TETRA TECH

September 1, 2017

Mr. Eric Amadi
Hydrogeologist
Remediation & Redevelopment Program
Wisconsin Department of Natural Resources
2300 N. Dr. Martin Luther King, Jr. Drive
Milwaukee WI 53212-3128

RE: Supplemental Site Investigation Work Plan

Former Koppers Tar Plant and Wabash Alloys Site
9100 S. 5t11 Avenue, Oak Creek, WI
BRRTS # 02-41-553761, FID # 241379050
Connell VPLE BRRTS # 06-41-560058
Beazer VPLE BRRTS # 06-41-561509

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

Dear Mr. Amadi:

Attached for your review and approval is a supplemental work plan for the referenced site. The proposed scope of work is consistent with what was discussed during a technical review meeting held on August 17, 2017 and includes 1) installing additional soil borings to confirm the vertical extent of potentially mobile tar at selected locations, 2) installing an additional monitoring well in the City of Oak Creek utility corridor to evaluate hydraulic flow conditions and 3) conducting test pit sampling to determine the waste characteristics of soil containing observed tar.

Access and utility clearance work will begin within one to two weeks of WDNR approval of the work plan. The field work will take one to two weeks to complete depending on the availability and schedule of drilling, hydrovac and excavation subcontractors. A site investigation report addendum will be submitted within three to four weeks of receiving analytical results.

After report submittal, Beazer proposes another technical meeting with the WDNR to discuss the supplemental site investigation results, the scope and magnitude of active remediation for areas of potentially mobile tar, and a schedule for preparing a revised RAOR.

Please let me know if you have any questions. We will proceed with the propsed work within one to two weeks of your approval.

Sincerely,
Tetra Tech, Inc.

Michael R. Noel
Vice President, Principal Hydrogeologist

Attachment

cc: Michele Norman, WDNR (via e-mail)
Judy Fassbender, WDNR (via e-mail)
Kody Hansen, WDNR (via e-mail)
Michael Slenska, Beazer East (via e-mail)
Mike Kellogg, Connell (via email)
Julie Zimdars, NRT (via e-mail)
Larry Haskin, Haskin & Karls (via e-mail)
Kathryn Huibregtse, Ramboll Environ (via e-mail)

WORK PLAN
SUPPLEMENTAL SITE INVESTIGATION

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:

Beazer

Beazer East, Inc.
One Oxford Centre
Suite 3000
Pittsburgh, PA 15219-6401

Prepared by:

TETRA TECH

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

August 30, 2017

CERTIFICATION

"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."

August 30, 2017
Michael R. Noel, P.G.
Date
Vice President, Principal Hydrogeologist

"I, Mark A. Manthey, hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03 (1), 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."

August 30, 2017
Mark A. Manthey, P.G.
Date
Senior Hydrogeologist

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FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Purpose

This supplemental work plan provides a scope of work to 1) install additional soil borings to confirm the vertical extent of potentially mobile tar at selected locations, 2) install an additional monitoring well in the City of Oak Creek utility corridor and 3) conduct test pit sampling to determine the waste characteristics of soil containing observed tar.

1.2 Location and Project Information

Site Address:
Former Koppers Tar Plant and Wabash Alloys Site
9100 South Fifth Avenue
Oak Creek, Wisconsin 53154

Site Location (Figure 1):
SW ¼ of the NW ¼, and the NW ¼ of the SW ¼
Section 24, T5N, R22E
Milwaukee County

Site Activity Numbers:
Wabash Parcel
FID # 241379050
BRRTS # 02-41-553761
Connell VPLE BRRTS # 06-41-560058
Beazer VPLE BRRTS # 06-41-561509

City Parcel
FID # 341074470
BRRTS # 02-41-561425
Beazer VPLE BRRTS # 06-41-561509

Current Property Owners:
Former Koppers Tar Plant and Wabash Alloys Site:
Connell Aluminum Properties, LLC
One International Place
Boston, MA 02110
Project Contact: Mr. Mike Kellogg
(919) 744-7522

City Utility Corridor Parcel:
City of Oak Creek
8040 S. 6th Street
Oak Creek, WI 53154
Project Contact: Mr. Larry Haskins
(414) 762-5105

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

2.0 FIELD INVESTIGATION

The proposed scope of work includes 1) installation of additional soil borings to confirm the vertical extent of potentially mobile tar at selected locations, 2) installation an additional monitoring well in the City of Oak Creek utility corridor and 3) conducting test pit sampling to determine the waste characteristics of soil containing observed tar.

The Site location is shown on Figure 1 and the proposed investigation locations are shown on Figures 2-4. Copies of the various field forms that will be used to document the field activities are provided in Appendix A. Standard operating procedures (SOPs) for the field work that will be implemented under this work plan are provided in Appendix B.

2.1 Pre-Sampling Activities

An on-site utility clearance meeting will be scheduled through Diggers' Hotline to mark the locations of the buried utilities in the vicinity of the proposed soil borings, monitoring well and test pits. The monitoring well within the utility corridor will be located within 3 feet of the large diameter storm sewer marking as the intent is to collect groundwater samples and water level data from within the trench of the buried utility. The sampling locations and procedures will be discussed and approved by the City of Oak Creek Water & Sewer Utility Department prior to conducting any work along the utilities.

2.2 Tar Delineation Probes/Boreholes

Seven (7) new boreholes will be installed at the locations shown on Figure 2 to confirm the vertical extent of potentially mobile tar. The tar delineation will be carried out using visual observations of tar in boreholes. Using this approach, soil samples will be collected using a Geoprobe direct push soil core sampler. Borings on any existing concrete slab will be installed through a concrete core through the slab. Continuous soil samples will be collected to a depth of 25 feet bgs or to the depth of observed tar, whichever is greater. The soil samples will be logged according to the United Soil Classification System. Observations of tar staining and odor will be noted. Soil samples will be screened for the presence of ionizable VOCs at 2-foot intervals using a photoionization detector (PID) equipped with a 10.6 eV lamp. WDNR soil boring log information forms, with tar observation notes, will be completed for each soil boring.

After borehole completion, the soil borings will be decommissioned in accordance with the procedures outlined in Chapter NR141 of the Wisconsin Administrative Code (WAC). For the borings through the concrete slab, the concrete cores will be replaced in the slab after borehole abandonment. WDNR borehole abandonment forms will be completed for each abandoned soil boring.

2.3 Utility Corridor Monitoring Well Installation and Sampling

In the July 14, 2017 review letter and August 17, 2017 technical meeting the WDNR raised concern that well MW-134 is coincident with a significant hydraulic sink. This is based on a comparison of water elevations in MW-134 and downhill well MW-118. However, MW-134 is completed within the larger diameter storm sewer line backfill and MW-118 is completed outside the utility corridor. To properly evaluate comparative groundwater elevations a new well (MW-136) will be installed adjacent to MW-118 (Figure 3), but within the storm sewer line backfill.

New well MW-136 will be installed following the same procedures that were implemented in the previous utility corridor investigation and described in the October 28, 2014 Work Plan. A hydro vacuum (Hydrovac) excavation subcontractor will be used to excavate a borehole down to the depth of the buried utilities at the proposed monitoring well locations to avoid damaging the utilities. A hollow stem auger drilling rig will then be used to advance the borehole excavated by the Hydrovac truck to approximately five to seven feet below the top of the water table for the installation of the monitoring well.

The soil cuttings produced during the hollow stem auger drilling process will be examined during the drilling and monitoring well installation activities. The soil samples will be logged according to the United Soil Classification System. Soil samples will be screened for the presence of ionizable VOCs at 2-foot intervals using a PID equipped with a 10.6 eV lamp. WDNR soil boring log information forms will be completed for each soil boring.

The monitoring well will be installed in accordance with the procedures described in Chapter NR141 of the Wisconsin Administrative Code (WAC). It is anticipated that the monitoring wells will be completed at depths of 15 to 20 feet below ground surface (bgs). The monitoring well will be constructed of 2-inch nominal diameter, threaded schedule 40 PVC well casing and stainless steel screen. The stainless steel screen will have a slot size of 0.010-inches and a nominal length of 10 feet. The proposed monitoring well will be located within the right-of-way of the access road that borders the south side of the Site and will therefore be completed with a flush mounted protective cover. The flush mounted protective covers will comply with the specifications listed in NR141.13(4) WAC.

The monitoring well will be developed in accordance with the procedures described in NR141.21 WAC. Dedicated PVC bailers will be used to surge and purge the monitoring wells during development. If the monitoring well does not bail dry, a portable submersible pump may be used to complete the development of the well. A WDNR monitoring well development form will be completed for the new monitoring well.

A groundwater sample will be collected from new well MW-136 a minimum of one week after the development of the monitoring well is completed to allow the zone disturbed during the drilling and development process to return to natural conditions. The groundwater sample will be submitted for laboratory analyses of volatile organic compounds (VOCs) by EPA Method 8260B and polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270D.

Depth to groundwater measurements will be collected from all site wells to provide an assessment of the groundwater gradients and flow direction in the utility corridor. An electronic water level meter will be used to measure the water levels in the monitoring wells to the nearest 0.01 foot.

2.4 Borehole and Well Survey

The location and elevation of the soil borings will be surveyed by a state licensed surveyor so they can be accurately placed on the Site base map. The locations, ground surface elevation, top of protective cover elevation, and top of well casing elevation of the new monitoring well will be surveyed by a licensed surveyor in accordance with the specifications listed in NR141.065(2)

WAC. WDNR monitoring well construction summary forms will be completed for the new monitoring well.

2.5 Waste Characterization Assessment

To determine the waste characteristics of soil containing observed tar, soil samples will be collected from five (5) representative test pit locations shown on Figure 4. The test pit locations were selected to occur in representative areas of observed tar while avoiding wetlands, concrete slabs and areas of proposed PCB excavations. The work will be scheduled to occur during a period when no precipitation is forecasted for a few days. Each stockpile location will have a polyethylene liner at the ground surface where material can be directly stockpiled on the liner. Each test pit will be excavated to a depth of 12 feet. Excavated soil will be placed in temporary stockpiles on the liner adjacent to each test pit. A sampling grid will be established for each stockpile and ten 2-foot long hand auger samples will be collected from each stockpile and placed in a 5-gallon bucket container. For each stockpile the containerized soil will be briefly mixed with a hand trowel and a representative soil sample will be collected for lab analysis. After sampling has been completed, the soil from each stockpile will be placed back into the test pit that it came from and compacted with the excavator.

The soil samples submitted to the lab will be analyzed for the following parameters to establish the waste profile:

- TCLP VOCs – 1311/8260B
- Total VOCs - 8260B
- TCLP SVOCs – 8270C
- TCLP Pesticides – 8081
- TCLP Herbicides – 8151
- TCLP Metals/Mercury – 6010B/7470A
- Reactive Sulfide
- Reactive Cyanide
- Corrosivity (pH)
- Ignitibility (flash)
- PCBs – 8082
- TOC – 9060 or SM5310B

3.0 DECONTAMINATION AND INVESTIGATION-DERIVED WASTE

Sampling equipment will be decontaminated between samples using a solution of trisodium phosphate (TSP) and potable water. A stiff bristle brush will be used to remove soil particles from the sampling equipment. The equipment will then be rinsed with potable water.

Decontamination of drilling and excavation equipment will be performed using a pressure washer or a steam cleaner in a decontamination area. The decontamination area will be constructed with a polyethylene liner working surface, a sump and berms. Contaminated liquids generated within the berm of the decontamination area will be containerized and disposed of at an appropriate landfill.

The soil cuttings produced during the installation of the soil borings and monitoring wells will be contained in 55-gallon drums and temporarily stored on-site pending off-site disposal at a landfill. The drums will be labeled as containing IDW soil cuttings. The date the soil cuttings were generated and the borehole identification from which the soil cuttings were collected will also be included on the drum labels.

Groundwater produced during the development and sampling of the monitoring wells will be contained in 55-gallon drums and temporarily stored on-site pending off-site disposal at a landfill. The drums will be labeled as containing IDW groundwater. The monitoring well identification from which the groundwater was purged and the date(s) the groundwater was purged from the monitoring wells will also be noted on the labels.

4.0 REPORT

Once all the tasks described above are completed a site investigation report addendum will be prepared presenting the findings of the supplemental site investigation work. The report addendum will include copies of the WDNR soil boring logs, monitoring well construction summary forms, monitoring well development forms, test pit excavation forms, and copies of the soil and groundwater analytical results. Previously submitted tables and figures from the Site Investigation Report will be updated as applicable to incorporate the supplemental information.

5.0 SCHEDULE

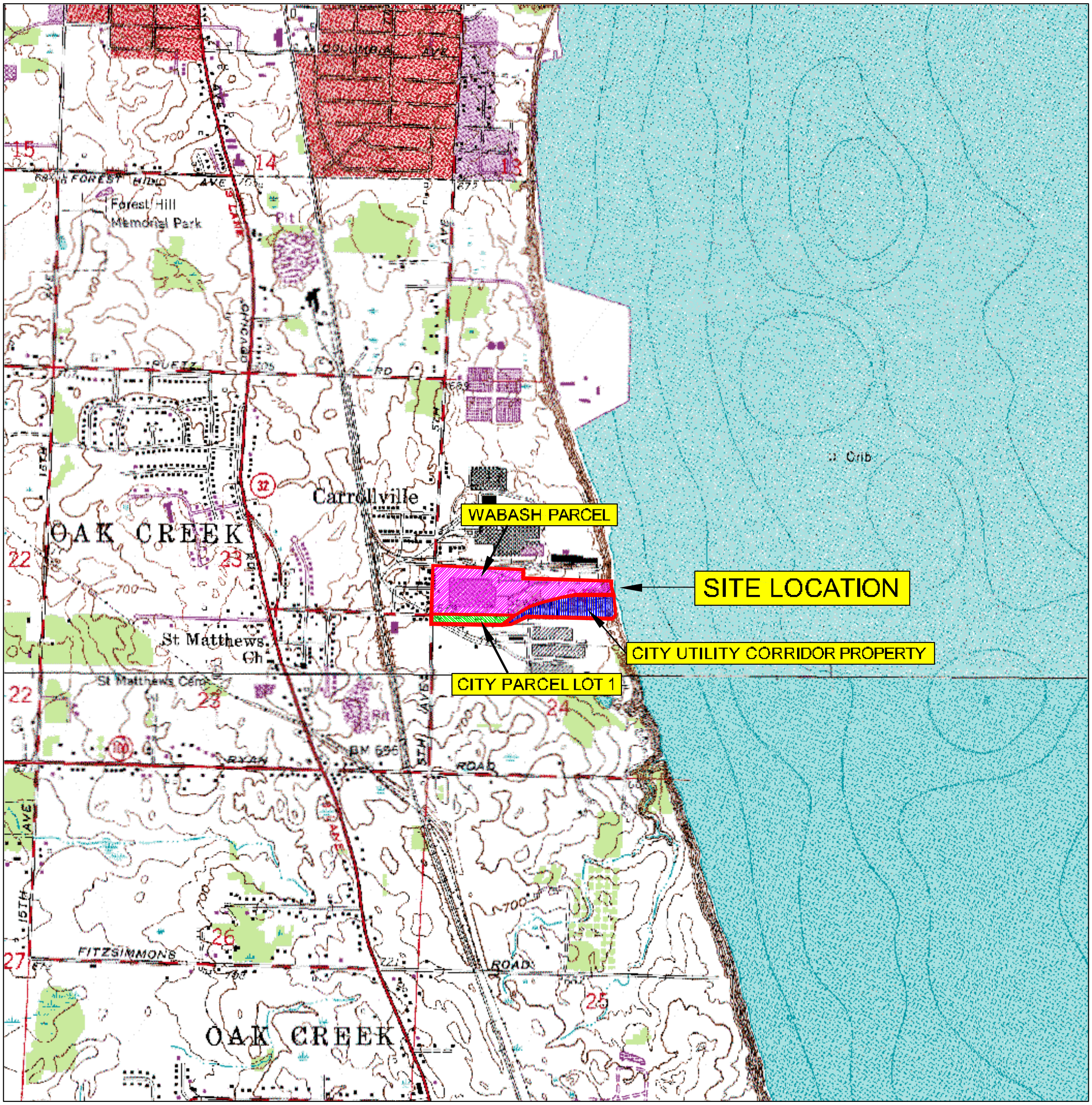
Access and utility clearance work will begin within one to two weeks of WDNR approval of the work plan. The field work will take one to two weeks to complete depending on the availability and schedule of drilling, hydrovac and excavation subcontractors. The site investigation report addendum will be submitted within three to four weeks of receipt of analytical results.

After report submittal, Beazer proposes another technical meeting with the WDNR to discuss the supplemental site investigation results, the scope and magnitude of active remediation for areas of potentially mobile tar, and a schedule for preparing a revised RAOR.

6.0 HEALTH AND SAFETY PLAN

A copy of the Site health and safety plan is provided in Appendix C.

FIGURES



National Geodetic Vertical Datum of 1929
Contour Interval 10 Feet

SCALE
0 5000
FEET

QUADRANGLE LOCATION

FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
OAK CREEK, WISCONSIN

SITE LOCATION and LOCAL TOPOGRAPHY

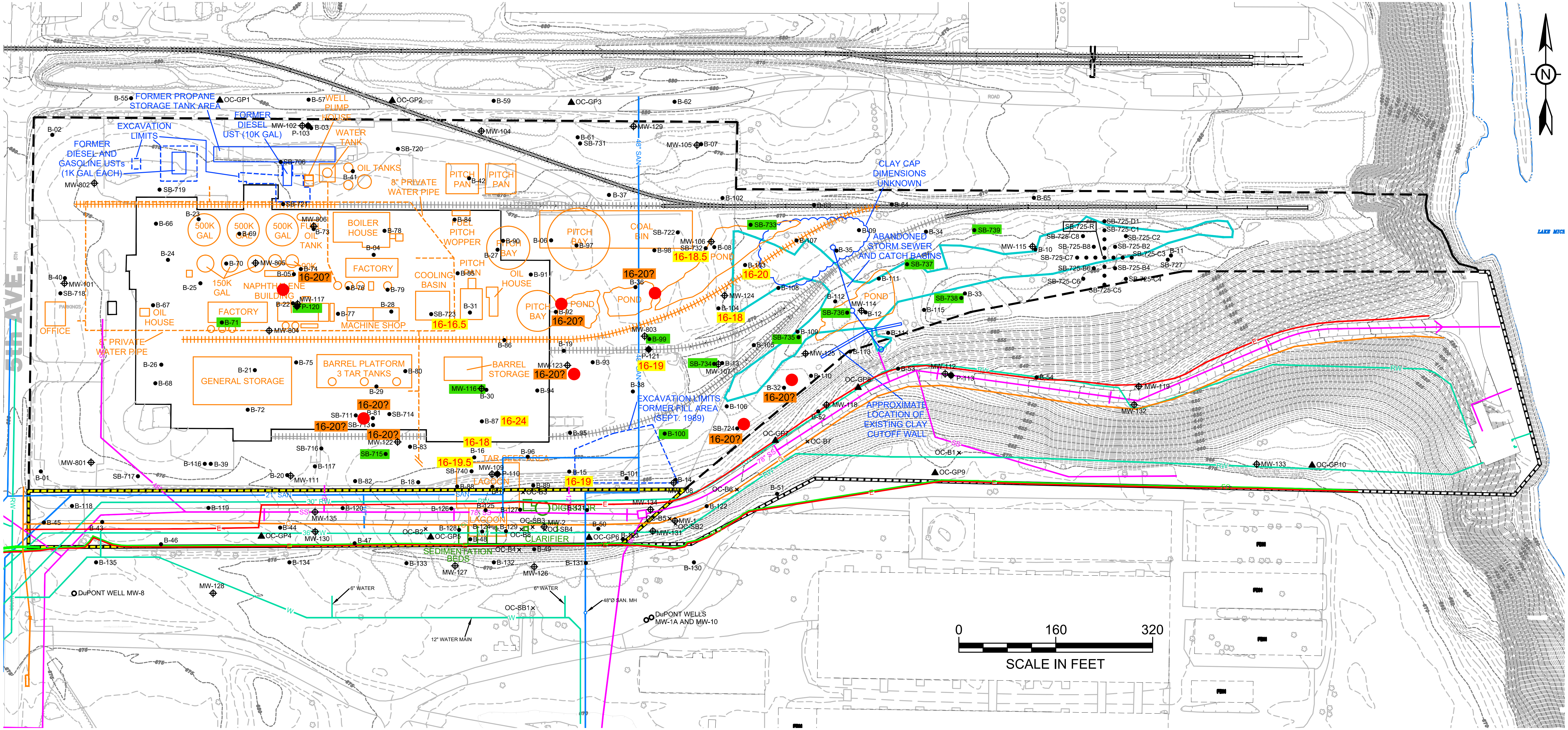
TETRA TECH

DATE:	10/6/14
DESIGNED:	HJW
CHECKED:	DLM
APPROVED:	DLM
DRAWN:	HJW
PROJ.: 117-2201323	

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\RAO REPORT\10-2-14\SITE LOCATION.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
16-20	OBSERVED TAR (16-20' BGS)
16-20?	POSSIBLE TAR
⊗ B-71	NO OBSERVED TAR
●	PROPOSED TAR OBSERVATION BOREHOLE
—E—	ELECTRICAL
—G—	NATURAL GAS
—RW—	RAW WATER
—SAN—	SANITARY
—SS—	STORM SEWER
—FO—	FIBER OPTIC

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.

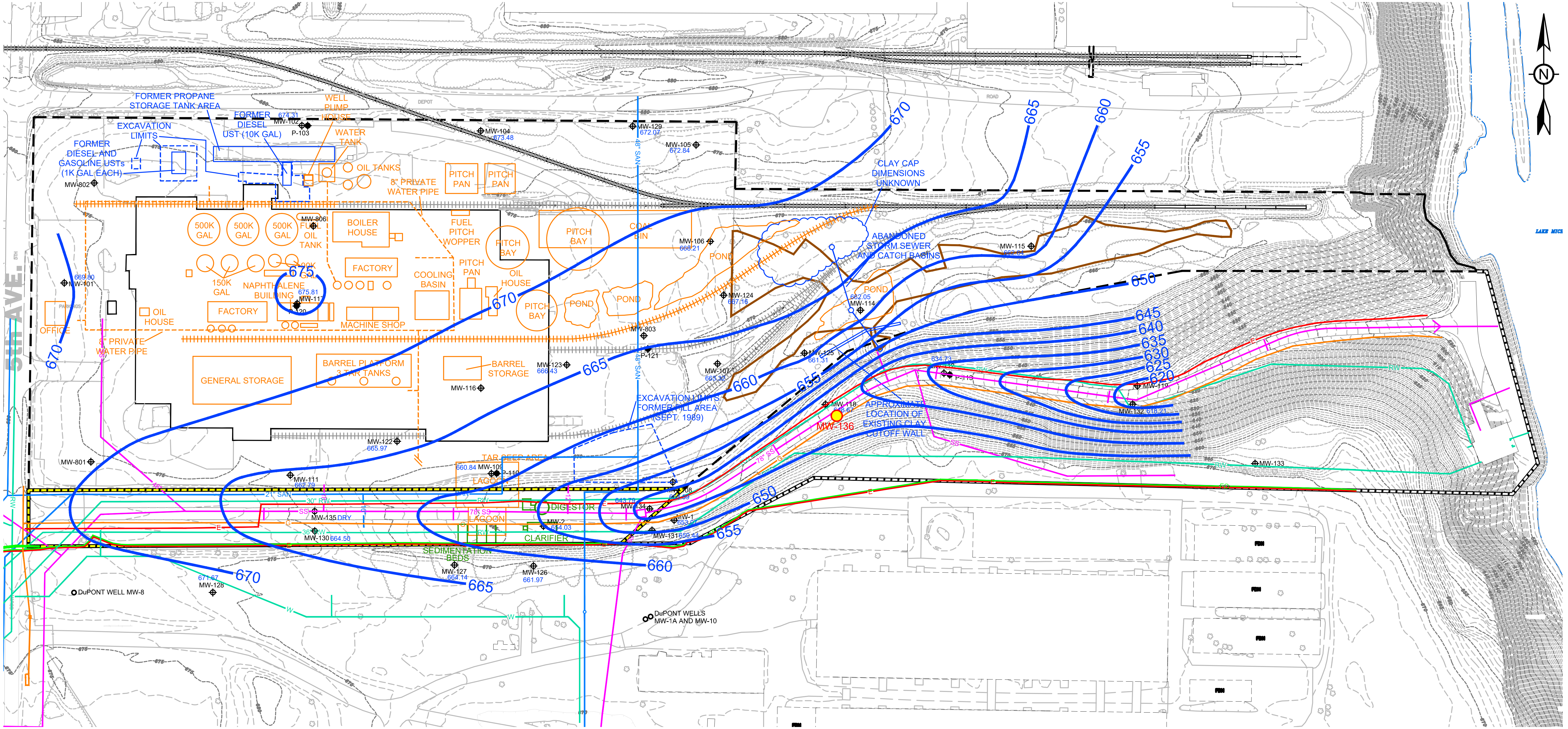
TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
OBSERVED TAR (16-20' BGS)

LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN	FIGURE:
DRAFTED	HJW	2
PROJECT	117-2201323	
DATE	8/30/17	

S:\CAD\BEAZER\WABASH\7-14-17\FIG B35.DWG



EXPLANATION

⌖ MW-101	WATER TABLE WELL
● P-103	NESTED PIEZOMETER
— — —	APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
▬▬▬	APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
669.86	WATER TABLE ELEVATION
—658—	WATER TABLE CONTOUR
○ MW-136	PROPOSED MONITORING WELL
□ ○	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.
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4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

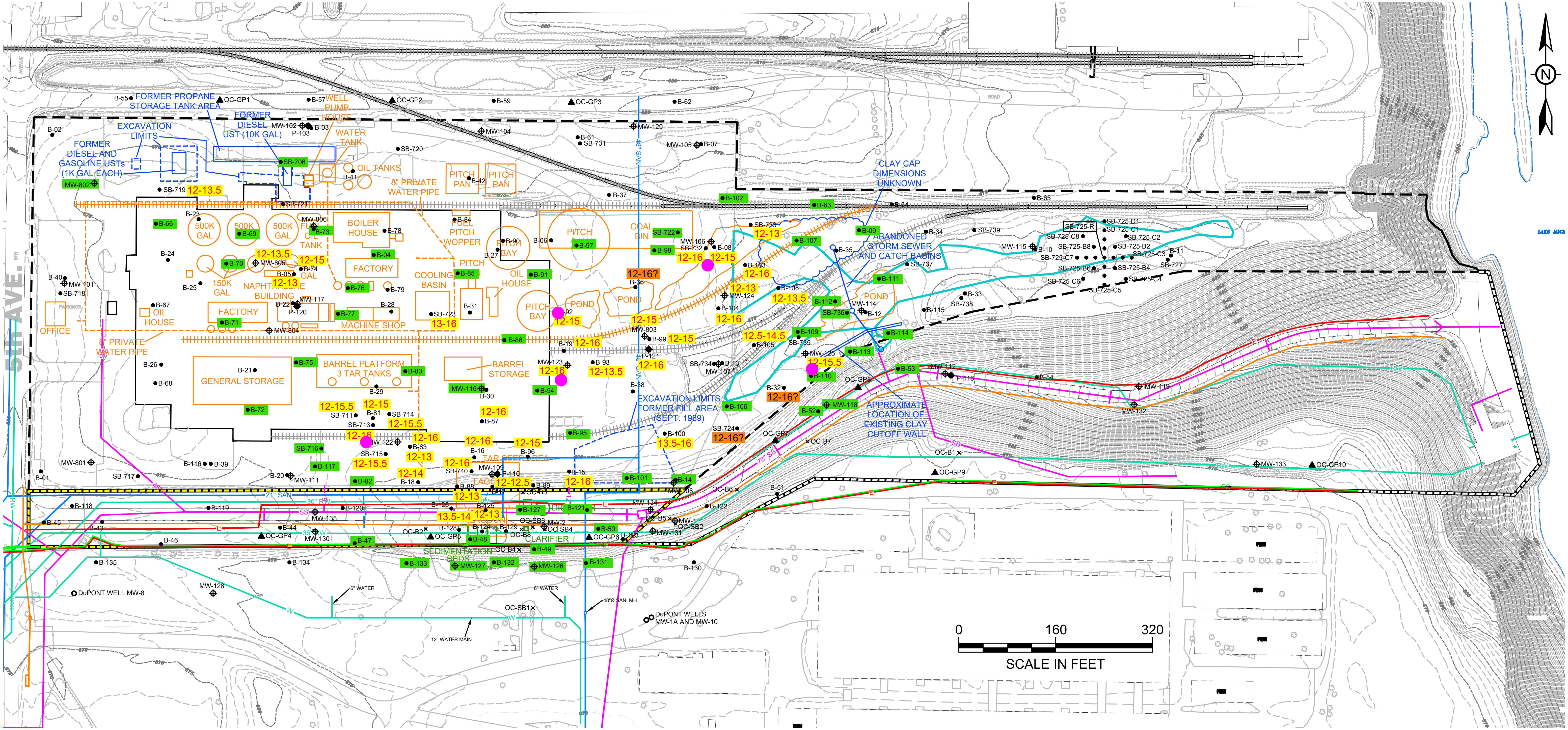
TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
SHALLOW GROUNDWATER FLOW MAP (JUNE 15, 2017)

LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN	FIGURE:
DRAFTED	HJW	3
PROJECT	117-2201372	
DATE	8/30/17	

S:\CAD\BEAZER\WABASH\7-14-17\WTM 6-15-2017.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
12-13	OBSERVED TAR (12-16' BGS)
12-16?	POSSIBLE TAR

E	ELECTRICAL
G	NATURAL GAS
RW	RAW WATER
SAN	SANITARY
SS	STORM SEWER
FO	FIBER OPTIC
●	PROPOSED WASTE CHARACTERIZATION TEST PIT LOCATION
⊗B-86	NO OBSERVED TAR

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
OBSERVED TAR (12-16' BGS)

LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN	FIGURE:
DRAFTED	HJW	4
PROJECT	117-2201323	
DATE	8/30/17	

S:\CAD\BEAZER\WABASH\7-14-17\FIG B34.DWG

APPENDICES

APPENDIX A

FIELD FORMS

TETRA TECH FIELD WATER LEVEL DATA SHEET

Project Number:______________________________ Project Name:______________________________

Location:______________________________ Instrument:______________________________

Personnel:____

Monitor Well/ Sample Port Identification	Date	Time	Depth to Groundwater (feet below top of casing)	Comments

P:\Beazer\Wabash Site\Work Plans\2014 Utility Migration Pathway & DuPont Property Inv Work Plan\Appendices files\Water_Level_FormTT.docx

TETRA TECH

TETRA TECH FIELD WATER QUALITY SAMPLING AND ANALYSIS FORM

PROJECT INFORMATION		INSTRUMENTS	
PROJECT		**Temp. & pH**	Hanna
PROJECT NO.		**Conductivity**	Hanna
LOCATION		**ORP**	Not Measured
PERSONNEL		**DO**	Not Measured

SAMPLE POINT ID						
WATER TYPE		**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**
DATE (month/day/year)						
CLOCK TIME (Military)						
DEPTH TO WATER (ft)*						
MEASURED WELL DEPTH (ft)*						
CASING VOLUME (gallons)						
PURGE VOLUME (gallons)						
DEPTH SAMPLE TAKEN (ft)*						
SAMPLING DEVICE						
FIELD TEMPERATURE (°C)						
pH						
ELEC. COND. (uS/cm)	**Measured**					
	at 25° C					
ORP (mV)						
DISSOLVED OXYGEN (ppm)						
DISSOLVED OXYGEN (% Sat.)						
COLOR						
ODOR						
CLARITY						
SAMPLING PARAMETERS		**# OF CONTAINERS & VOLUME; CONTAINER TYPE (A = AMBER GLASS; G = GLASS; P = PLASTIC); PRESERVATIVE TYPE (L = LAB ADDED; F = FIELD ADDED) OR NEUTRAL; FILTERED (YES or NO)**				
NAME OF LABORATORY						
DATE SENT TO LAB						
SAMPLER=S NAME						

***Measured from top of well casing.**

TETRA TECH LOW-FLOW METHOD FIELD WATER QUALITY SAMPLING AND ANALYSIS FORM

PROJECT INFORMATION		INSTRUMENTS	
PROJECT		Temp., pH,	
PROJECT NO.		Conductivity	
LOCATION		ORP	
PERSONNEL		DO	

MONITOR WELL ID									
WATER TYPE	Groundwater			Groundwater			Groundwater		
DATE (month/day/year)									
WELL DEPTH (feet)*									
PUMP INLET DEPTH (feet)*									
STATIC WATER LEVEL (ft)*/TIME									
ENDING WATER LEVEL (ft)*/TIME									
START PURGE TIME (Military)									
END PURGE TIME (Military)									
PURGE VOLUME (gallons)									
SAMPLE TIME (Military)									
INDICATOR PARAMETERS	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
TIME (minutes)									
TEMPERATURE (° C)									
pH									
ELEC. COND. (uS/cm) at 25° C									
ORP (mV)									
DISSOLVED OXYGEN (ppm)									
DISSOLVED OXYGEN (% Sat.)									
COLOR									
ODOR									
CLARITY									
SAMPLING PARAMETERS	# OF CONTAINERS & VOLUME; CONTAINER TYPE (A=AMBER; G=GLASS; P=PLASTIC); PRESERVATIVE TYPE (L=LAB ADDED; F=FIELD ADDED) OR NEUTRAL; FILTERED (YES or NO)								
NAME OF LABORATORY									
DATE SENT TO LAB									
SAMPLER′S NAME									

***Measured from top of well casing.**

TETRA TECH EQUIPMENT CALIBRATION FORM

Equipment Make	
Equipment Model	
Instrument Identification	

DATE	TIME	CALIBRATION MEDIA	RESULTS	COMMENTS

P:\Beazer\Wabash Site\Work Plans\2014 Utility Migration Pathway & DuPont Property Inv Work Plan\Appendices files\Calibration_FormTT.docx

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TETRA TECH WELL DEVELOPMENT/PURGE SUMMARY FORM

WELL ID. ______________________

PROJECT INFORMATION		WELL INFORMATION		INSTRUMENTS	
PROJECT	Beazer Oak Creek Former Koppers Tar Plant & Wabash Alloys Property	WELL COORDINATES		TEMPERATURE	Hanna
		CASING ELEVATION		CONDUCTIVITY	Hanna
PROJECT NO.	117-2201323	GROUND LEVEL ELEVATION		pH METER	Hanna
LOCATION	Oak Creek, WI	CONSTRUCTED WELL DEPTH		WATER LEVEL PROBE	Heron
PERSONNEL		WELL CASING INSIDE DIAMETER		OTHER	

Date	Time (Military)	Purge Method	Water Level* (Feet)	Measured Well Depth* (Feet)	Total Volume Purged** (Gallons)	APPEARANCE	pH (s.u.)	Temp (°C)	Elec. Cond. (umhos/cm)		COMMENTS
						Color / Odor / Clarity			Measured	at 25°C	

One Well Volume = ____ **Can Well be purged dry? Yes No**

*** Depth below top of well casing. Record both initial and final measurements when using as Well Development Summary.**

**** Purge three to four well casing volumes, if possible, prior to sampling.**

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TETRA TECH

TETRA TECH FIELD WATER LEVEL AND FREE PRODUCT DATA SHEET

Project Number: 117-2201323	Project Name: Beazer, Oak Creek, Former Koppers Tar Plant & Wabash Alloys Property	Location: 9100 South Fifth Ave., Oak Creek, WI
Instrument:	Personnel:	

Monitor Well Identification	Date	Time	Depth to LNAPL (ft btoc)	Depth to Groundwater (ft btoc)	Depth to DNAPL (ft btoc)	Well Depth (ft btoc)	Comments

Note: ft btoc = feet below top of casing. LNAPL = Light Non-Aqueous Phase Liquid. DNAPL = Dense Non-Aqueous Phase Liquid.

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TETRA TECH FIELD PID DATA FORM

Project Number: 117-2201323	Date(s):
Project Name: Beazer Oak Creek, Former Koppers Tar Plant & Wabash Alloys Property	Personnel:
Site Location: 9100 South Fifth Ave. Oak Creek, WI	Meter Number:
	Probe eV:

Sample Number	Location	Depth (feet)	Sample Media (1)	Moisture (2)	Time Sample Collected	Time Sample Analyzed	Volatilization Period Air Temp. (^{O}C)	PID Readings (Instrument Units)			Comments
								Background	Peak Response	After 15 sec.	

(1) SO – Soil SD – Sediment GW – Groundwater SW – Surface Water WS – Waste (Solid) WL – Waste (Liquid)

(2) D - Dry M - Moist W - Wet

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TETRA TECH

APPENDIX B

STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE

SAMPLE IDENTIFICATION

1.0 PURPOSE

Locations for collection of samples are affixed alpha-numeric codes which are used to track affixed laboratory results and enable presentation of data on maps and drawings. Each plan view location where a sample is collected is issued a unique numeric code (number) which corresponds to a specific map location at a site. An alpha-code (letter) is used to describe the type of sampling activity performed at the specific numeric location. The date of sample collection will be listed and used to delineate sampling events.

The alpha-numeric codes used to identify existing wells and sample locations will be used to identify samples collected from existing wells or sample locations. The following alpha codes will be used to identify new sample locations:

B: Borehole (no monitoring well installed)
EW or EX: Extraction well for remediation of groundwater
MW: Water table monitor well
P: Piezometer well
PW: Private residential well or Public water supply well
TP: Test pit
SS: Surface soil
SW: Surface water sampling station
A: Air sampling station
SD: Sediment

Each number used at a site should correspond to one, and only one, location. A typical series of alpha numeric codes for a site might include test pit locations T-1 through T-12; borings B-13, B-14, B-15; monitor wells MW-16, MW-17, MW-18, etc. A borehole drilled with the intent of installing a monitor well or piezometer will be identified as MW or P. There should not be a borehole log B-1 for monitor well MW-1.

If previous work has been performed at a site, the alpha-numeric code should continue with previous successive numbers. If there is any potential for conflict with identified sample number identifiers, the proposed sample number should begin with series 101, 10001, or other appropriate system.

2.0 CONTAINER LABELING

Each sample container, tag, and/or label will contain the following information:

- Project number and/or project name
- Sample type identification code and number
- Date and time of collection
- Sampler's initials
- Preservative

The sample identification code will be an alpha-numeric code used to specify the material type, location, and sampling interval (i.e., depth), where appropriate, for each sample. For example: SB110-3 to 5 refers to a soil sample from borehole location 110 over the 3 to 5-foot depth interval, and MW-203 refers to a groundwater sample from monitor well location 203. The date of sample collection will be listed and used to delineate sampling events.

Listed below are the standard codes to identify the type of material to be sampled. To an extent, these codes also identify the sampling location.

SB: Sample from a soil borehole
WB: Water sample from a borehole with no monitor well
MW: Water table monitor well (soils and groundwater)
P: Piezometer well (soils and groundwater)
PW: Private residential well water samples
ST: Trench or test pit (soil)
WT: Trench or test pit (water)
SS: Surficial soil
SW: Surface water
SD: Sediment
A: Air

If a sample is a composite, the letter "C" should follow the depth intervals over which the composite was collected. An appropriate description of the sample should be recorded on the chain-of-custody record and field notebook.

3.0 SAMPLE INDENTIFICATION – MULTI SITE PROJECTS

For project situations where a number of sites are being investigated concurrently for an individual client, each site should be assigned a series of numbers for use in identifying sampling locations. An example is given below:

Site	Environmental Samples	QA Samples
# 1	101 to 119	11 to 19
# 2	201 to 299	21 to 29
# 3	301 to 399	31 to 39
# 4	401 to 499	41 to 49
# 5	501 to 599	51 to 59

# 6	601 to 699	61 to 69
# 7	701 to 799	71 to 79
# 8	801 to 899	81 to 89

For example; SD301 refers to a sediment sample collected at sampling location 301 at the number 3 site; and MW-21 refers to a QA (trip blank, field blank, duplicate) groundwater sample from a monitoring well at the number 2 site.

Samples collected for matrix spike and matrix spike duplicates analysis will be identified with the code MSD (e.g., MW-21-MSD).

STANDARD OPERATING PROCEDURE

SOIL DESCRIPTIONS

1. PURPOSE

The purpose of this procedure is to describe and classify soil samples in the field during soil boring advancement.

2. PROCEDURE

2.1 FIELD PREPARATION

Call for utility clearance at least 72 hours in advance to arrange utility staking in any subsurface boring or exploration area.
Notify client, property owner, and Regulatory agency if necessary.

2.1.1 Forms

Soil Boring and Monitoring Well Logs
Tailgate Health and Safety
Daily Report Sheets

2.1.2 Equipment

Knife or spatula.
Ruler, tape measure, or scale.
Latex or nitrile gloves.
Sand gauge and geotechnical gauge, if necessary.
Pens, pencils and permanent markers.
Paper towels.
Small bottle of water.
Garbage bags.

2.1.3 Documents

Health and Safety Plan
Workplan
Maps
Site access agreements

2.1.4 Other

Cellular telephone
First aid kit
Personal comfort items

2.2 FIELD ACTIVITIES

The following sections provide guidance for how proper field visual descriptions of soils and rock samples should be conducted. These methods may not be applicable to every soil or rock sample found, but should provide enough guidance to allow accurate and defensible descriptions by a variety of field geologists.

The following section provides a description of the procedures that should be used when describing soils.

2.2.1 General Considerations for Description of Soils

The most popular soil classification method that is based on grain size and other properties, is the Unified Soil Classification System (USCS). This system was initially developed by A. Casagrande in 1948 and was then called the Airfield Classification System. It was adopted with minor modifications by the U.S. Bureau of Reclamation and the U.S. Corps of Engineers in 1952. In 1969, the American Society for Testing and Materials (ASTM) adopted the system. This system is designated currently by ASTM as D-2488-90 and will be used as a guideline for classifying and describing lithology. It requires certain information (e.g. liquid limit, plastic limit moisture content and plasticity index) about the soil which can only be obtained in a laboratory.

The USCS is based on grain size and response to physical manipulation at various water contents. This system is often used for classifying soils encountered in boreholes, test pits, and surface sampling. The following properties form the basis of USCS soil classification:

- Percentage of gravel, sand, and fines;
- Shape of the grain size distribution curve; and
- Plasticity and compressibility characteristics.

Four soil fractions are recognized. They are cobbles, gravel, sand, and fines (silt or clay). The soils are divided as coarse grained soils, fine grained soils, and highly organic soils. The coarse grained soils contain 50 percent of grains coarser than a number 200 sieve (approximately 0.08 mm). Fine grained soils contain more than 50 percent of material smaller than the number 200 sieve. Organic soils contain particles of leaves, roots, peat, etc.

2.2.2 Soil Description Procedures

The following will be used as a guideline for logging lithology from subsurface activities (i.e. borehole drilling, trenching, etc.).

The USCS recognizes 15 soil groups and uses names and letter symbols to distinguish between these groups. The coarse grained soils are subdivided into gravels (G) and sands (S). Both the gravel and sand groups are divided into four secondary groups. Fine grained soils are subdivided into silts (M) and clays (C).

Soils are also classified according to their plasticity and grading. Plastic soils are able to change shape under the influence of applied stress and to retain the shape once the stress is removed. Soils are referred to either low (L) or high (H) plasticity. The grading of a soil sample refers to the particle size distribution of the sample. A well graded (W) sand or gravel has a wide range of particle sizes and substantial amounts of particles sized between the coarsest and finest grains. A poorly graded (P) sand o gravel consists predominately of one size or has a wide range of sizes with some intermediate sizes missing.

Soils which have characteristics of two groups are given boundary classifications using the names that most nearly describe the soil. The two groups are separated by a slash. The same is true when a soil could be well or poorly graded. Again the two groups are separated by a slash.

Soil description should be concise and stress major constituents and characteristics for fine-grained, organic, or coarse-grained soils. Tables 1 and 2 are checklists for descriptions of fine-grained, organic soils, and coarse-grained soils, respectively. Field descriptions should include as a minimum:

- Soil name: The basic name of the predominant constituent and a single-word modifier indicating the major subordinate constituent.

- Particle Size Distribution: An estimate of the percentage and grain-size range of each of the soil's subordinate constituents with emphasis on clay-particle constituents. This description may also include a description of angularity. This parameter is critical for assessing hydrogeology of the site and should be carefully and fully documented.

Criteria for grain size (Wentworth Scale):

Particle Size (mm)	Individual Particle Term
>256	Boulder Gravel
64 - 256	Cobble Gravel
32 - 64	Very Coarse Pebble Gravel
16 - 32	Coarse Pebble Gravel
8 - 16	Medium Pebble Gravel
4 - 8	Fine Pebble Gravel
2 - 4	Granule Gravel
1 - 2	Very Coarse Sand
0.5 - 1	Coarse Sand
0.25 - 0.5	Medium Sand
0.125 - 0.25	Fine Sand
0.0625 - 0.125	Very Fine Sand
0.004 - 0.0625	Silt
<0.004	Clay

Criteria for Amounts

Term	%
Trace	0 – 5
Few	5 - 10
Little	10 - 20
Some	20 - 35
With	35 - 50
And	50 i.e. equal parts

- Gradation or Plasticity. For granular soil (sands or gravels) that should be described as wellgraded, poorly graded, uniform, or gap-graded, depending on the gradation of the minus 3-inch fraction. Cohesive soil (silts or clays) should be described as non-plastic, low plastic, medium plastic, or highly plastic.

Criteria for Describing Plasticity

Descriptive item	Criteria
Nonplastic	A 1/8 inch (3 mm) thread cannot be rolled at any moisture content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times close to the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

- Dry Strength. Dry strength describes the crushing characteristics of a dry soil crumb about ¼ inch (5 mm) in diameter. If a crumb of dry soil is not available, after removing particles larger than No. 40 sieve size, mold at least three balls of soil about ¼ inch (5 mm) in diameter to the consistency of putty, adding water if necessary. Allow the balls to dry completely by oven, sun, or air drying, and then test their strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

Criteria for Describing Dry Strength

Descriptive item	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure.
Medium	The dry specimen breaks into pieces and crumbles with considerable finger pressure.
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.
Very high	The dry specimen cannot be broken between the thumb and a hard surface.

- Dilatancy. Dilatancy describes the soils reaction to shaking. After removing particles larger than No. 40 sieve size, prepare a ball of moist soil about ½ inch (15 mm) in diameter. Add enough water, if necessary, to make the soil soft but not sticky. Place the ball in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the ball which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the ball stiffens, and finally cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.

Criteria for Describing Dilatancy

Descriptive item	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear, or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

- Toughness. Toughness is the consistency of the soil near the plastic limit. After removing particles larger than the No. 40 sieve size, mold a ball of soil about ½ inch (15 mm) in diameter to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. The specimen is then rolled out by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. The thread is folded and rerolled repeatedly. During this manipulation, the moisture content is gradually reduced and the specimen stiffens, finally loses it plasticity, and crumbles when the plastic limit is reached.

Criteria for Describing Toughness

Descriptive item	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The lump and thread have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.

- Color. The basic color of the soil (refer to Munsell soil color charts).

Criteria for Mottling:

Contrast Term	Description
Faint	indistinct
Distinct	easily seen
Prominent	outstanding

- Odor. Odor is described from a warm, moist sample. The odor should only be described if it is organic or unusual. An organic odor will have distinctive decaying vegetation smell. Unusual odors, petroleum product, chemical, and the like should be described.

- Soil Texture and Structure. Description of particle size distribution, arrangement of particles into aggregates, and their structure. This description includes joints, fissures, slicked sides, bedding, veins, root holes, debris, organic content, and residual or relict structure, as well as other characteristics that may influence the movement or retention of water or contaminants.

Structure (for description of soils only)

Descriptive item	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm (1/4 inch) thick; note thickness
Laminated	Alternating layers of varying material or color with layers less than 6 mm (1/ 4 inch) thick; note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated (parallel grooves or scratches)
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small lenses of sand scattered through a mass of clay; note thickness.
Homogeneous	Same color and appearance throughout.

Additional descriptors for bedding or laminations

Term	Thickness (feet/meters)
Very Thickly Bedded	> 3.3’ (1 m)
Thickly Bedded	1’- 3.3’ (30 - 100 cm)
Medium Bedded	4” - 1’ (10 - 30 cm)
Thinly Bedded	1” - 4” (3 - 10 cm)
Very Thinly Bedded	0.4” - 1” (1 - 3 cm)
Thickly Laminated	0.12” - 0.4” (0.1 - 1 cm)
Thinly Laminated	<0.12” (<0.3 cm)

- Moisture Content. The amount of soil moisture described as dry, moist, or wet/saturated.

Criteria for Describing Moisture

Descriptive item	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet/saturated	Visible free water, usually soil is below water table.

- Relative Density or Consistency. An estimate of density of a fine-grained soil or consistency of a cohesive soil, usually based on standard penetration tests.

Criteria for Describing Consistency

Descriptive item	Criteria
Very soft	Thumb penetrates soil more than 1 inch
Soft	Thumb penetrates about 1 inch
Firm	Thumb indentation up to ¼ inch
Hard	No indentation with thumb, readily indented with thumbnail
Very Hard	Not indented with thumbnail

Density, based upon blow counts:

Sand or Gravel	Blows per foot	Silt or Clay	Blows per foot	Thumb Penetration
Very loose	0 - 4	Very soft	0 - 2	Very easily
Loose	4 - 10	Soft	2 - 4	Easily
Medium dense	10 - 30	Medium stiff	4 - 8	Moderate effort
Dense	30 - 50	Stiff	8 - 15	Indented easily
Very dense	>50	Very stiff	15 - 30	Indented by nail
		Hard	>30	Difficult by nail

- Cementation. An estimate of cementation of a coarse-grained soil.

Criteria for Describing Cementation

Descriptive item	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

- Relative Permeability. An estimate of the permeability based on visual examination of materials (e.g., high permeability for course sand and gravel verses low permeability for silty clay). The estimate should address presence and condition of fractures (open, iron-stand, calcite-filled, open but claylined, etc.), as well as fracture density and orientation;

- Local Geologic Name. Any specific local name or generic name (i.e., alluvium, loess).

- Group Symbol. USCS of symbols.

The soil logs should also include a complete description of any tests run in the borehole; placement and construction details of piezometers, wells, and other monitoring equipment; abandonment records; geophysical logging techniques used; and notes on readings obtained by air monitoring instruments.

Examples of soil descriptions:
Fine to coarse **SAND**, and medium to coarse **GRAVEL**
Fine **GRAVEL**, some fine to coarse Sand, little Silt, trace Clay
Medium to coarse **SAND**, trace fine Gravel, trace fine Sand
Gray, wet, medium dense, fine to coarse **SAND**, some fine Gravel
Brown with distinct gray mottling, moist, soft, interbedded **SILT** and **CLAY**, trace fine Sand, very thinly bedded.

Notes:
-Always use capital letters for primary constituents, or both primary constituents if you use "and". The first letter of each subsequent component of soil content is capitalized.
-Describe grain size small to large (ex. fine to coarse Gravel).
-Within one percentage category, list in decreasing grain-size (ex. trace fine Gravel, trace fine Sand).

STANDARD OPERATING PROCEDURE

SOIL SCREENING USING A PID

1. PURPOSE

The purpose of this procedure is to screen soil samples while in the field for the presence of volatile organic vapors using a photoionization detector (PID).

2. PROCEDURE

2.1 FIELD PREPARATION

Charge and calibrate the instrument.

2.1.1 Forms

Daily Report Sheets
Tailgate Health and Safety
Field PID Screening Data Form

2.1.2 Equipment

PID with 10.6 eV lamp for lighter (molar mass) organic compounds, and an 11.7 eV lamp for heavier organic compounds.
Either a stainless steel (must be decontaminated between samples) or a disposable plastic or wooden spatula for cutting soil samples and transferring them to containers.
Latex or nitrile sampling gloves - sufficient quantity to change for each sample collection event.
Self-locking plastic bags for field screening
Watch or clock.
Permanent fine point markers.
DOT-approved sealed drums for storage of excess soil (if required).
Personal protective equipment as described within the Site Health and Safety Plan.

2.1.3 Documents

Health and Safety Plan
Workplan
Maps

2.1.4 Other

Cellular telephone
First aid kit
Personal comfort items
Bubble wrap for samples
Distilled water
Paper towels

2.2 FIELD ACTIVITIES

Select and install the lamp with the appropriate ionization energy for the objective of the field screening. See the PID instruction manual for proper lamp selection for various compounds.

2.2.1 Calibration

Calibrate the PID by following the calibration procedure described in the PID instruction manual. Be sure to use the appropriate calibration gas as identified within the manual.

2.2.2 Sample collection

After retrieving a soil sample from the sample location, segregate the portion of the sample identified for screening either a decontaminated stainless steel implement, or a disposable plastic or wooden implement. Place the soil sample into the zip-lock plastic bag and seal the bag. Set the plastic bag and sample aside for later PID screening. A new pair of disposable latex or nitrile gloves must be worn for each soil screening event.

After being placed into the self-locking plastic bag, the sample will be clearly labeled using permanent ink, and allowed to equilibrate with ambient air temperature (minimum wait of 15 minutes). If the ambient temperature is below 32 degrees Fahrenheit (0 degress Celsius), the sample should be placed in a heated vehicle or a building for 15 minutes prior to analysis.

Note and record the background PID response on the field PID data form, then slightly open the seal on the self-locking plastic bag, insert the PID probe tip, and observe and record the response. Do not allow the probe tip to come into contact with the soil sample to prevent the uptake of soil particles into the PID. If the vapor concentrations rise quickly and then subside, record the maximum reading indicated. If the vapor readings increase slowly, observe the readings and record the concentration response after one minute.

Record the observed vapor concentrations on the field PID data form, *and* the rate of response, as this provides useful information about the relative volatility of the vapor-emitting compounds. Record descriptions of the soil type and relative moisture content and note any visual or olfactory impacts.

Allow the monitoring equipment to return to zero before initiating the next sample screening.

3. QUALITY ASSURANCE

Always calibrate the instrument prior to use. Telephone the project manager prior to leaving the site at the completion of each day.

STANDARD OPERATING PROCEDURE

GROUNDWATER ELEVATIONS

1. PURPOSE

The purpose of this procedure is to obtain groundwater level measurements from wells and piezometers to assist in defining site hydrogeologic conditions.

2. PROCEDURE

2.1 FIELD PREPARATION

Notify client, property owner, and regulatory angency as necessary.

2.1.1 Forms

Water Level Data Sheet
Daily Report Sheets
Tailgate Health and Safety
Field Service Request

2.1.2 Equipment

Well keys
Electronic water level indicator
Calculator
Latex or nitrile gloves
Tools to access wells
Metal detector, turkey baster or plastic cup
Pens and permanent markers.
Decontamination equipment including deionized or distilled water, Alconox, and paper towels.
Garbage bags.

2.1.3 Documents

Well Construction Log, or total well depth and previous water level measurements
Well location map/site map
Work Plan
Health and Safety Plan
Signed site access agreement, as applicable

2.1.4 Other

Cellular phone
Replacement locks
Writing implements and an indelible marker
First aid kit
Personal comfort items
Machete or other vegetation-clearing tool

2.2 FIELD ACTIVITIES

Don a new pair of latex or nitrile gloves and open the well with a socket set if it is a flush grade manhole cover or a key if it is an above grade cover.

Beware of insects (particularly wasps and bees) that may be nesting within the protective casing. Bail out any standing water with a turkey baster or cup in flush-grade manholes. Note on presence and appearance of standing water, insects, and well condition.

Unlock, loosen, and carefully remove locking expandable well cap.

Well may be under pressure. Always face away from well when removing well cover. Allow groundwater elevation to stabilize for a minimum of five minutes prior to measuring depth to groundwater. When working on smaller sites, it may be appropriate to open all of the wells first, and then gauge them.

2.2.1 Identify the Monitoring Point for the Well

The well monitoring point may be the north side of the riser casing and marked with an indelible marker, or on the highest side of the top of casing. The top of an above-grade protector or flush-grade manhole should never be used as a reference point due to frost heave and settling. Note the reference point used on the *Water Level Data Sheet.*

2.2.2 Obtain the Water Level Measurement

Water levels will be measured from suspected cleanest (up-gradient) well to the suspected most contaminated (down-gradient or near source) well.

Use a consistent sensitivity setting for all wells.

Lower the decontaminated probe into the well until a “beep” sound is heard. The probe should be raised and lowered to confirm the exact water level. NOTE: condensation inside the well casing can result in a premature sounding and contaminants can result in incorrect confirmatory measurements. Refer to previous depths to groundwater recorded on the *Field Groundwater Sample Form* to verify measurement, if available. When a false reading is suspected, gently shake the tape of the electronic water level indicator until the audible sound stops. Then proceed to lower the probe to confirm.

Read the tape at the monitoring point and recorded the measurement to the nearest 0.01-foot on the *Water Level Data* Sheet.

Lower probe to bottom of well and record total depth on *Field Groundwater Sample Form,* if necessary.

Complete all information on the *Water Level Data* Sheet.

2.2.4 Decontamination

The measuring device shall be decontaminated immediately after each use. The decontamination procedure should be initiated while reeling in the tape and probe: wipe tape with clean paper towel soaked with deionized or distilled water and Alconox solution, rinse probe with deionized or distilled water and Alconox solution, rinse tape and probe with deionized or distilled water, and dry probe with clean paper towel. Apply decontamination fluids with a labeled spray bottle.

3. QUALITY ASSURANCE

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.
2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

STANDARD OPERATING PROCEDURE

MONITORING WELL DEVELOPMENT

1. PURPOSE

This procedure describes development procedures for wells and piezometers in unconsolidated and consolidated (rock) materials. Adherence to this procedure will ensure that wells and piezometers installed as part of a groundwater impact investigation will be adequate for the collection of groundwater quality samples and water level measurements. Wells or piezometers may be installed to determine one or more of the following: 1) water table or piezometric elevations and their fluctuation over time; 2) the presence or absence of light non-aqueous phase liquids (LNAPLs) on the water surface, or dense non-aqueous phase liquids (DNAPLs) at depth; and 3) the presence or absence of specific contaminant compounds in the groundwater.

2. PROCEDURE

2.1 FIELD PREPARATION

Call for utility clearance more than 72 hours in advance of field activity commencement to identify buried utilities in the area of subsurface activity.
Notify the client, property owner, and Regulatory agency as necessary.

2.1.1 Forms

Field notebook
Field well development forms
Tailgate Health and Safety form
Daily Report Sheets

2.1.2 Equipment

Extra well caps (expanding, locking) to replace missing or damaged caps.
Extra locks (keyed alike) to replace missing or broken well locks.
Well keys
Bailers (disposable or dedicated) and/or submersible pump, discharge hose and generator.
Graduated bucket.
Tools to open flush-mount wells.
Latex or nitrile gloves.
Pens, pencils and permanent markers.
Water quality meter (temperature-pH-conductivity)

2.1.3 Documents

Site Access Agreements (if necessary)
Site maps
Workplan
Health and Safety Plan

2.1.4 Other

Cellular telephone
First aid kit
Personal comfort items
Drum(s) or polyethylene tank(s) if groundwater needs to be contained.

2.2 Well Development

Wells and monitor wells will be developed using either a pump or a bailer or a combination of the two to remove the effects of drilling and installation operations. If a monitor well can be purged dry, development will consist of slowly purging the well dry to limit agitation. Development is complete when ten well volumes have been removed, or sediment-free water is produced. If a monitor well cannot be purged dry, it will be developed by alternately surging and purging the well for a minimum of 30 minutes and then pumping or bailing until ten well volumes are removed or until sediment free water is produced.

The well casing volume is determined as follows:

- Using the electronic water level indicator, determine the depth to the top of the water table surface (H_1).
- Determine the depth to the bottom of the well (H_2) using the *Well Construction Log* if verified, or by using the water level indicator. Measure the total well depth during your first visit to a site.
- Calculate the height of the column of water (H) as the difference between the two measurements ($H = H_2 - H_1$).
- Calculate the volume of water occupying the well casing using the formula to calculate the volume of a cylinder:

$$\mathbf{V = \pi r^2 H}$$

where:
V = volume of water in the casing, in <u>gallons</u>
π = the constant "Pi", approximately equal to 3.14
r = radius of the well casing, in <u>feet</u>
H = height of the initial column of water in the casing, in <u>feet</u>

It is imperative that all units are compatible; i.e., do not use inches for **r**, meters for **H**, and gallons for **V.**

A simplified version of this formula is provided using the well casing diameter in inches:

Well Casing Diameter (inches)	Equation
1	V= H (0.0408)
2	V= H (0.1632)
4	V=H (0.6528)
6	V=H (1.4688)

where:
V = volume of water in the casing, in <u>gallons</u>
H = height of the initial column of water in the casing, in <u>feet</u>

Multiply the casing volume by three or five to determine the minimum volume of water that should be purged from the well prior to collecting a water sample.

Periodic measurements and observations of field parameters including temperature, specific conductance, pH, visual appearance and odor will be made and recorded on well development/purge summary form as each well is developed. In addition, time expended in development, volume of water removed, and any sedimentation present in the bottom of each well before and after development will be noted. Water level measurements will be obtained prior to and following development, and following water level stabilization.

3. QUALITY ASSURANCE

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks/notebooks.
2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

STANDARD OPERATING PROCEDURE

LOW-FLOW (MINIMUM DRAWDOWN) GROUNDWATER SAMPLING

1. PURPOSE

This standard operating procedure (SOP) provides a general framework for collecting ground water samples that are indicative of mobile organic and inorganic loads at ambient flow conditions (both the dissolved fraction and the fraction associated with mobile particulates). The SOP emphasizes the need to minimize stress by low water-level drawdowns, and low pumping rates (usually less than 1 liter/min) in order to collect samples with minimal alterations to water chemistry. This SOP is aimed primarily at sampling monitoring wells that can accept a submersible pump and have a screen, or open interval length of 10 feet or less (this is the most common situation). However, this procedure is flexible and can be used in a variety of well construction and ground-water yield situations. Samples thus obtained are suitable for analyses of ground water contaminants (volatile and semi-volatile organic analytes, pesticides, PCBs, metals and other inorganics), or other naturally occurring analytes.

This procedure does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPLs and DNAPLs). For this the reader may wish to check: Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation; C.K. Smoley (CRC Press), Boca Raton, Florida and U.S. Environmental Protection Agency, 1992, RCRA Ground-Water Monitoring: Draft Technical Guidance; Washington, DC (EPA/530-R-93-001).

The screen, or open interval of the monitoring well should be optimally located (both laterally and vertically) to intercept existing contaminant plume(s) or along flowpaths of potential contaminant releases. It is presumed that the analytes of interest move (or potentially move) primarily through the more permeable zones within the screen, or open interval.

Proper well construction and development cannot be overemphasized, since the use of installation techniques that are appropriate to the hydrogeologic setting often prevents "problem well" situations from occurring. It is also recommended that as part of development or redevelopment the well should be tested to determine the appropriate pumping rate to obtain stabilization of field indicator parameters with minimal drawdown in shortest amount of time. With this information field crews can then conduct purging and sampling in a more expeditious manner.

The mid-point of the saturated screen length (which should not exceed 10 feet) is used by convention as the location of the pump intake. However, significant chemical or permeability contrast(s) within the screen may require additional field work to determine the optimum vertical location(s) for the intake, and appropriate pumping rate(s) for purging and sampling more localized target zone(s). Primary flow zones (high(er) permealability and/or high(er) chemical concentrations) should be identified in wells with screen lengths longer than 10 feet, or in wells with open boreholes in bedrock. Targeting these zones for water sampling will help insure that the low stress procedure will not underestimate contaminant concentrations. The Sampling and

Analysis Plan must provide clear instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 NTU and stable drawdowns of less than 0.3 feet, while desirable, are not mandatory. Sample collection may still take place provided the remaining criteria in this procedure are met. If after 4 hours of purging indicator field parameters have not stabilized, one of 3 optional courses of action may be taken: a) continue purging until stabilization is achieved, b) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization) c) discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may not meet the sampling objectives).

2. PROCEDURE

2.1 FIELD PREPARATION

Notify client, property owner, and Regulatory agency as necessary.

2.1.1 Forms

- Water Level Data Sheet
- Daily Report Sheets
- Chain of Custodies
- Water Quality Data Sheet
- Field Service Request
- Tailgate Health and Safety
- Well Construction Log
- Well location map/site map
- Work Plan
- Health and Safety Plan
- Signed site access agreement

2.1.2 Equipment

- Extraction device - Adjustable rate, submersible pumps are preferred (for example, centrifugal or bladder pump constructed of stainless steel or Teflon). Adjustable rate, peristaltic pumps (suction) may be used with caution. Note that EPA guidance states: "Suction pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" (EPA/540/P-87/001, 1987, page 8.5-11). The use of inertial pumps is discouraged. These devices frequently cause greater disturbance during purging and sampling and are less easily controlled than the pumps listed above. This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

- Tubing - Teflon or Teflon lined polyethylene tubing are preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics. PVC, polypropylene or polyethylene tubing may be used when collecting samples for inorganics analyses. However, these materials should be used with caution when sampling for organics. If these materials are used, the equipment blank (which includes the tubing) data must show that these materials do not add contaminants to the sample. Stainless steel tubing may be used when sampling for VOCs, SVOCs, pesticides, and PCBs. However, it should be used with caution when sampling for metals. The use of 1/4 inch or 3/8 inch (inner diameter) tubing is preferred. This will help ensure the tubing remains liquid filled when operating at very low pumping rates. Pharmaceutical grade (Pharmed) tubing should be used for the section around the rotor head of a peristaltic pump, to minimize gaseous diffusion.
- Water level measuring device(s), capable of measuring to 0.01 foot accuracy (electronic "tape", pressure transducer). Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level "tape" at the start and end of each record.
- Flow measurement supplies (e.g., graduated cylinder and stop watch).
- Interface probe, if needed.
- Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate the samples.
- Indicator field parameter monitoring instruments - pH, Eh, dissolved oxygen (DO), turbidity, specific conductance, and temperature. Use of a flow-through-cell is required when measuring all listed parameters, except turbidity. Standards to perform field calibration of instruments. Analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846. For Eh measurements, follow manufacturer's instructions.
- Decontamination equipment including deionized or distilled water, Alconox, graduated cylinders, and paper towel
- Logbook(s), and other forms (for example, well purging forms).
- Laboratory provided containers and labels
- Laboratory-cleaned cooler
- Ice to keep the samples cold
- Well construction data, location map, field data from last sampling event.
- Well keys.
- Site specific Sample and Analysis Plan/Quality Assurance Project Plan.
- PID or FID instrument (if appropriate) to detect VOCs for health and safety purposes, and provide qualitative field evaluations.
- Calculator
- Latex or nitrile gloves
- Tools to access wells
- Knife, or scissors
- Garbage bags
- Two graduated 5-gallon pails to collect purge water

- Cellular phone
- Replacement locks
- Writing implements and an indelible marker

If needed:

- DOT-approved sealed drums for storage of purged well water, or a suitable location to disperse of liquid (i.e., on-site treatment system)
- Quantab ™ and Hach™ Titration kits
- Bubble wrap if required to protect samples during shipment to the laboratory.
- Machete or other vegetation-clearing tool

2.2 FIELD ACTIVITIES

2.2.1 Preliminary Site Activities

Check well for security damage or evidence of tampering, record pertinent observations.

Lay out sheet of clean polyethylene for monitoring and sampling equipment.

Remove well cap and immediately measure VOCs at the rim of the well with a PID or FID instrument and record the reading in the field logbook.

If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the logbook.

A synoptic water level measurement round should be performed (in the shortest possible time) before any purging and sampling activities begin. It is recommended that water level depth (to 0.01 ft.) and total well depth (to 0.1 ft.) be measured the day before, in order to allow for re-settlement of any particulates in the water column. If measurement of total well depth is not made the day before, it should not be measured until after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

Check newly constructed wells for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent check measurements with an interface probe are usually not needed unless analytical data or field head space information signal a worsening situation. Note: procedures for collection of LNAPL and DNAPL samples are not addressed in this SOP.

2.2.2 Well Purging and Sampling Procedure

Sampling wells in order of increasing chemical concentrations (known or anticipated) is preferred.

1. Install Pump – Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the midpoint of the zone to be sampled. The Sampling and Analysis Plan should specify the sampling depth, or provide criteria for selection of intake depth for each well (see Section I). If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well. Collection of turbid free water samples may be especially difficult if there is two feet or less of standing water in the well.
2. Measure Water Level – Before starting pump, measure water level. If recording pressure transducer is used-initialize starting condition.
3. Purge Well
    a. Initial Low Stress Sampling Event – Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no water level drawdown (less than 0.3 feet). If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, continue purging until indicator field parameters stabilize.

       Monitor and record water level and pumping rate every three to five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (for example, 0.1 - 0.4 l/min) to ensure stabilization of indicator parameters. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. Do not allow the water level to fall to the intake level (if the static water level is above the well screen, avoid lowering the water level into the screen). The final purge volume must be greater than the stabilized drawdown volume plus the extraction tubing volume.

       Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (bladder, peristaltic), and/or the use of dedicated equipment. If the recharge rate of the well is lower than extraction rate capabilities of currently manufactured pumps and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples (ideally the intake should not be moved during this recovery period). Samples may then be collected even though the indicator field parameters have not stabilized.

       NOTE: If well goes dry before at least 3 well volumes can be purged from the well, allow groundwater to recharge, then collect sample.

    b. Subsequent Low Stress Sampling Events – After synoptic water level measurement round, check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s). Perform purging operations as above.

4. Monitor Indicator Field Parameters – During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, Eh, DO) every three to five minutes (or less frequently, if appropriate). Note: during the early phase of purging emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at three (3) to five (5) minute intervals, are within the following limits:
   - turbidity (10% for values greater than 1 NTU),
   - DO (10%), specific conductance (3%),
   - temperature (3%),
   - pH (± 0.1 unit),
   - ORP/Eh (± 10 millivolts).

   All measurements, except turbidity, must be obtained using a flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values measured within the cell and may also cause an underestimation of turbidity values measured after the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and continue monitoring activities.

   The flow-through-cell must be designed in a way that prevents air bubble entrapment in the cell. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must be submerged in water at all times. If two flow-through-cells are used in series, the one containing the dissolved oxygen probe should come first (this parameter is most susceptible to error if air leaks into the system).

5. Collect Water Samples – Water samples for laboratory analyses must be collected before water has passed through the flow-through-cell (use a by-pass assembly or disconnect cell to obtain sample).

   VOC samples should be collected first and directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

   During purging and sampling, the tubing should remain filled with water so as to minimize possible changes in water chemistry upon contact with the atmosphere. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help insure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use one of the following procedures to collect samples:

- add clamp, connector (Teflon or stainless steel) or valve to constrict sampling end of tubing;
- insert small diameter Teflon tubing into water filled portion of pump tubing allowing the end to protrude beyond the end of the pump tubing, collect sample from small diameter tubing;
- collect non-VOC samples first, then increase flow rate slightly until the water completely fills the tubing, collect sample and record new drawdown, flow rate and new indicator field parameter values.

Add preservative, as required by analytical methods, to samples immediately after they are collected if the sample containers are not pre-preserved. Check analytical methods (e.g. EPA SW-846, water supply, etc.) for additional information on preservation. Check pH for all samples requiring pH adjustment to assure proper pH value. For VOC samples, this will require that a test sample be collected during purging to determine the amount of preservative that needs to be added to the sample containers prior to sampling.

If determination of filtered metal concentrations is a sampling objective, collect filtered water samples using the same low flow procedures. The use of an in-line filter is required, and the filter size (0.45 um is commonly used) should be based on the sampling objective. Pre-rinse the filter with approximately 25 - 50 ml of ground water prior to sample collection. Preserve filtered water sample immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in ground water for human health risk calculations.

Label each sample as collected. Samples requiring cooling (volatile organics, cyanide, etc.) will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

6. Post Sampling Activities – If recording pressure transducer is used, remeasure water level with tape.

   After collection of the samples, the pump tubing may either be dedicated to the well for resampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

   Before securing the well, measure and record the well depth (to 0.1 ft.), if not measured the day before purging began. Note: measurement of total well depth is optional after the initial low stress sampling event. However, it is recommended if the well has a “silting” problem or if confirmation of well identity is needed.

   Secure the well.

2.2.3 Decontamination

Decontaminate sampling equipment prior to use in the first well and following sampling of each subsequent well. Pumps will not be removed between purging and sampling operations. The pump and tubing (including support cable and electrical wires which are in contact with the well) will be decontaminated by one of the procedures listed below.

Procedure 1
The decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump or the pump can be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and isopropyl alcohol be used sparingly in the decontamination process and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

- Flush the equipment/pump with potable water.
- Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.
- Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.
- Flush with isopropyl alcohol (pesticide grade). If equipment blank data from the previous sampling event show that the level of contaminants is insignificant, then this step may be skipped.
- Flush with distilled/deionized water. The final water rinse must not be recycled.

Procedure 2
Steam clean the outside of the submersible pump. Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.

Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

2.2.4 Disposal

Dispose of all gloves, bailers, rope/string, tubing, and filters used to collect the sample prior to accessing the next well. Empty purge water onto the ground, away from the well, or in the event containerizing is required, transfer purged water from the pail into the appropriate storage container for storage until disposal/treatment is arranged.

3. QUALITY ASSURANCE

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the ground water samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples shall be collected for each batch of samples (a batch may not exceed 20 samples). Trip blanks are required for the VOC samples at a frequency of one set per VOC sample cooler.

- Field duplicate.
- Matrix spike.
- Matrix spike duplicate.
- Equipment blank.
- Trip blank (VOCs).
- Temperature blank (one per sample cooler).

Equipment blank shall include the pump and the pump's tubing. If tubing is dedicated to the well, the equipment blank will only include the pump in subsequent sampling rounds.

Collect samples in order from wells with lowest contaminant concentration to highest concentration. Collect equipment blanks after sampling from contaminated wells and not after background wells.

Field duplicates are collected to determine precision of sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

If split samples are to be collected, collect split for each analyte group in consecutive order (VOC original, VOC split, etc.). Split sample should be as identical as possible to original sample.

All monitoring instrumentation shall be operated in accordance with EPA analytical methods and manufacturer's operating instructions. EPA analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW- 846 with exception of Eh, for which the manufacturer's instructions are to be followed. Instruments shall be calibrated at the beginning of each day. If a measurement falls outside the calibration range, the instrument should be re-calibrated so that all measurements fall within the calibration range. At the end of each day, check calibration to verify that instruments remained in calibration. Temperature measuring equipment, thermometers and thermistors, need not be calibrated to the above frequency. They should be checked for accuracy prior to field use according to EPA Methods and the manufacturer's instructions.

Avoid cross-contamination of wells with the water level indicator, and sampling equipment by conducting proper decontamination procedures described above. Take care in labeling the samples, and the corresponding *Chain-of-Custody* with the correct sample date, time and well identification. All labeling must be consistent between sample labels and the *Chain of Custody*. Keep samples on ice following collection, and be conscience of “hold-times” for the samples. It is imperative that samples are submitted to the laboratory prior to the exceedence of hold times.

4. FIELD LOG BOOK

A field log shall be kept to document all ground water field monitoring activities (see attached example matrix), and record all of the following:

- Well identification.
- Well depth, and measurement technique.
- Static water level depth, date, time and measurement technique.
- Presence and thickness of immiscible liquid (NAPL) layers and detection method.
- Pumping rate, drawdown, indicator parameters values, and clock time, at the appropriate time intervals; calculated or measured total volume pumped.
- Well sampling sequence and time of each sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations during sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.
- Any problems encountered should be highlighted.
- Description of all sampling equipment used, including trade names, model number, diameters, material composition, etc.

STANDARD OPERATING PROCEDURE

CHAIN-OF-CUSTODY PROCEDURES

1.0 PURPOSE

Chain-of-custody procedures are established to provide sample integrity. Sample custody protocols will be based on procedures as described in "NEIC Policies and Procedures", EPA-330/9-78-DD1-R, Revised June, 1985. This custody is in two parts: sample collection and laboratory analysis. A sample is under a person's custody if it meets the following requirements:

- It is in the person's possession;
- It is in the person's view, after being in the person's possession;
- It was in the person's possession and it was placed in a secured location; or
- It is in a designated secure area.

2.0 FIELD SPECIFIC CUSTODY PROCEDURES

The sample packaging and shipment procedures summarized below will assure that the samples will arrive at the laboratory with the chain-of-custody intact.

Field procedures are as follows:

(a) The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.

(b) All bottles should be tagged with sample numbers and locations.

(c) Sample tags should be filled out using waterproof ink for each sample.

(d) The Project Manager should review all field activities to determine whether proper custody procedures were followed during the field work and decide if additional samples are required.

Transfer of Custody and Shipment Procedures are as follows:

(a) Samples should be accompanied by a properly completed chain-of-custody form (Attachment A). The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

(b) Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate signed custody record enclosed in each sample box or cooler. Shipping containers will be locked and secured with strapping tape in at least two locations for shipment to the laboratory. Custody seals will be used for samples shipped to laboratories. When custody seals are used, two printed, numbered custody seals will be placed on each cooler and the numbers will also appear on the chain-of-custody forms, or two signed and dated seals will be placed on the cooler. Clear tape will be placed over the seals.

(c) Whenever samples are split with a source or government agency, a separate Sample Receipt is prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.

(d) If the samples are sent by common carrier, a bill of lading should be used. Receipts of bills of lading will be retained as part of the permanent documentation. If sent by mail, the package will be registered with return receipt requested. Commercial carriers are not required to sign off on the custody form as long as the custody forms are sealed inside the sample cooler. Air bill information will be recorded on chain-of-custody forms.

STANDARD OPERATING PROCEDURE

CALIBRATION OF FIELD INSTRUMENTS

Note: Taken from "Standard Operating Procedure Calibration of Field Instruments" (U.S. EPA January 19, 2010, Revision Number 2).

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide a framework for calibrating field instruments used to measure water quality parameters for groundwater and surface water. Water quality parameters include temperature, pH, dissolved oxygen, specific conductance, oxidation/reduction potential [ORP], and turbidity.

This SOP is written for instruments that measure temperature, pH, dissolved oxygen, specific conductance, turbidity, and/or oxidation/reduction potential [ORP] and the probe readings for pH, dissolved oxygen, and specific conductance are automatically corrected for temperature.

For groundwater monitoring, the instrument must be equipped with a flow-through-cell. Turbidity is measured using a separate instrument. It must not be measured in a flow-through-cell because the flow-through-cell acts as a sediment trap.

2.0 HEALTH AND SAFETY WARNINGS

Read all labels on the standards and note any warnings on the labels. Wear appropriate personal protection equipment (e.g., gloves, eye shields, etc.) when handling the standards. If necessary, consult the Material Safety Data Sheets (MSDS) for additional safety information on the chemicals in the standards.

3.0 GENERAL

All monitoring instruments must be calibrated before they are used to measure environmental samples. For instrument probes that rely on the temperature sensor (pH, dissolved oxygen, specific conductance, and oxidation/reduction potential [ORP]), each temperature sensor needs to be checked for accuracy against a thermometer that is traceable to the National Institute of Standards and Technology (NIST). Before any instrument is calibrated or used to perform environmental measurements, the instrument must stabilize (warm-up) according to manufacturer's instructions and must have no air bubbles lodged between the probe and probe guard.

Most projects will require at least two standards to bracket the expected measurement range. This means that one standard is less than the expected value and one is higher. When an environmental sample measurement falls outside the calibration range, the instrument must be recalibrated to bracket the new range before continuing measurements. Otherwise, the measurements that are outside the calibration range will need to be qualified.

The manufacturer's instruction manual (including the instrument specifications) must accompany the instrument into the field.

4.0 FREQUENCY OF CALIBRATION

At a minimum, the instrument is calibrated prior to use on the day the measurements are to be performed. A post calibration check at the end of the day is performed to determine if the instrument drifted out of calibration. Some projects may require more frequent calibration checks throughout the day in addition to the check at the end of the day. For these checks, the instrument can be recalibrated during the day if the instrument drifted out of calibration and only the data measured prior to the check would need to be qualified. The calibration/post calibration data information should be recorded in the field notebook and/or on an equipment calibration form.

Instruments (e.g., sonde) that monitor continuously over a period of time are calibrated before deployment. When these instruments are recovered, the calibration is checked to determine if any of them drifted out of calibration.

Some instruments lose their calibration criteria when they are turned off. Those instruments can either be left on all day (battery dependent) or calibrated at each sampling location. If they are calibrated at each sampling location, a post calibration check is not needed.

Ideally, the temperature of the standards should be close to the temperature of the ambient water that is being measured.

5.0 CALIBRATION PROCEDURES

Prior to calibration, all instrument probes and cable connections must be cleaned and the battery checked according to the manufacturer's instructions. Failure to perform these steps (proper maintenance) can lead to erratic measurements.

If a multi-probe instrument is to be used, program the instrument to display the parameters to be measured (e.g., temperature, pH, percent dissolved oxygen, mg/L dissolved oxygen, specific conductance, and ORP).

The volume of the calibration solutions must be sufficient to cover both the probe and temperature sensor (see manufacturer's instructions for the volume to be used). Check the expiration date of the standards. Do not use expired standards. All standards are stored according to manufacturer instructions.

5.1 TEMPERATURE

Most instrument manuals state there is no calibration of the temperature sensor, but the temperature sensor must be checked to determine its accuracy. This accuracy check is performed at least once per year and the accuracy check dat/ information is kept with the instrument. If the accuracy check date/information is not included with the instrument or the last check was over a year, the temperature sensor accuracy needs to be checked at the beginning of the sampling event. If the instrument contains multiple temperature sensors, each sensor must be checked. This procedure is not normally performed in the field. If the instrument is obtained from a rental company, the rental company should have performed the calibration check and should include with the instrument documentation that it was performed.

Verification Procedure

1. Fill a container with water and adjust the water temperature to below the water body's temperature to be measured. Use ice or warm water to adjust the temperature.

2. Place a thermometer that is traceable to the National Institute of Standards and Technology (NIST) and the instrument's temperature sensor into the water. Wait for both temperature readings to stabilize.

3. Compare the two measurements. The instrument's temperature sensor must agree with the reference thermometer measurement within the accuracy of the sensor (e.g., ±O.2°C). If the measurements do not agree, the instrument may not be working properly and the manufacturer needs to be consulted.

4. Adjust the water temperature to a temperature higher than the water body to be measured.

5. Compare the two measurements. The instrument's temperature sensor must agree with the reference thermometer measurement within the accuracy of the sensor (e.g., ± 0.20 C). If the measurements do not agree, the instrument may not be working properly and the manufacturer needs to be consulted.

5.2 pH (electro metric)

The pH of a sample is determined electrometrically using a glass electrode. Choose the appropriate buffered standards that will bracket the expected values at the sampling locations. If the water body's pH is unknown, then three standards are needed for the calibration: one c1ose to seven, one at least two pH units below seven, and the other at least two pH units above seven. Instruments that will not accept three standards will need to be re-calibrated if the water sample's pH is outside the initial calibration range described by the two standards.

Calibration Procedure

1. Allow the buffered standards to equilibrate to the ambient temperature.

2. Fill calibration containers with the buffered standards so each standard will cover the pH probe and temperature sensor.

3. Remove probe from its storage container, rinse with deionized water, and remove excess water.

4. Select measurement mode. Immerse probe into the initial standard (e.g., pH 7).

5. Wait until the readings stabilize. If the reading does not change within 30 seconds, select calibration mode and then select "pH". Enter the buffered standard value into instrument.

6. Remove probe from the initial standard, rinse with deionized water, and remove excess water.

7. Immerse probe into the second standard (e.g., pH 4). Repeat step 5.

8. Remove probe from the second standard, rinse with deionized water, and remove excess water. If instrument only accepts two standards, the calibration is complete. Go to step 'II. Otherwise continue.

9. Immerse probe in third buffered standard (e.g., pH 10) and repeat step 5.

10. Remove probe from the third standard, rinse with deionized water, and remove excess water.

11. Select measurement mode, if not already selected. To ensure that the initial calibration standard (e.g., pH 7) has not changed, immerse the probe into the initial standard. Wait for the readings to stabilize. The reading should read the initial standard value within the manufacturer's specifications. If not, re-calibrate the instrument. If re-calibration does not help, the calibration range may be too great. Reduce calibration range by using standards that are closer together.

12. The calibration is complete. Rinse the probe with deionized water and store the probe according to manufacturer's instructions.

13. Record the calibration information in the field notebook and/or on an equipment calibration form.

5.3 DISSOLVED OXYGEN

Dissolved oxygen (DO) content in water is measured using a membrane electrode. To insure proper operation, the DO probe's membrane and electrolyte should be replaced prior to calibration for the sampling event. The new membrane may need to be conditioned before it is used; consult manufacturer's manual on how the conditioning is to be performed. Failure to perform this step may lead to erratic measurements. Before performing the calibration/measurements, inspect the membrane for air bubbles and nicks.

Note: some manufacturers require an altitude correction instead of a barometric correction. In that case, enter the altitude correction according to the manufacturer's directions in Step 5 and then proceed to Step 6.

Note: some instruments have a built-in barometer. Follow the manufacturer's instructions for entering the barometric value in step 5.

<u>Calibration Procedure</u>

1. Gently dry the temperature sensor and remove any water droplets from the DO probe's sensor membrane according to manufacturer's instructions. Note that the evaporation of moisture on the temperature sensor or DO probe may influence the readings during calibration.

2. Create a 100 percent water-saturated air environment by placing a wet sponge or a wet paper towel on the bottom of the DO calibration container. Place the DO probe into the calibration container. The probe is loosely fitted into the calibration container to prevent the escape of moisture evaporating from the sponge or paper towel while maintaining ambient pressure (see manufacturer's instructions). Note that the probe and the temperature sensor must not come in contact with these wet items.

3. Allow the confined air to become saturated with water vapor (saturation occurs in approximately 10 to 15 minutes). During this time, turn on the instrument to allow the DO probe to warm-up. Select the measurement mode. Check the temperature readings. Readings must stabilize before continuing to the next step.

4. Select calibration mode; then select "DO %".

5. Enter the local barometric pressure (usually in mm of mercury) for the sampling location into the instrument. This measurement must be determined from an on-site barometer. Do not use barometric pressure obtained from the local weather services unless the pressure is corrected for the elevation of the sampling location. [Note: inches of mercury times 25.4 mm/inch equals mm of mercury or consult Oxygen Solubility at Indicated Pressure chart attached to the SOP for conversion at selected pressures].

6. The instrument should indicate that the calibration is in progress. After calibration, the instrument should display percent saturated DO.

7. Select measurement mode and set the display to read DO mg/L and temperature. Compare the DO mg/L reading to the Oxygen Solubility at Indicated Pressure chart attached to the SOP. The numbers should agree. If they do not agree within the accuracy of the instrument (usually ± 0.2 mg/L), repeat calibration. If this does not work, change the membrane and electrolyte solution.

8. Remove the probe from the container and place it into a 0.0 mglL DO solution (see footnote). Check temperature readings. They must stabilize before continuing.

9. Wait until the "mg/L DO" readings have stabilized. The instrument should read less than 0.5 mg/L (assuming an accuracy of ± 0.2 mg/L). If the instrument reads above 0.5 mg/L or reads negative, it will be necessary to clean the probe, and change the membrane and electrolyte solution. If this does not work, try a new 0.0 mg/L DO solution. If these changes do not work, contact the manufacturer. Note: some projects and instruments may have different accuracy requirements. The 0.5 mg/L value may need to be adjusted based on the accuracy requirements of the project or instrument.

10. After the calibration has been completed, rinse the probe with tap or deionized water and store the probe according to manufacturer's instructions. It is important that all of the 0.0 mg/L DO solution be rinsed off the probe so as not to effect the measurement of environmental samples.

11. Record calibration information in the field notebook and/or on an equipment calibration form.

Note: You can either purchase the 0.0 mg/L DO solution from a vendor or prepare the solution yourself. To prepare a 0.0 mg/L DO solution, follow the procedure stated in Standard Methods (Method 4500-0 G). The method basically states to add excess sodium sulfite (until no more dissolves) and a trace amount of cobalt chloride (read warning on the label before use) to water.

This solution is prepared prior to the sampling event. Note: this solution can be made without cobalt chloride, but the probe will take longer to respond to the low DO concentration.

5.4 SPECIFIC CONDUCTANCE

Conductivity is used to measure the ability of an aqueous solution to carry an electrical current. Specific conductance is the conductivity value corrected to 25°C.

Most instruments are calibrated against a single standard which is near the specific conductance of the environmental samples. The standard can be either below or above the specific conductance of the environmental samples. A second standard is used to check the linearity of the instrument in the range of measurements. When performing specific conductance measurement on groundwater or surface water and the measurement is outside the initial calibration range defined by the two standards, the instrument will need to be re-calibrated using the appropriate standards.

Specific Conductance Calibration Procedure

1. Allow the calibration standards to equilibrate to the ambient temperature.

2. Fill calibration containers with the standards so each standard will cover the probe and temperature sensor. Remove probe from its storage container, rinse the probe with deionized water or a small amount of the standard (discard the rinsate), and place the probe into the standard.

3. Select measurement mode. Wait until the probe temperature stabilizes.

4. Select calibration mode, then specific conductance. Enter the specific conductance standard. Value. Make sure the units on the standard are the same as the units used by the instrument. If the units are different, convert the units on the standard to the units used by the instrument.

5. Select measurement mode. The reading should remain within the manufacturer’s specifications. If it does not, re-calibrate. If readings continue to change after re-calibration, consult the manufacturer’s instruction manual or replace the calibration solution.

6. Remove probe from the standard, rinse the probe with deionized water or a small amount of the second standard (discard the rinsate), and place the probe into the second standard. The second standard will serve to verify the linearity of the instrument. Read the specific conductance value from the instrument and compare the value to the specific conductance on the standard. The two values should agree within the specifications of the instrument. If they do not agree, re-calibrate. If readings do not compare, then the second standard may be outside the linear range of the instrument. Use a standard that is closer to the first standard and repeat the verification. If values still do not compare, try cleaning the probe or consult the manufacturer.

7. After the calibration has been completed, rinse the probe with deionized water and store the probe according to manufacturer's instructions.

8. Record the calibration information in the field notebook and/or on an equipment calibration form.

Note: for projects where specific conductance is not a critical measurement it may be possible to calibrate with one standard in the range of the expected measurement.

5.5 OXIDATIONIREDUCTION POTENTIAL (ORP)

The oxidation/reduction potential is the electrometric difference measured in a solution between an inert indicator electrode and a suitable reference electrode. The electrometric difference is measured in millivolts and is temperature dependent.

Calibration or Verification Procedure

1. Allow the calibration standard (a Zobell solution: read the warning on the label before use) to equilibrate to ambient temperature.

2. Remove the probe from its storage container and place it into the standard.

3. Select measurement mode.

4. Wait for the probe temperature to stabilize, and then read the temperature.

5. If the instrument is to be calibrated, do Steps 6 and 7. If the instrument calibration is to be verified, then go to Step 8.

6. Look up the millivolt (mv) value at this temperature from the millivolt versus temperature correction table usually found on the standard bottle or on the standard instruction sheet. You may need to interpolate millivolt value between temperatures. Select "calibration mode", then "ORP". Enter the temperature-corrected ORP value into the instrument.

7. Select measurement mode. The readings should remain unchanged within manufacturer's specifications. If they change, re-calibrate. If readings continue to change after re-calibration, try a new Zobell solution or consult the manufacturer. Go to Step 9.

8. If the instrument instruction manual states that the instrument is factory calibrated, then verify the factory calibration against the Zobell solution. If they do not agree within the specifications of the instrument, try a new Zobell solution. If it does not agree, the instrument will need to be re-calibrated by the manufacturer.

9. After the calibration has been completed, rinse the probe with deionized water and store the probe according to manufacturer's instructions.

10. Record the calibration information in the field notebook and/or an equipment calibration form.

5.6 TURBIDITY

The turbidity method is based upon a comparison of intensity of light scattered by a sample under defined conditions with the intensity of light scattered by a standard reference suspension. A turbidity meter is a nephelometer with a visible light source for illuminating the sample and one or more photo-electric detectors placed ninety degrees to the path of the light source. Note: the below calibration procedure is for a turbidimeter which the sample is placed into a cuvette.

Some instruments will only accept one standard. For those instruments, the second, third, etc., standards will serve as check points.

Calibration Procedures

1. Allow the calibration standards to equilibrate at the ambient temperature. The use of commercially available polymer primary standards (AMCO-AEPA-l) is preferred; however, the standards can be prepared using Formazin (read the warning on the label before use) according to the EPA analytical Method 180.1. Other standards may be used if they can be shown that they are equivalent to the previously mentioned standards.

2. If the standard cuvette is not sealed, rinse a cuvette with deionized water. Shake the cuvette to remove as much water as possible. Do not wipe dry the inside of the cuvette because lint from the wipe may remain in the cuvette. Add the standard to the cuvette.

3. Before performing the calibration procedure, make sure the cuvettes are not scratched and the outside surfaces are dry and free from fingerprints and dust. If the cuvette is scratched or dirty, discard or clean the cuvette respectively. Note: some manufacturers require the cuvette to be orientated in the instrument in a particular direction for accurate reading.

4. Select a low value standard such as a zero or 0.02 NTU and calibrate according to manufacturer's instructions. Note: a zero standard (approximately 0 NTU) can be prepared by passing distilled water through a 0.45 micron pore size membrane filter.

5. Select a high standard and calibrate according to manufacturer's instructions or verify the calibration if instrument will not accept a second standard. In verifying, the instrument should read the standard value to within the specifications of the instrument. If the instrument has range of scales, check each range that will be used during the sampling event with a standard that falls within that range.

6. Record the calibration information in the field notebook and/or on an equipment calibration form.

6.0 POST CALIBRATION CHECK

After the initial calibration is performed, the instrument's calibration may drift during the measurement period. As a result, you need to detennine the amount of drift that occurred after collecting the measurements. This is performed by placing the instrument in measurement mode (not calibration mode) and placing the probe in one or more of the standards used during the initial calibration; for turbidity place the standard in a cuvette and then into the turbidimeter. Wait for the instrument to stabilize and record the measurement in the field notebook and/or on a field water quality form. Compare the measurement value to the initial calibration value. This difference in value is then compared to the drift criteria or post calibration criteria described in the quality assurance project plan or the sampling and analysis plan for the project. If the check value is outside the criteria, then the measurement data will need to be qualified.

For the dissolved oxygen calibration check, follow the calibration instructions steps one through three while the instrument is in measurement mode. Record dissolved oxygen value (mg/L), temperature, and barometric pressure. Compare the measurement value to the Oxygen Solubility at Indicated Pressure chart attached to this SOP. The value should be within the criteria specified for the project. If measurement value drifted outside the criteria, the data will need to be qualified.

If the quality assurance project plan or the sampling and analysis plan do not list the drift criteria or the post-calibration criteria, use the criteria below.

Measurement	**Post Calibration Criteria**
Dissolved Oxygen	± 0.5 mg/L of sat. value* < 0.5 mg/L for the 0 mg/L solution, but not a negative value
Specific Conductance	±5% of standard or ± 10 uS/cm (whichever is greater)
pH	± 0.3 pH unit with pH 7 buffer*
Turbidity	± 5% of standard
ORP	± 10 mv*

Note: * Table 8.1, USEPA Region 1 *YSI6-Series Sondes and Data Logger SOP,* January 30, 2007, revision 9.

7.0 DATA MANAGEMENT AND RECORDS MANAGEMENT

All calibration records must be documented in the project's field notebook or on an equipment calibration form. At a minimum, include the instrument manufacturer, model number, instrument identification number (when more than one instrument of the same model is used), the standards used to calibrate the instruments (including source), the calibration date, the instrument readings, the post calibration check, and the name of the person(s) who performed the calibration.

8.0 REFERENCES

Standard Methods for the Examination of Water and Wastewater, 20th edition, 1998.

Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Revised March 1983.

Turbidity - Methods for the Determination of Inorganic Substances in Environmental Samples, EP A/600/R-93/l00, August 1993.

U.S. EPA Region 1 Quality Assurance Unit, Standard Operating Procedure Calibration of Field Instruments, January 19, 2010, Revision Number 2.

U.S. EPA Region 1 YSI 6-Series Sondes and Data Logger SOP, January 30, 2007, Revision 9.

USGS Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting, Techniques and Methods 1-D3.

Oxygen Solubility at Indicated Pressure

	Pressure (Hg)							
Temp.	760	755	750	745	740	735	730	mm
°C	29.92	29.72	29.53	29.33	29.13	28.94	28.74	in
0	14.57	14.47	14.38	14.28	14.18	14.09	13.99	mg/L
1	14.17	14.08	13.98	13.89	13.79	13.70	13.61	mg/L
2	13.79	13.70	13.61	13.52	13.42	13.33	13.24	mg/L
3	13.43	13.34	13.25	13.16	13.07	12.98	12.90	mg/L
4	13.08	12.99	12.91	12.82	12.73	12.65	12.56	mg/L
5	12.74	12.66	12.57	12.49	12.40	12.32	12.23	mg/L
6	12.42	12.34	12.26	12.17	12.09	12.01	11.93	mg/L
7	12.11	12.03	11.95	11.87	11.79	11.71	11.63	mg/L
8	11.81	11.73	11.65	11.57	11.50	11.42	11.34	mg/L
9	11.53	11.45	11.38	11.30	11.22	11.15	11.07	mg/L
10	11.28	11.19	11.11	11.04	10.96	10.89	10.81	mg/L
11	10.99	10.92	10.84	10.77	10.70	10.62	10.55	mg/L
12	10.74	10.67	10.60	10.53	10.45	10.38	10.31	mg/L
13	10.50	10.43	10.36	10.29	10.22	10.15	10.08	mg/L
14	10.27	10.20	10.13	10.06	10.00	9.93	9.86	mg/L
15	10.05	9.98	9.92	9.85	9.78	9.71	9.65	mg/L
16	9.83	9.76	9.70	9.63	9.57	9.50	9.43	mg/L
17	9.63	9.57	9.50	9.44	9.37	9.31	9.24	mg/L
18	9.43	9.37	9.30	9.24	9.18	9.11	9.05	mg/L
19	9.24	9.18	9.12	9.05	8.99	8.93	8.87	mg/L
20	9.06	9.00	8.94	8.88	8.82	8.75	8.69	mg/L
21	8.88	8.82	8.76	8.70	8.64	8.58	8.52	mg/L
22	8.71	8.65	8.59	8.53	8.47	8.42	8.36	mg/L
23	8.55	8.49	8.43	8.38	8.32	8.26	8.20	mg/L
24	8.39	8.33	8.28	8.22	8.16	8.11	8.05	mg/L
25	8.24	8.18	8.13	8.07	8.02	7.96	7.90	mg/L
26	8.09	8.03	7.98	7.92	7.87	7.81	7.76	mg/L
27	7.95	7.90	7.84	7.79	7.73	7.68	7.62	mg/L
28	7.81	7.76	7.70	7.65	7.60	7.54	7.49	mg/L
29	7.68	7.63	7.57	7.52	7.47	7.42	7.36	mg/L
30	7.55	7.50	7.45	7.39	7.34	7.29	7.24	mg/L
31	7.42	7.37	7.32	7.27	7.22	7.16	7.11	mg/L
32	7.30	7.25	7.20	7.15	7.10	7.05	7.00	mg/L
33	7.08	7.13	7.08	7.03	6.98	6.93	6.88	mg/L
34	7.07	7.02	6.97	6.92	6.87	6.82	6.78	mg/L
35	6.95	6.90	6.85	6.80	6.76	6.71	6.66	mg/L
36	6.84	6.79	6.76	6.70	6.65	6.60	6.55	mg/L
37	6.73	6.68	6.64	6.59	6.54	6.49	6.45	mg/L
38	6.63	6.58	6.54	6.49	6.44	6.40	6.35	mg/L
39	6.52	6.47	6.43	6.38	6.35	6.29	6.24	mg/L
40	6.42	6.37	6.33	6.28	6.24	6.19	6.15	mg/L
41	6.32	6.27	6.23	6.18	6.14	6.09	6.05	mg/L
42	6.22	6.18	6.13	6.09	6.04	6.00	5.95	mg/L
43	6.13	6.09	6.04	6.00	5.95	5.91	5.87	mg/L
44	6.03	5.99	5.94	5.90	5.86	5.81	5.77	mg/L
45	5.94	5.90	5.85	5.81	5.77	5.72	5.68	mg/L

Source: Draft EPA Handbook of Methods for Acid Deposition Studies, Field Operations for Surface Water Chemistry, EPA/600/4-89/020, August 1989.

Oxygen Solubility at Indicated Pressure (continued)

	Pressure (Hg)								
Temp.	725	720	715	710	705	700	695	690	mm
°C	28.54	28.35	28.15	27.95	27.76	27.6	27.36	27.17	in
0	13.89	13.8	13.7	13.61	13.51	13.4	13.32	13.22	mg/L
1	13.51	13.42	13.33	13.23	13.14	13	12.95	12.86	mg/L
2	13.15	13.06	12.07	12.88	12.79	12.7	12.6	12.51	mg/L
3	12.81	12.72	12.63	12.54	12.45	12.4	12.27	12.18	mg/L
4	12.47	12.39	12.3	12.21	12.13	12	11.95	11.87	mg/L
5	12.15	12.06	11.98	11.89	11.81	11.7	11.64	11.56	mg/L
6	11.84	11.73	11.68	11.6	11.51	11.4	11.35	11.27	mg/L
7	11.55	11.47	11.39	11.31	11.22	11.1	11.06	10.98	mg/L
8	11.26	11.18	11.1	11.02	10.95	10.9	10.79	10.71	mg/L
9	10.99	10.92	10.84	10.76	10.69	10.6	10.53	10.46	mg/L
10	10.74	10.66	10.59	10.51	10.44	10.4	10.29	10.21	mg/L
11	10.48	10.4	10.33	10.28	10.18	10.1	10.04	9.96	mg/L
12	10.24	10.17	10.1	10.02	9.95	9.88	9.81	9.46	mg/L
13	10.01	9.94	9.87	9.8	9.73	9.66	9.59	9.52	mg/L
14	9.79	9.72	9.65	9.68	9.51	9.45	9.38	9.31	mg/L
15	9.58	9.51	9.44	9.58	9.31	9.24	9.18	9.11	mg/L
16	9.37	9.3	9.24	9.17	9.11	9.04	8.97	8.91	mg/L
17	9.18	9.11	9.05	8.98	8.92	8.85	8.79	8.73	mg/L
18	8.99	8.92	8.86	8.8	8.73	8.67	8.61	8.54	mg/L
19	8.81	8.74	8.68	8.62	8.56	8.49	8.43	8.37	mg/L
20	8.63	8.57	8.51	8.45	8.39	8.33	8.27	8.21	mg/L
21	8.46	8.4	8.34	8.28	8.22	8.16	8.1	8.04	mg/L
22	8.3	8.24	8.18	8.12	8.06	8	7.95	7.89	mg/L
23	8.15	8.09	8.03	7.97	7.91	7.86	7.8	7.74	mg/L
24	7.99	7.94	7.88	7.82	7.76	7.71	7.65	7.59	mg/L
25	7.85	7.79	7.74	7.68	7.6	7.57	7.51	7.46	mg/L
26	7.7	7.65	7.59	7.54	7.48	7.43	7.37	7.32	mg/L
27	7.57	7.52	7.46	7.41	7.35	7.3	7.25	7.19	mg/L
28	7.44	7.38	7.33	7.28	7.22	7.17	7.12	7.06	mg/L
29	7.31	7.26	7.21	7.15	7.1	7.05	7	6.94	mg/L
30	7.19	7.14	7.08	7.03	6.98	6.93	6.88	6.82	mg/L
31	7.06	7.01	6.96	6.91	6.86	6.81	6.76	6.7	mg/L
32	6.95	6.9	6.85	6.8	6.7	6.7	6.64	6.59	mg/L
33	6.83	6.78	6.73	6.68	6.83	6.58	6.53	6.48	mg/L
34	6.73	6.68	6.63	6.58	6.53	6.48	6.43	6.38	mg/L
35	6.61	6.56	6.51	6.47	6.42	6.37	6.36	6.27	mg/L
36	6.51	6.46	6.41	6.36	6.31	6.27	6.22	6.17	mg/L
37	6.4	6.35	6.31	6.26	6.21	6.16	6.12	6.07	mg/L
38	6.3	6.26	6.21	6.16	6.12	6.07	6.02	5.98	mg/L
39	6.26	6.15	6.11	6.06	6.01	5.97	5.92	5.87	mg/L
40	6.1	6.06	6.01	5.96	5.92	5.86	5.83	5.78	mg/L
41	6	5.96	5.91	5.87	5.82	5.78	5.73	5.69	mg/L
42	5.91	5.86	5.82	5.77	5.73	5.69	5.64	5.6	mg/L
43	5.82	5.78	5.73	5.69	5.65	5.6	5.56	5.51	mg/L
44	5.72	5.68	5.64	5.59	5.55	5.51	5.46	5.42	mg/L
45	5.64	5.59	5.55	5.51	5.47	5.42	5.38	5.34	mg/L

Source: Draft EPA Handbook of Methods for Acid Deposition Studies, Field Operations for Surface Water Chemistry, EPA/600/4-89/020, August 1989.

APPENDIX C

SITE HEALTH AND SAFETY PLAN

FORM HSP-3

1.0 GENERAL INFORMATION

Site/Location: Former Wabash Alloys Facility, 9100 South Fifth Avenue, Oak Creek, WI

Project #: 117-2201186 / 117-2201289/ 117-2201404

Plan Prepared by: Mark A. Manthey Date: June 2, 2009

Hazard Assessment Prepared by: * Mark A. Manthey Date: June 2, 2009

* I certify that I have assessed the type, risk level and severity of hazards for this project and have selected appropriate personal protective equipment for site personnel.

Plan Updated by: Ashley A. Wagner Date: September 1, 2017

Reviewed by: Michelle Gillie, CIH/Corporate Health & Safety

Date: 11/13/2014

Activity(s): 1) Use of hydro-excavacation to clear area of interest of utilities before installing monitoring wells in area of multiple utilities. 2) Installation and sampling of seven soil borings to a depth of 25 ft bgs. Locations can be found on attached Figure 2. 3) Installation, development, and sampling of a water table monitor well (will be installed to a depth of approximately 20 ft bgs, sampling will occur at 2 foot intervals). Location can be found on attached Figure 3. 4) Five test pits will be excavated to a depth of 12 ft bgs during a window of no forecasted precipitation for a few days. A composite soil sample will be collected from each test pit, to determine the waste characteristics of soil containing tar. Locations can be found on attached Figure 4.

Dates of work: Approximately September 2017 through March 2018 (hydro-excavation and drilling activities). Dates of activities will be coordinated after WDNR approval and will be based off sub-contractor availability and weather.

Tetra Tech, Inc. personnel:	Signature
Mike Noel (PM)	
Mark Manthey* **	

Todd Thomson**	
Ashley Weimer**	
Ashley Kowalewski**	

* Safety coordinator/emergency coordinator

** Designated First-Aid provider

Contractor Personnel:

1. Sub-contractor for installation and sampling of Geoprobe direct-push soil borings and installation of monitoring well to be determined. Personnel to be determined.
2. Sub-contractor for hydro-excavation to clear area of interest of potential utilities to be determined. Personnel to be determined.
3. Sub-contractor for excavating test pits. Personnel to be determined.

Description of Site: (include map if possible)

Closed former Wabash Alloys secondary aluminum smelting facility. The site occupies approximately 21 acres of land. Approximately 12 acres of the west side of the property had been developed in the past (included the former smelting facility structures, parking lot, and paved driveways). The remaining eastern portion of the property contained no structures except for remaining segments of railroad spurs. All building structures (including pits) and railroad spurs were removed from the site in 2013. The paved driveway and building foundation (above grade, but has shallowly sloped grading around the foundation on all but the southern side) are all that remain on site. The property contained a coal tar distillation facility from 1917 through 1968. The structures related to the coal tar distillation plant were removed prior to the construction of the aluminum smelting facility on the property in 1968. The area of the property being investigated is located in the south driveway of the former Wabash Alloys facility and is shown on the attached Site Layout figure. A tar seep consisting of two small pools of tar (1 to 2 feet in diameter) was found in the investigation area during a 2006 investigation of the property.

Access and security:

The Former Wabash Alloys facility can be accessed from South Fifth Avenue, through a locked gate. The facility is enclosed with fencing around majority of the property, except for the grassy/wetland area to the east. To access the wells located to the south on the City of Oak

Creek property, contact the water treatment facility at: (414)768-7060 and one of their staff members will unlock to gate.

Types of hazardous material:
Coal tar and soil and groundwater potentially impacted with coal tar constituents consisting of petroleum volatile organic compounds (PVOCs) and polynuclear aromatic hydrocarbons (PAHs).

Major safety/health hazards/risks: (contamination, equipment, fire etc.)
Direct contact with free coal tar or soil and groundwater impacted with coal tar constituents (PVOCs and PAHs) when collecting soil samples and when developing and sampling monitor wells. Inhalation of coal tar vapors and dermal contact. Hazards associated with working around a drill rig. Potential biological hazards (insects, coyotes) when doing work in the undeveloped area on the east side of the property. Trip and fall hazards when doing work in the location of the previously existing building. Entrance to the test pits will be prohibited.

The maximum detected COC concentrations in groundwater from the most recent round of groundwater sampling (June 2017) are shown in the table below:

VOC	**Concentration (ug/L)**	**Location**
Benzene	4,800	MW-117
Ethylbenzene	520	MW-107
Naphthalene	21,000	MW-117
Xylenes	2,900	MW-117
Toluene	4,400	MW-117
1,2,4-trimethylbenzene	550	MW-117
1,3,5-trimethylbenzene	240	MW-117

SVOC	Concentration (ug/L)	Location
Anthracene	300	MW-134
Benzo[a]pyrene	230	MW-134
Benzo[b]fluoranthene	310	MW-134
Chrysene	240	MW-134
Fluoranthene	1,500	MW-134
Fluorene	850	MW-134
Naphthalene	21,000	MW-117
Pyrene	1,100	MW-134

Tetra Tech's Certified Industrial Hygienist performed predictive modeling to evaluate the worst case airborne vapor concentrations using the March 2014 groundwater sampling data. The model shows that the predominant airborne vapors would be benzene (31%), toluene (27%), xylenes (22%), and naphthalene (9%) and that is it possible that the OSHA Permissible Exposure Limit (PEL) for benzene could be exceeded if there is an open and direct pathway from the groundwater to the ambient air. Level D PPE will be the initial level of worker protection supplemented by continuous monitoring with a PID to verify total VOC concentrations do not exceed the prescribed safe range for use of Level D PPE.

Confined space entry is not anticipated and is expressly prohibited as part of this scope of work. There are no confined spaces located at this Site. All pits/trenches (potential confined spaces) were removed and backfilled by Natural Resources and Technology in 2013.

A confined space is defined as a space that:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, vessels, storage bins, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

A Permit-Required Confined Space is a confined space that has one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized, serious, safety or health hazard.

2.0 SAFETY PLAN

Employee Training and Medical Surveillance:

This section specifies health and safety training requirements for Tetra Tech and subcontractor personnel working under the direction of Tetra Tech. Tetra Tech and identified personnel must complete 40 hours of introductory hazardous waste (HAZWOPER) operations site training prior to performing work onsite. Tetra Tech and subcontractor personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before being cleared for site work. In addition, 8-hour supervisory training and refresher training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel.

Training on the updated hazard communication/globally harmonized system (29 CFR 1910.1200) will also be required for site personnel handling any hazardous chemicals.

Additionally, at least one field person will be current with basic first aid and CPR training to be capable of providing aid to an injured co-worker or subcontractor employee in the event of an injury or illness.

Documentation of Tetra Tech and subcontractor personnel introductory, supervisory, and refresher HAZWOPERtraining as well as site-specific training will be maintained at the site.

The Tetra Tech FOL/ PHSO will provide site-specific training (HASP review) to Tetra Tech and subcontractor employees who will perform work on this project. The Tetra Tech FOL/SSO will also conduct a daily tailgate safety meeting prior to initiating site work. This will consist of a brief meeting at the beginning of each day to discuss operations planned for that day,

Tetra Tech and subcontractor personnel participating in project field activities will have had a physical examination meeting the requirements of paragraph (f) 29 CFR 1910.120 medical surveillance program requirements. Documentation for medical clearances will be maintained on the project site and be made available upon request.

FORM HSP-3

Protective Equipment/Instruments (specify type, as necessary)

Hard hat: X (when working around drill rig) Boots: X (steel toed when working around drill rig). Glasses (type): Safety Coveralls (type): _____

Respirator: _____ First aid kit: X (in vehicle) Gloves: Disposable Nitrile

PID: X CGI: _____ Hearing Protection: X (when working around drill rig or hydro-excavator)

Safety Equipment Levels/Upgrades: Modified Level D. Hard hat, hearing protection, safety glasses, disposal nitrile gloves, and steel-toed boots when working around the drill rig, hydro-excavator and excavating equipment. Safety glasses and disposable nitrile gloves when collecting soil samples and developing and sampling monitor wells.

Monitoring Requirements: The work area breathing space should be monitored with a photoionization detector (PID) during the drilling of the soil borings and monitor wells at least once per hour. The PID measurements of the work area breathing space should be recorded on Tetra Tech field PID data sheets. If a work area breathing zone PID reading is sustained at or above 5 ppm above background PID readings for more than 10 minutes, work will be stopped until PID readings decrease to below 5 ppm. If PID readings remain above 5 ppm, stop work evacuate the area, and contact the PM and Corporate H&S for guidance.

Decontamination/Work Zone Requirements: Work zones are at the soil borings and monitor wells being sampled and the area surrounding the test pit and stockpiled soil. If possible, potential trip and fall hazards should be removed from the work zones. Diggers Hotline should be contacted at least four business days prior to the start of soil boring and monitor well drilling activities to clear the work area of potential buried utilities. A level area close to the work zone should be selected for the cleaning of the drill rods during the drilling of the monitor wells. Decontamination of the other drilling and sampling equipment should be done at the soil borings and monitor wells. All waste products generated during the site investigation activities should be contained. Soil cuttings and groundwater will be contained on-site pending determination of appropriate disposal options for the media. The vessels containing the soil and groundwater should be appropriately labeled with the well/borehole identification, date(s), and type of media (soil or groundwater) contained in the vessel. Other waste (disposable gloves, used soil core liners, used canning jars, foil, etc.) generated during the site investigation should be placed in garbage bags and taken off-site for proper disposal.

3.0 EMERGENCY PLANNING

Emergency Phone Numbers

Hospital: St. Luke's South Shore Hospital 5900 S. Lake Drive, Cudahy, WI 53110 Tel: 414-489-9000 (approx. 4 miles from site)

Fire Department and EMS: 911; Non-Emergency: 414-570-5630
Police: 911; Non-Emergency: 414-762-8200
WorkCare Incident Intervention (24/7) 888-449-7787
Chartis/AIG Workers Compensation Clinic: Lakeshore Medical Clinic, 3611 S. Chicago Avenue, South Milwaukee, WI 53172 Tel:414-762-7270 (1.36 miles from site)
Tetra Tech: 262-792-1282
Contractors: To Be Determined

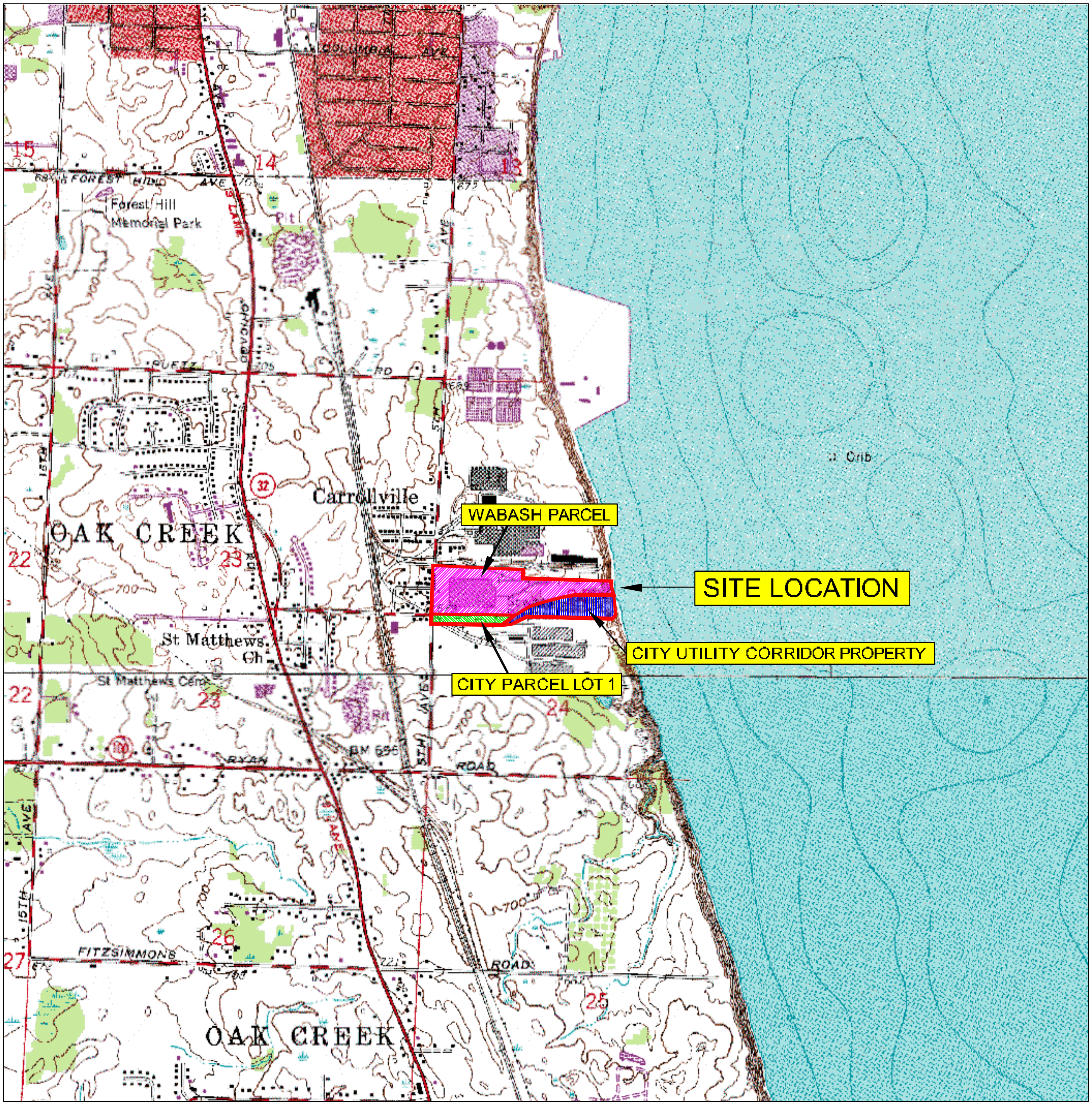
Note: Maps of route to hospital and workers comp clinic must be attached.

4.0 ATTACHMENTS

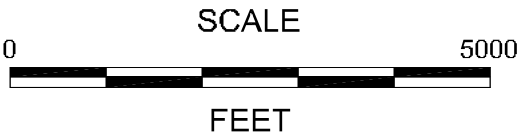
X Site Maps
X Route to Hospital
X Site Safety Plan Acknowledgment Form
X General Safe Work Practices
X Drill Rig Safety Procedures
X Direct Push Safety Procedures
X Heat Stress
X Cold Stress
X Biohazards
X SDS
X Data Tables

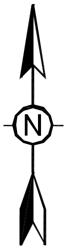
FORM HSP-3

__X__ Trenching and Excavation Practices



National Geodetic Vertical Datum of 1929
Contour Interval 10 Feet





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

FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
OAK CREEK, WISCONSIN

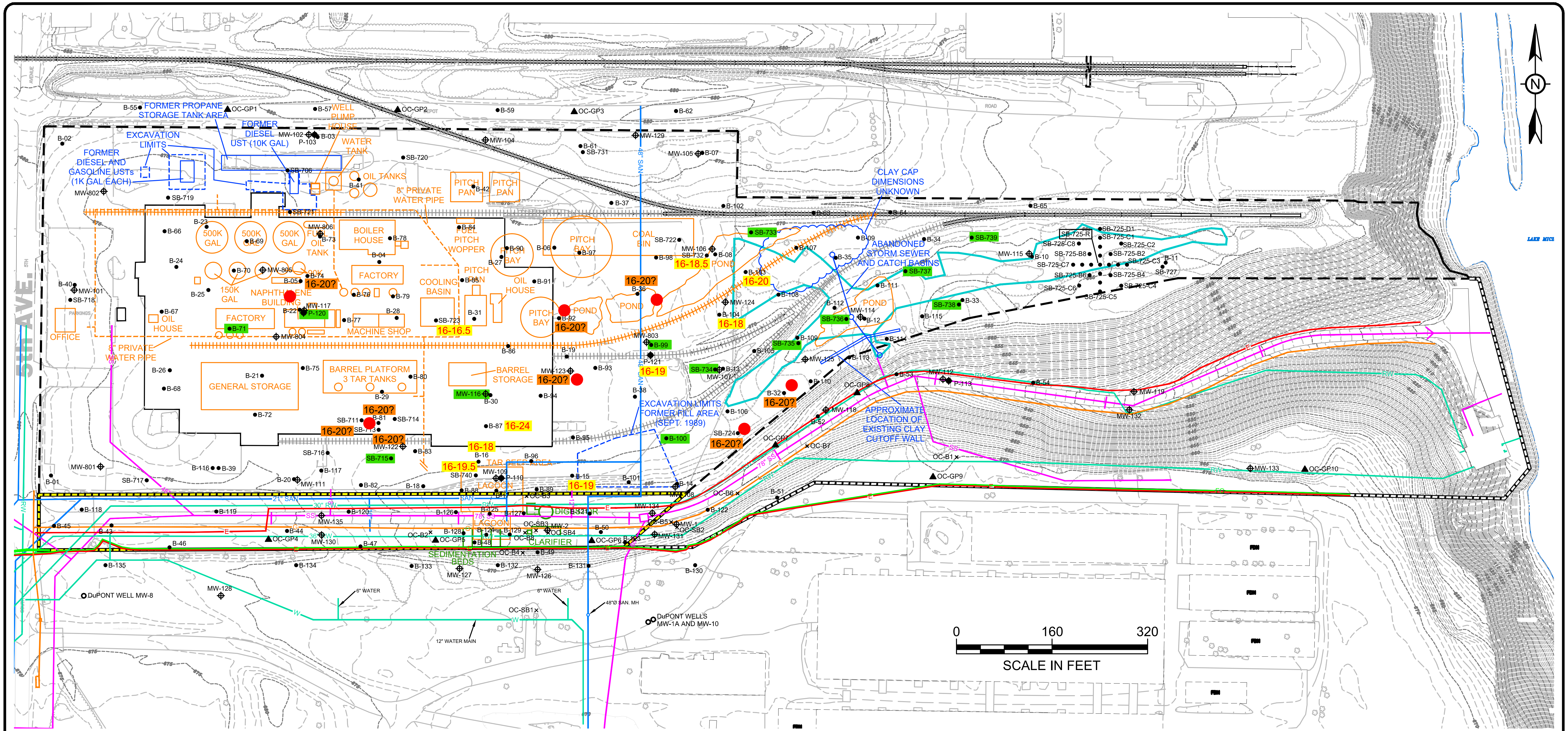
SITE LOCATION and LOCAL TOPOGRAPHY

TETRA TECH

DATE:	10/6/14
DESIGNED:	HJW
CHECKED:	DLM
APPROVED:	DLM
DRAWN:	HJW
PROJ.: 117-2201323	

Figure 1

S:\CAD\BEAZER\WABASH\RAO REPORT\10-2-14\SITE LOCATION.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 TAR OBSERVATION BOREHOLE
16-20	OBSERVED TAR (16-20' BGS)
16-20?	POSSIBLE TAR
⊗B-71	NO OBSERVED TAR
—E—	ELECTRICAL
—G—	NATURAL GAS
—RW—	RAW WATER
—SAN—	SANITARY
—SS—	STORM SEWER
—FO—	FIBER OPTIC

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.

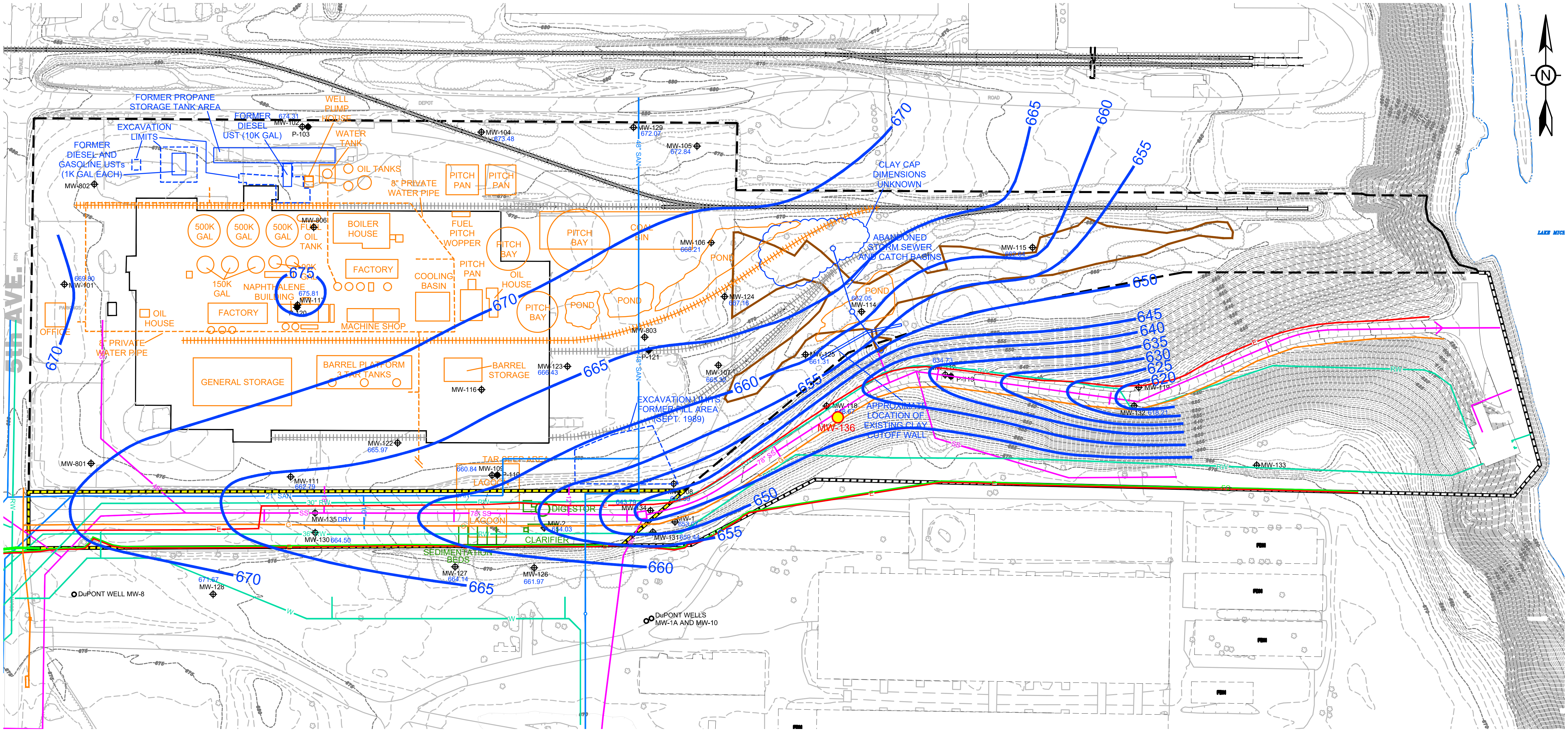
TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
OBSERVED TAR (16-20' BGS)

LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN	FIGURE:
DRAFTED	HJW	2
PROJECT	117-2201323	
DATE	8/30/17	

S:\CAD\BEAZER\WABASH\7-14-17\FIG B35.DWG



EXPLANATION

⌖ MW-101	WATER TABLE WELL
● P-103	NESTED PIEZOMETER
— — —	APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
▬▬▬	APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
669.86	WATER TABLE ELEVATION
—658—	WATER TABLE CONTOUR
○ MW-136	PROPOSED MONITORING WELL
□ ○	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
SHALLOW GROUNDWATER FLOW MAP (JUNE 15, 2017)

LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN	FIGURE:
DRAFTED	HJW	3
PROJECT	117-2201372	
DATE	8/30/17	

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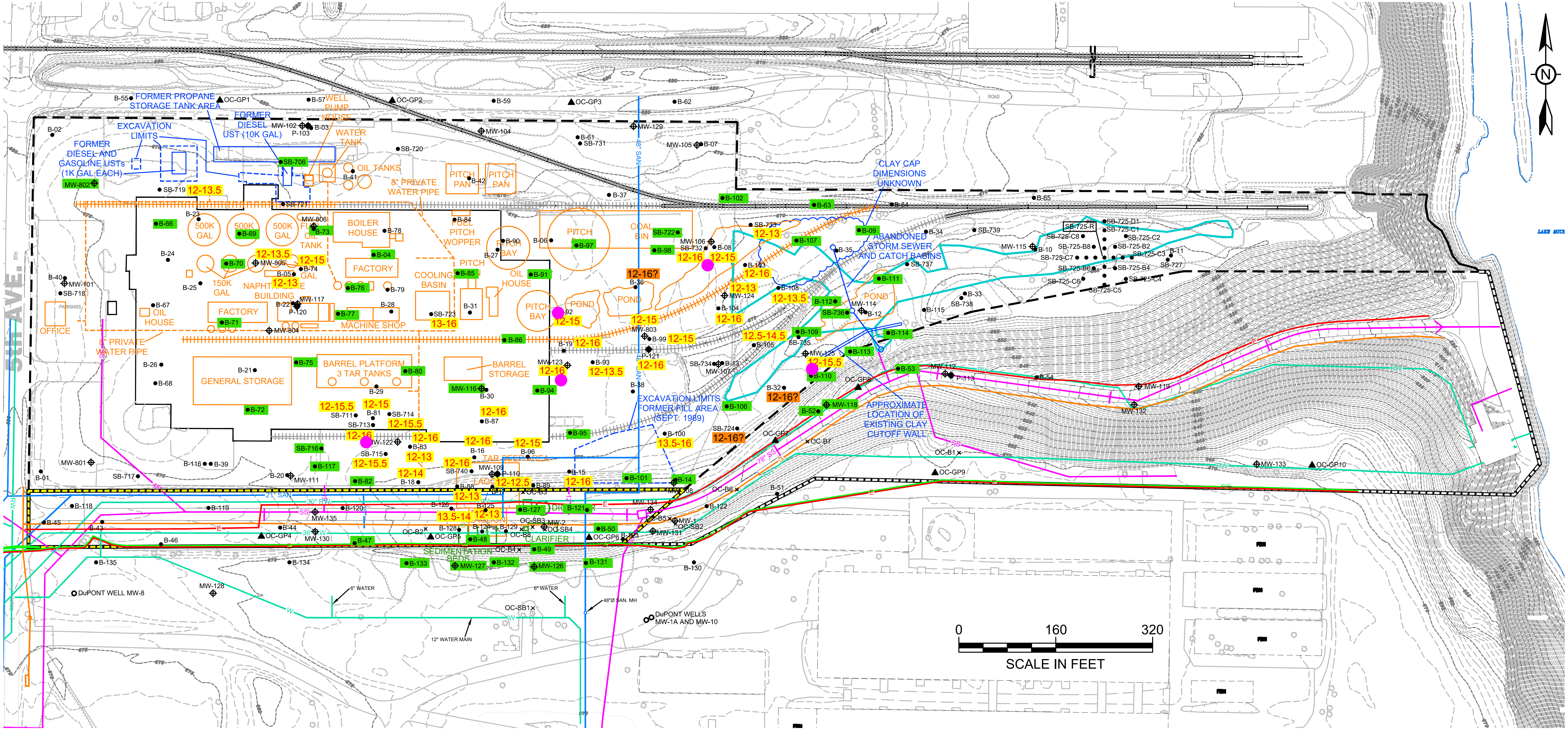


EXPLANATION

⌖ 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)
▬▬▬	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
12-13	OBSERVED TAR (12-16' BGS)
12-16?	POSSIBLE TAR
⊗ B-86	NO OBSERVED TAR
●	PROPOSED WASTE CHARACTERIZATION TEST PIT LOCATION
—E—	ELECTRICAL
—G—	NATURAL GAS
—RW—	RAW WATER
—SAN—	SANITARY
—SS—	STORM SEWER
—FO—	FIBER OPTIC

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
OBSERVED TAR (12-16' BGS)

LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN	FIGURE:
DRAFTED	HJW	4
PROJECT	117-2201323	
DATE	8/30/17	

S:\CAD\BEAZER\WABASH\7-14-17\FIG B34.DWG

mapquest

Notes

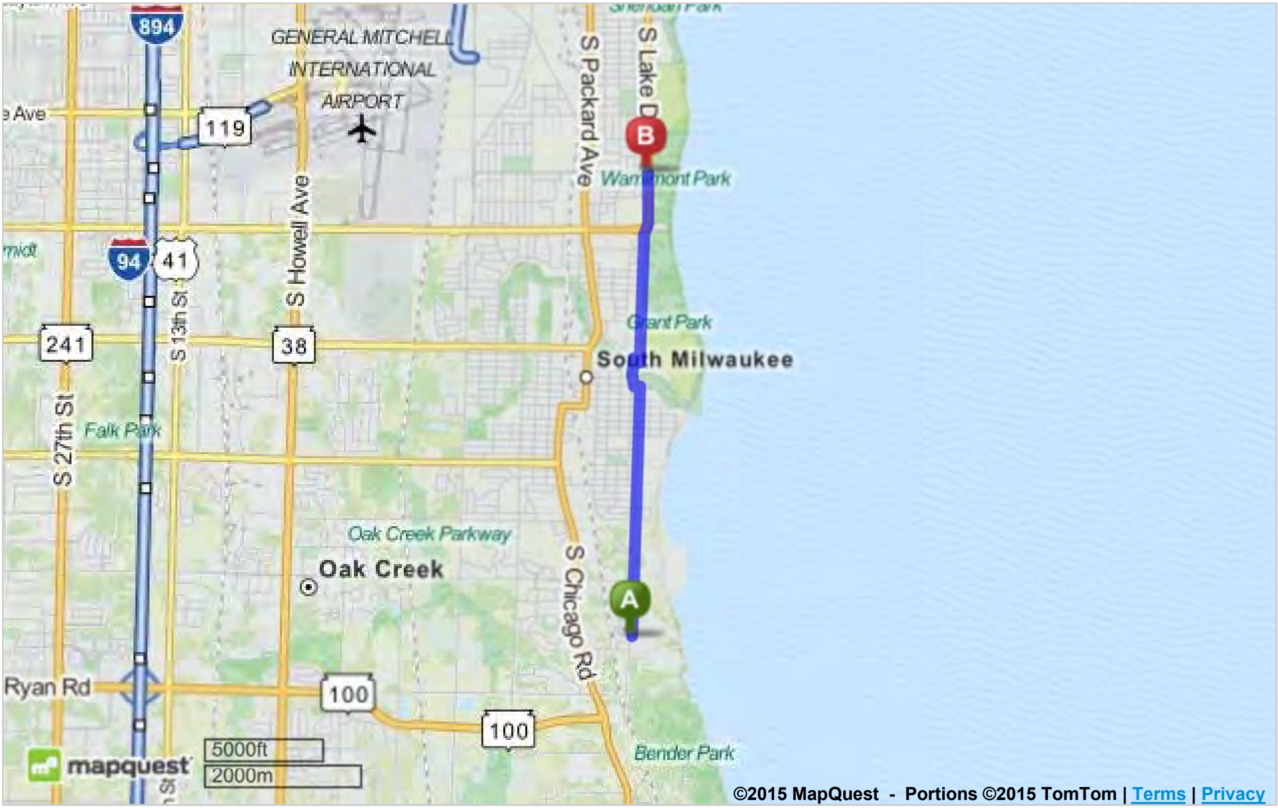
ROUTE TO EMERGENCY ROOM

Trip to:

Aurora St Luke's South Shore
5900 S Lake Dr
Cudahy, WI 53110
(414) 489-4017
4.20 miles / 10 minutes

A	**9100 S 5th Ave**, Oak Creek, WI 53154-4802	**Download Free App**
●	1. Start out going **north** on **S 5th Ave** toward **E Depot Rd**. Map	**2.2 Mi** *2.2 Mi Total*
↰	2. Turn **left** onto **Milwaukee Ave**. Map *Milwaukee Ave is just past Madison Ave*	**0.06 Mi** *2.2 Mi Total*
↱	3. Take the 1st **right** onto **Mill Rd**. Map *If you reach 7th Ave you've gone a little too far*	**0.3 Mi** *2.5 Mi Total*
↱	4. Turn **right** onto **Hawthorne Ave**. Map	**0.05 Mi** *2.5 Mi Total*
↰	5. Take the 1st **left** onto **Lake Dr**. Map *If you reach Oak Creek Pkwy you've gone about 0.5 miles too far*	**1.7 Mi** *4.2 Mi Total*
■	6. **5900 S LAKE DR** is on the **right**. Map *Your destination is 0.1 miles past E Henry Ave* *If you reach E Iona Ter you've gone about 0.1 miles too far*	
B	**Aurora St Luke's South Shore** 5900 S Lake Dr, Cudahy, WI 53110 (414) 489-4017	

Total Travel Estimate: **4.20 miles - about 10 minutes**



Trip to:

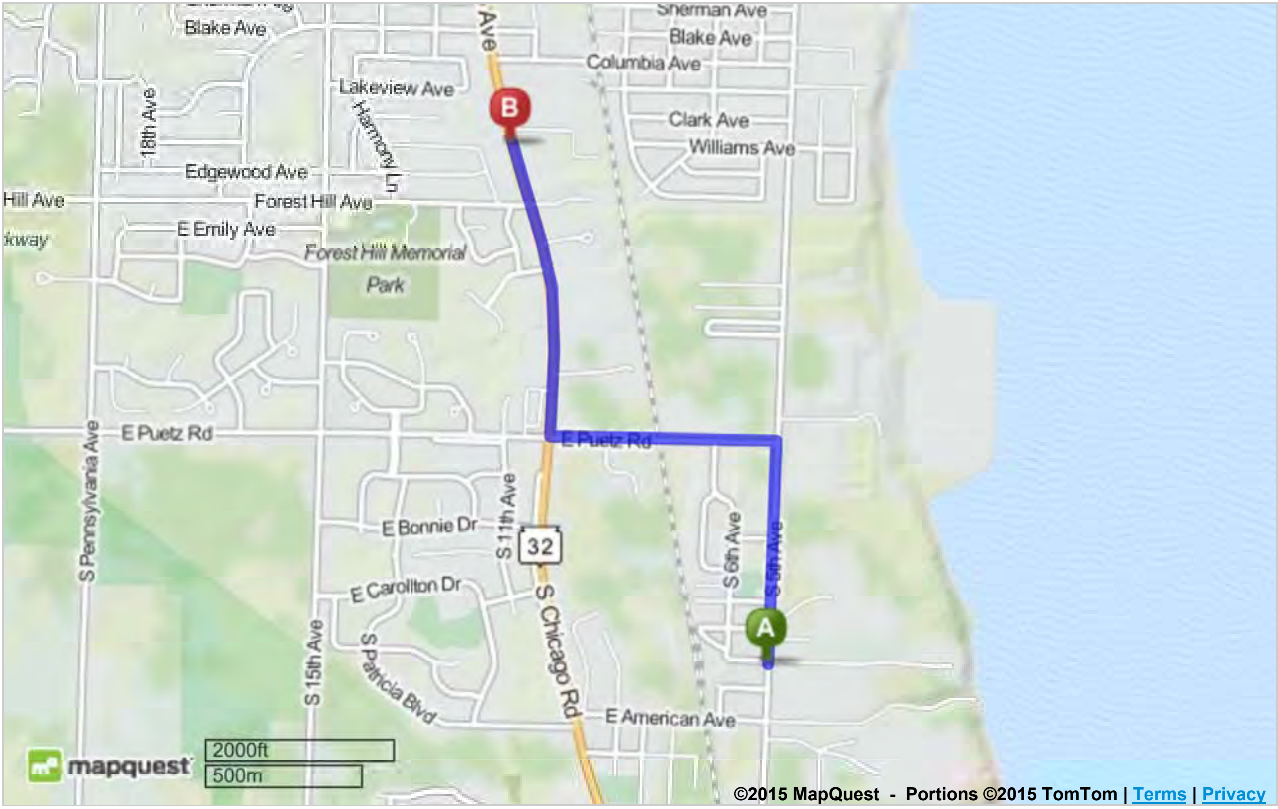
3611 S Chicago Ave

South Milwaukee, WI 53172-3708
1.64 miles / 3 minutes

Notes

	A	**9100 S 5th Ave**, Oak Creek, WI 53154-4802	**Download Free App**
●		1. Start out going **north** on **S 5th Ave** toward **E Depot Rd**. Map	**0.5 Mi** *0.5 Mi Total*
↰		2. Turn **left** onto **E Puetz Rd**. Map *E Puetz Rd is 0.2 miles past E Cooper Ct* *If you reach E Addison Ln you've gone about 0.2 miles too far*	**0.5 Mi** *1.0 Mi Total*
↱	32	3. Take the 1st **right** onto **S Chicago Rd / WI-32**. Continue to follow **WI-32**. Map *WI-32 is 0.1 miles past S Fieldpointe Dr* *If you reach S Market Pl you've gone a little too far*	**0.7 Mi** *1.6 Mi Total*
■		4. **3611 S CHICAGO AVE** is on the **right**. Map *Your destination is 0.1 miles past Forest Hill Ave* *If you reach Williams Ave you've gone a little too far*	
	B	**3611 S Chicago Ave**, South Milwaukee, WI 53172-3708	

Total Travel Estimate: **1.64 miles - about 3 minutes**



	TETRA TECH, INC. GENERAL SAFE WORK PRACTICES FOR FIELD WORK	**Revision Date: 10/1/2008** **Document Control Number:** SWP 5-1 **Page 1 of 3**

To prevent injuries and adverse health effects, the following general safe work practices (SWP) are to be followed when conducting work involving known and unknown site hazards. These SWPs establish a pattern of general precautions and measures for reducing risks associated with field operations not conducted on hazardous waste sites. This list is not inclusive and may be amended as necessary.

- Be familiar with and knowledgeable of and adhere to all instructions in the construction health and safety plan (C-HASP), job safety analysis, job hazard analysis, work permit or other health and safety documentation.
- At a minimum, a safety meeting will be held at the start of each project to discuss the hazards of the site and site work. Additional meetings will be held, as necessary, to address new or continuing safety and health concerns.
- Be aware of the location of the nearest telephone and all emergency telephone numbers.
- Attend a briefing on the anticipated hazards, equipment requirements, SWPs, emergency procedures, and communication methods before going on site.
- Plan and delineate entrance, exit, and emergency escape routes.
- Rehearse unfamiliar operations prior to implementation.
- Use the “buddy system” whenever respiratory protection, fall protection, or other protective equipment is in use. Buddies should establish hand signals or other means of emergency communication in case radios break down or are unavailable.
- In order to assist each other in the event of an emergency, buddies should maintain visual contact with each other and with other on-site team members by remaining in close proximity.
- Do not bring nonessential vehicles and equipment onto the site.
- Immediately report all injuries, illnesses, and unsafe conditions, practices, and equipment to the site safety coordinator (SSC).
- Maintain a portion of the site field logbook as a project safety log. The project safety log will be used to record the names, entry and exit dates, and times on site of all Tetra Tech personnel, subcontractor personnel, and project site visitors; and other information related to safety matters.

- A portable eyewash station should be located in the support zone if corrosive materials are used or stored on the site.
- Smoking is not allowed on Tetra Tech projects sites, except in designated smoking areas.
- Do not bring matches and lighters in the exclusion zone or contamination reduction zone.
- Observe coworkers for signs of toxic exposure and heat or cold stress.
- Inform coworkers of nonvisual effects of illness if you experience them, such as headaches, dizziness, nausea, or blurred vision.
- Anyone known to be under the influence of drugs or intoxicating substances that impair the employee’s ability to safely perform assigned duties shall not be allowed on the job while in that condition.
- Horseplay, scuffling, and other acts that tend to have an adverse influence on the safety or well-being of the employees is prohibited.
- Work shall be well planned to prevent injuries in the handling of materials and when working with equipment.
- No one shall knowingly be permitted or required to work while the employee’s ability or alertness is so impaired by fatigue, illness, or other causes that might unnecessarily expose the employee or others to injury.
- Use proper lifting techniques. Heavy objects will be lifted using the large muscles of the leg instead of the smaller muscles of the back.
- Wear appropriate footwear and all other protective equipment required for work.
- Cleanse thoroughly after handling hazardous substances.
- Maintain all tools and equipment in good condition.
- First aid kits shall be located in a prominent location and stocked with basic first aid supplies.

	TETRA TECH, INC. GENERAL SAFE WORK PRACTICES FOR FIELD WORK	Revision Date: 10/1/2008 Document Control Number: SWP 5-1 Page 3 of 3

Disclaimer: This safe work practice (SWP) is the property of Tetra Tech, Inc. (Tetra Tech). Any reuse of the SWP without Tetra Tech's permission is at the sole risk of the user. The user will hold harmless Tetra Tech for any damages that result from unauthorized reuse of this SWP. Authorized users are responsible for obtaining proper training and qualification from their employer before performing operations described in this SWP.

Revision Date	Document Authorizer	Revision Details
10/1/2008	Chris McClain	NEW

TETRA TECH, INC.
SAFE DRILLING PRACTICES

Revision Date: 10/1/2008

Document Control Number:

SWP 5-4

This document establishes safe work practices (SWP) to follow during drilling operations. These SWPs are based on suggested safety procedures provided in the National Drilling Association's "Drilling Safety Guide." Procedures to follow before, during, and after drilling are listed below.

Before beginning any drill operation, each employee must conform to the following requirements:

- Wear a hard hat, safety glasses or goggles, steel-toed work boots, a shirt and full-length pants when working with or near the drill rig. Shirts must be tucked in at the belt.
- Do not wear loose or frayed clothing, loose long hair, or loose jewelry while working with rotating equipment.
- Do not eat, drink, or smoke near the drill rig.
- Identify all underground utility and buried structure locations before drilling.
- Ensure that drill masts or other projecting devices will be farther than 25 feet in any direction from overhead power lines.
- Ensure that the drill rig and any other machinery used is inspected daily by competent, qualified individuals. The site safety coordinator (SSC) will ensure compliance with this precaution.
- Drill rig operators will be instructed to report any abnormalities, such as equipment failure, oozing liquids, and unusual odors, to their supervisors or the SSC.
- Establish hand-signal communications for use when verbal communication is difficult. One person per work team will be designated to give hand signals to equipment operators.

While the drill rig is operating, employees must:

- Wear appropriate respiratory and personal protective equipment (PPE) when conditions warrant their use.
- Avoid direct contact with known or suspected contaminated surfaces.
- Move tools, materials, cords, hoses, and debris to prevent tripping hazards and contact with moving drill rig parts.

- Adequately secure tools, materials, and equipment subject to displacement or falling.
- Store flammable materials away from ignition sources and in approved containers.
- Maintain adequate clearance of the drill rig and mast from overhead transmission lines. The minimum clearance is 25 feet unless special permission is granted by the utility company. Call the local utility company for proper clearance.
- Only qualified and licensed personnel should operate drill rigs.
- Workers should not assume that the drill rig operator is keeping track of the rig's exact location. Workers should never walk directly behind or beside heavy equipment without the operator's knowledge.
- Workers should maintain visual contact with drill rig operators at all times.
- When an operator must maneuver equipment in tight quarters, the presence of a second person is required to ensure adequate clearance. If much backing is required, two ground guides will be used: one in the direction the equipment is moving, and the other in the operator's normal field of vision to relay signals.
- Auger sections and other equipment are extremely heavy. All lifting precautions should be taken before moving heavy equipment. Appropriate equipment, such as chains, hoists, straps, and other equipment, should be used to safely transport heavy equipment too heavy to safely lift.
- Proper personal lifting techniques will be used. Workers should lift using their legs, not their backs.
- Workers will not use equipment they are not familiar with. This precaution applies to heavy as well as light equipment.
- All personnel not essential to work activities will be kept out of the work area.
- Workers will be aware of their footing at all times.
- Workers will remain alert at all times.

After drilling operations are completed, employees should do the following:

- Shut down machinery before repairing or lubricating parts (except parts that must be in motion for lubrication).
- Shut down mechanical equipment prior to and during fueling operations. When refueling or transferring fuel, containers and equipment must be bonded to prevent the buildup of static electricity.
- Keep drill rigs in the exclusion zone until work has been completed. Such equipment should then be decontaminated within the designated decontamination area.
- Engage parking brakes when equipment is not in use.
- Implement an ongoing maintenance program for all tools and equipment. All tools and moving equipment should be inspected regularly to ensure that parts are secured, are intact, and have no cracks or areas of weakness. The equipment must turn smoothly without wobbling and must operate in accordance with manufacturer specifications. Defective items should be promptly repaired or replaced. Maintenance and repair logs will be kept.
- Store tools in clean, secure areas to prevent damage, loss, or theft.

Disclaimer: This safe work practice (SWP) is the property of Tetra Tech, Inc. Any reuse of the SWP without Tetra Tech's permission is at the sole risk of the user. The user will hold harmless Tetra Tech for any damages that result from unauthorized reuse of this SWP. Authorized users are responsible for obtaining proper training and qualification from their employer before performing operations described in this SWP.

Revision Date	Document Authorizer	Revision Details
10/1/2008	Chris McClain	Update from 1998 format

TETRA TECH, INC.
SAFE BORING PRACTICES USING DIRECT PUSH TECHNOLOGY

Revision Date: 10/1/2008

Document Control Number:

SWP 5-5

This document establishes safe work practices (SWP) to follow during operating involving boring using direct push technology (DPT). These SWPs are based on suggested safety procedures provided in the National Drilling Association's "Drilling Safety Guide." Procedures to follow before, during, and after drilling are listed below.

Conventional and sonic drilling rigs can penetrate virtually any material to great depth, but they are expensive and cumbersome to operate in environmental investigations. Contaminated material brought to the surface requires special handling and can be a safety concern for workers. An alternative, the direct-push cone penetrometer, was developed in the 1930s in The Netherlands. This device uses up to 40,000 pounds of hydraulic force to push a steel instrumented cone or a sampling device into the ground. No material comes to the surface unless soil or groundwater samples are being collected. Direct-push technology eliminates the need for disposal of cuttings and solidification of drilling fluid. Therefore, DPT is frequently used for environmental investigation applications as an alternative to conventional drilling.

Before beginning any DPT operation, employees must understand and comply with the following requirements:

- Safety glasses or goggles, steel-toed work boots, hard hat, a shirt and full-length pants must be worn when working with or near the direct push rig. Shirts must be tucked in at the belt.
- Do not wear loose or frayed clothing, loose long hair, or loose jewelry while working with rotating equipment.
- Do not eat, drink, or smoke near the direct push rig.
- Identify all underground utility and buried structure locations before drilling.
- Ensure that the direct push rig and any other machinery used is inspected daily by competent, qualified individuals. The site safety coordinator (SSC) will ensure compliance with this precaution.
- Direct push rig operators will be instructed to report any abnormalities, such as equipment failure, oozing liquids, and unusual odors, to their supervisors or the SSC.
- Establish hand-signal communications for use when verbal communication is difficult. One person per work team will be designated to give hand signals to equipment operators.

While the direct push rig is operating, employees should be aware of the following:

- Wear appropriate respiratory and personal protective equipment (PPE) when conditions warrant their use.
- Avoid direct contact with known or suspected contaminated surfaces.
- Move tools, materials, cords, hoses, and debris to prevent tripping hazards and contact with moving direct push rig parts.
- Adequately secure tools, materials, and equipment subject to displacement or falling.
- Store flammable materials away from ignition sources and in approved containers.
- Maintain adequate clearance of the direct push rig and mast from overhead transmission lines. The minimum clearance is 25 feet unless special permission is granted by the utility company. Call the local utility company for proper clearance.
- Only qualified and licensed personnel should operate direct push rigs.
- Workers should not assume that the direct push rig operator is keeping track of their exact location. Workers should never walk directly behind or beside heavy equipment without the operator’s knowledge.
- Workers should maintain visual contact with direct push rig operators at all times.
- When an operator must maneuver equipment in tight quarters, the presence of a second person is required to ensure adequate clearance. If much backing is required, two ground guides will be used: one in the direction the equipment is moving, and the other in the operator’s normal field of vision to relay signals.
- Proper personal lifting techniques will be used. Workers should lift using their legs, not their backs.
- Workers will not use equipment they are not familiar with. This precaution applies to heavy as well as light equipment.
- All personnel not essential to work activities will be kept out of the work area.
- Workers will be aware of their footing at all times.

- Workers will remain alert at all times.

After drilling operations are completed, employees should do the following:

- Shut down machinery before repairing or lubricating parts (except parts that must be in motion for lubrication).
- Shut down mechanical equipment prior to and during fueling operations. When refueling or transferring fuel, containers and equipment must be bonded and grounded to prevent the buildup of static electricity.
- Keep direct push rigs in the exclusion zone until work has been completed. Such equipment should then be decontaminated within the designated decontamination area.
- Engage parking brakes when equipment is not in use.
- Implement an ongoing maintenance program for all tools and equipment. All tools and moving equipment should be inspected regularly to ensure that parts are secured, are intact, and have no cracks or areas of weakness. The equipment must turn smoothly without wobbling and must operate in accordance with manufacturer specifications. Defective items should be promptly repaired or replaced. Maintenance and repair logs will be kept.
- Store tools in clean, secure areas to prevent damage, loss, or theft.

Revision Date	Document Authorizer	Revision Details
10/1/2008	Chris McClain	NEW

	TETRA TECH INC. EXCAVATION AND TRENCHING	Revision Date: 10/01/2011
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		DCN 4-5
		Page 1 of 16

1.0 PURPOSE

This program provides the requirements for activities involving excavations in accordance with 29 CFR 1926, Subpart P - Excavations.

2.0 SCOPE

These requirements are applicable to all Tetra Tech operations.

3.0 MAINTENANCE

The VP, Corporate Health and Safety or designee is responsible for updating this procedure. Approval authority rests with Tetra Tech's Senior VP, Corporate Administration. Suggestions for revision shall be submitted to the Corporate Administration department.

4.0 DEFINITIONS

4.1 Benching

A method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

4.2 Competent Person

A competent person is one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

4.3 Excavation

Any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

4.4 Hazardous Atmosphere

An atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

4.5 Protective Systems

A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

4.6 Sloping

A method of protecting employees from cave-ins by forming sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

4.7 Support System

A structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

4.8 Trench

A narrow excavation made below the surface of the ground. In general the depth is greater than the width, but the width of a trench measured at the bottom is not greater than 15 feet. If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet or less, the excavation is also considered to be a trench.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Competent Person

The competent person(s) shall be responsible for:

- Day-to-day oversight of open excavations and trenches
- Conducting soil classifications
- Selection of protective systems
- Conducting daily inspections of open excavations and trenches; and
- Providing the PM and or Supervisor with all required documentation on a daily basis.

5.1.2 Line Management

The Project Manager (PM) shall be responsible for:

- Ensuring compliance with this procedure
- Providing the necessary resources for compliance with this procedure; and
- Designating competent personnel in consultation with the Site Safety Coordinator (SSC)

5.1.3 Site Safety Coordinator Personnel

The SSC shall be responsible for:

- Providing oversight on the implementation of the requirements contained in this procedure
- Conducting periodic reviews of open trenches and excavations
- Consulting with the project manager and competent person on excavation issues; and

- Maintaining required records.

5.2 Designation of Competent Personnel

Prior to the start of any excavation work the project manager shall designate a competent person to fulfill the requirements of this procedure.

5.3 General Requirements

The following section provides general requirements governing activities in and around excavation and trenches, as well as the requirements for the selection and use of protective systems.

- Surfaces surrounding open trenches and excavations shall have all surface hazards removed.
- All utilities shall be located and cleared prior to initiating digging. Public or facility utility groups shall be utilized where possible for this purpose. In the absence of either, the SSC shall specify the procedures to be used to clear utilities in consultation with the project manager. When the excavation is open, utilities shall be supported and protected from damage. Clearance and support methods shall be documented on the daily inspection checklist.
- No person may enter a trench or work at the foot of the face of an excavation until a qualified, competent person has inspected the excavation and determined whether sloping or shoring is required to protect against cave-in or subsidence and the appropriate protection has subsequently been installed.
- Trenches and excavations must be assessed by a qualified, competent person, even in the absence of working personnel, whenever heavy equipment will be operating nearby in order to ensure that the trench or excavation will support the weight of the equipment without subsistence or causing the accidental overturning of machinery.
- Access to trenching areas must be controlled and limited to authorized personnel. Prior to entering a trench or excavation, workers must notify the project manager, SSC, and nearby equipment operators whose activities could affect the trench or excavation.
- Trenches and excavations must be inspected regularly (daily at a minimum) to ensure that changes in temperature, precipitation, shallow groundwater, overburden, nearby building

weight, vibration, or nearby equipment operation have not caused weakening of the sides, faces, and floors and to ensure that personnel protection is being maintained.

- Where structural ramps are used for egress they shall be installed in accordance with 29 CFR 1926.651(c)(1).
- Stairways, ladders, or ramps shall be provided as means of egress in all trenches 4 feet or more in depth. Travel distance shall be no more than 25 feet between means of exit.
- Ladders if used must be secured from shifting, and must extend at least 3 feet above the top of the trench or excavation.
- Where necessary to prevent falls, crosswalks or walkways will be constructed. Structural ramps, walkway, and cross walks must be designed by a qualified competent person.
- Employees exposed to vehicular traffic shall wear traffic vests.
- No employee shall be permitted under loads being lifted or under loads being unloaded from vehicles.
- When vehicles and machinery are operating adjacent to excavations warning systems such as stop logs or shall be utilized to prevent vehicles from entering the excavation or trench.
- Scaling or barricades shall be used to prevent rock and soils from falling on employees.
- Excavated and loose materials should be kept at least 3 feet from the edge of excavations, but at a minimum 2 feet from the edge of the excavation in accordance with OSHA requirements.
- Walkways or bridges with standard railing shall be provided at points employees are to cross over excavations or trenches.
- Barriers shall be provided to prevent personnel from inadvertently falling into an excavation.
- Comply with any regulatory or contract required permitting and notification processes. For example, in California, a Cal-OSHA excavation permit and notification is required. Clients may classify excavations and trenches as permitted confined spaces, in these cases, DCN 2-5 Confines Space Entry shall be followed. These requirements shall be outlined in the site specific Health and Safety Plan

- When subsidence or tension cracks are apparent anywhere in an excavation, all work should be stopped until the problem is corrected.
- The competent person must inspect trenches or excavations after any precipitation event to ensure integrity has been maintained.
- If trenches or excavations are near walkways or roadways, guards or warning barriers must be placed to alert pedestrians and drivers of the presence of the trench or excavation.
- If possible, trenches or excavations should be covered or filled in when unattended. Otherwise, strong barriers must be placed around the trench or excavation and lighting must be provided at night if the trench or excavation is near a walkway or roadway.
- When a hazardous atmosphere could exist, the excavation must be tested for appropriate hazardous substances and oxygen level before personnel entry. Excavation where hazardous atmospheres exist must be treated as a confined space. Entry must follow procedures outlined in “Confined Spaced Entry Program,” Document Control No. 2 5.
- Entry is not allowed into excavations where water has accumulated.

5.4 Hazardous Atmospheres

Where atmospheres containing less than 19.5 percent oxygen or other types of hazardous atmospheres may exist the following requirements shall be implemented.

- Atmospheric testing shall be done prior to employees entering excavations 4 feet or greater in depth.
- Testing methods shall be listed on the daily inspection checklist and results documented daily in field logs.
- Control measures such as ventilation and personal protective equipment (PPE) shall be used to control employee exposure to hazardous atmospheres below published exposure limits.
- Ventilation shall be used to control flammable and combustible vapors to below 10 percent of their lower explosive limit.

- Testing shall be repeated as often as necessary to ensure safe levels of airborne contaminants.
- Emergency equipment shall be provided and attended when the potential for a hazardous atmosphere exists. This equipment shall include but not be limited to emergency breathing apparatus, harnesses, lifelines, and basket stretchers. Required equipment will be listed on the daily inspection checklist and reviewed daily.

5.5 Protection From Water Hazards

When water has collected or is collected in excavations and trenches the following requirements shall be applied.

- Employees shall not work in excavations in which water has, or is, accumulating without the use of additional protection such as special support systems or water removal.
- Water removal shall be monitored by a competent person.
- Barriers such as ditches and dikes shall be used to divert runoff from excavations and trenches.
- Trenches shall be re-inspected prior to re-entry after water accumulation due to heavy rainfall or seepage.

5.6 Stability of Adjacent Structures

When excavating or trenching near an adjacent structure the following practices shall be implemented.

- Support systems such as shoring, bracing, or underpinning shall be provided where the stability of buildings, walls, or other structures is endangered by excavation.
- Excavation bases or footings of foundations shall be prohibited unless support systems are used, the excavation is in stable rock, a professional engineer has determined the structure is sufficiently removed from the site as to not pose a hazard, or the PE determines that the excavation shall not pose a hazard to employees due to the structure.

- Support systems shall be used when it is necessary to undermine sidewalks, pavements, and appurtenant structures.
- Surcharge load sources and adjacent encumbrances shall be listed with their evaluation date on the daily inspection checklist.

5.7 Daily Inspections

Inspections shall be performed daily on all excavations, adjacent areas, and protective systems before personnel enter the trench. The checklist provided in Attachment A or equivalent shall be used.

5.8 Soil Classification

To perform soil classification, the competent person shall use a thumb test, pocket penetrometer, or shear vane to determine the unconfined compressive strength of the soils being excavated. In soils with properties that change (i.e., one soil type mixed with another within a given area) several tests may be necessary. When different soil types are present the overall classification shall be that of the type with the lowest unconfined compressive strength. Classifications shall result in a soil rating of Stable Rock, Type A, Type B, or Type C in accordance with 29 CFR 1926.652, Appendix A. Soil classifications shall be listed on the daily inspection checklist. The soils analysis checklist provided in Attachment B or equivalent shall be used for soil classifications.

5.9 Sloping and Benching

All sloping and benching shall be done in accordance with 29 CFR 1926.652, Appendix B. Selection of the sloping method and evaluation of surface surcharge loads shall be made by a competent person familiar with the requirements contained therein. Sloping and benching methods and specifications shall be listed on the daily inspection checklist.

5.10 Protective Systems

Protective systems are required on all excavations over 5 feet in depth or in excavations less than 5 feet when examination of the ground by a competent person reveals conditions that may result in cave-ins.

Selection and installation of protective systems shall be done in accordance with 29 CFR 1926.652, Appendices C & D, or manufacturers data for shoring and shielding systems. Selection of a protective system shall be made based upon soil classification and job requirements by a competent person.

Protective systems and specifications shall be listed on the daily inspection checklist.

5.11 Training

Competent persons shall have an adequate combination of experience and training to classify soil types and select protective systems as outlined in 29 CFR 1926.652. Training and experience pertaining to qualification as a competent person shall be documented and include the following:

- General safety practices related to working in or near open excavations;
- Inspection requirements and techniques;
- Classification of soils in accordance with 29 CFR 1926.652, Appendix A; and
- Uses, limitations, and specifications of protective systems in accordance with 29 CFR 1926.652.

Training records shall be maintained in accordance with DCN 1-4 Recordkeeping and Reporting Requirements..

6.0 REFERENCES

29 CFR 1926, Subpart P, Excavations. Environmental, Health & Safety - Programs Procedure EHS 1-9, Recordkeeping OSHA (U.S. Department of Labor, Occupational Safety and Health Administration),

DAILY EXCAVATION INSPECTION CHECKLIST To be completed by a "Competent Person"

Indicate for each item by circling: Y (Yes), N (No), - Address in Comments, Not Applicable (N/A.)

I. General Inspection of Job Site

A. Surface encumbrances removed or supported Y N N/A
B. Employees protected from loose rock or soil that could pose a hazard by falling or rolling into the excavation Y N N/A
C. Hard hats worn by all employees Y N N/A
D. Spoils, materials, and equipment set back at least 2 feet from the edge of the excavation Y N N/A
E. Barriers provided at all remotely located excavations, wells, pits, shafts, etc. Y N N/A
F. Walkways and bridges over excavations 4 feet or more in depth are equipped with standard guardrails Y N N/A
G. Warning vests or other highly visible clothing provided and worn by all employees exposed to public vehicular traffic Y N N/A
H. Warning system established and utilized when mobile equipment is operated near the edge of the excavation Y N N/A
I. Employees prohibited from working on the faces of sloped or benched excavations above other employees Y N N/A

II. Utilities

A. Utility companies contacted and/or utilities located Y N N/A
B. Exact location of utilities marked when approaching the utilities Y N N/A
C. Underground installations protected, supported or removed when excavation is open Y N N/A

III. Means of Access and Egress

A. Lateral travel to means of egress no greater than 25 feet in excavations 4 feet or more in depth Y N N/A
B. Ladders used in excavations secured and extended 3 feet above the edge of the trench Y N N/A
C. Structural ramps used by employees designed by a competent person Y N N/A
D. Structural ramps used for equipment designed by a registered professional engineer (RPE) Y N N/A
E. Ramps constructed of materials of uniform thickness, cleated together on the bottom, equipped with a no-slip surface Y N N/A
F. Employees protected from cave-ins when entering or exiting the excavation Y N N/A

IV. Wet Conditions

A. Precautions taken to protect employees from the accumulation of water Y N N/A

B. Water removal equipment monitored by a competent person Y N N/A
C. Surface water or runoff diverted or controlled to prevent accumulation in the excavation Y N N/A
D. Inspections made after every rainstorm or other hazard increasing occurrence Y N N/A

V. Hazardous Atmospheres

A. Atmosphere within the excavation tested where there is a reasonable possibility of an oxygen deficiency, combustible or other harmful contaminant exposing employees to a hazard Y N N/A
B. Ventilation Y N N/A
C. Testing conducted often to ensure that the atmosphere remains safe Y N N/A
D. Emergency equipment, such as breathing apparatus, safety harness and line, and basket stretcher readily available where hazardous atmospheres could or do exist Y N N/A
E. Safety harness and life line used and individually attended when entering deep confined excavations Y N N/A

VI. Support Systems

A. Materials and/or equipment for support systems selected based on soil analysis, trench depth and expected loads Y N N/A
B. Materials and equipment used for protective systems inspected and in good condition Y N N/A
C. Materials and equipment not in good condition have been removed from service Y N N/A
D. Damaged materials and equipment used for protective systems inspected by a RPE after repairs and before being placed back into service Y N N/A
E. Protective systems installed without exposing employees to the hazards of cave-ins, collapses or from being struck by materials or equipment Y N N/A
F. Members of support system securely fastened to prevent failure Y N N/A
G. Support systems provided to insure stability of adjacent structures, buildings, roadways, sidewalks, walls, etc. Y N N/A
H. Excavations below the level of the base or footing approved by an RPE Y N N/A
I. Removal of support systems progresses from the bottom and members are released slowly as to note any indication of possible failure Y N N/A
J. Backfilling progresses with removal of support system Y N N/A
K. Excavation of material to a level no greater than 2 feet below the bottom of the support system and only if the system is designed to support the loads calculated for the full depth Y N N/A
L. Shield system placed to prevent lateral movement Y N N/A
M. Employees are prohibited from remaining in shield system during vertical movement Y N N/A

VII. Comments

Site location

Date Time Competent Person

Soil Type(s)

Soil Classification(s)
Excavation depth
Excavation width

Type of protective system used

SOILS ANALYSIS CHECKLIST

This checklist must be completed when soil analysis is made to determine the soil type(s) present in the excavation. A separate analysis must be performed on each layer of soil in excavation walls. A separate analysis must also be performed if the excavation (trench) is stretched over a distance where soil type may change.

Site location:

Date:

Time:

Competent Person

Where was the sample taken from?

Excavation:
Depth:
Width:
Length:

VISUAL TEST

Particle type: Fine Grained (cohesive) Course grained (sand or gravel)

Water conditions: Wet Dry Surface water present Submerged

Previously disturbed soils? Yes No

Underground utilities? Yes No

Layered soils? Yes No

Layered soil dipping into excavation? Yes No

Excavation exposed to vibrations: Yes No

Crack-like openings or spallings observed? Yes No
Conditions that may create hazardous atmosphere? Yes No

If yes, identify condition and source:

Surface encumbrances: Yes No

Work to be performed near public vehicular traffic? Yes No

Possible confined space exposure? Yes No

MANUAL TEST

Plasticity: Cohesive Non-cohesive
Dry Strength: Granular (crumbles easily) Cohesive (broken with difficulty)

NOTE: The following unconfined compressive strength tests should be performed on undisturbed soils.

THUMB TEST (used to estimate unconfined compressive strength of cohesive soil)
Test performed: Yes No

Type A (soil indented by thumb with very great effort)

Type B (soil indented by thumb with some effort)

Type C (soil easily penetrated several inches by thumb with little or no effort).If soil is submerged, seeping water, subjected to surface water, runoff, exposed to wetting.

PENETROMETER OR SHEARVANE (used to estimate unconfined compressive strength of cohesive soils)
Test performed: Yes No

Type A (soil with unconfined compressive strength of 1.5 tsf or greater)

Type B (soil with unconfined compressive strength of 0.5 tsf to 1.5 tsf)

Type C (soil with unconfined compressive strength of 1.5 tsf or less). If soil is submerged, seeping water, subjected to surface water, runoff, exposed to wetting.

WET SHAKING TEST (used to determined percentage of granular and cohesive materials). Compare results to soil textural classification chart to determine soil type. Test performed Yes No

Type A (clay, silty clay, sandy clay, clay loam, and in some cases silty clay, loam and sandy clay loam)
Type B [angular gravel (similar to crushed rock), silt, silt loam, sandy loam, and in some cases, silty clay loam and sandy clay loam
Type C(granular soil including gravel, sand and loamy sand)

% granular

% cohesive

% silt

NOTE: Type A – no soil is Type "A" if soil is fissured; subject to vibration; previously disturbed; layered dipping into the excavation on a slope of 4H:1V.

SOIL CLASSIFICATION

Type A

Type B

Type C

SELECTION OF PROTECTIVE SYSTEM

Sloping, Specify angle:

Timber Shoring

Aluminum Hydraulic Shoring

NOTE: Although OSHA will accept the above tests in most cases, some states will not. Check your state safety requirements for trenching regulations.

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	Name	
10/1/2011	Chris McClain	Update

TETRA TECH, INC.
GENERAL SAFE WORK PRACTICE for HEAT STRESS PREVENTION and MONITORING

Revision Date: 10/1/2008

Document Control Number:

SWP 5-15

This safe work practice (SWP) describes situations where heat stress is likely to occur and provides procedures for the prevention and treatment of heat-related injuries and illnesses. Wearing personal protective equipment (PPE), especially during warm weather, puts employees at considerable risk of developing heat-related illness. Health effects from heat stress may range from transient heat fatigue or rashes to serious illness or death.

Many factors contribute to heat stress, including PPE, ambient temperature and humidity, workload, and the physical condition of the employee, as well as predisposing medical conditions. However, the primary factors are elevated ambient temperatures in combination with fluid loss. Because heat stress is one of the more common health concerns that may be encountered during field activities, employees must be familiar with the signs, symptoms, and various treatment methods of each form of heat stress. Heat stroke is the most serious heat-related illness—it is a threat to life and has a 20 percent mortality rate. Direct exposure to sun, poor air circulation, poor physical condition, and advanced age directly affect the tendency to heat stroke. Table 1 lists the most serious heat conditions, their causes, signs and symptoms, and treatment.

Training is an important component of heat stress prevention. Employees are instructed to recognize and treat heat-related illnesses during 8-hour health and safety refresher and first aid training courses. When working in hot environments, specific steps should be taken to lessen the chances of heat-related illnesses. These include the following:

- Ensuring that all employees drink plenty of fluids (Gatorade® or its equivalent)
- Ensuring that frequent breaks are scheduled so overheating does not occur
- Revising work schedules, when necessary, to take advantage of the cooler parts of the day (such as working from 5:00 a.m. to 11:00 a.m. and 6:00 p.m. to nightfall).

When PPE must be worn (especially Levels A and B), suggested guidelines relating to ambient temperature and maximum wearing time per excursion are as shown in Table 2.

TABLE 1
HEAT STRESS CONDITIONS

Condition	Causes	Signs and Symptoms	Treatment
Heat cramps	Fluid loss and electrolyte imbalance from dehydration	• Painful muscle cramps, especially in legs and abdomen • Faintness • Profuse perspiration	• Move affected worker to cool location • Provide sips of liquid such as Gatorade® • Stretch cramped muscles • Transport affected worker to hospital if condition worsens
Heat Exhaustion	Blood transport to skin to dissipate excessive body heat, resulting in blood pooling in the skin with inadequate return to the heart	• Weak pulse • Rapid and shallow breathing • General weakness • Pale, clammy skin • Profuse perspiration • Dizziness • Unconsciousness	• Move affected worker to cool area • Remove as much clothing as possible • Provide sips of cool liquid or Gatorade® (only if conscious) • Fan the person but do not overcool or chill • Treat for shock • Transport to hospital if condition worsens
Heat Stroke	Life threatening condition from profound disturbance of body's heat-regulating mechanism	• Dry, hot, and flushed skin • Constricted pupils • Early loss of consciousness • Rapid pulse • Deep breathing at first, and then shallow breathing • Muscle twitching leading to convulsions • Body temperature reaching 105 or 106 °F or higher	• Immediately transport victim to medical facility • Move victim to cool area • Remove as much clothing as possible • Reduce body heat promptly by dousing with water or wrapping in wet cloth • Place ice packs under arms, around neck, at ankles, and wherever blood vessels are close to skin surface • Protect patient during convulsions

TABLE 2
SUGGESTED GUIDELINES WHEN WEARING PPE

Ambient Temperature	Maximum PPE Wearing Time per Excursion
Above 90 °F	15 minutes
85 to 90 °F	30 minutes
80 to 85 °F	60 minutes
70 to 80 °F	90 minutes
60 to 70 °F	120 minutes
50 to 60 °F	180 minutes

Source: National Institute for Occupational Safety and Health (NIOSH). 1985. Memorandum Regarding Recommended Personal Protective Equipment Wearing Times at Different Temperatures. From Austin Henschel. To Sheldon Rabinovitz. June 20.

To monitor the level of an employee's heat stress, the following should be measured:

- Heart Rate: Count the radial (wrist) pulse during a 30-second period as early as possible in the rest period; if heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.

  If the heart rate still exceeds 110 beats per minute at the next period, shorten the following work cycle by one-third.

- Oral Temperature: Use a clinical thermometer (3 minutes under the tongue) to measure the oral temperature at the end of the work period. If oral temperature exceeds 99.6 °F (37.6 °C), shorten the next work cycle by one-third without changing the rest period. If oral temperature still exceeds 99.6 °F at the beginning of the next rest period, shorten the following work cycle by one-third. Do not permit a worker to wear impermeable PPE when his or her oral temperature exceeds 100.6 °F (38.1 °C).

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	TETRA TECH, INC. GENERAL SAFE WORK PRACTICES for COLD STRESS	**Revision Date: 10/1/2008**
		Document Control Number:
		SWP 5-16
		Page 1 of 3

This safe work practices (SWP) describes situations where cold stress is likely to occur and discusses procedures for the prevention and treatment of cold-related injuries and illnesses. Cold conditions may present health risks to employees during field activities. The two primary factors that influence the risk potential for cold stress are temperature and wind velocity. Wetness can also contribute to cold stress. Other factors that increase susceptibility to cold stress include age (very young or old), smoking, alcohol consumption, fatigue, and wet clothing. Hypothermia can occur at temperatures above freezing if the individual has on wet or damp clothing or is immersed in cold water. The combined effect of temperature and wind can be evaluated using a wind chill index as shown in Table 1.

Bare flesh and body extremities that have high surface area-to-volume ratios such as fingers, toes, and ears are most susceptible to wind chill or extremely low ambient temperatures. Because cold stress can create the potential for serious injury or death, employees must be familiar with the signs and symptoms and various treatments for each form of cold stress. Table 2 provides information on frostbite and hypothermia, the two most common forms of cold-related injuries.

Training is an essential component of cold stress prevention. Employees are instructed to recognize and treat cold-related injuries during 8-hour health and safety refresher and first aid training courses. When working in cold environments, specific steps should be taken to lessen the chances of cold-related injuries. These include the following:

- Protecting of exposed skin surfaces with appropriate clothing (such as face masks, handwear, and footwear) that insulates, stays dry, and blocks wind;
- Shielding the work area with windbreaks to reduce the cooling effects of wind;
- Providing equipment for keeping workers' hands warm by including warm air jets and radiant heaters in addition to insulated gloves;
- Using adequate insulating clothing to maintain a body core temperature of above 36 °C;
- Providing extra insulating clothing on site;
- Reducing the duration of exposure to cold; and
- Changing wet or damp clothing as soon as possible.

During periods of extreme cold (10 °F or less) workers should use the buddy system to ensure constant protective observation.

Specific monitoring criteria are not established for cold stress. However, employees should be thoroughly cognizant of the signs and symptoms of frostbite and hypothermia (see Table 1) in themselves as well as in coworkers. All instances of cold stress should be reported to the site safety coordinator. Work schedules may be adjusted and warm-up regimes imposed as needed to deal with temperature and wind conditions.

TABLE 1
COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE

Estimated Wind Speed (in miles per hour - mph)	**Actual Temperature Reading (°F)**											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
CALM	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	*LITTLE DANGER* in less than 1 hour with dry skin; maximum danger from false sense of security				*INCREASING DANGER* from freezing of exposed flesh within 1 minute				*GREAT DANGER* that flesh may freeze within 30 seconds			

Trench foot and immersion foot may occur at any point on this chart.

Source: Modified from American Conference of Governmental Industrial Hygienists. 1997. "Threshold Limit Values for Chemical Substances and Physical Agents."

TABLE 2
COLD STRESS CONDITIONS

Condition	Causes	Signs and Symptoms	Treatment
Frostbite	Freezing of body tissue, usually the nose, ears, chin, cheeks, fingers, or toes	• Pain in affected area that later goes away • Area feels cold and numb • Incipient frostbite (frostnip) - skin is blanched or whitened and feels hard on the surface • Moderate frostbite - large blisters • Deep frostbite - tissues are cold, pale, and hard	• Move affected worker to a warm area • Immerse affected body part in warm (100 to 105 °F) water—not hot! • Handle affected area gently; do not rub • After warming, bandage loosely and seek immediate medical treatment
Hypothermia	Exposure to freezing or rapidly dropping temperatures	• Shivering, dizziness, numbness, weakness, impaired judgment, and impaired vision • Apathy, listlessness, or sleepiness • Loss of consciousness • Decreased pulse and breathing rates • Death	• Immediately move affected person to warm area • Remove all wet clothing and redress with loose, dry clothes • Provide warm, sweet drinks or soup (only if conscious) • Seek immediate medical treatment

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Revision Date	Document Authorizer	Revision Details
10/1/2008	Chris McClain	Update from 1998 format

	TETRA TECH, INC. BIOHAZARD SAFETY	**Revision Date: 10/1/2008**
		Document Control Number:
		SWP 5-17
		Page 1 of 7

Biological hazards, or "biohazards," include plants, animals or their products, and parasitic or infectious agents that may present potential risks to worker health. This safe work practice (SWP) discusses procedures for working with biohazards, preventive guidelines, and first-aid procedures for the most common hazards field staff are likely to encounter. This SWP does not address biohazards such as those associated with medical waste. Procedures for working with this type of biohazard should be addressed in the site-specific health and safety plan (HASP), construction health and safety plan (C-HASP), job safety analyses (JSAs), activity hazard analyses (AHAs), or other health and safety project planning documents on a case-by-case basis.

During preparation for site work, the document preparer should consider which plants, animals, and other biological agents may be encountered; assess their potential risk to project personnel; and attach this SWP to the document if necessary. Office health and safety representatives should become familiar with biological hazards indigenous to the geographical area in which most of their office personnel work and assist in evaluating the risks to personnel on projects staffed from their offices. SWPs for insects, snakes, animals, plants, waterborne pathogens (giardia), and hantavirus are provided below.

1.0 INSECTS

SWPs for reducing the chance of insect bites or stings and for treating bites or stings are listed below.

- Workers should keep as much skin area covered as possible by wearing long-sleeved shirts, long pants, and a hat. Pant legs should be tucked into socks or boots and shirts into pants. In addition, workers should wear light colored clothing.
- A proven insect repellent should be used on bare skin and clothing.
- When possible, tall grasses and brush that could harbor ticks should be avoided.
- Several times during the day and at the end of the work day, each worker should perform a check for evidence of imbedded ticks or previous bites. Particular attention should be paid to the scalp, neck, ankles, back of the legs, and waist.

- When opening well covers, vaults, or other closed items, workers should watch for hornet or wasp nests and black widow or brown recluse spiders. Workers should never reach into spaces with unprotected arms.
- Workers should watch carefully for bees around open soft drinks or food.
- If a worker is stung by a bee, the stinger should be carefully removed, if present. The wound should be washed and a cold pack applied. Allergic reaction should be watched for and is evidenced by extreme swelling, redness, pain, or difficulty breathing.
- If a worker is stung or bit by a spider or scorpion, medical attention should be obtained immediately.

2.0 SNAKES

SWPs for encounters with snakes and for treating snakebites are listed below.

- Workers should avoid walking in areas known to harbor snakes. Workers should be cautious when picking up or moving items that have been on the ground.
- Workers should wear boots made of heavy material that protect the ankles and pants. Heavy work gloves should be worn for picking up items.
- If one snake is encountered, others may be present. Workers should leave the area by retracing their steps.
- If a worker is bitten, the wound should be washed and the injured area immobilized and kept lower than the heart, if possible. Ice or a tourniquet should not be applied to a snake bite. The wound should not be cut. If medical care is more than 30 minutes away from a work site, a snakebite kit should be available on site and workers should know how to use it.

3.0 ANIMALS

SWPs for encounters with animals and for treating associated wounds are listed below.

- If workers encounter a wild animal, the animal should be observed for unusual behavior such as a nocturnal animal out during the day, drooling, an appearance of partial paralysis, irritability, meanness, or a strangely quiet demeanor.

- Workers should never touch the body of a dead animal because certain diseases could be carried by fleas still on the body.

- Workers should avoid animal droppings (including bird droppings). Pathogens, some of which can become airborne, may still be present in the droppings.

- If a worker is bitten, he or she should get away from the animal to avoid further bites. Workers should not try to stop, hold, or catch the animal.

- If the wound is minor, it should be washed with soap and water. Any bleeding should then be controlled, and an antibiotic ointment and dressing should be applied. All animal bite wounds should be watched for signs of infection.

- If the wound is bleeding seriously, the bleeding should be controlled but the wound should not be cleaned. Medical assistance should be summoned immediately.

- If a rabid animal is suspected, immediate medical attention should be summoned. If possible, workers should try to remember what the rabid animal looked like and the area in which it was last seen. The animal should be reported by calling the local emergency number.

4.0 PLANTS

SWPs for plants are as follows:

- Workers should be aware of the types and appearances of poisonous plants in the work site area. Poison ivy, oak, and sumac are the most frequently encountered plants that can cause reaction from casual contact. If a worker is extremely sensitive to these plants, he or she should avoid the area entirely because airborne drift could be sufficient to cause a reaction. Other plants, such as fireweed, can cause painful, short-term irritation and should be avoided as well. Workers should avoid touching face and eye areas after contact with any suspicious plant.

- Workers should wear proper clothing if working in or near overgrown areas. Disposable outerwear should be used, if necessary, and workers should not touch the material with bare hands during removal if the outerwear may have contacted poisonous plants.

- If contact with a poisonous plant has occurred, the affected area should be immediately washed thoroughly with soap and water. If a rash or weeping sore has already begun to develop, a paste of baking soda and water should be applied to the area several times a day to reduce discomfort. Lotions such as Calamine or Caladryl should be applied to help soothe the area. If the condition gets worse and affects large areas of the body or the face, a doctor should be consulted.

- Bushy and wooded areas should be thoroughly checked for thorn-bearing trees, brush, and bramble. In some cases, impalement can cause severe pain or infection.

5.0 WATERBORNE PATHOGENS-GIARDIA

Giardia is a waterborne pathogen consisting of a protoplasmic parasite of the mammalian digestive tract. Giardia is present worldwide, with the highest occurrence in areas with poor sanitation. In the United States, most reported cases are in mountainous regions where drinking water is obtained from streams and is unfiltered or untreated.

Giardia is contracted by ingesting water contaminated with giardia cysts in the dormant state. Giardia parasites can only thrive in the digestive tracts of mammals. Dormant giardia organisms enter water through the feces of infected animals or humans. Giardia symptoms include severe diarrhea and upset stomach. Some people are asymptomatic but can transmit the disease to others. Medical treatment of giardia can be difficult and unpleasant; therefore, prevention is critical. Precautions for preventing exposure to giardia are listed below.

- Workers should assume that all fresh water streams are infected with the giardia organism and not drink any untreated water.

- Team members collecting sediment and water samples from streams should wash their hands thoroughly with soap and water after collecting the samples.

- Giardia parasites are relatively easy to destroy or filter. Water should be treated for drinking or cooking with iodine or another recommended giardia treatment before use.

6.0 HANTAVIRUS

Hantavirus pulmonary syndrome (HPS) is a potentially fatal infection caused by a rodent-borne hantavirus. HPS begins with a brief illness most commonly characterized by fever, muscle pain, headache, coughing, and nausea or vomiting. Other early symptoms include chills, diarrhea, shortness of breath, abdominal pain, and dizziness. In the first identified cases of HPS, this stage of the infection lasted 2 to 5 days before victims were hospitalized. Typically, by the time of hospitalization, victims were found to have tachycardia (a heart rate of greater than 100 beats per minute) and tachypnea (a breathing rate of greater than 20 breaths per minute). Fever was also common. In most cases, death occurred within 2 to 16 days of the onset of symptoms, and victims exhibited pulmonary edema and severe hypotension.

Currently, experts believe that HPS is spread by the deer mouse (*Peromyscus maniculatus*). Though the deer mouse has been found to be the primary host of hantavirus, several other rodent species have also tested positive for the virus. Pinon mice (*Peromyscus truei*), brush mice (*Peromyscus boylii*), and western chipmunks (*Tamia spp.*) are also likely to carry the virus. Also, cases of HPS have been reported in areas of the United States where these particular rodents are not indigenous.

Infected rodents shed the virus in their urine, feces, and saliva. Humans can be exposed to the virus through (1) inhalation of suspended rodent excreta or dust particles containing rodent excreta, (2) introduction of rodent excreta into the eyes or broken skin, and (3) ingestion of food or water contaminated by rodent excreta. HPS has a reported mortality rate of 55 percent. Transmission of hantavirus from infected individuals to healthy persons has not been documented.

Prevention of HPS infection is essential because no known antidote and no specific treatment exists for treating HPS. Therefore, employees should practice risk reduction and control measures. Guidelines for workers in locations that may have rodent infestations or habitats are listed below.

- The best approach for HPS control and prevention is through environmental hygiene practices that deter rodents from colonizing the work environment.

- Information about the symptoms of HPS and detailed guidance on preventive measures should be provided to all employees assigned to field activities.

- Medical attention should be sought immediately for workers who develop a febrile or respiratory illness within 45 days of the last potential exposure to rodents. Attending physicians should be advised of each worker's potential for occupational exposure to hantavirus. Physicians should contact local health authorities promptly if hantavirus-associated illness is suspected. A blood sample should be obtained from the affected worker and forwarded with the baseline serum sample through the state health department to the Centers for Disease Control and Prevention for hantavirus antibody testing.

- Respiratory protective equipment should be worn when handling rodents, when removing rodents from traps, and when working in areas with evidence of rodent droppings or hair. Respiratory protective equipment should include, at a minimum, a half-face air-purifying respirator (APR) or powered APR equipped with a high-efficiency particulate air (HEPA) filter (P100). Full-face regulators may be needed under some circumstances. Respiratory protective equipment should be used in accordance with Occupational Safety and Health Administration regulations.

- Dermal protection should be worn when handling rodents or traps containing rodents, or if contact with contaminated surfaces could occur. Dermal protection should include rubber or plastic gloves that should be washed and disinfected before removal.

- A trap contaminated with rodent urine or feces or in which a rodent was captured should be disinfected with a commercial disinfectant or a 0.4 percent bleach solution. A dead rodent should be disposed of by placing the carcass in a plastic bag containing enough general-purpose household disinfectant to thoroughly wet the carcass. The bag should be sealed and disposed of by burning or by burying it in a 2- to 3-foot-deep hole. Local and state health departments can also provide appropriate disposal methods.

Revision Date	Document Authorizer	Revision Details
10/1/2008	Chris McClain	Update from 1998 format

KOPPERS CO INC -- COAL TAR CREOSOTE-PRESS/NON-PRESS/GEN.APPLI -- 6840-00-257-2482

===================== Product Identification =====================

Product ID:COAL TAR CREOSOTE-PRESS/NON-PRESS/GEN.APPLI
MSDS Date:08/01/1989
FSC:6840
NIIN:00-257-2482
MSDS Number: BJPKL
=== Responsible Party ===
Company Name:KOPPERS CO INC
Address:3000 KOPPERS BLDG
City:PITTSBURGH
State:PA
ZIP:15219-1818
Country:US
Info Phone Num:412-227-2884
Emergency Phone Num:800-553-5631
CAGE:80592
=== Contractor Identification ===
Company Name:KOPPERS CO INC
Address:3000 KOPPERS BLDG
Box:City:PITTSBURGH
State:PA
ZIP:15219-1818
Country:US
CAGE:80592

============= Composition/Information on Ingredients =============

Ingred Name:CREOSOTE (SARA III)
CAS:8001-58-9
RTECS #:GF8615000
Other REC Limits:NONE SPECIFIED
EPA Rpt Qty:1 LB
DOT Rpt Qty:1 LB

Ingred Name:INDENE
CAS:95-13-6
RTECS #:NK8225000
Fraction by Wt: <10%
Other REC Limits:NONE SPECIFIED
OSHA PEL:10 PPM
ACGIH TLV:10 PPM; 9192

Ingred Name:NAPHTHALENE (SARA III)
CAS:91-20-3
RTECS #:QJ0525000
Fraction by Wt: <15%
Other REC Limits:NONE SPECIFIED
OSHA PEL:10 PPM/15 STEL
ACGIH TLV:10 PPM/15 STEL; 9192
EPA Rpt Qty:100 LBS
DOT Rpt Qty:100 LBS

Ingred Name:DIPHENYL (BIPHENYL) (SARA III)
CAS:92-52-4
RTECS #:DU8050000
Fraction by Wt: <5%
Other REC Limits:NONE SPECIFIED
OSHA PEL:0.2 PPM
ACGIH TLV:0.2 PPM; 9192
EPA Rpt Qty:1 LB

DOT Rpt Qty:1 LB

Ingred Name:BENZENE (SARA III)
CAS:71-43-2
RTECS #:CY1400000
Fraction by Wt: <1%
Other REC Limits:NONE SPECIFIED
OSHA PEL:1PPM/5STEL;1910.1028
ACGIH TLV:10 PPM; A2; 9192
EPA Rpt Qty:10 LBS
DOT Rpt Qty:10 LBS

Ingred Name:ALKYL NAPHTHALENE
Fraction by Wt: <10%
Other REC Limits:NONE SPECIFIED

===================== Hazards Identification =====================

LD50 LC50 Mixture:LD50 (ORAL RAT) IS 1,700 MG/KG
Routes of Entry: Inhalation:YES Skin:YES Ingestion:NO
Reports of Carcinogenicity:NTP:YES   IARC:YES   OSHA:YES
Health Hazards Acute and Chronic:ACUTE-EYE:MAY CAUSE MODERATE IRRITATION.SKIN:CAN RESULT IN SEVERE IRRITATION WHICH WHEN ACCENTUATED BY SUNLIGHT MAY RESULT IN PHOTOTOXIC SKIN REACTION.INHALATION:IRRITATION,CNS EFFECTS,SUCH AS HEADACHE,DIZZINESS,COMA AND POSSIBLE DEATH.INGESTION:IRRITATION,NAUSEA,VOMITING & ABDOMINAL PAIN.CHRONIC-MAY CAUSE CANCER.
Explanation of Carcinogenicity:BENZENE. IARC LISTS CREOSOTE AS A POSSIBLE CARCINOGENIC AGENT TO HUMAN.
Effects of Overexposure:WARNING! MAY CAUSE CANCER. MAY BE FATAL IF SWALLOWED. HARMFUL TO THE SKIN OR IF INHALED. CAUSES EYE AND SKIN IRRITATION.
Medical Cond Aggravated by Exposure:PERSONS WITH PRE-EXISTING DISEASE IN OR A HISTORY OF AILMENTS INVOLVING THE SKIN OR BLOOD-FORMING ORGANS MAY BE AT A GREATER RISK OF DEVELOPING ADVERSE HEALTH EFFECTS WHEN EXPOSED TO THIS MATERIAL.

======================= First Aid Measures =======================

First Aid:SEEK MEDICAL AID.EYE:FLUSH WITH WATER FOR 15 MINUTES.SKIN:WIPE MATERIAL OFF.WASH THOROUGHLY WITH SOAP & WATER/WATERLESS HAND CLEANER.INHALATION:REMOVE TO FRESH AIR.GIVE CPR/OXYGEN IF NEEDED.INGESTION: GIVE 1-2 GLASSES OF WATER/MILK IF CONSCIOUS.INDUCE VOMITING USING IPECAC SYRUP.THEN,GIVE A SLURRY OF 100 G OF ACTIVATED CHARCOAL IN 8 OZ OF WATER.

===================== Fire Fighting Measures =====================

Flash Point Method:CC
Flash Point:>200F,>93C
Extinguishing Media:USE WATER FOG, CARBON DIOXIDE, FOAM, OR DRY CHEMICAL. WATER OR FOAM MAY CAUSE FROTHING, IF MOLTEN.
Fire Fighting Procedures:WEAR COMPLETE FIRE SERVICE PROTECTIVE EQUIPMENT,INCLUDING FULL-FACE MSHA/NIOSH APPROVED SELF-CONTAINED BREATHING APPARATUS.USE WATER TO COOL CONTAINERS BY FIRE.
Unusual Fire/Explosion Hazard:TOXIC VAPORS/DECOMPOSITION PRODUCTS MAY BE RELEASED FORMING FLAMMABLE/EXPLOSIVE MIXTURES IN AIR. CLOSED CONTAINERS MAY EXPLODE WHEN EXPOSED TO EXTREME HEAT.

================== Accidental Release Measures ==================

Spill Release Procedures:STOP LEAK IF NO RISK INVOLVED.STAY

UPWIND.SOLIDIFIED SPILL:SHOVEL INTO DRY CONTAINERS AND COVER.FLUSH AREA WITH WATER.SMALL WET SPILL:TAKE UP WITH SAND.FLUSH AREA WITH WATER.DIKE LARGE SPILLS FOR LATE R DISPOSAL.CONTAIN RUNOFF FROM FIRE CONTROL.

====================== Handling and Storage ======================

Handling and Storage Precautions:STORE IN COOL,DRY AND WELL VENTILATED AREA.KEEP CONTAINER CLOSED WHEN NOT IN USE.
Other Precautions:AVOID PROLONGED/REPEATED BREATHING OF VAPORS,MISTS/FUMES.AVOID PROLONGED/REPEATED CONTACT WITH SKIN/EYES.APPLICATION OF CERTAIN PROTECTIVE CREAMS (SUN SCREENS FOR COAL TAR PRODUCTS) BEFORE WORKING/SEV ERAL TIMES DURING WORK MAY BE BENEFICIAL

============= Exposure Controls/Personal Protection =============

Respiratory Protection:NONE NORMALLY REQUIRED.IF EXPOSURES ARE NOT BELOW TLV(PEL),USE NIOSH/MSHA APPROVED UNITS AS PER CURRENT 29 CFR 1910.134 AND MANUFACTURERS' "INSTRUCTIONS" AND "WARNINGS".COMBINATION FILTER/ORGANIC VAPO R CARTRIDGES OR CANISTER MAY BE USED.
Ventilation:PROVIDE SUFFICIENT GENERAL/LOCAL EXHAUST VENTILATION IN PATTERN/VOLUME TO CONTROL INHALATION EXPOSURE < EXPOSURE LIMITS.
Protective Gloves:IMPERVIOUS
Eye Protection:SAFETY GLASSES/GOGGLES
Other Protective Equipment:IMPERVIOUS PROTECTIVE GARMENTS SUCH AS HEAD/NECK COVER,APRONS,JACKETS,PANTS,BOOTS,ETC.EYE-WASH FACILITIES,SAFETY SHOWER.
Work Hygienic Practices:AVOID CONTACT WITH EYES AND SKIN;DO NOT BREATHE VAPORS/MIST.WASH THOROUGHLY AFTER EACH USE.
Supplemental Safety and Health
DO NOT USE UNTIL MANUFACTURER'S PRECAUTIONS HAVE BEEN READ & UNDERSTOOD. WASH EXPOSED AREAS PROMPTLY AND THOROUGHLY AFTER SKIN CONTACT FROM WORKING WITH THIS PRODUCT AND BEFORE EATING,DRINKING OR USIN G REST ROOMS.DO NOT WEAR CONTACT LENS WITHOUT PROPER EYE PROTECTION WHEN USING THIS PRODUCT.

================== Physical/Chemical Properties ==================

HCC:T2
Boiling Pt:B.P. Text:>355
Vapor Pres:1 @ 30C
Vapor Density:>1
Spec Gravity:1.050
Evaporation Rate & Reference:SLOW (N-BUTYL ACETATE=1)
Solubility in Water:SLIGHT
Appearance and Odor:BROWN TO BLACK LIQUID WITH CREOSOTE OR TARRY ODOR

================= Stability and Reactivity Data =================

Stability Indicator/Materials to Avoid:YES
NONE KNOWN
Stability Condition to Avoid:HIGH TEMPERATURES AND OPEN FLAMES
Hazardous Decomposition Products:OXIDES OF CARBON

==================== Disposal Considerations ====================

Waste Disposal Methods:CONSULT LOCAL AUTHORITIES;DISPOSAL MUST BE IN ACCORDANCE WITH LOCAL,STATE AND FEDERAL REGULATIONS. THIS PRODUCT RELEASED INTO THE ENVIRONMENT MUST BE REPORTED TO THE NATIONAL RESPONSE CENTER (800-424- 8802).WHEN SPILLED,REPORTABLE QUANTITY IS 1 LB.

VOC June 2017 Results
Former Koppers Tar Plant and Wabash Alloys Site
Beazer Oak Creek VPLE
BRRTS #:06-41-561509/06-41-561426

	WDNR NR140		MW-1	MW-2	MW-101	W-101 DU	MW-102	P-103	MW-104	MW-105	MW-107	MW-108	P-110	MW-111	W-111 DU	MW-112	P-113	MW-115	MW-117	W-117 DU	MW-118	P-120	P-121	MW-122	MW-123	MW-125	MW-126	MW-127	MW-128	MW-129	MW-130
	PAL	ES	6/22/17	6/16/17	6/20/17	6/20/17	6/22/17	6/22/17	6/22/17	6/20/17	6/20/17	6/22/17	6/22/17	6/22/17	6/22/17	6/20/17	6/21/17	6/20/17	6/22/17	6/22/17	6/20/17	6/22/17	6/21/17	6/20/17	6/21/17	6/22/17	6/16/17	6/16/17	6/21/17	6/21/17	6/16/17
1,1,1,2-Tetrachloroethane	*7*	**70**	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<4.6	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<23	<23	<0.46	<0.46	<0.46	<2.3	<9.2	<4.6	<0.46	<0.46	<0.46	<0.46	<2.3
1,1,1-Trichloroethane	*40*	**200**	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<3.8	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<19	<19	<0.38	<0.38	<0.38	<1.9	<7.6	<3.8	<0.38	<0.38	<0.38	<0.38	<1.9
1,1,2,2-Tetrachloroethane	*0.02*	**0.2**	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<4.0	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<20	<20	<0.40	<0.40	<0.40	<2.0	<8.0	<4.0	<0.40	<0.40	<0.40	<0.40	<2.0
1,1,2-Trichloroethane	*0.5*	**5**	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<3.5	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<18	<18	<0.35	<0.35	<0.35	<1.8	<7.0	<3.5	<0.35	<0.35	<0.35	<0.35	<1.8
1,1-Dichloroethane	*85*	**850**	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<4.1	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<21	<21	<0.41	<0.41	<0.41	<2.1	<8.2	<4.1	<0.41	<0.41	<0.41	<0.41	<2.1
1,1-Dichloroethene	*0.7*	**7**	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<20	<20	<0.39	<0.39	<0.39	<2.0	<7.8	<3.9	<0.39	<0.39	<0.39	<0.39	<2.0
1,1-Dichloropropene			<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<3.0	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<15	<15	<0.30	<0.30	<0.30	<1.5	<5.9	<3.0	<0.30	<0.30	<0.30	<0.30	<1.5
1,2,3-Trichlorobenzene			<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<4.6	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<23	<23	<0.46	<0.46	<0.46	<2.3	<9.2	<4.6	<0.46	<0.46	<0.46	<0.46	<2.3
1,2,3-Trichloropropane	*12*	**60**	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<4.1	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<21	<21	<0.41	<0.41	<0.41	<2.1	<8.3	<4.1	<0.41	<0.41	<0.41	<0.41	<2.1
1,2,4-Trichlorobenzene	*14*	**70**	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<3.4	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<17	<17	<0.34	<0.34	<0.34	<1.7	<6.8	<3.4	<0.34	<0.34	<0.34	<0.34	<1.7
1,2,4-Trimethylbenzene	*96*	**480**	<0.36	16	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	*330*	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	**550**	**550**	<0.36	<0.36	<0.36	11	*200*	*140*	<0.36	<0.36	<0.36	<0.36	11
1,2-Dibromo-3-Chloropropane	*0.02*	**0.2**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<20	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<100	<100	<2.0	<2.0	<2.0	<10	<40	<20	<2.0	<2.0	<2.0	<2.0	<10
1,2-Dibromoethane (EDB)	*0.005*	**0.05**	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<19	<19	<0.39	<0.39	<0.39	<1.9	<7.7	<3.9	<0.39	<0.39	<0.39	<0.39	<1.9
1,2-Dichlorobenzene	*60*	**600**	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<3.3	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<17	<17	<0.33	<0.33	<0.33	<1.7	<6.7	<3.3	<0.33	<0.33	<0.33	<0.33	<1.7
1,2-Dichloroethane	*0.5*	**5**	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<20	<20	<0.39	<0.39	<0.39	<2.0	<7.8	<3.9	<0.39	<0.39	<0.39	<0.39	<2.0
1,2-Dichloropropane	*0.5*	**5**	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<4.3	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<21	<21	<0.43	<0.43	<0.43	<2.1	<8.6	<4.3	<0.43	<0.43	<0.43	<0.43	<2.1
1,3,5-Trimethylbenzene	*96*	**480**	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	86	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	*240*	*240*	<0.25	<0.25	<0.25	8.2	*110*	83	<0.25	<0.25	<0.25	<0.25	7.1
1,3-Dichlorobenzene	*125*	**1250**	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<4.0	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<20	<20	<0.40	<0.40	<0.40	<2.0	<8.0	<4.0	<0.40	<0.40	<0.40	<0.40	<2.0
1,3-Dichloropropane	*0.02*	**0.2**	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<3.6	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<18	<18	<0.36	<0.36	<0.36	<1.8	<7.2	<3.6	<0.36	<0.36	<0.36	<0.36	<1.8
1,4-Dichlorobenzene	*15*	**75**	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<3.6	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<18	<18	<0.36	<0.36	<0.36	<1.8	<7.3	<3.6	<0.36	<0.36	<0.36	<0.36	<1.8
2,2-Dichloropropane			<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<4.4	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<22	<22	<0.44	<0.44	<0.44	<2.2	<8.9	<4.4	<0.44	<0.44	<0.44	<0.44	<2.2
2-Chlorotoluene			<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<3.1	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<16	<16	<0.31	<0.31	<0.31	<1.6	<6.3	<3.1	<0.31	<0.31	<0.31	<0.31	<1.6
4-Chlorotoluene			<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<3.5	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<17	<17	<0.35	<0.35	<0.35	<1.7	<7.0	<3.5	<0.35	<0.35	<0.35	<0.35	<1.7
Benzene	*0.5*	**5**	<0.15	**13**	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	**1700**	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	**4800**	**4800**	<0.15	<0.15	<0.15	**18**	**350**	**400**	<0.15	<0.15	<0.15	<0.15	1.6 J
Bromobenzene			<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<3.6	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<18	<18	<0.36	<0.36	<0.36	<1.8	<7.1	<3.6	<0.36	<0.36	<0.36	<0.36	<1.8
Bromochloromethane			<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<4.3	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<21	<21	<0.43	<0.43	<0.43	<2.1	<8.6	<4.3	<0.43	<0.43	<0.43	<0.43	<2.1
Bromodichloromethane	*0.06*	**0.6**	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<3.7	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<19	<19	<0.37	<0.37	<0.37	<1.9	<7.4	<3.7	<0.37	<0.37	<0.37	<0.37	<1.9
Bromoform	*0.44*	**4.4**	<0.48	<0.48	<0.48	<0.48	<0.48	<0.48	<0.48	<0.48	<4.8	<0.48	<0.48	<0.48	<0.48	<0.48	<0.48	<0.48	<24	<24	<0.48	<0.48	<0.48	<2.4	<9.7	<4.8	<0.48	<0.48	<0.48	<0.48	<2.4
Bromomethane	*1*	**10**	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<8.0	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<40	<40	<0.80	<0.80	<0.80	<4.0	<16	<8.0	<0.80	<0.80	<0.80	<0.80	<4.0
Carbon tetrachloride	*0.5*	**5**	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<3.8	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<19	<19	<0.38	<0.38	<0.38	<1.9	<7.7	<3.8	<0.38	<0.38	<0.38	<0.38	<1.9
Chlorobenzene			<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<19	<19	<0.39	<0.39	<0.39	<1.9	<7.7	<3.9	<0.39	<0.39	<0.39	<0.39	<1.9
Chloroethane	*80*	**400**	<0.51	<0.51	<0.51	<0.51	<0.51	<0.51	<0.51	<0.51	<5.1	<0.51	<0.51	<0.51	<0.51	<0.51	<0.51	<0.51	<25	<25	<0.51	<0.51	<0.51	<2.5	<10	<5.1	<0.51	<0.51	<0.51	<0.51	<2.5
Chloroform	*0.6*	**6**	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<3.7	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<19	<19	<0.37	<0.37	<0.37	<1.9	<7.4	<3.7	<0.37	<0.37	<0.37	<0.37	<1.9
Chloromethane	*0.3*	**3**	<0.32	<0.32	<0.32	<0.32	<0.32	<0.32	<0.32	<0.32	<3.2	<0.32	<0.32	<0.32	<0.32	<0.32	<0.32	<0.32	<16	<16	<0.32	<0.32	<0.32	<1.6	<6.4	<3.2	<0.32	<0.32	<0.32	<0.32	<1.6
cis-1,2-Dichloroethene	*7*	**70**	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<4.1	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<20	<20	<0.41	<0.41	<0.41	<2.0	<8.2	<4.1	<0.41	<0.41	<0.41	<0.41	<2.0
cis-1,3-Dichloropropene			<0.42	<0.42	<0.42	<0.42	<0.42	<0.42	<0.42	<0.42	<4.2	<0.42	<0.42	<0.42	<0.42	<0.42	<0.42	<0.42	<21	<21	<0.42	<0.42	<0.42	<2.1	<8.3	<4.2	<0.42	<0.42	<0.42	<0.42	<2.1
Dibromochloromethane			<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	<4.9	<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	<24	<24	<0.49	<0.49	<0.49	<2.4	<9.8	<4.9	<0.49	<0.49	<0.49	<0.49	<2.4
Dibromomethane			<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<2.7	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<14	<14	<0.27	<0.27	<0.27	<1.4	<5.4	<2.7	<0.27	<0.27	<0.27	<0.27	<1.4
Dichlorodifluoromethane	*200*	**1000**	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<6.7	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<34	<34	<0.67	<0.67	<0.67	<3.4	<13	<6.7	<0.67	<0.67	<0.67	<0.67	<3.4
Ethylbenzene	*140*	**700**	<0.18	26	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	*520*	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	*460*	*470*	<0.18	<0.18	<0.18	90	120	120	<0.18	<0.18	<0.18	<0.18	41
Hexachlorobutadiene			<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<4.5	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<22	<22	<0.45	<0.45	<0.45	<2.2	<8.9	<4.5	<0.45	<0.45	<0.45	<0.45	<2.2
Isopropyl ether			<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<2.8	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<14	<14	<0.28	<0.28	<0.28	<1.4	<5.5	<2.8	<0.28	<0.28	<0.28	<0.28	<1.4
Isopropylbenzene			<0.39	3.3	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	26	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	28J	25 J	<0.39	<0.39	<0.39	14	14 J	<3.9	<0.39	<0.39	<0.39	<0.39	20
Methyl tert-butyl ether	*12*	**60**	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<20	<20	<0.39	<0.39	<0.39	<2.0	<7.9	<3.9	<0.39	<0.39	<0.39	<0.39	<2.0
Methylene Chloride	*0.5*	**5**	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	**6.3**	**57**	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	**6.9**	<82	<82	<1.6	<1.6	<1.6	**29**	<33	<16	<1.6	<1.6	<1.6	<1.6	<8.2
Naphthalene	*10*	**100**	NA	NA	<0.34	<0.34	NA	NA	NA	<0.34	NA	NA	NA	NA	NA	<0.34	NA	<0.34	NA	NA	<0.34	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Butylbenzene			<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<19	<19	<0.39	<0.39	<0.39	<1.9	<7.8	<3.9	<0.39	<0.39	<0.39	<0.39	<1.9
N-Propylbenzene			<0.41	1.3	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	9.5 J	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<21	<21	<0.41	<0.41	<0.41	<2.1	<8.3	<4.1	<0.41	<0.41	<0.41	<0.41	3.9 J
p-Isopropyltoluene			<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<3.6	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<18	<18	<0.36	<0.36	<0.36	<1.8	<7.2	<3.6	<0.36	<0.36	<0.36	<0.36	<1.8
sec-Butylbenzene			<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<4.0	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<20	<20	<0.40	<0.40	<0.40	<2.0	<8.0	<4.0	<0.40	<0.40	<0.40	<0.40	<2.0
Styrene	*10*	**100**	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	**140**	**130**	<0.39	<0.39	<0.39	<1.9	<7.7	<3.9	<0.39	<0.39	<0.39	<0.39	<1.9
tert-Butylbenzene			<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	4.4 J	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<20	<20	<0.40	<0.40	<0.40	<2.0	<8.0	<4.0	<0.40	<0.40	<0.40	<0.40	<2.0
Tetrachloroethene	*0.5*	**5**	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<3.7	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<19	<19	<0.37	<0.37	<0.37	<1.9	<7.4	<3.7	<0.37	<0.37	<0.37	<0.37	<1.9
Toluene	*200*	**1000**	<0.15	1.6	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	81	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	**4400**	**4500**	<0.15	<0.15	<0.15	1.9 J	140	*280*	<0.15	<0.15	<0.15	<0.15	1.7 J
trans-1,2-Dichloroethene	*20*	**100**	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<3.5	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<17	<17	<0.35	<0.35	<0.35	<1.7	<7.0	<3.5	<0.35	<0.35	<0.35	<0.35	<1.7
trans-1,3-Dichloropropene			<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<3.6	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<18	<18	<0.36	<0.36	<0.36	<1.8	<7.2	<3.6	<0.36	<0.36	<0.36	<0.36	<1.8
Trichloroethene	*0.5*	**5**	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<1.6	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<8.2	<8.2	<0.16	<0.16	<0.16	<0.82	<3.3	<1.6	<0.16	<0.16	<0.16	<0.16	<0.82
Trichlorofluoromethane			<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<4.3	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<21	<21	<0.43	<0.43	<0.43	<2.1	<8.5	<4.3	<0.43	<0.43	<0.43	<0.43	<2.1
Vinyl chloride	*0.02*	**0.2**	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<2.0	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<10	<10	<0.20	<0.20	<0.20	<1.0	<4.1	<2.0	<0.20	<0.20	<0.20	<0.20	<1.0
Xylenes, Total	*1000*	**10000**	<0.22	6.9	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	*1400*	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	*2900*	*2900*	<0.22	<0.22	<0.22	7.4	500	670	<0.22	<0.22	<0.22	<0.22	43

Italic: Value exceeds NR140 Preventive Action Limit
Bold: Value exceeds NR140 Enforcement Standard
J: Result is <RL but >MDL; concentration is approximate
*: LCS or LCSD exceeds the control limits

VOC June 2017 Results
Former Koppers Tar Plant and Wabash Alloys Site
Beazer Oak Creek VPLE
BRRTS #:06-41-561509/06-41-561426

	WDNR NR140		MW-131	MW-132	MW-133	MW-134
	PAL	ES	6/16/17	6/16/17	6/16/17	6/20/17
1,1,1,2-Tetrachloroethane	*7*	**70**	<0.46	<0.46	<0.46	<0.92
1,1,1-Trichloroethane	*40*	**200**	<0.38	<0.38	<0.38	<0.76
1,1,2,2-Tetrachloroethane	*0.02*	**0.2**	<0.40	<0.40	<0.40	<0.80
1,1,2-Trichloroethane	*0.5*	**5**	<0.35	<0.35	<0.35	<0.70
1,1-Dichloroethane	*85*	**850**	<0.41	<0.41	<0.41	<0.82
1,1-Dichloroethene	*0.7*	**7**	<0.39	<0.39	<0.39	<0.78
1,1-Dichloropropene			<0.30	<0.30	<0.30	<0.59
1,2,3-Trichlorobenzene			<0.46	1.8	<0.46	<0.92
1,2,3-Trichloropropane	*12*	**60**	<0.41	<0.41	<0.41	<0.83
1,2,4-Trichlorobenzene	*14*	**70**	<0.34	4.7	<0.34	<0.68
1,2,4-Trimethylbenzene	*96*	**480**	<0.36	<0.36	<0.36	57
1,2-Dibromo-3-Chloropropane	*0.02*	**0.2**	<2.0	<2.0	<2.0	<4.0
1,2-Dibromoethane (EDB)	*0.005*	**0.05**	<0.39	<0.39	<0.39	<0.77
1,2-Dichlorobenzene	*60*	**600**	<0.33	17	<0.33	<0.67
1,2-Dichloroethane	*0.5*	**5**	<0.39	<0.39	<0.39	<0.78
1,2-Dichloropropane	*0.5*	**5**	<0.43	<0.43	<0.43	<0.86
1,3,5-Trimethylbenzene	*96*	**480**	<0.25	<0.25	<0.25	23
1,3-Dichlorobenzene	*125*	**1250**	<0.40	8.2	<0.40	<0.80
1,3-Dichloropropane	*0.02*	**0.2**	<0.36	<0.36	<0.36	<0.72
1,4-Dichlorobenzene	*15*	**75**	<0.36	1.3	<0.36	<0.73
2,2-Dichloropropane			<0.44	<0.44	<0.44	<0.89
2-Chlorotoluene			<0.31	<0.31	<0.31	<0.63
4-Chlorotoluene			<0.35	<0.35	<0.35	<0.70
Benzene	*0.5*	**5**	<0.15	0.27 J	<0.15	**14**
Bromobenzene			<0.36	<0.36	<0.36	<0.71
Bromochloromethane			<0.43	<0.43	<0.43	<0.86
Bromodichloromethane	*0.06*	**0.6**	<0.37	<0.37	<0.37	<0.74
Bromoform	*0.44*	**4.4**	<0.48	<0.48	<0.48	<0.97
Bromomethane	*1*	**10**	<0.80	<0.80	<0.80	<1.6
Carbon tetrachloride	*0.5*	**5**	<0.38	<0.38	<0.38	<0.77
Chlorobenzene			<0.39	2.1	<0.39	<0.77
Chloroethane	*80*	**400**	<0.51	<0.51	<0.51	<1.0
Chloroform	*0.6*	**6**	<0.37	<0.37	<0.37	<0.74
Chloromethane	*0.3*	**3**	<0.32	<0.32	<0.32	<0.64
cis-1,2-Dichloroethene	*7*	**70**	<0.41	<0.41	<0.41	<0.82
cis-1,3-Dichloropropene			<0.42	<0.42	<0.42	<0.83
Dibromochloromethane			<0.49	<0.49	<0.49	<0.98
Dibromomethane			<0.27	<0.27	<0.27	<0.54
Dichlorodifluoromethane	*200*	**1000**	<0.67	<0.67	<0.67	<1.3
Ethylbenzene	*140*	**700**	<0.18	<0.18	<0.18	48
Hexachlorobutadiene			<0.45	<0.45	<0.45	<0.89
Isopropyl ether			<0.28	<0.28	<0.28	<0.55
Isopropylbenzene			<0.39	<0.39	<0.39	15
Methyl tert-butyl ether	*12*	**60**	<0.39	<0.39	<0.39	<0.79
Methylene Chloride	*0.5*	**5**	<1.6	<1.6	<1.6	<3.3
Naphthalene	*10*	**100**	NA	NA	NA	NA
n-Butylbenzene			<0.39	<0.39	<0.39	<0.78
N-Propylbenzene			<0.41	<0.41	<0.41	4.3
p-Isopropyltoluene			<0.36	<0.36	<0.36	<0.72
sec-Butylbenzene			<0.40	<0.40	<0.40	<0.80
Styrene	*10*	**100**	<0.39	<0.39	<0.39	<0.77
tert-Butylbenzene			<0.40	<0.40	<0.40	3.7
Tetrachloroethene	*0.5*	**5**	<0.37	<0.37	<0.37	<0.74
Toluene	*200*	**1000**	<0.15	<0.15	<0.15	1.2
trans-1,2-Dichloroethene	*20*	**100**	<0.35	<0.35	<0.35	<0.70
trans-1,3-Dichloropropene			<0.36	<0.36	<0.36	<0.72
Trichloroethene	*0.5*	**5**	<0.16	<0.16	<0.16	<0.33
Trichlorofluoromethane			<0.43	<0.43	<0.43	<0.85
Vinyl chloride	*0.02*	**0.2**	<0.20	<0.20	<0.20	<0.41
Xylenes, Total	*1000*	**10000**	<0.22	<0.22	<0.22	25

Italic: Value exceeds NR140 Preventive Action Limit
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J: Result is <RL but >MDL; concentration is approximate
*: LCS or LCSD exceeds the control limits

SVOC June 2017 Results
Former Koppers Tar Plant and Wabash Alloys Site
Beazer Oak Creek VPLE
BRRTS #:06-41-561509/06-41-561426

	WDNR NR140		MW-1	MW-2	MW-101	MW-101 DUP	MW-102	P-103	MW-104	MW-105	MW-107	MW-108	P-110	MW-111	MW-111 DUP	MW-112	P-113	MW-115	MW-117	MW-117 DUP	MW-118	P-120	P-121	MW-122	MW-123	MW-125	MW-126	MW-127	MW-128	MW-129
	PAL	ES	6/22/17	6/16/17	6/20/17	6/20/17	6/22/17	6/22/17	6/22/17	6/20/17	6/20/17	6/22/17	6/22/17	6/22/17	6/22/17	6/20/17	6/21/17	6/20/17	6/22/17	6/22/17	6/20/17	6/22/17	6/21/17	6/20/17	6/21/17	6/22/17	6/16/17	6/16/17	6/21/17	6/21/17
1-Methylnaphthalene			<0.23	75	<0.23	<0.23	<0.23	<0.23	<0.24	<0.23	590	<0.24	<0.23	<0.23	<0.23	0.45 J	<0.22	0.23 J	1300	790	<0.23	0.29 J	<0.23	72	360	290	<0.23	<0.23	<0.23	<0.23
1,2,4-Trichlorobenzene	*14*	**70**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	*60*	**600**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	*125*	**1250**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	*15*	**75**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,2'-oxybis[1-chloropropane]			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	*5*	**50**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	*0.005*	**0.05**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	*0.005*	**0.05**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene			0.24 J	0.14 J	0.091 J	<0.049	0.085 J	<0.050	0.20 J	0.28	1000 D	<0.052	0.077 J	0.13 J	0.17 J	0.34 J	<0.048	0.25 J	2600	1500	0.18 J	0.61 J	<0.049	28	470	410	<0.049	<0.050	<0.050	0.41 J
2-Methylphenol			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitroaniline			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3 & 4 Methylphenol			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Bromophenyl phenyl ether			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl phenyl ether			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene			<0.24	38	<0.24	<0.23	<0.24	<0.24	<0.24	<0.23 J	200	<0.24	0.24 J	<0.24	<0.24	0.44 J	<0.23	<0.23	480	250 J	<0.24	<0.24	<0.23	69	240	210	<0.23	<0.23	<0.24	<0.23
Acenaphthylene			<0.21	6.3	<0.21	<0.20	<0.21	<0.21	<0.21	<0.20	<1.0	<0.21	<0.20	<0.20	<0.21	<0.20	<0.20	<0.20	<100	<100	<0.20	<0.20	<0.20	<0.20	18	66	<0.20	<0.20	<0.21	<0.20
Anthracene	*600*	**3000**	<0.26	0.51 J	<0.26	<0.25	<0.26	<0.26	<0.26	<0.25	11	<0.26	0.27 J	<0.26	<0.26	<0.25	<0.25	<0.25	150 J	<130	<0.25	<0.25	<0.25	4.2	30	22 J	<0.25	<0.25	<0.26	<0.25
Benzo[a]anthracene			<0.044	0.068 J	<0.044	0.093 J	1.4	<0.043	<0.044	<0.043	0.55	<0.045	0.42	<0.043	<0.044	<0.043	<0.042	0.14 J	<22	<22	0.22	<0.043	<0.043	0.19	19	10	<0.043	<0.043	<0.043	<0.043
Benzo[a]pyrene	*0.02*	**0.2**	<0.076	*0.16*	*0.17*	*0.13 J*	**1.8**	<0.076	<0.077	<0.075	<0.37	<0.078	**0.43**	<0.076	<0.076	<0.074	<0.074	*0.11 J*	<38	<38	**0.23**	<0.075	<0.074	*0.18*	**13**	**5.4 J**	<0.075	<0.075	<0.076	<0.075
Benzo[b]fluoranthene	*0.02*	**0.2**	<0.062	*0.069 J*	**0.37**	**0.26**	**2.3**	<0.062	*0.11 J*	<0.061	<0.30	<0.064	**0.64**	<0.062	<0.062	<0.061	<0.060	*0.14 J*	<31	<31	**0.32**	<0.061	<0.061	*0.18*	**15**	**6.6 J**	<0.061	<0.061	<0.062	<0.061
Benzo[g,h,i]perylene			<0.29	<0.28	<0.29	<0.28	1	<0.29	<0.29	<0.29	<1.4	<0.30	0.28 J	<0.29	<0.29	<0.28	<0.28	<0.28	<150	<140	<0.29	<0.29	<0.28	<0.28	<2.8	<14	<0.28	<0.29	<0.29	<0.28
Benzo[k]fluoranthene			<0.049	<0.049	<0.049	<0.048	0.69	<0.049	<0.050	<0.049	<0.24	<0.051	0.19	<0.049	<0.049	<0.048	<0.048	0.052 J	<25	<24	<0.049	<0.049	<0.048	<0.048	7.6	<2.4	<0.048	<0.049	<0.049	<0.048
Benzoic acid			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzyl alcohol			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethoxy)methane			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl) phthalate	*0.6*	**6**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Butyl benzyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbazole			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	*0.02*	**0.2**	<0.053	*0.11 J*	**0.29**	**0.21**	**1.9**	<0.052	<0.053	<0.052	**0.34 J**	<0.054	**0.52**	<0.052	<0.052	<0.051	<0.051	**0.21**	<26	<26	**0.22**	<0.052	<0.051	*0.18*	**16**	**7.9**	<0.051	<0.052	<0.052	<0.052
Dibenz(a,h)anthracene			<0.039	<0.038	<0.039	<0.038	0.39	<0.039	<0.040	<0.039	<0.19	<0.040	<0.038	<0.039	<0.039	<0.038	<0.038	<0.039	<20	<19	0.042 J	<0.039	<0.038	<0.038	<0.38	<1.9	<0.038	<0.039	<0.039	<0.038
Dibenzofuran			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butyl phthalate	*20*	**100**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-octyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	*80*	**400**	<0.35	1.3	0.49 J	0.35 J	1.8	<0.35	<0.35	<0.35	10	<0.36	1.3	<0.35	<0.35	<0.34	<0.34	<0.34	*300 J*	<170	<0.35	<0.35	<0.34	2.1	58	35 J	<0.34	<0.34	<0.35	<0.34
Fluorene	*80*	**400**	<0.19	11	<0.19	<0.18	<0.19	<0.19	<0.19	<0.19	*97*	<0.19	<0.18	<0.19	<0.19	0.24 J	<0.18	<0.18	*360 J*	*130 J*	<0.19	<0.19	<0.18	33	*140*	*130*	<0.18	<0.19	<0.19	<0.18
Hexachlorobenzene	*0.1*	**1**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno[1,2,3-cd]pyrene			<0.058	0.13 J	0.19	0.14 J	1.1	<0.057	<0.058	<0.057	<0.28	<0.059	0.24	<0.057	<0.057	<0.056	<0.056	0.064 J	<29	<29	0.13 J	<0.057	<0.056	0.14 J	6.1	<2.9	<0.056	<0.057	<0.057	<0.057
Isophorone			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	*10*	**100**	1.8	*62*	0.54 J	<0.23	0.50 J	0.25 J	1.3	0.27	**12000 D**	<0.24	0.70 J	0.24 J	0.30 J	0.79	<0.23	2.6	**21000**	**15000**	0.33 J	5.5	<0.23	**1300**	**5200**	**140**	<0.23	<0.23	<0.24	4.6
Nitrobenzene			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	*0.1*	**1**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene			<0.23	13	<0.23	<0.23	0.42 J	<0.23	<0.24	<0.23 J	84	<0.24	0.70 J	<0.23	<0.23	0.25 J	<0.22	<0.23	750	190 J	<0.23	<0.23	<0.23	28	190	30 J	<0.23	<0.23	<0.23	<0.23
Phenol	*1200*	**6000**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	*50*	**250**	<0.33	0.79	0.36 J	<0.32	1.7	<0.33	<0.33	<0.32	6.1	<0.34	1	<0.33	<0.33	<0.32	<0.32	<0.32	**270 J**	<160	<0.32	<0.32	<0.32	1	*52*	**3400**	<0.32	<0.32	<0.33	<0.32

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*: LCS or LCSD exceeds the control limits

SVOC June 2017 Results
Former Koppers Tar Plant and Wabash Alloys Site
Beazer Oak Creek VPLE
BRRTS #:06-41-561509/06-41-561426

	WDNR NR140		MW-130	MW-131	MW-132	MW-133	MW-134
	PAL	ES	6/16/17	6/16/17	6/16/17	6/16/17	6/20/17
1-Methylnaphthalene			36	<0.22	0.79 J	<0.23	510
1,2,4-Trichlorobenzene	*14*	**70**	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	*60*	**600**	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	*125*	**1250**	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	*15*	**75**	NA	NA	NA	NA	NA
2,2'-oxybis[1-chloropropane]			NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	*5*	**50**	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol			NA	NA	NA	NA	NA
2,4-Dichlorophenol			NA	NA	NA	NA	NA
2,4-Dimethylphenol			NA	NA	NA	NA	NA
2,4-Dinitrophenol			NA	NA	NA	NA	NA
2,4-Dinitrotoluene	*0.005*	**0.05**	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	*0.005*	**0.05**	NA	NA	NA	NA	NA
2-Chloronaphthalene			NA	NA	NA	NA	NA
2-Chlorophenol			NA	NA	NA	NA	NA
2-Methylnaphthalene			9.2	<0.049	0.28 J	<0.049	280
2-Methylphenol			NA	NA	NA	NA	NA
2-Nitroaniline			NA	NA	NA	NA	NA
2-Nitrophenol			NA	NA	NA	NA	NA
3 & 4 Methylphenol			NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine			NA	NA	NA	NA	NA
3-Nitroaniline			NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol			NA	NA	NA	NA	NA
4-Bromophenyl phenyl ether			NA	NA	NA	NA	NA
4-Chloro-3-methylphenol			NA	NA	NA	NA	NA
4-Chloroaniline			NA	NA	NA	NA	NA
4-Chlorophenyl phenyl ether			NA	NA	NA	NA	NA
4-Nitroaniline			NA	NA	NA	NA	NA
4-Nitrophenol			NA	NA	NA	NA	NA
Acenaphthene			130	2.7	0.29 J	<0.23	900
Acenaphthylene			2	<0.20	<0.20	<0.20	45
Anthracene	*600*	**3000**	4.5	<0.25	<0.25	<0.25	300
Benzo[a]anthracene			0.49	<0.042	0.16	<0.043	410
Benzo[a]pyrene	*0.02*	**0.2**	*0.16*	<0.074	**0.23**	<0.075	**230**
Benzo[b]fluoranthene	*0.02*	**0.2**	*0.11 J*	<0.060	*0.19*	<0.061	**310**
Benzo[g,h,i]perylene			<0.28	<0.28	<0.28	<0.28	110
Benzo[k]fluoranthene			<0.048	<0.048	0.064 J	<0.049	110
Benzoic acid			NA	NA	NA	NA	NA
Benzyl alcohol			NA	NA	NA	NA	NA
Bis(2-chloroethoxy)methane			NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether			NA	NA	NA	NA	NA
Bis(2-ethylhexyl) phthalate	*0.6*	**6**	NA	NA	NA	NA	NA
Butyl benzyl phthalate			NA	NA	NA	NA	NA
Carbazole			NA	NA	NA	NA	NA
Chrysene	*0.02*	**0.2**	**0.33**	<0.051	*0.15*	<0.052	**240**
Dibenz(a,h)anthracene			<0.038	<0.038	<0.038	<0.039	28
Dibenzofuran			NA	NA	NA	NA	NA
Diethyl phthalate			NA	NA	NA	NA	NA
Dimethyl phthalate			NA	NA	NA	NA	NA
Di-n-butyl phthalate	*20*	**100**	NA	NA	NA	NA	NA
Di-n-octyl phthalate			NA	NA	NA	NA	NA
Fluoranthene	*80*	**400**	12	2.8	0.34J	<0.34	**1500**
Fluorene	*80*	**400**	59	2.3	0.43J	<0.19	**850**
Hexachlorobenzene	*0.1*	**1**	NA	NA	NA	NA	NA
Hexachlorobutadiene			NA	NA	NA	NA	NA
Hexachlorocyclopentadiene			NA	NA	NA	NA	NA
Hexachloroethane			NA	NA	NA	NA	NA
Indeno[1,2,3-cd]pyrene			<0.056	<0.056	<0.056	<0.057	100
Isophorone			NA	NA	NA	NA	NA
Naphthalene	*10*	**100**	4.1	<0.23	<0.23	<0.23	**620**
Nitrobenzene			NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine			NA	NA	NA	NA	NA
N-Nitrosodiphenylamine			NA	NA	NA	NA	NA
Pentachlorophenol	*0.1*	**1**	NA	NA	NA	NA	NA
Phenanthrene			55	<0.22	0.38 J	<0.23	2300
Phenol	*1200*	**6000**	NA	NA	NA	NA	NA
Pyrene	*50*	**250**	7.8	2	<0.32	<0.32	**1100**

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