-14\COMBINED SOIL BARRIER.DWG



EXPLANATION

MW-101	WATER TABLE WELL
P-103	NESTED PIEZOMETER
B-01	SOIL BORING
× OC-SB1	SOIL BORING (CITY OF OAK CREEK)
▲ OC-GP1	GEOPROBE (CITY OF OAK CREEK)
	APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
	APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
	FORMER TAR PLANT STRUCTURES
	PAST REMEDIAL ACTIVITIES
	FORMER WASTEWATER TREATMENT PLANT STRUCTURES
	APPROXIMATE WETLAND BOUNDARY
	APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
	PROPOSED EXCAVATION AREAS BOUNDARY FOR PCBs, APPROXIMATE
	PROPOSED EXCAVATION AREAS BOUNDARY FOR TAR, APPROXIMATE

NOTE: POTENTIALLY MOBILE TAR OBSERVED SEEPING INTO PCB EXCAVATIONS WILL BE EXCAVATED OR SOLIDIFIED PRIOR TO BACKFILLING.

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
COMBINED EXCAVATION AREAS (ALTERNATIVES PMT-3A.1 AND S-4)

LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN	FIGURE:
DRAFTED	HJW	11
PROJECT	117-2201323	
DATE	11/7/14	

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Alternative SW-1
Site Wide Institutional Controls

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Legal & Administrative				
Legal & Administrative Services				$ 25,000
Total Capital Costs				$ 25,000
O&M COSTS				
Total O&M Costs				$ -
TOTAL ALTERNATIVE COST				$ 25,000

Alternative S-1
Soil Barrier

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Soil Barrier				
Mob/Demob	$ 30,000	LS	1	$ 30,000
Stormwater Control & Treatment	$ 30,000	LS	1	$ 30,000
Import General Fill for Drainage	$ 16	CY	5000	$ 80,000
Grading Subbase for Drainage	$ 2,500	Acre	21.2	$ 53,000
Imported Soil Characterization	$ 150	300 CY	230	$ 34,500
Furnish and Place Imported Soil	$ 21	CY	51,175	$ 1,074,675
Grade Soil for Dermal Protection Layer (18")	$ 4	CY	51,175	$ 204,700
Furnish and Place Imported Topsoil	$ 26	CY	17,050	$ 443,300
Grade Topsoil (6")	$ 3,000	Acre	21.2	$ 63,600
Seeding, Mulch and Erosion Control	$ 4,000	Acre	21.2	$ 84,800
Documentation Survey	$ 25,000	LS	1	$ 25,000
SubTotal				$ 2,123,575
Engineering & Contingency				
Permitting & Design (15%)				$ 318,536
Construction Oversight (7.5%)				$ 159,268
Contingency (15%)				$ 318,536
SubTotal				$ 796,341
Total Capital Costs				**$ 2,919,916**
O&M COSTS				
O&M (cap inspection & repairs)	$ 1,000	YR		
30 Years NPV Annual Costs			30	$ 24,940
Total O&M Costs				**$ 24,940**
TOTAL ALTERNATIVE COST				**$ 2,944,856**

Average of Superfund Interest Rates for 2008-2014 (%)	1.235
30 year Net Present Value Multiplier	24.94

Alternative S-2
Impermeable Cap

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Impermeable Cap				
Mob/Demob	$ 30,000	LS	1	$ 30,000
Stormwater Control & Treatment	$ 30,000	LS	1	$ 30,000
Import General Fill for Drainage	$ 16	CY	5000	$ 80,000
Grading Subbase for Drainage	$ 2,500	Acre	21.2	$ 53,000
Install Geomembrane	$ 2.50	SQ FT	921,150	$ 2,302,875
Imported Soil Characterization	$ 150	300 CY	230	$ 34,500
Furnish and Place Imported Soil	$ 21	CY	51,175	$ 1,074,675
Grade Soil for Dermal Protection Layer (18")	$ 4	CY	51,175	$ 204,700
Furnish and Place Imported Topsoil	$ 26	CY	17,050	$ 443,300
Grade Topsoil (6")	$ 3,000	Acre	21.2	$ 63,600
Seeding, Mulch and Erosion Control	$ 4,000	Acre	21.2	$ 84,800
Documentation Survey	$ 25,000	LS	1	$ 25,000
SubTotal				$ 4,426,450
Engineering & Contingency				
Permitting & Design (15%)				$ 663,968
Construction Oversight (7.5%)				$ 331,984
Contingency (15%)				$ 663,968
SubTotal				$ 1,659,919
Total Capital Costs				**$ 6,086,369**
O&M COSTS				
O&M (cap inspection & repairs)	$ 1,000	YR		
30 Years NPV Annual Costs			30	$ 24,940
Total O&M Costs				**$ 24,940**
TOTAL ALTERNATIVE COST				**$ 6,111,309**

Average of Superfund Interest Rates for 2008-2014 (%)	1.235
30 year Net Present Value Multiplier	24.94

APPENDIX S-3 & S-4 Summary of Material Quantities (PCBS and Metals)

Remedial Action Options Report
Former Koppers Tar Plant and Wabash Alloys Site
Oak Creek, Wisconsin

Materials	Area (SF)	Excavation Volume Range (CY)	Estimated Volume used for cost estimate (CY)	Remedial Alternative	Imported, Reused as Backfill or Landfilled
Soil Barrier (24 inches)					
PCB Soil Barrier (10-inches Clay)	500,000		15,400	S-3	Imported
PCB Soil Barrier (10-inches Rooting Zone)	500,000		15,400	S-3	Imported
Arsenic Soil Barrier (20-inches Rooting Zone)	22,000		1,400	S-3	Imported
Topsoil (4 inches)	522,000		6,400	S-3	Imported
Total Barrier Volume Needed			**38,600**		
Excavated Soil (Cleanup level 10 mg/kg total PCBs)					
Soil with PCB >50 mg/kg	--	1,100 - 1,500 (3)	1,500	S-4	Landfilled
Soil with PCB >10 & <50 mg/kg	--	4,000 - 5,000 (3)	5,000	S-4	Landfilled
Segregated Soil, PCB <10 mg/kg (1)	--	2,500 - 3,500	3,000	S-4	Reused as backfill or landfilled(2)
Total Excavated Soil			**9,500**		
Imported Backfill	--		9,500	S-4	Imported

Notes:
SF: Square Feet
CY: Cubic Yards

(1) Soils with concentrations less than or equal to 10 mg/kg total PCBs that require removal due to soil layer below having concentrations greater than 10 mg/kg total PCBs.
(2) Soil may be reused as backfill following verification testing of less than or equal to 10 mg/kg total PCBs in accordance with NR718; for cost estimates, soil is assumed to be landfilled.

(3) Estimated volume includes 2-inch buffer for excavated soil >50 mg/kg total PCBs and also excavated soil >10 and <50 mg/kg total PCBs.

APPENDIX S-3. Cost Estimate Alternative S-3 - Soil Barrier (PCBs and Metals)

Remedial Action Options Report
Former Koppers Tar Plant and Wabash Alloys Site
Oak Creek, Wisconsin

Description	Quantity	Unit	Unit Cost	Item Cost	Subtotal
CAPITAL COSTS					
Soil Barrier (12 acres)					
Mob/Demob	1	LS	$20,000	$20,000	
Site Prep/Stormwater Control	1	LS	$30,000	$30,000	
Import general fill for drainage	5000	CY	$16	$80,000	
Grading subbase for Drainage	12	Acres	$2,500	$29,959	
Imported Soil Characterization	130	300 CY	$150	$19,500	
Furnish and Place Imported Clay (10 inches for PCB barrier)	15,400	CY	$22	$338,800	
Furnish and Place Imported Rooting Zone	16,800	CY	$21	$352,800	
Compact clay, grade soil fill	32,200	CY	$4	$128,800	
Furnish and Place Topsoil	6,400	CY	$26	$166,400	
Grade Topsoil	12	Acres	$3,000	$35,950	
Seeding, Mulch and Erosion Control	12	Acres	$4,000	$48,000	
Documentation Survey	1	LS	$25,000	$25,000	
SUBTOTAL					$1,275,209
Engineeering & Contingency					
Permitting & Design (15%)				$191,281	
Construction Oversight (7.5%)				$95,641	
Contingency (15%)				$191,281	
SUBTOTAL					$478,203
Total Capital Costs					**$1,753,413**
O&M COSTS					
Annual O&M Costs					
Annual O&M (cap inspection and repairs)	1	LS	$1,000	$1,000	
					$1,000
30 Year Net Present Value Costs	30	YR			24,940
Total O&M Costs					**$24,940**
TOTAL ALTERNATIVE COST (PRESENT VALUE)					**$1,778,353**

Notes:

Average of Superfund Interest Rates for 2008-2014 (%)	1.235
30 year Net Present Value Multiplier	24.94

NATURAL RESOURCE TECHNOLOGY

APPENDIX S-4. Cost Estimate Alternative S-4 - Soil Excavation and Disposal (PCBs and Metals)

Remedial Action Options Report
Former Koppers Tar Plant and Wabash Alloys Site
Oak Creek, Wisconsin

Description	Quantity	Unit	Unit Cost	Item Cost	Subtotal
CAPITAL COSTS					
Soil Excavation and Off-site Disposal (Cleanup to 10 mg/kg total PCBs)					
Mob/Demob	1	LS	$20,000	$20,000	
Site Prep/Stormwater Control	1	LS	$30,000	$30,000	
Soil Excavation	9,500	CY	$5	$47,500	
Soil Loading	9,500	CY	$4	$38,000	
Transportation and Disposal of >50 mg/kg PCBs	1,500	CY	$300	$450,000	
Transportation and Disposal of <50 mg/kg PCBs	8,000	CY	$70	$560,000	
Imported Soil Characterization	32	300 CY	$150	$4,750	
Furnish and Place Imported Backfill	9,500	CY	$21	$199,500	
Confirmation Sampling (250 sidewall and base samples for PCBs)	250	EA	$60	$15,000	
Wetlands Mitigation (off-site credits or in-lieu fee)	1	LS	$10,000	$10,000	
Documentation Survey	1	LS	$25,000	$25,000	
SUBTOTAL					$1,399,750
Engineeering & Contingency					
Permitting & Design (15%)				$209,963	
Construction Oversight (7.5%)				$104,981	
Contingency (15%)				$209,963	
SUBTOTAL					$524,906
Total Capital Costs					**$1,924,656**
O&M COSTS					
Annual O&M Costs					
Annual O&M	1	LS	$0	$0	
					$0
Total O&M Costs					**$0**
TOTAL ALTERNATIVE COST (PRESENT VALUE)					**$1,924,656**

Notes:
This alternative would be implemented in conjunction with Alternative S-3.

Alternative PMT-1A
Solidifcation via In-Situ Soil Mixing (0-4 ft)

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Bench Test for In Situ Mixing				
Collect Composite Soil Samples	$ 7,500	Event	1	$ 7,500
Soil Sample Laboratory Analyses	$ 3,000	Lot	1	$ 3,000
Technology Bench Test and Report	$ 15,000	Each	1	$ 15,000
SubTotal				$ 25,500
Solidification				
Mob/DeMob	$ 30,000	LS	1	$ 30,000
Stormwater Control & Treatment	$ 10,000	Each	1	$ 10,000
Mechanical Mixing (Excavator)	$ 25	CY	9,700	$ 242,500
Stabilizer - 15% by soil weight - Portland cement	$ 200	Ton	2,200	$ 440,000
Water Supply (50% of Soil Weight)	$ 0.01	LS	1,750,000	$ 17,500
Sample Treated Soils	$ 200	Each	35	$ 7,000
Furnish and Place Imported Topsoil	$ 26	CY	1,250	$ 32,500
Seeding, Mulch and Erosion Control	$ 4,000	Acre	1.5	$ 6,000
Wetland Mitigation (off-site credits or in-lieu fee)	$ 75,000	Acre	0.3	$ 22,500
SubTotal				$ 808,000
Engineering & Contingency				
Permitting & Design (15%)				$ 125,025
Construction Oversight (7.5%)				$ 62,513
Contingency (15%)				$ 125,025
SubTotal				$ 312,563
Total Capital Costs				**$ 1,146,063**
O&M COSTS				
Total O&M Costs				$ -
TOTAL ALTERNATIVE COST				**$ 1,146,063**

Alternative PMT-1B
Solidifcation via In-Situ Soil Mixing (Total Depth)

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Bench Test for In Situ Mixing				
Collect Composite Soil Samples	$ 4,000	Event	1	$ 4,000
Soil Sample Laboratory Analyses	$ 3,000	Lot	1	$ 3,000
Technology Bench Test and Report	$ 15,000	Each	1	$ 15,000
SubTotal				$ 22,000
Solidification				
Mob/DeMob	$ 100,000	LS	1	$ 100,000
Stormwater Control & Treatment	$ 30,000	Each	1	$ 30,000
Mechanical Mixing (Auger)	$ 50	CY	90,000	$ 4,500,000
Stabilizer - 15% by soil weight - Portland cement	$ 200	Ton	20,250	$ 4,050,000
Water Supply (50% of Soil Weight)	$ 0.01	Gal	16,000,000	$ 160,000
Sample Treated Soils	$ 200	Ea	350	$ 70,000
Spoils Management	$ 5	CY	18,000	$ 90,000
Furnish and Place Imported Topsoil	$ 26	CY	3,350	$ 87,100
Seeding, Mulch and Erosion Control	$ 4,000	Acre	4	$ 16,000
Wetland Mitigation (off-site credits or in-lieu fee)	$ 75,000	Acre	0.3	$ 22,500
SubTotal				$ 9,125,600
Engineering & Contingency				
Permitting & Design (15%)				$ 1,372,140
Construction Oversight (7.5%)				$ 686,070
Contingency (15%)				$ 1,372,140
SubTotal				$ 3,430,350
Total Capital Costs				**$ 12,577,950**
O&M COSTS				
Total O&M Costs				$ -
TOTAL ALTERNATIVE COST				**$ 12,577,950**

These costs include treatment of 0-4 ft surface soil interval (Alternative PMT-1A)

Alternative PMT-2
Engineered Barrier (0-4 ft)

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Engineered Barrier				
Mob/Demob	$ 10,000	LS	1	$ 10,000
Stormwater Control & Treatment	$ 10,000	LS	1	$ 10,000
Grading Subbase for Drainage	$ 2,500	Acre	1.5	$ 3,750
Install Geomembrane	$ 2.50	SQ FT	65,300	$ 163,250
Imported Soil Characterization	$ 150	300 CY	17	$ 2,550
Furnish and Place Imported Soil	$ 21	CY	3,700	$ 77,700
Grade Soil for Dermal Protection Layer (18")	$ 4	CY	3,700	$ 14,800
Furnish and Place Imported Topsoil	$ 26	CY	1,300	$ 33,800
Grade Topsoil (6")	$ 3,000	Acre	1.5	$ 4,500
Seeding, Mulch and Erosion Control	$ 4,000	Acre	1.5	$ 6,000
Wetland Mitigation (off-site credits or in-lieu fee)	$ 75,000	Acre	0.3	$ 22,500
Documentation Survey	$ 5,000	LS	1	$ 5,000
SubTotal				$ 353,850
Engineering & Contingency				
Permitting & Design (15%)				$ 53,078
Construction Oversight (7.5%)				$ 26,539
Contingency (15%)				$ 53,078
SubTotal				$ 132,694
Total Capital Costs				**$ 486,544**
O&M COSTS				
Total O&M Costs				$ -
TOTAL ALTERNATIVE COST				**$ 486,544**

These costs include associated soil barrier costs (Alternative S-1)

Alternative PMT-2.1
Engineered Barrier (0-4 ft) Excluding Wetland Areas

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Engineered Barrier				
Mob/Demob	$ 10,000	LS	1	$ 10,000
Stormwater Control & Treatment	$ 10,000	LS	1	$ 10,000
Grading Subbase for Drainage	$ 2,500	Acre	1.1	$ 2,750
Install Geomembrane	$ 2.50	SQ FT	52,725	$ 131,813
Imported Soil Characterization	$ 150	300 CY	13	$ 1,950
Furnish and Place Imported Soil	$ 21	CY	2,950	$ 61,950
Grade Soil for Dermal Protection Layer (18")	$ 4	CY	2,950	$ 11,800
Furnish and Place Imported Topsoil	$ 26	CY	1,000	$ 26,000
Grade Topsoil (6")	$ 3,000	Acre	1.2	$ 3,600
Seeding, Mulch and Erosion Control	$ 4,000	Acre	1.2	$ 4,800
Wetland Mitigation (off-site credits or in-lieu fee)	$ 75,000	Acre	0.3	$ 22,500
Documentation Survey	$ 5,000	LS	1	$ 5,000
SubTotal				$ 292,163
Engineering & Contingency				
Permitting & Design (15%)				$ 43,824
Construction Oversight (7.5%)				$ 21,912
Contingency (15%)				$ 43,824
SubTotal				$ 109,561
Total Capital Costs				**$ 401,723**
O&M COSTS				
Total O&M Costs				$ -
TOTAL ALTERNATIVE COST				**$ 401,723**

These costs include associated soil barrier costs (Alternative S-1)

Alternative PMT-3A
Excavation with Off-Site Landfill Disposal (0-4 ft)

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Soil Excavation and Disposal				
Mob/DeMob	$ 20,000	LS	1	$ 20,000
Stormwater Control & Treatment	$ 10,000	Each	1	$ 10,000
Soil Excavation	$ 5	CY	9,700	$ 48,500
Soil Loading	$ 4	CY	9,700	$ 38,800
Transportation & Off-Site Soil Disposal (Special Waste)	$ 70	CY	9,700	$ 679,000
Imported Soil Characterization	$ 150	300 CY	32	$ 4,800
Furnish and Place Imported Backfill Soil	$ 21	CY	9,700	$ 203,700
Furnish and Place Imported Topsoil	$ 26	CY	1,200	$ 31,200
Seeding, Mulch and Erosion Control	$ 4,000	Acre	2	$ 6,000
Wetland Mitigation (off-site credits or in-lieu fee)	$ 75,000	Acre	0.3	$ 22,500
SubTotal				$ 1,064,500
Engineering & Contingency				
Permitting & Design (15%)				$ 159,675
Construction Oversight (7.5%)				$ 79,838
Contingency (15%)				$ 159,675
SubTotal				$ 399,188
Total Capital Costs				**$ 1,463,688**
O&M COSTS				
Total O&M Costs				$ -
TOTAL ALTERNATIVE COST				**$ 1,463,688**

Alternative PMT-3A.1
Excavation with Off-Site Landfill Disposal (0-4 ft) for Wetland Areas Only

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Soil Excavation and Disposal				
Mob/DeMob	$ 20,000	LS	1	$ 20,000
Stormwater Control & Treatment	$ 5,000	Each	1	$ 5,000
Soil Excavation	$ 5	CY	1,900	$ 9,500
Soil Loading	$ 4	CY	1,900	$ 7,600
Transportation & Off-Site Soil Disposal (Special Waste)	$ 70	CY	1,900	$ 133,000
Imported Soil Characterization	$ 150	300 CY	7	$ 1,050
Furnish and Place Imported Backfill Soil	$ 21	CY	1,900	$ 39,900
Wetland Mitigation (off-site credits or in-lieu fee)	$ 75,000	Acre	0.3	$ 22,500
SubTotal				$ 238,550
Engineering & Contingency				
Permitting & Design (15%)				$ 35,783
Construction Oversight (7.5%)				$ 17,891
Contingency (15%)				$ 35,783
SubTotal				$ 89,456
Total Capital Costs				**$ 328,006**
O&M COSTS				
Total O&M Costs				$ -
TOTAL ALTERNATIVE COST				**$ 328,006**

Alternative PMT-3B
Excavation with Off-Site Landfill Disposal (Total Depth)

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Soil Excavation and Disposal				
Mob/DeMob	$ 20,000	LS	1	$ 20,000
Stormwater Control & Treatment	$ 25,000	Each	1	$ 25,000
Soil Excavation	$ 5	CY	90,000	$ 450,000
Soil Loading	$ 4	CY	90,000	$ 360,000
Transportation & Off-Site Soil Disposal (Special Waste)	$ 70	CY	90,000	$ 6,300,000
Imported Soil Characterization	$ 150	300 CY	300	$ 45,000
Furnish and Place Imported Backfill Soil	$ 21	CY	90,000	$ 1,890,000
Furnish and Place Imported Topsoil	$ 26	CY	3,350	$ 87,100
Seeding, Mulch and Erosion Control	$ 4,000	Acre	4	$ 16,000
Wetland Mitigation (off-site credits or in-lieu fee)	$ 75,000	Acre	0.3	$ 22,500
SubTotal				$ 9,215,600
Engineering & Contingency				
Permitting & Design (15%)				$ 1,382,340
Construction Oversight (7.5%)				$ 691,170
Contingency (15%)				$ 1,382,340
SubTotal				$ 3,455,850
Total Capital Costs				**$ 12,671,450**
O&M COSTS				
Total O&M Costs				$ -
TOTAL ALTERNATIVE COST				**$ 12,671,450**

These costs include excavation and disposal of 0-4 ft surface soil interval (Alternative PMT-3A)

Alternative GW-1
Monitored Plume Stability

Description		Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS					
Well Installation/Repair					
Well Installation/Repair (4 shallow & 1 deep)		$ 30,000	LS	1	$ 30,000
	SubTotal				$ 30,000
Engineering & Contingency					
Permitting & Design (15%)					$ 4,500
Construction Oversight (7.5%)					$ 2,250
Contingency (15%)					$ 4,500
	SubTotal				$ 11,250
Total Capital Costs					**$ 41,250**
O&M COSTS					
Annual Groundwater Sampling & Reporting		$ 30,000	YR	2	$ 60,000
Total O&M Costs					**$ 60,000**
TOTAL ALTERNATIVE COST					**$ 101,250**

Alternative GW-2
In-Situ Treatment

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Funnel and Gate Construction				
Mob/DeMob	$ 75,000	LS	1	$ 75,000
Well Installation/Repair (4 shallow & 1 deep)	$ 30,000	LS	1	$ 30,000
Slurry Wall Construction (30" W x 1,000' L x 25' D)	$ 6.5	SQ FT	25,000	$ 162,500
Disposal of Extra Excavated Material and Slurry (30%)	$ 70	Tons	1,000	$ 70,000
Treatment Gate Trench (6' wide x 200' long x 25' deep)	$ 20	CY	1,100	$ 22,000
Disposal of Trench Soil	$ 70	Tons	1,650	$ 115,500
Granular Trench Fill	$ 21	CY	1,100	$ 23,100
Sparge and Nutrient Addition System	$ 100,000	LS	1	$ 100,000
SubTotal				$ 598,100
Engineering & Contingency				
Permitting & Design (15%)				$ 89,715
Construction Oversight (7.5%)				$ 44,858
Contingency (15%)				$ 89,715
SubTotal				$ 224,288
Total Capital Costs				**$ 822,388**
O&M COSTS				
Annual O&M Treatment System (NPV)	$ 25,000	YR	30	$ 623,500
Annual Groundwater Sampling & Reporting	$ 30,000	YR	30	$ 748,200
Total O&M Costs				**$ 1,371,700**
TOTAL ALTERNATIVE COST				**$ 2,194,088**

Average of Superfund Interest Rates for 2008-2014 (%)	1.235
30 year Net Present Value Multiplier	24.94

Alternative GW-3
Pump & Treatment

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Collection Trench and Treatment System Construction				
Mob/DeMob	$ 50,000	LS	1	$ 50,000
Well Installation/Repair (4 shallow & 1 deep)	$ 30,000	LS	1	$ 30,000
Trench Construction (30" W x 1000' L x 25' D)	$ 20	CY	2,320	$ 46,400
Disposal of Trench Soil	$ 70	Tons	3,825	$ 267,750
Granular Trench Fill	$ 24	CY	2,550	$ 61,200
GAC Treatment System	$ 100,000	LS	1	$ 100,000
SubTotal				$ 555,350
Engineering & Contingency				
Permitting & Design (15%)				$ 83,303
Construction Oversight (7.5%)				$ 41,651
Contingency (15%)				$ 83,303
SubTotal				$ 208,256
Total Capital Costs				**$ 763,606**
O&M COSTS				
Annual O&M Treatment System (NPV)	$ 25,000	YR	30	$ 623,500
Annual Groundwater Sampling & Reporting	$ 30,000	LS	30	$ 748,200
Total O&M Costs				**$ 1,371,700**
TOTAL ALTERNATIVE COST				**$ 2,135,306**

Average of Superfund Interest Rates for 2008-2014 (%)	1.235
30 year Net Present Value Multiplier	24.94

Alternative UT-1
Trench Plug

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Trench Plug Construction				
Pavement Removal (6' x 70')	$ 10	SQ FT	420	$ 4,200
Trench Excavation (6' W x 70' L x 20' D)	$ 20	CY	325	$ 6,500
Utility Shoring	$ 40,000	LS	1	$ 40,000
Disposal of Trench Soil	$ 70	Tons	325	$ 22,750
Low Permeability Flowable Trench Fill	$ 30	CY	325	$ 9,750
Pavement Replacement (6' x 70')	$ 20	SQ FT	420	$ 8,400
SubTotal				$ 91,600
Engineering & Contingency				
Permitting & Design (15%)				$ 13,740
Construction Oversight (7.5%)				$ 6,870
Contingency (15%)				$ 13,740
SubTotal				$ 34,350
Total Capital Costs				**$ 125,950**
O&M COSTS				
Total O&M Costs				$ -
TOTAL ALTERNATIVE COST				**$ 125,950**

Alternative UT-2
In-Situ Treatment

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Trench Construction				
Pavement Removal (6' x 70')	$ 10	SQ FT	420	$ 4,200
Trench Excavation (6' W x 70' L x 20' D)	$ 20	CY	325	$ 6,500
Utility Shoring	$ 40,000	LS	1	$ 40,000
Disposal of Trench Soil	$ 70	Tons	325	$ 22,750
Granular Fill	$ 30	CY	325	$ 9,750
Pavement Replacement (6' x 70')	$ 20	SQ FT	420	$ 8,400
Sparge and Nutrient Addition System	$ 75,000	LS	1	$ 75,000
SubTotal				$ 166,600
Engineering & Contingency				
Permitting & Design (15%)				$ 24,990
Construction Oversight (7.5%)				$ 12,495
Contingency (15%)				$ 24,990
SubTotal				$ 62,475
Total Capital Costs				**$ 229,075**
O&M COSTS				
Annual O&M Treatment System (NPV)	$ 25,000	YR	30	$ 623,500
Total O&M Costs				**$ 623,500**
TOTAL ALTERNATIVE COST				**$ 852,575**

Average of Superfund Interest Rates for 2008-2014 (%)	1.235
30 year Net Present Value Multiplier	24.94

Alternative UT-3
Extraction with Treatment

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Trench Construction				
Pavement Removal (6' x 70')	$ 10	SQ FT	420	$ 4,200
Trench Excavation (6' W x 70' L x 20' D)	$ 20	CY	325	$ 6,500
Utility Shoring	$ 40,000	LS	1	$ 40,000
Disposal of Trench Soil	$ 70	Tons	325	$ 22,750
Granular Fill	$ 30	CY	325	$ 9,750
Pavement Replacement (6' x 70')	$ 20	SQ FT	420	$ 8,400
GAC Treatment System	$ 75,000	LS	1	$ 75,000
SubTotal				$ 166,600
Engineering & Contingency				
Permitting & Design (15%)				$ 24,990
Construction Oversight (7.5%)				$ 12,495
Contingency (15%)				$ 24,990
SubTotal				$ 62,475
Total Capital Costs				**$ 229,075**
O&M COSTS				
Annual O&M Treatment System (NPV)	$ 25,000	YR	30	$ 623,500
Total O&M Costs				**$ 623,500**
TOTAL ALTERNATIVE COST				**$ 852,575**

Average of Superfund Interest Rates for 2008-2014 (%)	1.235
30 year Net Present Value Multiplier	24.94

Alternative VI-1
Institutional Controls

Description	Unit Cost	Unit	Quantity	Extension
CAPITAL COSTS				
Legal & Administrative				
Legal & Administrative Services				$ 12,500
Total Capital Costs				$ 12,500
O&M COSTS				
Total O&M Costs				$ -
TOTAL ALTERNATIVE COST				**$ 12,500**