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May 9, 2013

U.S. Army Engineer District, Nashville
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Subject: ***Submittal of the Final Remedial Investigation Report for Waste Water Treatment Plant No. 1 and Waste Water Treatment Plant No. 3 Former Plum Brook Ordnance Works, Sandusky, Ohio Contract No. W912P5-12-D-0001: Shaw Project Number 145159***

Dear Ms. Coleman:

In accordance with the requirements of Delivery Order No. 0001 of Contract No. W912P5-12-D-0001 Shaw Environmental & Infrastructure, Inc., a CB&I company, is pleased to submit the Final Remedial Investigation Report for Waste Water Treatment Plant No. 1 and Waste Water Treatment Plant No. 3 at the Former Plum Brook Ordnance Works (PBOW) located in Sandusky, Ohio. This report represents the full compilation and summary for the DERP-FUDS project no. G05OH001817 Remedial Investigation. This report was prepared consistent with the following: the site characterization reports, baseline human health risk assessments, and screening-level ecological risk assessments that were prepared and finalized for each of the PBOW sites; the agreements among the PBOW project delivery team members; and communications with the U.S. Army Corps of Engineers regarding the scope of this report.

This Final RI report incorporates the comments of the Corps on the previously submitted September 20, 2012 internal draft.

Enclosed for your records are four copies of this report and a complete electronic copy is attached to each hard copy on compact disk (CD). As agreed during the November 29, 2012 PDT meeting, the appendices to the RI Report are included on the CD only. Copies of the deliverable have also been sent to those on the distribution list as indicated for their records.

Should you have any questions or require additional information regarding this submittal, please do not hesitate to contact me at (865) 694-7496.

Sincerely,

Steven. T. Downey, PE, PMP
Project Manager

200-1e

G05OH001817_03.10_0005_a

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Client Name: U.S. Army Engineer District, Nashville; CELRN-EC-E

Project Description: Remedial Investigation Report for Waste Water Treatment Plant No. 1 and Waste Water Treatment Plant No. 3 Former Plum Brook Ordnance Works, Sandusky, Ohio

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Remedial Investigation Report
Waste Water Treatment Plant No. 1 and
Waste Water Treatment Plant No. 3

Former Plum Brook Ordnance Works,
Sandusky, Ohio

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FUDS Project No. G05OH001817
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May 2013

Final

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List of Acronyms

amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BHHRA	baseline human health risk assessment
BSC	background screening concentration
CD	compact disk
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSEM	conceptual site exposure model
DERP	Defense Environmental Restoration Program
D&M	Dames & Moore, Inc.
DNB	dinitrobenzene
DNT	dinitroluene
DOD	U.S. Department of Defense
DQO	data quality objectives
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
FS	feasibility study
FUDS	Formerly Used Defense Sites
gpm	gallons per minute
HI	hazard index
HQ	hazard quotients
ICI	International Consultants Incorporated
ILCR	incremental lifetime cancer risk
IT	IT Corporation
K_{ow}	octanol-water partitioning coefficient
LBA	Locomotive Building Area
LOAEL	lowest-observed-adverse-effect level
LRD	Great Lakes and Rivers Division
LSI	limited site investigation
MCL	maximum contaminant level
MDC	maximum detected concentration
µg/L	micrograms per liter
mg/kg	milligrams per kilogram

mg/L	milligram per liter
NASA	National Aeronautics and Space Administration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAEL	no-observed-adverse-effects level
NWI	National Wetland Inventory
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
PAH	polynuclear aromatic hydrocarbon
PBOW	Plum Brook Ordnance Works
PBS	Plum Brook Station
PCB	polychlorinated biphenyl
ppm	parts per million
PRG	preliminary remediation goal
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RBRC	risk-based remedial concentration
RBSC	risk-based screening concentration
RfD	reference dose
RI	remedial investigation
RSLs	regional screening level
SCR	site characterization report
SDWR	Secondary Drinking Water Regulations
Shaw	Shaw Environmental, Inc.
SLERA	screening-level ecological risk assessment
SVOC	semivolatile organic compound
T&E	threatened or endangered
TAL	target analyte list
TDS	total dissolved solids
TNB	trinitrobenzene
TNT	trinitrotoluene
TNTA	TNT Area A
TNTB	TNT Area B
TNTC	TNT Area C

List of Acronyms *(Continued)*

TOC	total organic carbon
TRV	toxicity reference values
UCL	upper confidence limit
USACE	U.S. Corps of Engineers
USGS	U.S. Geological Survey
VOC	volatile organic compound
WWTP	waste water treatment plant
WWTP1	Waste Water Treatment Plant No. 1
WWTP2	Waste Water Treatment Plant No. 2
WWTP3	Waste Water Treatment Plant No. 3

Executive Summary

A remedial investigation (RI) was conducted for four sites at Plum Brook Ordnance Works (PBOW), including Waste Water Treatment Plant No. 1 (WWTP1), the TNT Area A (TNTA) to WWTP1 (TNTA/WWTP1) Sewer Lines, TNT Area B (TNTB) to WWTP1 (TNTB/WWTP1) Sewer Lines, and Waste Water Treatment Plant No. 3 (WWTP3). The results of the RI have been previously reported in site characterization reports, baseline human health risk assessments (BHHRA), and screening-level ecological risk assessments (SLERA) performed and finalized for each of the four sites. This RI report summarizes these 12 reports and presents recommendations based on their findings. No additional investigation results, evaluation, or information is presented in this RI. However, recommendations are developed in this RI based on the information previously presented in the finalized documents. Thus, the purpose of this RI report is to consolidate the information for these four sites into one report and document recommendations as to whether or not conditions for each site warrants the performance of a feasibility study (FS).

WWTP1

Site Characterization Report

RI activities were conducted by Shaw Environmental & Infrastructure, Inc. (Shaw) (a CB&I company) at WWTP1 from December 2008 through May 2010. Field activities included direct-push drilling; direct-push soil and groundwater sampling; temporary piezometer installation; surface water and sediment sampling; permanent monitoring well installation in upgradient, source area, and downgradient locations; two rounds of groundwater sampling from the newly installed wells (one in the PBOW wet season and one in the dry season); surveying of sample locations and a staff gauge; and investigation-derived waste management.

Soil. A total of 27 RI soil samples, including three quality assurance/quality control samples, were collected from seven direct-push borings at WWTP1. Four nitroaromatics and four semivolatile organic compounds (SVOC) exceeded risk-based screening concentrations (RBSC) in surface and/or subsurface soil. Based on the presence of nitroaromatics and SVOCs above RBSCs in the soil, it was determined that former operations have impacted both the surface and subsurface soil at WWTP1.

Surface Water. One surface water sample was collected in an unnamed drainage ditch located north of the site. Four samples were planned for collection, but no surface water was present at the other three sample locations. No analytes were detected at concentrations exceeding RBSCs

in surface water; therefore, the surface water appears to be unimpacted by former WWTP1 operations.

Sediment. Four sediment samples were collected from the locations where surface water sampling had been planned, including the three locations which lacked surface water at the time of sampling. The sediment samples were primarily intended to determine whether or not polychlorinated biphenyls (PCB), which had been detected in previous investigations, were present. No PCBs were detected; therefore, former WWTP1 operations appear not to have impacted the sediment in adjacent ditches.

Overburden/Shale Piezometer Groundwater. In December 2008, a total of three groundwater samples were collected from three (PZ-01, PZ-02, and PZ-03) of the six temporary piezometers installed; three piezometers lacked sufficient groundwater to sample. The detection of nitroaromatics in the piezometer groundwater samples suggest that the overburden/shale groundwater at the WWTP1 site may have been impacted during former U.S. Department of Defense (DOD) activities and that permanent monitoring well installation was warranted.

Overburden/Shale Monitoring Well Groundwater. Monitoring well groundwater sampling from an upgradient well (WTP1-MW03), a source area well (WTP1-MW02), and a downgradient well (WTP1-MW01) occurred in May (wet season) and October (dry season) of 2009. Based on the presence of nitroaromatics above RBSCs and/or background screening concentrations (BSC) in the groundwater, it is determined that former operations have impacted the overburden/shale groundwater at WWTP1. Groundwater elevation measurements from these monitoring wells and the piezometers indicate that the flow direction is toward the north or north-northwest.

Bedrock Groundwater. Monitoring well sampling from upgradient well WTP1-BEDGW-003 and source area well WTP1-BEDGW-002 occurred in May (wet season) and October and November (dry season) of 2009. A downgradient monitoring well was not installed at WWTP1 because bedrock groundwater was not encountered during drilling of the borehole to a depth of nearly 100 feet. Only a groundwater sample from upgradient bedrock well WTP1-BEDGW-003 was collected during May 2009 due to insufficient recharge in the source area well. Both wells were sampled during the dry season sampling, but neither sample was collected using the low-flow method due to inadequate groundwater yield. No contaminants associated with site-related operations were detected in bedrock groundwater. Therefore, former manufacturing operations at the WWTP1 site do not appear to have impacted the bedrock groundwater. Groundwater

elevation measurements from these monitoring wells indicate that the flow direction is toward the northwest.

Baseline Human Health Risk Assessment

The BHHRA evaluated exposure to chemicals in bedrock groundwater, overburden groundwater, surface soil, subsurface soil, surface water, and sediment for cancer risks and noncancer hazards. The receptors listed below were evaluated for exposure to the chemicals of potential concern (COPC) and their associated hazards and risks. The media evaluated for each receptor are shown in parentheses.

- Current groundskeeper (surface soil)
- Future groundskeeper (combined surface and subsurface soil [referred to as "total soil"], bedrock groundwater, and overburden groundwater)
- Indoor worker (surface soil, subsurface soil [air pathway only], bedrock groundwater, and overburden groundwater)
- Construction worker (total soil, surface water, and sediment)
- On-site resident (total soil, surface water, sediment, bedrock groundwater, and overburden groundwater)
- Hunter (surface soil)
- Hunter's child (surface soil [venison pathway only]).

Risks were characterized for each COPC identified in each medium for the relevant receptors. The overall hazard index (HI) and incremental lifetime cancer risk (ILCR) values are summarized in the following bullets; exceedances of the PBOW cancer risk goal (ILCR>1E-5) are shown as bold and exceedances of the noncancer hazard criterion (HI>1) or the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) risk management range (1E-6 to 1E-4) are shown as bold italics:

- Current groundskeeper: ILCR = 2E-6; HI = 0.07
- Future groundskeeper – all pathways, assuming bedrock groundwater use: ***ILCR = 8E-4; HI = 6***
- Future groundskeeper – all pathways, assuming overburden groundwater use: **ILCR = 4E-5**; HI = 0.4

- Future groundskeeper – all pathways, excluding groundwater use: ILCR = 3E-6; HI = 0.08
- Indoor worker – all pathways, assuming bedrock groundwater use: ***ILCR = 8E-4; HI = 6***
- Indoor worker – all pathways, assuming overburden groundwater use: **ILCR = 4E-5**; HI = 0.4
- Future indoor worker – all pathways, excluding groundwater use: ILCR = 5E-7; HI = 0.03
- Construction worker: ILCR = 1E-7; HI = 0.2
- Resident – all pathways, assuming bedrock groundwater use: ***ILCR = 4E-3***; ***child HI = 74***; ***adult HI = 32***
- Resident – all pathways, assuming overburden groundwater use: ***ILCR = 2E-4***; ***child HI = 3***; adult HI = 1
- Resident – all pathways, excluding groundwater use: ILCR = 8E-6; child HI = 0.8; adult HI = 0.09
- Hunter: ILCR = 1E-7; HI = 0.004
- Hunter's child: ILCR = 2E-11; HI = 0.000006.

The cancer risks and noncancer hazards associated with bedrock groundwater are nearly entirely attributable to natural petroleum-related compounds and arsenic. The cancer risks associated with overburden groundwater are mostly due to arsenic in one sample from upgradient well WWTP1-MW01; arsenic in this sample does not appear to be associated with former site activities. Use of either the overburden or bedrock groundwater is regarded as implausible because of insufficient yield. Additionally, the naturally poor quality of the bedrock groundwater and associated hydrogen sulfide off-gassing make it unsuitable as a potable source. The readily available municipal water supply obviates the need for use of groundwater as a potential source of tap water in the general vicinity of PBOW.

If the contributions of exposure to groundwater are appropriately excluded, none of the WWTP1 receptors had ILCRs or HIs that exceed the PBOW target values (ILCR$\leq$1E-5; HI$\leq$1) or the NCP risk management range (1E-6 to 1E-4). This indicates that the associated environmental media at WWTP1 are unlikely to pose an unacceptable cancer risk to any receptor, and that exposure to these media is unlikely to result in adverse noncancer health effects for any human receptor.

Screening-Level Ecological Risk Assessment

A SLERA was performed to provide an estimate of current and future ecological risk associated with potential hazardous substance releases within WWTP1. No threatened or endangered species, sensitive habitats, or areas of vegetative stress were observed on site.

Six representative receptor species that are expected to be present at the site were selected as indicator species for the potential effects of chemicals of potential ecological concern (COPEC) that were identified during an initial screening step. The six species selected included the deer mouse, short-tailed shrew, Eastern cottontail rabbit, marsh wren, white-tailed deer, and red-tailed hawk. Aquatic receptors were not utilized in this SLERA, because the ditches adjacent to the site are normally dry and do not represent viable aquatic habitat. Semiaquatic receptors, such as the raccoon, were also not included because COPECs were not identified in sediment, and other receptors (e.g., the short-tailed shrew) are more protective of terrestrial exposure scenarios.

For soil, terrestrial invertebrates and plants may have slightly elevated hazard based upon the exceedance of ecological benchmarks. However, only 10 chemicals exceeded benchmarks, and the concentrations were not highly elevated, with the possible exception of one detection of 2,4,6-trinitrotoluene (TNT) at a concentration of 181 milligrams per kilogram (mg/kg). Given the conservative nature of benchmark values, it is unlikely that ecological communities are adversely impacted at the site. Ecological risk from soil was primarily evaluated using food chain models for the selected terrestrial assessment receptors (i.e., deer mouse, short-tailed shrew, Eastern cottontail rabbit, marsh wren, white-tailed deer, raccoon, and red-tailed hawk). Ingestion of surface water was also evaluated in the food chain models. Four explosives compounds in soil (1,3,5-trinitrobenzene, 1,3-dinitrobenzene, 2,4,6-TNT, and tetryl) were the only chemicals that resulted in hazard quotients (HQ) that exceeded a value of 1. However, HQ values using conservative inputs did not exceed 10 when rounded and were likely overestimated due to conservative assumptions used in the models, particularly with regards to uptake of chemicals in soil by terrestrial invertebrate prey items. Further, the small area where elevated concentrations were detected is spatially irrelevant for most receptors. Therefore, the potential for adverse ecological impacts associated with chemicals in soil and surface water is considered to be low at this site.

Based on the findings of the SLERA, the potential for adverse effects to populations of ecological receptors exposed to chemicals in soil, surface water, and sediment at WWTP1 is expected to be very low, especially given the limited area of WWTP1.

Recommendations for WWTP1

No remedial actions or further investigation of WWTP1 media are recommended based on the results of the WWTP1 RI efforts, including the BHHRA and the SLERA. This recommendation is based on the following:

- None of the WWTP1 human receptors had ILCRs or HIs that exceed the PBOW target criteria or the NCP risk management range, excluding groundwater pathways.
- The unacceptable risks and hazards associated with WWTP1 groundwater exposure in the BHHRA are attributable to naturally occurring conditions rather than former DOD activities. Also, because groundwater use is not regarded as plausible based on insufficient yield and/or poor natural quality, the risks associated with WWTP1 groundwater are accordingly implausible.
- Ecological threats associated with WWTP1 are very low.
- No T&E species, sensitive habitats, or vegetative stress were identified for WWTP1.

TNT Area A to WWTP1 Sewer Lines

Site Characterization Report

No previous investigation has been performed for the TNTA/WWTP1 sewer lines. RI activities were conducted by Shaw for the TNTA/WWTP1 sewer lines from December 2008 through September 2011. Field activities included a geophysical survey; test pit excavation; test pit soil sampling; direct-push drilling; direct-push soil and groundwater sampling; composite soil sample collection; temporary piezometer installation; surface water and sediment sampling; permanent monitoring well installation in upgradient, source area, and downgradient locations; two rounds of groundwater sampling from the newly installed wells (one in the PBOW wet season and one in the dry season); surveying of sample locations; and investigation-derived waste management.

Geophysical Investigation. In December 2008, a geophysical investigation was conducted in the open field between WWTP1 and the TNTA settling tanks to identify the specific subsurface locations of the northern and southern subsurface trenches and to determine the presence or absence of the wood-stave pipelines that were used for transporting TNT waste. Geophysical instrumentation was used to identify the possible existence of the pipeline under Columbus Avenue, but the pipeline in the open field could not be located using geophysics. However, a review of aerial photographs was used to identify the locations of the sewer line traces.

Surface Soil Investigations. A total of 12 surface soil samples (which includes one quality assurance [QA] and one quality control [QC] sample) were collected from 10 locations at the TNTA/WWTP1 Sewer Lines area in January 2009. In August and September 2011, 24 surface soil samples were collected and analyzed for nitroaromatics only to delineate contamination previously detected in the vicinity of soil boring location SB05. The data indicate that surface soil in the vicinity of soil boring SB05 is contaminated with nitroaromatics including 2,4,6-TNT, which was detected at concentrations up to 1,280 mg/kg. The data suggest that the contamination is restricted to surface soil, is not laterally extensive, and likely is the result of a surface spill during removal of the sewer line.

Subsurface Soil Investigations. Eighteen test pits were excavated in the open grassy field between the former WWTP1 and TNTA settling tanks area. Twenty-three soil samples (which include three QA/QC samples) were collected from the base of each test pit and analyzed for nitroaromatics. Six nitroaromatics were detected in test pit soil samples, and the nitroaromatics 2,4-dinitrotoluene and 2,4,6-TNT were above RBSCs in three samples. To further confirm the detection of nitroaromatics in subsurface soil, a total of 12 soil samples, which include 1 QC and 1 QA sample, were collected from 10 borings drilled along the northern and southern flume line locations in January 2009.

In October and November 2010, 117 composite soil samples were collected along 5,850 feet of the sewer line using direct-push sampling. Utilities and roads prevented sampling along 2,350 feet of the line. The samples consisted of five-point composites collected along 50-foot segments of the former sewer line at depths corresponding to the bottom of the sewer line. All samples were field screened using colorimetric test kits, and confirmation samples were sent to an analytical laboratory for all screening samples exceeding 10 mg/kg total nitroaromatics. This protocol resulted in eight composite soil samples being sent for laboratory analysis, as were six discrete soil samples.

The former sewer lines appear to have only minimally impacted the subsurface soil. Detection of nitroaromatics was sporadic and not reproducible. Based on visual observations, subsurface contamination is restricted to thin layers of soil immediately below the former sewer line and is not interpreted to be laterally continuous.

Surface Water. Eight surface water samples (which include one QC and one QA sample) were collected from surface water sample locations 1SLA-SW01 through 1SLA-SW06 in adjacent Plum Brook. No analytes were detected in surface water; therefore, the TNTA/WWTP1 Sewer Lines appear not to have had any impact on Plum Brook surface water.

Sediment. Eight sediment samples (1SLA-SD01 through 1SLA-SD06 and one QC and one QA sample) were collected from collocated surface water sample locations in Plum Brook on October 30, 2010. No nitroaromatics were detected in sediment and no PCBs exceeded RBSCs; therefore, the TNTA/WWTP1 sewer lines appear to have had no impact to the sediment in adjacent Plum Brook.

Piezometer Groundwater. From January 26 through 30, 2009, groundwater was collected from 4 (SL-PZ02, SL-PZ05, SL-PZ08, and SL-PZ09) of the 10 piezometers installed at the TNTA/WWTP1 Sewer Lines. Four regular and two QA/QC samples were collected. Five nitroaromatics were detected in the overburden/shale groundwater in the temporary piezometers, and two were above RBSCs. The results from the piezometer groundwater samples suggested that the overburden/shale groundwater at the TNTA/WWTP1 sewer line site may have been impacted during former DOD activities and that permanent monitoring well installation was warranted.

Overburden/Shale Groundwater. Three permanent overburden/shale monitoring wells were installed at the TNTA/WWTP1 Sewer Lines to assess groundwater quality. A total of five regular samples were collected for laboratory analysis. There were no detections above RBSCs of nitroaromatics, volatile organic compounds (VOC), SVOCs, or cyanide in any of the monitoring wells. It appears that the overburden/shale groundwater has not been impacted by the presence of the TNTA/WWTP1 Sewer Lines. The detection of nitroaromatics in groundwater samples from piezometers but not in monitoring wells is likely due to entrained sediment and not to leaching of contamination from overlying soil. Groundwater elevation measurements from these monitoring wells and the piezometers indicate that groundwater flows locally in a radial south-to-west direction.

Bedrock Groundwater. Three permanent bedrock monitoring wells were installed at the TNTA/WWTP1 sewer lines to assess the groundwater quality. Bedrock monitoring well 1SLA-BEDGW-001 was installed in an upgradient location, 1SLA-BEDGW-MW02 was drilled as a source area well, and well 1SLA-BEDGW-MW03 was drilled in a downgradient location. Like the overburden/shale wells, groundwater was sampled in May 2009 during the wet season and in November 2009 during the PBOW dry season. A total of seven groundwater samples (which include one QC and two QA samples) were collected from the bedrock wells. Based on only one nitroaromatic detection, this groundwater is interpreted to have been minimally impacted by the TNTA/WWTP1 sewer lines. Groundwater elevation measurements from these monitoring wells indicate that the flow direction is toward the north-northeast.

Baseline Human Health Risk Assessment

The BHHRA evaluated exposure to chemicals in bedrock groundwater, overburden groundwater, surface soil, subsurface soil, surface water, and sediment for cancer risks and noncancer hazards. The receptors listed below were evaluated for exposure to the COPCs and their associated hazards and risks. The media evaluated for each receptor are shown in parentheses.

- Current groundskeeper (surface soil)
- Future groundskeeper (combined surface and subsurface soil [referred to as "total soil"], bedrock groundwater, and overburden groundwater)
- Indoor worker (surface soil, subsurface soil [air pathway only], bedrock groundwater, and overburden groundwater)
- Construction worker (total soil, surface water, and sediment)
- On-site resident (total soil, surface water, sediment, bedrock groundwater, and overburden groundwater)
- Hunter (surface soil)
- Hunter's child (surface soil [venison pathway only]).

Risks were characterized for each COPC identified in each medium for the relevant receptors. The overall HI and ILCR values are summarized in the following bullets; exceedances of the PBOW cancer risk goal (ILCR>1E-5) are shown as bold and exceedances of the noncancer hazard criterion (HI>1) or the NCP risk management range (1E-6 to 1E-4) are shown as bold italics:

- Current groundskeeper: ILCR = 1E-5; HI = 0.8
- Future groundskeeper – all pathways, including bedrock groundwater use: ***ILCR = 4E-4; HI = 4***
- Future groundskeeper – all pathways, including overburden groundwater use: ILCR = 7E-6; ***HI = 5***
- Future groundskeeper – all pathways, excluding groundwater use: ILCR = 7E-6; HI = 0.4
- Indoor worker – all pathways, including bedrock groundwater use: ***ILCR = 4E-4; HI = 4***

- Indoor worker – all pathways, including overburden groundwater use: ILCR = 4E-6; ***HI = 5***

- Future indoor worker – all pathways, excluding groundwater use: ILCR = 4E-6; HI = 0.3

- Construction worker: ILCR = 4E-7; HI = 1

- Resident – all pathways, including bedrock groundwater use: ***ILCR = 2E-3; child HI = 32; adult HI = 12***

- Resident – all pathways, including overburden groundwater use: ILCR =1E-5 (**2E-5**); ***child HI = 34; adult HI = 13***

- Resident – all pathways, excluding groundwater use: ILCR = 1E-5 (**2E-5**); ***child HI = 4;*** adult HI = 0.5

- Hunter: ILCR = 9E-7; HI = 0.4

- Hunter's child: ILCR = 2E-12; HI = 0.00001.

The cancer risks and noncancer hazards associated with bedrock groundwater are almost entirely attributable to naturally occurring petroleum-related compounds and arsenic, which also does not appear to be related to former site activities. The noncancer hazards associated with overburden groundwater are entirely due to inorganics, especially thallium and cobalt, which do not appear to be associated with former site activities. Use of either the overburden or bedrock groundwater is regarded as implausible because of insufficient yield. Additionally, the naturally poor quality of the bedrock and overburden groundwater and the associated hydrogen sulfide off-gassing of the bedrock unit make the underlying groundwater unsuitable for potable use. The readily available municipal water supply obviates the need for use of groundwater as a potential source of tap water in the general vicinity of PBOW.

If the use of groundwater is excluded, only the HI value of 4 for the child resident exceeds the target HI of 1. This HI is almost entirely associated with 2,4,6-TNT. Elevated 2,4,6-TNT concentrations are not representative of the entire length of the sewer line traces, but instead were limited in the BHHRA characterization to reported concentrations near test pits TP-27 and TP-33. Therefore, these two test pit areas were further investigated for nitroaromatics and evaluated as to whether they represent potential hot spots. The investigation of the TP-33 area revealed that the elevated TNT concentration detected in a single TP-33 area sample was not representative of the vicinity of TP-33 and that the TP-33 location is thus not a hot spot. This

investigation identified the TP-27 area as a hot spot because additional contamination was found in delineation samples, and the contaminated area near TP-27 is estimated as being approximately 60 feet by 20 feet.

As such, the TP-27 area may be considered for remediation using cleanup levels derived from risk-based remedial concentration (RBRC) values. TNT was identified as a preliminary chemical of concern in the BHHRA. RBRCs, which will be considered in the derivation of cleanup levels in the FS, were developed for TNT to support site management decisions.

Because the TP-27 area is regarded as a hot spot, the analytical results may be excluded from the general TNTA/WWTP1 sewer lines data sets and addressed separately as described in the previous paragraphs. Likewise, the single elevated nitroaromatics sample that is nonrepresentative of TP-33 may be excluded from this re-evaluation. If both the TP-27 and the TP-33 data sets are removed from the risk characterization (and groundwater exposure is excluded), none of the TNTA/WWTP1 sewer lines receptors has an ILCR value that exceeds the PBOW cancer risk goal or an HI that exceeds the target HI of 1. The results of this evaluation indicates that exposure to soil along the TNTA/WWTP1 Sewer Lines, outside of the TP-27 area, would not result in unacceptable cancer risks or noncancer hazard for any receptor.

Screening-Level Ecological Risk Assessment

A SLERA was performed to provide an estimate of current and future ecological risks associated with potential hazardous substance releases with the TNTA/WWTP1 sewer lines site. No T&E species, sensitive habitats, or areas of vegetative stress were observed on site.

Eight representative receptor species that are expected to potentially reside at the site were selected as indicator species for estimating the potential effects of COPECs that were identified during an initial screening step: the deer mouse, short-tailed shrew, Eastern cottontail rabbit, marsh wren, white-tailed deer, raccoon, red-tailed hawk, and muskrat. The raccoon and muskrat were evaluated for semiaquatic or aquatic exposure.

For soil, terrestrial invertebrates and plants may have slightly elevated hazard based upon the exceedance of ecological benchmarks. Ecological hazard from soil was primarily evaluated using food chain models for the selected terrestrial assessment receptors (i.e., deer mouse, short-tailed shrew, Eastern cottontail rabbit, marsh wren, white-tailed deer, raccoon, and red-tailed hawk). Aroclor 1016 (marsh wren), 1,3,5-trinitrobenzene (marsh wren), and 2,4,6-TNT (deer mouse, short-tailed shrew, cottontail rabbit, and marsh wren) in soil exceeded an HQ of 1 at the TNTA/WWTP1 sewer lines. Uptake into terrestrial invertebrate prey items was the critical

exposure pathway for these three chemicals. Based on comparisons of the modeled uptake factors of these three chemicals to empirical site-specific factors based on data collected at the installation for other organic compounds, uptake into terrestrial invertebrates was likely overestimated for Aroclor 1016, 1,3,5-trinitrobenzene, and 2,4,6-TNT. The potential for Aroclor 1016 and 1,3,5-trinitrobenzene in soil to adversely affect ecological receptors is considered to be very low. 2,4,6-TNT was detected at elevated concentrations in two areas, TP-33 and TP-27. Further sampling indicated that only one of these areas, TP-27, represents a hot spot of elevated concentrations. The impacted area within this hot spot is very small (approximately 0.04 acre), which reduces its potential to be a threat to local populations of ecological receptors. Therefore, the potential for adverse ecological impacts associated with 2,4,6-TNT is also considered to be low at this site; however, localized impacts of 2,4,6-TNT exposure to ecological receptors in the vicinity of TP-27 cannot be discounted.

For sediment, benthic invertebrates may have slightly elevated hazard based upon the presence of one chemical (Aroclor 1254) at concentrations greater than its ecological benchmark. Based on the food chain model results, the aquatic receptors (i.e., raccoon and muskrat) were not predicted to have elevated hazards from exposure to chemicals in sediment at the site.

Based on the findings of the SLERA, the potential for adverse effects to populations of ecological receptors exposed to chemicals in soil, surface water, and sediment at the TNTA/WWTP1 sewer lines is expected to be low, although localized impacts in the vicinity of TP-27 associated with exposure to TNT in soil cannot be discounted. However, the area affected (0.04 acre) is likely too small to adversely affect ecological populations or communities at the site. Therefore, based on ecological considerations alone, no chemicals at this site are recommended for further evaluation.

Recommendations for the TNTA/WWTP1 Sewer Lines

Based on the results of the TNTA/WWTP1 RI efforts, including the BHHRA and SLERA, remedial action should be considered to address human health concerns for the small (approximately 60 feet by 20 feet) area of surface soil in the vicinity of test pit TP-27, where elevated 2,4,6-TNT concentrations were identified. RBRC values were developed in the BHHRA for 2,4,6-TNT to support site management decisions. These RBRC values will be considered in the derivation of cleanup levels in the FS, if performed. Because of the negligible areal extent with respect to ecological populations, the lack of T&E species, the lack of sensitive habitat, and no observations of vegetative stress, no further evaluation or remediation is warranted with respect to ecological receptors; however, any remediation at TP-27 will also reduce the ecological hazard associated with localized exposure to the 2,4,6-TNT hot spot.

Although TNTA/WWTP1 bedrock groundwater risks/hazards and overburden/shale groundwater hazards exceeded the PBOW goals for one or more receptors, no further evaluation or other actions are warranted because the unacceptable risks and hazards associated with WWTP1 groundwater exposure in the BHHRA are attributable to naturally occurring conditions rather than former DOD activities. Also, because groundwater use is not regarded as plausible based on insufficient yield and/or poor natural quality, the risks associated with WWTP1 groundwater are accordingly implausible.

TNT Area B to WWTP1 Sewer Lines

Site Characterization Report

RI field activities were conducted by Shaw for the TNTB/WWTP1 sewer lines from July 2009 through May 2010. These activities included test pit excavation; test pit soil sampling; direct-push drilling; direct-push soil and groundwater sampling; temporary piezometer installation; permanent monitoring well installation in upgradient, source area, and downgradient locations; two rounds of groundwater sampling from the newly installed wells (one in the PBOW wet season and one in the dry season); surveying of sample locations; and investigation-derived waste management.

Test Pit Excavation. Twenty test pits were excavated between the former WWTP1 and TNTB settling tanks area. No intact piping was encountered during excavations, but the trenching did uncover evidence of soil discoloration consistent with a filled trench and indications that a pipeline had been present (i.e., portions of wood stave piping and metal bands). A total of 24 soil samples (including 2 QC and 2 QA samples) were collected and analyzed for nitroaromatics. Test pit soil samples were typically collected from depths of 1.5 to 2 or 2 to 3 feet below ground surface. A total of six nitroaromatics were detected in 4 of the 24 test pit soil samples; only 2,4,6-TNT exceeded the RBSC of 3.6 parts per million.

Direct-Push Soil. To confirm nitroaromatic detections in the test pit soil and any impact to the groundwater, direct-push soil drilling was conducted in August 2009. A total of 30 soil samples, including QA/QC samples, were collected from 14 direct-push borings at the TNTB/WWTP1 sewer lines. Fourteen surface (0 to 1 foot, including 2 QC and 2 QA samples) and 16 subsurface (below 0 to 1 foot, including 1 QC and 1 QA sample) soil samples were collected from the borings. The soil appears not to have been impacted by the presence of the TNTB/WWTP1 sewer lines based on the observation that no nitroaromatics detections exceeded the RBSCs. The

only organic compounds exceeding the RBSCs were polynuclear aromatic hydrocarbons (PAH), interpreted to be from controlled vegetation burns not associated with the sewer lines.

Overburden/Shale Piezometer Groundwater. During August 2009, a total of six overburden groundwater samples (including one QC and one QA sample) were collected from the six temporary piezometers installed at TNTB/WWTP1. One nitroaromatic (2,4,6-TNT) was detected above the RBSC in the overburden/shale groundwater.

Overburden/Shale Monitoring Well Groundwater. Based on the limited detections of nitroaromatics in soil and piezometer groundwater samples, only two permanent overburden/shale monitoring wells (1SLB-MW01 and 1SLB-MW02) were installed at the TNTB/WWTP1 sewer lines to assess groundwater quality. Groundwater sampling was conducted in May 2009, during the wet season, and in November 2009, during the dry season. Based on the absence of nitroaromatics and other organics at concentrations exceeding RBSCs, the overburden/shale groundwater appears not to have been impacted by the TNTB/WWTP1 sewer lines. Groundwater elevation measurements from these monitoring wells and the piezometers indicate that the flow direction is toward the north-northeast.

Baseline Human Health Risk Assessment

The BHHRA was conducted to evaluate risks associated with exposure to soil and groundwater along the TNTB/WWTP1 sewer lines trace. The receptors listed below were evaluated for exposure to the COPCs and their associated hazards and risks. The media evaluated for each receptor are shown in parentheses.

- Current groundskeeper (surface soil)
- Future groundskeeper (combined surface and subsurface soil [referred to as “total soil”] and overburden groundwater)
- Indoor worker (surface soil, subsurface soil [air pathway only], and overburden groundwater)
- Construction worker (total soil)
- On-site resident (total soil and overburden groundwater; noncancer hazards evaluated separately for the young child [ages 1 through 6 years] and adult)
- Hunter (surface soil)
- Hunter’s child (surface soil [venison pathway only]).

Risks were characterized for each COPC identified in each medium for the relevant receptors. Noncancer hazards were evaluated against a target HI criterion of 1 and the PBOW team target ILCR goal of 1E-5 (i.e., one additional incidence of cancer per 100,000 individuals exposed). Cancer risk results are also compared to the NCP acceptable cancer risk range of 1E-6 to 1E-4 (i.e., a rate of one additional incidence of cancer per 1,000,000 to 1 in 10,000 individuals exposed), which is referred to herein as the "NCP risk management range."

The overall HI and ILCR values are summarized for each receptor in the following bullets:

- Current groundskeeper: ILCR = 6E-6; HI not calculated (No noncancer COPCs were identified; thus, adverse noncancer health effects are extremely unlikely.)
- Future groundskeeper: ILCR = 2E-6; HI = 0.04
- Future Indoor worker: ILCR = 2E-6; HI not calculated (No noncancer COPCs were identified; thus, adverse noncancer health effects are extremely unlikely.)
- Construction worker: ILCR = 8E-8; HI = 0.002
- Resident: ILCR = 5E-6; child HI = 0.2; adult HI = 0.1
- Hunter: ILCR = 4E-7; HI not calculated (No noncancer COPCs were identified; thus, adverse noncancer health effects are extremely unlikely.)
- Hunter's child: No ILCR or HI calculated (The carcinogenic COPCs are regarded as nonbioaccumulative, thus cancer risks are regarded as de minimis; no noncancer COPCs were identified, thus adverse noncancer health effects are extremely unlikely.).

None of the receptors had ILCR values that exceed either the PBOW cancer risk goal (ILCR>1E-5) or the NCP risk management range (1E-6 to 1E-4). Neither did any of the receptors have HI values that exceed the noncancer hazard criterion (HI>1). This indicates that the associated environmental media along the TNTB/WWTP1 sewer line trace are unlikely to pose an unacceptable cancer risk to any receptor and that exposure to these media is unlikely to result in adverse noncancer health effects for any human receptor.

Screening-Level Ecological Risk Assessment

A SLERA was performed to provide an estimate of current and future ecological risk associated with potential hazardous substance releases from the former sewer lines that connected the TNTB/WWTP1 sewer lines. The state-endangered golden-winged warbler (*Vermivora chrysoptera*) was observed along the sewer line trace and is possibly nesting on or near the site.

Other than the golden-winged warbler, no T&E species or sensitive habitats were observed on site, nor were any areas of vegetative stress observed.

Six representative receptor species that are expected to be present at the site were selected as indicator species for the potential effects of COPECs that were identified during an initial screening step: the deer mouse, short-tailed shrew, Eastern cottontail rabbit, marsh wren, white-tailed deer, and red-tailed hawk. The marsh wren served as a surrogate for the state-endangered golden-winged warbler. Aquatic receptors were not utilized in this SLERA, because the sewer lines do not intersect habitat that supports aquatic or semiaquatic receptors.

For soil, terrestrial invertebrates and plants may have slightly elevated hazard based upon the exceedance of ecological benchmarks. However, only 12 chemicals were selected as COPECs, and the concentrations associated with these chemicals were not highly elevated. Given the conservative nature of benchmark values, it is unlikely that ecological communities are adversely impacted at the site. The potential for ecological effects from COPECs in soil was primarily evaluated using food chain models for the selected terrestrial assessment receptors (i.e., deer mouse, short-tailed shrew, Eastern cottontail rabbit, marsh wren, white-tailed deer, raccoon, and red-tailed hawk). Carbazole was the only chemical that resulted in HQs that exceeded a value of 1. Carbazole in soil had elevated HQs for several receptors due to the extremely conservative toxicity reference values (TRV) used in the food chain models. However, a weight-of-evidence analysis suggests that the TRV used to assess carbazole is considered questionable, and ecological impacts associated with exposure to carbazole are assumed to be minor.

Based on the findings of the SLERA, the potential for adverse effects to populations of ecological receptors exposed to chemicals in soil at the TNTB/WWTP1 sewer lines is expected to be low.

Recommendations for the TNTB/WWTP1 Sewer Lines

No remedial actions or further investigation of TNTB/WWTP1 sewer lines media are recommended based on the results of the TNTB/WWTP1 sewer lines RI efforts, including the BHHRA and SLERA, based on the following:

- None of the TNTB/WWTP1 sewer lines human receptors had ILCRs or HIs that exceed the PBOW target criteria or the NCP risk management range.
- Ecological threats are associated with WWTP1/TNTB sewer lines are very low.

- Other than the golden-winged warbler, no T&E species, sensitive habitats, or vegetative stress were identified for the TNTB/WWTP1 sewer lines.

WWTP3

Site Characterization Report

RI activities were conducted by Shaw at WWTP3 from December 2008 through May 2010. Field activities included direct-push drilling; direct-push soil and groundwater sampling; temporary piezometer installation; surface water and sediment sampling; permanent monitoring well installation in upgradient, source area, and downgradient locations; two rounds of groundwater sampling from the newly installed wells (one during the PBOW wet season and one during the dry season); surveying of sample locations and staff gauges; and investigation-derived waste management.

Soil. From December 10 through 11, 2008, a total of 27 RI soil samples, including three QA/QC samples, were collected from seven direct-push borings at WWTP3. Soil samples included 7 surface and 20 subsurface soil samples. One PCB was detected above the RBSC in the surface soil, and seven SVOCs were detected above RBSCs in the surface and intermediate soil samples. No target analyte list metals were detected above both RBSCs and BSCs. Based on the presence of SVOCs above RBSCs in the soil, former operations may have impacted both the surface and subsurface soil at WWTP3.

Surface Water. Three RI surface water samples were collected from the unnamed drainage ditch located adjacent to and on the western side of WWTP3. A total of five surface water samples (including one field duplicate and field split sample) were collected. No organics were detected in surface water at concentrations exceeding RBSCs; therefore, the surface water appears not to have been impacted by former WWTP3 operations.

Sediment. Collocated with the RI surface water samples, three sediment samples were collected from WWTP3. Two PAHs were detected in sediments at concentrations exceeding RBSCs; no other organics were detected at concentrations exceeding the RBSCs.

Overburden/Shale Piezometer Groundwater. A total of three groundwater samples were collected from three (PZ-01, PZ-02, and PZ-03) of the six temporary piezometers. Eight metals (aluminum, arsenic, cobalt, copper, iron, manganese, nickel, and zinc) exceeded both the RBSCs and BSCs in the unfiltered groundwater samples. Only arsenic and manganese exceeded both the

RBSCs and BSCs in filtered samples. No organics were detected at concentrations that exceeded the RBSCs.

Overburden/Shale Groundwater. Overburden/shale monitoring well sampling from WTP3-MW01 (upgradient well), WTP3-MW02 (source area well), and WTP3-MW03 (downgradient well) was performed in May 2009 during the wet season and in November 2009 during the dry season. Based on the presence of the nitroaromatic 2,4-dinitrotoluene, which was detected at a concentration slightly greater than the RBSC, it is possible that former WWTP3 operations have impacted overburden/shale groundwater. Groundwater elevation measurements from these monitoring wells and the piezometers indicate that the flow direction is generally toward the northeast and northwest, but is variable based on precipitation.

Bedrock Groundwater. Bedrock monitoring well groundwater sampling in bedrock wells (WTP3-BEDGW-001 [downgradient well], WTP3-BEDGW-002 [source area], and WTP3-yBEDGW-003 [upgradient well]) occurred in May (wet season) and November (dry season) 2009. Based on the lack of nitroaromatic detections and the detection of only a few metals and petroleum-related VOCs and SVOCs at concentrations above the RBSCs and/or BSCs in the Delaware Limestone groundwater, this groundwater unit is interpreted as not to have been impacted by former WWTP3 operations. Groundwater elevation measurements from these monitoring wells indicate that the flow direction is southeast toward a groundwater trough.

Baseline Human Health Risk Assessment

The BHHRA was conducted to evaluate risks associated with exposure to soil, groundwater, surface water, and sediment at WWTP3. One or more COPCs were found in each WWTP3 environmental medium. The receptors listed below were evaluated for exposure to the COPCs and their associated hazards and risks. The media evaluated for each receptor are shown in parentheses.

- Current groundskeeper (surface soil)
- Future groundskeeper (combined surface and subsurface soil [referred to as “total soil”], bedrock groundwater, and overburden groundwater)
- Indoor worker (surface soil, subsurface soil [air pathway only], bedrock groundwater, and overburden groundwater)
- Construction worker (total soil, surface water, and sediment)
- On-site resident (total soil, surface water, sediment, bedrock groundwater, and overburden groundwater)

- Hunter (surface soil)
- Hunter's child (surface soil [venison pathway only]).

Risks were characterized for each COPC identified in each medium for the relevant receptors. The overall HI and ILCR values are summarized in the following bullets; exceedances of the PBOW cancer risk goal (ILCR>1E-5) are shown as bold and exceedances of the noncancer hazard criterion (HI>1) or the NCP risk management range (1E-6 to 1E-4) are shown as bold italics:

- Current groundskeeper: **ILCR = 5E-5** (re-evaluated as 7E-6); HI = 0.07
- Future groundskeeper – all pathways, including bedrock groundwater use: ***ILCR = 4E-4; HI = 4***
- Future groundskeeper – all pathways, including overburden groundwater use: **ILCR = 9E-5**; HI = 1
- Future groundskeeper – all pathways, excluding groundwater use: ILCR = 1E-5; HI = 0.05
- Indoor worker – all pathways, including bedrock groundwater use: ***ILCR = 4E-4; HI = 3***
- Indoor worker – all pathways, including overburden groundwater use: **ILCR = 8E-5**; HI = 1
- Future indoor worker – all pathways, excluding groundwater use: ILCR = 1E-5; HI = 0.02
- Construction worker: ILCR = 1E-6; HI = 0.9
- Resident – all pathways, including bedrock groundwater use: ***ILCR = 2E-3***; ***child HI = 25***; ***adult HI = 10***

  Resident – all pathways, including overburden groundwater use: ***ILCR = 3E-4***; ***child HI = 7***; ***adult HI = 3***
- Resident – all pathways, excluding groundwater use: **ILCR = 5E-5** (re-evaluated as 1E-5)*;* child HI = 0.7; adult HI = 0.1
- Hunter: ILCR = 3E-6; HI = 0.004
- Hunter's child: ILCR = 2E-10; HI = 0.00004.

The ILCR values of the current groundkeeper scenario (5E-5) and the future resident (5E-5) associated with exposure to surface soil and total soil, respectively, are due nearly exclusively to PAHs in soil. The source of the PAHs may be cinders observed in several WWTP3 soil borings from a depth of just below the surface to approximately 3.5 feet below the surface. Although the cinders likely contribute to the PAH concentrations, it appears that sources other than the cinders are responsible for PAHs in surface and near-surface soils, especially at the locations with the highest concentrations. These include two surface soil samples from immediately adjacent to the patio adjoining the former National Aeronautics and Space Administration (NASA) K-Site control building (former neutralization tank) and a surface soil sample located immediately east of the current access road. NASA demolished the K-Site control building and adjoining patio in October 2012. As agreed by the PBOW Project Delivery Team, NASA removed and properly disposed of the PAH-contaminated soil in the immediate vicinity of the building and patio in conjunction with the demolition. The sample collected along the access road represents anthropogenic background associated with the asphalt road materials and vehicle emissions. If these three samples are excluded from the PAH database for WWTP3, the resulting hypothetical current groundskeeper ILCR is 7E-6 and the future resident ILCR is 1E-5. For all other receptors evaluated for WWTP3 under current or future land use, cancer risks and noncancer hazards are at acceptable levels, and adverse noncancer effects are unlikely to occur under these potential current and future scenarios.

The cancer risks and noncancer hazards associated with bedrock groundwater are mostly attributable to natural petroleum-related compounds, cyanide, and arsenic. The cancer risks associated with overburden groundwater are mostly due to arsenic, which does not appear to be associated with former site activities. Use of either the overburden or bedrock groundwater is regarded as implausible because of insufficient yield. Additionally, the naturally poor quality of the bedrock groundwater and associated hydrogen sulfide off-gassing make it unsuitable as a potable source. The readily available municipal water supply obviates the need for use of groundwater as a potential source of tap water in the general vicinity of PBOW.

Screening Level Ecological Risk Assessment

A SLERA was performed to provide an estimate of current and future ecological risk associated with potential hazardous substance releases within the WWTP3. Eight representative receptor species that are expected to be present at the site were selected as indicator species for the potential effects of COPECs that were identified following a screening step. The eight species selected included six terrestrial birds and mammals (deer mouse, short-tailed shrew, Eastern cottontail rabbit, marsh wren, white-tailed deer, and red-tailed hawk), one semiaquatic mammal (raccoon), and one aquatic mammal (muskrat).

For soil, terrestrial invertebrates and plants may have slightly elevated hazard based upon the exceedance of ecological benchmarks. However, detected concentrations in soil were not highly elevated. Benthic invertebrates and aquatic plants may also have slightly elevated hazard based upon the exceedance of ecological benchmarks. However, due to the limited aquatic habitat present near the site and the limited number of exceedances, it is unlikely that these communities are significantly impacted.

Ecological hazard from soil, surface water, and sediment was primarily evaluated using food chain models for the selected assessment receptors (i.e., deer mouse, short-tailed shrew, Eastern cottontail rabbit, marsh wren, white-tailed deer, raccoon, red-tailed hawk, and muskrat). Lead, PCBs, and PAHs (including carbazole) in soil and selenium in sediment had HQs greater than 1 based on the food chain model. However, detected concentrations and frequency of occurrence of samples exceeding screening criteria were generally low, and the HQs were not significantly elevated. Carbazole in soil had elevated HQs for several receptors; however, a weight-of-evidence analysis suggests that the TRV used to assess carbazole is considered questionable, and ecological impacts associated with exposure to carbazole are assumed to be minor.

Based on the findings of the SLERA, the potential for adverse effects to populations of ecological receptors exposed to chemicals in soil, surface water, and sediment at WWTP3 is expected to be very low.

Recommendations for WWTP3

No remedial actions or further investigation of WWTP3 media are recommended based on the results of the WWTP3 RI efforts, including the BHHRA and SLERA. (Please note that NASA has removed the soil with elevated PAH concentrations associated with the former NASA K-Site control building.) This recommendation is based on the following:

- None of the re-evaluated (i.e., excluding the area of NASA soil removal and the sample associated with road materials) WWTP3 human receptors had ILCRs or HIs that exceed the PBOW target criteria or the NCP risk management range, excluding groundwater pathways.

- The unacceptable risks and hazards associated with WWTP3 groundwater exposure in the BHHRA are attributable to naturally occurring conditions rather than former DOD activities. Also, because groundwater use is not regarded as plausible based on insufficient yield and/or poor natural quality, the risks associated with WWTP3 groundwater are accordingly implausible.

- Ecological threats are associated with WWTP3 are very low.
- No T&E species, sensitive habitats, or areas of vegetative stress were identified for WWTP3.

1.0 Introduction

The U.S. Army is conducting studies of environmental impacts attributable to releases associated with historical operations of a property previously owned by the U.S. Department of Defense (DOD), the former Plum Brook Ordnance Works (PBOW) in Sandusky, Erie County, Ohio. PBOW is an Army Defense Environmental Restoration Program (DERP) project under the Great Lakes and Rivers Division (LRD) Formerly Used Defense Sites (FUDS) program. The Louisville District office of the U.S. Corps of Engineers (USACE) is the program management district for the LRD FUDS program. Management support for PBOW is provided by the USACE Huntington District office and technical oversight is provided by the USACE Nashville District office.

This remedial investigation (RI) has been performed to determine if there has been any releases of hazardous substances, pollutants, or contaminants that present an unacceptable risk to human health or the environment associated with the following four PBOW sites, which comprise DERP-FUDS Project No. G05OH001817:

- Waste Water Treatment Plant No. 1 (WWTP1)
- TNT Area A (TNTA) to WWTP1 (TNTA/WWTP1) sewer lines
- TNT Area B (TNTB) to WWTP1 (TNTB/WWTP1) sewer lines
- Waste Water Treatment Plant No. 3 (WWTP3).

Please note that the TNTA/WWTP1 and TNTB/WWTP1 sewer lines were investigated separately from WWTP1 but are administratively part of WWTP1. This RI was conducted under Delivery Order No. 0001 of Contract No. W912P5-12-D-0001.

1.1 Report Organization

As part of the RI effort, each of the four PBOW sites listed above was previously investigated and evaluated in a site characterization report (SCR), baseline human health risk assessment (BHHRA), and screening-level ecological risk assessment (SLERA). This RI report summarizes these 12 reports and presents recommendations based on their findings. The SCRs, BHHRAs, and SLERAs are appended to this report in their entirety (Appendices A through L) in electronic format on compact disk (CD).

The remainder of this chapter provides a description and history of the PBOW facility and of the waste water treatment plants (WWTP) and WWTP1 sewer lines. This description of the WWTPs and sewer lines discusses their relationship to the three 2,4,6-trinitrotoluene (TNT) manufacturing areas with respect to the handling of waste water and briefly describes the history and current conditions

associated with each. More specific information on WWTP1, the TNTA/WWTP1 sewer lines, the TNTB/WWTP1 sewer lines, and WWTP3 are included in the respective SCRs, BHHRAs, and SLERAs that are appended to this RI report. Chapter 2.0 of this report summarizes the physical setting of PBOW and specifically addresses the four sites currently being evaluated (i.e., WWTP1, the TNTA/WWTP1 sewer lines, the TNTB/WWTP1 sewer lines, and WWTP3). This discussion of physical setting includes the geography, topography, drainage, and geology, including hydrogeology and natural groundwater quality.

Chapters 3.0 through 6.0 summarize the SCR, BHHRA, and SLERA analytical results and conclusions for WWTP1, the TNTA/WWTP1 sewer lines, the TNTB/WWTP1 sewer lines, and WWTP3, respectively. Chapter 7.0 presents site-specific recommendations for site management decisions. These recommendations primarily discuss whether or not a remedial action is warranted. These recommendations do not identify a specific technological approach, but are provided to help site managers form a basis for determining whether a feasibility study (FS) is required or if proceeding to a no-action proposed plan is the appropriate course for a given site. References used in the RI are provided in Chapter 8.0.

Additional details pertaining to the SCR, BHHRA, and SLERA for each of these four sites are provided in the 12 previously submitted final reports, which are included on CD as Appendices A though L.

1.2 Facility Location and Description

The former 9,000-acre PBOW facility was used for the manufacture of nitroaromatics during World War II. The National Aeronautics and Space Administration (NASA) operates and maintains the site as the Plum Brook Station (PBS), which is a satellite facility of the John H. Glenn Research Center, located at Lewis Field in Cleveland, Ohio. PBOW is located approximately 4 miles south of Sandusky, Ohio, and 59 miles west of Cleveland. Although primarily in Perkins and Oxford Townships, the eastern edge of PBOW extends into Huron and Milan Townships. PBOW is bounded on the north by Bogart Road, on the south by Mason Road, on the west by Patten Tract Road, and on the east by U.S Highway 250. The areas surrounding PBOW are primarily agricultural and residential. Public access is prohibited at PBOW except during the annual deer hunting season, when hunter access is allowed by permit only. Figure 1-1 shows the geographical location of the former PBOW site.

1.3 Facility History and Background

The PBOW facility was constructed on property comprising 9,009 acres in early 1941 as a manufacturing plant for 2,4,6-TNT, 2,4-dinitrotoluene (DNT), and pentolite (International

Consultants Incorporated [ICI], 1995). Production of explosives at PBOW began in December 1941 and continued until 1945. It is estimated that more than 1 billion pounds of nitroaromatic explosives were manufactured during the 4-year operating period. The three explosive manufacturing areas were designated TNTA, TNTB, and TNT Area C (TNTC). Twelve process lines were used in the manufacture of 2,4,6-TNT, including four lines at TNTA, three lines at TNTB, and five lines at TNTC.

After plant operations ceased, the manufacturing process lines were decontaminated by the Army in late 1945. During decontamination, all structures, equipment, and manufacturing debris were either removed and salvaged or removed and burned. After the property was certified as decontaminated, 3,230 acres of the property were initially transferred to the Ordnance Department, then to the War Assets Administration on September 6, 1946. In 1949, PBOW was transferred to the General Services Administration. This transfer did not include the Plum Brook Depot area, which consists of 2,800 acres. The Department of the Army reacquired the 3,230 acres in 1954. In 1955, the Army completed further decontamination of the manufacturing process lines. This effort included removal of contaminated surface and subsurface soil around the building and wooden and ceramic waste disposal lines containing TNT. Thousands of pounds of TNT were discovered in catch basins; this TNT was removed and burned at the burning grounds. The Army continued cleanup efforts until 1963.

Two property use agreements were entered into by the Army and the National Advisory Committee of Aeronautics, the predecessor of NASA, in 1956 and 1958, respectively. Accountability and custody for the entire portion of the former PBOW property (6,030 acres) that had been under the accountability and custody of the Department of the Army were transferred to NASA on March 15, 1963. NASA performed further decontamination efforts during 1964. The NASA decontamination process included removing contaminated surface soil above the drain tiles, flumes, etc.; destruction of all buildings by fire; then removal of all soil, debris, sumps, and above-grade portions of concrete foundations. Portions of the concrete foundations located below grade were left buried, and some that had been previously slightly above grade were covered with fill material. All materials, including the soil in those areas, were flashed; the area was then rough-graded. The decontamination process was also to have included the burning of excavated nitroaromatic-filled pipelines (Dames & Moore, Inc. [D&M], 1997a).

NASA has operated and maintained the former PBOW property since 1963. The current PBS facility supports the NASA John H. Glenn Research Center at Lewis Field, Cleveland, Ohio, as a satellite operation. Most of the aerospace testing facilities built in the 1960s at PBOW are currently on standby or inactive status. However, NASA has constructed newer research

facilities on site since the 1960s. On April 18, 1978, NASA declared approximately 2,152 acres of PBOW as excess. This excess included former buffer areas that had not been used by the Army and were thus not subject to decontamination efforts. The Perkins Township Board of Education acquired 46 acres of the excess acreage and uses this area as a bus transportation area. The General Services Administration retains ownership of the remaining excess acreage and currently has a use agreement with the Ohio National Guard for 604 acres of this land. The details of land transactions are listed in the site management plan (ICI, 1995).

1.4 WWTPs and Sewer Lines Description and History

Three PBOW WWTPs received waste water from former TNT manufacturing operations. These are WWTP1, Waste Water Treatment Plant No. 2 (WWTP2), and WWTP3. Two of these, WWTP1 and WWTP3, along with the TNTA/WWTP1 and TNTB/WWTP1 sewer lines, are the focus of this RI. WWTP2 is not part of this RI but is included in this section to provide a more complete description of the relationships between the three TNT areas and the three WWTPs with respect to waste water treatment. More complete descriptions of the individual WWTPs and the sewer lines are included in the appended SCRs, BHHRAs, and SLERAs.

The locations of WWTP1, the TNTA/WWTP1 sewer lines, the TNTB/WWTP1 sewer lines, and WWTP3 are shown on Figure 1-2. WWTP1 is located in the eastern-central portion of the PBOW facility, near the intersection of Maintenance Road and Ransom Road. The TNTA/WWTP1 sewer lines extended to the west/southwest from the settling basins at TNTA to WWTP1. The more southern of these TNTA/WWTP1 lines extended directly west-southwest from TNTA to WWTP1, approximately 3,800 feet. The more northern of these lines extended due west approximately 2,700 feet from TNTA before angling southwest for 1,500 feet to WWTP1. WWTP3 is located in the western central portion of the PBOW facility, approximately 650 feet southwest of the intersection of Maintenance Road and Ransom Road.

WWTP1 received waste water from settling basins located at TNTA and from TNTB. WWTP2, which is addressed as part of a different DERP-FUDS project (G05OH001818), received waste water from TNTC. WWTP3 is located between WWTP1 and WWTP2 and northwest of TNTB. WWTP3 acted as an overflow treatment plant for WWTP1 and WWTP2 and was connected to those facilities by a 6-inch steel sewer line (ICI, 1995). TNT manufacturing wastes were transferred from TNTA, TNTB, and TNTC by below-ground 4- to 6-inch-diameter wood-stave sewer pipelines (USACE, 1995).

The waste water that was transferred and received from TNT manufacturing areas consisted of spent sulfuric and nitric acids and red water from the TNT purification process. Chemicals in the

waste streams included sodium salts of sulfite, sulfate, nitrite, nitrate, sulfonates of unwanted TNT isomers, trinitrobenzoic acid, trinitrobenzaldehyde, trinitrobenzyl alcohol, nitrotoluenes, and dinitrotoluenes (D&M, 1996).

Each of the WWTPs consisted of a neutral storage tank, an equalization tank, a condensate storage tank, an evaporator building, an incinerator, and a thick liquid storage tank. WWTP1 and WWTP2 also each included a caustic storage tank and a raw waste storage tank. The plants received waste water from the TNT manufacturing settling basins and neutralized the slurry through a chemical depuration process. The liquid was discharged to open ditches or ponds surrounding the facilities or thickened by evaporation. The thickened liquid was then incinerated. The incinerators were located to the east of the storage tanks at WWTP1 and to the north of the storage tanks at WWTP3. Ash from the incinerator was disposed of in nearby ash pits associated with the WWTPs, although it is noted that most of the materials disposed of at the ash pits was coal ash from the associated powerhouses (USACE, 2000).

No aboveground structures are present at WWTP1, but foundations which had been generally covered with sand were encountered during sampling. An exception is a foundation west of monitoring wells WTP1-MW02 and WTP1-BEDGW-002, which is still visible. The only aboveground structure at WWTP3 was the former neutral storage tank that NASA converted and used as the K-Site control building and associated patio. No foundations were encountered at WWTP3.

During the 2009-2011 investigations of the TNTA/WWTP1 and TNTB/WWTP1 sewer lines, no structures or foundations of any kind were encountered. Only small pieces of intact sewer line (e.g., several inches long) were observed, as were miscellaneous pieces of metal banding which had held the staves together (Shaw Environmental & Infrastructure, Inc. [Shaw] [a CB&I company], 2012a). No intact sewer lines were found. Because the observed small pieces of wood-stave lines were very well preserved, it is apparent that the wood-stave sewer lines were previously removed and that the absence of intact sewer lines is not due to deterioration. Thus, it is likely that the majority of any residual contamination within the sewer lines was likewise removed during sewer line removal.

2.0 Physical Setting

2.1 Geography, Topography, and Surface Drainage

PBOW is located within the Eastern Lake Region of the Central Lowland Province (Soil Conservation Service, 1971). The facility is on a plain with a slight slope to the north-northeast toward Lake Erie at approximately 25 feet per mile. Elevations across the PBOW facility range from 680 feet above mean sea level (amsl) at the intersection of Taylor Road and Patrol Road on the southwestern side of the site to 625 feet amsl at the northern portion of the installation (Figure 1-2). In general, the topography of PBOW is characterized by a flat ground surface with occasional low hummocks caused primarily by glacial scouring and deposition. A low escarpment trends from the western to the northeastern portion of the site (Shaw, 2005).

PBOW lies in the eastern region of the Pickeral Creek-Pipe Creek Basin, which is part of the St. Lawrence River drainage basin (D&M, 1997b). Eleven streams exist within PBOW and flow north-northeast toward Lake Erie, which is located approximately 3.5 miles north of the site. The site is part of four drainage areas: (1) Sawmill Creek (southern PBOW); (2) Plum Brook (central PBOW); (3) Pipe Creek (western PBOW); and (4) Storrs-Hemminger Ditch (north-central PBOW). All four drainage areas flow into Sandusky Bay (D&M, 1997a). Four discharge points at PBOW (Lindsley Ditch, Ransom Brook, Kuebler Ditch, and Plum Brook) are monitored by NASA PBS under a National Pollutant Discharge Elimination System outfall permit (Ohio Environmental Protection Agency [OEPA], 2012). In addition to the streams, 17 isolated ponds and reservoirs and former red water ponds are located at PBOW (U.S. Geological Survey [USGS], 1992; D&M, 1997a).

WWTP1. Surface water for WWTP1 drains into small unnamed ditches north and west of the site that connect with larger ditches that eventually drain into Plum Brook.

TNTA/WWTP1 Sewer Lines. Surface water of the TNTA/WWTP1 sewer lines drains to two different PBOW creeks. Surface runoff in the western portion of the lines is interpreted to drain toward Plum Brook, while the majority of runoff is thought to drain toward a small creek on the southern portion of the site that discharges into Lindsley Ditch.

TNTB/WWTP1 Sewer Lines. Surface water of the TNTB/WWTP1 sewer lines drains to low-lying areas which drain to tributaries for the larger creeks. Surface water at the southern end of the line drains west toward Ransom Brook. Water located near the center and northern end of the line drains east toward Plum Brook.

WWTP3. Surface water for WWTP3 water drains toward a small creek located in the northwest portion of the site that eventually discharges into Pipe Creek.

2.2 Geology

2.2.1 Regional Geology

The bedrock in northern Ohio and found at PBOW consists of Devonian and Silurian carbonates (limestone and dolomite) and clastics (shale, siltstone, and sandstone). These units unconformably overlie older sedimentary sequences of Ordovician and Cambrian Age rocks, which in turn unconformably overlie pre-Cambrian basement rocks (D&M, 1997b). The local bedrock is situated on the eastern flank of the Findlay Arch. In the Devonian and Silurian of northern and western Erie County, weathering of the carbonates has produced cavernous porosity and karst topography.

2.2.2 Local Geology

At PBOW, three bedrock units have been encountered during well installation. These are the Delaware Limestone, the Olentangy Shale, and the Ohio Shale. The Delaware Limestone is the lowermost formation screened by site wells. It is characterized as a hard, dense, finely crystalline limestone and dolomite. The unit is typically buff colored, hard, and massive and usually is described as fossiliferous with pyrite crystals. In the vicinity of PBOW, quarries (Hanson Aggregates to the north, Hanson-Sandusky Crushed Stone to the southwest, and abandoned Castalia quarry to the west) mine limestone from the Delaware. Traces of natural petroleum-derived hydrocarbons and hydrogen sulfide are common in all three quarries. Overlying the Delaware Limestone is the Olentangy Shale. Two members of the Olentangy Shale have been characterized at the site: the Plum Brook Shale and the overlying Prout Limestone. The Plum Brook Shale is interpreted to consist of approximately 35 feet of bluish-gray, soft, fossiliferous shale containing thin layers of dark, hard, fossiliferous limestone. The Prout Limestone has been described as an approximate 15- to 50-foot-thick unit which occasionally outcrops in a 1,000- to 2,000-foot-wide, northeast-striking band across the middle portion of PBOW. It is described as a dark-gray to blue, very hard, siliceous, fossiliferous limestone or dolomitic mudstone. The Olentangy Shale of PBOW dips to the southeast at a slope of approximately 21 feet per mile. The uppermost formation at PBOW is the Ohio Shale. Geographic Information System data show that the Ohio Shale dips to the southeast at a slope of approximately 26 feet per mile (Shaw, 2005). Only one member of the Ohio Shale is present in the PBOW area, the Huron Shale. This unit is described as black and thinly bedded, with abundant carbonaceous matter. Some large

pyrite/carbonate concretions are also present in the Huron Shale, some as large as 6 feet in diameter (D&M, 1997b).

WWTP1. The WWTP1 area is located above the Prout Limestone (Olentangy Shale). Approximately 200 feet west of WWTP1, the geologic horizon changes to the Plum Brook Shale. Below the shale horizon at WWTP1, the Delaware Limestone was encountered in all three of the bedrock borings drilled during the investigation. Shale thicknesses varied only slightly and ranged from depths of 14.6 feet in WTP1-BEDGW-001 to 17.3 feet in WTP1-BEDGW-003.

TNTA/WWTP1 Sewer Lines. For the TNTA/WWTP1 sewer lines, the settling tank at the beginning of the line is located above the Prout Limestone (Olentangy Shale), very near to the interpreted Prout Limestone and Plum Brook Shale (Olentangy Shale) boundary. Approximately 200 feet west toward WWTP1, the geologic horizon changes to the Plum Brook Shale and remains above this bedrock unit past WWTP1. Below the shale horizon, the Delaware Limestone was encountered in all three of the bedrock borings drilled during the investigation. Shale thicknesses from the three bedrock borings vary from approximately 36 to 22 feet.

TNTB/WWTP1 Sewer Lines. The TNTB/WWTP1 sewer line was installed within the unconsolidated overburden soil and not within the underlying competent shale. However, to provide some context to the site geology, the following discussion relates the trace of the TNTB Sewer Line to the underlying site geology. The trace of the TNTB/WWTP1 sewer line begins at the settling tanks in the TNTB area, which is located above the Ohio Shale geologic unit. As the trace of the line continues north-northeast to WWTP1, it crosses through the Prout Limestone and ends in the Plum Brook Shale at WWTP1. Although no bedrock wells were installed for the TNTB/WWTP1 sewer line investigation, information pertaining to the geologic units obtained from nearby bedrock wells reveal that the shale thickness varies from approximately 15 feet in the north around WWTP1 to more than 40 feet in the south near the TNTB settling tank area.

WWTP3. The WWTP3 area is located above the Plum Brook Shale (Olentangy Shale). A thin lens of the Olentangy Shale encountered at an average depth of 26.4 feet below ground surface (bgs) was dark gray in color and had an average thickness of 1.3 feet. Below the shale horizon, the Delaware Limestone was encountered in all three of the bedrock borings drilled during the investigation.

2.2.3 Regional Hydrogeology

Regional groundwater flow is to the north-northeast towards Lake Erie, although local flow may vary due to local topography. Water in the limestone typically occurs in joints and along bedding

planes or in solutionally enlarged openings. Although some limestone in the middle of the county provide well yields of up to 500 gallons per minute (gpm), the overburden and the majority of the other formations can sustain groundwater pumping of only 10 gpm or less (D&M, 1997a). A hydrogeological study conducted by the USGS on the glacial deposits in Sandusky in 1990 reported a horizontal hydraulic conductivity of 0.046 feet per day and a vertical hydraulic conductivity of 1.2 feet per day (USGS, 1992).

2.2.4 Local Hydrogeology

From domestic groundwater wells outside of PBOW boundaries, the bedrock groundwater has been divided into three horizontal zones based on location and yield. Zone 1 occurs in the north and northwestern portion of PBOW. It is characterized as yielding from 100 to 500 gpm from karstic limestone approximately 100 feet below grade. Zone 2 is in the northern portion of PBOW and has yields of 15 gpm or less from limestone approximately 300 feet below grade. Zone 3 is located in the eastern and southern portion of the site in predominantly shale bedrock. In addition to being found in the shale, groundwater is located in thin sand and gravel horizons interbedded with silt and clay deposits. Most Zone 3 wells are poor yielding, many of them providing less than 3 gpm (D&M, 1997b). WWTP1 lies within Zone 1, the sewer lines lie chiefly within Zone 3, and WWTP3 appears to lie within Zone 2.

Two main vertical water-bearing zones are present at PBOW: one in the overburden/shale and one in the underlying Delaware Limestone bedrock. Data from previous investigations (IT Corporation [IT], 1997, 1999, 2000a,b; Shaw, 2003, 2005) show that groundwater in the overburden is in discontinuous pockets during dry time periods exemplified by monitoring wells that are typically dry or site areas in which wells could not be installed due to a lack of water in the overburden soil at the time of drilling.

2.2.5 Influence of Precipitation on Water Levels

As mentioned in the *2004 Groundwater Data Summary and Evaluation Report* (Shaw, 2005), previous investigations have indicated that there is a strong connection between precipitation and groundwater elevations, but no clear correlation exists between monthly precipitation rates and water level elevations in site wells. The lack of observed correlation is probably influenced by the amount of precipitation and the runoff rate. For example, summer thunderstorms that produce short periods of heavy precipitation may result in more surface runoff and less infiltration. Conversely, constant periods of precipitation at a lower rate over a period of days may result in more infiltration. Freezing rain or snow will also not result in an immediate recharge to groundwater. From review of local monthly precipitation data, evapotranspiration and rainfall runoff rates calculations, and a comparison table of sitewide monitoring well groundwater

elevations verses aquifer recharge rates, a seasonal correlation was determined. During the months of January through June, a greater volume of groundwater in the overburden/shale monitoring wells was present as compared to the months of July through December, when a lesser amount of water was present. Therefore, the time period of January through June is termed the "wet" time period, while July through December is termed the "dry" time period.

Corresponding to this interpretation, to determine if any water quality differences may be present during one of the time periods, groundwater sampling dates for the investigations were conducted during the month of May (wet season) and during the months of October and November (dry season), as described in the SCRs for WWTP1 (Appendix A), TNTA/WWTP1 (Appendix D), TNTB/WWTP1 (Appendix G), and WWTP3 (Appendix J).

2.3 Groundwater Quality and Use

2.3.1 Groundwater Quality

Two groundwater aquifer systems are utilized for drinking water in the region: a carbonate aquifer to the west and a shale aquifer to the east (Shaw, 2005). PBOW is located within the transition of the two systems. The limestone unit typically yields an adequate volume of groundwater for a drinking water source but is regionally regarded by the Ohio Department of Natural Resources (ODNR) as being of low quality because of high mineral content (ODNR, 1962).

The two main water-bearing zones underlying the PBOW facility are located in the overburden/shale unit and the limestone bedrock and are thus called the overburden/shale and bedrock water-bearing zones. The overburden and shale groundwater units exhibit similar water levels, suggesting substantial vertical communication, and are considered one hydrogeologic unit.

Overburden/Shale Groundwater. Groundwater in the overburden is in discontinuous pockets during dry time periods (Shaw, 2005; IT, 1997, 1999, 2001a). Also, the shallow overburden generally has low yields over most of PBOW due to the high percentage of silt and clay. Because of these conditions, the overburden/shale groundwater yields insufficient volume for potable use in many areas of the underlying PBOW. Additionally, groundwater from background wells in competent shale bedrock was found to have elevated concentrations of chloride, sulfate, iron, manganese, and total dissolved solids (TDS) (Shaw, 2006). Some of these concentrations, especially those of sulfate and TDS, were found at levels that far exceed the respective U.S. Environmental Protection Agency (EPA) Office of Groundwater Secondary

Drinking Water Regulations (SDWR) or health advisories (EPA, 2011). The SDWRs are nonenforceable levels that are based on aesthetic properties (e.g., taste, odor, color) or cosmetic effects (e.g., skin or tooth discoloration). The following list compares concentrations of these analytes in samples from off-site upgradient background shale unit groundwater wells to the respective Office of Drinking Water SDWRs or health advisories.

- ***Chloride*** – Fifty percent of the background wells exceeded the chloride SDWR of 250 milligrams per liter (mg/L) or parts per million (ppm). The maximum background concentration (3,540 ppm) was 14 times higher than the SDWR.

- ***Sulfate*** – Eleven percent of the background wells exceeded the sulfate SDWR of 250 ppm. The maximum background concentration (514 ppm) was approximately twice the SDWR.

- ***Iron*** – Thirty-two percent of the background wells exceeded the iron SDWR of 0.3 ppm. The maximum background concentration (1.55 ppm) was approximately 5 times higher than the SDWR.

- ***Manganese*** – Sixty-one percent of the background wells exceeded the manganese SDWR of 0.05 ppm. The maximum background concentration (0.728 ppm) was over 14 times higher than the SDWR.

- ***Sodium*** – One hundred percent of the background wells exceeded the sodium health advisory level of 20 ppm. The maximum background concentration (1,390 ppm) was approximately 70 times higher than the sodium health advisory level. (Note that no SDWR exists for sodium.)

- ***TDS*** – Eighty-two percent of the background wells exceeded the TDS SDWR of 500 ppm. The maximum background concentration (6,850 ppm) was nearly 14 times higher than the SDWR.

Based on naturally occurring high TDS and other analytes as described above, this groundwater unit is consistent with the EPA guidelines for Class III nonpotable groundwater. Therefore, overburden/shale groundwater is not a suitable drinking water source based on both low yield and naturally poor quality.

The low yield in the overburden/shale groundwater that is characteristic under much of PBOW was observed in the vicinity of WWTP1, the TNTA/WWTP1 sewer lines, the TNTB/WWTP1 sewer lines, and WWTP3. At each of these sites, at least half of the piezometers were dry and thus could not be sampled. At WWTP1, only two of the six overburden/shale monitoring well samples could be collected using low-flow methodology because of low yield. Three of five TNTA/WWTP1 sewer line overburden/shale well samples could be collected using low-flow

methodology, but samples could not be collected from well 1SLA-MW01 in May 2009 due to low yield. All four samples from the two TNTB/WWTP1 sewer line overburden/shale wells could be collected as low-flow samples, but a planned third well was not installed due to a lack of water in this unit. At WWTP3, none of the six samples collected from the three overburden/shale wells could be collected using low-flow methodology because of low water yield. All overburden/shale monitoring well samples that could not be collected using low-flow methodology were collected via bailer (with the exception of 1SLA-MW01 in May 2009, because it was dry).

Limestone Bedrock Groundwater. The limestone bedrock water-bearing zone yields groundwater year round, although specific locations may not produce water due to limited bedrock fractures in some areas. During periods of low precipitation, only limited migration of contaminants would occur in the overburden due to reduced infiltration. Limestone bedrock groundwater underlying most of PBOW is of poor natural quality, largely due to naturally occurring petroleum hydrocarbons and hydrogen sulfide gas emissions.

As mentioned in Section 2.2.2, the presence of natural petroleum-derived hydrocarbon seeps are common along the walls of area quarries (Shaw, 2005). Petroleum hydrocarbons were observed at depth during the drilling of all three WWTP1 bedrock wells. WTP1-BEDGW-001 had petroleum hydrocarbon staining at 47.9 to 49.3, 52.4 to 52.6, and 68.8 to 80.6 feet, and hydrocarbon seeping from factures at 68.4 to 68.5 and 74.0 to 74.4 feet bgs. Note that WTP1-BEDGW-001 was dry and no samples could be collected from this well. Petroleum hydrocarbon staining was also observed at depth in the cores of WTP1-BEDGW-002 (51.7 to 54.3 feet bgs) and WTP1-BEDGW-003 (49.9 to 54.8 feet bgs), with hydrogen sulfide odor observed in the latter during well purging. Note that hydrogen sulfide has been observed at high concentrations in bedrock wells at nearby PBOW sites, notably in Ash Pit 1 well AP1-BEDGW-002 and in Locomotive Building Area (LBA) monitoring well MNTA-BEDGW-001 (more than 200 ppm) (Shaw, 2011a). Also, in nearby Ash Pit 1 well AP1-BEDGW-001 to the south (generally upgradient), nearly 1 foot of free product has been found on the surface of the water during sampling (Shaw, 2010a). Petroleum hydrocarbons were also found at depth in four of the six bedrock wells in the nearby LBA (Shaw, 2010b) to the west (side gradient), indicating the prevalence of petroleum contamination in the bedrock zone within this general area of PBOW. These observations provide evidence that petroleum hydrocarbons and elevated levels of hydrogen sulfide are naturally occurring in this general area of PBOW.

Similarly, petroleum hydrocarbon odors and/or staining were observed at depth during the drilling of all three TNTA/WWTP1 sewer line bedrock wells. At well 1SLA-BEDGW-001,

petroleum hydrocarbon staining was observed on the cores at 52.8 to 58.2 feet bgs. No samples could be collected from this well due to insufficient yield. Well 1SLA-BEDGW-002 exhibited strong hydrocarbon odors from 50 to 65 feet bgs. This well also produced extremely high levels of hydrogen sulfide (i.e., more than 200 ppm), which made it unsuitable to develop due to health and safety reasons. Petroleum hydrocarbon staining was also observed at depth on the cores of 1SLA-BEDGW-003 at 63.8 to 71.7 feet bgs, along with associated petroleum hydrocarbon odors. These observations provide evidence that petroleum hydrocarbons and elevated levels of hydrogen sulfide are naturally occurring in this general area of PBOW. No bedrock wells were installed at the TNTB/WWTP1 sewer lines because it was observed that no site-related chemicals were detected in the overlying TNTB/WWTP1 overburden/shale sewer line wells and very little contamination was found in TNTB/WWTP1 sewer lines soil samples.

At WWTP3, petroleum was observed at depth in the rock cores of all three bedrock monitoring wells, including wells WTP-BEDGW-001 (40.4 to 42.9, 47.6, 51.0, and 53.1 feet bgs), WTP-BEDGW-002 (40.5 to 43.4 and 47.8 feet bgs), and WTP3-BEDGW-003 (40.2 to 44.2, 47.3, and 52.9 feet bgs) (Appendix J). Well WTP3-BEDGW-002 also exhibited high levels of hydrogen sulfide (above 200 ppm), which indicates that bedrock groundwater in the vicinity of WWTP3 is of naturally poor quality.

Consistent with the findings of naturally occurring petroleum hydrocarbons in the limestone wells, benzene was detected in each of the WWTP1, TNTA/WWTP1 sewer line, and WWTP3 wells; note that no limestone bedrock wells were installed at the TNTB/WWTP1 sewer lines. All of the limestone bedrock groundwater samples at WWTP1 had benzene concentrations (5.6 to 403 micrograms per liter [µg/L]) that exceed the promulgated Safe Drinking Water Act maximum contaminant level (MCL) of 5 µg/L for benzene (EPA, 2011). Similarly, each of the TNTA/WWTP1 sewer line limestone bedrock groundwater samples had benzene concentrations (17.7 to 175 µg/L) that exceed the benzene MCL. At WWTP3, benzene concentrations (2.1 to 16.0 µg/L) exceeded the MCL in only two samples: the May 2009 quality control (QC) sample (16.0 µg/L) and the November 2009 sample (15.4 µg/L) from well WTP3-BEDGW-003.

The TDS concentration of each WWTP1 (2,630 to 4,600 mg/L), TNTA/WWTP1 sewer line (2,250 to 12,200 mg/L), and WWTP3 (1,160 to 1,790 mg/L) limestone bedrock groundwater sample exceeded the SDWR for TDS of 500 mg/L. The most common components of TDS are common salts; very small particulates; and ionic forms of common elements such as calcium, magnesium, sodium, iron, sulfate, and strontium (OEPA, 2009). The elevated TDS within the limestone bedrock that underlies PBOW likely results from the reducing conditions that mobilize

metals. In addition, naturally occurring long-chained petroleum hydrocarbon molecules may also contribute to TDS in PBOW bedrock groundwater.

In summary, the limestone unit generally provides an adequate quantity of groundwater for hypothetical potable use. However, the natural quality of this water would fail drinking water standards with respect to naturally occurring benzene that consistently exceeds the MCL and the elevated TDS. The elevated benzene is related to naturally occurring petroleum hydrocarbons, and the high TDS is likely associated with naturally occurring reducing conditions.

2.3.2 Groundwater Use

Approximately 170 private drinking water wells permitted by the Erie County Health Department are located within 4 miles of PBOW. USACE conducted a private well survey for the area within 1 mile of the downgradient PBOW boundary. Only five private wells were identified within the 1-mile radius. Two of these were identified as being used for the irrigation of lawns and gardens and washing cars, and the other three were not used at all (Appendix A of Shaw [2006]). Groundwater is not used within the PBOW facility.

3.0 Waste Water Treatment Plant No. 1

This chapter provides a summary of the sampling, analyses, results, and evaluation of the environmental media associated with WWTP1 (i.e., soil, overburden/shale groundwater, limestone bedrock groundwater, surface water, and sediment) that have been presented in the WWTP1 SCR (Appendix A), BHHRA (Appendix B), and SLERA (Appendix C). The reference for each of these documents is provided below:

- Shaw Environmental, Inc. (Shaw), 2011b, *Waste Water Treatment Plant 1, Site Characterization Report,* Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, April.

- Shaw Environmental, Inc. (Shaw), 2011c, *Baseline Human Health Risk Assessment, Waste Water Treatment Plant 1,* Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, December.

- Shaw Environmental, Inc. (Shaw), 2011d, *Screening Level Ecological Risk Assessment, Waste Water Treatment Plant 1,* Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, December.

In addition, results of the previous limited site investigation (LSI) of WWTP1 are briefly summarized in Section 3.1. Identification of the samples and the recommendations from the LSI present a context for the performance of the RI and for some of the specific sampling locations and analyses performed in the RI.

Please note that this chapter provides no data or other information that has not been previously presented in the WWTP1 SCR, BHHRA, or SLERA (Appendices A, B, and C).

3.1 Previous Investigation and Evaluation

Prior to the RI, analytical samples were collected from WWTP1 in 1999 as part of the LSI of WWTP1 (USACE, 2000). The following samples were collected:

- Ten surface soil samples (including two QC samples)
- Five sediment samples (including one QC sample).

No surface water samples could be collected during the LSI because the drainage ditches were dry. Surface soil and sediment samples were analyzed for nitroaromatics, volatile organic compounds (VOC), semivolatile organic compounds (SVOC), polychlorinated biphenyls (PCB), target analyte list (TAL) metals, and asbestos.

The analytical results were compared to EPA Region 9 preliminary remediation goals (PRG) as described in the SCR as a qualitative screening evaluation. Based on this screening evaluation, which identified two samples with elevated TNT concentrations, USACE recommended that an RI be performed. This RI report addresses the concerns raised by the LSI. The LSI results are summarized in the SCR (Appendix A) and were further evaluated in the BHHRA (Section 3.3 and Appendix B) and SLERA (Section 3.4 and Appendix C).

3.2 Site Characterization and Evaluation

This section summarizes the RI sampling of environmental media at WWTP1, the analytical results, and an evaluation of these results that are presented in the SCR. Additional details are provided in the SCR (Appendix A).

3.2.1 Samples and Analyses

The RI samples were collected consistent with the site-specific quality assurance project plan (QAPP) (Shaw, 2008a) and Phase 1 and Phase 2 work plans for WWTP1 (Shaw, 2008b; 2009a). Soil, groundwater, surface water, and sediment sampling locations are shown on Figure 3-1.

Surface and subsurface soil samples were collected as part of the RI from eight borings. Generally, surface soil is defined as samples collected from within the interval of 0 to 1 foot bgs, and subsurface soil is defined as samples collected from depths greater than 1 foot bgs per the Phase 1 RI work plan (Shaw, 2008b). However, during the RI, it was observed that WWTP1 was covered with up to 2.6 feet of the sandy fill material described in the SCR (Appendix A). This sandy material likely comprised most of the soil sampled during the LSI. Therefore, the RI surface soil samples were collected from the native material below the fill. The work plan called for subsurface soil samples to be collected at depths of 3 to 5 and 8 to 10 feet bgs. However, the shallower subsurface interval was adjusted to a target range of 5 to 7 feet bgs because of the presence of the sandy fill. The interval for the deepest soil samples was kept at 8 to 10 feet bgs. In addition to the surface soil samples collected from the eight boring locations, four additional surface soil samples were collected in the vicinity of sample SSW-108 to evaluate the presence of an exceedingly high concentration of TNT (170,000 milligrams per kilogram [mg/kg]) that was reported at this location during the LSI. As described in Section 3.2.2, this high TNT concentration was not verified.

Six piezometers were installed as described in the Phase 1 work plan. However, only three of these (WWTP-PZ01, WWTP1-PZ02, and WWTP1-PZ03) yielded adequate groundwater volume for sampling.

Three overburden/shale groundwater monitoring wells (WTP1-MW01, WTP1-MW02, and WTP1-MW03) and two limestone bedrock monitoring wells (WTP1-BEDGW-002 and WTP1-BEDGW-003) were installed at WWTP1 according to the Phase 2 work plan. The work plan was designed to include upgradient, on-site, and downgradient groundwater locations, as was done with respect to the overburden/shale wells. The location of a planned third bedrock well (WTP1-BEDGW-0001) would have been downgradient to WWTP1, but this well was not installed because groundwater was not encountered during drilling. The placement of overburden monitoring wells was based on groundwater flow directions determined from newly installed piezometers. Sitewide bedrock groundwater flow maps were used to place new bedrock monitoring wells.

The collection of four collocated surface water and sediment samples had been planned at locations within the drainage ditches north and west of WWTP1. However, surface water was present only within a pooled area of the northern ditch at WWTP1-SW01, and the ditches were otherwise dry. Therefore, only one surface water sample was collected.

The following list summarizes the samples and analyses collected for the RI:

- ***Surface Soil*** – Ten samples, including one QC sample and one quality assurance (QA) sample, were analyzed for nitroaromatics, TAL metals, PCBs, and SVOCs. Additionally, the four verification samples near LSI sample SSW-108 were analyzed for nitroaromatics only.

- ***Subsurface Soil*** - Ten samples, including one QC sample and one QA sample, from within an overall depth interval of 5 to 7.6 feet were analyzed for nitroaromatics, TAL metals, PCBs, and SVOCs. Ten samples, which includes one QC sample and one QA sample, from within a depth interval of 8 to 10 feet were analyzed for nitroaromatics, TAL metals, and SVOCs.

- ***Overburden/Shale Piezometers*** – Three groundwater samples were analyzed for nitroaromatics, TAL metals (filtered and unfiltered), SVOCs, cyanide, and general chemistry parameters; field tests were also conducted.

- ***Overburden/Shale Monitoring Wells*** – A total of six groundwater samples, three in the wet season and three in the dry season, were analyzed for nitroaromatics, TAL metals (filtered and unfiltered), SVOCs, VOCs, and general chemistry parameters; field tests were also conducted.

- ***Limestone Bedrock Monitoring Wells*** – A total of three groundwater samples, one in the wet season and two in the dry season, were analyzed for nitroaromatics, TAL metals (filtered and unfiltered), SVOCs, VOCs, and general chemistry parameters; field tests were also conducted.

- ***Sediment*** – Four samples were collected from the same locations as during the LSI and analyzed for PCBs and general chemistry parameters. Other parameters (nitroaromatics, TAL metals, and SVOCs) were previously analyzed during the LSI.

- ***Surface Water*** – A single surface water sample was collected from an area of pooled water and analyzed for nitroaromatics, TAL metals, and SVOCs.

All analytical data from these samples were reviewed for accuracy and completeness. One hundred percent of the data analyzed were subjected to data validation following the guidelines in the EPA *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (EPA, 2008) and EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 2004a), the QAPP (Shaw, 2008a), and specific analytical method requirements. Data were evaluated against specific criteria to verify the achievement of precision, accuracy, representativeness, completeness, and comparability goals established to meet the project data quality objectives (DQO). The criteria for blank evaluation were based on those detailed in *Region 3 Modifications to National Functional Guidelines for Evaluating Organic Analyses* (EPA, 1994) and *Region 3 Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA, 1993). Additional information on data evaluation, data validation, and data quality are provided in the SCR and information attached therein (Appendix A).

3.2.2 Characterization of WWTP1

3.2.2.1 Local Soils

At many PBOW sites, following closure and removal of the manufacturing structures, tanks, and equipment, a local fill sand was brought to the areas to cover the remaining concrete building foundations and demolition scars and to provide a natural landscape appearance. Based on drilling and sampling results, some fill is present at WWTP1, with an interpreted thickness of up to 2.6 feet. The fill material and the interpreted 1940 ground surface are very similar in lithology (very fine-grain sand), but the native ground surface soil is interpreted to be characterized by color laminations and striations compared to a homogeneous and sometimes mottled fill sand. At some of the borings, a thin gravel layer was encountered and interpreted to be a former working or road surface. The average thickness of fill sand encountered at WWTP1 is 1.3 feet, but fill material is absent in some portions of the site.

Native soil at WWTP1 was predominantly derived from glacial deposits (till, outwash, or glacial lacustrine [lake] deposits). The top 6 feet of soil at WWTP1 generally consists of a very fine-

grain, homogeneous, stratified sand with vertical laminations. Below 6 feet, the soil changes to a stiff, homogeneous, dark gray, highly plastic, silty clay. Rock fragments consisting of shale and limestone were commonly encountered near the bottom of borings that were advanced to bedrock.

3.2.2.2 Local Geology

Bedrock units in WWTP1 consist of the Olentangy Shale and the underlying Delaware Limestone, both of Devonian age (Figure 3-2). The Olentangy Shale at WWTP1 was encountered at an average depth of 22.8 feet bgs. In general, the shale was gray in color, highly weathered, friable, and thinly laminated. Thickness of the shale in the bedrock monitoring well locations averaged 18.6 feet. Below the shale, the Delaware Limestone was encountered. It was found at depths ranging from 38.1 feet bgs (600.5 feet amsl) in bedrock well WTP1-BEDGW-002 to 38.8 feet bgs (597.8 feet amsl) in well WTP1-BEDGW-001. The limestone was typically dark gray in color, massive, fossiliferous, slightly weathered, and hard. Pyrite crystals were located on several cores along with a light brown hydrocarbon staining. All three of the bedrock wells exhibited a strong hydrocarbon and hydrogen sulfide odor. A description of the presence of naturally occurring petroleum hydrocarbons and hydrogen sulfide is presented in the SCR.

3.2.2.3 Local Hydrogeology

Overburden/shale groundwater at WWTP1 was encountered at depths ranging from 2.4 feet bgs (PZ-02) to 5.5 feet bgs (SB-08/PZ-05 and PZ-01) in December 2008 (wet season) during soil boring drilling/piezometer installation. During monitoring well installation conducted in March 2009 (wet season), overburden/shale groundwater was encountered at depths of 1 foot bgs (WTP1-MW01 and WTP1-BEDGW-001) to 3 feet bgs (WTP1-BEDGW-003). As shown by the May 26, 2009 overburden/shale groundwater elevation contour map, which includes water level measurements from both the temporary piezometers and permanent monitoring wells, groundwater flow is in a north-northwest direction toward an unnamed drainage ditch (Figure 3-3). Figure 3-4 presents an overburden/shale groundwater potentiometric map of water level measurements in October 2009 (dry season). The October 2009 map does not include measurements from temporary piezometers because they had been abandoned in June 2009, although groundwater measurements from two newly installed overburden/shale wells (1SLB-MW01 and 1SLB-MW02, installed in October 2009) are included. Overburden/shale wells 1SLB-MW01 and 1SLB-MW02 were installed to address contamination from an adjacent investigation area (the TNTB/WWTP1 sewer line). The groundwater flow direction during October 2009 is also northwest. Overburden/shale groundwater flow from both contour maps indicates that it mimics the surface topography.

In addition, one stream level staff gauge (SG01) was placed in the drainage ditch located north of the area, beside surface water-sediment sample location SDW-02, and survey elevations were recorded at the top and base of the rod. The drainage ditch was dry during all water level measuring events. This suggests that the surface drainage may not act as a point of groundwater discharge, at least in the vicinity of the staff gauge. However, it should be noted that the May 2009 water level in PZ-01 is approximately 0.5 foot higher than the bottom of the ditch. Piezometer PZ-01 is approximately 29 feet south of the staff gauge, suggesting the potential does exist for limited groundwater discharge during periods of higher precipitation and groundwater recharge.

Two bedrock wells were installed at WWTP1 during the RI. Bedrock groundwater was encountered in fractures at depths of 45 feet bgs (WTP1-BEDGW-002) and 47.2 feet bgs (WTP1-BEDGW-003) during bedrock monitoring well installation in March 2009. No water-bearing fractures were encountered during bedrock drilling for WTP1-BEDGW-001, so the borehole was properly abandoned and a well was not installed. To provide a regional bedrock groundwater flow determination instead of a local interpretation based on only two bedrock wells, groundwater level measurements were recorded from all PBOW sitewide bedrock monitoring wells during the months of May and October 2010. As determined by elevations shown on Figures 3-5 and 3-6, bedrock groundwater flow is in a northwest direction toward a bedrock groundwater trough. The trough has been interpreted to be the result of continuous bedrock groundwater pumping by sumps in the Reactor Building and/or preferential flow along southwest-to-northeast bedrock fractures. Previously, this trough has been based primarily on groundwater levels from bedrock monitoring wells TNTC-BEDGW-001 in the TNTC area and BED-MW15 and BED-MW23 in the Pentolite Road area. In general, fluctuations in bedrock groundwater elevations from 2002 through 2010 reflect only seasonal changes that are generally consistent site wide both in seasonal trends and magnitude (approximately 10 feet of variation). However, one of the wells defining the trough BED-MW23 has shown variable water levels. Water levels ranged from a low of 560.67 feet amsl in 2002 to 611.22 feet amsl in 2010. The water levels in this well have consistently been rising over the 8 years that water levels have been recorded. The reason for this rise is not clear; however, it could be the result of lower pumping of sump wells in the Reactor Building leading to a rise in water levels in the near proximity. This effect has not been seen in BED-MW15, suggesting that it may be screened in a bedrock fracture isolated from BED-MW23. Because of this rise in water levels, a mound is shown on the current interpretation of bedrock groundwater (Figures 3-5 and 3-6). This interpretation is speculative, however, given that water levels are not available for the Reactor Area wells.

Vertical hydraulic gradients were calculated for the two WWTP1 well pairs, WTP1-MW02/ WTP1-BEDGW-002 and WTP1-MW03/WTP1-BEDGW-003. One well pair is located in the northwestern portion of the site and the other is located near the center of the site. Both of the overburden wells are screened in the overburden material, and both of the bedrock wells are screened in the Delaware Limestone. During all water level measurement events, groundwater elevations from the overburden/shale well were higher than those of the bedrock well. This difference suggests that there may be relatively limited connectivity between the overburden and bedrock water-bearing zones in these areas. In addition, any vertical groundwater migration that occurs will be downward from the overburden into the bedrock. Vertical gradients of both well pairs (0.701 and 0.848 foot per foot) are similar to the vertical gradients from other PBOW well pairs. The comparison shows similar results in that the WWTP1 wells have a downward vertical gradient, implying the potential for downward groundwater migration from the overburden/shale water-bearing zone to the bedrock aquifer.

3.2.2.4 Summary of Analytical Results

The analytical results of the RI samples, described in Section 3.2.1, are summarized in this section. As part of this evaluation, analytes detected in the respective environmental media were compared to risk-based screening concentrations (RBSC) and background screening concentrations (BSC) as points of reference only. Concentrations of analytes that exceed the RBSCs are highlighted in the associated tables (Tables 3-1 through 3-6). RBSCs do not infer a regulatory limit or mandated cleanup level, nor is the identification of an exceedance intended to indicate an unacceptable human health risk or a need for remedial action. Formal evaluation of human health risks was performed in the BHHRA. Concentrations in individual samples that exceed the respective BSCs are identified by bold text in Tables 3-1 through 3-4.

The RBSCs are derived from May 2010 regional screening levels (RSL) (EPA, 2010) as described in the BHHRA (Appendix B). The groundwater RBSCs are based on a generalized residential drinking water scenario, assumed to be the most restrictive use of groundwater, and they correspond to a one-in-one-million (1E-6) incremental lifetime cancer risk (ILCR) or a noncancer hazard quotient (HQ) of 0.1, whichever results in a lower concentration (Shaw, 2009b). The soil RBSCs are based on a long-term residential land-use scenario that assumes use by a young child for noncancer effects and use by the combined young child and adult life stages for carcinogenic effects. Together, these capture a worst plausible case for future land use. The soil RBSCs are likewise based on an ILCR of 1E-6 and an HQ of 0.1. Although no RSLs exist for surface water or sediment, the tap water and residential soil regional RSLs are used directly as the RBSCs for surface water and sediment based on a Project Delivery Team agreement (OEPA, 1999) which used the former EPA Region 9 PRGs (EPA, 2004b) for this purpose. The

method has been updated to use RSLs rather than PRGs (Shaw, 2010c). Further details on the RBSCs and their derivation are provided in the BHHRA (Appendix B).

The evaluation of the analytical results of the samples and analyses (Section 3.2.1), as presented in the SCR, are summarized below for each medium.

Surface and Subsurface Soil Summary

- Seven nitroaromatics were detected in surface soil samples at WWTP1, but only 2,4,6-TNT in borings SB-04, SSW-108-NW, and SSW-108-S was above the RBSC.
- Eight nitroaromatics were detected in subsurface soil samples, with four nitroaromatics (1,3-dinitrobenzene [DNB], 2,4-DNT, 2,6-DNT, and 2,4,6-TNT) above RBSC values.
- One PCB, Aroclor 1254, was detected above the RBSC in the surface soil. It was detected only in the QA soil sample from boring SB06 and was not in the associated regular or QC soil samples.
- No PCBs were detected above RBSCs in any subsurface soil samples.
- Nine SVOCs were detected in surface soil samples; however, only benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene were detected above RBSCs in the surface soil from two borings (SB03 and SB06).
- Five SVOCs were detected above RBSCs in subsurface soil samples. Four SVOCs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, and indeno[1,2,3-cd]pyrene) were detected above RBSCs in boring SB-08 at the intermediate sample depth of 5 to 6.8 feet, and the nitroaromatic 2,4-DNT (detected as an SVOC) was above the RBSC in five subsurface soil samples.
- Vanadium was the only metal detected above both the RBSC and BSC in surface soil (sample WW0016 from boring SB05).
- In subsurface soils, no metals were detected above both the RBSC and BSC.
- Total organic carbon (TOC) was measured at 36.1 ppm in the surface soil sample from SB-06, the only sample in which it was analyzed.

Piezometer Overburden/Shale Groundwater Sample Summary

- Four nitroaromatics were detected in overburden/shale groundwater samples; however, only two, 2,4-DNT and 2,6-DNT, were detected above the RBSCs (in WWTP1-PZ03).

- Two SVOCs, the nitroaromatic compounds 2,4-DNT and 2,6-DNT, were detected above the RBSCs (in WWTP1-PZ03).

- Metals that exceeded both the RBSCs and BSCs in the unfiltered samples are aluminum, arsenic, cobalt, iron, and manganese.

- Only manganese exceeded both the RBSC and BSC in the filtered sample from one piezometer (WWTP1-PZ01).

Monitoring Well Overburden/Shale Groundwater Sample Summary. Three groundwater samples were collected during the wet season month of May 2009 and three groundwater samples were collected during the dry season month of October 2009. The major findings related to monitoring well locations, upgradient (WTP1-MW03), source area (WTP1-MW02), and downgradient (WTP1-MW01), are summarized as follows:

Upgradient

- Manganese was the only compound that exceeded the RBSC screening level, and aluminum was the only metal to exceed the BSC. Both compounds were detected in the unfiltered sample during the dry season (October) sampling event. Neither metal exceeded both the RBSC and BSC.

Source Area

- Two nitroaromatics (2,4-DNT and 2,6-DNT) were detected above RBSCs in source area well WTP1-MW02 during both sampling events.

Downgradient

- Two nitroaromatics (2,4-DNT and 2,6-DNT) were detected above RBSCs in downgradient well WTP1-MW01 only during the wet season (May). One SVOC (bis[2-ethylhexyl]phthalate) exceeded the RBSC only during the dry season of October.

- Arsenic was detected above the RBSC during the dry season in both the filtered and unfiltered sample and was also above the BSC in the unfiltered sample. Manganese was detected above the RBSC during both sampling events in both the filtered and unfiltered samples but did not exceed the BSC during either event.

Bedrock Groundwater Sample Summary. One groundwater sample was collected during the wet season month of May 2009 and two groundwater samples were collected during the dry season in October and November 2009. Inadequate groundwater recharge permitted only one groundwater sample to be collected using the low-flow sampling methodology. Groundwater recharge in well WTP1-BEDGW-002 was insufficient during the month of May, so no

groundwater sample was collected. The major findings related to monitoring well location (upgradient and source area) are summarized as follows:

Upgradient

- No nitroaromatics were detected in upgradient well WTP1-BEDGW-003 during either the wet (May) or dry season (November) sampling event. Six VOCs exceeded RBSCs and four exceeded BSCs during the wet and dry season sampling. The petroleum hydrocarbon-related compounds benzene and ethylbenzene were detected above RBSCs and BSCs during both sampling events, total xylenes were detected above the RBSC and BSC only during the dry season sampling, and toluene was detected above the BSC during both sampling events. Chloroform and chloromethane were detected above the RBSCs during the dry season, and 1,1,2,2-tetrachloroethane was detected above the RBSC during the dry season.

- One hydrocarbon-related SVOC, naphthalene, was detected above the RBSC during both sampling events.

- Three metals (arsenic, barium, and manganese) were detected above the RBSC in both the filtered and unfiltered samples during the May 2009 sampling. Only the concentrations of arsenic and manganese exceeded both the RBSC and BSC values, and these were exceeded during both events. Antimony was detected above the RBSC during the month of May only in the filtered groundwater sample but was not detected in the unfiltered sample.

Source Area

- No nitroaromatics were detected in source area well WTP1-BEDGW-002 during the dry season (October) sampling event. Four VOCs exceeded both RBSCs and BSCs during the dry season sampling event: the petroleum hydrocarbon-related compounds benzene, ethylbenzene, toluene, and total xylenes. Methylene chloride was also detected above the RBSC during the dry season.

- The petroleum hydrocarbon-related SVOC naphthalene was detected above the RBSC during the sampling event and is likely attributable to the naturally occurring hydrocarbons.

- Only two metals (arsenic and iron) were detected above both the RBSCs and BSCs. Arsenic concentrations also exceeded RBSCs and BSCs in the filtered samples, but iron was not detected.

Downgradient

- Groundwater was not encountered while drilling the downgradient area, so no bedrock well was installed.

Surface Water Summary. No analytes were detected above RBSC values in the single surface water sample collected from a pooled area of the ditch north of WWTP1.

Sediment Summary. Four WWTP1 sediment samples were collected and analyzed for PCBs, and one was analyzed for TOC. Analytical results for other parameters were evaluated in the LSI. The findings of WWTP1 sediment are as follows:

- PCBs were not detected in any of the WWTP1 sediment samples.
- TOC was detected at a concentration of 6.9 ppm in the sample analyzed for it.

3.3 Baseline Human Health Risk Assessment

The BHHRA evaluates potential human health risks associated with exposure to soil, overburden/shale groundwater, bedrock groundwater, surface water, and sediment associated with WWTP1 at the former PBOW. This section summarizes the human health risk assessment. It identifies the chemicals of potential concern (COPC); summarizes the receptors, media, and exposure pathway evaluated; summarizes the risk characterization; and presents the BHHRA conclusions. The final BHHRA, submitted previously, is included as Appendix B.

This BHHRA is consistent with EPA guidance and with the procedures established in the BHHRA for TNTA and TNTC soil (IT, 2001b), the BHHRA for groundwater at PBOW (Shaw, 2006), and, most specifically, the WWTP1 BHHRA work plan (Shaw, 2009c).

3.3.1 Identification of COPCs

A screening procedure was conducted on the RI and LSI analytical data from each WWTP1 environmental medium. This screening process is used to identify COPCs, which are the detected chemical analytes carried through the full risk assessment process. The objectives of COPC screening are to focus the risk assessment on those chemicals that may contribute significantly to overall risk and to remove from quantification those chemicals whose contribution is clearly inconsequential. COPC screening includes a risk-based screen, which also considers status as a human nutrient; a frequency-of-detection evaluation; and a background screen. As described in the Chapter 2.0 of the BHHRA (Appendix B), the risk-based screening for non-cancer-based effects of chemicals in surface water and sediment (Section 3.2.2.4) and the determination of background differ somewhat from current OEPA guidance. These differences are based on established PBOW Project Delivery Team decisions, which include agreement between OEPA, USACE, and NASA. The risk-based values and background values used for screening in the BHHRA are the RBSCs and BSCs discussed in Section 3.2.2.4. These screening values are described in the BHHRA.

The COPC screening process results in the generation of a data summary table for each medium to be quantitatively evaluated in the BHHRA. A data summary table for each WWTP1 medium is provided as follows: surface soil (Table 3-7), subsurface soil (Table 3-8), total soil (Table 3-9), bedrock groundwater (Table 3-10), overburden groundwater (Table 3-11), sediment (Table 3-12), and surface water (Table 3-13). These tables provide the following information for each detected chemical in each environmental medium:

- Chemical name
- Frequency of detection
- Range of detected concentrations
- Range of detection limits
- Arithmetic mean of site concentrations
- 95th percent upper confidence limit (UCL) on the arithmetic mean (for COPCs only)
- Appropriate RBSC
- Appropriate BSC
- Selection/exclusion of chemical as a COPC
- Exposure point concentration (EPC) (for COPCs only).

Additional details of this data summary, including the estimation of the UCL values and EPCs for COPCs, are discussed in the BHHRA (Appendix B).

- ***Surface Soil*** – Vanadium, Aroclor 1254, TNT, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene

- ***Subsurface Soil*** – 1,3-Dinitrobenzene, 2,4-DNT, 2,6-DNT, TNT, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene

- ***Total Soil*** – Vanadium, Aroclor 1254, TNT, 2,4-DNT, 2,6-DNT, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene

- ***Bedrock Groundwater*** – Arsenic, chromium, iron, manganese, 2-methylnaphthalene, naphthalene, benzene, chloroform, chloromethane, ethylbenzene, methylene chloride, 1,1,2,2-tetrachloroethane, toluene, xylenes, and nitrate-nitrite

- ***Overburden Groundwater*** – Arsenic, cobalt, manganese, 2,4-DNT, 2,6-DNT, and bis(2-ethylhexyl)phthalate

- ***Sediment*** – Chromium

- ***Surface Water*** – None.

Please note that the total soil COPCs include all surface soil and subsurface soil COPCs.

3.3.2 Exposure Assessment

Exposure is the contact of a receptor with a chemical or physical agent. An exposure assessment estimates the type and magnitude of potential exposure of a receptor to COPCs found at or migrating from a site (EPA, 1989). The WWTP1 BHHRA characterizes potential exposures to COPCs in WWTP1 environmental media as portrayed by the conceptual site exposure model (CSEM). These environmental media include soil, surface water, sediment, and groundwater. The CSEM provides the basis for identifying and evaluating the potential risks to human health in the BHHRA. The CSEM, graphically depicted on Figure 3-7, includes the receptors appropriate to all plausible site-use scenarios and the potential exposure pathways. This presentation of all possible pathways by which a potential receptor may be exposed, including all sources, release and transport pathways, and exposure routes, facilitates consistent and comprehensive evaluation of risk to human health and helps to ensure that potential pathways are not overlooked. The elements of a CSEM include the following:

- Source
- Source media (i.e., initially contaminated environmental media)
- Contaminant release mechanisms
- Contaminant transport pathways
- Intermediate or transport media
- Exposure media
- Receptors
- Routes of exposure.

Contaminant release mechanisms and transport pathways are not relevant for direct receptor contact with a contaminated source medium (e.g., ingestion or dermal contact).

The receptors and pathways on Figure 3-7 reflect scenarios developed from information regarding site background and history, topography, climate, and demographics as presented by D&M (1997b) and the sitewide groundwater investigation (IT, 1997). No current or future exposure by off-site residents is evaluated. Most of the off-site residents are serviced by municipal water from surface water sources. Although there are numerous private groundwater wells in the vicinity, including several within 1 mile of the facility boundary, none of these is used as a potable source. Based on the investigations of other PBOW sites, natural hydrocarbons and hydrogen sulfide are known to be present within the bedrock limestone, and shale formation groundwater generally provides low yields and is of low quality (Shaw, 2008c); however, the groundwater underlying WWTP1 was not summarily excluded for consideration as a tap water source based on natural water quality parameters or general assumptions concerning yield.

Therefore, given the presence of numerous off-site wells and the assumption of unrestricted future land use on site, the development of groundwater for on-site residential (or on-site worker) use as tap water was evaluated for purposes of this BHHRA. Groundwater quality and use are discussed further in Section 2.3.

Exposure associated with the COPCs were evaluated using the following receptors. The media that were quantitatively evaluated for each receptor are listed in parentheses:

- Current groundskeeper (surface soil)
- Future groundskeeper (total soil and groundwater)
- Future indoor worker (surface soil, subsurface soil [inhalation pathway only], and groundwater)
- Current/future construction worker (total soil and sediment)
- Future resident (total soil, sediment, overburden groundwater, and bedrock groundwater)
- Future adult hunter (surface soil, including venison pathway)
- Future hunter's child (surface soil [venison pathway only]).

As mentioned in Section 3.3.1, no COPCs were identified in surface water. If COPCs had been identified for this medium, then exposure to surface water also would have been quantitatively evaluated for the construction worker and resident receptors.

Each receptor scenario that includes groundwater was run separately for overburden groundwater and bedrock groundwater. Because groundwater yield was found to be insufficient for potable use in the overburden and bedrock units underlying WWTP1 and the WWTP1 bedrock groundwater was observed to be of naturally poor quality due to the presence of petroleum and hydrogen sulfide, the receptors evaluated for potable groundwater use were also evaluated assuming no groundwater use. The resident was evaluated for noncancer hazards separately for the young child (ages 1 through 6 years) and adult life stages.

The equations for the calculations of intake values for each exposure pathway, exposure assumptions, and the calculation of EPCs of COPCs for modeled pathways (e.g., venison or airborne concentrations) are presented in the BHHRA (Appendix B).

3.3.3 Risk Characterization

Risk characterization is the process of applying numerical methods and professional judgment to determine the potential for adverse human health effects to result from the presence of site-specific chemicals. This is done by combining the intake rates estimated during the exposure assessment with the appropriate toxicity information identified in the toxicity assessment (Chapter 4.0 of the BHHRA [Appendix B]). Noncancer hazards and cancer risks are characterized separately, including COPCs that induce both types of effects.

Quantitative expressions are calculated during risk characterization that describe the probability of developing cancer (i.e., ILCRs), or the nonprobabilistic comparison of estimated dose with a reference dose (RfD) for noncancer effects (i.e., HQ and hazard indices [HI]). Quantitative estimates are developed for individual chemicals, exposure pathways, and exposure media for each receptor. These quantitative risk characterization expressions, in combination with qualitative information, are used to guide risk management decisions. Risk characterization is applied only to COPCs.

3.3.3.1 Cancer Risk

The risk from exposure to potential chemical carcinogens is estimated as the probability of an individual developing cancer over a lifetime and is called the ILCR. Equations for calculating the ILCR are presented in the BHHRA (Appendix B).

Total ILCRs in the range of 1E-6 to 1E-4 are regarded as acceptable (EPA, 1990); this range is referred to as the "National Oil and Hazardous Substances Pollution Contingency Plan (NCP) risk management range." Risks less than this range are regarded as negligible. A target cancer risk goal of 1E-5 is used by OEPA and was selected by the PBOW Project Delivery Team as a basis to consider remedial action. Use of this 1E-5 goal represents a departure from the Army's practice of generally using a cancer risk exceeding a value of 1E-4 (the upper end of the NCP risk management range) to trigger remedial action considerations.

3.3.3.2 Noncancer Effects of Chemicals

The hazards associated with noncancer effects of chemicals are evaluated by comparing an exposure level or intake with an RfD. The HQ, defined as the ratio of intake to RfD, is estimated by dividing the intake of a chemical by the RfD as described in the BHHRA (Appendix B).

Chemical noncancer hazards are evaluated using chronic RfD values. An HQ of unity indicates that the estimated intake equals the RfD. If the HQ is greater than unity, there may be concern for potential adverse health effects. In the case of simultaneous exposure of a receptor to multiple

chemicals or to a given chemical by multiple pathways, an HI is calculated as the sum of the HQs.

A total HI is calculated as the sum of all HI values, including all media and all COPCs, for a given receptor. Calculating a total HI as the sum of HQ values is based on the assumption that the potential for noncancer effects is additive. EPA (1989), however, acknowledges that the assumption of additivity is probably appropriate only for chemicals that induce adverse effects by the same mechanism. Therefore, if the total HI for a receptor exceeds 1, individual HI values may be calculated for each target organ, as described in Appendix B.

3.3.3.3 Risk Characterization Results

Cancer and noncancer risk characterization results were evaluated for each receptor and each environmental medium using the methods described in Sections 3.3.3.1 and 3.3.3.2. The cancer risks and noncancer hazards are presented for each receptor in Table 3-14. Because of the naturally low quality of the groundwater associated with petroleum hydrocarbons and hydrogen sulfide off-gassing as well as the limited groundwater volumes, exposure and risk was also characterized for the future groundskeeper, indoor worker, and future on-site resident assuming no exposure to groundwater underlying WWTP1 (Table 3-15).

The overall HI and ILCR values are summarized in the following bullets; exceedances of the PBOW cancer risk goal (ILCR>1E-5) are shown in bold type, and exceedances of the noncancer hazard criterion (HI>1) or the NCP risk management range (1E-6 to 1E-4) are shown in bold italics:

- Current groundskeeper: ILCR = 2E-6; HI = 0.08
- Future groundskeeper – all pathways, assuming bedrock groundwater use:
  ILCR = 8E-4; HI = 6
- Future groundskeeper – all pathways, assuming overburden groundwater use:
  ILCR = 4E-5; HI = 0.4
- Future groundskeeper – all pathways, excluding groundwater use:
  ILCR = 3E-6; HI = 0.07
- Indoor worker – all pathways, assuming bedrock groundwater use:
  ILCR = 8E-4; HI = 6
- Indoor worker – all pathways, assuming overburden groundwater use:
  ILCR = 4E-5; HI = 0.4

- Future indoor worker – all pathways, excluding groundwater use:
  ILCR = 5E-7; HI = 0.03

- Construction worker: ILCR = 1E-7; HI = 0.2

- Resident – all pathways, assuming bedrock groundwater use:
  ILCR = 4E-3; ***child HI = 74***; ***adult HI = 32***

- Resident – all pathways, assuming overburden groundwater use:
  ILCR = 2E-4; ***child HI = 3***; adult HI = 1

- Resident – all pathways, excluding groundwater use:
  ILCR = 8E-6; child HI = 0.8; adult HI = 0.09

- Hunter: ILCR = 1E-7; HI = 0.004

- Hunter's child: ILCR = 2E-11; HI = 0.000006.

3.3.3.4 BHHRA Conclusions

The ILCR and HI values for the two current exposure scenarios (current groundskeeper and construction worker) each meet the PBOW cancer risk goal (ILCR≤1E-5) and the noncancer hazard criterion (HI≤1). Note that no groundskeeping appears to have occurred at WWTP1 in recent years, except occasional mowing in the far eastern part of the site and more regular mowing along Maintenance Road. Thus, the current groundskeeper scenario, which assumes a full-time, 25-year employee who works exclusively at WWTP1 for 8 hours per day, 250 days per year (refer to Chapter 3.0 of Appendix B), appears to greatly overestimate the exposure levels of any current on-site worker or other current receptor.

Each of the potential future exposure scenarios that does not assume potable use of groundwater also meets the PBOW risk goal and hazard criterion.

The cancer risks associated with the following future receptors assumed to use bedrock groundwater as a hypothetical source of tap water exceed the NCP risk management range and PBOW cancer risk goal: future groundskeeper, future indoor worker, and future resident. Each of these also exceeds the target HI criterion of 1. The ILCR for each of these under the assumption of overburden groundwater use also exceeds the PBOW cancer risk goal, but only the resident exceeds the NCP risk management range. Of all the receptors that are assumed to use overburden groundwater, only the child resident exceeds the HI criterion.

The cancer risks and noncancer hazards associated with bedrock groundwater are nearly entirely attributable to natural petroleum-related compounds and to arsenic, which also appears to be

unrelated to former site activities. The noncancer hazards associated with overburden groundwater are mostly due to arsenic, which does not appear to be associated with former site activities. Use of either the overburden or bedrock groundwater is regarded as implausible because of insufficient yield. Additionally, the naturally poor quality of the bedrock groundwater and associated hydrogen sulfide off-gassing make it unsuitable as a potable source. The readily available municipal water supply obviates the need for use of groundwater as a potential source of tap water in the general vicinity of PBOW.

If the contributions of exposure to groundwater are excluded because of poor groundwater quality and yield, none of the WWTP1 receptors have ILCRs or HIs that exceed the PBOW goals or the NCP risk management range. This indicates that the associated environmental media at WWTP1 are unlikely to pose an unacceptable cancer risk to any receptor and that exposure to these media is unlikely to result in adverse noncancer health effects for any human receptor. Because groundwater use is not regarded as plausible based on insufficient yield in both the overburden and bedrock units, the risks associated with WWTP1 groundwater use are accordingly implausible.

3.4 Screening-Level Ecological Risk Assessment

The SLERA, summarized in this section, was performed to evaluate and provide an estimate of current and future ecological hazard associated with exposure to potential releases to soil, groundwater, surface water, and sediment associated with WWTP1. This SLERA summary provides an ecological site description, identifies chemicals of potential ecological concern (COPEC), identifies ecological receptors, characterizes exposure and ecological risks, and presents the conclusions of the SLERA. The final SLERA, submitted previously, is included as Appendix C.

The SLERA is consistent with EPA guidance and with the procedures established in the SLERA for TNTA and TNTC soil (IT, 2001c) and, most specifically, the WWTP1 SLERA work plan (Shaw, 2009c).

3.4.1 Ecological Site Description

The ecological site description, presented in full in the SLERA (Appendix C) and summarized in the following paragraphs, includes a general site description; a description of surface water resources, wetlands, and vegetative communities; a species inventory; and a discussion of threatened and endangered species.

General descriptions of PBOW and WWTP1 are presented in Chapters 1.0 and 2.0. During PBOW manufacturing operations from 1941 to 1944, WWTP1 received TNT manufacturing wastes from TNTA and TNTB through 4-, 5-, and 6-inch wooden waste sewer lines for treatment and disposal. The purpose of the treatment plants was to reduce the volume of waste water discharged from each of the manufacturing areas to the waste water ponds. WWTP1 is approximately 2 acres in size and is essentially flat with a slight sloping, topographic gradient of less than 5 feet toward the north and west (USACE, 2000). Surface water for WWTP1 drains into ditches north and west of the site. These ditches eventually connect with Plum Brook and are often dry, as was the case during the LSI and RI sampling events. However, one surface water sample was collected during the RI from within a pooled area of the northern ditch at WWTP1-SW01.

Ecological characterization of the study area was initially based on a compilation of existing ecological information pertaining to the site. Shaw personnel obtained maps and other relevant site information and determined the locations of potential ecological units such as streams, creeks, ponds, grasslands, forest, and wetlands on or near the site. Additionally, biological inventories performed in 1994 and 2001 at PBOW (ODNR, 1995; NASA, 2002) that identify and indicate the locations of threatened and endangered species at the installation were reviewed.

Shaw ecological scientists performed site visits to WWTP1 on October 16, 2008 and April 27 and June 2, 2009. These visits were performed at different times of year to identify early- and late-blooming plant species (especially threatened and endangered species) and migrating and nesting bird species present at the site. Reconnaissance personnel used these site visits to confirm assumptions based on information previously gathered about the site, identify current site ecological conditions, and evaluate the site for more subtle indications of potential effects from contaminant release. Information obtained during the reconnaissance trips was used to select representative receptors, refine exposure scenarios for the risk assessment, and identify protected species or habitats of special concern in the study area. A photographic record was made during the site reconnaissance (Appendix C).

A botanist developed a list of plant species observed at the site during the late spring and fall reconnaissance visits. Vegetative communities at the site were also identified during site reconnaissance trips. The portion of the site immediately adjacent to Maintenance Road consists of a mowed field edge. The remainder of WWTP1 contains a mosaic of upland old field and dense shrub thicket dominated by *Cornus racemosa* (gray dogwood). The old field portions of the site contain a variety of grasses and herbs. A small ditch with scrub/shrub wetland vegetation occurs along the northern border of the study area. Habitat maps showing the types and extent of

vegetation communities present within the immediate vicinity of the site were prepared based on information collected during the site reconnaissance. A vegetation community map and a list of plant species identified during the site visits are presented in the SLERA (Appendix C). Vegetative stress attributable to chemical contamination was not observed at WWTP1. No federally or state-listed plant species were observed.

A fauna species list was developed for the site based on existing site investigation reports (e.g., ODNR, 1995; NASA, 2002) and other environmental data sources. Also, bird surveys were performed during the site reconnaissance visits to identify bird species and communities using the site during migration (early spring reconnaissance visit) and nesting (late spring/early summer reconnaissance visit) periods. Direct or indirect (e.g., prints) observations of mammals and other fauna classes were also noted. A list of species observed or expected to be present at the site is presented in the SLERA (Appendix C).

According to the National Wetland Inventory (NWI) maps for the area (U.S. Fish and Wildlife Service, 2011), there are no designated wetlands at the WWTP1 site. The nearest wetland is Reservoir #1, located approximately 800 feet north/northeast of the site. NASA is currently performing a wetland delineation study at PBOW that will more accurately identify the locations and extent of sensitive wetland habitat throughout the installation.

No threatened or endangered (T&E) plant or animal species were observed during site reconnaissance. Based on the habitat present at WWTP1 and/or lack of sightings in the vicinity of PBOW, no T&E bird species are expected to be found at WWTP1. Likewise, the only T&E mammal (Ohio endangered) historically documented at PBOW, the Indiana bat, has widespread sightings throughout Ohio, but WWTP1 does not provide the preferred habitat for this species (i.e., caves or trees with exfoliated bark).

3.4.2 Identification of Chemicals of Potential Ecological Concern

A screening process was performed on the analytical data from the RI and LSI to identify COPECs that may pose a threat to ecological receptors. These data include all soil samples collected to a depth of 6 feet (extended to 7.6 feet bgs at WWTP1 due to the presence of fill cover soil), surface water, and sediment. Groundwater was excluded because exposure to this WWTP1 medium is considered to be an incomplete pathway for ecological receptors. A list of the WWTP1 media samples used for the SLERA is presented in Table 3-16. Sample locations are presented on Figure 3-1.

The COPEC selection process was used to develop a subset of chemicals detected at the site that are not naturally occurring or associated with non-site-related sources. These chemicals are also present at sufficient frequencies, concentrations, and spatial areas to possibly pose a potential risk to ecological receptors. Examples of screening criteria that were used include analytical detection limit, frequency of detection less than 5 percent, comparability with background, status as a nutrient, and comparison with risk-based screening ecotoxicity values. This selection process and the screening values used for COPEC selection are described in the SLERA (Appendix C).

The results of the COPEC screening are presented in Tables 3-17 through 3-19 for soil, surface water, and sediment, respectively. The selected EPC is also presented for each chemical identified as a COPEC. For soil, two EPC results are presented, a total soil EPC for concentrations in the 0 to 6 feet bgs depth range and a surface soil EPC for concentrations in the 0 to 1 foot bgs depth range (the total soil and surface soil depths were extended to 7.6 and 3.6 feet, respectively), to account for the presence of sand fill material, as described in Section 3.2.1. These two sets of EPCs are used to evaluate various ecological receptors that may be exposed to different soil depths associated with their various life history characteristics. As described in the SLERA, the EPC is the lower value between the maximum detected concentration (MDC) and the 95 percent UCL of the mean.

Ten COPECs were selected for total soil (Table 3-17), three were selected for surface water (Table 3-18), and none were selected for sediment (Table 3-19). These COPECs were quantitatively evaluated in the predictive SLERA, as summarized in Sections 3.4.3 through 3.4.6.

3.4.3 Selection of Ecological Receptors

Following COPEC selection, ecological assessment receptors were selected in the SLERA to focus the exposure characterization on species, groups of species, or functional groups that are directly related to the following assessment endpoints: the protection of long-term survival and reproductive capabilities for terrestrial invertebrates, herbivorous mammals, omnivorous mammals, insectivorous mammals and birds, and carnivorous birds.

As part of this receptor selection process, site biota were organized into major functional groups. For terrestrial communities, the major groups are plants and wildlife, including terrestrial invertebrates, mammals, and birds. Aquatic and/or wetland communities or functional groups are not present at WWTP1 and were not evaluated because true aquatic habitat is not present at the site and no COPECs were identified in sediment.

Six representative terrestrial receptor species that are expected or possible in the area of WWTP1 (based on the ecological description of the site presented in Section 3.4.1) were selected as indicator species for the potential effects of COPECs. These indicator species represent two classes of vertebrate wildlife (mammals and birds) and a range of both body size and food habits and include herbivores, omnivores, and carnivores. The six species selected include the deer mouse (*Peromyscus maniculatus*) (small omnivorous mammal), short-tailed shrew (*Blarina brevicauda*) (small insectivorous mammal), Eastern cottontail rabbit (*Sylvilagus floridanus*) (medium-sized terrestrial herbivorous mammal), marsh wren (*Cistothorus palustris*) (small insectivorous bird), white-tailed deer (*Odocoileus virginianus*) (large herbivorous mammal), and red-tailed hawk (*Buteo jamaicensis*) (large carnivorous bird).

A terrestrial food web is presented on Figure 3-8. Many of the species evaluated, particularly the deer mouse, cottontail rabbit, short-tailed shrew, and marsh wren, have limited home ranges which make them particularly vulnerable to exposure from site contaminants.

3.4.4 Exposure Characterization

A description of the nature, extent, and magnitude of potential exposure of assessment receptors to COPECs that are present at or migrating from the site is presented in this section, considering both current and reasonably plausible future use of the site.

Ecological routes of exposure for biota may be direct or through the food web via the consumption of contaminated organisms. Direct exposure routes include dermal contact, absorption, inhalation, and ingestion. Examples of direct exposure include animals incidentally ingesting contaminated soil or sediment (e.g., during burrowing or dust-bathing activities), animals ingesting surface water, plants absorbing contaminants by uptake from contaminated sediment or soil, and dermal contact of aquatic organisms with contaminated surface water or sediment. Given the scarcity of available data for wildlife dermal and inhalation exposure pathways, potential risk from these pathways is not estimated in the SLERA. In addition, these pathways are generally considered to be incidental for most species, with the possible exceptions of burrowing animals and dust-bathing birds. Food web exposure can occur when terrestrial or aquatic fauna consume contaminated biota. Examples of food web exposure include animals at higher trophic levels consuming plants or animals that bioaccumulate contaminants.

Daily doses of COPECs for vertebrate receptors were calculated using standard exposure algorithms. These algorithms incorporate species-specific natural history parameters (i.e., feeding rates, water ingestion rates, dietary composition, etc.) as well as site-specific area use factors, which scale the estimated hazard by a fraction value based on the comparison of the size

of the affected area to the home range of the specific receptor. These algorithms are presented and described in the SLERA (Appendix C).

Exposure to soil, sediment, and surface water is discussed in the following paragraphs. As stated in Section 3.4.2, groundwater is not a medium of concern for ecological receptors at this site.

Soil Exposure Pathway. Soil exposure pathways are potentially important for terrestrial plants and animals at the site. For nonburrowing animals, exposure to soil from a depth of 0 to 3.6 feet bgs (extended from the standard surface soil range of 0 to 1 foot bgs, due to the adjustment in soil sampling depth associated with the presence of sand fill at WWTP1) was considered, as this soil depth would represent the depth of regular exposure for these types of organisms. For burrowing animals such as the shrew, exposure to soil from a depth of 0 to 7.6 feet bgs (extended from the standard soil range of 0 to 6 feet, due to the presence of sand fill at WWTP1) was considered. It is noted that although the shrew itself may not actually burrow to a depth of 7.6 feet, there may be other burrowing mammals that do burrow this deep. For plants and herbivores that feed on deep-rooted plants (e.g., the white-tailed deer, which is assumed to ingest leaves of trees translocating COPECs from subsoils), exposure to soil from a depth of 0 to 7.6 feet bgs (or the water table surface) was also evaluated because most feeder roots are located within this depth. Thus, the shrew and the white-tailed deer (Figure 3-8) were evaluated for exposure to deeper (0 to 7.6 feet bgs) soil. All other receptors exposed to soil were evaluated for exposure to concentrations in surface (0 to 3.6 feet bgs) soil.

Sediment Exposure Pathway. No COPECs were identified in WWTP1 sediment (Table 3-19). Therefore, sediment exposure pathways and routes are not evaluated at this site.

Surface Water Exposure Pathway. Surface water represents a potential transport medium for COPECs. However, the ditches adjacent to WWTP1 are typically dry and do not support viable populations of fish or aquatic invertebrates that may comprise the food source for upper trophic level organisms. Therefore, the direct ingestion of surface water that accumulates in depressions is the only surface water exposure route evaluated at this site.

3.4.5 Risk Characterization

Food chain modeling was used to estimate exposure rates for the representative assessment receptors. These exposure rates were compared with toxicity reference values (TRV) to calculate HQs (Wentsel, et al., 1996). Two types of TRVs were used in the food chain models: those based on a no-observed-adverse-effects level (NOAEL) and those based on a lowest-observed-adverse-effect level (LOAEL), the former being more conservative. HQs are calculated by

summing intake doses across all exposure pathways for each chemical for a given receptor and dividing by the TRV. HQs for those chemicals that have a similar mode of toxicological action may be summed to account for cumulative effects. In the SLERA, the five nitroaromatic COPECs in soil were identified as potentially having similar mechanisms of toxicity, and their HQs were summed. HQs are a means of estimating the potential for adverse effects to organisms at a contaminated site and for assessing the potential for toxicological effects among site receptors. HQs less than or equal to 1 represent no probable hazard. Although OEPA considers all HQs above 1 to be potentially significant, the following uncertainties regarding HQ interpretation are noted:

- HQs are not measures of risk.
- HQs are not population based.
- HQs are not linearly scaled.
- HQs are often produced that are unrealistically high and toxicologically impossible (e.g., estimated HQs greater than 1,000).
- Trace soil concentrations of inorganic chemicals (including concentrations well below background levels) can lead to HQ values that are (much) greater than 1.

Therefore, it should be understood that HQs greater than 1 are not a definitive indication that adverse ecological effects are occurring at the site or may occur in the future.

Table 3-20 summarizes the NOAEL and LOAEL-based HQs for the six evaluated assessment receptors. The following explosives compounds had HQ values greater than 1:

- ***1,3,5-Trinitrobenzene (TNB):*** Marsh Wren (NOAEL HQ = 4.59)
- ***1,3-DNB:*** Short-Tailed Shrew (NOAEL HQ = 11; LOAEL HQ = 4.73)
- ***TNT:*** Marsh Wren (NOAEL HQ = 8.44, LOAEL HQ = 1.69)
- ***All Nitrotoluenes:*** Short-Tailed Shrew (NOAEL HQ = 1.93); Marsh Wren (NOAEL HQ = 8.45, LOAEL HQ = 1.69)
- ***Tetryl:*** Deer Mouse (NOAEL HQ = 4.35); Short-Tailed Shrew (NOAEL HQ = 2.4).

All chemicals with HQ values greater than 1 were soil COPECs; no surface water COPECs resulted in HQs above unity. No HQs exceeded 10 when rounded to one significant figure; therefore, they are all considered minor exceedances given the conservative assumptions that

were used to generate HQs from food chain effects. Only two chemicals, 1,3-DNB and TNT, resulted in both NOAEL- and LOAEL-based HQs greater than 1 for a given receptor (combined nitrotoluenes also had both HQs above 1 for the marsh wren, but this exceedance was almost entirely due to the influence of TNT).

Although four explosives compounds exceeded an HQ of 1, none of these compounds are considered to be final COPECs requiring further investigation. Because the HQ values using conservative input values did not exceed 10 when rounded to one significant figure, the potential for adverse ecological effects is considered low. Also, the primary exposure route of concern for all four compounds was ingestion of terrestrial invertebrates. The uptake into terrestrial invertebrates for these chemicals was modeled using an equation that uses the compound's log octanol-water partitioning coefficient (K_{ow}) to determine the degree to which the chemical is retained in the lipid fraction of the invertebrate's body burden. This approach was shown in the SLERA (Appendix C) to likely overestimate concentrations in prey items at this site. This conclusion was based on a comparison of site-specific uptake factors for soil-to-earthworm uptake that had been performed for structurally similar nitroaromatic compounds that were developed at another PBOW site (IT, 2001d) to their correlating uptake factors that were calculated using the K_{ow} model. This comparison showed that the uptake factors for nitroaromatics into earthworms based on site-specific data were two orders of magnitude lower than uptake factors predicted by the model. Because all of the nitroaromatic COPECs whose food chain HQs exceeded 1 used modeled (rather than site-specific) uptake factors for the soil-to-earthworm bioaccumulation factor, the dose incurred from the ingestion of invertebrates is likely overestimated by up to two orders of magnitude for these chemicals.

Another important consideration is that the spatial area where elevated explosives compounds were detected is very limited and restricted to the area in the immediate vicinity of individual sample locations (e.g., WWTP1-SB03, WWTP1-SB04, and PBOW99-SSW104). The home range size and density characteristics of various ecological species of concern make it unlikely that local populations of a given species (i.e., local populations) would be exposed to contaminated soil at a small portion of the 2-acre WWTP1 site on a regular basis.

3.4.6 SLERA Conclusions

Explosives compounds were detected at elevated concentrations in soil, particularly in the vicinity of sample location WWTP1-SB04. Several ecological receptors selected to represent site biota had HQ values greater than 1, but the conclusions of the food chain model likely overestimate hazard because populations of receptors would unlikely be exposed to the very

limited area where elevated concentrations were detected. Also, the assumptions of the model likely overestimate exposure, particularly with regards to ingestion of invertebrate prey items.

Local impacts to invertebrates and possibly plants are possible at the areas with elevated explosives. Although plants and invertebrates are typically not selected as receptors of concern, they provide an important food source for higher trophic level organisms, and any impacts to their presence at a site could affect higher-order species. However, any impacts to these types of organisms due to chemicals present at WWTP1 would be very localized, and broader impacts to plant or invertebrate communities are unlikely to occur due to compensatory population dynamics of these types of organisms. It should be noted that American woodcocks (*Scolopax minor*) were observed at the site during the breeding season. Woodcocks are obligate vermivores (worm eaters); therefore, the presence of these birds suggests that their food source (i.e., earthworms) is also present at the site. Also, no signs of stressed vegetation were noted during the site reconnaissance visits. For these reasons, the potential for adverse ecological impacts is considered to be very low at this site.

3.5 WWTP1 Recommendations

No remedial actions or further investigation of WWTP1 media are recommended based on the results of the WWTP1 RI efforts, including the BHHRA and SLERA.

If the contributions of exposure to groundwater are appropriately excluded, none of the WWTP1 human receptors had ILCRs or HIs that exceed the PBOW target criteria or the NCP risk management range. This indicates that the associated environmental media at WWTP1 are unlikely to pose an unacceptable cancer risk to any receptor and that exposure to these media is unlikely to result in adverse noncancer health effects for any human receptor. The unacceptable risks and hazards associated with groundwater exposure in the BHHRA are attributable to naturally occurring conditions rather than former DOD activities. Because groundwater use is not regarded as plausible based on insufficient yield in both the overburden and bedrock units and poor quality associated with naturally occurring constituents in the bedrock unit, the risks associated with WWTP1 groundwater are accordingly implausible.

Based the results and findings of the SLERA, the ecological HQ values indicated a low potential for adverse ecological effects. Observations of the species present and the lack of vegetative stress, combined with the low hazard estimates calculated in the COPEC selection and food chain modeling, suggest a lack of impact to ecological receptors. Although minor HQ exceedances were observed in the food chain model, hazards were likely overestimated, particularly with regards to uptake of nitroaromatics into terrestrial invertebrates. Further, the

small areal extent of WWTP1 reduces the potential for multiple individuals of most ecological receptor species to be regularly exposed to site media, thus diminishing the potential for adverse impacts to populations of organisms to negligible levels.

4.0 TNTA/WWTP1 Sewer Lines Investigation and Evaluation

This chapter provides a summary of the sampling, analyses, results, and evaluation of the environmental media associated with TNTA/WWTP1 sewer lines (i.e., soil, overburden/shale groundwater, limestone bedrock groundwater, surface water, and sediment) that have been presented in the TNTA/WWTP1 Sewer Lines SCR (Appendix D), BHHRA (Appendix E), and SLERA (Appendix F). The reference for each of these documents is provided below:

- Shaw Environmental, Inc. (Shaw), 2012a, *TNTA/Waste Water Treatment Plant No. 1 Sewer Lines, Site Characterization Report,* Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, January.

- Shaw Environmental, Inc. (Shaw), 2012b, *Baseline Human Health Risk Assessment, TNT Area A to Waste Water Treatment Plant 1 Sewer Lines,* Final, Plum Brook Ordnance Works, Sandusky, Ohio, July.

- Shaw Environmental, Inc. (Shaw), 2012c, *Screening-Level Ecological Risk Assessment, TNT Area A to Waste Water Treatment Plant 1 Sewer Lines,* Final, Plum Brook Ordnance Works, Sandusky, Ohio, July.

Please note that this chapter provides no data or other information that has not been previously presented in the TNTA/WWTP1 sewer lines SCR, BHHRA, or SLERA (Appendices D, E, and F, respectively).

4.1 Previous Investigation and Evaluation

No previous environmental investigations have been conducted at the TNTA/WWTP1 sewer lines.

4.2 Site Characterization and Evaluation

This section summarizes the RI sampling of environmental media at the TNTA/WWTP1 sewer lines, the analytical results, and an evaluation of these results that are presented in the SCR. Additional details are provided in the SCR (Appendix D).

4.2.1 Samples and Analyses

The RI samples were collected consistent with the site-specific QAPP (Shaw, 2008a) and Phase 1, Phase 2, and soil delineation work plans for the TNTA/WWTP1 sewer lines (Shaw, 2008b; 2009a; 2010d). Soil, groundwater, surface water, and sediment sampling locations are shown on Figure 4-1.

A geophysics survey was performed to determine the former subsurface pipeline traces and/or confirm or rule out the presence of the wooden pipelines between the TNTA settling tanks and WWTP1. Based upon survey results and visual observations, the sewer line trace was detected at a limited number of locations, but the complete extents of the sewer lines were not confirmed.

Surface and subsurface soil samples were collected as part of the RI from 18 trench excavations and 2 additional phases: investigation and delineation. Generally, surface soil is defined as samples collected from within the interval of 0 to 1 foot bgs and subsurface soil is defined as samples collected from depths greater than 1 foot bgs. Only subsurface soil samples were collected during the trench excavations, from native material below the former pipeline trace. For the direct-push drilling soil samples during the investigation, per the RI work plans, to determine any impact to native soil, surface soil samples 0 to 1 foot bgs and subsurface soil samples 3 to 5 foot bgs were adjusted to be collected below any fill material, if interpreted to be present. The interval for the deepest soil samples of 8 to 10 feet bgs was retained.

Ten piezometers were installed as described in the Phase 1 work plan. However, only four of these (SL-PZ02, SL-PZ05, SL-PZ08, and SL-PZ09) yielded adequate groundwater volume for sampling.

Three overburden/shale groundwater monitoring wells (1SLA-MW01, 1SLA-MW02, and 1SLA-MW03) and three limestone bedrock monitoring wells (1SLA-BEDGW-001, 1SLA-BEDGW-002, and 1SLA-BEDGW-003) were installed at the TNTA/WWTP1 sewer lines according to the Phase 2 work plan (Shaw, 2009a). The work plan was designed to include upgradient, on-site, and downgradient groundwater locations, as was done with respect to the overburden/shale wells. The placement of overburden monitoring wells was based on groundwater flow directions determined from newly installed piezometers. Sitewide bedrock groundwater flow maps were used to place new bedrock monitoring wells.

Six collocated surface water and sediment samples were collected at locations within the drainage ditches south and west of the TNTA/WWTP1 sewer lines.

The following list summarizes the sampling and analyses conducted for the RI:

- ***Surface Soil***
  - 2009 Investigation – Twelve samples, including one QC sample and one QA sample, were collected and analyzed for nitroaromatics, TAL metals, PCBs, and SVOCs, and one sample was analyzed for TOC.
  - 2010 Delineation – Twenty-eight samples, including four QA and QC samples, were collected and analyzed for nitroaromatics.

- ***Subsurface Soil***
  - 2008 Test Pit - Twenty-three samples, including three QC and two QA samples, were collected at depths ranging from 3 to 5.5 feet and analyzed for nitroaromatics.
  - 2009 Investigation - Twenty subsurface soil samples, including one QA and one QC sample, were collected and analyzed for nitroaromatics, TAL metals, PCBs, and SVOCs.
  - 2010-2011 Delineation - One hundred seventeen composite soil samples were collected and analyzed for nitroaromatics.

- ***Overburden/Shale Piezometers*** – Four groundwater samples were analyzed for nitroaromatics, TAL metals (filtered and unfiltered), SVOCs, cyanide, and general chemistry parameters; field tests were also conducted.

- ***Overburden/Shale Monitoring Wells*** – A total of five groundwater samples, two in the wet season and three in the dry season, were analyzed for nitroaromatics, TAL metals (filtered and unfiltered), SVOCs, VOCs, and general chemistry parameters; field tests were also conducted.

- ***Limestone Bedrock Monitoring Wells*** – A total of four groundwater samples from three wells, two in the wet season and two in the dry season, were analyzed for nitroaromatics, TAL metals (filtered and unfiltered), SVOCs, VOCs, and general chemistry parameters; field tests were also conducted.

- ***Sediment*** – Eight samples, which include one QC and one QA sample, were collocated with the surface water samples from Plum Brook and analyzed for nitroaromatics and PCBs.

- ***Surface Water*** – Eight samples, which includes one QC and one QA sample, were collected and analyzed for nitroaromatics.

All analytical data from these samples were reviewed for accuracy and completeness. One hundred percent of the data analyzed were subjected to data validation following the guidelines in the EPA *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (EPA, 2008) and EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 2004a), the QAPP (Shaw, 2008a), and specific analytical method requirements. Data were evaluated against specific criteria to verify

the achievement of precision, accuracy, representativeness, completeness, and comparability goals established to meet the project DQOs. The criteria for blank evaluation were based on those detailed in *Region 3 Modifications to National Functional Guidelines for Evaluating Organic Analyses* (EPA, 1994) and *Region 3 Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA, 1993). Additional information on data evaluation, data validation, and data quality are provided in the SCR and information attached therein (Appendix D).

4.2.2 Characterization of TNTA/WWTP1 Sewer Lines

4.2.2.1 Local Soils

Following closure and removal of the manufacturing structures, tanks, and equipment, a local fill sand was brought to the areas to cover the remaining concrete building foundations and demolition scars and to provide a level ground surface for promotion of a natural landscape. Fill material is suspected to have been encountered in 1 of the 12 soil borings drilled during the January 2009 fieldwork along the sewer lines trace. Boring PZ-05 encountered suspected fill material consisting of a loose, dark yellowish-brown, fine-grain, well-sorted sand beginning at the ground surface to a depth of 7 feet. This boring may have been drilled within material that was used as backfill after initial emplacement or abandonment of the TNTA/WWTP1 sewer lines.

Native soil in borings drilled at the TNTA/WWTP1 sewer lines area consisted of a glacial till, glacial outwash, or a glacial lacustrine (lake) deposit. In general, along the northern half of the field, the soil consisted of a stiff, olive-brown, mottled brown, silty clay overlying a fine-grain, homogeneous, well-sorted sand overlying a very stiff, dark gray, silty clay. This area is within a topographic high and represents a different depositional environment than was found in the southern portion. In the southern portion of the field, no sand lenses were encountered and bedrock refusal on the underlying Olentangy Shale occurred at a shallower depth. The average thickness of soil at TNTA/WWTP1 sewer lines was 12.5 feet bgs.

During excavation of test pits in 2008 and 2010, visible red staining indicative of nitroaromatics was evident in soils, particularly on the eastern end of the southern line adjacent to Columbus Avenue and the western end of the northern line adjacent to (east of) Taylor Road. Based on results of the field screening, it was evident that this staining represented leaks and residual soil contamination from the former waste line. The extent of the red staining appeared to be confined to very narrow layers within the soil column and the staining is interpreted to be the result of

minor leaks during operations or minor spills during the removal of the TNTA/WWTP1 sewer lines.

4.2.2.2 Local Geology

Bedrock units below the TNTA/WWTP1 sewer lines consist of the Olentangy Shale and the underlying Delaware Limestone, both of Devonian age. The Olentangy Shale at the TNTA/WWTP1 sewer lines was encountered at an average depth of 12.5 feet bgs. In general, the shale was gray in color, highly weathered, friable, and thinly laminated. Thickness of the shale in the bedrock monitoring well locations averaged 30.2 feet. Below the shale, the Delaware Limestone was encountered. It was found at depths ranging from 40.2 feet bgs (592.8 feet amsl) in bedrock well 1SLA-BEDGW-001 to 52.3 feet bgs (631.7 feet amsl) in well 1SLA-BEDGW-003. The limestone was typically dark gray in color, massive, fossiliferous, slightly weathered, and hard. Pyrite crystals were located on several cores along with a light brown hydrocarbon staining. All three of the bedrock wells exhibited a strong hydrocarbon and hydrogen sulfide odor. A description of the presence of naturally occurring petroleum hydrocarbons and hydrogen sulfide is presented in the SCR (Appendix D).

4.2.2.3 Local Hydrogeology

Overburden/shale groundwater at the TNTA/WWTP1 sewer lines was encountered at depths ranging from 3 feet bgs (PZ-05) to 10 feet bgs (SB-07/PZ-09) in January 2009 (wet season) during soil boring drilling/piezometer installation. Groundwater was not encountered in six of the borings, probably due to the typical silt and silty clay present at those boring locations. During monitoring well installation conducted in February and March 2009 (wet season), overburden/shale groundwater was found in a perched lens in two wells (1SLA-BEDGW-002 and 1SLA-BEDGW-003). Overburden/shale groundwater was encountered at the greatest depth of 17 feet bgs in well 1SLA-BEDGW-001. Table 4-1 shows water level elevations at piezometers and monitoring wells. As shown by the May 26, 2009 overburden/shale groundwater elevation contour map (Figure 4-2), which includes water level measurements from both the temporary piezometers and permanent monitoring wells, groundwater flow is in a south-to-west radial direction, toward an unnamed drainage ditch and Plum Brook. Figure 4-3 presents an overburden/shale groundwater potentiometric map of water level measurements taken on October 27, 2009 (dry season) from the overburden/shale monitoring wells (the piezometers were abandoned in July 2009). The groundwater flow direction during October 2009 is also in a radial south-to-west direction. Overburden/shale groundwater flow mimics the surface topography from both contour maps.

Three bedrock monitoring wells were installed at the TNTA/WWTP1 sewer lines. The locations of the three bedrock wells (upgradient, source, and downgradient) were based on historical sitewide bedrock groundwater flow maps. Well 1SLA-BEDGW-001 was installed in an upgradient position, south of the sewer lines; bedrock well 1SLA-BEDGW-002 was installed as a source area well near the southern sewer line; and monitoring well 1SLA-BEDGW-003 was installed as a downgradient well. Bedrock groundwater was encountered during February and March 2009 drilling in fractures at depths of 57.1 feet (1SLA-BEDGW-001), 68 feet (1SLA-BEDGW-002), and 76.6 feet (1SLA-BEDGW-003). The screened interval of each of these wells is within the Delaware Limestone bedrock. Because minimal information is available from mapping of groundwater from only three bedrock wells, sitewide (regional) Delaware Limestone groundwater flow maps are shown on Figure 3-5 (wet season, May 2010) and Figure 3-6 (dry season, August 2010) to characterize groundwater flow in the vicinity of the TNTA/WWTP1 sewer lines. Delaware Limestone groundwater flow is determined to be in a north-northeast direction in the general vicinity of the TNTA/WWTP1 sewer lines.

4.2.2.4 Summary of Analytical Results

The analytical results of the RI samples described in Section 4.2.1 are summarized in this section. As part of this evaluation, analytes detected in the respective environmental media were compared to RBSCs and BSCs as points of reference only. Concentrations of analytes that exceed the RBSCs are highlighted in associated tables (Tables 4-2 through 4-9). RBSCs do not infer a regulatory limit or mandated cleanup level, nor is the identification of an exceedance intended to indicate an unacceptable human health risk or a need for remedial action. Formal evaluation of human health risks was performed in the BHHRA. Concentrations in individual samples that exceed the respective BSCs are identified by bold text in Tables 4-2 through 4-9.

The RBSCs are derived from May 2010 RSLs (EPA, 2010) as described in the BHHRA (Appendix E). The groundwater RBSCs are based on a generalized residential drinking water scenario, assumed to be the most restrictive use of groundwater, and they correspond to a one-in-one-million (1E-6) ILCR or a noncancer HQ of 0.1, whichever results in a lower concentration (Shaw, 2009b). The soil RBSCs are based on a long-term residential land-use scenario that assumes use by a young child for noncancer effects and use by the combined young child and adult life stages for carcinogenic effects. Together, these capture a worst plausible case for future land use. The soil RBSCs are likewise based on an ILCR of 1E-6 and an HQ of 0.1. Although no RSLs exist for surface water or sediment, the tap water and residential soil regional RSLs are used directly as the RBSCs for surface water and sediment based on a Project Delivery Team agreement (OEPA, 1999) which used the former EPA Region 9 PRGs (EPA, 2004b) for this

purpose. The method has been updated to use RSLs rather than PRGs (Shaw, 2010a). Further details on the RBSCs and their derivation are provided in the BHHRA (Appendix E).

The evaluation of the analytical results of the samples and analyses (Section 4.2.1), as presented in the SCR, are summarized below for each medium.

Geophysical Survey. The sewer line trace was detected at a limited number of locations, but the complete extents of the sewer lines were not confirmed. Results from the geophysical survey did reveal that the sewer lines still may be present under the existing Columbus Avenue roadway.

Surface and Subsurface Soil Summary

2008 Test Pits

- No sewer lines were encountered in any of the excavations, but metallic banding, broken terracotta piping, and wood stave fragments were uncovered. Test pit excavation results concluded that the wooden flume lines previously used to transport TNT manufacturing wastes from the TNTA settling tanks to WWTP1 are no longer present.

- Six nitroaromatics were detected in test pit soil samples. The nitroaromatic 2,4-DNT was detected above the RBSC in test pits TP-27 (southern line), TP-30 (southern line), and TP-33 (northern line); 2,4,6-TNT also exceeded the RBSC in the test pit TP-30 subsurface soil sample.

2009 Geoprobe Drilling

- Up to five nitroaromatics exceeded respective RBSCs in the 2009 surface soil samples at three borings (SB05, SB12, and SB14). Nitroaromatics included 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2,4-DNT, 2,6-DNT, and 2,4,6-TNT.

- Two PCBs, Aroclor 1016 (boring SB05) and Aroclor 1260 (boring SB07), were detected above respective RBSCs in the surface soil.

- Only one PCB, Aroclor 1221, was detected above its RBSC in the QC subsurface soil sample from boring SB02. It was detected at a concentration of 0.199 ppm, only slightly above the RBSC of 0.14 ppm, and it was not detected in the associated regular or QA samples.

- Up to five SVOCs exceeded respective RBSCs in surface soil samples at two borings (SB02 and SB08): benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

- No metals exceeded both the RBSC and BSC in surface soil.
- No metals exceeded both the RBSC and BSC in subsurface soil.
- TOC was measured at 3,260 ppm in the surface soil sample from SB01.

2010 Data Gaps Assessment

To address data gaps related to the wide spacing of test pits and soil borings, 117 composite soil samples were collected. The majority of the TNTA/WWTP1 sewer lines did not show appreciable contamination in subsurface soil based on field screening and fixed-base samples with two notable exceptions:

- 2,4-DNT and 2,4,6-TNT were detected at concentrations of 2.39 and 9.67 ppm, respectively, in one composite sample at TNTA-53BL. This sample is in the same approximate location as the discrete sample collected from test pit TP-27, which also showed elevated concentrations of nitroaromatics.
- 2,4-DNT and 2,4,6-TNT were detected at concentrations of 2.12 and 10.3 ppm, respectively, in one composite sample at TNTA-46BL. This sample is in the vicinity of test pit sample TP-30, which had elevated concentrations of 2,4-DNT and 2,4,6-TNT.

2011 Soil Sampling

- No nitroaromatics were detected above RBSCs in subsurface soil samples collected from soil borings. Confirmation sampling was conducted in the vicinity of test pit TP-33 due to the detection of 2,4,6-TNT at 1,380 ppm in 2008. Nitroaromatics were not detected above RBSCs in any of the borings completed.
- No SVOCs were detected above RBSCs in subsurface soil samples.
- No metals exceeded both the RBSC and BSC in surface soil.
- No metals exceeded both the RBSC and BSC in subsurface soil.

Based on analytical results and field observations, contamination is present in areas along the TNTA/WWTP1 sewer lines. However, it is interpreted to be restricted to very thin bands of soil immediately below the former sewer line. These bands are interpreted to be the result of minor leaks and/or spills that occurred when the sewer line was removed.

Piezometer Overburden/Shale Groundwater Sample Summary

- Five nitroaromatics were detected in overburden/shale groundwater samples, and two (2,4-DNT and 2,4,6-TNT) were detected above the RBSCs. Nitroaromatics were detected above RBSCs in piezometers PZ08 and PZ09.

Monitoring Well Overburden/Shale Groundwater Sample Summary. Two groundwater samples were collected during the wet season month of May 2009, and three groundwater samples were collected during the dry season month of November 2009. The major findings related to monitoring well location (upgradient [SLA-MW03], source area [SLA-MW02], and downgradient [SLA-MW01]) are summarized as follows:

Upgradient

- No analytes were detected at concentrations above both RBSCs and BSCs in overburden/shale groundwater.

Source Area

- No analytes were detected at concentrations above both RBSCs and BSCs in overburden/shale groundwater.

Downgradient

- Two metals (cobalt and nickel) exceeded both the RBSC and BSC in both the unfiltered and filtered groundwater samples in downgradient monitoring well 1SLA-MW01. Note that nickel (75 µg/L) only marginally exceeded the RBSC of 73 µg/L.

Bedrock Groundwater Sample Summary. Two groundwater samples were collected during the wet season month of May 2009, and four groundwater samples were collected from two bedrock wells during the dry season in November 2009. Groundwater samples were collected from wells 1SLA-BEDGW-002 (source area well) and 1SLA-BEDGW-003 (downgradient area well). Upgradient well 1SLA-BEDGW-001 contained insufficient groundwater for sample collection during both the May and November 2009 field events, so a groundwater sample could not be collected. The major findings related to monitoring well location (source area and downgradient) are summarized as follows:

Source Area

- No nitroaromatics were detected in source area well 1SLA-BEDGW-002 during the wet season (May) or dry season (November) sampling event. Four VOCs exceeded both RBSCs and BSCs during each sampling event: the petroleum hydrocarbon-

related compounds benzene, ethylbenzene, toluene, and total xylenes. Methylene chloride was also above the RBSC during the wet season, but the analytical result was "B" qualified.

- The petroleum hydrocarbon-related SVOCs 2-methylnaphthalene and naphthalene were detected above the RBSCs during the both sampling events and are likely attributable to naturally occurring hydrocarbons.

- Only arsenic was detected above both the RBSC and BSC in both the unfiltered and filtered groundwater samples.

Downgradient

- The nitroaromatic nitrobenzene was detected in downgradient well 1SLA-BEDGW-003 during the dry season (November) sampling event in only the QC sample. Four VOCs exceeded both RBSCs and BSCs during each sampling event: the petroleum hydrocarbon-related compounds benzene, ethylbenzene, toluene, and total xylenes. In addition, chloroform was detected above the RBSC during the wet season (May) and the dry season (November) sampling events, although the detection of chloroform was found only in the QC sample, and the analytical result was "B" qualified. Chloromethane was also detected above the RBSC in the downgradient well during the November sampling event in the regular and QC samples.

- The petroleum hydrocarbon-related SVOCs 2-methylnaphthalene and naphthalene were detected above the RBSCs. 2-Methylnaphthalene was detected only in the QC sample during the dry season, and naphthalene was detected above the RBSC during both sampling events in all but the QA sample.

- Only arsenic was detected above both the RBSC and BSC in the unfiltered and filtered groundwater samples, and iron was detected above the RBSC and BSC during only the dry season (November) in the unfiltered groundwater sample.

Surface Water Summary

- No nitroaromatics were detected in the surface water samples from Plum Brook, and no analytes were detected at concentrations exceeding RBSCs.

Sediment Summary. A total of eight sediment samples (QC and QA samples included in total) were collocated with the surface water sample locations in Plum Brook. Sediment samples were analyzed for nitroaromatics and PCBs. The major findings are summarized as follows:

- No nitroaromatics were detected in any of the sediment samples.
- No PCBs were detected above RBSCs.

4.3 Baseline Human Health Risk Assessment Summary

The BHHRA evaluates potential human health risks associated with exposure to soil and groundwater associated with the trace of the former sewer lines running from TNTA to WWTP1 at the former PBOW. This section summarizes the BHHRA. It identifies the COPCs, summarizes the receptors, media, and exposure pathway evaluated; summarizes the risk characterization; and presents the BHHRA conclusions. The final BHHRA, submitted previously, is included as Appendix E. This BHHRA is consistent with EPA guidance and with the procedures established in the BHHRA for TNTA and TNTC soil (IT, 2001b), the BHHRA for groundwater at PBOW (Shaw, 2006) and, most specifically, the TNTA/WWTP1 BHHRA work plan (Shaw, 2010c).

4.3.1 Identification of COPCs

A screening procedure was conducted on the RI and LSI analytical data from each TNTA/WWTP1 sewer lines environmental medium. This screening process is used to identify COPCs, which are the detected chemical analytes carried through the full risk assessment process. The objectives of COPC screening are to focus the risk assessment on those chemicals that may contribute significantly to overall risk and to remove from quantification those chemicals whose contribution is clearly inconsequential. COPC screening includes a risk-based screen that also considers status as a human nutrient, a frequency-of-detection evaluation, and a background screen. As described in the Section 2.4.3 of the BHHRA (Appendix E), the screening for background chemicals in soil and limestone bedrock groundwater differs somewhat from current OEPA (2004) guidance. This difference is based on established PBOW Project Delivery Team decisions, which include agreement between OEPA, USACE, and NASA. The background concentrations used for screening in the BHHRA were developed from soil samples collected near the property boundary, away from any potential source areas, and the background groundwater wells that were installed in off-site areas upgradient of PBOW sources.

The COPC screening process results in the generation of a data summary table for each medium to be quantitatively evaluated in the BHHRA. A data summary table for each TNTA/WWTP1 medium is provided as follows: surface soil (Table 4-10), subsurface soil (Table 4-11), total soil (Table 4-12), bedrock groundwater wells (Table 4-13), overburden groundwater wells (Table 4-14), and sediment (Table 4-15). These tables provide the following information for each detected chemical in each environmental medium:

- Chemical name
- Frequency of detection and percentage of detected samples
- Range of detected concentrations and related data validation qualifiers
- Range of detection limits
- Arithmetic mean of site concentrations

- 95th percent UCL (for COPCs only)
- Appropriate RBSC
- Appropriate BSC
- Selection/exclusion of chemical as a COPC
- EPC (for COPCs only).

Additional details of this data summary, including the statistical analysis of estimation of the UCL values and EPCs for COPCs, are discussed in the BHHRA (Appendix E). The COPCs for each of the TNTA/WWTP1 sewer lines media are identified as follows:

- ***Surface Soil*** – Aroclor 1016, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, 2,4-DNT, 2,6-DNT, TNT, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene

- ***Subsurface Soil*** – 2,4-DNT and TNT

- ***Total Soil*** – Aroclor 1016, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, 2,4-DNT, 2,6-DNT, TNT, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene

- ***Bedrock Groundwater*** – Aluminum, arsenic, chromium, iron, selenium, 2-methylnaphthalene, naphthalene, benzene, chloroform, chloromethane, trans-1,3-dichloropropene, ethylbenzene, toluene, xylenes, cyanide, and nitrate-nitrite

- ***Overburden Groundwater*** – Cobalt, nickel, thallium, and sulfate

- ***Sediment*** – Aroclor 1254

- ***Surface Water*** – None.

Please note that the total soil COPCs include all surface soil and subsurface soil COPCs.

4.3.2 Exposure Assessment

Exposure is the contact of a receptor with a chemical or physical agent. An exposure assessment estimates the type and magnitude of potential exposure of a receptor to COPCs found at or migrating from a site (EPA, 1989). The BHHRA characterizes potential exposures to COPCs in TNTA/WWTP1 sewer lines environmental media as portrayed by the CSEM. These environmental media include soil and groundwater.

The CSEM provides the basis for identifying and evaluating the potential risks to human health in the BHHRA. The CSEM, graphically depicted on Figure 4-4, includes the receptors appropriate to all plausible site-use scenarios and the potential exposure pathways. This

presentation of all possible pathways by which a potential receptor may be exposed, including all sources, release and transport pathways, and exposure routes, facilitates consistent and comprehensive evaluation of risk to human health and helps to ensure that potential pathways are not overlooked. The elements of a CSEM include the following:

- Source
- Source media (i.e., initially contaminated environmental media)
- Contaminant release mechanisms
- Contaminant transport pathways
- Intermediate or transport media
- Exposure media
- Receptors
- Routes of exposure.

Contaminant release mechanisms and transport pathways are not relevant for direct receptor contact with a contaminated source medium (e.g., ingestion or dermal contact).

The BHHRA evaluated exposure to chemicals in bedrock groundwater, overburden groundwater, surface soil, subsurface soil, surface water, and sediment for cancer risks and noncancer hazards. The receptors and pathways depicted on Figure 4-4 reflect scenarios developed from information regarding site background and history, topography, climate, and demographics as presented by D&M (1997b) and the sitewide groundwater investigation (IT, 1997). Justification for exclusion of other pathways is provided in the Figure 4-4 footnotes, and the exclusion of other potential receptors is discussed in Section 3.1.3.8 of the BHHRA (Appendix E). No current or future exposure by off-site residents is evaluated. Most of the off-site residents are serviced by municipal water from surface water sources. Although there are numerous private groundwater wells in the vicinity, including several within 1 mile of the facility boundary, none of these is used as a potable source.

Groundwater quality and potential use are discussed further in the uncertainty analysis of the BHHRA (Chapter 6.0 of the BHHRA [Appendix E]).

Exposures associated with the COPCs were evaluated for the receptors listed below. The media that were quantitatively evaluated for each receptor are listed in parentheses:

- Current groundskeeper (surface soil)

- Future groundskeeper (combined surface and subsurface soil [referred to as “total soil”], bedrock groundwater, and overburden groundwater)

- Indoor worker (surface soil, subsurface soil [inhalation pathway only], bedrock groundwater, and overburden groundwater)
- Current/future construction worker (total soil, surface water, and sediment)
- Future on-site resident (total soil, surface water, sediment, bedrock groundwater, and overburden groundwater)
- Future adult hunter (surface soil, including venison pathway)
- Future hunter's child (surface soil [venison pathway only]).

The resident was evaluated for noncancer hazards separately for the young child (ages 1 through 6 years) and adult life stages.

The equations for the calculations of intake values for each exposure pathway, exposure assumptions, and the calculation of EPCs of COPCs for modeled pathways (e.g., venison, airborne concentrations) are presented in the BHHRA (Appendix E).

4.3.3 Risk Characterization

Risk characterization is the process of applying numerical calculations and professional judgment to determine the potential for adverse human health effects to result from the presence of site-specific chemicals. This is done by combining the intake rates estimated during the exposure assessment with the appropriate toxicity information identified in the toxicity assessment (Chapter 5.0 of the BHHRA [Appendix E]). Noncancer hazards and cancer risks are characterized separately, including COPCs that induce both types of effects.

Quantitative expressions are calculated during risk characterization that describe the probability of developing cancer (i.e., ILCRs), or the nonprobabilistic comparison of estimated dose with an RfD for noncancer effects (i.e., HQs and HIs). Quantitative estimates are developed for individual chemicals, exposure pathways, and exposure media for each receptor. These quantitative risk characterization expressions, in combination with qualitative information, are used to guide risk management decisions. Risk characterization is applied only to COPCs.

4.3.3.1 Cancer Risk

The risk from exposure to potential chemical carcinogens is estimated as the probability of an individual developing cancer over a lifetime and is called the ILCR. Equations for calculating the ILCR are presented in the BHHRA (Appendix E).

Total ILCRs in the range of 1E-6 to 1E-4 are regarded as acceptable (EPA, 1990); this range is referred to as the "NCP risk management range." Risks less than this range are regarded as negligible. A target cancer risk goal of 1E-5 is used by OEPA and was selected by the PBOW Project Delivery Team as a basis to consider remedial action. Use of this 1E-5 goal represents a departure from the Army's practice of generally using a cancer risk exceeding a value of 1E-4 (the upper end of the NCP risk management range) to trigger remedial action considerations.

4.3.3.2 Noncancer Effects of Chemicals

The hazards associated with noncancer effects of chemicals are evaluated by comparing an exposure level or intake with chronic RfD values. The HQ, defined as the ratio of intake to RfD, is estimated by dividing the intake of a chemical by the RfD as described in the BHHRA (Appendix E). An HQ of unity indicates that the estimated intake equals the RfD. If the HQ is greater than unity, there may be concern for potential adverse health effects. In the case of simultaneous exposure of a receptor to multiple chemicals or to a given chemical by multiple pathways, an HI is calculated as the sum of the HQs for each chemical.

A total HI is calculated as the sum of all HI values, including all media and all COPCs, for a given receptor. Calculating a total HI as the sum of HQ values is based on the assumption that the potential for noncancer effects is additive. EPA (1989), however, acknowledges that the assumption of additivity is probably appropriate only for chemicals that induce adverse effects by the same mechanism or affect the same target organ. Therefore, if the total HI for a receptor exceeds 1, individual HI values may be calculated for each target organ, as described in Appendix E.

4.3.3.3 Risk Characterization Results

Cancer and noncancer risk characterization results were evaluated for each receptor and each environmental medium using the methods described in Sections 3.3 and 5.0 of the BHHRA (Appendix E). The cancer risks and noncancer hazards are presented for each receptor in Table 4-16 for all pathways including groundwater use and in Table 4-17 for all pathways excluding groundwater use.

The overall HI and ILCR values are summarized in the following list; exceedances of the PBOW cancer risk goal (ILCR>1E-5) are shown in bold type and exceedances of the noncancer hazard criterion (HI>1) or the NCP risk management range (1E-6 to 1E-4) are shown in bold italics:

- Current groundskeeper – surface soil pathways, excluding groundwater use: ILCR = 1E-5; HI = 0.8

- Future groundskeeper – all pathways, including bedrock groundwater use:
  ILCR = 4E-4; HI = 4

- Future groundskeeper – all pathways, including overburden groundwater use:
  ILCR = 7E-6; ***HI =5***

- Future groundskeeper – all pathways, excluding groundwater use:
  ILCR = 7E-6; HI = 0.4

- Indoor worker – all pathways, including bedrock groundwater use:
  ILCR = 4E-4; HI = 4

- Indoor worker – all pathways, including overburden groundwater use:
  ILCR = 4E-6; **HI = 5**

- Future Indoor worker – all pathways, excluding groundwater use:
  ILCR = 4E-6; HI = 0.3

- Construction worker: ILCR = 4E-7; HI = 1

- Resident – all pathways, including bedrock groundwater use:
  ILCR = 2E-3; child HI = 32; adult HI = 12

- Resident – all pathways, including overburden groundwater use:
  ILCR =1E-5 (**2E-5** including polynuclear aromatic hydrocarbon [PAH] compounds unrelated to TNT manufacturing waste); ***child HI = 34; adult HI = 13***

- Resident – all pathways, excluding groundwater use:
  ILCR =1E-5 (**2E-5** including PAH compounds unrelated to TNT manufacturing waste); ***child HI = 4;*** adult HI = 0.5

- Hunter: ILCR = 9E-7; HI = 0.4

- Hunter's child: ILCR = 2E-12; HI = 0.00001.

4.3.3.4 BHHRA Conclusions

The ILCR and HI values for the two current exposure scenarios (current groundskeeper and construction worker) each meet the PBOW cancer risk goal (ILCR≤1E-5) and the noncancer hazard criterion (HI≤1). Note that no groundskeeping appears to have occurred along the TNTA/WWTP1 sewer line traces in recent years, except occasional mowing or burning. Thus, the current groundskeeper scenario, which assumes a full-time, 25-year employee who works exclusively along the TNTA/WWTP1 sewer line traces for 8 hours per day, 250 days per year, appears to greatly overestimate the exposure levels of any current on-site worker or other current receptor.

The cancer risks associated with the following future receptors assumed to use bedrock groundwater as a hypothetical source of tap water exceed the NCP risk management range and PBOW cancer risk goal: future groundskeeper, future indoor worker, and future resident. Each of these also exceeds the target HI criterion of 1. The HI value for each of these three receptors under the assumption of overburden groundwater use also exceeds the HI target goal.

The cancer risks and noncancer hazards associated with bedrock groundwater are almost entirely attributable to naturally occurring petroleum-related compounds and arsenic, which appear to be unrelated to former site activities. The noncancer hazards associated with overburden groundwater are entirely due to inorganics, especially thallium and cobalt, which do not appear to be associated with former site activities. Use of either the overburden or bedrock groundwater is regarded as implausible because of insufficient yield. Additionally, the naturally poor quality of the groundwater and associated hydrogen sulfide off-gassing of the bedrock unit make the underlying groundwater unsuitable as a potable source. The readily available municipal water supply obviates the need for use of groundwater as a potential source of tap water in the general vicinity of PBOW.

If the use of groundwater is excluded in recognition of low yield, the observation that virtually all cancer risks and noncancer hazards associated with groundwater result from naturally occurring constituents, and hydrogen sulfide off-gassing from bedrock groundwater wells, only the HI value of 4 for the child resident exceeds the target HI of 1. This HI is almost entirely associated with TNT in soil.

Elevated TNT concentrations are not representative of soil along the entire length of the sewer line traces but instead are limited to reported concentrations near test pits TP-27 and TP-33. Further investigation of these test pits revealed that the elevated TNT concentration detected in a single TP-33 area sample was not representative of the vicinity of TP-33 and that the TP-33 location is thus not a hot spot. This investigation identified the TP-27 area as a hot spot because additional contamination was found in an area estimated as approximately 60 feet by 20 feet. As such, this location may be considered for remediation using cleanup levels derived based on risk-based remedial concentration (RBRC) values. TNT was identified as a preliminary chemical of concern in the BHHRA. RBRCs, which will be considered in the derivation of cleanup levels in the FS, were developed for TNT to support site management decisions, as presented in Table 4-18. A description of how the TNT RBRCs were developed is provided in the BHHRA (Appendix E).

Because the TP-27 area is regarded as a hot spot, the analytical results may be excluded from the general TNTA/WWTP1 sewer line data sets and addressed separately as described in the previous paragraphs. Likewise, data from TP-33, which had been identified as a potential hot spot, may be excluded from the data set because the single elevated concentration was found to be clearly nonrepresentative of the TP-33 area. If both the TP-27 and the TP-33 data sets are removed from the risk characterization (and groundwater exposure is excluded), none of the TNTA/WWTP1 sewer line receptors have an ILCR value that exceeds the PBOW cancer risk goal and none of these receptors have an HI that exceeds the target HI of 1. The results of this evaluation indicates that exposure to soil along the TNTA/WWTP1 sewer lines, outside of the TP-27 area, would not result in unacceptable cancer risks or noncancer hazard for any receptor.

4.4 Screening-Level Ecological Risk Assessment

The SLERA, summarized in this section, was performed to evaluate and provide an estimate of current and future ecological hazard associated with exposure to potential releases to soil, groundwater, surface water, and sediment associated with the TNTA/WWTP1 sewer lines. This SLERA summary provides an ecological site description, identifies COPECs at the site, identifies ecological receptors, characterizes exposure, characterizes ecological risks, and presents the conclusions of the SLERA. The final SLERA, submitted previously, is included as Appendix F.

The SLERA is consistent with EPA guidance and with the procedures established in the SLERA for TNTA and TNTC soil (IT, 2001c) and, most specifically, the TNTA/WWTP1 sewer lines work plan (Shaw, 2010c).

4.4.1 Ecological Site Description

The ecological site description, presented in full in the SLERA (Appendix F) and summarized in the following paragraphs, includes a general site description; a description of surface water resources, wetlands, and vegetative communities; a species inventory; and a discussion of threatened and endangered species. Ecological characterization of the study area was initially based on a compilation of existing ecological information pertaining to the site. Shaw personnel obtained maps and other relevant site information and determined the locations of potential ecological units such as streams, creeks, ponds, grasslands, forest, and wetlands on or near the site. Additionally, biological inventories performed in 1994 and 2001 at PBOW (ODNR, 1995; NASA, 2002) that identify and indicate the locations of threatened and endangered species at the installation were reviewed.

General descriptions of PBOW and the TNTA/WWTP1 sewer lines are presented in Chapters 1.0 and 2.0. This site consists of the two sewer lines extending from the TNTA settling tanks to WWTP1. One line was a 4-inch-diameter line that extended due west from the TNTA settling basins (Building 187) for approximately 2,700 feet before angling southwest to WWTP1. The other sewer line extended directly west-southwest from the TNTA settling basins for approximately 3,800 feet to WWTP1. Assuming the potentially affected area from sewer line releases extends perpendicular to the sewer line 10 feet in both directions, the sewer line traces comprise approximately 3 acres.

Surface water at the TNTA/WWTP1 sewer lines site drains to two different PBOW creeks. Water in the western portion of the lines is interpreted to drain toward Plum Brook, while the majority of the water is interpreted to drain toward a small creek on the south portion of the site that drains into Lindsley Ditch. The TNTA/WWTP1 sewer lines traces cross Plum Brook in the western portion of the site, near WWTP1. Surface water is typically present in Plum Brook. Other, shallower drainage channels that typically only contain water after significant rain events are present near the eastern and western boundaries of the site.

Shaw ecological scientists performed site visits to WWTP1 on April 27, June 2, and September 9, 2009; September 8, 2010; and September 1, 2011. These visits were performed at different times of year to identify early- and late-blooming plant species (especially threatened and endangered species) and migrating and nesting bird species present at the site. Reconnaissance personnel used these site visits to confirm assumptions based on information previously gathered about the site, identify current site ecological conditions, and evaluate the site for more subtle indications of potential effects from contaminant release. Information obtained during the reconnaissance trips was used to select representative receptors, refine exposure scenarios for the risk assessment, and identify protected species or habitats of special concern in the study area. A photographic record was made during the site reconnaissance (Appendix F).

Vegetative communities at the site were classified during the site reconnaissance trips. The early summer site vegetation trip occurred on June 2, 2009. The site was visited three times for the late summer vegetation survey in September of 2009, 2010, and 2011. NASA personnel had indicated that the management goal for this area is to reintroduce a native prairie ecosystem on this parcel of land through management practices. A controlled burn was performed by NASA in the field between Taylor Road and Columbus Avenue in the spring of 2009 in order to encourage the growth of a prairie ecosystem, which relies on a regular burn cycle to stimulate seed germination and eliminate invasive species that outcompete prairie species for sunlight and other resources. In September 2009, however, it was observed that site personnel had mowed the area.

Therefore, a second site visit was performed in September 2010, which was anticipated to be the first year following the controlled burns that the full prairie vegetation assemblage would be expressed. However, site personnel had mowed the area again. Because of the less than ideal conditions of the first two late summer vegetation surveys, a third late summer vegetation survey was attempted in 2011. Although the site had not been mowed recently, it appeared that it had been mowed earlier in the year. During this final survey, it was noted that most of the prairie indicator species that had been observed during some of the previous trips to the site had been replaced by ruderal/invasive species, and the vegetation communities were more accurately described as "old field" rather than "prairie." A vegetation community map and the full list of plant species identified during the reconnaissance visits are presented in the SLERA (Appendix F). Vegetative stress attributable to chemicals was not observed at the TNTA/WWTP1 sewer lines, although the mowing activities had removed most of the aboveground vegetation present during the 2009 and 2010 late summer vegetation surveys. Based on site reconnaissance information, the TNTA/WWTP1 sewer lines area consists of a relatively undisturbed parcel of old field habitat that is capable of supporting ecological receptors. There was no evidence that significant ecological threats exist at the site.

A fauna species list was developed for the site based on existing site investigation reports (e.g., ODNR, 1995; NASA, 2002) and other environmental data sources. Bird surveys were performed during the site reconnaissance visits to identify bird species and communities using the site during migration (early spring reconnaissance visit) and nesting (late spring/early summer reconnaissance visit) periods. Direct or indirect (e.g., prints) observations of mammals and other fauna classes were also noted. One of the species identified at the site was a northern harrier (*Circus cyaneus*), which is a state-listed endangered species. This species was observed during both the spring and early summer surveys in 2009 and likely breeds at or near the site. A full list of species observed or expected to be present at the site is presented in the SLERA (Appendix F).

According to the NWI maps for the area (U.S. Fish and Wildlife Service, 2011), the TNTA/WWTP1 sewer line traces do not intersect any designated wetlands. An area in the open field between the two sewer line traces, approximately 200 feet east of Taylor Road and 500 feet north of Maintenance Road, is classified as a palustrine, emergent, seasonally flooded wetland. Two low-lying wet meadow areas that supported wetland indicator plant species were identified in the field between the sewer line traces during the ecological site reconnaissance visits as well. The wet meadow area farther to the west roughly overlaps the NWI wetland. This area is also significant because one of the areas where elevated 2,4,6-TNT was identified may fall within this area. NASA is currently performing a wetland delineation study at PBOW that will more

accurately identify the locations and extent of sensitive wetland habitat throughout the installation.

The only T&E plant or animal species observed during site reconnaissance was the state-listed northern harrier. Based on the habitat present at the TNTA/WWTP1 sewer lines and other available information, no additional T&E bird species are expected to be found at the TNTA/WWTP1 sewer lines. Likewise, the only T&E mammal (Ohio endangered) historically documented at PBOW, the Indiana bat, has widespread sightings throughout Ohio, but the TNTA/WWTP1 sewer lines area does not provide the preferred habitat for this species (i.e., caves or trees with exfoliated bark).

4.4.2 Identification of Chemicals of Potential Ecological Concern

A screening process was performed on the analytical data from the RI to identify COPECs that may pose a threat to ecological receptors. These data include all soil samples collected to a depth of 6 feet, surface water, and sediment. Groundwater was excluded because exposure to this TNTA/WWTP1 sewer lines medium is considered to be an incomplete pathway for ecological receptors. A list of the TNTA/WWTP1 sewer lines media samples used for the SLERA is presented in Table 4-19. Sample locations are presented on Figure 4-1.

Two general types of soil sampling were employed during the RI. Samples used for the SLERA consisted of soil, sediment, and surface water samples originally collected as part of the scoped RI sampling effort in 2008, supplemented with additional soil samples collected in 2009 through 2011. Two general types of soil sampling were employed during the RI: test pit sampling and direct-push sampling. The test pit samples were collected in December 2008 from 18 test pits excavated along the sewer line trace, perpendicular to the trace. These were analyzed for nitroaromatics only. Each test pit sample was collected beginning at the base of the former sewer line (as interpreted from soil disturbance along the test pit walls associated with sewer line installation) to a depth of 0.25 to 0.5 foot below this interface. Direct-push soil samples were collected from 10 soil borings in January 2009 to augment the test pit soil results. These were analyzed for a more complete suite of chemicals, including metals, PCBs, and SVOCs. Additional soil samples were collected in 2010 and 2011 based on test kit results for nitroaromatics and to delineate elevated nitroaromatics detected in TP-27 and TP-33, where 2,4,6-TNT was detected at concentrations of 3.35 and 1,380 mg/kg, respectively, in 2008. Although the TP-27 2,4,6-TNT concentration was relatively low (3.35 mg/kg), additional samples were collected from this area based on a reported 2,4,6-TNT concentration of 138 mg/kg in the surface soil sample from soil boring SL-SB12, which is located approximately 10 feet east of TP-27, along the sewer line trace. Eight composite soil samples were also collected in 2010 in

areas offset by approximately 10 feet from the sewer lines. These composite samples were collected near test pit locations TP-27, TP-29, and TP-30. Because these samples were collected as composites, they were not used in the SLERA. Each of the composite sample areas were also characterized by grab samples, which were included in the risk assessment. Please see the SCR (Appendix D) for additional details of the sampling efforts performed at this site.

Sample SL-SB02 was collected in 2011 at the same location as TP-33 to try to replicate the high result. Because TP-33 and SL-SB02 were collected from the same sample location and depth, they were treated as duplicate samples in the SLERA. Two additional samples on the sewer line trace and in close proximity to TP-33 (SL-SB15 and SL-SB22) were collected to delineate the elevated concentrations horizontally. Six additional samples (SL-SB16 through SL-SB21) were collected from locations slightly offset from the sewer line to provide additional delineation. Because many of these samples were not collected for the purpose of identifying COPECs or estimating exposure concentrations to receptors in a risk assessment, the approach was adopted to include all soil samples (including the supplemental samples) that were collected along the transect in the SLERA, except for samples that were nondetect for nitrotoluenes, and that bounded another sample with nondetects. Such samples are considered to be from "clean" areas, and their inclusion in the data set could artificially lower estimated exposure concentrations. Also, delineation samples offset from the sewer line were not included in the SLERA data set either. The *a priori* hypothesis was that these samples would exhibit low or nondetect concentrations for explosives due to the low mobility of these samples, and their inclusion in the data set could also lower the estimated exposure concentrations. After chemical analysis, this was confirmed to be the case.

A similar approach was taken at sample location TP-27, where 2,4,6-TNT was detected at a concentration of 3.35 mg/kg in 2008 at a depth of 3 to 3.5 feet bgs. Two surface soil (0 to 1 foot bgs) samples from location SL-SB05 were collected in 2010 and 2011 at the same location as TP-27. These two samples were treated as duplicate samples in the SLERA. Six additional samples (SL-SB23, SL-SB14, SL-SB12, SL-SB27, SL-SB30, and SL-SB32) were collected in 2011 along the sewer line trace, within 100 feet east and west of TP-27 to delineate the elevated concentrations along the sewer line trace. Eight additional samples (SL-SB13, SL-SB11, SL-SB24, SL-SB25, SL-SB26, SL-SB28, SL-SB29, and SL-SB31) were collected from locations slightly offset from the sewer line. These offset samples were not included in the SLERA because they were primarily collected for delineation purposes to determine if contamination had spread laterally from the sewer line, and the inclusion of the low detections and nondetections from these samples could nonconservatively "dilute" the 2,4,6-TNT concentrations in the rest of the data set. The samples placed on the sewer line trace were included in the SLERA, but

SL-SB30 and SL-SB32 were not. These two samples were nondetect for 2,4,6-TNT and bounded another nondetect result at SL-SB27. SL-SB27 was included in the SLERA, but the other two samples were not, as it was judged that they might "dilute" the 2,4,6-TNT concentrations in the rest of the data set. The other two samples along the sewer line trace, SL-SB14 and SL-SB23, were included in the SLERA because SL-SB14 had detected concentrations of 2,4,6-TNT and SL-SB23 was a nondetect sample bounding SL-SB14.

The COPEC selection process was used to develop a subset of chemicals detected at the site that are not naturally occurring or associated with non-site-related sources. These chemicals are also present at sufficient frequencies, concentrations, and spatial areas to possibly pose a potential risk to ecological receptors. Examples of screening criteria that were used include analytical detection limit, frequency of detection less than 5 percent, comparability with background, status as a nutrient, and comparison with risk-based screening ecotoxicity values. This selection process and the screening values used for COPEC selection are described in the SLERA (Appendix F).

The results of the COPEC screening are presented in Tables 4-20 and 4-21 for soil and sediment, respectively; no chemicals were detected in surface water, so a COPEC table was not developed for this medium. The selected EPC is also presented in these tables for each chemical identified as a COPEC. For soil, two EPC results are presented, a total soil EPC for concentrations in the 0 to 6 feet bgs depth range and a surface soil EPC for concentrations in the 0 to 1 foot bgs depth range. These two sets of EPCs are used to evaluate various ecological receptors that may be exposed to different soil depths associated with their various life history characteristics. As described in the SLERA, the EPC is the lower value between the MDC and the 95 percent UCL of the mean.

Sixteen chemicals were selected as COPECs in soil (Table 4-20), and one was selected in sediment (Table 4-21). No chemicals were detected in surface water; therefore, surface water is not a medium of concern at the TNTA/WWTP1 sewer lines site and is not discussed further. The selected COPECs were quantitatively evaluated in the predictive SLERA, as summarized in Sections 4.4.3 through 4.4.6.

4.4.3 Selection of Ecological Receptors

Following COPEC selection, ecological assessment receptors were selected in the SLERA to focus the exposure characterization on species, groups of species, or functional groups that are directly related to the following assessment endpoints: the protection of long-term survival and reproductive capabilities for terrestrial invertebrates, herbivorous mammals, omnivorous

mammals, insectivorous mammals and birds, and carnivorous birds. As part of this receptor selection process, site biota were organized into major functional groups. For terrestrial communities, the major groups are plants and wildlife, including terrestrial invertebrates, mammals, and birds. For aquatic and/or wetland communities, the major groups are flora and fauna, including vertebrates (water fowl and fish), aquatic invertebrates, and wetland/terrestrial mammals.

Seven representative terrestrial receptor species that are expected or possible in the area of the TNTA/WWTP1 sewer lines (based on the ecological description of the site presented in Section 4.4.1) were selected as indicator species for the potential effects of COPECs. These indicator species represent two classes of vertebrate wildlife (mammals and birds) and a range of both body size and feeding habits, and include herbivores, omnivores, and carnivores. Terrestrial invertebrates and vegetation are not considered assessment receptors. The seven terrestrial species selected include the deer mouse (*Peromyscus maniculatus*) (small omnivorous mammal), short-tailed shrew (*Blarina brevicauda*) (small insectivorous mammal), Eastern cottontail rabbit (*Sylvilagus floridanus*) (medium-sized herbivorous mammal), marsh wren (*Cistothorus palustris*) (small insectivorous bird), white-tailed deer (*Odocoileus virginianus*) (large herbivorous mammal), raccoon (*Procyon lotor*) (medium-sized omnivorous mammal), and red-tailed hawk (*Buteo jamaicensis*) (large carnivorous bird). The red-tailed hawk was used to evaluate the state-endangered northern harrier.

Terrestrial and aquatic food webs are presented on Figures 4-5 and 4-6, respectively. Many of the species evaluated, particularly the deer mouse, cottontail rabbit, short-tailed shrew, and marsh wren, have limited home ranges which make them particularly vulnerable to exposure from site contaminants.

4.4.4 Exposure Characterization

A description of the nature, extent, and magnitude of potential exposure of assessment receptors to COPECs that are present at or migrating from the site is presented in this section, considering both current and reasonably plausible future use of the site.

Ecological routes of exposure for biota may be direct or through the food web via the consumption of contaminated organisms. Direct exposure routes include dermal contact, absorption, inhalation, and ingestion. Examples of direct exposure include animals incidentally ingesting contaminated soil or sediment (e.g., during burrowing or dust-bathing activities), animals ingesting surface water, plants absorbing contaminants by uptake from contaminated sediment or soil, and dermal contact of aquatic organisms with contaminated surface water or

sediment. Given the scarcity of available data for wildlife dermal and inhalation exposure pathways, potential risk from these pathways is not estimated in the SLERA. In addition, these pathways are generally considered to be incidental for most species, with the possible exceptions of burrowing animals and dust-bathing birds. Food web exposure can occur when terrestrial or aquatic fauna consume contaminated biota. Examples of food web exposure include animals at higher trophic levels consuming plants or animals that bioaccumulate contaminants.

Daily doses of COPECs for vertebrate receptors were calculated using standard exposure algorithms. These algorithms incorporate species-specific natural history parameters (i.e., feeding rates, water ingestion rates, dietary composition, etc.) as well as site-specific area use factors, which scale the estimated hazard by a fraction value based on the comparison of the size of the affected area to the home range of the specific receptor. These algorithms are presented and described in the SLERA (Appendix F).

Exposure to soil, sediment, and surface water is discussed in the following paragraphs. As stated in Section 4.4.2, groundwater is not a medium of concern for ecological receptors at this site.

Soil Exposure Pathway. Soil exposure pathways are potentially important for terrestrial plants and animals at the site. For nonburrowing animals, exposure to soil from a depth of 0 to 1 foot bgs was considered, as this soil depth would represent the depth of regular exposure for these types of organisms. For burrowing animals such as the shrew, exposure to soil from a depth of 0 to 6 feet bgs was considered. It is noted that although the shrew itself may not actually burrow to a depth of 6 feet, there may be other burrowing mammals that do burrow this deep. For plants and herbivores that feed on deep-rooted plants (e.g., the white-tailed deer, which is assumed to ingest leaves of trees translocating COPECs from subsoils), exposure to soil from a depth of 0 to 6 feet bgs (or the water table surface) was also evaluated because most feeder roots are located within this depth. Thus, the shrew and the white-tailed deer (Figure 4-5) were evaluated for exposure to deeper (0 to 6 feet bgs) soil. All other receptors exposed to soil were evaluated for exposure to concentrations in surface (0 to 1 foot bgs) soil.

Sediment Exposure Pathway. Potential contaminant sources for sediment include over-ground transport from the TNTA/WWTP1 sewer lines area and contaminated surface water, groundwater, and soil. The release mechanisms include surface water runoff, groundwater discharge, and airborne deposition. Potential receptors of chemicals in contaminated sediment include aquatic flora and fauna. Direct exposure routes for contaminated sediment include contact by benthic-dwelling organisms such as amphipod invertebrates, uptake by aquatic flora,

and ingestion by aquatic fauna. Indirect exposure pathways from sediment include consumption of bioaccumulated contaminants by consumers in the food chain.

Surface Water Exposure Pathway. Surface water represents a potential transport medium for COPECs. However, no chemicals were detected in surface water samples. Therefore, surface water exposure pathways are not quantified in the SLERA.

4.4.5 Risk Characterization

Food chain modeling was used to estimate exposure rates for the representative assessment receptors. These exposure rates were compared with TRVs to calculate HQs (Wentsel, et al., 1996). Two types of TRVs were used in the food chain models: those based on a NOAEL and those based on a LOAEL, the former being more conservative. As a conservative measure, only NOAEL HQs were used to evaluate the red-tailed hawk, because this species represents the state-endangered northern harrier that was observed at the site. HQs are calculated by summing intake doses across all exposure pathways for each chemical for a given receptor and dividing by the TRV. HQs for those chemicals that have a similar mode of toxicological action may be summed to account for cumulative effects. In the SLERA, the five nitroaromatic COPECs in soil were identified as potentially having similar mechanisms of toxicity, and their HQs were summed. HQs are a means of estimating the potential for adverse effects to organisms at a contaminated site and assessing the potential for toxicological effects among site receptors. HQs less than or equal to 1 represent no probable hazard. Although OEPA considers all HQs above 1 to be potentially significant, the following uncertainties regarding HQ interpretation are noted:

- HQs are not measures of risk.
- HQs are not population based.
- HQs are not linearly scaled.
- HQs are often produced that are unrealistically high and toxicologically impossible (e.g., estimated HQs greater than 1,000).
- Trace soil concentrations of inorganic chemicals (including concentrations well below background levels) can lead to HQ values that are (much) greater than 1.

Therefore, it should be understood that HQs greater than 1 are not a definitive indication that adverse ecological effects are occurring at the site or may occur in the future.

Table 4-22 summarizes the NOAEL and LOAEL-based HQs for the eight evaluated assessment receptors. The following compounds had HQ values greater than 1:

- ***Aroclor 1016 (and All PCBs):*** Marsh Wren (NOAEL HQ = 20.5; LOAEL HQ = 2.05)
- ***1,3,5-TNB:*** Marsh Wren (NOAEL HQ = 1.79)
- ***2,4,6-TNT:*** Deer Mouse (NOAEL HQ = 13.3, LOAEL HQ = 2.67), Short-Tailed Shrew (NOAEL HQ = 12.3; LOAEL HQ = 2.46), Cottontail Rabbit (NOAEL HQ = 3.27), Marsh Wren (NOAEL HQ = 125, LOAEL HQ = 25)
- ***All Nitrotoluenes:*** Deer Mouse (NOAEL HQ = 15.8, LOAEL HQ = 3.07), Short-Tailed Shrew (NOAEL HQ = 12.5; LOAEL HQ = 2.5), Cottontail Rabbit (NOAEL HQ = 5), Marsh Wren (NOAEL HQ = 125, LOAEL HQ = 25).

A summary of the discussion presented in the SLERA (Appendix F) for these chemicals is presented below.

Aroclor 1016

- The critical pathway for receptors that had HQs greater than 1 for Aroclor 1016 was ingestion of terrestrial invertebrates, which accounted for approximately 99 percent of the hazard to the wren. The uptake factor used to estimate body burden concentrations in invertebrate prey tissue was based on a model that uses the log K_{ow} of the target chemical. Comparison of modeled uptake factors to uptake factors developed during site-specific field studies at another site at PBOW (IT, 2001d) suggest that the modeled uptake factors for this pathway are overestimated, perhaps by several orders of magnitude.
- The LOAEL-based HQ only marginally exceeded 1 (HQ = 2.05), suggesting low potential for hazard given the conservative nature of the food chain modeling.
- Aroclor 1016 was only detected in 1 out of 15 soil samples; therefore, the potential area affected is too small to warrant concern for populations of ecological receptors.

1,3,5-TNB

- The critical pathway for the only receptor that had an HQ greater than 1 for 1,3,5-TNB was ingestion of terrestrial invertebrates. The uptake factor used to estimate body burden concentrations in invertebrate prey tissue was based on a model that uses the log K_{ow} of the target chemical. Comparison of modeled uptake factors to uptake factors developed during site-specific field studies at another site at PBOW (IT, 2001d) suggest that the modeled uptake factors for this pathway are overestimated, perhaps by several orders of magnitude.

- The HQ associated with 1,3,5-TNB was not highly elevated (i.e., less than 10), and the LOAEL-based HQ did not exceed 1.

- 1,3,5-TNB was only detected at concentrations exceeding its ESV in 6 out of 29 soil samples. Therefore, the potential area affected is likely too small to warrant concern for populations of ecological receptors.

2,4,6-TNT

- The critical pathway for receptors that had HQs greater than 1 for 2,4,6-TNT was ingestion of terrestrial invertebrates. The uptake factor used to estimate body burden concentrations in invertebrate prey tissue was based on a model that uses the log K_{ow} of the target chemical. Comparison of modeled uptake factors to uptake factors developed during site-specific field studies at another site at PBOW (IT, 2001d) suggest that the modeled uptake factors for this pathway are overestimated, perhaps by several orders of magnitude. When the site-specific uptake factor for 2,4-DNT was used as a surrogate value, only the deer mouse (HQ = 4.5) and cottontail rabbit (HQ = 3.3) NOAEL-based HQs would exceed 1; all LOAEL-based HQs are below 1. These results are presented in Table 4-22 for informational purposes.

- The elevated HQs for 2,4,6-TNT are not representative of the entire sewer line trace. Rather, they are primarily associated with sample locations TP-27 and TP-33.

- Subsequent sampling indicates that elevated concentrations of nitrotoluenes at TP-33 appear to be anomalous and could not be replicated.

- TP-27 appears to be a localized hot spot for elevated 2,4,6-TNT. This area is bounded by samples SB23 and SB30 and is approximately 60 feet by 20 feet, or less than a tenth of an acre in size. The average concentration of 2,4,6-TNT within this hot spot is 149.5 mg/kg. The marsh wren has the smallest home range of all evaluated receptors, with a home range of 0.13 acre. Therefore, the impacted area is too small to affect populations of the ecological receptors evaluated, or a single individual of the state-endangered northern harrier (as represented by the red-tailed hawk in the food chain model).

In summary, a small area with elevated 2,4,6-TNT may exist at the TP-27 location of the TNTA/WWTP1 sewer lines site, but exposure to this area is unlikely to represent a significant threat to ecological receptors. A second small area at TP-33 where 2,4,6-TNT was detected at an elevated concentration appears to be of less concern because follow-up sampling could not replicate the elevated concentration, and delineation sampling resulted in nondetects or very low detections. Therefore, the original sample was determined to be nonrepresentative.

4.4.6 SLERA Conclusions

Although 1,3,5-TNB and Aroclor 1016 both had HQs greater than 1, adverse ecological effects associated with exposure to these chemicals is considered unlikely because of their limited distribution area of these chemicals and the likely overestimation in the food chain model of uptake into invertebrate prey tissue. Potential effects associated with 2,4,6-TNT are also likely overestimated, but small areas where a release of 2,4,6-TNT occurred do appear to be evident at the TP-27 location. Although elevated 2,4,6-TNT was also identified at TP-33, additional sampling indicates that the elevated detection at this location is apparently anomalous.

In conclusion, with the possible exception of some localized effects associated with 2,4,6-TNT in soil near the TP-27 area, the potential for adverse ecological impacts is considered to be very low at the TNTA/WWTP1 sewer lines site. A hot spot area at TP-27 does appear to have elevated 2,4,6-TNT, and localized adverse impacts in this hot spot area cannot be completely discounted. However, neither the hot spot area nor the area potentially affected by the entire sewer line trace is large enough to warrant concern for adverse effects to local populations of ecological receptors, even if contamination is present. Thus, ecological impacts are considered unlikely given the fact that the affected area is so small that impacts to local receptor populations (other than plants and invertebrates) are implausible. Also, there is considerable uncertainty regarding uptake of 2,4,6-TNT into invertebrate prey items, which was responsible for elevated food chain model HQs for some insectivorous receptors. Therefore, based on the results of the SLERA, no chemicals are identified as requiring further evaluation for protection of the environment at the TNTA/WWTP1 sewer lines.

4.5 TNTA/WWTP1 Sewer Lines Investigation and Evaluation Recommendations

Based on the results of the TNTA/WWTP1 RI efforts, including the BHHRA and SLERA, remedial action should be considered to address human health concerns for the small (approximately 60 feet by 20 feet) area of surface soil in the vicinity of test pit TP-27, where elevated TNT concentrations were identified. RBRC values were developed in the BHHRA for TNT to support site management decisions. These RBRC values will be considered in the derivation of cleanup levels in the FS.

If the contributions of exposure to groundwater are appropriately excluded, none of the TNTA/WWTP1 sewer lines human receptors had ILCRs or HIs that exceed the PBOW target criteria or the NCP risk management range. The unacceptable risks and hazards associated with groundwater exposure in the BHHRA are attributable to naturally occurring conditions and not related to former DOD activities. Because groundwater use is not regarded as plausible based on

insufficient yield in both the overburden and bedrock units, the risks associated with TNTA/WWTP1 sewer lines groundwater are accordingly implausible.

Based on results and findings of the SLERA, the ecological HQ values indicated a low potential for adverse ecological effects. Observations of the species present and the lack of vegetative stress, combined with the low hazard estimates calculated in the COPEC selection and food chain modeling, suggest a lack of impact to ecological receptors. Although minor HQ exceedances were observed in the food chain model, hazards were likely overestimated, particularly with regards to uptake of organics into terrestrial invertebrates. However, elevated concentrations of TNT near TP-27 represent a small area where localized impacts could occur. Due to the small size of the impacted area (approximately 60 feet by 20 feet), it is highly unlikely that most ecological receptors could be exposed to this area to a sufficient extent that adverse effects to populations would occur. Further, the low bioaccumulation potential of TNT makes it unlikely that food chain effects from prey items exposed to this hot spot would occur. Localized effects to nonmobile receptors or receptors with limited mobility (e.g., plants or earthworms) cannot be completely discounted, but such organisms at the base of the food chain are typically not selected as assessment endpoints and also generally have compensatory life-cycle dynamics (e.g., seed banks, r-selection reproductive strategy) that buffer impacts to local populations. For these reasons, no further investigation is recommended solely for the protection of ecological receptors; however, any remedial action performed for human health on TNT in the TP-27 area will also serve to ameliorate any potential localized ecological hazard in the immediate vicinity.

5.0 TNTB/WWTP1 Sewer Lines Investigation and Evaluation

This chapter provides a summary of the sampling, analyses, results, and evaluation of the environmental media associated with TNTB/WWTP1 sewer lines (i.e., soil, overburden/shale groundwater, surface water, and sediment) that have been presented in the TNTB/WWTP1 sewer lines SCR (Appendix G), BHHRA (Appendix H), and SLERA (Appendix I). The reference for each of these documents is provided below:

- Shaw Environmental, Inc. (Shaw), 2011e, *TNTB/Waste Water Treatment Plant No. 1 Sewer Lines, Site Characterization Report,* Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, September.
- Shaw Environmental, Inc. (Shaw), 2011f, *Baseline Human Health Risk Assessment, TNT Area B to Waste Water Treatment Plant 1 Sewer Lines,* Final, Plum Brook Ordnance Works, Sandusky, Ohio, December.
- Shaw Environmental, Inc. (Shaw), 2011g, *Screening-Level Ecological Risk Assessment, TNT Area B to Waste Water Treatment Plant 1 Sewer Lines,* Final, Plum Brook Ordnance Works, Sandusky, Ohio, December.

Please note that this chapter provides no data or other information that has not been previously presented in the TNTB/WWTP1 Sewer Lines, BHHRA, or SLERA (Appendices G, H, and I).

5.1 Previous Investigation and Evaluation

No previous environmental investigations have been conducted at the TNTB/WWTP1 sewer lines.

5.2 Site Characterization and Evaluation

This section summarizes the RI sampling of environmental media at TNTB/WWTP1 sewer lines, the analytical results, and an evaluation of these results that are presented in the SCR. Additional details are provided in the attached SCR (Appendix G).

5.2.1 Samples and Analyses

The RI samples were collected consistent with the site-specific QAPP (Shaw, 2008a) and work plan for the TNTB/WWTP1 sewer lines (Shaw, 2009b). Soil and groundwater sampling locations are shown on Figure 5-1.

Surface and subsurface soil samples were collected as part of the RI from 20 trench excavations and direct-push investigation operations. Generally, surface soil is defined as samples collected

from within the interval of 0 to 1 foot bgs, and subsurface soil is defined as samples collected from depths greater than 1 foot bgs. Only subsurface soil samples were collected during the trench excavations, from native material below the former pipeline trace. For the direct-push drilling soil samples during the investigation, per the RI work plans, to determine any impact to native soil, surface soil samples (0 to 1 foot bgs) and subsurface soil samples (3 to 5 feet bgs) were adjusted to be collected below any fill material, if interpreted to be present. The interval for the deepest soil samples of 8 to 10 feet bgs was retained.

Six piezometers were installed as described in the work plan. However, only four of these (TNTB-SL-PZ01, TNTB-SL-PZ02, TNTB-SL-PZ03, and TNTB-SL-PZ06) yielded adequate groundwater volume for sampling.

Three overburden/shale and three bedrock wells were planned at the TNTB/WWTP1 sewer lines, but because limited nitroaromatic surface contamination was found and limited groundwater was encountered, only two overburden/shale wells were installed.

Two overburden/shale monitoring wells (1SLB-MW01 and 1SLB-MW02) were installed in suspected source area locations based on analytical data from soil and groundwater samples obtained during test pit soil sampling, soil borings, and temporary piezometer groundwater samplings. Monitoring wells were installed in accordance with guidelines specified in the work plan (Shaw, 2009b).

The following list summarizes the sampling and analyses conducted for the RI:

- ***Surface Soil***
  - Fourteen samples, including two QC samples and two QA samples, were collected and analyzed for nitroaromatics, TAL metals, PCBs, and SVOCs; one sample was analyzed for TOC.

- ***Subsurface Soil***
  - Test Pit - Twenty-four samples, including two QC and two QA samples, were collected typically from depths of 1.5 to 2 feet bgs or 2 to 3 feet bgs and analyzed for nitroaromatics.
  - Sixteen subsurface soil samples, including one QA and one QC sample, were collected and analyzed for nitroaromatics, TAL metals, PCBs, and SVOCs.

- ***Overburden/Shale Piezometers*** – Six groundwater samples, including one QC and one QA sample, were analyzed for nitroaromatics and general chemistry parameters; field tests were also conducted.

- ***Overburden/Shale Monitoring Wells*** – A total of four groundwater samples, two in the wet season and two in the dry season, were analyzed for nitroaromatics, TAL metals (filtered and unfiltered), SVOCs, VOCs, and general chemistry parameters; field tests were also conducted.

- ***Limestone Bedrock Monitoring Wells*** – A total of four groundwater samples from three wells, two in the wet season and two in the dry season, were analyzed for nitroaromatics, TAL metals (filtered and unfiltered), SVOCs, VOCs, and general chemistry parameters; field tests were also conducted.

All analytical data from these samples were reviewed for accuracy and completeness. One hundred percent of the data analyzed were subjected to data validation following the guidelines in the EPA *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (EPA, 2008) and EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 2004a), the QAPP (Shaw, 2008a), and specific analytical method requirements. Data were evaluated against specific criteria to verify the achievement of precision, accuracy, representativeness, completeness, and comparability goals established to meet the project DQOs. The criteria for blank evaluation were based on those detailed in *Region 3 Modifications to National Functional Guidelines for Evaluating Organic Analyses* (EPA, 1994) and *Region 3 Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA, 1993). Additional information on data evaluation, data validation, and data quality are provided in the SCR and information attached therein (Appendix D).

5.2.2 Characterization of TNTB/WWTP1 Sewer Lines

5.2.2.1 Local Soils

At various PBOW locations, a local fill sand was brought to the areas to cover the remaining concrete building foundations and demolition scars and provide a level ground surface to promote a natural landscape. No fill material was believed to have been encountered in any of the soil borings drilled during the August 2009 fieldwork along the sewer line trace. No buildings or other structures were known to be present along the TNTB/WWTP1 sewer line trace except for the TNTB pump house/settling tanks and the raw storage tank at WWTP1, located at the south and north ends of the former sewer lines, respectively.

Native soil in borings drilled at the TNTB/WWTP1 sewer lines area (TNTB-SL-DP01 through TNTB-SL-DP014) and monitoring well borings (1SLB-MW01 and 1SLB-MW02) consisted of a glacial till, glacial outwash, or glacial lacustrine (lake) deposit. In general, along the northern portion of the sewer lines (Figure 5-1), soil consisted of a loose, very fine-grain, dark yellowish-

brown sand to a depth of approximately 10 feet bgs, where a gray, medium to stiff silt with shale fragments was encountered. Along the southern portion of the TNTB/WWTP1 sewer lines, the total depth to refusal became much shallower and the soil generally consisted of only a dark yellowish-brown, loose sand. Refusal was met in 14 of the 16 borings in shale (Olentangy Shale), and the two borings that did not encounter shale were drilled near former WWTP1 only to a maximum depth of 10 feet bgs. The average depth at which shale was encountered in the northern portion of the sewer line was approximately 17 feet bgs. In the southern end of the sewer line, the shale was encountered at an average depth of 6.3 feet bgs although, for the most part, the closer to the TNTB settling tanks a borehole was drilled, the less overburden was encountered.

5.2.2.2 Local Geology

Bedrock units in the TNTB/WWTP1 sewer lines area consist of the Olentangy Shale. The Olentangy Shale was encountered in 14 of the 16 borings at depths ranging from 3.5 feet bgs (TNTB-SL-DP09) to 17 feet bgs (TNTB-SL-DP04). The average elevation of the top of the Olentangy Shale ranged from approximately 640 to 660 feet amsl. Based on samples recovered from the direct-push and monitoring well borings, the Olentangy Shale was typically gray in color, highly weathered near the soil bedrock interface, thinly laminated, and friable. The depth of the Delaware Limestone in the TNTB/WWTP1 sewer lines area ranges from 23 feet bgs at WWTP1 to 40 feet bgs at TNTB.

5.2.2.3 Local Hydrogeology

Overburden/shale groundwater at the TNTB/WWTP1 sewer lines was encountered at depths ranging from 5 feet bgs (TNTB-SL-DP01) to 8.2 feet bgs (TNTB-SL-DP06) in August 2009 (dry season) during soil boring drilling/piezometer installation. Groundwater was not encountered in eight of the borings, possibly due to the dry conditions or because the stiff silt at these locations served as a groundwater barrier. During monitoring well installation conducted in October 2009 (dry season), overburden/shale groundwater was encountered at a depth of 6 feet bgs (636.43 feet amsl) in 1SLB-MW01 and at a depth of 4 feet bgs (637.46 feet amsl) in well 1SLB-MW02. Groundwater elevations for October 27, 2009 are shown in Table 5-1. Figure 5-2 presents an overburden/shale groundwater potentiometric map of water level measurements taken October 27, 2009 (dry season) from the overburden/shale monitoring wells (the piezometers were abandoned in July 2009, so a wet and dry season water level measurement comparison was not possible). The groundwater flow direction during October 2009 varies depending upon the monitoring well groundwater measurement location, but in all cases, the groundwater flow direction mimics the surface topography in both contour maps. In general, overburden/shale groundwater flow direction is towards the north.

Sitewide (regional) Delaware Limestone groundwater flow maps are shown on Figure 3-5 (wet season, May 2010) and Figure 3-6 (dry season, August 2010). Delaware Limestone groundwater flow is determined to be in a north-northeast direction.

5.2.2.4 Summary of Analytical Results

The analytical results of the RI samples, as described in Section 5.2.1, are summarized in this section. As part of this evaluation, analytes detected in the respective environmental media were compared to RBSC and BSC as points of reference only. Concentrations of analytes that exceed the RBSCs are highlighted in associated tables (Tables 5-2 through 5-5). RBSCs do not infer a regulatory limit or mandated cleanup level, nor is the identification of an exceedance intended to indicate an unacceptable human health risk or a need for remedial action. Formal evaluation of human health risks was performed in the BHHRA. Concentrations in individual samples that exceed the respective BSCs are identified by bold text in Tables 5-2 through 5-5.

The RBSCs are derived from May 2010 RSL (EPA, 2010) as described in the BHHRA (Appendix H). The groundwater RBSCs are based on a generalized residential drinking water scenario, assumed to be the most restrictive use of groundwater, and they correspond to a one-in-one-million (1E-6) ILCR or a noncancer HQ of 0.1, whichever results in a lower concentration (Shaw, 2009b). The soil RBSCs are based on a long-term residential land-use scenario that assumes use by a young child for noncancer effects and use by the combined young child and adult life stages for carcinogenic effects. Together, these capture a worst plausible case for future land use. The soil RBSCs are likewise based on an ILCR of 1E-6 and an HQ of 0.1. Although no RSLs exist for surface water or sediment, the tap water and residential soil RSLs are used directly as the RBSCs for surface water and sediment based on a Project Delivery Team agreement (OEPA, 1999) which used the former EPA Region 9 PRGs (EPA, 2004b) for this purpose. The method has been updated to use RSLs rather than PRGs (Shaw, 2010c). Further details on the RBSCs and their derivation are provided in the BHHRA (Appendix H).

The evaluation of the analytical results of the samples and analyses (Section 5.1.2), as presented in the SCR, are summarized below for each medium.

Surface and Subsurface Soil Summary

Test Pits

- No sewer lines were encountered in any of the excavations, but metallic banding and wood stave fragments were uncovered. Test pit excavation results concluded that the

wooden flume lines previously used to transport TNT manufacturing wastes from the TNTB settling tanks to WWTP1 are no longer present.

- As many as six nitroaromatics were detected from four test pit soil samples, but only 2,4,6-TNT was detected above the RBSC in one of the samples.

Soil Sampling

- No nitroaromatics or PCBs were detected above RBSCs in surface or subsurface soil samples.

- Nineteen SVOCs were detected in surface soil samples and five were above RBSCs; however, the detections above RBSCs were from two of the samples from borings DP01 and DP06. Soil boring DP01 exhibited five detections above RBSCs, and boring DP06 exhibited one detection above the RBSC.

- Fourteen SVOCs were detected in subsurface soil samples and three were above RBSCs; however, the detections above RBSCs were from only one of the samples from boring DP01.

- TOC was detected at 0.29 ppm in the surface soil sample from soil boring DP01.

Piezometer Overburden/Shale Groundwater Sample Summary

- Four nitroaromatics were detected in overburden/shale groundwater samples and one, 2,4,6-TNT, was detected at a concentration above its RBSC. The nitroaromatic 2,4,6-TNT was detected above the RBSC in the groundwater from QC samples in piezometer PZ03.

- Only 4 of the 10 locations planned for piezometer installation yielded groundwater.

Monitoring Well Overburden/Shale Groundwater Sample Summary. Two groundwater samples were collected during the wet season month of May 2010, and two groundwater samples were collected during the dry season month of November 2009. The major findings related to monitoring well location (source area [1SLB-MW01 and 1SLB-MW02]) are summarized as follows:

- No nitroaromatics, PCBs, or SVOCs were detected above RBSCs in source area wells 1SLB-MW01 or 1SLB-MW02 during the wet season (May) or dry season (November) sampling event.

- No metals were detected above both RBSC and BSC values during either sampling event.

5.3 Baseline Human Health Risk Assessment Summary

The BHHRA evaluates potential human health risks associated with exposure to soil and groundwater associated with the trace of the former sewer lines running from TNTB to WWTP1 at the former PBOW. This section summarizes the baseline human health risk assessment. It identifies the COPCs; summarizes the receptors, media, and exposure pathway evaluated; summarizes the risk characterization; and presents the BHHRA conclusions. The final BHHRA, submitted previously, is included as Appendix H. This BHHRA is consistent with EPA guidance and with the procedures established in the BHHRA for TNTA and TNTC soil (IT, 2001b), the BHHRA for groundwater at PBOW (Shaw, 2006), and, most specifically, the WWTP1 BHHRA work plan (Shaw, 2010c).

5.3.1 Identification of COPCs

A screening procedure was conducted on the RI and LSI analytical data from each TNTB/WWTP1 environmental medium. This screening process is used to identify COPCs, which are the detected chemical analytes carried through the full risk assessment process. The objectives of COPC screening are to focus the risk assessment on those chemicals that may contribute significantly to overall risk and to remove from quantification those chemicals whose contribution is clearly inconsequential. COPC screening includes a risk-based screen that also considers status as a human nutrient, a frequency-of-detection evaluation, and a background screen. As described in the Section 2.4.3 of the BHHRA (Appendix H), the screening for background chemicals in soil and limestone bedrock groundwater differs somewhat from current OEPA (2004) guidance. This difference is based on established PBOW Project Delivery Team decisions, which include agreement between OEPA, USACE, and NASA. The background concentrations used for screening in the BHHRA were developed from soil samples collected near the property boundary, away from any potential source areas, and the background groundwater wells that were installed in off-site areas upgradient of PBOW sources (Section 2.4.3.1 of Appendix H).

The COPC screening process results in the generation of a data summary table for each medium to be quantitatively evaluated in the BHHRA. A data summary table for each TNTB/WWTP1 medium is provided as follows: surface soil (Table 5-6), subsurface soil (Table 5-7), total soil (Table 5-8), and overburden groundwater wells (Table 5-9). These tables provide the following information for each detected chemical in each environmental medium:

- Chemical name
- Frequency of detection and percentage of detected samples
- Range of detected concentrations and related data validation qualifiers
- Range of detection limits
- Arithmetic mean of site concentrations

- 95th percent UCL (for COPCs only)
- Appropriate RBSC
- Appropriate BSC
- Selection/exclusion of chemical as a COPC
- EPC (for COPCs only).

Additional details of this data summary, including the statistical analysis of estimation of the UCL values and EPCs for COPCs, are discussed in the BHHRA (Appendix H). The COPCs for each of the TNTB/WWTP1 sewer line media are identified as follows:

- ***Surface Soil*** – Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene

- ***Subsurface Soil*** – TNT, benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene

- ***Total Soil*** – TNT, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene

- ***Overburden Groundwater*** – Manganese.

Please note that the total soil COPCs include all surface soil and subsurface soil COPCs.

5.3.2 Exposure Assessment

Exposure is the contact of a receptor with a chemical or physical agent. An exposure assessment estimates the type and magnitude of potential exposure of a receptor to COPCs found at or migrating from a site (EPA, 1989). The BHHRA characterizes potential exposures to COPCs in TNTB/WWTP1 sewer line environmental media as portrayed by the CSEM. These environmental media include soil and groundwater.

The CSEM provides the basis for identifying and evaluating the potential risks to human health in the BHHRA. The CSEM, graphically depicted on Figure 5-3, includes the receptors appropriate to all plausible site-use scenarios and the potential exposure pathways. This presentation of all possible pathways by which a potential receptor may be exposed, including all sources, release and transport pathways, and exposure routes, facilitates consistent and comprehensive evaluation of risk to human health and helps to ensure that potential pathways are not overlooked. The elements of a CSEM include the following:

- Source
- Source media (i.e., initially contaminated environmental media)
- Contaminant release mechanisms

- Contaminant transport pathways
- Intermediate or transport media
- Exposure media
- Receptors
- Routes of exposure.

Contaminant release mechanisms and transport pathways are not relevant for direct receptor contact with a contaminated source medium (e.g., ingestion or dermal contact).

The receptors and pathways depicted on Figure 5-3 reflect scenarios developed from information regarding site background and history, topography, climate, and demographics as presented by D&M (1997b) and the sitewide groundwater investigation (IT, 1997). Justification for exclusion of other pathways is provided in the Figure 5-3 footnotes, and the exclusion of other potential receptors is discussed in Section 3.1.3.8 of the BHHRA (Appendix H). No current or future exposure by off-site residents is evaluated. Most of the off-site residents are serviced by municipal water from surface water sources. Although there are numerous private groundwater wells in the vicinity, including several within 1 mile of the facility boundary, none of these is used as a potable source. Based on the investigations of other PBOW sites, bedrock limestone groundwater was observed to be of naturally poor quality due to the presence of petroleum constituents and hydrogen sulfide off-gassing, a concern with respect to nuisance odors and potential health issues. Shale formation (overburden) groundwater generally provides low yields and is of low quality (Shaw, 2008c). However, the overburden groundwater underlying the TNTB/WWTP1 sewer lines is not summarily excluded for consideration as a tap water source based on natural water quality parameters or general assumptions concerning yield. Therefore, given the presence of numerous off-site wells and the assumption of unrestricted future land use on site, the development of overburden groundwater for on-site residential (or on-site worker) use as tap water was evaluated for purposes of this BHHRA. Groundwater quality and potential use are discussed further in the uncertainty analysis in Chapter 6.0 of the BHHRA (Appendix H).

Exposures associated with the COPCs were evaluated for the receptors listed below. The media that were quantitatively evaluated for each receptor are listed in parentheses:

- Current groundskeeper (total soil)
- Future groundskeeper (surface soil and overburden groundwater)
- Future indoor worker (surface soil, subsurface soil [inhalation pathway only], and overburden groundwater)
- Current/future construction worker (total soil)

- Future resident (total soil and overburden groundwater)
- Future adult hunter (surface soil, including venison pathway)
- Future hunter's child (surface soil [venison pathway only]).

Each BHHRA receptor scenario that includes hypothetical groundwater use was evaluated for overburden groundwater along the TNTB/WWTP1 sewer line trace, although overburden groundwater yield was found to be insufficient for potable use. The resident was evaluated for noncancer hazards separately for the young child (ages 1 through 6 years) and adult life stages.

The equations for the calculations of intake values for each exposure pathway, exposure assumptions, and the calculation of EPCs of COPCs for modeled pathways (e.g., venison, airborne concentrations) are presented in the BHHRA (Appendix H).

5.3.3 Risk Characterization

Risk characterization is the process of applying numerical calculations and professional judgment to determine the potential for adverse human health effects to result from the presence of site-specific chemicals. This is done by combining the intake rates estimated during the exposure assessment with the appropriate toxicity information identified in the toxicity assessment (Chapter 5.0 of the BHHRA [Appendix H]). Noncancer hazards and cancer risks are characterized separately, including COPCs that induce both types of effects.

Quantitative expressions are calculated during risk characterization that describe the probability of developing cancer (i.e., ILCRs) or the nonprobabilistic comparison of estimated dose with an RfD for noncancer effects (i.e., HQs and HIs). Quantitative estimates are developed for individual chemicals, exposure pathways, and exposure media for each receptor. These quantitative risk characterization expressions, in combination with qualitative information, are used to guide risk management decisions. Risk characterization is applied only to COPCs.

5.3.3.1 Cancer Risk

The risk from exposure to potential chemical carcinogens is estimated as the probability of an individual developing cancer over a lifetime and is called the ILCR. Equations for calculating the ILCR are presented in the BHHRA (Appendix H).

Total ILCRs in the range of 1E-6 to 1E-4 are regarded as acceptable (EPA, 1990); this range is referred to as the "NCP risk management range." Risks less than this range are regarded as

negligible. A target cancer risk goal of 1E-5 is used by OEPA and was selected by the PBOW Project Delivery Team as a basis to consider remedial action. Use of this 1E-5 goal represents a departure from the Army's practice of generally using a cancer risk exceeding a value of 1E-4 (the upper end of the NCP risk management range) to trigger remedial action considerations.

5.3.3.2 Noncancer Effects of Chemicals

The hazards associated with noncancer effects of chemicals are evaluated by comparing an exposure level or intake with chronic RfD values. The HQ, defined as the ratio of intake to RfD, is estimated by dividing the intake of a chemical by the RfD as described in the BHHRA (Appendix H). An HQ of unity indicates that the estimated intake equals the RfD. If the HQ is greater than unity, there may be concern for potential adverse health effects. In the case of simultaneous exposure of a receptor to multiple chemicals or to a given chemical by multiple pathways, an HI is calculated as the sum of the HQs for each chemical.

A total HI is calculated as the sum of all HI values, including all media and all COPCs, for a given receptor. Calculating a total HI as the sum of HQ values is based on the assumption that the potential for noncancer effects is additive. EPA (1989), however, acknowledges that the assumption of additivity is probably appropriate only for chemicals that induce adverse effects by the same mechanism or affect the same target organ. Therefore, if the total HI for a receptor exceeds 1, individual HI values may be calculated for each target organ, as described in Appendix H.

5.3.3.3 Risk Characterization Results

Cancer and noncancer risk characterization results were evaluated for each receptor and each environmental medium using methods described in Sections 3.3 and 5.0 of the BHHRA (Appendix H). The cancer risks and noncancer hazards are presented for each receptor for all pathways in Table 5-10.

The overall HI and ILCR values are summarized in the following bullets; exceedances of the PBOW cancer risk goal (ILCR>1E-5) are shown in bold type and exceedances of the noncancer hazard criterion (HI>1) or the NCP risk management range (1E-6 to 1E-4) are shown in bold italics:

- Current groundskeeper: ILCR = 6E-6; HI not calculated (No noncancer COPCs were identified; thus, adverse noncancer health effects are extremely unlikely.)
- Future groundskeeper: ILCR = 2E-6; HI = 0.04

- Future indoor worker: ILCR = 2E-6; HI not calculated (No noncancer COPCs were identified; thus, adverse noncancer health effects are extremely unlikely.)

- Construction worker: ILCR = 8E-8; HI = 0.002

- Resident: ILCR = 5E-6; child HI = 0.2; adult HI = 0.1

- Hunter: ILCR = 4E-7; HI not calculated (No noncancer COPCs were identified; thus, adverse noncancer health effects are extremely unlikely.)

- Hunter's child: No ILCR or HI calculated. (The carcinogenic COPCs are regarded as nonbioaccumulative, thus cancer risks are regarded as de minimis; no noncancer COPCs were identified, thus adverse noncancer health effects are extremely unlikely.)

5.3.3.4 BHHRA Conclusions

The ILCR and HI values for all exposure scenarios meet the PBOW cancer risk goal (ILCR≤1E-5) and the noncancer hazard criterion (HI≤1). Note that no groundskeeping except occasional mowing appears to have occurred at TNTB/WWTP1 in recent years. Thus, the current groundskeeper scenario, which assumes a full-time, 25-year employee who works exclusively at the TNTB/WWTP1 sewer lines for 8 hours per day, 250 days per year (Appendix H), appears to greatly overestimate the exposure levels of any current on-site worker or other current receptor.

The BHHRA results indicate that the associated environmental media at the TNTB/WWTP1 sewer lines are unlikely to pose an unacceptable cancer risk to any receptor and that exposure to these media is unlikely to result in adverse noncancer health effects for any human receptor. Because groundwater use is not regarded as plausible based on insufficient yield in the overburden unit, the risks associated with the TNTB/WWTP1 sewer lines groundwater use are accordingly implausible.

5.4 Screening-Level Ecological Risk Assessment

The SLERA, summarized in this section, was performed to evaluate and provide an estimate of current and future ecological hazard associated with exposure to potential releases to soil, groundwater, surface water, and sediment associated with the TNTB/WWTP1 sewer lines. This SLERA summary provides an ecological site description, identifies COPECs at the site, identifies ecological receptors, characterizes exposure, characterizes ecological risks, and presents the conclusions of the SLERA. The final SLERA, submitted previously, is included as Appendix I.

The SLERA is consistent with EPA guidance and with the procedures established in the SLERA for TNTA and TNTC soil (IT, 2001c) and, most specifically, the TNTB/WWTP1 sewer lines work plan (Shaw, 2010c).

5.4.1 Ecological Site Description

The ecological site description, presented in full in the SLERA (Appendix I) and summarized in the following paragraphs, includes a general description of the site; a description of surface water resources, wetlands, and vegetative communities; a species inventory; and a discussion of threatened and endangered species. Ecological characterization of the study area was initially based on a compilation of existing ecological information pertaining to the site. Shaw personnel obtained maps and other relevant site information and determined the location of potential ecological units such as streams, creeks, ponds, grasslands, forest, and wetlands on or near the site. Additionally, biological inventories performed in 1994 and 2001 at PBOW (ODNR, 1995; NASA, 2002) to identify and indicate the locations of threatened and endangered species at the installation were reviewed.

A general description of PBOW and the TNTB/WWTP1 sewer lines is presented in Chapters 1.0 and 2.0. This site consists of the two parallel sewer lines extending from the TNTB settling basins to WWTP1. The two parallel TNTB sewer lines were reportedly of wood stave construction, with one 6 inches and the other 4 inches in diameter. These two lines extended from the TNTB settling basins (Building 187) to the north-northeast for approximately 5,500 feet to WWTP1. Assuming the potentially affected area from sewer line releases extends perpendicular to the sewer line 10 feet in both directions, the sewer line traces comprise approximately 2.5 acres.

Surface water for TNTB/WWTP1 drains into ditches and low-lying areas which drain to tributaries for the larger creeks. Surface water at the southern end of the line drains west toward Ransom Brook. Water located near the center and northern end of the line drains east toward Plum Brook. The TNTB/WWTP1 sewer lines trace runs adjacent to retention ponds associated with a NASA building south of Fox Road (Figure 5-1). The southern portion of the sewer lines is adjacent to Ransom Brook and crosses a tributary to this creek. No other surface water bodies are in the immediate vicinity of the sewer line traces. This area of Ransom Brook and the tributary have been previously evaluated as part of the TNTB RI report and SLERA (IT, 2000c,d,e). It is noted that no nitroaromatics were detected in Ransom Brook surface water and that a low concentration of nitroaromatic compounds (i.e., less than 2 mg/kg total nitroaromatics) was detected in only one sediment sample collected in this vicinity (IT, 2000d). Because these media

have previously been investigated, surface water and sediment are not evaluated in the SLERA with respect to the TNTB/WWTP1 sewer lines, and soil is the only medium investigated.

Shaw ecological scientists performed site visits to the TNTB/WWTP1 sewer lines on April 28, June 2, and September 9, 2009. These visits were performed at different times of year to identify early- and late-blooming plant species (especially threatened and endangered species) and migrating and nesting bird species present at the site. Reconnaissance personnel used these site visits to confirm assumptions based on information previously gathered about the site, identify current site ecological conditions, and evaluate the site for more subtle indications of potential effects from contaminant release. Information obtained during the reconnaissance trips was used to select representative receptors, refine exposure scenarios for the risk assessment, and identify protected species or habitats of special concern in the study area. A photographic record was made during the site reconnaissance (Appendix I).

A botanist developed a list of plant species observed at the site during the late spring and fall reconnaissance visits. Vegetative communities at the site were classified during site reconnaissance trips. The TNTB/WWTP1 sewer lines run through successional woods, shrub thicket, upland old field, and wet meadow habitat. The highest plant diversity occurs between Fox Road and Taylor Road. The area between Taylor Road and the abandoned railroad track contains sandy, disturbed soils with a good diversity of plants. The old fields and shrub thickets to the south of Fox Road are, for the most part, not as botanically diverse. Both of the wet meadow areas are located within disturbed areas and are dominated primarily by *Typha angustifolia* (narrow-leaf cattail). A vegetation community map and a list of plant species identified during the site visits are presented in the SLERA (Appendix I). Vegetative stress attributable to chemical contamination was not observed at WWTP1. No federally or state-listed plant species were observed.

A fauna species list was developed for the site based on existing site investigation reports (ODNR, 1995; NASA, 2002) and other environmental data sources. Also, bird surveys were performed during the site reconnaissance visits to identify bird species and communities using the site during migration (early spring reconnaissance visit) and nesting (late spring/early summer reconnaissance visit) periods. Direct or indirect (e.g., prints) observations of mammals and other fauna classes were also noted. One of the species identified at the site was a golden-winged warbler (*Vermivora chrysoptera*), which is a state-listed endangered species. This species was observed during the early summer bird survey and may breed at or near the site.

A list of species observed or expected to be present at the site is presented in the SLERA (Appendix I).

According to the NWI maps for the area (U.S. Fish and Wildlife Service, 2011), the TNTB/WWTP1 sewer line trace does not intersect any designated wetlands. Directly south of the intersection of the TNTB/WWTP1 sewer lines and Short Cut Road, the sewer line trace runs adjacent to retention ponds associated with a NASA support building. These ponds are classified as a palustrine, unconsolidated bottom, intermittently exposed wetland. Two other areas along the sewer line trace have not been formally identified as wetlands but possess some wetland characteristics. One such area is a low-lying wet meadow southwest of the retention ponds near the sewer line trace's southern terminus at TNTB. A second area is immediately north of Fox Road, where a vegetation community containing sensitive fern (*Onoclea sensibilis*) was identified. Sensitive fern is a facultative wetland indicator species (i.e., the species usually occurs in wetlands but is occasionally found in non-wetlands) and may indicate the presence of a wetland in this area. It should be noted, however, that the soil in this area appeared to be sandy and well drained. NASA is currently performing a wetland delineation study at PBOW, which will more accurately identify the locations and extent of sensitive wetland habitat throughout the installation.

Other than the state-listed golden-winged warbler, no T&E plant or animal species were observed during site reconnaissance. Based on the habitat present at TNTB/WWTP1 sewer lines and/or lack of sightings in the vicinity of PBOW, no other T&E bird species are expected to be found at the site. Likewise, the only T&E mammal (Ohio endangered) historically documented at PBOW, the Indiana bat, has widespread sightings throughout Ohio, but the TNTB/WWTP1 sewer lines does not provide the preferred habitat for this species (i.e., caves or trees with exfoliated bark).

5.4.2 Identification of Chemicals of Potential Ecological Concern

A screening process was performed on the analytical data from the RI to identify COPECs that may pose a threat to ecological receptors. These data include all soil samples collected to a depth of 6 feet. Groundwater was excluded because exposure to this TNTB/WWTP1 sewer lines medium is considered to be an incomplete pathway for ecological receptors. As described previously, surface water and sediment adjacent to the TNTB/WWTP1 sewer lines have been previously investigated. Therefore, soil was the only medium of concern for the SLERA. A list of the TNTB/WWTP1 sewer lines samples for soil that were used for the SLERA is presented in Table 5-11. Sample locations are presented on Figure 5-1.

The COPEC selection process was used to develop a subset of chemicals detected at the site that are not naturally occurring or associated with non-site-related sources. These chemicals are also present at sufficient frequencies, concentrations, and spatial areas to possibly pose a potential risk to ecological receptors. Examples of screening criteria that were used include analytical detection limit, frequency of detection less than 5 percent, comparability with background, status as a nutrient, and comparison with risk-based screening ecotoxicity values. This selection process and the screening values used for COPEC selection are described in the SLERA (Appendix I).

The results of the COPEC screening for soil are presented in Table 5-12. The selected EPC is also presented for each chemical identified as a COPEC. For soil, two EPC results are presented, a total soil EPC for concentrations in the 0 to 6 feet bgs depth range and a surface soil EPC for concentrations in the 0 to 1 foot bgs depth range. These two sets of EPCs are used to evaluate various ecological receptors that may be exposed to different soil depths associated with their various life history characteristics. As described in the SLERA, the EPC is the lower value between the MDC and the 95 percent UCL of the mean.

Twelve chemicals were selected as COPECs in soil (Table 5-12). These COPECs were quantitatively evaluated in the predictive SLERA, as summarized in Sections 5.4.3 through 5.4.6.

5.4.3 Selection of Ecological Receptors

Following COPEC selection, ecological assessment receptors were selected in the SLERA to focus the exposure characterization on species, groups of species, or functional groups that are directly related to the following assessment endpoints: the protection of long-term survival and reproductive capabilities for terrestrial invertebrates, herbivorous mammals, omnivorous mammals, insectivorous mammals and birds, and carnivorous birds. Aquatic assessment endpoints were not developed at this site because aquatic features were not evaluated in the TNTB/WWTP1 sewer lines SLERA. As part of the receptor selection process, site biota were organized into major functional groups. For terrestrial communities, the major groups are plants and wildlife, including terrestrial invertebrates, mammals, and birds.

Six representative terrestrial receptor species that are expected or possible in the area of the TNTB/WWTP1 sewer lines (based on the ecological description of the site presented in Section 5.4.1) were selected as indicator species for the potential effects of COPECs. These indicator species represent two classes of vertebrate wildlife (mammals and birds) and a range of both body size and feeding habits, and include herbivores, omnivores, and carnivores. Terrestrial invertebrates and vegetation are not considered assessment receptors. The six terrestrial species

selected include the deer mouse (*Peromyscus maniculatus*) (small omnivorous mammal), short-tailed shrew (*Blarina brevicauda*) (small insectivorous mammal), Eastern cottontail rabbit (*Sylvilagus floridanus*) (medium-sized herbivorous mammal), marsh wren (*Cistothorus palustris*) (small insectivorous bird), white-tailed deer (*Odocoileus virginianus*) (large herbivorous mammal), and red-tailed hawk (*Buteo jamaicensis*) (large carnivorous bird). The marsh wren was selected to represent the state-endangered golden-winged warbler.

A terrestrial food web is presented on Figure 5-4. Many of the species evaluated, particularly the deer mouse, cottontail rabbit, short-tailed shrew, and marsh wren, have limited home ranges which make them particularly vulnerable to exposure from site contaminants.

5.4.4 Exposure Characterization

A description of the nature, extent, and magnitude of potential exposure of assessment receptors to COPECs that are present at or migrating from the site is presented in this section, considering both current and reasonably plausible future use of the site.

Ecological routes of exposure for biota may be direct or through the food web via the consumption of contaminated organisms. Direct exposure routes include dermal contact, absorption, inhalation, and ingestion. Examples of direct exposure include animals incidentally ingesting contaminated soil or sediment (e.g., during burrowing or dust-bathing activities), animals ingesting surface water, plants absorbing contaminants by uptake from contaminated sediment or soil, and dermal contact of aquatic organisms with contaminated surface water or sediment. Given the scarcity of available data for wildlife dermal and inhalation exposure pathways, potential risk from these pathways is not estimated in the SLERA. In addition, these pathways are generally considered to be incidental for most species, with the possible exceptions of burrowing animals and dust-bathing birds. Food web exposure can occur when terrestrial or aquatic fauna consume contaminated biota. Examples of food web exposure include animals at higher trophic levels consuming plants or animals that bioaccumulate contaminants.

Daily doses of COPECs for vertebrate receptors were calculated using standard exposure algorithms. These algorithms incorporate species-specific natural history parameters (i.e., feeding rates, water ingestion rates, dietary composition, etc.) as well as site-specific area use factors, which scale the estimated hazard by a fraction value based on the comparison of the size of the affected area to the home range of the specific receptor. These algorithms are presented and described in the SLERA (Appendix I).

Exposure to soil is discussed in the following paragraph. As stated previously, surface water, sediment, and groundwater are not media of concern for ecological receptors at this site.

Soil Exposure Pathway. Soil exposure pathways are potentially important for terrestrial plants and animals at the site. For nonburrowing animals, exposure to soil from a depth of 0 to 1 foot bgs was considered, as this soil depth would represent the depth of regular exposure for these types of organisms. For burrowing animals such as the shrew, exposure to soil from a depth of 0 to 6 feet bgs was considered. For plants and herbivores that feed on deep-rooted plants (e.g., the white-tailed deer, which is assumed to ingest leaves of trees translocating COPECs from subsoils), exposure to soil from a depth of 0 to 6 feet bgs (or the water table surface) was also evaluated because most feeder roots are located within this depth. Thus, the shrew and the white-tailed deer (Figure 5-4) were evaluated for exposure to deeper (0 to 6 feet bgs) soil. All other receptors exposed to soil were evaluated for exposure to concentrations in surface (0 to 1 foot bgs) soil.

5.4.5 Risk Characterization

Food chain modeling was used to estimate exposure rates for the representative assessment receptors. These exposure rates were compared with TRVs to calculate HQs (Wentsel, et al., 1996). Two types of TRVs were used in the food chain models: those based on a NOAEL and those based on a LOAEL, the former being more conservative. As a conservative measure, only NOAEL HQs were used to evaluate the marsh wren, because this species represents the state-endangered golden-winged warbler that was observed at the site. HQs are calculated by summing intake doses across all exposure pathways for each chemical for a given receptor and dividing by the TRV. HQs for those chemicals that have a similar mode of toxicological action may be summed to account for cumulative effects. In the SLERA, the four nitroaromatic COPECs in soil were identified as potentially having similar mechanisms of toxicity, and their HQs were summed. HQs are a means of estimating the potential for adverse effects to organisms at a contaminated site and for assessing the potential for toxicological effects among site receptors. HQs less than or equal to 1 represent no probable hazard. Although OEPA considers all HQs above 1 to be potentially significant, the following uncertainties regarding HQ interpretation are noted:

- HQs are not measures of risk.
- HQs are not population based.
- HQs are not linearly scaled.

- HQs are often produced that are unrealistically high and toxicologically impossible (e.g., estimated HQs greater than 1,000).

- Trace soil concentrations of inorganic chemicals (including concentrations well below background levels) can lead to HQ values that are (much) greater than 1.

Therefore, it should be understood that HQs greater than 1 are not a definitive indication that adverse ecological effects are occurring at the site or may occur in the future.

Table 5-13 summarizes the NOAEL and LOAEL-based HQs for the six evaluated assessment receptors. The following compound had HQ values greater than 1:

- ***Carbazole:*** Deer Mouse (NOAEL HQ = 1380, LOAEL HQ = 138), Short-Tailed Shrew (NOAEL HQ = 1210, LOAEL HQ = 121), Cottontail Rabbit (NOAEL HQ = 444, LOAEL HQ = 44.4).

Carbazole was the only chemical with HQ values greater than 1. Carbazole is a heterocycle, which is a PAH in which one of the carbons within the aromatic structure is substituted by a nitrogen atom. Carbazole occurs as a natural constituent of creosote and coal tar (Agency for Toxic Substances and Disease Registry, 2002). This chemical was detected in only 1 out of 16 samples at a concentration of 0.345 mg/kg, which is consistent with detected concentrations of other PAHs. The sample location where carbazole was detected, TNTB-SL-DP01, is also the only location where many of the PAHs (e.g., anthracene) were detected. The carbazole detection was an estimated (i.e., "J"-qualified) concentration below the reporting limit and was carried forward as a COPEC because no ESV was available for this chemical. The elevated food chain model HQs for carbazole are due to the use of mammalian NOAEL and LOAEL TRVs of 2.3E-05 and 2.3E-04 mg/kg per day, respectively (Table 4-1 in the SLERA [Appendix I]). These mammalian TRVs are approximately four orders of magnitude lower than other PAHs detected at the site such as benzo(a)anthracene and chrysene, which have TRVs of 0.17 mg/kg per day. The carbazole TRV was adopted from the Los Alamos National Laboratory (2010) EcoRisk database and derived from a chronic study in which female mice were exposed orally to carbazole mixed in feed at 0.6, 0.3, or 0.15 percent carbazole in their diet for 96 weeks. Survival rates of the test organisms were reduced in relation to control groups due to intraperitoneal hemorrhaging associated with rupture of liver tumors (Los Alamos National Laboratory, 2010). No alternate mammalian TRVs for carbazole were identified in the literature, but several soil toxicity studies have shown that heterocycles, including carbazole, do not exhibit significantly different toxicity to soil invertebrates compared with their unsubstituted hydrocarbon counterparts (i.e., PAHs) (Wassenberg, et al., 2005; Sverdrup, et al., 2001, 2002a,b). The

conclusions from these studies do not corroborate or support the use of a TRV for carbazole that is four orders of magnitude lower than PAHs.

HQs were not calculated for dibenzofuran (both mammals and birds) or carbazole (birds only) due to the lack of TRVs identified for these chemicals. Both chemicals were selected as COPECs in soil because they lacked screening values (Table 5-12). Dibenzofuran was detected in 1 out of 16 samples at an estimated ("J"-qualified) concentration of 0.208 mg/kg. Carbazole detection patterns were discussed in the previous paragraph. Although the lack of toxicity data represents an uncertainty, the presence of low-level concentrations of these two chemicals in a single sample is unlikely to impact ecological receptors at the site.

5.4.6 SLERA Conclusions

Carbazole, a heterocycle closely related to PAHs, was the only chemical with an HQ greater than 1 and had HQs ranging from 44 for the cottontail rabbit to over 1,300 for the deer mouse (Table 5-13). This chemical was a COPEC in soil and was detected in 1 out of 16 samples at a concentration of 0.345 mg/kg, which is consistent with detected concentrations of other PAHs. The single detection was from the same sample location where other PAHs were identified and was an estimated (i.e., "J"-qualified) concentration below the reporting limit. The elevated food chain model HQs for carbazole are the result of the use of TRVs that are approximately four orders of magnitude lower than PAHs, the next-lowest TRVs that were used in the SLERA. Given the structural similarity to PAHs and the results of soil toxicity studies that have shown carbazole exhibits similar toxic responses as PAHs in soil invertebrates, the appropriateness of using such a conservative TRV is highly questionable. Concern regarding exposure to chemicals at the TNTB/WWTP1 sewer lines is further reduced because it is unlikely that populations of ecological receptors would be exposed to soil at the 2.5-acre TNTB/WWTP1 sewer lines site on a regular basis. Because of the low detection frequency, the low concentrations observed, and carbazole's association with PAHs that are likely present as a result of ubiquitous anthropogenic sources, further investigation of this chemical in soil for ecological purposes alone is not recommended.

The golden-winged warbler, a state-listed endangered species, was evaluated using the marsh wren, which was selected as a surrogate receptor based on similarities in its life history, e.g., a small, insectivorous passerine with a limited home range. Evaluation of the golden-winged warbler using the marsh wren is conservative because the wren is assumed to use the site year-round, whereas the warbler is a neotropical migrant and is only present at the site during the breeding season. Further, only the more conservative (i.e., no-effect level) toxicity values were

used to calculate the HQs for this species to reflect the increased concern for a listed species. Even given these conservative assumptions, no HQs exceeded 1 for the marsh wren.

For these reasons, although carbazole exceeded an HQ of 1, the potential for adverse ecological impacts is considered to be very low at this site, and no chemicals in soil are considered to be final COPECs requiring further investigation.

5.5 TNTB/WWTP1 Sewer Lines Investigation and Evaluation Recommendations

No remedial actions or further investigation of TNTB/WWTP1 sewer lines media are recommended based on the results of the TNTB/WWTP1 sewer lines RI efforts, including the BHHRA and SLERA.

The ILCR and HI values for all exposure scenarios meet the PBOW cancer risk goal (ILCR$\leq$1E-5) and the noncancer hazard criterion (HI$\leq$1). Thus, the BHHRA results indicate that the associated environmental media at the TNTB/WWTP1 sewer lines are unlikely to pose an unacceptable cancer risk to any receptor and that exposure to these media is unlikely to result in adverse noncancer health effects for any human receptor.

Based the results and findings of the TNTB/WWTP1 sewer lines SLERA, the ecological HQ values indicated a low potential for adverse ecological effects. Observations of the species present and the lack of vegetative stress, combined with the low hazard estimates calculated in the COPEC selection and food chain modeling (with the exception of carbazole), suggest a lack of impact to ecological receptors. Carbazole was the only chemical with HQs exceeding 1 in the food chain model. Although carbazole was detected in only a few soil samples at concentrations below its reporting limit, highly elevated HQs (i.e., greater than 1,000) were calculated for several receptors for this chemical. However, carbazole, a compound closely related to PAHs that is found in creosote, is likely present as the result of non-site-related activities. Hazards for this chemical are likely overestimated due to its extremely conservative TRV, which is several orders of magnitude lower than PAH TRVs. Soil toxicity studies in the literature suggest that this large difference in toxicity between carbazole and structurally similar PAHs is unwarranted.

6.0 Waste Water Treatment Plant No. 3

This chapter provides a summary of the sampling, analyses, results, and evaluation of the environmental media associated with WWTP3 (i.e., soil, overburden/shale groundwater, limestone bedrock groundwater, surface water, and sediment) that have been presented in the WWTP3 SCR (Appendix J), BHHRA (Appendix K), and SLERA (Appendix L). The reference for each of these documents is provided below:

- Shaw Environmental, Inc. (Shaw), 2011h, *Waste Water Treatment Plant 3, Site Characterization Report,* Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, August.

- Shaw Environmental, Inc. (Shaw), 2013, *Baseline Human Health Risk Assessment, Waste Water Treatment Plant 3,* Draft, Former Plum Brook Ordnance Works, Sandusky, Ohio, August.

- Shaw Environmental, Inc. (Shaw), 2012d, *Screening Level Ecological Risk Assessment, Waste Water Treatment Plant 3,* Draft, Former Plum Brook Ordnance Works, Sandusky, Ohio, August.

In addition, results of the previous LSI of WWTP3 are briefly summarized in Section 6.1. Identification of the samples and the recommendations from the LSI present a context for the performance of the RI and for some of the specific sampling locations and analyses performed in the RI.

Please note that this chapter provides no data or other information that has not been previously presented in the WWTP3 SCR, BHHRA, or SLERA (Appendices J, K, and L).

6.1 Previous Investigation and Evaluation

Prior to the RI, analytical samples were collected from WWTP3 in 1999 as part of the LSI of WWTP3 (USACE, 2000). The following samples were collected:

- Fourteen surface (0.5 to 1 foot bgs) soil samples, including one QC sample
- Two sediment samples.

No surface water samples could be collected during the LSI because the drainage ditch to the west of the site was dry. Surface soil and sediment samples were analyzed for nitroaromatics, VOCs, SVOCs, PCBs, TAL metals, and asbestos, and one soil sample was analyzed for TOC, although not all samples were analyzed for all compounds. Figure 6-1 shows LSI sampling locations.

The analytical results were compared to EPA Region 9 PRGs as described in the SCR as a qualitative screening evaluation. Two surface soil samples exhibited detections of nitroaromatics and one VOC was detected, but none were above PRGs. However, four SVOCs, one PCB, and one metal (arsenic) were detected above the respective PRGs. In the sediment samples, no nitroaromatics or SVOCs were detected, but a total of 17 metals were detected, and arsenic was above the PRG of 0.38 ppm in each. Due to the SVOCs, PCBs, and arsenic in soil samples above PRG levels and the arsenic above the sediment PRG, USACE recommended further evaluation of the nature and extent of the WWTP3 contaminants in an RI. This RI report addresses the concerns raised by the LSI evaluation. The LSI results are summarized in the SCR (Appendix J) and were further evaluated in the BHHRA (Appendix K) and SLERA (Appendix L).

6.2 Site Characterization and Evaluation

This section summarizes the RI sampling of environmental media at WWTP3, the analytical results, and an evaluation of these results that are presented in the SCR. Additional details are provided in the SCR (Appendix J).

6.2.1 Samples and Analyses

The RI samples were collected consistent with the site-specific QAPP (Shaw, 2008a) and Phase 1 and Phase 2 work plans for WWTP3 (Shaw, 2008b; 2009a). Soil, groundwater, surface water, and sediment sampling locations are shown on Figure 6-1.

Surface and subsurface soil samples were collected as part of the RI from seven borings. Generally, surface soil is defined as samples collected from within the interval of 0 to 1 foot bgs, and subsurface soil is defined as samples collected from depths greater than 1 foot bgs per the Phase 1 RI work plan (Shaw, 2008b). However, during the RI, it was interpreted that only up to ≤ 0.7 foot of sandy fill material was present at WWTP3 as described in the SCR. RI surface soil samples were collected from the native material below the fill, if a fill was interpreted to be present. The work plan called for subsurface soil samples to be collected at depths of 3 to 5 and 8 to 10 feet bgs. However, the shallower subsurface interval was adjusted to a target collection depth of 3 to 5 feet bgs below the surface soil sample collection depth. The interval for the deepest soil samples of 8 to 10 feet bgs was retained.

Six piezometers were installed as described in the Phase 1 work plan. However, only three of these (WWTP3-PZ01, WWTP3-PZ02, and WWTP3-PZ03) yielded adequate groundwater volume for sampling.

Three overburden/shale groundwater monitoring wells (WTP3-MW01, WTP3-MW02, and WTP3-MW03) and three limestone bedrock monitoring wells (WTP3-BEDGW-001, WTP3-EDGW-002, and WTP3-BEDGW-003) were installed at WWTP3 according to the Phase 2 work plan. The work plan was designed to include upgradient, on-site, and downgradient groundwater locations, as was done with respect to the overburden/shale wells. The placement of overburden monitoring wells was based on groundwater flow directions determined from newly installed piezometers. Sitewide bedrock groundwater flow maps were used to place new bedrock monitoring wells.

The collection of three collocated surface water and sediment samples was also conducted at locations within the drainage ditch located on the western side of WWTP3. Two of the three sediment samples, WWTP3-SD01 and WWTP3-SD02, were collected from the drainage ditch near the 1999 LSI sediment sample locations.

The following list summarizes the samples and analyses collected for the RI:

- ***Surface Soil*** – Seven samples were analyzed for nitroaromatics, TAL metals, PCBs, and SVOCs. Additionally, one surface soil sample was analyzed for TOC.
- ***Subsurface Soil*** - Twenty samples, including three QC samples and three QA samples, were analyzed for nitroaromatics, TAL metals, and SVOCs. In addition, soil samples collected in the 3- to 5-foot depth range were analyzed for PCBs.
- ***Overburden/Shale Piezometers*** – Three groundwater samples were analyzed for nitroaromatics, TAL metals (filtered and unfiltered), SVOCs, cyanide, and general chemistry parameters; field tests were also conducted.
- ***Overburden/Shale Monitoring Wells*** – A total of six groundwater samples, three in the wet season and three in the dry season, were analyzed for nitroaromatics, TAL metals (filtered and unfiltered), SVOCs, VOCs, and general chemistry parameters; field tests were also conducted.
- ***Limestone Bedrock Monitoring Wells*** – A total of six groundwater samples, three in the wet season and three in the dry season, were collected and analyzed for nitroaromatics, TAL metals (filtered and unfiltered), SVOCs, VOCs, and general chemistry parameters; field tests were also conducted.
- ***Sediment*** – Three samples were collocated with the surface water samples. Sediment samples WWTP3-SD01 and WWTP3-SD02 were collected from the drainage ditch near the 1999 LSI sediment sample locations and analyzed only for PCBs. Sediment sample WWTP3-SD03 was located upstream (north) of the previous two and analyzed for nitroaromatics, PCBs, SVOCs, TAL metals, and TOC.

- ***Surface water*** – Five samples were collected, including one QC and one QA sample, and analyzed for nitroaromatics, TAL metals, SVOCs, and general chemistry parameters.

All analytical data from these samples were reviewed for accuracy and completeness. One hundred percent of the data analyzed were subjected to data validation following the guidelines in the EPA *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (EPA, 2008) and EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 2004a), the QAPP (Shaw, 2008a), and specific analytical method requirements. Data were evaluated against specific criteria to verify the achievement of precision, accuracy, representativeness, completeness, and comparability goals established to meet the project DQOs. The criteria for blank evaluation were based on those detailed in *Region 3 Modifications to National Functional Guidelines for Evaluating Organic Analyses* (EPA, 1994) and *Region 3 Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA, 1993). Additional information on data evaluation, data validation, and data quality are provided in the SCR and information attached therein (Appendix J).

6.2.2 Characterization of WWTP3

6.2.2.1 Local Soils

As mentioned, following closure and removal of the manufacturing structures, tanks, and equipment, a local fill sand was brought to the areas to cover the remaining concrete foundations and demolition scars and to provide a natural landscape appearance. Based on boring logs at WWTP3, this may not have occurred. Most of the present ground surface at WWTP3 is interpreted as being very near the 1940s ground surface. Little to no fill material is believed to be present due to black cinders and burnt wood located near the present ground surface (see Hazardous, Toxic, and Radioactive Waste bore logs in Appendix J). Aside from the neutral waste storage tank, the buildings and structures at WWTP3 were burned and demolished in the 1950s or early 1960s. The neutral waste storage tank was converted for use by NASA as the K-Site control building and adjoining patio. This building and patio were demolished by NASA in October 2012. Soil boring SB-01 was drilled in a berm located on the west side of the building (Figure 6-1) and encountered black cinders and soil indicative of the original surface. With little to no fill material encountered at the site, the berm around the building is suspected to have been created with the 1940 surface soil. Interpreted bore log information from piezometer and monitoring well drilling shows the thickness of the 1940 disturbed soil ranges from the existing ground surface (SB-06) to a maximum depth of 4 feet bgs (WTP3-BEDGW-003).

The native soil at PBOW and the soil at WWTP3 are predominantly derived from glacial till, glacial outwash, or glacial lacustrine (lake) deposits. Below the 1940 fill material at WWTP3, the soil generally consists of a stiff, dark brown to dark gray, mottled silt to a depth of approximately 7 feet, then changes to a homogeneous, dark gray, highly plastic silt or clay. Rock fragments (shale) were typically found in split-spoon samples during monitoring well borehole drilling prior to refusal.

6.2.2.2 Local Geology

Bedrock units at WWTP3 consist of the Olentangy Shale and the underlying Delaware Limestone, both of Devonian age. A 2- to 3-foot-thick possible limestone lens, limestone floater, or glacial erratic was interpreted to have been encountered above the Olentangy Shale during drilling of wells WTP3-BEDGW-001 and WTP3-BEDGW-002. A detailed description of the rock could not be made because only minor fragments were recovered during installation of the isolation casing while "wet" drilling. From recovered fragments and the driller's interpretation, the rock was a very hard (harder than any other bedrock cut during this monitoring well installation task), nonfractured, limestone or glacial erratic. Shale was encountered below the hard rock at WTP3-BEDGW-001 and WTP3-BEDGW-002 and at 25.8 feet bgs in boring/well WTP3-BEDGW-003. The shale (Olentangy) at WWTP3 was encountered at an average depth of 26.4 feet bgs, was dark gray in color, and had an average thickness of 1.3 feet. A hard, shaley limestone encountered below the shale quickly changed to a hard, gray, competent, fossiliferous limestone at a depth of approximately 29.5 feet bgs. All three of the bedrock wells exhibited hydrocarbon staining on the bedrock cores, and hydrogen sulfide odors were detectable.

6.2.2.3 Local Hydrogeology

Overburden/shale groundwater at WWTP3 was encountered at depths ranging from 3.4 (SB-06) to 10.5 feet bgs (SB-02/PZ-03) in December 2008 (wet season) during soil boring drilling/piezometer installation. During monitoring well installation conducted in March and April 2009 (wet season), overburden/shale groundwater was encountered at depths from 9.7 feet bgs (WTP3-MW03) to 10.3 feet bgs (WTP3-BEDGW-001). As shown by the May 18, 2009 overburden/shale groundwater elevation contour map, which includes water level measurements from both the temporary piezometers and permanent monitoring wells (Figure 6-2), groundwater basically follows topographic contours and flow is in a northeast and northwest direction toward an unnamed drainage ditch. Figure 6-3 presents an overburden/shale groundwater elevation map of water level measurements in November 2009 (dry season). The November 2009 contour map was drawn using only the three overburden/shale monitoring wells (groundwater from temporary piezometers were not measured because they were removed in July 2009). The November 2009

contour map shows a change in groundwater flow direction to the southeast, likely due to localized groundwater recharge from the unnamed ditch at the site.

Table 6-1 shows water level elevations at piezometers and monitoring wells relevant to this effort.

In addition, one stream level staff gauge (SG03) was placed in the drainage ditch located north of WWTP3 and survey elevations were recorded at the top and base of the rod. Water level measurements of the drainage ditch surface water were conducted from the staff gauge. When groundwater elevations from the nearest monitoring well (WTP3-MW03) are compared with surface water measurements from the drainage ditch, the drainage ditch meets the definition of a water "gaining" stream during the wet season month of May (Figure 6-2) and the definition of a water "losing" stream during the dry season month of November (Figure 6-3). Figure 6-2 shows that the May groundwater elevation of WTP3-MW03 adjacent to the ditch is greater than the water level elevation measured at SG03, indicating the potential for groundwater to discharge into the ditch. Figure 6-3 shows that the November groundwater elevation near the drainage ditch is less than the surface elevation of the ditch (approximately 630.6 feet above mean sea level), indicating that the ditch is potentially losing water to the adjacent overburden/shale groundwater system.

Three bedrock wells were installed at WWTP3 during the RI. Bedrock groundwater at WWTP3 was encountered in fractures at depths of 37 feet bgs in WTP3-BEDGW-001, 37.1 feet bgs in WTP3-BEDGW-002, and 36 feet bgs in WTP3-BEDGW-003 during bedrock monitoring well installation in April 2009. To provide a regional bedrock groundwater flow determination instead of a local interpretation based on only three bedrock wells, groundwater level measurements were recorded from all PBOW sitewide bedrock monitoring wells during the months of May and August 2010. Based on the May and August 2010 data, bedrock groundwater flow is in a southeast direction toward a trough. The groundwater trough has been interpreted to be the result of the bedrock fracture network coupled with groundwater withdrawal from pumping by wells in the Reactor Building (Figures 3-5 and 3-6).

6.2.2.4 Summary of Analytical Results

The analytical results of the RI samples, described in Section 6.2.1 of Appendix J, are summarized in this section. As part of this evaluation, analytes detected in the respective environmental media were compared to RBSCs and BSCs as points of reference only. Concentrations of analytes that exceed the RBSCs are highlighted in the associated table (Tables 6-2 through 6-7). RBSCs do not infer a regulatory limit or mandated cleanup level, nor is the

identification of an exceedance intended to indicate an unacceptable human health risk or a need for remedial action. Formal evaluation of human health risks was performed in the BHHRA. Concentrations in individual samples that exceed the respective BSCs are identified by bold text in Tables 6-2 through 6-5.

The RBSCs are derived from May 2010 RSLs (EPA, 2010) as described in the BHHRA (Appendix K). The groundwater RBSCs are based on a generalized residential drinking water scenario, assumed to be the most restrictive use of groundwater, and they correspond to a one-in-one-million (1E-6) ILCR or a noncancer HQ of 0.1, whichever results in a lower concentration (Shaw, 2009b). The soil RBSCs are based on a long-term residential land-use scenario that assumes use by a young child for noncancer effects and use by the combined young child and adult life stages for carcinogenic effects. Together, these capture a worst plausible case for future land use. The soil RBSCs are likewise based on an ILCR of 1E-6 and an HQ of 0.1. Although no RSLs exist for surface water or sediment, the tap water and residential soil regional RSLs are used directly as the RBSCs for surface water and sediment based on a Project Delivery Team agreement (OEPA, 1999) which used the former EPA Region 9 PRGs (EPA, 2004b) for this purpose. The method has been updated to use RSLs rather than PRGs (Shaw, 2010c). Further details on the RBSCs and their derivation are provided in the BHHRA (Appendix K).

The evaluation of the analytical results of the samples and analyses (Section 6.2.1; Appendix J), as presented in the SCR, are summarized below for each medium.

Surface and Subsurface Soil Summary

- No nitroaromatics were detected in any surface or subsurface soil samples at WWTP3.

- One PCB (Aroclor 1260) was detected above the RBSC in surface soil samples. It was detected in the surface soil sample from boring SB05. No PCBs were detected above RBSCs in any subsurface soil samples.

- Six SVOCs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene) were detected above RBSCs in five of the seven surface soil borings (SB01, SB02, SB05, SB06, and SB07).

- Four SVOCs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, and indeno[1,2,3-cd]pyrene) were detected above RBSCs in soil borings SB02, SB03, and SB06 in the intermediate sample depths of 5 to 5.7, 3 to 5, and 3 to 3.7 feet bgs, respectively.

- No metals were detected at concentrations exceeding both RBSCs and BSCs in either surface or subsurface soil samples.

- TOC was measured at 33.5 ppm in the surface soil sample from SB01; the detection was "B" qualified.

Piezometer Overburden/Shale Groundwater Sample Summary

- No nitroaromatics or SVOCs were detected in the three WWTP3 temporary piezometer groundwater samples.

- Unfiltered metals that exceeded both the RBSC and BSC included aluminum, arsenic, cobalt, copper, iron, manganese, nickel, and zinc.

- Only arsenic (two samples) and manganese (one sample) exceeded both the RBSCs and BSCs in filtered samples.

Monitoring Well Overburden/Shale Groundwater Sample Summary. Three groundwater samples were collected during the wet season month of May 2009 and three groundwater samples were collected during the dry season month of November 2009. The major findings related to monitoring well locations, upgradient (WTP3-MW01), source area (WTP3-MW02), and downgradient (WTP3-MW03), are summarized as follows:

Upgradient

- Arsenic and iron exceeded both the RBSC and BSC screening levels in the unfiltered sample from upgradient monitoring well WTP3-MW01 during the dry season (November) sampling event.

Source Area

- Arsenic was detected above both the RBSCs and BSCs in both the filtered and unfiltered samples from source area overburden/shale well WTP3-MW02 during the November sampling events.

Downgradient

- One nitroaromatic (2,4-DNT) was detected above the RBSC in downgradient well WTP3-MW03 during both the wet season (May) and dry season (November).

Bedrock Groundwater Sample Summary. Five groundwater samples (including two QC samples) were collected during the wet season month of May 2009 and three groundwater samples were collected during the dry season in November 2009. Groundwater from upgradient well WTP3-BEDGW-003 was the only sample collected using the low-flow sampling method

due to sufficient water recharge. Groundwater from the other bedrock wells was collected by purging with a bladder pump one day and sampling with a new, disposable Teflon® bailer the following day. The major findings related to monitoring well location (upgradient and source area) are summarized as follows:

Upgradient

- No nitroaromatics were detected in upgradient well WTP3-BEDGW-003 during the wet season (May) or dry season (November) sampling event. Three VOCs exceeded both RBSCs and BSCs during each sampling event: the petroleum hydrocarbon-related compounds benzene, ethylbenzene, and total xylenes.

- The petroleum hydrocarbon-related SVOC naphthalene was detected above the RBSC only during the wet season sampling and is suspected of being related to the naturally occurring hydrocarbon at WWTP3.

- Two metals (arsenic and manganese) were detected above RBSCs in most of the unfiltered groundwater samples from upgradient well WTP3-BEDGW-003 during the May sampling event, and the same two compounds (arsenic and manganese) were detected above RBSCs in most of the filtered groundwater samples during the same event. Only arsenic was detected above both the RBSC and BSC in all of the unfiltered samples and one of the filtered groundwater samples during May 2009. Total cyanide was also detected above the RBSC; it was detected only in the regular sample during the May groundwater sampling.

Source Area

- No nitroaromatics were detected in source area well WTP3-BEDGW-002 during the wet season (May) or dry season (November) sampling event. One VOC (benzene) exceeded the RBSC, and three VOCs (ethylbenzene, toluene, and total xylenes) exceeded BSCs during both sampling events. Benzene, the only VOC that exceeded both the RBSC and BSC, was detected during the dry season (November) sampling event. All four compounds are petroleum hydrocarbon-related compounds.

- Naphthalene, the only petroleum hydrocarbon-related SVOC detected above the RBSC, was detected during May sampling event. The detection above the RBSC is likely attributable to the naturally occurring hydrocarbon at WWTP3.

- Two metals (arsenic and manganese) were detected above RBSCs and BSCs during both sampling events in the unfiltered and filtered groundwater samples from source area well WTP3-BEDGW-002.

Downgradient

- No nitroaromatics were detected in downgradient well WTP3-BEDGW-003 during the wet season (May) or dry season (November) sampling event. Three VOCs

exceeded both RBSCs and BSCs during each sampling event: the petroleum hydrocarbon-related compounds benzene, ethylbenzene, and total xylenes.

- The petroleum hydrocarbon-related SVOC naphthalene was above the RBSC during both sampling events and is likely attributable to the naturally occurring hydrocarbon.
- Arsenic, the only metal detected above both the RBSC and BSC, was found in both the unfiltered and filtered groundwater samples during the wet season (May) groundwater sampling.

Surface Water Summary. Two surface water samples were collected near 1999 LSI locations at WWTP3 from the drainage ditch west of the site, and one surface water sample was collected from the ditch approximately 30 feet south of an intersecting east-west drainage ditch, downgradient of a historic pipeline. The major findings from WWTP3 surface water are summarized as follows:

- No nitroaromatics or SVOCs were detected in the surface water samples in the drainage ditch west and northwest of WWTP3.
- Four metals were detected above RBSCs: arsenic, chromium (all samples), iron, and manganese.

Sediment Summary. Collocated with surface water samples, three sediment samples were collected from the drainage ditch located west of WWTP3. Two sediment samples were collected near the same locations of the 1999 LSI sediment sample locations and analyzed only for PCBs. The third sample was collected south of an intersecting drainage ditch. The sediment sample was analyzed for explosives, SVOCs, metals, and TOC. The major findings from WWTP3 sediment samples are summarized as follows:

- No PCBs were detected in either of the two sediment samples analyzed for PCBs.
- In the third sediment sample, no nitroaromatics were detected.
- The SVOCs benzo(a)pyrene and benzo(b)fluoranthene were detected above RBSCs, although benzo(b)fluoranthene (0.191 ppm) was detected only slightly above the RBSC of 0.15 ppm.
- Three metals (arsenic, chromium, and manganese) were detected above their respective RBSCs.
- TOC was detected at a concentration of 2.2 ppm in sediment sample SD03.

6.3 Baseline Human Health Risk Assessment

The BHHRA evaluates potential human health risks associated with exposure to soil, overburden/shale groundwater, bedrock groundwater, surface water, and sediment associated with WWTP3 at the former PBOW. This section summarizes the human health risk assessment. It identifies the COPCs, summarizes the receptors, media, and exposure pathway evaluated; summarizes the risk characterization; and presents the BHHRA conclusions. The final BHHRA, submitted previously, is included as Appendix K.

This BHHRA is consistent with EPA guidance and with the procedures established in the BHHRA for TNTA and TNTC soil (IT, 2001b), the BHHRA for groundwater at PBOW (Shaw, 2006), and, most specifically, the WWTP3 BHHRA work plan (Shaw, 2009c).

6.3.1 Identification of COPCs

A screening procedure was conducted on the RI and LSI analytical data from each WWTP3 environmental medium. This screening process is used to identify COPCs, which are the detected chemical analytes carried through the full risk assessment process. The objectives of COPC screening are to focus the risk assessment on those chemicals that may contribute significantly to overall risk and to remove from quantification those chemicals whose contribution is clearly inconsequential. COPC screening includes a risk-based screen which also considers status as a human nutrient, a frequency-of-detection evaluation, and a background screen. As described in the Chapter 2.0 of the BHHRA (Appendix K), the risk-based screening for non-cancer-based effects of chemicals in surface water and sediment and the determination of background differ somewhat from current OEPA guidance. These differences are based on established PBOW Project Delivery Team decisions, which include agreement between OEPA, USACE, and NASA. The risk-based values and background values used for screening in the BHHRA are the RBSCs and BSCs. These screening values are described in the BHHRA.

The COPC screening process results in the generation of a data summary table for each medium to be quantitatively evaluated in the BHHRA. A data summary table for each WWTP1 medium is provided as follows: surface soil (Table 6-8), subsurface soil (Table 6-9), total soil (Table 6-10), bedrock groundwater (Table 6-11), overburden groundwater (Table 6-12), sediment (Table 6-13), and surface water (Table 6-14). These tables provide the following information for each detected chemical in each environmental medium:

- Chemical name
- Frequency of detection
- Range of detected concentrations
- Range of detection limits

- Arithmetic mean of site concentrations
- 95th percent UCL (for COPCs only)
- Appropriate RBSC
- Appropriate BSC
- Selection/exclusion of chemical as a COPC EPC (for COPCs only).

Additional details of this data summary, including the estimation of the UCL values and EPCs for COPCs, are discussed in the BHHRA (Appendix K).

- ***Surface Soil*** – Aroclor 1016, Aroclor 1254, Aroclor 1260, benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene

- ***Subsurface Soil*** – Benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-c,d)pyrene

- ***Total Soil*** – Aroclor 1016, Aroclor 1254, Aroclor 1260, benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene

- ***Bedrock Groundwater*** – Arsenic, manganese, vanadium, 2-methylnaphthalene, naphthalene, benzene, ethylbenzene, xylenes, and cyanide

- ***Overburden Groundwater*** – Arsenic, barium, chromium, cobalt, iron, 1,3-dinitrobenzene, 2,4-DNT, and cyanide

- ***Sediment*** – Arsenic, chromium, manganese, thallium, benzo(a)pyrene, and benzo(b)fluoranthene

- ***Surface Water*** – Arsenic, chromium, iron, and manganese.

Please note that the total soil COPCs include all surface soil and subsurface soil COPCs.

6.3.2 Exposure Assessment

Exposure is the contact of a receptor with a chemical or physical agent. An exposure assessment estimates the type and magnitude of potential exposure of a receptor to COPCs found at or migrating from a site (EPA, 1989). The WWTP3 BHHRA characterizes potential exposures to COPCs in WWTP1 environmental media as portrayed by the CSEM. These environmental media include soil, surface water, sediment, and groundwater.

The CSEM provides the basis for identifying and evaluating the potential risks to human health in the BHHRA. The CSEM, graphically depicted on Figure 6-4, includes the receptors appropriate to all plausible site-use scenarios and the potential exposure pathways. This

presentation of all possible pathways by which a potential receptor may be exposed, including all sources, release and transport pathways, and exposure routes, facilitates consistent and comprehensive evaluation of risk to human health and helps to ensure that potential pathways are not overlooked. The elements of a CSEM include the following:

- Source
- Source media (i.e., initially contaminated environmental media)
- Contaminant release mechanisms
- Contaminant transport pathways
- Intermediate or transport media
- Exposure media
- Receptors
- Routes of exposure.

Contaminant release mechanisms and transport pathways are not relevant for direct receptor contact with a contaminated source medium (e.g., ingestion or dermal contact).

The receptors and pathways on Figure 6-4 reflect scenarios developed from information regarding site background and history, topography, climate, and demographics as presented by D&M (1997b) and the sitewide groundwater investigation (IT, 1997). No current or future exposure by off-site residents is evaluated. Most of the off-site residents are serviced by municipal water from surface water sources. Although there are numerous private groundwater wells in the vicinity, including several within 1 mile of the facility boundary, none of these is used as a potable source. Based on the investigations of other PBOW sites, natural hydrocarbons and hydrogen sulfide are known to be present within the bedrock limestone, and shale formation groundwater generally provides low yields and is of low quality (Shaw, 2008c); however, the groundwater underlying WWTP3 was not summarily excluded for consideration as a tap water source based on natural water quality parameters or general assumptions concerning yield. Therefore, given the presence of numerous off-site wells and the assumption of unrestricted future land use on site, the development of groundwater for on-site residential (or on-site worker) use as tap water was evaluated for purposes of this BHHRA. Groundwater quality and use are discussed further in Section 2.3.

Exposure associated with the COPCs were evaluated using the following receptors. The media that were quantitatively evaluated for each receptor are listed in parentheses:

- Current groundskeeper (surface soil)

- Future groundskeeper (total soil and groundwater)

- Future indoor worker (surface soil, subsurface soil [inhalation pathway only], and groundwater)
- Current/future construction worker (total soil, surface water, and sediment)
- Future resident (total soil, surface water, sediment, overburden groundwater, and bedrock groundwater)
- Future adult hunter (surface soil, including venison pathway)
- Future hunter's child (surface soil [venison pathway only]).

Each receptor scenario that includes groundwater was run separately for overburden groundwater and bedrock groundwater. Because groundwater yield was found to be insufficient for potable use in the overburden and bedrock units underlying WWTP3 and the WWTP3 bedrock groundwater was observed to be of naturally poor quality due to the presence of petroleum and hydrogen sulfide, the receptors evaluated for potable groundwater use were also evaluated assuming no groundwater use. The resident was evaluated for noncancer hazards separately for the young child (ages 1 through 6 years) and adult life stages.

The equations for the calculations of intake values for each exposure pathway, exposure assumptions, and the calculation of EPCs of COPCs for modeled pathways (e.g., venison, airborne concentrations) are presented in the BHHRA (Appendix K).

6.3.3 Risk Characterization

Risk characterization is the process of applying numerical methods and professional judgment to determine the potential for adverse human health effects to result from the presence of site-specific chemicals. This is done by combining the intake rates estimated during the exposure assessment with the appropriate toxicity information identified in the toxicity assessment (Chapter 4.0 of the BHHRA [Appendix K]). Noncancer hazards and cancer risks are characterized separately, including COPCs that induce both types of effects.

Quantitative expressions are calculated during risk characterization that describe the probability of developing cancer (i.e., ILCRs) or the nonprobabilistic comparison of estimated dose with an RfD for noncancer effects (i.e., HQs and HIs). Quantitative estimates are developed for individual chemicals, exposure pathways, and exposure media for each receptor. These quantitative risk characterization expressions, in combination with qualitative information, are used to guide risk management decisions. Risk characterization is applied only to COPCs.

6.3.3.1 Cancer Risk

The risk from exposure to potential chemical carcinogens is estimated as the probability of an individual developing cancer over a lifetime and is called the ILCR. Equations for calculating the ILCR are presented in the BHHRA (Appendix K).

Total ILCRs in the range of 1E-6 to 1E-4 are regarded as acceptable (EPA, 1990); this range is referred to as the "NCP risk management range." Risks less than this range are regarded as negligible. A target cancer risk goal of 1E-5 is used by OEPA and was selected by the PBOW Project Delivery Team as a basis to consider remedial action. Use of this 1E-5 goal represents a departure from the Army's practice of generally using a cancer risk exceeding a value of 1E-4 (the upper end of the NCP risk management range) to trigger remedial action considerations.

6.3.3.2 Noncancer Effects of Chemicals

The hazards associated with noncancer effects of chemicals are evaluated by comparing an exposure level or intake with an RfD. The HQ, defined as the ratio of intake to RfD, is estimated by dividing the intake of a chemical by the RfD as described in the BHHRA (Appendix K).

Chemical noncancer hazards are evaluated using chronic RfD values. An HQ of unity indicates that the estimated intake equals the RfD. If the HQ is greater than unity, there may be concern for potential adverse health effects. In the case of simultaneous exposure of a receptor to multiple chemicals or to a given chemical by multiple pathways, an HI is calculated as the sum of the HQs.

A total HI is calculated as the sum of all HI values, including all media and all COPCs, for a given receptor. Calculating a total HI as the sum of HQ values is based on the assumption that the potential for noncancer effects is additive. EPA (1989), however, acknowledges that the assumption of additivity is probably appropriate only for chemicals that induce adverse effects by the same mechanism. Therefore, if the total HI for a receptor exceeds 1, individual HI values may be calculated for each target organ, as described in Appendix K.

6.3.3.3 Risk Characterization Results

Cancer and noncancer risk characterization results were evaluated for each receptor and each environmental medium using the methods described in Sections 6.3.3.1 and 6.3.3.2. The cancer risks and noncancer hazards are presented for each receptor in Table 6-15. Because of the naturally low quality of the groundwater associated with petroleum hydrocarbons and hydrogen sulfide off-gassing as well as the limited groundwater volumes, exposure and risk were also

characterized for the future groundskeeper, indoor worker, and future on-site resident assuming no exposure to groundwater underlying WWTP3 (Table 6-16).

The overall HI and ILCR values are summarized in the following bullets; exceedances of the PBOW cancer risk goal (ILCR>1E-5) are shown in bold type and exceedances of the noncancer hazard criterion (HI>1) or the NCP risk management range (1E-6 to 1E-4) are shown in bold italics:

- Current groundskeeper: **ILCR = 5E-5** (re-evaluated as 7E-6); HI = 0.07
- Future groundskeeper – all pathways, including bedrock groundwater use: ***ILCR = 4E-4; HI = 4***
- Future groundskeeper – all pathways, including overburden groundwater use: **ILCR = 9E-5**; HI = 1
- Future groundskeeper – all pathways, excluding groundwater use: ILCR = 1E-5; HI = 0.05
- Indoor worker – all pathways, including bedrock groundwater use: ***ILCR = 4E-4; HI = 3***
- Indoor worker – all pathways, including overburden groundwater use: **ILCR = 8E-5**; HI = 1
- Future indoor worker – all pathways, excluding groundwater use: ILCR = 1E-5; HI = 0.02
- Construction worker: ILCR = 1E-6; HI = 0.8
- Resident – all pathways, including bedrock groundwater use: ***ILCR = 2E-3***; ***child HI = 25***; ***adult HI = 10***
- Resident – all pathways, including overburden groundwater use: ***ILCR = 3E-4***; ***child HI = 7***; ***adult HI = 32***
- Resident – all pathways, excluding groundwater use: **ILCR = 5E-5** (re-evaluated as 1E-5)*;* child HI = 0.5; adult HI = 0.1
- Hunter: ILCR = 3E-6; HI = 0.004
- Hunter's child: ILCR = 2E-10; HI = 0.00004.

The above bullets for the current groundskeeper and the resident include a re-evaluation of the cancer risks (excluding groundwater exposure) because the exceedances of the PBOW target

cancer risk goal for these receptors, each with an ILCR or 5E-5, resulted from elevated PAH soil concentrations that are not attributable to former DOD activities. As discussed in Section 6.3.3.4, the cancer risks for the current groundskeeper and resident (excluding groundwater exposure) were re-evaluated excluding three soil samples with elevated, non-DOD-related PAH concentrations. The resulting ILCR values for the current groundskeeper (7E-6) and resident (1E-5) did not exceed the target cancer risk goal of 1E-5 (Table 6-17).

6.3.3.4 BHHRA Conclusions

The ILCR and HI values for the two current exposure scenarios, current groundskeeper and construction worker, each meet the PBOW cancer risk goal (ILCR≤1E-5) and the noncancer hazard criterion (HI≤1). Note that the ILCR for the current groundskeeper meets the target criterion when re-evaluated as described in the previous section. Note groundskeeping in recent years appear to have been limited to regular mowing during the growing season and occasional maintenance work at the K-Site control building. Thus, the current groundskeeper scenario, which assumes a full-time, 25-year employee who works exclusively at WWTP1 for 8 hours per day, 250 days per year (Appendix K), appears to greatly overestimate the exposure levels of any current on-site worker or other current receptor.

Each of the potential future exposure scenarios that does not assume potable use of groundwater also meets the PBOW hazard criterion. Of the potential future exposure scenarios that exclude groundwater use, only the ILCR of the future resident exceeds the PBOW cancer risk criterion; this ILCR does not exceed the NCP risk management range.

The cancer risks associated with each of the future receptors evaluated under the assumption of bedrock groundwater use as a hypothetical source of tap water (i.e., future groundskeeper, future indoor worker, or future resident) exceed the NCP risk management range and PBOW cancer risk goal. Each of these receptors assuming bedrock groundwater use also exceeds the target noncancer HI criterion of 1. The ILCR for each of these under the assumption of overburden groundwater use also exceeds the PBOW cancer risk goal, but only the resident exceeds the NCP risk management range. Of all the receptors that are assumed to use overburden groundwater, only the child resident and adult resident exceed the HI criterion.

The cancer risks associated with bedrock groundwater are nearly entirely attributable to natural petroleum hydrocarbon-related compounds and arsenic, which do not appear to be related to former site activities. The noncancer hazards associated with overburden groundwater are mostly due to arsenic, which does not appear to be associated with former site activities. Use of either the overburden or bedrock groundwater is regarded as implausible because of insufficient water

yield. Additionally, the naturally poor quality of the bedrock groundwater and associated hydrogen sulfide off-gassing make it unsuitable as a potable source. The readily available municipal water supply obviates the need for use of groundwater as a potential source of tap water in the general vicinity of PBOW.

The ILCR values of the current groundkeeper (5E-5) and the future resident (5E-5) associated with exposure to surface soil and total soil, respectively, are due to PAHs in soil. A possible source of the PAHs is cinders observed in several WWTP3 soil borings from a depth of just below the surface to approximately 3.5 feet below the surface. Based on analytical samples collected to date and a review of the boring log descriptions, the cinders appear to be more widely occurring than the elevated levels of PAHs. Although the cinders likely contribute to the PAH concentrations, it appears that sources other than the cinders are responsible for PAHs in surface and near-surface soils, especially at the locations with the highest concentrations. These include the surface soil samples from SB-01 and SB-02 (located immediately adjacent to the patio adjoining the NASA K-Site control building [former neutralization tank]) and surface soil sample SSW303. SSW303 was collected immediately east of an access road and is interpreted to represent anthropogenic background sources (i.e., petroleum constituents of the asphalt and vehicle emissions).

If these three samples are excluded from the PAH database for WWTP3, the resulting re-evaluated hypothetical current groundskeeper ILCR is 7E-6 and the future resident ILCR is 1E-5. Both of these re-evaluated ILCR values meet the PBOW cancer risk goal and are within the NCP risk management range.

NASA demolished the former K-Site control building and associated patio in October 2012. As agreed by the PBOW Project Delivery Team, NASA removed and properly disposed of the soil identified as having elevated PAHs in the immediate vicinity of the former K-Site control building and patio during demolition activities (NASA, 2013). This area includes the two sampling locations SB-01 and SB-02. This area of NASA soil removal is depicted on Figure 6-1.

6.4 Screening-Level Ecological Risk Assessment

The SLERA, summarized in this section, was performed to evaluate and provide an estimate of current and future ecological hazard associated with exposure to potential releases to soil, groundwater, surface water, and sediment associated with WWTP3. This SLERA summary provides an ecological site description, identifies COPECs at the site, identifies ecological receptors, characterizes exposure, characterizes ecological risks, and presents the conclusions of the SLERA. The SLERA is included as Appendix L.

The SLERA is consistent with EPA guidance and with the procedures established in the SLERA for TNTA and TNTC soil (IT, 2001c) and, most specifically, the WWTP3 work plan (Shaw, 2009c).

6.4.1 Ecological Site Description

The ecological site description, presented in full in the SLERA (Appendix L) and summarized in the following paragraphs, includes a general site description; a description of surface water resources, wetlands, and vegetative communities; a species inventory; and a discussion of threatened and endangered species.

A general description of PBOW and the WWTP3 is presented in Chapters 1.0 and 2.0. WWTP3 was one of the waste water treatment plants that received waste water from the TNT manufacturing settling basins and neutralized the slurry through a chemical depuration process. WWTP3 acted as an overflow treatment plant for WWTP1 and WWTP2 and was connected to those facilities by a 6-inch steel sewer line.

WWTP3 is approximately 3 acres in size, with generally flat terrain. Therefore, water from precipitation events tends to pool in localized shallow depressions. The area as a whole drains to a north-south-trending ditch that flows through approximately the middle of the site. Water is typically present in this ditch. This ditch in turn drains to a small east-west-trending creek in the northwest portion of the site and eventually drains into Pipe Creek. No flow was observed in the ditch or the creek during site visits.

Ecological characterization of the study area was initially based on a compilation of existing ecological information pertaining to the site. Shaw personnel obtained maps and other relevant site information and determined the location of potential ecological units such as streams, creeks, ponds, grasslands, forest, and wetlands on or near the site. Additionally, biological inventories performed in 1994 and 2001 at PBOW (ODNR, 1995; NASA, 2002) that identify and indicate the locations of threatened and endangered species at the installation were reviewed.

Shaw ecological scientists performed site visits to WWTP3 on October 16, 2008 and April 28 and June 2, 2009. These visits were performed at different times of year to identify early- and late-blooming plant species (especially threatened and endangered species) and migrating and nesting bird species present at the site. Reconnaissance personnel used these site visits to confirm assumptions based on information previously gathered about the site, identify current site ecological conditions, and evaluate the site for more subtle indications of potential effects from

contaminant release. Information obtained during the reconnaissance trips was used to select representative receptors, refine exposure scenarios for the risk assessment, and identify protected species or habitats of special concern in the study area. A photographic record was made during the site reconnaissance (Appendix L).

A botanist developed a list of plant species observed at the site during the late spring and fall reconnaissance visits. Vegetative communities at the site were also classified during site reconnaissance trips. WWTP3 consists mostly of an upland old field containing grasses and herbs. This area appears to be periodically mowed and has a low diversity of grasses and herbs. A small area of successional woods is found along the banks of the drainage ditch. The drainage ditch contains some emergent wetland vegetation such as *Carex spp.* (sedges). Vegetative stress attributable to chemicals was not observed at the WWTP3. A vegetation community map and a list of plant species identified during the site visits are presented in the SLERA (Appendix L). Vegetative stress attributable to chemical contamination was not observed at WWTP3. No federally or state-listed plant species were observed.

A fauna species list was developed for the site based on existing site investigation reports (e.g., ODNR, 1995; NASA, 2002) and other environmental data sources. Bird surveys were performed during the site reconnaissance visits to identify bird species and communities using the site during migration (early spring reconnaissance visit) and nesting (late spring/early summer reconnaissance visit) periods. Direct or indirect (e.g., prints) observations of mammals and other fauna classes were also noted. A list of species observed or expected to be present at the site is presented in the SLERA (Appendix L).

According to the NWI maps for the area (U.S. Fish and Wildlife Service, 2011), there are no designated wetlands at the WWTP3 site. NASA is currently performing a wetland delineation study at PBOW that will more accurately identify the locations and extent of sensitive wetland habitat throughout the installation.

No T&E plant or animal species were observed during the site reconnaissance visits. Based on the habitat present at WWTP3 and/or lack of sightings in the vicinity of PBOW, no T&E bird species are expected to be found at WWTP3. Likewise, the only T&E mammal (Ohio endangered) historically documented at PBOW, the Indiana bat, has widespread sightings throughout Ohio, but WWTP3 does not provide the preferred habitat for this species (i.e., caves or trees with exfoliated bark).

6.4.2 Identification of Chemicals of Potential Ecological Concern

A screening process was performed on the analytical data from the LSI and the RI to identify COPECs that may pose a threat to ecological receptors. These data include all soil samples collected to a depth of 6 feet, surface water, and sediment. Groundwater was excluded because exposure to this WWTP3 medium is considered to be an incomplete pathway for ecological receptors. A list of the WWTP3 media samples used for the SLERA is presented in Table 6-18. Sample locations are presented on Figure 6-1.

The COPEC selection process was used to develop a subset of chemicals detected at the site that are not naturally occurring or associated with non-site-related sources. These chemicals are also present at sufficient frequencies, concentrations, and spatial areas to possibly pose a potential risk to ecological receptors. Examples of screening criteria that were used include analytical detection limit, frequency of detection less than 5 percent, comparability with background, status as a nutrient, and comparison with risk-based screening ecotoxicity values. This selection process and the screening values used for COPEC selection are described in the SLERA (Appendix L).

The results of the COPEC screening are presented in Tables 6-19 through 6-21 for soil, surface water, and sediment, respectively. The selected EPC is also presented for each chemical identified as a COPEC. For soil, two EPC results are presented, a total soil EPC for concentrations in the 0 to 6 feet bgs depth range and a surface soil EPC for concentrations in the 0 to 1 foot bgs depth range. These two sets of EPCs are used to evaluate various ecological receptors that may be exposed to different soil depths associated with their various life history characteristics. As described in the SLERA, the EPC is the lower value between the MDC and the 95 percent UCL of the mean.

Twenty-one chemicals were selected as COPECs in soil (Table 6-19), seven were selected as COPECs in surface water (Table 6-20), and one was selected as a COPEC in sediment (Table 6-21). These COPECs were quantitatively evaluated in the predictive SLERA, as summarized in Sections 6.4.3 through 6.4.6.

6.4.3 Selection of Ecological Receptors

Following COPEC selection, ecological assessment receptors were selected in the SLERA to focus the exposure characterization on species, groups of species, or functional groups that are directly related to the following assessment endpoints: the protection of long-term survival and reproductive capabilities for terrestrial invertebrates, herbivorous mammals, omnivorous mammals, insectivorous mammals and birds, and carnivorous birds. As part of this receptor

selection process, site biota were organized into major functional groups. For terrestrial communities, the major groups are plants and wildlife, including terrestrial invertebrates, mammals, and birds. For aquatic and/or wetland communities, the major groups are flora and fauna, including vertebrates (water fowl and fish), aquatic invertebrates, and wetland/terrestrial mammals.

Seven representative terrestrial receptor species that are expected or possible in the area of the WWTP3 (based on the ecological description of the site presented in Section 6.4.1) were selected as indicator species for the potential effects of COPECs. These indicator species represent two classes of vertebrate wildlife (mammals and birds) and a range of both body size and feeding habits, and include herbivores, omnivores, and carnivores. Terrestrial invertebrates and vegetation are not considered assessment receptors. The seven terrestrial species selected include the deer mouse (*Peromyscus maniculatus*) (small omnivorous mammal), short-tailed shrew (*Blarina brevicauda*) (small insectivorous mammal), Eastern cottontail rabbit (*Sylvilagus floridanus*) (medium-sized herbivorous mammal), marsh wren (*Cistothorus palustris*) (small insectivorous bird), white-tailed deer (*Odocoileus virginianus*) (large herbivorous mammal), raccoon (*Procyon lotor*) (medium-sized omnivorous mammal), and red-tailed hawk (*Buteo jamaicensis*) (large carnivorous bird).

Terrestrial and aquatic food webs are presented on Figures 6-5 and 6-6, respectively. Many of the species evaluated, particularly the deer mouse, cottontail rabbit, short-tailed shrew, and marsh wren, have limited home ranges which make them particularly vulnerable to exposure from site contaminants.

6.4.4 Exposure Characterization

A description of the nature, extent, and magnitude of potential exposure of assessment receptors to COPECs that are present at or migrating from the site is presented in this section, considering both current and reasonably plausible future use of the site.

Ecological routes of exposure for biota may be direct or through the food web via the consumption of contaminated organisms. Direct exposure routes include dermal contact, absorption, inhalation, and ingestion. Examples of direct exposure include animals incidentally ingesting contaminated soil or sediment (e.g., during burrowing or dust-bathing activities), animals ingesting surface water, plants absorbing contaminants by uptake from contaminated sediment or soil, and dermal contact of aquatic organisms with contaminated surface water or sediment. Given the scarcity of available data for wildlife dermal and inhalation exposure pathways, potential risk from these pathways is not estimated in the SLERA. In addition, these

pathways are generally considered to be incidental for most species, with the possible exceptions of burrowing animals and dust-bathing birds. Food web exposure can occur when terrestrial or aquatic fauna consume contaminated biota. Examples of food web exposure include animals at higher trophic levels consuming plants or animals that bioaccumulate contaminants.

Daily doses of COPECs for vertebrate receptors were calculated using standard exposure algorithms. These algorithms incorporate species-specific natural history parameters (i.e., feeding rates, water ingestion rates, dietary composition, etc.) as well as site-specific area use factors, which scale the estimated hazard by a fraction value based on the comparison of the size of the affected area to the home range of the specific receptor. These algorithms are presented and described in the SLERA (Appendix L).

Exposure to soil, sediment, and surface water is discussed in the following paragraphs. As stated in Section 6.4.2, groundwater is not a medium of concern for ecological receptors at this site.

Soil Exposure Pathway. Soil exposure pathways are potentially important for terrestrial plants and animals at the site. For nonburrowing animals, exposure to soil from a depth of 0 to 1 foot bgs was considered, as this soil depth would represent the depth of regular exposure for these types of organisms. For burrowing animals such as the shrew, exposure to soil from a depth of 0 to 6 feet bgs was considered. It is noted that although the shrew itself may not actually burrow to a depth of 6 feet, there may be other burrowing mammals that do burrow this deep. For plants and herbivores that feed on deep-rooted plants (e.g., the white-tailed deer, which is assumed to ingest leaves of trees translocating COPECs from subsoils), exposure to soil from a depth of 0 to 6 feet bgs (or the water table surface) was also evaluated because most feeder roots are located within this depth. Thus, the shrew and the white-tailed deer (Figure 6-5) were evaluated for exposure to deeper (0 to 6 feet bgs) soil. All other receptors exposed to soil were evaluated for exposure to concentrations in surface (0 to 1 foot bgs) soil.

Sediment Exposure Pathway. Potential contaminant sources for sediment include over-ground transport from the WWTP3 area and contaminated surface water, groundwater, and soil. The release mechanisms include surface water runoff, groundwater discharge, and airborne deposition. Potential receptors of chemicals in contaminated sediment include aquatic flora and fauna. Direct exposure routes for contaminated sediment include contact by benthic-dwelling organisms such as amphipod invertebrates, uptake by aquatic flora, and ingestion by aquatic fauna. Indirect exposure pathways from sediment include consumption of bioaccumulated contaminants by consumers in the food chain.

Surface Water Exposure Pathway. Surface water represents a potential transport medium for COPECs. The ditches adjacent to WWTP3 may contain fish and other aquatic biota that could be ingested as prey species by other receptors. Direct exposure routes for contaminated surface water include contact by aquatic organisms and ingestion by aquatic fauna. Indirect exposure pathways from surface water include consumption of bioaccumulated contaminants by consumers in the food chain.

6.4.5 Risk Characterization

Food chain modeling was used to estimate exposure rates for the representative assessment receptors. These exposure rates were compared with TRVs to calculate HQs (Wentsel, et al., 1996). Two types of TRVs were used in the food chain models: those based on a NOAEL and those based on a LOAEL, the former being more conservative. HQs are calculated by summing intake doses across all exposure pathways for each chemical for a given receptor and dividing by the TRV. HQs for those chemicals that have a similar mode of toxicological action may be summed to account for cumulative effects. In the SLERA, the five nitroaromatic COPECs in soil were identified as potentially having similar mechanisms of toxicity, and their HQs were summed. HQs are a means of estimating the potential for adverse effects to organisms at a contaminated site and for assessing the potential for toxicological effects among site receptors. HQs less than or equal to 1 represent no probable hazard. Although OEPA considers all HQs above 1 to be potentially significant, the following uncertainties regarding HQ interpretation are noted:

- HQs are not measures of risk.
- HQs are not population based.
- HQs are not linearly scaled.
- HQs are often produced that are unrealistically high and toxicologically impossible (e.g., estimated HQs greater than 1,000).
- Trace soil concentrations of inorganic chemicals (including concentrations well below background levels) can lead to HQ values that are (much) greater than 1.

Therefore, it should be understood that HQs greater than 1 are not a definitive indication that adverse ecological effects are occurring at the site or may occur in the future.

Table 6-22 summarizes the NOAEL and LOAEL-based HQs for the eight evaluated assessment receptors. The following COPECs in soil (except for selenium, which was a sediment COPEC) had HQ values greater than 1:

- ***Lead:*** Marsh Wren (NOAEL HQ = 6.49)
- ***Selenium (sediment):*** Muskrat (NOAEL HQ = 2.38)
- ***Aroclor 1016:*** Marsh Wren (NOAEL HQ = 19.2, LOAEL HQ = 1.92)
- ***Aroclor 1254:*** Deer Mouse (NOAEL HQ = 9.41), Short-Tailed Shrew (NOAEL HQ = 14.2), Marsh Wren (NOAEL HQ = 13.9)
- ***Benzo(a)anthracene:*** Deer Mouse (NOAEL HQ = 2.4), Short-Tailed Shrew (NOAEL HQ = 1.67), Marsh Wren (NOAEL HQ = 2.04)
- ***Benzo(b)fluoranthene:*** Marsh Wren (NOAEL HQ = 4.46)
- ***Carbazole:*** Deer Mouse (NOAEL HQ = 5670, LOAEL HQ = 567), Short-Tailed Shrew (NOAEL HQ = 2870; LOAEL HQ = 287), Cottontail Rabbit (NOAEL HQ = 714, LOAEL HQ = 71.4), Raccoon (NOAEL HQ = 7.64)
- ***Chrysene:*** Deer Mouse (NOAEL HQ = 2.01).

HQs could not be calculated for dibenzofuran (both mammals and birds) or carbazole (birds only) due to a lack of TRVs for these chemicals. Both chemicals were selected as COPECs in soil because they lacked screening values. Dibenzofuran was detected in 3 out of 16 samples at estimated ("J"-qualified) concentrations of 0.078 to 1.35 mg/kg. Carbazole detection patterns were discussed in the previous paragraph. Although the lack of toxicity data represents an uncertainty in the SLERA, the presence of low concentrations of these two chemicals in fewer than 20 percent of the soil samples is unlikely to impact ecological receptors at the site.

A summary of the discussion presented in the SLERA (Appendix L) for the chemicals with HQs exceeding 1 is presented below.

Lead and Selenium

- Both of these metals had HQs above 1 that were not highly elevated (i.e., less than 10), and the LOAEL-based HQs did not exceed 1 for the marsh wren or muskrat, respectively. This suggests that there is low concern for ecological toxicity associated with these two metals.

Aroclor 1016 and Aroclor 1254

- Although several receptors exceeded an HQ of 1, only the marsh wren had LOAEL HQs greater than 1 for these two PCBs. The short-tailed shrew also had a LOAEL HQ slightly greater than 1 when rounded (HQ = 1.64) for all PCBs.

- The critical pathway for the marsh wren (and short-tailed shrew) was ingestion of terrestrial invertebrates. The uptake factor used to estimate body burden concentrations in invertebrate prey tissue was based on a model that uses the log K_{ow} of the target chemical. Comparison of modeled uptake factors to uptake factors developed during site specific field studies at another site at PBOW (IT, 2001d) suggest that the modeled uptake factors for this pathway are overestimated, perhaps by several orders of magnitude.

- The LOAEL-based HQs for the marsh wren (HQs = 1.92 and 3.32 for Aroclor 1016 and 1254, respectively) and for the short-tailed shrew (HQ = 1.64) only marginally exceeded 1, suggesting low potential for hazard given the conservative nature of the food chain modeling.

- Only 1 out of 16 soil samples for both Aroclor 1016 and Aroclor 1254 exceeded their ESV; therefore, the potentially impacted area is too small to warrant concern for populations of ecological receptors.

PAHs (Benzo[a]anthracene, Benzo[b]fluoranthene, and Chrysene)

- For all PAHs, none of the NOAEL-based HQs were elevated (less than 5).

- No LOAEL-based HQs exceeded 1.

- PAHs do not appear to be related to previous PBOW activities. Two of the four samples with elevated PAHs (SB01 and SB02) are located in a portion of the site for which NASA has performed a soil removal.

Carbazole

- Carbazole is a PAH heterocycle in which one of the carbons within the aromatic structure is substituted by a nitrogen atom, occurs as a natural constituent of creosote and coal tar (Agency for Toxic Substances and Disease Registry, 2002). Carbazole was detected in 3 out of 16 samples at concentrations ranging from 0.0443 to 1.12 mg/kg, which is consistent with the detection frequency and concentration ranges of detected PAHs.

- The elevated food chain model HQs for carbazole are the result of the use of a mammalian NOAEL and LOAEL TRVs that are approximately five orders of magnitude lower than other, structurally similar PAHs (e.g., benzo[a]pyrene). However, several soil toxicity studies have shown that heterocycles, including carbazole, do not exhibit significantly different toxicity to soil invertebrates compared with their unsubstituted hydrocarbon counterparts (i.e., PAHs) (Wassenberg, et al., 2005; Sverdrup, et al., 2001, 2002a,b). Therefore, these studies do not corroborate or

support the use of a TRV for carbazole that is five orders of magnitude lower than the TRVs for PAHs.

- Carbazole does not appear to be related to previous PBOW activities. Two of the four samples with elevated PAHs (SB01 and SB02) are located near the former NASA K-Site control building, where NASA has removed and properly disposed of soils with elevated PAH concentrations.

6.4.6 SLERA Conclusions

Concern regarding exposure to chemicals at WWTP3 is unwarranted for most species because considerations such as the home range size and density characteristics of various ecological species of concern make it unlikely that multiple individuals of a given species (i.e., local populations) would be exposed to media at the 3-acre WWTP3 site on a regular basis. In other words, the small size of the site precludes the possibility of population-level impacts at the WWTP3, regardless of whether contamination is present. However, hazard estimates for COPECs were generated for a number of measurement receptors under the conservative assumption that impacts to populations are plausible. The results of this exercise revealed that the potential for adverse ecological impacts is considered to be minimal at his site for the following reasons:

- For all chemicals except carbazole, HQ exceedances using the most conservative assumptions were relatively low and only exceeded 10 for PCBs; however, PCB HQs based on more realistic assumptions only marginally exceeded 1.

- For all COPECs, the number of samples detected at elevated concentrations represents a very small portion of a 3-acre site. Therefore, exposure frequency of receptors of concern to these areas is expected to be very low, resulting in a negligible probability of adverse impacts at the population level.

- The only COPEC with elevated HQs, carbazole, had a TRV that toxicity studies and its chemical similarity to PAHs suggest is improbably low (conservative). This chemical was detected at low concentrations and is a ubiquitous creosote compound. Therefore, it is likely that the toxicity for this chemical is overestimated and its presence is neither site-related nor harmful to wildlife at its detected concentrations.

- The area where the highest PAHs (including carbazole) were detected is within an area immediately adjacent to the K-site control building, where soil has subsequently been removed by NASA.

For these reasons, the potential for adverse ecological impacts is considered to be very low at WWTP3, and no further evaluation of chemicals for the protection of ecological receptors appears to be warranted.

6.5 WWTP3 Investigation and Evaluation Recommendations

No remedial actions or further investigation of WWTP3 media are recommended based on the results of the WWTP3 RI efforts, including the BHHRA and SLERA. Please note that NASA has removed and properly disposed of the PAH-contaminated soil associated with the former NASA K-Site control building and adjoining patio (NASA, 2013).

The unacceptable risks and hazards associated with groundwater exposure in the BHHRA are attributable to naturally occurring hydrocarbons and background-related arsenic. If the contributions of exposure to groundwater are appropriately excluded due to its low yield and naturally poor quality, all receptors meet the noncancer hazard criterion of 1 and the target ILCR of 1E-05. Because groundwater use is not regarded as plausible based on insufficient yield and naturally poor quality in both the overburden and bedrock units, groundwater use and the associated risks reported in the WWTP3 BHHRA are accordingly implausible.

Based on the results and findings of the SLERA, the potential for adverse ecological effects at WWTP3 is low. Observations of the species present and the lack of vegetative stress, combined with the low hazard estimates calculated in the COPEC selection and food chain modeling, suggest a lack of impact to ecological receptors. Further, the small areal extent of WWTP3 reduces the potential for multiple individuals of most ecological receptor species to be regularly exposed to site media, further diminishing the potential for adverse impacts to populations of organisms to negligible levels. Although some HQ exceedances were observed for some chemicals in the food chain model, all COPECs responsible for these exceedances were detected very infrequently at concentrations above ESVs and/or BSVs. Also, all HQs except carbazole were relatively low, with most NOAEL-based HQs below 10 and most LOAEL-based HQs below or only marginally above 1. Given the conservative nature of the food chain modeling, the observed HQs for these chemicals are unlikely to be of concern. Carbazole was the only chemical with elevated food chain model HQs (e.g., NOAEL HQ of greater than 5,000 for the deer mouse receptor). Hazards for carbazole are likely overestimated due to its extremely conservative TRV, which is several orders of magnitude lower than PAH TRVs. Soil toxicity studies in the literature suggest that this large difference in toxicity between carbazole and structurally similar PAHs is unwarranted. Carbazole was detected in only three soil samples at low concentrations that did not exceed its reporting limit. Carbazole is a compound closely related to PAHs that is found in creosote. It was detected along with PAHs in some samples (including the sample where the MDC was identified) adjacent to the former NASA K-site control building, where NASA has removed soils identified as having elevated PAH concentrations. PAHs and creosote in this area (as well as in other areas at WWTP3 where they

were detected) are likely present as the result of non-site-related activities (e.g., vehicular traffic, creosote on utility poles, etc.).

7.0 DERP-FUDS Project No. G05OH001817 Recommendations

The purpose of the RI is to gather information concerning the site characteristics so that appropriate remedial alternatives may be developed in the FS. However, it is unnecessary to perform an FS if the BHHRA indicates that the human health risk goals are met under baseline conditions, and the ecological risk assessment indicates a lack of adverse ecological effects (DOD, 2004; 2012).

The purpose of including recommendations in this RI is to clearly convey information to the Project Delivery Team that USACE regards as imperative to the total CERCLA and DERP-FUDS project closure processes. Types of recommendations arising from the RI process may include one or more of the following:

- Proceed to FS
- No (further) action: no FS required; proceed to no (further) action proposed plan
- Perform additional evaluation (e.g., treatability study)
- Perform a time-critical or non-time-critical removal action.

7.1 WWTP1

Based on the findings of the RI that WWTP1 environmental media pose no DOD-related unacceptable risks or hazards to human health or the environment and no DOD-related chemical exceeds a chemical-specific applicable or relevant and appropriate requirement (ARAR) level, no further action is recommended at WWTP1.

7.2 TNTA/WWTP1 Sewer Lines

The RI identified a hot spot of 2,4,6-TNT in surface soil in the vicinity of test pit location TP-27 at the TNTA/WWTP1 sewer lines site. Exposure to soil in this area may pose a DOD-related unacceptable risk or hazard to human health and the environment. This hot spot area is estimated to be approximately 60 feet by 20 feet in size. It is recommended that an FS be performed at this limited hot spot area using cleanup levels derived based on RBRC values. These 2,4,6-TNT RBRCs were developed to support site management decisions and will be considered in the derivation of cleanup levels in the FS.

7.3 TNTB/WWTP1 Sewer Lines

Based on the findings of the RI that the TNTB/WWTP1 sewer lines environmental media pose no DOD-related unacceptable risks or hazards to human health or the environment and no

DOD-related chemical exceeds a chemical-specific ARAR level, no further action is recommended along the TNTB/WWTP1 sewer lines trace.

7.4 WWTP3

Based on the findings of the RI that the WWTP3 environmental media pose no DOD-related unacceptable risks or hazards to human health or the environment and no DOD-related chemical exceeds a chemical-specific ARAR level, no further action is recommended at WWTP3.

7.5 Overall Project Recommendation

Remediation is recommended to address elevated 2,4,6-TNT concentrations in surface soil within a hot spot along the TNTA/WWTP1 sewer line traces. This hot spot, located in the vicinity of test pit TP-27, is estimated to comprise an area of 60 feet by 20 feet. Remedial action is necessary to reduce potential human health risk to acceptable levels. No further action is recommended for any media (i.e., soil, groundwater, surface water, and sediment) at WWTP1, the TNTB/WWTP1 sewer line trace, and WWTP3. Also, no further action is recommended for media other than soil (i.e., groundwater, surface water, and sediment) at the TNTA/WWTP1 sewer line traces. Therefore, the FS for DERP-FUDS Project No. G05OH001817 will address only TNTA/WWTP1 sewer lines soil contamination. The FS will present and discuss potential remedial alternatives for addressing elevated 2,4,6-TNT in soil at the TNTA/WWTP1 sewer line traces.

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TABLES

Table 3-1

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1															
				LOCATION CODE	WWTP1-SB01		WWTP1-SB01		WWTP1-SB01		WWTP1-SB02		WWTP1-SB02		WWTP1-SB02		WWTP1-SB02		WWTP1-SB02	
				SAMPLE NO	WW0001		WW0002		WW0003		WW0004		WW0005		WW0006		WW0066		WW0007	
				SAMPLE DATE	5-Dec-08		5-Dec-08		5-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08	
				DEPTH	2_6 - 3_6 Ft		5_6 - 7_6 Ft		8 - 10 Ft		1_6 - 2_6 Ft		5 - 6_6 Ft		5 - 6_6 Ft		5 - 6_6 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		FD		FS		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
EXPLOSIVES																				
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	8.06	-	-	-	-	-	-	-	-	-	-	-	-	0.33		-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	7.74	-	-	-	-	-	-	-	-	0.243	J	-	-	0.54		-	-
Dinitrobenzene, 1,3-	mg/kg	0.61	NE	0.922	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	9.47	-	-	-	-	-	-	-	-	0.566	J	1.81	J	2.4		-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	2.03	-	-	-	-	-	-	-	-	-	-	0.239	J	0.42		-	-
RDX	mg/kg	5.5	NE	0.239	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tetryl	mg/kg	24	NE	2.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	2.6	-	-	-	-	-	-	-	-	-	-	-	-	0.2		-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	181	-	-	-	-	-	-	-	-	0.155	J	0.182	J	0.49		-	-
PCBs																				
Aroclor 1016	mg/kg	0.39	NE	1.16	-	-	-	-			-	-	0.0521	J	0.108	J	-	-		
Aroclor 1221	mg/kg	0.14	NE	0.199	-	-	-	-			-	-	-	-	-	-	-	-		
Aroclor 1232	mg/kg	0.14	NE	0.0328	0.0328	J	-	-			-	-	-	-	-	-	-	-		
Aroclor 1242	mg/kg	0.22	NE	0.0432	-	-	0.0432	J			-	-	-	-	-	-	-	-		
Aroclor 1254	mg/kg	0.11	NE	0.16	-	-	-	-			-	-	-	-	-	-	-	-		
Aroclor 1260	mg/kg	0.22	NE	0.268	-	-	-	-			-	-	-	-	-	-	-	-		
SEMIVOLATILES																				
Acenaphthene	mg/kg	340	NE	0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	mg/kg	NE	NE	0.829	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg	1,700	NE	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	2.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.015	NE	1.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	2.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	NE	NE	0.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	1.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzoic acid	mg/kg	24,000	NE	0.639	-	-	-	-	-	-	-	-	-	-	-	-			-	-
Bis(2-ethylhexyl)phthalate	mg/kg	35	NE	0.0869	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbazole	mg/kg	NE	NE	0.603	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	15	NE	2.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.247	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	mg/kg	7.8	NE	0.376	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-butyl phthalate	mg/kg	610	NE	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	4.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	2.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIPHENYLAMINE	mg/kg	150	NE	0.0432	-	-	-	-	-	-	-	-	-	-	-	-			-	-
Fluoranthene	mg/kg	230	NE	6.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	mg/kg	230	NE	0.755	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	1.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	mg/kg	31	NE	0.259	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	3.6	NE	0.0765	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1															
				LOCATION CODE	WWTP1-SB01		WWTP1-SB01		WWTP1-SB01		WWTP1-SB02		WWTP1-SB02		WWTP1-SB02		WWTP1-SB02		WWTP1-SB02	
				SAMPLE NO	WW0001		WW0002		WW0003		WW0004		WW0005		WW0006		WW0066		WW0007	
				SAMPLE DATE	5-Dec-08		5-Dec-08		5-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08	
				DEPTH	2_6 - 3_6 Ft		5_6 - 7_6 Ft		8 - 10 Ft		1_6 - 2_6 Ft		5 - 6_6 Ft		5 - 6_6 Ft		5 - 6_6 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		FD		FS		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Nitroaniline, 3-	mg/kg	NE	NE	0.706	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg	NE	NE	5.62	-	-	-	-	0.0631	J	-	-	-	-	-	-	-	-	-	-
Pyrene	mg/kg	170	NE	4.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
METALS																				
Aluminum	mg/kg	7,700	15,500	15000	2,840		8,210		9,740		6,820		6,530		5,210		7,050		8,770	
Antimony	mg/kg	3.1	9.3	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	mg/kg	0.39	36.5	20.3	2.43		5.29		8.95		2.55		1.47		1.59		3.8		6	
Barium	mg/kg	1,500	826	116	14.2		56.9		31.6		17.2		37.4		30.9		50.1		51.3	
Beryllium	mg/kg	16	1	10.3	**4.48**	J	**5.31**	J	**7.75**	J	**6.36**	J	**4.78**	J	**4.57**	J	-	-	**6.01**	J
Cadmium	mg/kg	7	NE	0.638	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.296	J
Calcium	mg/kg	NE	52,300	55000	15,200	J	47,200		34,500	J	1,810		43,000		36,800		**55,000**	J	50,300	J
Chromium	mg/kg	0.29	29	22	9.05		11.9		14.9		15.7	J	10.6	J	9.05	J	12.7		13.9	
Cobalt	mg/kg	2.3	116	18.2	4.56	J	10.2	J	11.7	J	4.27		6		4.82		9		9.07	J
Copper	mg/kg	310	56.2	46.4	4.64		25.4		28.7		4.03		16.4		11.6		18.5		26	
Iron	mg/kg	5,500	234,000	65600	12,600	J	16,800	J	25,200	J	18,300	J	15,000	J	14,600	J	18,300		18,500	J
Lead	mg/kg	40	48.6	64.1	3.05		11.9		12.1		4.24	J	6.91	J	6.61	J	9.7		14.3	
Magnesium	mg/kg	NE	10,400	18900	4,160		**18,900**		9,700		830	J	**15,300**	J	**12,900**	J	**17,800**		**17,700**	
Manganese	mg/kg	180	3,506	1040	300	J	402	J	379	J	157		345		272		500		433	J
Mercury	mg/kg	2.3	0.09	0.443	-	-	-	-	0.0118	J	0.0188	J	-	-	-	-	-	-	-	-
Nickel	mg/kg	150	55.1	39.7	-	-	14.2		18		-	-	6.73	J	1.89	J	23.4		15	
Potassium	mg/kg	NE	3,390	2280	256		1,150		1,470		168		941		758		1,520		1,300	
Selenium	mg/kg	39	2	2.3	-	-	-	-	-	-	-	-	-	-	-	-	0.7		-	-
Silver	mg/kg	39	11.1	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium	mg/kg	NE	NE	783	98.2		397		263		51.6		151		134		-	-	261	
Thallium	mg/kg	NE	1.3	1.4	-	-	0.373	J	0.387	J	-	-	-	-	0.262	J	-	-	0.41	J
Vanadium	mg/kg	39	40.9	56.7	24.5		20.2		17.8		40.5		20.9		20.5		19.1		21.2	
Zinc	mg/kg	2,300	321.75	261	23.9		53.2		79.1		30.4		40.2		31.7		51.6		60.2	
GENERAL CHEMISTRY																				
Total organic carbon	mg/kg	NE	NE	3260	36.1	B														

Table 3-1

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1																		
				LOCATION CODE	WWTP1-SB03		WWTP1-SB03		WWTP1-SB03		WWTP1-SB04		WWTP1-SB04		WWTP1-SB04		WWTP1-SB05		WWTP1-SB05		WWTP1-SB05		WWTP1-
				SAMPLE NO	WW0008		WW0009		WW0010		WW0011		WW0012		WW0013		WW0014		WW0015		WW0016		WW0(
				SAMPLE DATE	4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		3-Dec
				DEPTH	1.2 - 2.2 Ft		5 - 6_2 Ft		8 - 10 Ft		1_7 - 2_7 Ft		5 - 6_7 Ft		8 - 10 Ft		2_2 - 3_2 Ft		5_2 - 7_2 Ft		8 - 10 Ft		1_1 - 2_
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG		REG		REG		REG		REC
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result
EXPLOSIVES																							
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	8.06	-	-	0.458		-	-	2.31		-	-	-	-	-	-	2.95		0.168	J	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	7.74	-	-	1.05		-	-	3.09		7.51		-	-	-	-	7.74		0.499		-
Dinitrobenzene, 1,3-	mg/kg	0.61	NE	0.922	-	-	0.922		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	9.47	-	-	2.58		-	-	-	-	2.09		-	-	-	-	9.47		0.766		-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	2.03	-	-	0.272	J	-	-	-	-	0.326		-	-	-	-	2.03		-	-	-
RDX	mg/kg	5.5	NE	0.239	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tetryl	mg/kg	24	NE	2.94	-	-	-	-	-	-	0.587		2.94		-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	2.6	-	-	-	-	-	-	0.836		2.6		-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	181	-	-	0.24	J	-	-	26.9		181		-	-	-	-	3.54		-	-	-
PCBs																							
Aroclor 1016	mg/kg	0.39	NE	1.16	-	-	-	-			-	-	-	-			-	-	-	-			-
Aroclor 1221	mg/kg	0.14	NE	0.199	-	-	-	-			-	-	-	-			-	-	-	-			-
Aroclor 1232	mg/kg	0.14	NE	0.0328	-	-	-	-			-	-	-	-			-	-	-	-			-
Aroclor 1242	mg/kg	0.22	NE	0.0432	-	-	-	-			-	-	-	-			-	-	-	-			-
Aroclor 1254	mg/kg	0.11	NE	0.16	-	-	-	-			-	-	-	-			-	-	-	-			-
Aroclor 1260	mg/kg	0.22	NE	0.268	0.041	J	-	-			-	-	0.0197	J			-	-	-	-			0.124
SEMIVOLATILES																							
Acenaphthene	mg/kg	340	NE	0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	mg/kg	NE	NE	0.829	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg	1,700	NE	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	2.43	0.122	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0419
Benzo(a)pyrene	mg/kg	0.015	NE	1.96	0.115	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	2.8	0.182	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	NE	NE	0.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	1.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzoic acid	mg/kg	24,000	NE	0.639	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	mg/kg	35	NE	0.0869	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0568	J	-
Carbazole	mg/kg	NE	NE	0.603	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	15	NE	2.25	0.117	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0496
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.247	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	mg/kg	7.8	NE	0.376	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-butyl phthalate	mg/kg	610	NE	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	4.42	-	-	1.07		-	-	-	-	0.714		-	-	0.0375	J	2.39		0.301	J	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	2.18	-	-	0.0944	J	-	-	-	-	0.162	J	-	-	-	-	0.504		0.0683	J	-
DIPHENYLAMINE	mg/kg	150	NE	0.0432	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	mg/kg	230	NE	6.57	0.179	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0851
Fluorene	mg/kg	230	NE	0.755	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	1.12	0.295	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.27
Methylnaphthalene, 2-	mg/kg	31	NE	0.259	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	3.6	NE	0.0765	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3-1

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1																		
				LOCATION CODE	WWTP1-SB03		WWTP1-SB03		WWTP1-SB03		WWTP1-SB04		WWTP1-SB04		WWTP1-SB04		WWTP1-SB05		WWTP1-SB05		WWTP1-SB05		WWTP1-
				SAMPLE NO	WW0008		WW0009		WW0010		WW0011		WW0012		WW0013		WW0014		WW0015		WW0016		WW0(
				SAMPLE DATE	4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		3-Dec
				DEPTH	1.2 - 2.2 Ft		5 - 6_2 Ft		8 - 10 Ft		1_7 - 2_7 Ft		5 - 6_7 Ft		8 - 10 Ft		2_2 - 3_2 Ft		5_2 - 7_2 Ft		8 - 10 Ft		1_1 - 2_
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG		REG		REG		REG		REC
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result
Nitroaniline, 3-	mg/kg	NE	NE	0.706	-	-	0.706		-	-	-	-	-	-	-	-	-	-	0.183	J	-	-	-
Phenanthrene	mg/kg	NE	NE	5.62	0.0579	J	-	-	-	-	-	-	-	-	0.0424	J	-	-	-	-	-	-	-
Pyrene	mg/kg	170	NE	4.35	0.158	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.071
METALS																							
Aluminum	mg/kg	7,700	15,500	15000	3,400		10,300		10,900		4,610		2,210		13,100		5,310		2,300		15,000		6,030
Antimony	mg/kg	3.1	9.3	1.9	0.421	J	-	-	-	-	0.299	J	-	-	-	-	-	-	-	-	-	-	0.677
Arsenic	mg/kg	0.39	36.5	20.3	2.15		5.54		4.71		2.96		1.14		5.34		1.78		1.99		2.86		2.14
Barium	mg/kg	1,500	826	116	20.7		58.1		64.5		14.4		9.57		79.1		13.9		7.93		112		20.9
Beryllium	mg/kg	16	1	10.3	**4.21**	J	**6.57**	J	**7.07**	J	**5.67**	J	**3.23**	J	**8.23**	J	**8.44**	J	**2.14**	J	**8.89**	J	**5.59**
Cadmium	mg/kg	7	NE	0.638	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.378
Calcium	mg/kg	NE	52,300	55000	8,260		38,000		44,700	J	3,880		25,800		36,400	J	1,790		37,000		34,000	J	2,290
Chromium	mg/kg	0.29	29	22	10.9	J	14.7	J	16.2		13	J	6.8	J	18.8		17.6	J	4.96	J	22		13.7
Cobalt	mg/kg	2.3	116	18.2	3.61		9.24		10	J	3.41		2.4		12.4	J	4.83		2.89		13.2	J	3.16
Copper	mg/kg	310	56.2	46.4	6.46		21.3		28		3.92		3.96		27		4.28		5.1		25.1		14.6
Iron	mg/kg	5,500	234,000	65600	12,000	J	21,000	J	21,600	J	16,400	J	9,280	J	25,600	J	28,600	J	6,480	J	27,200	J	15,500
Lead	mg/kg	40	48.6	64.1	13.2	J	7.49	J	11.8		5.04	J	4.73	J	12.1		1.83	J	6.94	J	11.3		39.1
Magnesium	mg/kg	NE	10,400	18900	2,320	J	**11,400**	J	**12,700**		1,140	J	8,310		**10,700**		692	J	**10,600**	J	**11,000**		959
Manganese	mg/kg	180	3,506	1040	411		393		429	J	122		123		396	J	235		216		399	J	108
Mercury	mg/kg	2.3	0.09	0.443	0.0207	J	-	-	0.0114	J	-	-	-	-	0.0116	J	0.0166	J	0.0191	J	0.0115	J	0.0571
Nickel	mg/kg	150	55.1	39.7	-	-	12.9		15.2		-	-	-	-	18.5		-	-	2.23		20.7		-
Potassium	mg/kg	NE	3,390	2280	220		1,480		1,610		274		253		1,960		156		298		2,280		169
Selenium	mg/kg	39	2	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silver	mg/kg	39	11.1	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium	mg/kg	NE	NE	783	65.8		223		279		50.1		90.5		379		34.7		104		239		60.1
Thallium	mg/kg	NE	1.3	1.4	-	-	-	-	0.317	J	-	-	-	-	0.307	J	-	-	-	-	0.242	J	-
Vanadium	mg/kg	39	40.9	56.7	22		17.7		21.8		31.5		19.7		22.7		**56.7**		12.4		25.2		24.8
Zinc	mg/kg	2,300	321.75	261	25.1		56.3		60.6		27.1		17.6		67.7		30.8		15.6		72.8		47.6
GENERAL CHEMISTRY																							
Total organic carbon	mg/kg	NE	NE	3260																			

Table 3-1

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1														
				LOCATION CODE	SB06	WWTP1-SB06		WWTP1-SB06		WWTP1-SB06		WWTP1-SB06		WWTP1-SB07		WWTP1-SB07		WWTP1-SB07	
				SAMPLE NO	17	WW0018		WW0067		WW0019		WW0020		WW0021		WW0022		WW0023	
				SAMPLE DATE	-08	3-Dec-08		3-Dec-08		3-Dec-08		3-Dec-08		3-Dec-08		3-Dec-08		3-Dec-08	
				DEPTH	1 Ft	1_1 - 2_1 Ft		1_1 - 2_1 Ft		5 - 6_1 Ft		8 - 10 Ft		1 - 2 Ft		5 - 6 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	S	FD		FS		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
EXPLOSIVES																			
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	8.06	-	-	-	-	-	-	-	-	-	-	-	0.197	J	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	7.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrobenzene, 1,3-	mg/kg	0.61	NE	0.922	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	9.47	-	-	-	-	-	0.585		-	-	-	-	3.87	J	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	2.03	-	-	-	-	-	-	-	-	-	-	-	1.48		-	-
RDX	mg/kg	5.5	NE	0.239	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tetryl	mg/kg	24	NE	2.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	181	-	0.164	J	0.87		-	-	-	-	-	-	-	-	-	-
PCBs																			
Aroclor 1016	mg/kg	0.39	NE	1.16	-	-	-	-	-	-	-			-	-	-	-		
Aroclor 1221	mg/kg	0.14	NE	0.199	-	-	-	-	-	-	-			-	-	-	-		
Aroclor 1232	mg/kg	0.14	NE	0.0328	-	-	-	-	-	-	-			-	-	-	-		
Aroclor 1242	mg/kg	0.22	NE	0.0432	-	-	-	-	-	-	-			-	-	-	-		
Aroclor 1254	mg/kg	0.11	NE	0.16	-	-	-	0.16		-	-			-	-	-	-		
Aroclor 1260	mg/kg	0.22	NE	0.268		0.123		-	-	0.0126	J			-	-	-	-		
SEMIVOLATILES																			
Acenaphthene	mg/kg	340	NE	0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	mg/kg	NE	NE	0.829	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg	1,700	NE	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	2.43	J	0.0468	J	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.015	NE	1.96	-	0.0403	J	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	2.8	-	0.0728	J	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	NE	NE	0.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	1.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzoic acid	mg/kg	24,000	NE	0.639	-	-	-			-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	mg/kg	35	NE	0.0869	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbazole	mg/kg	NE	NE	0.603	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	15	NE	2.25	J	0.0496	J	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.247	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	mg/kg	7.8	NE	0.376	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-butyl phthalate	mg/kg	610	NE	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	4.42	-	-	-	-	-	0.219	J	-	-	-	-	1.11		-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	2.18	-	-	-	-	-	0.0429	J	-	-	-	-	0.429		-	-
DIPHENYLAMINE	mg/kg	150	NE	0.0432	-	-	-			-	-	-	-	-	-	-	-	-	-
Fluoranthene	mg/kg	230	NE	6.57	J	0.0955	J	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	mg/kg	230	NE	0.755	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	1.12	J	0.272	J	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	mg/kg	31	NE	0.259	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	3.6	NE	0.0765	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3-1

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1														
				LOCATION CODE	SB06	WWTP1-SB06		WWTP1-SB06		WWTP1-SB06		WWTP1-SB06		WWTP1-SB07		WWTP1-SB07		WWTP1-SB07	
				SAMPLE NO	17	WW0018		WW0067		WW0019		WW0020		WW0021		WW0022		WW0023	
				SAMPLE DATE	-08	3-Dec-08		3-Dec-08		3-Dec-08		3-Dec-08		3-Dec-08		3-Dec-08		3-Dec-08	
				DEPTH	1 Ft	1_1 - 2_1 Ft		1_1 - 2_1 Ft		5 - 6_1 Ft		8 - 10 Ft		1 - 2 Ft		5 - 6 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	S	FD		FS		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Nitroaniline, 3-	mg/kg	NE	NE	0.706	-	-	-	-	-	-	-	-	-	-	-	0.0534	J	-	-
Phenanthrene	mg/kg	NE	NE	5.62	-	0.037	J	-	-	-	-	-	-	-	-	-	-	0.0527	J
Pyrene	mg/kg	170	NE	4.35	J	0.0752	J	-	-	-	-	-	-	-	-	-	-	-	-
METALS																			
Aluminum	mg/kg	7,700	15,500	15000		5,930		5,450		2,370		12,400		4,850		2,380		9,450	
Antimony	mg/kg	3.1	9.3	1.9	J	1.89	J	-	-	0.488	J	-	-	-	-	-	-	-	-
Arsenic	mg/kg	0.39	36.5	20.3		2.41		3.8		1.41		5.6		0.998		1.82		10.8	
Barium	mg/kg	1,500	826	116		13.4		-	-	7.69		77.3		15		9.98		45.4	
Beryllium	mg/kg	16	1	10.3	J	**5.39**	J	-	-	**3.37**	J	**7.55**	J	**6.3**	J	**2.29**	J	**7.24**	J
Cadmium	mg/kg	7	NE	0.638	J	0.638	J	-	-	-	-	0.272	J	-	-	-	-	-	-
Calcium	mg/kg	NE	52,300	55000		2,400		5,100	J	32,300		46,100	J	1,910	J	48,400	J	43,200	J
Chromium	mg/kg	0.29	29	22	J	13.4	J	12.8		7.64	J	18.6		12.2		5.09		16.4	
Cobalt	mg/kg	2.3	116	18.2		3.09		-	-	2.21		11.1	J	5.26	J	2.91	J	10.5	J
Copper	mg/kg	310	56.2	46.4		10.2		11.4		5.63		26.1		5.3		6.2		28.9	
Iron	mg/kg	5,500	234,000	65600	J	15,200	J	13,700		9,910	J	23,300	J	18,200	J	7,080	J	23,700	J
Lead	mg/kg	40	48.6	64.1	J	**64.1**	J	34.6		17.7	J	11.8		2.02		4.88		12.7	
Magnesium	mg/kg	NE	10,400	18900	J	972	J	1,170		8,360	J	**13,200**		792		**15,000**		**11,000**	
Manganese	mg/kg	180	3,506	1040		101		102		182		456	J	519	J	194	J	491	J
Mercury	mg/kg	2.3	0.09	0.443		0.0728		-	-	-	-	0.0121	J	0.0201	J	-	-	-	-
Nickel	mg/kg	150	55.1	39.7	-	-	-	10.6		-	-	17.7		-	-	1.85		14.8	
Potassium	mg/kg	NE	3,390	2280		182		-	-	206		1,820		165		359		1,330	
Selenium	mg/kg	39	2	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silver	mg/kg	39	11.1	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium	mg/kg	NE	NE	783		54.9		-	-	90.1		783		50.7		202		313	
Thallium	mg/kg	NE	1.3	1.4	-	-	-	-	-	-	-	0.429	J	-	-	-	-	0.414	
Vanadium	mg/kg	39	40.9	56.7		28.2		21.6		21.1		23.8		36.4		12.3		18.1	
Zinc	mg/kg	2,300	321.75	261		32.9		37.9		19.1		64.4		25		17.6		85.7	
GENERAL CHEMISTRY																			
Total organic carbon	mg/kg	NE	NE	3260															

Table 3-1

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1																	
				LOCATION CODE	WWTP1-SB08		WWTP1-SB08		WWTP1-SB08		WWTP1-SB08		WWTP1-SB08		PBOW99-SSW108		PBOW99-SSW108		PBOW99-SSW108		PBOW99-SSW108	
				SAMPLE NO	WW0024		WW0025		WW0026		WW0027		WW0064		SSW-108-NE		SSW-108-NW		SSW-108-R		SSW-108-S	
				SAMPLE DATE	4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		18-Nov-10		18-Nov-10		18-Nov-10		18-Nov-10	
				DEPTH	1_8 - 2_8 Ft		5 - 6_8 Ft		8 - 10 Ft		8 - 10 Ft		8 - 10 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft	
				SAMPLE PURPOSE	REG		REG		REG		FD		FS		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
EXPLOSIVES																						
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	8.06	-	-	-	-	0.207	J	-	-	-	-	-	-	8.06		0.154	J	2.17	J
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	7.74	0.185	J	-	-	0.635		0.612		0.4		1.84		6.02		0.0932	J	1.46	
Dinitrobenzene, 1,3-	mg/kg	0.61	NE	0.922	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	9.47	-	-	0.192	J	1.21		1.09		0.85		-	-	-	-	0.176	J	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	2.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RDX	mg/kg	5.5	NE	0.239	-	-	-	-	-	-	-	-	-	-	-	-	0.239	-	-	-	-	-
Tetryl	mg/kg	24	NE	2.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	2.6	-	-	-	-	-	-	-	-	-	-	-	-	0.461	J	0.159	J	0.116	J
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	181	-	-	0.413		0.303		0.364		0.31		2.74	J	49.9		0.352		6.24	
PCBs																						
Aroclor 1016	mg/kg	0.39	NE	1.16	0.0294	J	0.131	J	-	-	-	-	-	-								
Aroclor 1221	mg/kg	0.14	NE	0.199	-	-	-	-	-	-	-	-	-	-								
Aroclor 1232	mg/kg	0.14	NE	0.0328	-	-	-	-	-	-	-	-	-	-								
Aroclor 1242	mg/kg	0.22	NE	0.0432	-	-	-	-	-	-	-	-	-	-								
Aroclor 1254	mg/kg	0.11	NE	0.16	-	-	-	-	-	-	-	-	-	-								
Aroclor 1260	mg/kg	0.22	NE	0.268	-	-	-	-	-	-	-	-	-	-								
SEMIVOLATILES																						
Acenaphthene	mg/kg	340	NE	0.12	-	-	-	-	-	-	-	-	-	-								
Acenaphthylene	mg/kg	NE	NE	0.829	-	-	0.0467	J	-	-	-	-	-	-								
Anthracene	mg/kg	1,700	NE	1.2	-	-	-	-	-	-	-	-	-	-								
Benzo(a)anthracene	mg/kg	0.15	NE	2.43	-	-	0.169	J	-	-	-	-	-	-								
Benzo(a)pyrene	mg/kg	0.015	NE	1.96	-	-	0.19	J	-	-	-	-	-	-								
Benzo(b)fluoranthene	mg/kg	0.15	NE	2.8	-	-	0.279	J	-	-	-	-	-	-								
Benzo(ghi)perylene	mg/kg	NE	NE	0.94	-	-	0.105	J	-	-	-	-	-	-								
Benzo(k)fluoranthene	mg/kg	1.5	NE	1.07	-	-	-	-	-	-	-	-	-	-								
Benzoic acid	mg/kg	24,000	NE	0.639	-	-	-	-	-	-	-	-										
Bis(2-ethylhexyl)phthalate	mg/kg	35	NE	0.0869	-	-	-	-	-	-	-	-	-	-								
Carbazole	mg/kg	NE	NE	0.603	-	-	-	-	-	-	-	-	-	-								
Chrysene	mg/kg	15	NE	2.25	-	-	0.15	J	-	-	-	-	-	-								
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.247	-	-	-	-	-	-	-	-	-	-								
Dibenzofuran	mg/kg	7.8	NE	0.376	-	-	-	-	-	-	-	-	-	-								
Di-n-butyl phthalate	mg/kg	610	NE	0.15	-	-	-	-	-	-	-	-	-	-								
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	4.42	-	-	0.0766	J	0.526		0.87		0.37									
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	2.18	-	-	-	-	0.0735	J	0.106	J	-	-								
DIPHENYLAMINE	mg/kg	150	NE	0.0432	-	-	-	-	-	-	0.0432	J										
Fluoranthene	mg/kg	230	NE	6.57	-	-	0.221	J	-	-	-	-	-	-								
Fluorene	mg/kg	230	NE	0.755	-	-	-	-	-	-	-	-	-	-								
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	1.12	-	-	0.343	J	-	-	-	-	-	-								
Methylnaphthalene, 2-	mg/kg	31	NE	0.259	-	-	-	-	-	-	-	-	-	-								
Naphthalene	mg/kg	3.6	NE	0.0765	-	-	-	-	-	-	-	-	-	-								

Table 3-1

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1																	
				LOCATION CODE	WWTP1-SB08		WWTP1-SB08		WWTP1-SB08		WWTP1-SB08		WWTP1-SB08		PBOW99-SSW108		PBOW99-SSW108		PBOW99-SSW108		PBOW99-SSW108	
				SAMPLE NO	WW0024		WW0025		WW0026		WW0027		WW0064		SSW-108-NE		SSW-108-NW		SSW-108-R		SSW-108-S	
				SAMPLE DATE	4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		18-Nov-10		18-Nov-10		18-Nov-10		18-Nov-10	
				DEPTH	1_8 - 2_8 Ft		5 - 6_8 Ft		8 - 10 Ft		8 - 10 Ft		8 - 10 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft	
				SAMPLE PURPOSE	REG		REG		REG		FD		FS		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Nitroaniline, 3-	mg/kg	NE	NE	0.706	-	-	-	-	-	-	-	-	-	-								
Phenanthrene	mg/kg	NE	NE	5.62	-	-	0.0577	J	0.0535	J	0.035	J	-	-								
Pyrene	mg/kg	170	NE	4.35	-	-	0.214	J	-	-	-	-	-	-								
METALS																						
Aluminum	mg/kg	7,700	15,500	15000	6,230		4,220		6,330		7,220		7,580									
Antimony	mg/kg	3.1	9.3	1.9	-	-	-	-	-	-	-	-	-	-								
Arsenic	mg/kg	0.39	36.5	20.3	2.02		1.61		7.82		9.55		11.5									
Barium	mg/kg	1,500	826	116	19.7		9.68		28.4		37.2		43.4									
Beryllium	mg/kg	16	1	10.3	**4.73**	J	**4.86**	J	**5.45**	J	**6.36**	J	-	-								
Cadmium	mg/kg	7	NE	0.638	-	-	-	-	-	-	-	-	-	-								
Calcium	mg/kg	NE	52,300	55000	1,830		9,000		40,700	J	48,800	J	46,700	J								
Chromium	mg/kg	0.29	29	22	11.7	J	12.9	J	9.71		10.6		12.8									
Cobalt	mg/kg	2.3	116	18.2	3.15		2.76		7.1	J	8.88	J	10.9									
Copper	mg/kg	310	56.2	46.4	3.26		4.33		20.4		23.1		25.4									
Iron	mg/kg	5,500	234,000	65600	12,500	J	13,600	J	17,100	J	19,700	J	23,700									
Lead	mg/kg	40	48.6	64.1	7.11	J	8.13	J	10.2		11.3		11.4									
Magnesium	mg/kg	NE	10,400	18900	858	J	2,740	J	**12,000**		**11,300**		**11,100**									
Manganese	mg/kg	180	3,506	1040	150		84.2		439	J	395	J	392									
Mercury	mg/kg	2.3	0.09	0.443	0.0146	J	-	-	-	-	-	-	-	-								
Nickel	mg/kg	150	55.1	39.7	-	-	-	-	8.92		12.2		30.8									
Potassium	mg/kg	NE	3,390	2280	143		222		897		1,050		1,850									
Selenium	mg/kg	39	2	2.3	-	-	-	-	-	-	-	-	0.65									
Silver	mg/kg	39	11.1	0.11	-	-	-	-	-	-	-	-	-	-								
Sodium	mg/kg	NE	NE	783	33.3		62		120		128		-	-								
Thallium	mg/kg	NE	1.3	1.4	-	-	-	-	0.356	J	0.413	J	-	-								
Vanadium	mg/kg	39	40.9	56.7	26.7		25.6		16.5		15.9		14.5									
Zinc	mg/kg	2,300	321.75	261	38.8		38.8		49.9		58		92.6									
GENERAL CHEMISTRY																						
Total organic carbon	mg/kg	NE	NE	3260																		

Table 3-1

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

FD- Field duplicate.
FS - Field split.
NE - Not established (RBSCs), not evaluated (BSCs).
Shaded cell indicates value is greater than RBSC.
Bold text indicates value is greater than the BSC.
RBSC - Risk-based concentration. Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
MDC - Maximum detected concentration for the AOC ("B"-qualified data not included).
BSC - Background screening concentration.
"-" - Not Detected.
An empty (clear) cell indicates that parameter was not analyzed.
mg/kg - Milligrams per kilogram.
WWTP1 - Waste Water Treatment Plant 1.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
B - Analyte was not detected significantly above the levels found in the associated method blank or field blanks.

Table 3-2

Detections Above RBSCs and/or BSCs in Piezometer Groundwater - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1					
				LOCATION CODE	WWTP1-PZ01*		WWTP1-PZ02*		WWTP1-PZ03*	
				SAMPLE NO	WW3000		WW3001		WW3002	
				SAMPLE DATE	10-Dec-08		10-Dec-08		9-Dec-08	
				DEPTH	0 - 0 Ft		13 - 13 Ft		15 - 15 Ft	
				SAMPLE PURPOSE	REG		REG		REG	
				LOW-FLOW SAMPLED	No		No		No	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ
EXPLOSIVES										
Amino-2,6-dinitrotoluene, 4-	µg/L	7.3	NE	1.66	-	-	-	-	1.66	
Amino-4,6-dinitrotoluene, 2-	µg/L	7.3	NE	0	-	-	-	-	-	-
Dinitrotoluene, 2,4-	µg/L	0.099	NE	8.09	-	-	-	-	8.09	
Dinitrotoluene, 2,6-	µg/L	0.099	NE	4.14	-	-	-	-	4.14	
Tetryl	µg/L	15	NE	0	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	µg/L	110	NE	0	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	µg/L	1.8	NE	0.504	-	-	0.504	J	-	-
SEMIVOLATILES										
Dinitrotoluene, 2,4-	µg/L	0.099	NE	9.92	-	-	-	-	9.92	J
Dinitrotoluene, 2,6-	µg/L	0.099	NE	3.99	-	-	-	-	3.99	J
METALS (UNFILTERED)										
Aluminum	µg/L	3,700	309	17100	**17,100**		**3,300**		**3,010**	
Arsenic	µg/L	0.045	7.4	12.7	**12.7**		-	-	-	-
Barium	µg/L	730	11,800	202	202		98.1		60.6	
Beryllium	µg/L	7.3	NE	2.96	2.96	J	-	-	-	-
Calcium	µg/L	NE	316,000	545000	**545,000**		103,000		53,500	
Chromium	µg/L	0.043	NE	18	18		-	-	-	-
Cobalt	µg/L	1.1	12.1	18.5	**18.5**		-	-	-	-
Copper	µg/L	150	19.8	31.9	**31.9**		6.4	J	5.6	J
Iron	µg/L	2,600	1,550	21500	**21,500**		**3,640**		**3,710**	
Lead	µg/L	NE	NE	12.4	12.4		-	-	-	-
Magnesium	µg/L	NE	217,000	144000	144,000		23,900		16,900	
Manganese	µg/L	88	636	2620	**2,620**		85.3		242	
Nickel	µg/L	73	8.6	18.9	**18.9**		-	-	-	-
Potassium	µg/L	NE	116,000	9300	9,300		2,460		4,070	
Sodium	µg/L	NE	1,390,000	185000	185,000		26,300		103,000	
Vanadium	µg/L	18	NE	44.1	44.1		9.19		7.88	
METALS (FILTERED)										
Arsenic	µg/L	0.045	7.4	6.22	6.22	J	-	-	-	-
Barium	µg/L	730	11,800	80.6	80.6		44.4			
Calcium	µg/L	NE	316,000	126000	126,000		99,000			
Cobalt	µg/L	1.1	12.1	5.68	5.68		-	-		
Iron	µg/L	2,600	1,550	92.1	92.1		-	-		
Lead	µg/L	NE	NE	9.17	-	-	-	-	9.17	
Magnesium	µg/L	NE	217,000	40600	40,600		22,000			
Manganese	µg/L	88	636	1120	**1,120**		21.2			
Nickel	µg/L	73	8.6	8.83	**8.83**		-	-		
Potassium	µg/L	NE	116,000	3340	3,340		876			
Sodium	µg/L	NE	1,390,000	175000	175,000		24,700			
Thallium	µg/L	NE	NE	4.19	-	-	-	-	4.19	J

Table 3-2

Detections Above RBSCs and/or BSCs in Piezometer Groundwater - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1					
				LOCATION CODE	WWTP1-PZ01*		WWTP1-PZ02*		WWTP1-PZ03*	
				SAMPLE NO	WW3000		WW3001		WW3002	
				SAMPLE DATE	10-Dec-08		10-Dec-08		9-Dec-08	
				DEPTH	0 - 0 Ft		13 - 13 Ft		15 - 15 Ft	
				SAMPLE PURPOSE	REG		REG		REG	
				LOW-FLOW SAMPLED	No		No		No	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ
WATER QUALITY PARAMETERS										
Alkalinity	µg/L	NE	NE	232000	232,000		119,000		201,000	J
Chloride	µg/L	NE	NE	9760	4,900		1,090		9,760	
Hardness	µg/L	NE	NE	1950000	1,950,000		355,000		203,000	
Hardness	µg/L	NE	NE	481000	481,000		338,000			
Nitrate-Nitrite	µg/L	NE	NE	292	33	J	292		21	J
Sulfate	µg/L	NE	NE	279000	279,000		76,700		105,000	
Total dissolved solids	µg/L	NE	NE	1660000	1,660,000		416,000		509,000	
Total suspended solids	µg/L	NE	NE	1160000	1,160,000		237,000		333,000	
Turbidity	NTU	NE	NE	387	387		118		141	J

NE - Not established (RBSCs), not evaluated (BSCs).
Shaded cell indicates value is greater than RBSC.
Bold text indicates value is greater than the BSC.
RBSC - Risk-based screening concentration. Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
BSC - Background screening concentration.
"-" - Not detected.
µg/L - Micrograms per liter.
NTU - Nephelometric turbidity units.
WWTP1 - Waste Water Treatment Plant 1.

Validation Qualifiers (VQ)
J - The analyte was positively identifed; the reported value is estimated.
*Due to turbidity results greater than 100 nephelometric turbidity units, analytical data associated with sample may be questionable and should not be used in any risk determinations.

Table 3-3

Detections Above RBSCs and/or BSCs in Overburden/Shale Monitoring Wells - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1											
				LOCATION CODE	WTP1-MW01				WTP1-MW02				WTP1-MW03			
				SAMPLE NO	WW3015		WW3027A		WW3016		WW3028A		WW3017		WW3029	
				SAMPLE DATE	7-May-09		28-Oct-09		8-May-09		29-Oct-09		9-May-09		29-Oct-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG	
				LOW-FLOW SAMPLED	Yes		Yes		No		No		No		No	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
EXPLOSIVES																
Amino-2,6-dinitrotoluene, 4-	µg/L	7.3	NE	1.3	1.3		0.14		-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	µg/L	7.3	NE	2.2	2.2		-	-	-	-	-	-	-	-	-	-
Dinitrobenzene, 1,3-	µg/L	0.37	NE	0.12	0.12	J	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	µg/L	0.099	NE	1.7	1.7		-	-	0.38		0.2		-	-	-	-
Dinitrotoluene, 2,6-	µg/L	0.099	NE	1.7	1.7		-	-	0.4		0.2		-	-	-	-
Trinitrotoluene, 2,4,6-	µg/L	1.8	NE	1.7	1.7		-	-	-	-	-	-	-	-	-	-
VOLATILES																
Acetone	µg/L	2,200	NE	49.2	-	-	-	-	-	-	49.2		-	-	-	-
Butanone, 2-	µg/L	710	NE	17.5	-	-	-	-	-	-	17.5		-	-	-	-
Carbon disulfide	µg/L	100	NE	1.2	-	-	-	-	-	-	1.2		-	-	-	-
SEMIVOLATILES																
Bis(2-ethylhexyl)phthalate	µg/L	4.8	NE	6.5	-	-	6.5		-	-	-	-	-	-	-	-
METALS (UNFILTERED)																
Aluminum	µg/L	3,700	309	1010	-	-	92.7		**560**		**1,010**		132	J	**539**	
Arsenic	µg/L	0.045	7.4	7.7	-	-	**7.7**		-	-	7.2		-	-	-	-
Barium	µg/L	730	11,800	161	84.8	J	161		66	J	105		86.2	J	132	
Calcium	µg/L	NE	316,000	87600	87,600		73,500		28,900		33,700		30,300		34,900	
Cobalt	µg/L	1.1	12.1	1.1	-	-	-	-	-	-	1.1		-	-	-	-
Copper	µg/L	150	19.8	8.4	-	-	-	-	-	-	8.4		-	-	5.9	
Iron	µg/L	2,600	1,550	1690	-	-	473		892		**1,690**		123	J	551	
Lead	µg/L	NE	NE	3.3	3	B	-	-	3.3	B	2.8		2.2	B	-	-
Magnesium	µg/L	NE	217,000	22600	20,900		22,600		8,560		10,500		9,800		11,000	
Manganese	µg/L	88	636	564	564		384		98.9		109		39.5		105	
Mercury	µg/L	1.1	NE	0.15	0.15	J	-	-	-	-	-	-	-	-	-	-
Nickel	µg/L	73	8.6	4.5	2.9	J	-	-	3	J	4.5		-	-	3.4	
Potassium	µg/L	NE	116,000	18500	4,360	J	6,490		6,380	J	8,790		18,500		13,800	
Selenium	µg/L	18	NE	7.4	-	-	-	-	-	-	7.4		-	-	6.9	
Sodium	µg/L	NE	1,390,000	118000	16,800		34,100		118,000		107,000		91,400		101,000	
Vanadium	µg/L	18	NE	4.2	-	-	-	-	2.5	J	4.2		2	J	2.3	
Zinc	µg/L	1,100	507	13.7	11.1	B	-	-	13.7	B	11.1		11.3	B	-	-
METALS (FILTERED)																
Aluminum	µg/L	3,700	309	15.2	-	-	-	-	-	-	-	-	15.2	J	-	-
Arsenic	µg/L	0.045	7.4	6.8	-	-	6.8		-	-	-	-	-	-	-	-
Barium	µg/L	730	11,800	156	80.6	J	156		59	J	103		85.8	J	126	
Calcium	µg/L	NE	316,000	88500	88,500		76,100		26,900		26,900		29,700		31,400	
Iron	µg/L	2,600	1,550	80.9	-	-	80.9		-	-	-	-	-	-	-	-
Lead	µg/L	NE	NE	2.5	-	-	-	-	-	-	-	-	2.5	J	-	-
Magnesium	µg/L	NE	217,000	23200	20,800		23,200		8,070		8,920		9,780		9,940	
Manganese	µg/L	88	636	550	550		390		77.2		59.3		20.7		85.7	
Nickel	µg/L	73	8.6	3.3	3.3	J	2.3		3	J	2.3		-	-	3.1	
Potassium	µg/L	NE	116,000	19700	4,020	J	7,200		6,020	J	9,750		19,700		14,100	
Selenium	µg/L	18	NE	3.4	3.4	J	-	-	-	-	-	-	-	-	-	-
Sodium	µg/L	NE	1,390,000	114000	14,400		33,700		114,000		104,000		99,300		99,000	
Vanadium	µg/L	18	NE	2	-	-	-	-	1	J	2		1.3	J	-	-
Zinc	µg/L	1,100	507	11.3	10.9	J	-	-	11.3	J	9.5		9.7	J	10.1	

Table 3-3

Detections Above RBSCs and/or BSCs in Overburden/Shale Monitoring Wells - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1											
				LOCATION CODE	WTP1-MW01				WTP1-MW02				WTP1-MW03			
				SAMPLE NO	WW3015		WW3027A		WW3016		WW3028A		WW3017		WW3029	
				SAMPLE DATE	7-May-09		28-Oct-09		8-May-09		29-Oct-09		9-May-09		29-Oct-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG	
				LOW-FLOW SAMPLED	Yes		Yes		No		No		No		No	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
WATER QUALITY PARAMETERS																
Alkalinity	µg/L	NE	NE	291000	286,000		265,000		269,000		242,000		261,000		291,000	
Chloride	µg/L	NE	NE	25800	5,500		7,000		9,500		9,800		4,600		25,800	
Cyanide, total	µg/L	73	NE	26	11	J	-	-	18	J	-	-	26	J	-	-
HARDNESS (as CaCO3)	µg/L	NE	NE	305000	305,000		276,000		107,000		128,000		116,000		133,000	
Nitrate-Nitrite	µg/L	NE	NE	140	-	-	-	-	48	J	-	-	-	-	140	
Sulfate	µg/L	NE	NE	93300	62,800		70,400		93,300		83,100		35,800		39,900	
Total dissolved solids	µg/L	NE	NE	544000	380,000		419,000		466,000		544,000		533,000		352,000	
Total suspended solids	µg/L	NE	NE	230000	-	-	6,000		16,000		230,000		15,000		102,000	
Turbidity	NTU	NE	NE	180	-	-	4.5		24.9		180		6	J	90	

Bold text indicates value is greater than the BSC.
RBSC - Risk-based screening concentration. Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1.
For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
MDC - Maximum detected concentration for the AOC ("B"-qualified data not included).
BSC - Background screening concentration.
"-" - Not detected.
µg/L - Micrograms per liter.
NTU - Nephelometric turbidity unit.
WWTP1 - Waste Water Treatment Plant 1.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
B - The analyte was not detected significantly above the levels found in the associated method blank or field blanks.

Table 3-4

Detections Above RBSCs and/or BSCs in Bedrock Monitoring Wells - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP1					
				LOCATION	WTP1-BEDGW-003		WTP1-BEDGW-002		WTP1-BEDGW-003	
				SAMPLE NO	WW3020		WW3030		WW3031	
				SAMPLE DATE	11-May-09		29-Oct-09		3-Nov-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG	
				LOW-FLOW SAMPLED	Yes		No		No	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ
VOLATILES										
Acetone	µg/L	2,200	NE	98.9	50.2	J	-	-	98.9	J
Benzene	µg/L	0.41	2.4	403	**5.6**		**403**		**19.7**	
Butanone, 2-	µg/L	710	NE	172	11.9		172		-	-
Carbon disulfide	µg/L	100	NE	2.8	2.8	J	-	-	-	-
Chloroform	µg/L	0.19	NE	19.7	-	-	-	-	19.7	
Chloromethane	µg/L	19	NE	31.3	-	-	-	-	31.3	
Ethylbenzene	µg/L	1.5	0.87	172	**16.4**		**172**		**37.7**	
Methylene chloride	µg/L	4.8	NE	12.9	-	-	12.9		-	-
Tetrachloroethane, 1,1,2,2-	µg/L	0.067	NE	2.5	-	-	-	-	2.5	J
Toluene	µg/L	230	1.7	530	**31.8**		**530**		**74.3**	
Xylenes, total	µg/L	20	5.5	1040			**1,040**		**625**	
SEMIVOLATILES										
3-Methylphenol and 4-Methylphenol	µg/L	NE	NE	4.6	1.8	J	4.6		-	-
Chloro-3-methylphenol, 4-	µg/L	370	NE	1.5	1.5	J	-	-	-	-
Dimethylphenol, 2,4-	µg/L	73	NE	16.1	6.9		16.1		11.5	J
Methylnaphthalene, 2-	µg/L	15	NE	13.9	12.3		12.8		13.9	J
Naphthalene	µg/L	0.14	NE	19.5	13.7		19.5		18.5	J
METALS (UNFILTERED)										
Aluminum	µg/L	3,700	309	243	39.6	J	243		27.3	J
Arsenic	µg/L	0.045	7.4	129	**129**		**23.1**		-	-
Barium	µg/L	730	11,800	11200	4,250		392		11,200	
Calcium	µg/L	NE	316,000	296000	283,000		171,000		296,000	J
Chromium	µg/L	0.043	NE	3.3	-	-	3.3		-	-
Copper	µg/L	150	19.8	5.8	-	-	5.8		-	-
Iron	µg/L	2,600	1,550	2600	-	-	**2,600**		-	-
Magnesium	µg/L	NE	217,000	213000	156,000		128,000		213,000	
Manganese	µg/L	88	636	860	**860**		61		45.6	
Nickel	µg/L	73	8.6	4.6	4.6	J	3.8		-	-
Potassium	µg/L	NE	116,000	104000	68,100		95,900		104,000	J
Selenium	µg/L	18	NE	5.5	3.4	J	-	-	5.5	J
Sodium	µg/L	NE	1,390,000	1050000	710,000		1,040,000		1,050,000	
Vanadium	µg/L	18	NE	2.5	1.6	J	2.5		2.5	J
Zinc	µg/L	1,100	507	14.1	14.1	B	14		-	-

Table 3-4

Detections Above RBSCs and/or BSCs in Bedrock Monitoring Wells - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP1					
				LOCATION	WTP1-BEDGW-003		WTP1-BEDGW-002		WTP1-BEDGW-003	
				SAMPLE NO	WW3020		WW3030		WW3031	
				SAMPLE DATE	11-May-09		29-Oct-09		3-Nov-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG	
				LOW-FLOW SAMPLED	Yes		No		No	
METALS (FILTERED)										
Aluminum	µg/L	3,700	309	29.4	27.1	J	29.4		20.8	J
Antimony	µg/L	1.5	NE	6.9	6.9		-	-	-	-
Arsenic	µg/L	0.045	7.4	141	**141**		**13.6**		-	-
Barium	µg/L	730	11,800	10300	4,250		342		10,300	
Calcium	µg/L	NE	316,000	282000	280,000		151,000		282,000	
Lead	µg/L	NE	NE	2.4	2.4	J	-	-	-	-
Magnesium	µg/L	NE	217,000	205000	157,000		120,000		205,000	
Manganese	µg/L	88	636	844	**844**		35.2		40.7	
Nickel	µg/L	73	8.6	2.5	2.5	J	-	-	-	-
Potassium	µg/L	NE	116,000	98300	67,000		98,300		95,800	
Selenium	µg/L	18	NE	5.2	4.8	J	-	-	5.2	J
Sodium	µg/L	NE	1,390,000	1050000	701,000		1,050,000		1,020,000	
Vanadium	µg/L	18	NE	2.1	2.1	J	1.1		2	J
Zinc	µg/L	1,100	507	9.7	9.7	J	-	-	8.8	J
WATER QUALITY PARAMETERS										
Alkalinity	µg/L	NE	NE	702000	536,000		702,000		555,000	
Chloride	µg/L	NE	NE	1960000	1,070,000		1,960,000		1,870,000	
Cyanide, total	µg/L	73	NE	42	42	J	-	-	-	-
HARDNESS (as CaCO3)	µg/L	NE	NE	1620000	1,350,000		954,000		1,620,000	
Nitrate-Nitrite	µg/L	NE	NE	2200	2,200		190		930	
Sulfate	µg/L	NE	NE	28600	28,600		-	-	14,300	
Total dissolved solids	µg/L	NE	NE	4600000	2,630,000		3,150,000		4,600,000	
Total suspended solids	µg/L	NE	NE	112000	13,000		112,000		9,000	J
Turbidity	NTU	NE	NE	220	70.4	J	220		36.9	

NE - Not established (RBSCs), not evaluated (BSCs).
Shaded cell indicates value is greater than RBSC.
Bold text indicates value is greater than the BSC.
RBSC - Risk-based screening concentration. Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1.
For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
MDC - Maximum detected concentration for the area of concern ("B-qualified data not included).
BSC - Background screening concentration.
"-" - Not Detected.
µg/L - Micrograms per liter.
mg/L - Milligrams per liter.
NTU - Nephelometric turbidity unit.
WWTP1 - Waste Water Treatment Plant 1.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
B - The analyte was not detected significantly above the levels found in the associated method blank or field blanks.

Table 3-5

Detections Above RBSCs and/or BSCs in Surface Water Samples - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

			LOCATION CODE	WWTP1-SW01	
			SAMPLE NO	WW2000	
			SAMPLE DATE	21-May-09	
			DEPTH	0 - 0 Ft	
			SAMPLE PURPOSE	REG	
Parameter	Units	RBSC	MDC	Result	VQ
SEMIVOLATILES					
3-Methylphenol and 4-Methylphenol	µg/L	NE	4.7	4.7	J
Phenol	µg/L	11,000	2.8	2.8	J
METALS					
Aluminum	µg/L	37,000	66.5	66.5	J
Barium	µg/L	7,300	37.9	37.9	J
Calcium	µg/L	NE	102000	102,000	
Iron	µg/L	26,000	5330	5,330	
Magnesium	µg/L	NE	18100	18,100	
Manganese	µg/L	880	534	534	
Potassium	µg/L	NE	3490	3,490	J
Selenium	µg/L	180	3.8	3.8	J
Sodium	µg/L	NE	38900	38,900	
Zinc	µg/L	11,000	9.8	9.8	B

RBSC - Risk-based screening concentration. Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1.
For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
µg/L - Micrograms per liter.
WWTP1 - Waste Water Treatment Plant 1.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
B - Analyte was not detected significantly above the levels found in the associated method blank or field blanks.

*No detections greater than the RBSC are present in surface water samples.

Table 3-6

Detections Above RBSCs in Sediment Samples - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

			LOCATION	WWTP1							
			LOCATION CODE	WWTP1-SD01		WWTP1-SD02		WWTP1-SD03		WWTP1-SD04	
			SAMPLE NO	WW1000		WW1001		WW1002		WW1003	
			SAMPLE DATE	21-May-09		21-May-09		20-May-09		20-May-09	
			DEPTH	0 - _5 Ft		0 - _5 Ft		0 - _5 Ft		0 - _5 Ft	
			SAMPLE PURPOSE	REG		REG		REG		REG	
Parameter	Units	RBSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ
PCBs											
Aroclor 1254	mg/kg	0.22	0	-	-	-	-	-	-	-	-
GENERAL CHEMISTRY											
Total organic carbon	mg/kg	NE	6.9	6.9							

NE - Not established (RBSC).
RBSC - Risk-based screening concentration. Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
"-" - Not detected.
mg/kg - Milligrams per kilogram.
WWTP1 - Waste Water Treatment Plant 1.

No detections greater than the RBSC are present in sediment samples.

Table 3-7

COPC Summary for Surface Soil - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Inorganics														
Aluminum	12 / 12	100	2.84E+03		8.02E+03		1.61E+00	2.68E+01	5.24E+03	1.55E+04	7.70E+03	N (b)		---
Antimony	4 / 12	33	2.99E-01	J	3.90E+00		4.02E-01	1.30E+00	7.35E-01	9.30E+00	3.10E+00	N (b)		---
Arsenic	17 / 17	100	9.98E-01		4.50E+00		8.04E-01	1.30E+00	3.03E+00	3.65E+01	3.90E-01	N (b)		---
Barium	16 / 17	94	1.39E+01		3.58E+01		1.61E-01	2.65E+01	2.18E+01	8.26E+02	1.50E+03	N (b)		---
Beryllium	8 / 12	67	4.21E+00	J	8.44E+00	J	1.61E-01	6.70E-01	3.91E+00	1.00E+00	1.60E+01	N (a)		---
Cadmium	1 / 17	6	5.08E-01	J/J	5.08E-01	J/J	2.20E-01	4.90E-01	1.86E-01	NA	7.00E+00	N (a)		---
Calcium	12 / 12	100	1.79E+03		2.01E+04		4.02E+00	6.70E+02	6.44E+03	5.23E+04	Nutrient	N (c)		---
Chromium	17 / 17	100	6.80E+00		1.76E+01	J	4.02E-01	6.60E-01	1.19E+01	2.90E+01	2.90E-01	N (b)		---
Cobalt	8 / 12	67	3.13E+00		5.26E+00	J	1.61E-01	6.70E+00	3.70E+00	1.16E+02	2.30E+00	N (b)		---
Copper	12 / 12	100	3.26E+00		1.24E+01		4.02E-01	3.30E+00	6.18E+00	5.62E+01	3.10E+02	N (b)		---
Iron	12 / 12	100	8.11E+03		2.86E+04	J	1.61E+00	1.34E+01	1.49E+04	2.34E+05	5.50E+03	N (b)		---
Lead	17 / 17	100	1.83E+00	J	1.15E+02		3.30E-01	4.90E-01	3.46E+01	4.86E+01	4.00E+02	N (a)		---
Magnesium	12 / 12	100	6.92E+02	J	4.16E+03		1.61E+00	6.70E+02	1.59E+03	1.04E+04	Nutrient	N (c)		---
Manganese	12 / 12	100	1.05E+02		5.19E+02	J	1.61E-01	2.00E+00	2.28E+02	3.51E+03	1.80E+02	N (b)		---
Mercury	10 / 17	59	1.46E-02	J	1.30E+00		2.02E-02	1.30E-01	1.38E-01	8.50E-02	2.30E+00	N (a)		---
Nickel	4 / 12	33	6.10E+00		9.00E+00		2.41E-01	5.40E+00	2.50E+00	5.51E+01	1.50E+02	N (b)		---
Potassium	8 / 12	67	1.43E+02		2.74E+02		2.01E+01	6.70E+02	2.31E+02	3.39E+03	Nutrient	N (c)		---
Selenium	2 / 17	12	6.13E-01	/U	7.60E-01		5.40E-01	9.79E-01	4.16E-01	2.00E+00	3.90E+01	N (b)		---
Sodium	8 / 12	67	3.33E+01		9.82E+01		8.04E+00	6.70E+02	1.38E+02	NA	Nutrient	N (c)		---
Vanadium	12 / 12	100	1.26E+01		5.67E+01		1.61E-01	6.70E+00	2.77E+01	4.09E+01	3.90E+01	Y	3.42E+01	3.42E+01
Zinc	12 / 12	100	2.39E+01		5.94E+01		2.01E+00	2.70E+00	3.40E+01	3.22E+02	2.30E+03	N (b)		---
Polychlorinated biphenyls (PCB)														
Aroclor 1016	1 / 11	9	2.94E-02	J	2.94E-02	J	3.60E-02	4.40E-02	2.05E-02		3.90E-01	N (a)		---
Aroclor 1232	1 / 11	9	3.28E-02	J	3.28E-02	J	3.60E-02	4.40E-02	2.07E-02		1.40E-01	N (a)		---
Aroclor 1254	3 / 11	27	7.40E-02		1.80E-01		3.60E-02	4.40E-02	4.50E-02		1.10E-01	Y	1.05E-01	1.05E-01
Aroclor 1260	5 / 11	45	4.10E-02	J	1.24E-01		3.60E-02	4.40E-02	4.44E-02		2.20E-01	N (a)		---
Explosives														
Amino-2,6-dinitrotoluene, 4-	6 / 20	30	1.54E-01	J	8.06E+00		2.50E-01	5.00E+00	9.10E-01		1.50E+01	N (a)		---
Amino-4,6-dinitrotoluene, 2-	8 / 20	40	9.32E-02	J	6.02E+00		2.50E-01	5.00E+00	8.86E-01		1.50E+01	N (a)		---
Dinitrotoluene, 2,4-	1 / 20	5	1.76E-01	J	1.76E-01	J	1.50E-01	5.00E+00	2.53E-01		7.10E-01	N (a)		---
RDX	1 / 20	5	2.39E-01		2.39E-01		1.50E-01	1.00E+01	4.22E-01		5.50E+00	N (a)		---
Tetryl	1 / 20	5	5.87E-01		5.87E-01		1.50E-01	1.30E+01	5.36E-01		2.40E+01	N (a)		---
Trinitrobenzene, 1,3,5-	4 / 20	20	1.16E-01	J	8.36E-01		1.50E-01	5.00E+00	3.02E-01		2.20E+02	N (a)		---
Trinitrotoluene, 2,4,6-	9 / 20	45	1.53E-01	J/U	1.30E+02		2.50E-01	5.00E+00	1.10E+01		3.60E+00	Y	2.32E+01	2.32E+01

Table 3-7

COPC Summary for Surface Soil - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Semivolatile Organic Compounds														
Benzo(a)anthracene	3 / 12	25	4.44E-02	J/J	5.10E-01		3.60E-01	4.40E-01	2.03E-01		1.50E-01	Y	2.12E-01	2.12E-01
Benzo(a)pyrene	3 / 12	25	1.15E-01	J	4.20E-01		3.60E-01	4.40E-01	2.01E-01		1.50E-02	Y	2.03E-01	2.03E-01
Benzo(b)fluoranthene	3 / 12	25	1.37E-01	J/U	5.50E-01		3.60E-01	4.40E-01	2.19E-01		1.50E-01	Y	2.68E-01	2.68E-01
Chrysene	3 / 12	25	4.96E-02	J/J	4.50E-01		3.60E-01	4.40E-01	1.98E-01		1.50E+01	N (a)		---
Dinitrotoluene, 2,4-	1 / 12	8	3.75E-02	J	3.75E-02	J	3.60E-01	4.40E-01	1.82E-01		7.10E-01	N (a)		---
Fluoranthene	3 / 12	25	9.03E-02	J/J	1.20E+00		3.60E-01	4.40E-01	2.69E-01		2.30E+02	N (a)		---
Indeno(1,2,3-cd)pyrene	2 / 12	17	2.71E-01	J/J	2.95E-01	J	3.60E-01	4.40E-01	2.08E-01		1.50E-01	Y	2.28E-01	2.28E-01
Phenanthrene	3 / 12	25	5.79E-02	J	9.40E-01		3.60E-01	4.40E-01	2.39E-01		1.70E+02 [g]	N (a)		---
Pyrene	3 / 12	25	7.31E-02	J/J	8.60E-01		3.60E-01	4.40E-01	2.37E-01		1.70E+02	N (a)		---

BSC - Background screening concentration.
COPC - Chemical of potential concern
mg/kg - Milligrams per kilogram.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
/ - When in the VQ column, this separates two qualifiers from field duplicate samples, where the concentration is the averaged field duplicate concentrations.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.
U - The sample result was nondetect.
RDX - Hexahydro-1,3,5-trinitro-1,3,5-triazine.

[a] IT Corporation (IT), 1998, *Site Investigation of Acid Areas* , *Plum Brook Ordnance Works, Sandusky, Ohio* , August.
[b] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (November 2010) residential soil values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[c] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
[d] Y = Chemical is chosen as a COPC.
[e] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.00.05 (EPA, 2010, ProUCL Version 4.00.05, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm).
[f] Exposure point concentration (EPC) used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower. The EPC used to evaluate lead using the Lead Model is equal to the arithmetic mean.
[g] RBSC based on pyrene.

Table 3-8

COPC Summary for Subsurface Soil - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg		COPC? [c,d]
Inorganics													
Aluminum	16 / 16	100	2.21E+03		1.50E+04		1.62E+00	2.10E+00	7.75E+03	1.55E+04	7.70E+03		N (b)
Antimony	1 / 16	6	4.88E-01	J	4.88E-01	J	4.01E-01	4.86E-01	2.42E-01	9.30E+00	3.10E+00		N (b)
Arsenic	16 / 16	100	1.14E+00		1.08E+01		8.01E-01	9.71E-01	4.58E+00	3.65E+01	3.90E-01		N (b)
Barium	16 / 16	100	7.69E+00		1.12E+02		1.62E-01	2.10E-01	4.30E+01	8.26E+02	1.50E+03		N (b)
Beryllium	16 / 16	100	2.14E+00	J	8.89E+00	J	1.62E-01	2.10E-01	5.69E+00	1.00E+00	1.60E+01		N (a)
Cadmium	2 / 16	13	2.72E-01	J	2.96E-01	J	4.01E-01	4.86E-01	2.33E-01	NA	7.00E+00		N (a)
Calcium	16 / 16	100	9.00E+03		5.03E+04	J	4.05E+00	5.25E+00	3.82E+04	5.23E+04	Nutrient		N (c)
Chromium	16 / 16	100	4.96E+00	J	2.20E+01		4.05E-01	5.25E-01	1.28E+01	2.90E+01	2.90E-01		N (b)
Cobalt	16 / 16	100	2.21E+00		1.32E+01	J	1.62E-01	2.10E-01	7.75E+00	1.16E+02	2.30E+00		N (b)
Copper	16 / 16	100	3.96E+00		2.89E+01		4.05E-01	5.25E-01	1.86E+01	5.62E+01	3.10E+02		N (b)
Iron	16 / 16	100	6.48E+03	J	2.72E+04	J	1.62E+00	2.10E+00	1.77E+04	2.34E+05	5.50E+03		N (b)
Lead	16 / 16	100	4.73E+00	J	1.77E+01	J	4.01E-01	4.86E-01	1.03E+01	4.86E+01	4.00E+02		N (b)
Magnesium	16 / 16	100	2.74E+03	J	1.89E+04		1.62E+00	2.10E+00	1.17E+04	1.04E+04	Nutrient		N (c)
Manganese	16 / 16	100	8.42E+01		4.91E+02	J	1.62E-01	2.10E-01	3.31E+02	3.51E+03	1.80E+02		N (b)
Mercury	6 / 16	38	1.14E-02	J	1.91E-02	J	1.96E-02	2.44E-02	1.19E-02	8.50E-02	2.30E+00		N (b)
Nickel	13 / 16	81	1.85E+00		2.07E+01		2.43E-01	3.15E-01	1.04E+01	5.51E+01	1.50E+02		N (b)
Potassium	16 / 16	100	2.06E+02		2.28E+03		2.03E+01	2.62E+01	1.10E+03	3.39E+03	Nutrient		N (c)
Sodium	16 / 16	100	6.20E+01		7.83E+02		8.10E+00	1.05E+01	2.47E+02	NA	Nutrient		N (c)
Thallium	10 / 16	63	2.42E-01	J	4.29E-01	J	4.01E-01	4.86E-01	3.07E-01	1.30E+00	5.10E-01	g	N (b)
Vanadium	16 / 16	100	1.23E+01		2.56E+01		1.62E-01	2.10E-01	1.98E+01	4.09E+01	3.90E+01		N (b)
Zinc	16 / 16	100	1.56E+01		8.57E+01		2.03E+00	2.62E+00	4.99E+01	3.22E+02	2.30E+03		N (b)
Polychlorinated biphenyls (PCB)													
Aroclor 1016	2 / 8	25	8.01E-02	J/J	1.31E-01	J	3.90E-02	4.04E-02	4.14E-02		3.90E-01		N (a)
Aroclor 1242	1 / 8	13	4.32E-02	J	4.32E-02	J	3.90E-02	4.04E-02	2.28E-02		2.20E-01		N (a)
Aroclor 1260	2 / 8	25	1.26E-02	J	1.97E-02	J	3.90E-02	4.04E-02	1.90E-02		2.20E-01		N (a)
Explosives													
Amino-2,6-dinitrotoluene, 4-	5 / 16	31	1.68E-01	J	2.95E+00		2.74E-01	3.17E-01	3.46E-01		1.50E+01		N (a)
Amino-4,6-dinitrotoluene, 2-	6 / 16	38	1.93E-01	J/U	7.74E+00		2.74E-01	1.53E+00	1.19E+00		1.50E+01		N (a)
Dinitrobenzene, 1,3-	1 / 16	6	9.22E-01		9.22E-01		2.74E-01	3.17E-01	1.94E-01		6.10E-01		Y
Dinitrotoluene, 2,4-	9 / 16	56	1.92E-01	J	9.47E+00		2.74E-01	1.53E+00	1.43E+00		7.10E-01		Y
Dinitrotoluene, 2,6-	5 / 16	31	1.88E-01	U/J	2.03E+00		2.74E-01	3.17E-01	3.68E-01		7.10E-01		Y
Tetryl	1 / 16	6	2.94E+00		2.94E+00		2.74E-01	3.17E-01	3.21E-01		2.40E+01		N (a)
Trinitrobenzene, 1,3,5-	1 / 16	6	2.60E+00		2.60E+00		2.74E-01	3.17E-01	3.00E-01		2.20E+02		N (a)
Trinitrotoluene, 2,4,6-	6 / 16	38	1.69E-01	J/J	1.81E+02		2.74E-01	2.80E+01	1.17E+01		3.60E+00		Y
Semivolatile Organic Compounds													
Acenaphthylene	1 / 16	6	4.67E-02	J	4.67E-02	J	3.73E-01	4.04E-01	1.87E-01		3.40E+02	h	N (a)
Benzo(a)anthracene	1 / 16	6	1.69E-01	J	1.69E-01	J	3.73E-01	4.04E-01	1.95E-01		1.50E-01		Y
Benzo(a)pyrene	1 / 16	6	1.90E-01	J	1.90E-01	J	3.73E-01	4.04E-01	1.96E-01		1.50E-02		Y
Benzo(b)fluoranthene	1 / 16	6	2.79E-01	J	2.79E-01	J	3.73E-01	4.04E-01	2.01E-01		1.50E-01		Y

Table 3-8

COPC Summary for Subsurface Soil - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg		COPC? [c,d]
Benzo(ghi)perylene	1 / 16	6	1.05E-01	J	1.05E-01	J	3.73E-01	4.04E-01	1.91E-01		1.70E+02	i	N (a)
Bis(2-ethylhexyl)phthalate	1 / 16	6	5.68E-02	J	5.68E-02	J	3.73E-01	4.04E-01	1.87E-01		3.50E+01		N (a)
Chrysene	1 / 16	6	1.50E-01	J	1.50E-01	J	3.73E-01	4.04E-01	1.93E-01		1.50E+01		N (a)
Diphenylamine	1 / 16	6	1.14E-01	U/J	1.14E-01	U/J	3.73E-01	4.04E-01	1.92E-01		1.50E+02		N (a)
Fluoranthene	1 / 16	6	2.21E-01	J	2.21E-01	J	3.73E-01	4.04E-01	1.98E-01		2.30E+02		N (a)
Indeno(1,2,3-cd)pyrene	1 / 16	6	3.43E-01	J	3.43E-01	J	3.73E-01	4.04E-01	2.05E-01		1.50E-01		Y
Nitroaniline, 3-	3 / 16	19	5.34E-02	J	7.06E-01		3.73E-01	4.04E-01	2.18E-01		6.10E+01	j	N (a)
Phenanthrene	5 / 16	31	4.24E-02	J	6.31E-02	J	3.73E-01	4.04E-01	1.53E-01		1.70E+02	i	N (a)
Pyrene	1 / 16	6	2.14E-01	J	2.14E-01	J	3.73E-01	4.04E-01	1.97E-01		1.70E+02		N (a)

BSC - Background screening criterion.
COPC - Chemical of potential concern.
mg/kg - Milligrams per kilogram.
BSC - Background screening concentration.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
/ - When in the VQ column, this separates two qualifiers from field duplicate samples, where the concentration is the averaged field duplicate concentrations.
U - The sample result was nondetect.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.
NA - Not available.

[a] IT Corporation (IT), 1998, *Site Investigation of Acid Areas* , *Plum Brook Ordnance Works, Sandusky, Ohio* , August.
[b] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (November 2010) residential soil values are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[c] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
[d] Y = Chemical is chosen as a COPC.
[e] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.00.05 (EPA, 2010, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm). Calculated only for COPC.
[f] Exposure point concentration (EPC) used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower.
[g] RBSC based on thallium from IRIS, 2009.
[n] RBSC based on acenaphthene.
[i] RBSC based on pyrene.
[j] RBSC based on 2-nitroaniline.

Table 3-9

COPC Summary for Total Soil - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Detected Concentrations Maximum	VQ	Reporting Limits Minimum	Reporting Limits Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Inorganics														
Aluminum	28 / 28	100	2.21E+03		1.50E+04		1.61E+00	2.68E+01	6.68E+03	1.55E+04	7.70E+03	N (b)		---
Antimony	5 / 28	18	2.99E-01	J	3.90E+00		4.01E-01	1.30E+00	4.53E-01	9.30E+00	3.10E+00	N (b)		---
Arsenic	33 / 33	100	9.98E-01		1.08E+01		8.01E-01	1.30E+00	3.78E+00	3.65E+01	3.90E-01	N (b)		---
Barium	32 / 33	97	7.69E+00		1.12E+02		1.61E-01	2.65E+01	3.21E+01	8.26E+02	1.50E+03	N (a)		---
Beryllium	24 / 28	86	2.14E+00	J	8.89E+00	J	1.61E-01	6.70E-01	4.93E+00	1.00E+00	1.60E+01	N (a)		---
Cadmium	3 / 33	9	2.72E-01	J	5.08E-01	J/J	2.20E-01	4.90E-01	2.09E-01	NA	7.00E+00	N (a)		---
Calcium	28 / 28	100	1.79E+03		5.03E+04	J	4.02E+00	6.70E+02	2.46E+04	5.23E+04	Nutrient	N (c)		---
Chromium	33 / 33	100	4.96E+00	J	2.20E+01		4.02E-01	6.60E-01	1.23E+01	2.90E+01	2.90E-01	N (b)		---
Cobalt	24 / 28	86	2.21E+00		1.32E+01	J	1.61E-01	6.70E+00	6.01E+00	1.16E+02	2.30E+00	N (b)		---
Copper	28 / 28	100	3.26E+00		2.89E+01		4.02E-01	3.30E+00	1.33E+01	5.62E+01	3.10E+02	N (a)		---
Iron	28 / 28	100	6.48E+03	J	2.86E+04	J	1.61E+00	1.34E+01	1.65E+04	2.34E+05	5.50E+03	N (b)		---
Lead	33 / 33	100	1.83E+00	J	1.15E+02		3.30E-01	4.90E-01	2.28E+01	4.86E+01	4.00E+02	N (a)		---
Magnesium	28 / 28	100	6.92E+02	J	1.89E+04		1.61E+00	6.70E+02	7.36E+03	1.04E+04	Nutrient	N (c)		---
Manganese	28 / 28	100	8.42E+01		5.19E+02	J	1.61E-01	2.00E+00	2.87E+02	3.51E+03	1.80E+02	N (b)		---
Mercury	16 / 33	48	1.14E-02	J	1.30E+00		1.96E-02	1.30E-01	7.68E-02	8.50E-02	2.30E+00	N (a)		---
Nickel	17 / 28	61	1.85E+00		2.07E+01		2.41E-01	5.40E+00	7.01E+00	5.51E+01	1.50E+02	N (a)		---
Potassium	24 / 28	86	1.43E+02		2.28E+03		2.01E+01	6.70E+02	7.26E+02	3.39E+03	Nutrient	N (c)		---
Selenium	2 / 33	6	6.13E-01	/U	7.60E-01		5.40E-01	9.79E-01	4.34E-01	2.00E+00	3.90E+01	N (a)		---
Sodium	24 / 28	86	3.33E+01		7.83E+02		8.04E+00	6.70E+02	2.00E+02	NA	Nutrient	N (c)		---
Thallium	10 / 28	36	2.42E-01	J	4.29E-01	J	4.01E-01	1.30E+00	3.27E-01	1.30E+00	5.10E-01 g	N (a)		
Vanadium	28 / 28	100	1.23E+01		5.67E+01		1.61E-01	6.70E+00	2.32E+01	4.09E+01	3.90E+01	Y	2.62E+01	2.62E+01
Zinc	28 / 28	100	1.56E+01		8.57E+01		2.01E+00	2.70E+00	4.31E+01	3.22E+02	2.30E+03	N (a)		---
Polychlorinated biphenyls (PCB)														
Aroclor 1016	3 / 19	16	2.94E-02	J	1.31E-01	J	3.60E-02	4.40E-02	2.93E-02		3.90E-01	N (a)		---
Aroclor 1232	1 / 19	5	3.28E-02	J	3.28E-02	J	3.60E-02	4.40E-02	2.03E-02		1.40E-01	N (a)		---
Aroclor 1242	1 / 19	5	4.32E-02	J	4.32E-02	J	3.60E-02	4.40E-02	2.09E-02		2.20E-01	N (a)		---
Aroclor 1254	3 / 19	16	7.40E-02		1.80E-01		3.60E-02	4.40E-02	3.44E-02		1.10E-01	Y	9.17E-02	9.17E-02
Aroclor 1260	7 / 19	37	1.26E-02	J	1.24E-01		3.60E-02	4.40E-02	3.37E-02		2.20E-01	N (a)		---
Explosives														
Amino-2,6-dinitrotoluene, 4-	11 / 36	31	1.54E-01	J	8.06E+00		2.50E-01	5.00E+00	6.60E-01		1.50E+01	N (a)		---
Amino-4,6-dinitrotoluene, 2-	14 / 36	39	9.32E-02	J	7.74E+00		2.50E-01	5.00E+00	1.02E+00		1.50E+01	N (a)		---
Dinitrobenzene, 1,3-	1 / 36	3	9.22E-01		9.22E-01		1.50E-01	5.00E+00	2.22E-01		6.10E-01	Y	5.22E-01	5.22E-01
Dinitrotoluene, 2,4-	10 / 36	28	1.76E-01	J	9.47E+00		1.50E-01	5.00E+00	7.77E-01		7.10E-01	Y	1.25E+00	1.25E+00
Dinitrotoluene, 2,6-	5 / 36	14	1.88E-01	U/J	2.03E+00		1.50E-01	5.00E+00	3.00E-01		7.10E-01	Y	5.47E-01	5.47E-01
RDX	1 / 36	3	2.39E-01		2.39E-01		1.50E-01	1.00E+01	2.99E-01		5.50E+00	N (a)		---
Tetryl	2 / 36	6	5.87E-01		2.94E+00		1.50E-01	1.30E+01	4.41E-01		2.40E+01	N (a)		---
Trinitrobenzene, 1,3,5-	5 / 36	14	1.16E-01	J	2.60E+00		1.50E-01	5.00E+00	3.01E-01		2.20E+02	N (a)		---
Trinitrotoluene, 2,4,6-	15 / 36	42	1.53E-01	J/U	1.81E+02		2.50E-01	2.80E+01	1.13E+01		3.60E+00	Y	2.20E+01	2.20E+01
Semivolatile Organic Compounds														
Acenaphthylene	1 / 28	4	4.67E-02	J	4.67E-02	J	3.60E-01	4.40E-01	1.90E-01		3.40E+02 h	N (a)		---
Benzo(a)anthracene	4 / 28	14	4.44E-02	J/J	5.10E-01		3.60E-01	4.40E-01	1.98E-01		1.50E-01	Y	1.98E-01	1.98E-01
Benzo(a)pyrene	4 / 28	14	1.15E-01	J	4.20E-01		3.60E-01	4.40E-01	1.98E-01		1.50E-02	Y	2.08E-01	2.08E-01

Table 3-9

COPC Summary for Total Soil - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg		COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Benzo(b)fluoranthene	4 / 28	14	1.37E-01	J/U	5.50E-01		3.60E-01	4.40E-01	2.09E-01		1.50E-01		Y	2.98E-01	2.98E-01
Benzo(ghi)perylene	1 / 28	4	1.05E-01	J	1.05E-01	J	3.60E-01	4.40E-01	1.92E-01		1.70E+02	i	N (a)		---
Bis(2-ethylhexyl)phthalate	1 / 28	4	5.68E-02	J	5.68E-02	J	3.60E-01	4.40E-01	1.90E-01		3.50E+01		N (a)		---
Chrysene	4 / 28	14	4.96E-02	J/J	4.50E-01		3.60E-01	4.40E-01	1.95E-01		1.50E+01		N (a)		---
DIPHENYLAMINE	1 / 24	4	1.14E-01	U/J	1.14E-01	U/J	3.73E-01	4.05E-01	1.93E-01		1.50E+02		N (a)		---
Fluoranthene	4 / 28	14	9.03E-02	J/J	1.20E+00		3.60E-01	4.40E-01	2.28E-01		2.30E+02		N (a)		---
Indeno(1,2,3-cd)pyrene	3 / 28	11	2.71E-01	J/J	3.43E-01	J	3.60E-01	4.40E-01	2.07E-01		1.50E-01		Y	3.39E-01	3.39E-01
Nitroaniline, 3-	3 / 28	11	5.34E-02	J	7.06E-01		3.73E-01	1.10E+00	2.47E-01		6.10E+01	j	N (a)		---
Phenanthrene	8 / 28	29	4.24E-02	J	9.40E-01		3.60E-01	4.40E-01	1.90E-01		1.70E+02	i	N (a)		---
Pyrene	4 / 28	14	7.31E-02	J/J	8.60E-01		3.60E-01	4.40E-01	2.14E-01		1.70E+02		N (a)		---

BSC - Background screening concentration.
COPC - Chemical of potential concern.
mg/kg - Milligrams per kilogram.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
/ - When in the VQ column, this separates two qualifiers from field duplicate samples, where the concentration is the averaged field duplicate concentrations.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed
U - The sample result was nondetect.

[a] IT Corporation (IT), 1998, *Site Investigation of Acid Areas*, *Plum Brook Ordnance Works, Sandusky, Ohio*, August.
[b] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (November 2010) residential soil values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[c] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
(d) = Frequency of detection is less than 5 percent.
[d] Y = Chemical is chosen as a COPC.
[e] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.00.05 (EPA, 2010, ProUCL Version 4.00.05, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm).
[f] Exposure point concentration (EPC) used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower. The EPC used to evaluate lead using the Lead Model is equal to the arithmetic mean.
[g] RBSC based on thallium from IRIS, 2009.
[h] RBSC based on acenaphthene.
[i] RBSC based on pyrene.
[j] RBSC based on 2-nitroaniline.

Table 3-10

COPC Summary for Bedrock Groundwater - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent hits	Range of values, µg/L: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Arithmetic Mean µg/L	BSC [a] µg/L	RBSC [b] µg/L	COPC? [c,d]	EPC [e] µg/L
Inorganics - Unfiltered													
Aluminum	3 / 3	100	2.73E+01	J	2.43E+02	J	2.00E+02	2.00E+02	1.03E+02	3.09E+02	3700	N (a)	---
Arsenic	2 / 3	67	2.31E+01		1.29E+02		1.00E+01	1.00E+01	5.24E+01	7.40E+00	0.045	Y	1.29E+02
Barium	3 / 3	100	3.92E+02		1.12E+04		2.00E+02	8.00E+02	5.28E+03	1.18E+04	730	N (b)	---
Calcium	3 / 3	100	1.71E+05		2.96E+05	J	1.00E+03	1.00E+03	2.50E+05	3.16E+05	Nutrient	N (c)	---
Chromium	1 / 3	33	3.30E+00	J	3.30E+00	J	1.00E+01	1.00E+01	4.43E+00	NA	0.043	Y	3.30E+00
Copper	1 / 3	33	5.80E+00	J	5.80E+00	J	2.50E+01	2.50E+01	1.03E+01	1.98E+01	150	N (a)	---
Iron	1 / 3	33	2.60E+03		2.60E+03		3.00E+02	3.00E+02	9.67E+02	1.55E+03	2600	Y	2.60E+03
Magnesium	3 / 3	100	1.28E+05		2.13E+05		5.00E+03	5.00E+03	1.66E+05	2.17E+05	Nutrient	N (c)	---
Manganese	3 / 3	100	4.56E+01		8.60E+02		1.50E+01	1.50E+01	3.22E+02	6.36E+02	88	Y	8.60E+02
Nickel	2 / 3	67	3.80E+00	J	4.60E+00	J	4.00E+01	4.00E+01	9.47E+00	8.60E+00	73	N (a)	---
Potassium	3 / 3	100	6.81E+04		1.04E+05	J	1.00E+04	4.00E+04	8.93E+04	1.16E+05	Nutrient	N (c)	---
Selenium	2 / 3	67	3.40E+00	J	5.50E+00	J	1.00E+01	2.00E+01	4.63E+00	NA	18	N (a)	---
Sodium	3 / 3	100	7.10E+05		1.05E+06		1.00E+05	4.00E+05	9.33E+05	1.39E+06	Nutrient	N (c)	---
Vanadium	3 / 3	100	1.60E+00	J	2.50E+00	J	5.00E+01	5.00E+01	2.20E+00	NA	18	N (a)	---
Zinc	1 / 2 [f]	50	1.40E+01	J	1.40E+01	J	2.00E+01	2.00E+01	1.20E+01	5.01E+02	1100	N (a)	---
Semivolatile Organic Compounds													
3-Methylphenol and 4-Methylphenol	2 / 3	67	1.80E+00	J	4.60E+00	J	4.80E+00	2.10E+01	5.63E+00		93	N (a)	---
Dimethylphenol, 2,4-	1 / 3	33	1.50E+00	J	1.50E+00	J	4.80E+00	2.10E+01	4.92E+00		73	N (a)	---
Methylnaphthalene, 2-	3 / 3	100	6.90E+00		1.61E+01		4.80E+00	2.10E+01	1.15E+01		15	Y	1.61E+01
Methylphenol, 2-	3 / 3	100	1.23E+01		1.39E+01	J	4.80E+00	2.10E+01	1.30E+01		180	N (a)	---
Naphthalene	3 / 3	100	1.37E+01		1.95E+01		4.80E+00	2.10E+01	1.72E+01		0.14	Y	1.95E+01
Volatile Organic Compounds													
Acetone	2 / 2 [f]	100	5.02E+01	J	9.89E+01	J	5.00E+01	1.30E+02	7.46E+01		2200	N (a)	---
Benzene	3 / 3	100	5.60E+00		4.03E+02		2.00E+00	1.00E+01	1.43E+02		0.41	Y	4.03E+02
Butanone, 2-	2 / 3	67	1.19E+01		1.72E+02		1.00E+01	5.00E+01	6.55E+01		710	N (a)	---
Carbon disulfide	1 / 3	33	2.80E+00	J	2.80E+00	J	4.00E+00	2.00E+01	5.93E+00		100	N (a)	---
Chloroform	1 / 3	33	1.97E+01		1.97E+01		2.00E+00	1.00E+01	8.57E+00		0.19	Y	1.97E+01
Chloromethane	1 / 3	33	3.13E+01		3.13E+01		4.00E+00	2.00E+01	1.44E+01		19	Y	3.13E+01
Ethylbenzene	3 / 3	100	1.64E+01		1.72E+02		2.00E+00	1.00E+01	7.54E+01		1.5	Y	1.72E+02
Methylene chloride	1 / 3	33	1.29E+01	J	1.29E+01	J	1.00E+01	5.00E+01	1.01E+01		4.8	Y	1.29E+01
Tetrachloroethane, 1,1,2,2-	1 / 3	33	2.50E+00	J	2.50E+00	J	2.00E+00	1.00E+01	2.83E+00		0.067	Y	2.50E+00
Toluene	3 / 3	100	3.18E+01		5.30E+02		2.00E+00	1.00E+01	2.12E+02		230	Y	5.30E+02
Xylenes, total	2 / 2 [f]	100	6.25E+02		1.04E+03		1.50E+01	3.00E+01	8.33E+02		20	Y	1.04E+03
General Chemistry													
Chloride	3 / 3	100	1.07E+06		1.96E+06		1.00E+05	2.00E+05	1.63E+06		Nutrient	N (c)	---

Table 3-10

COPC Summary for Bedrock Groundwater - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent hits	Range of values, µg/L: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Arithmetic Mean µg/L	BSC [a] µg/L	RBSC [b] µg/L		COPC? [c,d]	EPC [e] µg/L
Cyanide, total	1 / 3	33	4.20E+01	J	4.20E+01	J	1.00E+01	1.00E+01	1.73E+01		73		N (a)	---
Nitrate-Nitrite	3 / 3	100	1.90E+02		2.20E+03		1.00E+02	2.00E+03	1.11E+03		1000	h	Y	2.20E+03
Sulfate	2 / 3	67	1.43E+04		2.86E+04		2.00E+03	2.00E+05	4.76E+04		250,000	i	N (a)	---

µg/L - Micrograms per liter.
BSC - Background screening concentration.
COPC - Chemical of potential concern.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzec

[a] Shaw Environmental, Inc. (Shaw), 2005, *2004 Groundwater Data Summary and Evaluation Report, Final, Former Plum Brook Ordnance Works, Sandusky, Ohic*, April.
[b] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (November 2010) tap water values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[c] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
[d] Y = Chemical is chosen as a COPC.
[e] Exposure point concentration (EPC) used in risk assessment equal to maximum detected concentration.
[f] Some samples were excluded from the dataset because of blank contamination.
[g] Screening criteria for lead based on the action level of 15 µg/L (EPA, 2011, 2011 Edition of the Drinking Water Standards and Health Advisories, Office of Water, Washington, DC, January, EPA 822-R-11-002).
[h] Because no Regional Screening Level exists for nitrate-nitrite, 0.1 X the nitrate-nitrite MCL (10 mg/L) is used for screening
[i] Screening level based on the Secondary Drinking Water Regulation (EPA, 2011)

Table 3-11

COPC Summary for Overburden Groundwater - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent hits	Range of values, µg/L: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Arithmetic Mean µg/L	RBSC [a] µg/L	COPC? [b,c]	95% UCL [d] µg/L	EPC [e] µg/L
Inorganics-Unfiltered													
Aluminum	5 / 6	83	9.27E+01	J	1.01E+03	J	2.00E+02	2.00E+02	4.06E+02	3700	N (a)		---
Arsenic	2 / 6	33	7.20E+00	J	7.70E+00	J	1.00E+01	1.00E+01	5.82E+00	0.045	Y	6.90E+00	6.90E+00
Barium	6 / 6	100	6.60E+01	J	1.61E+02	J	2.00E+02	2.00E+02	1.06E+02	730	N (a)		---
Calcium	6 / 6	100	2.89E+04		8.76E+04		1.00E+03	1.00E+03	4.82E+04	Nutrient	N (b)		---
Cobalt	1 / 6	17	1.10E+00	J	1.10E+00	J	5.00E+01	5.00E+01	2.10E+01	1.1	Y	NA	1.10E+00
Copper	2 / 6	33	5.90E+00	J	8.40E+00	J	2.50E+01	2.50E+01	1.07E+01	150	N (a)		---
Iron	5 / 6	83	1.23E+02	J	1.69E+03		3.00E+02	3.00E+02	6.47E+02	2600	N (a)		---
Lead	1 / 3 [f]	33	2.80E+00	J	2.80E+00	J	5.00E+00	5.00E+00	2.60E+00	15 [g]	N (a)		---
Magnesium	6 / 6	100	8.56E+03		2.26E+04		5.00E+03	5.00E+03	1.39E+04	Nutrient	N (b)		---
Manganese	6 / 6	100	3.95E+01		5.64E+02		1.50E+01	1.50E+01	2.17E+02	88	Y	3.89E+02	3.89E+02
Mercury	1 / 6	17	1.50E-01	J	1.50E-01	J	1.00E+00	1.00E+00	4.42E-01	1.1	N (a)		---
Nickel	4 / 6	67	2.90E+00	J	4.50E+00	J	4.00E+01	4.00E+01	8.97E+00	73	N (a)		---
Potassium	6 / 6	100	4.36E+03	J	1.85E+04		1.00E+04	1.00E+04	9.72E+03	Nutrient	N (b)		---
Selenium	2 / 6	33	6.90E+00	J	7.40E+00	J	1.00E+01	2.00E+01	6.55E+00	18	N (a)		---
Sodium	6 / 6	100	1.68E+04		1.18E+05		1.00E+04	2.00E+04	7.81E+04	Nutrient	N (b)		---
Vanadium	4 / 6	67	2.00E+00	J	4.20E+00	J	5.00E+01	5.00E+01	1.02E+01	18	N (a)		---
Zinc	1 / 3 [f]	33	1.11E+01	J	1.11E+01	J	2.00E+01	2.00E+01	1.04E+01	1100	N (a)		---
Explosives													
Amino-2,6-dinitrotoluene, 4-	2 / 6	33	1.40E-01	J	1.30E+00		1.90E-01	2.00E-01	3.03E-01	7.3	N (a)		---
Amino-4,6-dinitrotoluene, 2-	1 / 6	17	2.20E+00		2.20E+00		1.90E-01	2.00E-01	4.47E-01	7.3	N (a)		---
Dinitrobenzene, 1,3-	1 / 6	17	1.20E-01	J	1.20E-01	J	1.90E-01	2.00E-01	1.00E-01	0.37	N (a)		---
Dinitrotoluene, 2,4-	3 / 6	50	2.00E-01		1.70E+00		1.90E-01	2.00E-01	4.28E-01	0.099	Y	1.03E+00	1.03E+00
Dinitrotoluene, 2,6-	3 / 6	50	2.00E-01		1.70E+00		1.90E-01	2.00E-01	4.32E-01	0.099	Y	1.04E+00	1.04E+00
Trinitrotoluene, 2,4,6-	1 / 6	17	1.70E+00		1.70E+00		1.90E-01	2.00E-01	3.63E-01	1.8	N (a)		---
Semivolatile Organic Compounds													
Bis(2-ethylhexyl)phthalate	1 / 6	17	6.50E+00		6.50E+00		4.80E+00	5.10E+00	3.11E+00	4.8	Y	4.48E+00	4.48E+00
Volatile Organic Compounds													
Acetone	1 / 5 [f]	20	4.92E+01	J	4.92E+01	J	2.50E+01	2.50E+01	1.98E+01	2200	N (a)		---
Butanone, 2-	1 / 6	17	1.75E+01		1.75E+01		5.00E+00	5.00E+00	5.00E+00	710	N (a)		---
Carbon disulfide	1 / 6	17	1.20E+00	J	1.20E+00	J	2.00E+00	2.00E+00	1.03E+00	100	N (a)		---

Table 3-11

COPC Summary for Overburden Groundwater - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

General Chemistry														
Chloride	6 / 6	100	4.60E+03		2.58E+04		2.00E+03	2.00E+03	1.04E+04	Nutrient		N (b)		---
Cyanide, total	3 / 6	50	1.10E+01	J	2.60E+01	J	1.00E+01	1.00E+01	1.17E+01	73		N (a)		---
Nitrate-Nitrite	2 / 6	33	4.80E+01	J	1.40E+02		1.00E+02	2.00E+03	2.23E+02	1000	h	N (a)		---
Sulfate	6 / 6	100	3.58E+04		9.33E+04		2.00E+03	4.00E+03	6.42E+04	250,000	i	N (a)		---

µg/L - Micrograms per liter.
COPC - Chemical of potential concern.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed

[a] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (November 2010) tap water values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[b] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Essential nutrient.
[c] Y = Chemical is chosen as a COPC.
[d] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.00.05 (EPA, 2010, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm). Calculated only for COPC
[e] Exposure point concentration (EPC) used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower.
[f] Some samples were excluded from the data set because of blank contamination.
[g] Screening criteria for lead based on the action level of 15 µg/L (EPA, 2011, 2011 Edition of the Drinking Water Standards and Health Advisories, Office of Water, Washington, DC, January, EPA 822-R-11-002).
[h] Because no Regional Screening Level exists for nitrate-nitrite, 0.1 X the nitrate-nitrite MCL (10 mg/L) is used for screening.
i Screening level based on the Secondary Drinking Water Regulation (EPA, 2011).

Table 3-12

COPC Summary for Sediment - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Detected Concentrations Maximum	VQ	Reporting Limits Minimum	Reporting Limits Maximum	Mean mg/kg	RBSC [a] mg/kg	COPC? [b,c]	EPC [d] mg/kg
Inorganics												
Aluminum	4 / 4	100	3.70E+00		1.22E+01		1.20E+00	1.30E+00	8.14E+00	7.70E+04	N (a)	---
Barium	3 / 4	75	2.55E+01	/U	4.74E+01		2.38E+01	2.58E+01	2.84E+01	1.50E+04	N (a)	---
Cadmium	1 / 4	25	2.60E-01		2.60E-01		2.35E-01	2.60E-01	1.56E-01	7.00E+01	N (a)	---
Chromium	4 / 4	100	8.20E+00		1.40E+01		5.95E-01	6.40E-01	1.24E+01	2.90E-01	Y	1.40E+01
Lead	4 / 4	100	2.80E+00		8.90E+00		3.55E-01	3.90E-01	6.31E+00	4.00E+02	N (a)	---
Selenium	2 / 4	50	7.30E-01		8.50E-01		5.95E-01	6.40E-01	5.47E-01	3.90E+02	N (a)	---

COPC - Chemical of potential concern.
mg/kg - Milligrams per kilogram.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
/ - When in the VQ column, this separates two qualifiers from field duplicate samples, where the concentration is the averaged field duplicate concentrations.
U - The sample result was nondetect.

[a] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (November 2010) residential soil and are based on a risk level of 1.0E-06 and a hazard index of 1.
[b] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Rssential nutrient.
[c] Y = Chemical is chosen as a COPC.
[d] Exposure point concentration (EPC) used in risk assessment equal to maximum detected concentration.

Table 3-13

COPC Summary for Surface Water - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent hits	Range of values, µg/L: Detected Conc Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Arithmetic Mean µg/L	RBSC [a] µg/L	COPC? [b,c]
Metals											
Aluminum	1 / 1	100	66.5	J	66.5	J	200	200	6.65E+01	3.70E+04	N (a)
Barium	1 / 1	100	37.9	J	37.9	J	200	200	3.79E+01	7.30E+03	N (a)
Calcium	1 / 1	100	102000		102000		1000	1000	1.02E+05	Nutrient	N (b)
Iron	1 / 1	100	5330		5330		300	300	5.33E+03	2.60E+04	N (a)
Magnesium	1 / 1	100	18100		18100		5000	5000	1.81E+04	Nutrient	N (b)
Manganese	1 / 1	100	534		534		15	15	5.34E+02	8.80E+02	N (a)
Potassium	1 / 1	100	3490	J	3490	J	20000	20000	3.49E+03	Nutrient	N (b)
Selenium	1 / 1	100	3.8	J	3.8	J	10	10	3.80E+00	1.80E+02	N (a)
Sodium	1 / 1	100	38900		38900		10000	10000	3.89E+04	Nutrient	N (b)
Semivolatile Organic Compounds											
3-Methylphenol and 4-Methylphenol	1 / 1	100	4.7	J	4.7	J	4.8	4.8	4.70E+00	9.30E+02	N (a)
Phenol	1 / 1	100	2.8	J	2.8	J	4.8	4.8	2.80E+00	1.10E+04	N (a)

µg/L - Micrograms per liter.
COPC - Chemical of potential concern.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.

[a] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency Regional Screening Level Table (November 2010) tap water values are ba
on a risk level of 1.0E-06 and a hazard index of 1.
[b] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Essential nutrient.
[c] Y = Chemical is chosen as a COPC.

Table 3-14

Summary of Risk for All Receptors - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

	Groundskeeper [a]		Construction Worker		Indoor Worker		Resident			Hunter		Hunter's Child	
	Total ILCR	Total HI	Total ILCR	Total HI	Total ILCR	Total HI	Total ILCR	Total Adult - HI	Total Child - HI	Total ILCR	Total HI	Total ILCR	Total HI
All Pathways Assuming Bedrock Groundwater Use													
Exposure Media													
Surface Soil	1.74E-06	0.07	NE	NE	5.08E-07	0.029	NE	NE	NE	1.17E-07	0.004	2.02E-11	0.000006
Total Soil	2.50E-06	0.08	1.28E-07	0.20	NE	NE	8.12E-06	0.09	0.8	NE	NE	NE	NE
Groundwater	7.64E-04	6.0	NE	NE	7.64E-04	6.0	4.22E-03	32	73.5	NE	NE	NE	NE
Sediment	NE	NE	NA	0.002	NE	NE	NA	0.00009	0.0009	NE	NE	NE	NE
Surface Water	NE	NE	NA	NA	NE	NE	NA	NA	NA	NE	NE	NE	NE
Total ILCR or HI	**8.E-04**	**6**	**1.E-07**	**0.2**	**8.E-04**	**6**	**4.E-03**	**32**	**74**	**1.E-07**	**0.004**	**2.E-11**	**0.000006**
All Pathways Assuming Overburden Groundwater Use													
Exposure Media													
Surface Soil	1.74E-06	0.07	NE	NE	5.08E-07	0.029	NE	NE	NE	1.17E-07	0.004	2.02E-11	0.000006
Total Soil	2.50E-06	0.08	1.28E-07	0.2	NE	NE	8.12E-06	0.09	0.8	NE	NE	NE	NE
Groundwater	4.17E-05	0.37	NE	NE	4.17E-05	0.4	1.81E-04	1.0	2.4	NE	NE	NE	NE
Sediment	NE	NE	NA	0.002	NE	NE	NA	0.00009	0.0009	NE	NE	NE	NE
Surface Water	NE	NE	NA	NA	NE	NE	NA	NA	NA	NE	NE	NE	NE
Total ILCR or HI	**4.E-05**	**0.4**	**1.E-07**	**0.2**	**4.E-05**	**0.4**	**2.E-04**	**1**	**3**	**1.E-07**	**0.004**	**2.E-11**	**0.000006**

HI - Hazard index.
ILCR - Incremental lifetime cancer risk.
NA - No chemicals of potential concern available for exposure evaluation.
NE - Pathway not evaluated for this receptor.

Note:
[a] Total ILCR and total HI values for the groundskeeper reflect the respective totals for the future groundskeeper assumed to use either bedrock or overburden groundwater. The total ILCR and HI values for the current groundskeeper are simply those shown for soil. The rounded current groundskeeper ILCR is 2E-6 and the rounded HI is 0.07

Table 3-15

Summary of Risk for Receptors[a] Excluding Exposure to Groundwater[b] - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

	Future Groundskeeper		Indoor Worker		Resident		
	Total ILCR	Total HI	Total ILCR	Total HI	Total ILCR	Total Adult - HI	Total Child - HI
Exposure Media							
Surface Soil	NE	NE	5.08E-07	0.03	NE	NE	NE
Total Soil	2.50E-06	0.08	NE	NE	8.12E-06	0.09	0.8
Sediment	NE	NE	NE	NE	NA	0.00009	0.0009
Surface Water	NE	NE	NE	NE	NA	NA	NA
Total ILCR or HI	**3.E-06**	**0.08**	**5.E-07**	**0.03**	**8.E-06**	**0.09**	**0.8**

HI - Hazard index.
ILCR - Incremental lifetime cancer risk.
NA - No chemicals of potential concern available for exposure evaluation.
NE - Pathway not evaluated for this receptor.

Notes:
[a] The above receptors are those which were evaluated for groundwater exposure.
[b] Groundwater use is not regarded as plausible because of low yield in the overburden and bedrock units and naturally poor quality in the bedrock unit.

Table 3-16

Summary of Samples Evaluated in the Ecological Risk Assessment - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Location	Sample Number	Sample Purpose	Sample Date	Depth (ft)	Analyses
Soil Samples					
PBOW99-SSW101	PBOW99SSW101	REG	10-Jun-99	0.5 - 1	Explosives, Gen Chem, Metals[a], SVOC
PBOW99-SSW102	PBOW99SSW102	REG	10-Jun-99	0.5 - 1	Explosives, Metals, PCB, SVOC, VOC
PBOW99-SSW103	PBOW99SSW103	REG	10-Jun-99	0.5 - 1	Explosives, Metals, PCB, SVOC, VOC
PBOW99-SSW104	PBOW99SSW104	REG	10-Jun-99	0.5 - 1	Explosives, Metals[a]
PBOW99-SSW104	PBOW99SSW105	REG	10-Jun-99	0.5 - 1	Explosives, Metals[a]
PBOW99-SSW106	PBOW99SSW106	REG	10-Jun-99	0.5 - 1	Explosives, Metals, PCB, SVOC, VOC
PBOW99-SSW107	PBOW99SSW107	REG	10-Jun-99	0.5 - 1	Explosives, Metals[a]
PBOW99-SSW108	PBOW99SSW108	REG	10-Jun-99	0.5 - 1	Explosives[b], Metals[a]
PBOW99-SSW108	PBOW99SSW110	FD	10-Jun-99	0.5 - 1	Explosives[b], Metals
PBOW99-SSW109	PBOW99SSW109	REG	10-Jun-99	0.5 - 1	Explosives, Metals[a]
PBOW99-SSW108	SSW-108-NE	REG	18-Nov-10	0 - 1	Explosives
PBOW99-SSW108	SSW-108-NW	REG	18-Nov-10	0 - 1	Explosives
PBOW99-SSW108	SSW-108-R	REG	18-Nov-10	0 - 1	Explosives
PBOW99-SSW108	SSW-108-S	REG	18-Nov-10	0 - 1	Explosives
WWTP1-SB01	WW0001	REG	5-Dec-08	2.6 - 3.6	Explosives, Gen Chem, Metals, PCB, SVOC
WWTP1-SB01	WW0002	REG	5-Dec-08	5.6 - 7.6	Explosives, Metals, PCB, SVOC
WWTP1-SB02	WW0004	REG	4-Dec-08	1.6 - 2.6	Explosives, Metals, PCB, SVOC
WWTP1-SB02	WW0005	REG	4-Dec-08	5 - 6.6	Explosives, Metals, PCB, SVOC
WWTP1-SB02	WW0006	FD	4-Dec-08	5 - 6.6	Explosives, Metals, PCB, SVOC
WWTP1-SB03	WW0008	REG	4-Dec-08	1.2 - 2.2	Explosives, Metals, PCB, SVOC
WWTP1-SB03	WW0009	REG	4-Dec-08	5 - 6.2	Explosives, Metals, PCB, SVOC
WWTP1-SB04	WW0011	REG	4-Dec-08	1.7 - 2.7	Explosives, Metals, PCB, SVOC
WWTP1-SB04	WW0012	REG	4-Dec-08	5 - 6.7	Explosives, Metals, PCB, SVOC
WWTP1-SB05	WW0014	REG	4-Dec-08	2.2 - 3.2	Explosives, Metals, PCB, SVOC
WWTP1-SB05	WW0015	REG	4-Dec-08	5.2 - 7.2	Explosives, Metals, PCB, SVOC
WWTP1-SB06	WW0017	REG	3-Dec-08	1.1 - 2.1	Explosives, Metals, PCB, SVOC
WWTP1-SB06	WW0018	FD	3-Dec-08	1.1 - 2.1	Explosives, Metals, PCB, SVOC
WWTP1-SB06	WW0019	REG	3-Dec-08	5 - 6.1	Explosives, Metals, PCB, SVOC
WWTP1-SB07	WW0021	REG	3-Dec-08	1 - 2	Explosives, Metals, PCB, SVOC
WWTP1-SB07	WW0022	REG	3-Dec-08	5 - 6	Explosives, Metals, PCB, SVOC
WWTP1-SB08	WW0024	REG	4-Dec-08	1.8 - 2.8	Explosives, Metals, PCB, SVOC
WWTP1-SB08	WW0025	REG	4-Dec-08	5 - 6.8	Explosives, Metals, PCB, SVOC
Sediment Samples					
PBOW99-SDW101	PBOW99SDW101	REG	9-Jun-99	0 - 0	Explosives, Metals, SVOC
PBOW99-SDW102	PBOW99SDW102	REG	9-Jun-99	0 - 0	Explosives, Metals, SVOC
PBOW99-SDW103	PBOW99SDW103	REG	9-Jun-99	0 - 0	Explosives, Metals, SVOC
PBOW99-SDW104	PBOW99SDW104	REG	9-Jun-99	0 - 0	Explosives, Metals, SVOC
PBOW99-SDW104	PBOW99SDW105	FD	9-Jun-99	0 - 0	Explosives, Metals, SVOC
WWTP1-SD01	WW1000	REG	21-May-09	0 - 0.5	Gen Chem, PCB
WWTP1-SD02	WW1001	REG	21-May-09	0 - 0.5	Gen Chem, PCB
WWTP1-SD03	WW1002	REG	20-May-09	0 - 0.5	Gen Chem, PCB
WWTP1-SD04	WW1003	REG	20-May-09	0 - 0.5	Gen Chem, PCB
Surface Water Samples					
WWTP1-SW01	WW2000	REG	21-May-09	NA	Explosives, Metals, SVOC

[a] Metals analysis was for RCRA metals only.
[b] Explosives data from this sample location were replaced by the explosives data collected in November 2010. See text for details.

Exp - Explosives.
FD - Field duplicate; averaged with the regular sample at the same location to create one result.
Gen Chem - General Chemistry.
NA - Not applicable.
PCB - Polychlorinated biphenyls.
Pest - Organochlorine pesticides.
REG - Regular sample.
SVOC - Semivolatile organic compounds.
VOC - Volatile organic compounds.

Table 3-17

Statistical Summary and COPEC Selection of Chemicals Detected in Soil (0 to 6 Feet) - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean (mg/kg)	BSC [a] (mg/kg)	ESV [b] (mg/kg)	COPEC? [c,d]	Distribution [e]	95% UCL [e] (mg/kg)	EPC [f] (mg/kg)	UCL 0-1' soil depth [g] (mg/kg)	MDC 0-1' soil depth [g] (mg/kg)	EPC 0-1' soil depth [g] (mg/kg)
Inorganics																		
Aluminum	20 / 20	100	2.21E+03		1.03E+04		1.61E+00	2.68E+01	5.04E+03	1.55E+04	pH Dependent	N (a)			---			
Antimony	5 / 20	25	2.99E-01	J	3.90E+00		4.02E-01	1.30E+00	5.45E-01	9.30E+00	0.27	N (b)			---			
Arsenic	25 / 25	100	9.98E-01		5.54E+00		8.04E-01	1.30E+00	2.87E+00	3.65E+01	18	N (a)			---			
Barium	24 / 25	96	7.69E+00		5.81E+01		1.61E-01	2.65E+01	2.26E+01	8.26E+02	330	N (a)			---			
Beryllium	16 / 20	80	2.14E+00	J	8.44E+00	J	1.61E-01	6.70E-01	3.97E+00	1.00E+00	21	N (a)			---			
Cadmium	1 / 25	4	5.08E-01	J/J	5.08E-01	J/J	2.20E-01	4.90E-01	2.00E-01	NA	0.36	N (e)			---			
Calcium	20 / 20	100	1.79E+03		4.84E+04	J	4.02E+00	6.70E+02	1.77E+04	5.23E+04	Nutrient	N (c)			---			
Chromium	25 / 25	100	4.96E+00	J	1.76E+01	J	4.02E-01	6.60E-01	1.10E+01	2.90E+01	26	N (a)			---			
Cobalt	16 / 20	80	2.21E+00		1.02E+01	J	1.61E-01	6.70E+00	4.12E+00	1.16E+02	13	N (a)			---			
Copper	20 / 20	100	3.26E+00		2.54E+01		4.02E-01	3.30E+00	8.01E+00	5.62E+01	28	N (a)			---			
Iron	20 / 20	100	6.48E+03	J	2.86E+04	J	1.61E+00	1.34E+01	1.39E+04	2.34E+05	pH Dependent	N (a)			---			
Lead	25 / 25	100	1.83E+00	J	1.15E+02		3.30E-01	4.90E-01	2.63E+01	4.86E+01	11	N (d)			---			
Magnesium	20 / 20	100	6.92E+02	J	1.89E+04		1.61E+00	6.70E+02	5.43E+03	1.04E+04	Nutrient	N (c)			---			
Manganese	20 / 20	100	8.42E+01		5.19E+02	J	1.61E-01	2.00E+00	2.32E+02	3.51E+03	220	N (b)			---			
Mercury	11 / 25	44	1.46E-02	J	1.30E+00		2.02E-02	1.30E-01	9.77E-02	8.50E-02	0.00051	Y	Nonparametric	1.83E-01	1.83E-01	2.79E-01	1.30E+00	2.79E-01
Nickel	9 / 20	45	1.85E+00		1.42E+01		2.41E-01	5.40E+00	3.29E+00	5.51E+01	38	N (a)			---			
Potassium	16 / 20	80	1.43E+02		1.48E+03		2.01E+01	6.70E+02	3.80E+02	3.39E+03	Nutrient	N (c)			---			
Selenium	2 / 25	8	6.13E-01	/U	7.60E-01		5.40E-01	9.79E-01	4.30E-01	2.00E+00	0.52	N (b)			---			
Sodium	16 / 20	80	3.33E+01		3.97E+02		8.04E+00	6.70E+02	1.49E+02	NA	Nutrient	N (c)			---			
Thallium	1 / 20	5	3.73E-01	J	3.73E-01	J	4.02E-01	1.30E+00	3.13E-01	1.30E+00	1	N (a)			---			
Vanadium	20 / 20	100	1.23E+01		5.67E+01		1.61E-01	6.70E+00	2.41E+01	4.09E+01	7.8	N (d)			---			
Zinc	20 / 20	100	1.56E+01		5.94E+01		2.01E+00	2.70E+00	3.31E+01	3.22E+02	46	N (b)			---			
Polychlorinated biphenyls																		
Aroclor 1016	3 / 19	16	2.94E-02	J	1.31E-01	J	3.60E-02	4.40E-02	2.93E-02		0.371	N (a)			---			
Aroclor 1232	1 / 19	5	3.28E-02	J	3.28E-02	J	3.60E-02	4.40E-02	2.03E-02		0.371	N (a)			---			
Aroclor 1242	1 / 19	5	4.32E-02	J	4.32E-02	J	3.60E-02	4.40E-02	2.09E-02		0.371	N (a)			---			
Aroclor 1254	3 / 19	16	7.40E-02		1.80E-01		3.60E-02	4.40E-02	3.44E-02		0.371	N (a)			---			
Aroclor 1260	7 / 19	37	1.26E-02	J	1.24E-01		3.60E-02	4.40E-02	3.37E-02		0.371	N (a)			---			
Explosives																		
1,3,5-Trinitrobenzene	5 / 28	18	1.16E-01	J	2.60E+00		1.50E-01	5.00E+00	3.46E-01		0.376	Y	Normal	6.47E-01	6.47E-01	5.03E-01	8.36E-01	5.03E-01
1,3-Dinitrobenzene	1 / 28	4	9.22E-01		9.22E-01		1.50E-01	5.00E+00	2.45E-01		0.655	Y [h]	Nonparametric	6.30E-01	6.30E-01	NA	NA	NA
2,4,6-Trinitrotoluene	14 / 28	50	1.53E-01	J/U	1.81E+02		2.50E-01	2.80E+01	1.45E+01		NSV	Y	Gamma	2.82E+01	2.82E+01	2.32E+01	1.30E+02	2.32E+01
2,4-Dinitrotoluene	8 / 28	29	1.76E-01	J	9.47E+00		1.50E-01	5.00E+00	8.99E-01		1.28	Y	Gamma	1.51E+00	1.51E+00	7.69E-01	1.76E-01	1.76E-01
2,6-Dinitrotoluene	4 / 28	14	2.72E-01	J	2.03E+00		1.50E-01	5.00E+00	3.44E-01		0.0328	Y	Normal	1.52E+00	1.52E+00	NA	NA	NA
2-Amino-4,6-dinitrotoluene	12 / 28	43	9.32E-02	J	7.74E+00		2.50E-01	5.00E+00	1.24E+00		0.0328	Y	Gamma	1.91E+00	1.91E+00	1.39E+00	6.02E+00	1.39E+00
4-Amino-2,6-dinitrotoluene	9 / 28	32	1.54E-01	J	8.06E+00		2.50E-01	5.00E+00	8.05E-01		0.0328	Y	Gamma	1.29E+00	1.29E+00	1.57E+00	8.06E+00	1.57E+00
RDX	1 / 28	4	2.39E-01		2.39E-01		1.50E-01	1.00E+01	3.44E-01		NSV	N (e)			---			
Tetryl	2 / 28	7	5.87E-01		2.94E+00		1.50E-01	1.30E+01	5.25E-01		NSV	Y	Nonparametric	1.58E+00	1.58E+00	3.79E+00	5.87E-01	5.87E-01
Semivolatile Organic Compounds																		
Acenaphthylene	1 / 20	5	4.67E-02	J	4.67E-02	J	3.60E-01	4.40E-01	1.89E-01		29	N (a)			---			
Benzo(a)anthracene	4 / 20	20	4.44E-02	J/J	5.10E-01		3.60E-01	4.40E-01	2.00E-01		1.1	N (a)			---			
Benzo(a)pyrene	4 / 20	20	1.15E-01	J	4.20E-01		3.60E-01	4.40E-01	2.00E-01		1.1	N (a)			---			
Benzo(b)fluoranthene	4 / 20	20	1.37E-01	J/U	5.50E-01		3.60E-01	4.40E-01	2.15E-01		1.1	N (a)			---			
Benzo(ghi)perylene	1 / 20	5	1.05E-01	J	1.05E-01	J	3.60E-01	4.40E-01	1.92E-01		1.1	N (a)			---			
Chrysene	4 / 20	20	4.96E-02	J/J	4.50E-01		3.60E-01	4.40E-01	1.96E-01		1.1	N (a)			---			
2,4-Dinitrotoluene	7 / 20	35	3.75E-02	J	2.39E+00		3.60E-01	4.40E-01	4.08E-01		1.28	N (f)				NA		
2,6-Dinitrotoluene	5 / 20	25	4.29E-02	J	5.04E-01		3.60E-01	4.40E-01	2.08E-01		0.0328	N (f)				NA		
Fluoranthene	4 / 20	20	9.03E-02	J/J	1.20E+00		3.60E-01	4.40E-01	2.42E-01		1.1	Y	Gamma	3.32E-01	3.32E-01	4.21E-01	1.20E+00	4.21E-01
Indeno(1,2,3-cd)pyrene	3 / 20	15	2.71E-01	J/J	3.43E-01	J	3.60E-01	4.40E-01	2.12E-01		1.1	N (a)			---			
Nitroaniline, 3-	3 / 20	15	5.34E-02	J	7.06E-01		3.74E-01	1.10E+00	2.69E-01		3.16	N (a)			---			
Phenanthrene	4 / 20	20	5.77E-02	J	9.40E-01		3.60E-01	4.40E-01	2.17E-01		29	N (a)			---			
Pyrene	4 / 20	20	7.31E-02	J/J	8.60E-01		3.60E-01	4.40E-01	2.23E-01		1.1	N (a)			---			

Table 3-17

Statistical Summary and COPEC Selection of Chemicals Detected in Soil (0 to 6 Feet) - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

BSC - Background screening concentration
COPEC - Chemical of potential ecological concern
EPC - Exposure point concentration
ESV - Ecological screening value
mg/kg - milligrams per kilogram
NA - Not available or not applicable
NSV - No screening value
UCL - Upper confidence limit
VQ - Validation qualifier (a "/" indicates combined VQs for a regular and field duplicate sample pair)
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed
U - Not detected.

[a] IT Corporation (IT), 1998, ***Site Investigation of Acid Areas*** , Plum Brook Ordnance Works, Sandusky, Ohio, August.
[b] ESVs and their sources are in Appendix B.
[c] N = Chemical is not chosen as a COPEC:
(a) = Maximum detected concentration is less than the ESV.
(b) = Maximum detected concentration is less than the BSC.
(c) = Rssential nutrient.
(d) = Site concentrations are not statistically higher than background concentrations as determined by the Wilcoxon Rank Sum test and box-and-whisker plots. See Appendix C
(e) = Infrequently detected (fewer than 5 percent of all samples).
(f) Chemical is retained as a COPEC under the Explosives analytical suite. See text for details.
[d] Y = Chemical is chosen as COPEC.
[e] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.00.05 (U.S. Environmental Protection Agency (EPA), 2010, ProUCL Version 4.00.05, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/software.htm)
[f] Concentration used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower.
[g] The EPC for the COPEC at the surface soil depth range is used as the exposure concentration for some ecological receptors. Note that the end depth of the surface soil data set extended beyond 1 foot (see text for details).
[h] The chemical may be a site-related contaminant, and was included as a COPEC even though it was infrequently detected.

Table 3-18

Statistical Summary and COPEC Selection of Chemicals Detected in Surface Water - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of values, µg/L: Detected Conc Minimum	VQ	Detected Conc Maximum	VQ	Reporting Limits Minimum	Reporting Limits Maximum	Arithmetic Mean µg/L	ESV [a] µg/L	COPEC? [b,c]	EPC [d] µg/L
Metals												
Aluminum	1 / 1	100	66.5	J	66.5	J	200	200	6.65E+01	8.70E+01	N (a)	---
Barium	1 / 1	100	37.9	J	37.9	J	200	200	3.79E+01	4.00E+00	Y	3.79E+01
Calcium	1 / 1	100	102000		102000		1000	1000	1.02E+05	Nutrient	N (b)	---
Iron	1 / 1	100	5330		5330		300	300	5.33E+03	1.00E+03	N (b)	---
Magnesium	1 / 1	100	18100		18100		5000	5000	1.81E+04	Nutrient	N (b)	---
Manganese	1 / 1	100	534		534		15	15	5.34E+02	1.20E+02	Y	5.34E+02
Potassium	1 / 1	100	3490	J	3490	J	20000	20000	3.49E+03	Nutrient	N (b)	---
Selenium	1 / 1	100	3.8	J	3.8	J	10	10	3.80E+00	3.90E-01	Y	3.80E+00
Sodium	1 / 1	100	38900		38900		10000	10000	3.89E+04	Nutrient	N (b)	---
Semivolatile Organic Compounds												
3-Methylphenol and 4-Methylphenol	1 / 1	100	4.7	J	4.7	J	4.8	4.8	4.70E+00	5.30E+01	N (a)	---
Phenol	1 / 1	100	2.8	J	2.8	J	4.8	4.8	2.80E+00	1.10E+02	N (a)	---

ESV - Ecological screening value.
EPC - Exposure point concentration.
COPEC - Chemical of potential ecological concern.
µg/L - Micrograms per liter.
VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.

[a] ESVs and their sources are in Appendix B.
[b] N = Chemical is not chosen as a COPEC:
(a) = Maximum detected concentration is less than the ESV.
(b) = Essential nutrient.
[c] Y = Chemical is chosen as COPEC.
[d] Due to the small sample size (i.e., < 5 samples), the maximum detected concentration is selected as the EPC.

Table 3-19

Statistical Summary and COPEC Selection of Chemicals Detected in Sediment - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	ESV [b] mg/kg	COPEC? [c,d]	EPC [e] mg/kg
Inorganics													
Aluminum	4 / 4	100	3.70E+00		1.22E+01		1.20E+00	1.30E+00	8.14E+00	1.55E+04	NSV	N (b)	---
Barium	3 / 4	75	2.55E+01	/U	4.74E+01		2.38E+01	2.58E+01	2.84E+01	8.26E+02	NSV	N (b)	---
Cadmium	1 / 4	25	2.60E-01		2.60E-01		2.35E-01	2.60E-01	1.56E-01	NA	9.90E-01	N (a)	---
Chromium	4 / 4	100	8.20E+00		1.40E+01		5.95E-01	6.40E-01	1.24E+01	2.90E+01	4.34E+01	N (a)	---
Lead	4 / 4	100	2.80E+00		8.90E+00		3.55E-01	3.90E-01	6.31E+00	4.86E+01	3.58E+01	N (a)	---
Selenium	2 / 4	50	7.30E-01		8.50E-01		5.95E-01	6.40E-01	5.47E-01	2.00E+00	NSV	N (b)	---

BSC - Background screening concentration. The soil BSC is used for sediment in this evaluation. See text for details.
COPEC - Chemical of potential ecological concern.
EPC - Exposure point concentration.
ESV - Ecological screening value.
/U - The compound/analyte was positively identified in one sample averaged with a field duplicate that was nondetect (U qualified).
mg/kg - Milligrams per kilogram.
NA - Not available.
NSV - No screening value available.
VQ - Validation qualifier.

[a] Soil background screening concentrations are used for sediment. See text for details.
[b] ESVs and their sources are in Appendix B.
[c] N = Chemical is not chosen as a COPEC:
(a) = Maximum detected concentration is less than the ESV.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
[d] Y = Chemical is chosen as COPEC.
[e] Due to the low sample size (< 5), the maximum detected concentration is selected as the EPC.

Table 3-20

Wildlife Hazard Quotients for all Assessment Receptors - WWTP1
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

COPEC	Deer Mouse		Short-tailed Shrew		Cottontail Rabbit		Marsh Wren		White-tailed Deer		Red-tailed Hawk	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Metals												
Barium	1.10E-03	2.85E-04	1.14E-03	2.94E-04	7.22E-04	1.86E-04	4.92E-04	2.45E-04	7.61E-07	1.96E-07	1.04E-07	5.21E-08
Manganese	9.02E-04	2.80E-04	9.30E-04	2.88E-04	5.90E-04	1.83E-04	1.48E-04	1.48E-05	6.22E-07	1.93E-07	3.13E-08	3.13E-09
Mercury	5.75E-03	5.66E-04	7.18E-03	7.07E-04	1.32E-03	1.30E-04	4.61E-01	2.30E-01	5.94E-07	5.85E-08	7.53E-06	3.76E-06
Selenium	2.82E-03	1.71E-03	2.91E-03	1.77E-03	1.85E-03	1.12E-03	2.05E-03	1.03E-03	1.95E-06	1.18E-06	4.95E-07	1.45E-07
Nitroaromatics												
1,3,5-Trinitrobenzene	6.10E-02	1.22E-02	9.42E-02	1.88E-02	1.81E-02	3.62E-03	**4.59E+00**	9.18E-01	1.40E-05	2.79E-06	7.68E-05	1.54E-05
1,3-Dinitrobenzene	0.00E+00	0.00E+00	**1.10E+01**	**4.73E+00**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.53E-03	6.56E-04	0.00E+00	0.00E+00
2,4,6-Trinitrotoluene	9.32E-01	1.86E-01	1.47E+00	2.93E-01	2.44E-01	4.87E-02	**8.44E+00**	**1.69E+00**	1.77E-04	3.54E-05	1.17E-04	2.34E-05
2,4-Dinitrotoluene	5.49E-02	7.32E-03	2.26E-01	3.01E-02	3.78E-02	5.04E-03	6.28E-04	1.26E-04	1.79E-04	2.39E-05	2.07E-08	4.14E-09
2,6-Dinitrotoluene	0.00E+00	0.00E+00	2.27E-01	3.03E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.53E-04	2.04E-05	0.00E+00	0.00E+00
2-Amino-4,6-dinitrotoluene	6.11E-02	1.15E-02	6.36E-03	1.19E-03	4.45E-02	8.34E-03	4.94E-03	9.89E-04	3.66E-05	6.87E-06	1.63E-07	3.25E-08
4-Amino-2,6-dinitrotoluene	6.91E-02	1.30E-02	4.30E-03	8.05E-04	5.03E-02	9.43E-03	5.59E-03	1.12E-03	2.48E-05	4.64E-06	1.84E-07	3.68E-08
All Nitrotoluenes (summed)	*1.30E+00*	*2.43E-01*	**1.93E+00**	*3.56E-01*	*3.76E-01*	*7.15E-02*	**8.45E+00**	**1.69E+00**	*5.71E-04*	*9.13E-05*	*1.17E-04*	*2.34E-05*
Tetryl	**4.35E+00**	8.69E-01	**2.40E+00**	4.79E-01	1.10E+00	2.19E-01	NA	NA	2.74E-04	5.48E-05	NA	NA
Semivolatile Organics												
Fluoranthene	2.59E-03	5.19E-04	1.22E-03	2.45E-04	1.61E-03	3.22E-04	7.11E-04	7.11E-05	7.08E-07	1.42E-07	1.22E-08	1.22E-09

COPEC - Chemical of potential ecological concern.
LOAEL - Lowest-observed-adverse-effect level.
NA - No toxicity data available; hazard quotients not calculated.
NOAEL - No-observed-adverse-effect level.

Shaded cells indicate a hazard quotient greater than 1, when rounded.

Table 4-1

Summary of Water Level Measurements - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Well Identification	Coordinates (Ohio Plane)[a] Northing (y)	Easting (x)	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (ft msl)			
TNTA/WWTP1 Sewer Lines								
					26-May-09		9-Nov-09	
					DTW	Elevation	DTW	Elevation
Temporary Piezometer								
PZ01	NS	NS	NS	NS	6.45	--	[c]Abandoned	--
PZ02	624,614.47	1,921,581.00	632.10	629.40	6.31	625.79	[c]Abandoned	--
PZ03	624,612.42	1,921,713.34	632.08	629.00	5.63	626.45	[c]Abandoned	--
PZ04	624,609.33	1,921,832.45	631.01	629.80	4.34	626.67	[c]Abandoned	--
PZ05	624,592.56	1,922,545.31	639.03	635.70	7.55	631.48	[c]Abandoned	--
PZ06	624,306.47	1,922,397.79	634.08	631.30	5.43	628.65	[c]Abandoned	--
PZ07	624,335.37	1,922,550.74	633.80	630.60	5.28	628.52	[c]Abandoned	--
PZ08	624,360.52	1,922,687.65	633.93	630.90	5.79	628.14	[c]Abandoned	--
PZ09	624,464.54	1,923,237.32	633.84	631.20	riser bent	--	[c]Abandoned	--
PZ10	624,484.42	1,923,339.45	632.11	630.40	3.26	628.85	[c]Abandoned	--
Overburden/Shale Monitoring Well								
1SLA-MW01	624,190.42	1,922,785.52	634.66	631.70	20.20	614.46	11.48	623.18
1SLA-MW02	624,354.65	1,922,688.56	633.93	630.80	8.05	625.88	4.55	629.38
1SLA-MW03	624,654.19	1,922,564.00	639.71	636.70	7.53	632.18	11.04	628.67
Delaware Limestone Monitoring Well								
1SLA-BEDGW-001	624,129.03	1,922,624.33	636.14	633.00	58.35	577.79	57.06	579.08
1SLA-BEDGW-002	624,368.22	1,922,687.20	634.16	630.90	46.94	587.22	46.55	587.61
1SLA-BEDGW-003	624,696.73	1,922,811.24	636.74	634.00	49.60	587.14	51.59	585.15

Notes:

[a]Northings and Eastings are scaled to the Ohio State Plane Coordinate System (North Zone), NAD 1983, Vertical datum to National Geodetic Vertical Datum 1929.

[b]Piezometers were abandoned.

[c]Temporary Piezometer - Survey data taken from associated test pit, piezometers not surveyed.

DTW - Depth to water. NM - Not measured.

ft msl - Feet above mean sea level.

NA - Not applicable. NS - Not surveyed.

Table 4-2

Detected Analytes in Surface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines									
				LOCATION CODE	SL-SB01		SL-SB02		SL-SB03		SL-SB04		SL-SB05	
				SAMPLE NO	SL0061		SL0063		SL0067		SL0069		SL0071	
				SAMPLE DATE	13-Jan-09		12-Jan-09		13-Jan-09		13-Jan-09		13-Jan-09	
				DEPTH	0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives														
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	31.3	0.471		-	-	-	-	-	-	18.5	
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	50.1	0.605		-	-	-	-	-	-	16.4	
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	1.46	-	-	-	-	-	-	-	-	1.46	
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.75	-	-	-	-	-	-	-	-	0.75	
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.196	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	1,200	-	-	-	-	-	-	-	-	138	
PCBs														
Aroclor 1016	mg/kg	0.39	NE	1.16	-	-	0.125	J	0.0478	J	0.0191	J	1.16	J
Aroclor 1260	mg/kg	0.22	NE	0.268	-	-	-	-	-	-	-	-	-	-
SEMIVOLATILES														
Acenaphthylene	mg/kg	NE	NE	0.111	-	-	0.111	J	-	-	-	-	-	-
Anthracene	mg/kg	1,700	NE	0.299	-	-	0.299	J	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	1.54	0.047	J	1.54		-	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.015	NE	1.18	-	-	1.18		-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	2	0.0713	J	2		-	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	NE	NE	0.69	-	-	0.69		-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	0.54	-	-	0.54		-	-	-	-	-	-
Benzoic acid	mg/kg	24,000	NE	0.639	0.639	QJ	0.537		-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	mg/kg	35	NE	0.0869	-	-	0.0869	J	-	-	-	-	-	-
Chrysene	mg/kg	15	NE	1.36	0.0632	J	1.36		-	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.196	-	-	0.196	J	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	4.42	-	-	0.0615	J	-	-	-	-	4.42	
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	2.18	-	-	-	-	-	-	-	-	2.18	
Fluoranthene	mg/kg	230	NE	3.05	0.111	J	3.05		-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	1.06	-	-	1.06		-	-	-	-	-	-
Nitroaniline, 3-	mg/kg	NE	NE	0.299	-	-	-	-	-	-	-	-	0.299	J
Phenanthrene	mg/kg	NE	NE	0.392	0.0427	J	0.392	J	-	-	-	-	-	-
Pyrene	mg/kg	170	NE	2.22	0.0726	J	2.22		-	-	-	-	-	-

Table 4-2

Detected Analytes in Surface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines									
				LOCATION CODE	SL-SB01		SL-SB02		SL-SB03		SL-SB04		SL-SB05	
				SAMPLE NO	SL0061		SL0063		SL0067		SL0069		SL0071	
				SAMPLE DATE	13-Jan-09		12-Jan-09		13-Jan-09		13-Jan-09		13-Jan-09	
				DEPTH	0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS														
Aluminum	mg/kg	7,700	15,500	12400	8,710		12,400		9,090		8,870		8,810	
Antimony	mg/kg	3.1	9.3	0.67	-	-	-	-	0.357	J	-	-	-	-
Arsenic	mg/kg	0.39	36.5	12.2	4.8	J	5.93	J	12.2	J	5.76	J	6.15	J
Barium	mg/kg	1,500	826	84	52.3		84		51.7		52.2		52.3	
Beryllium	mg/kg	16	1	7.87	**5.22**	J	**6.82**	J	**7.87**	J	**5.95**	J	**6.43**	J
Cadmium	mg/kg	7	NE	0.387	-	-	-	-	-	-	-	-	-	-
Calcium	mg/kg	NE	52,300	7330	4,090		6,360		7,330		5,630		4,030	
Chromium	mg/kg	0.29	29	16.5	11.2		16.5		14.1		13.2		1.7	
Cobalt	mg/kg	2.3	116	8.65	4.19		5.97		8.65		5.36		7.1	
Copper	mg/kg	310	56.2	27.8	15.4		25.6		27.8		20.9		21.9	
Iron	mg/kg	5,500	234,000	25200	14,600		19,500		25,200		16,400		19,000	
Lead	mg/kg	400	48.6	28.3	14		20.2		13.9		11.9		11.4	
Magnesium	mg/kg	NE	10,400	3500	1,610	J	2,840	J	3,500	J	2,350	J	2,270	J
Manganese	mg/kg	180	3,506	306	156		137		306		153		211	
Mercury	mg/kg	2.3	0.09	0.443	**0.443**		0.0483		0.0419		0.0406		0.0441	
Nickel	mg/kg	150	55.1	19.6	2.68	J	9.06	J	11.8	J	9.5	J	8.35	J
Potassium	mg/kg	NE	3,390	900	480		718		900		633		616	
Selenium	mg/kg	39	2	0.8	-	-	0.608	J	-	-	-	-	-	-
Sodium	mg/kg	NE	NE	76.7	48.1		68.7		76.7		51.6		51.9	
Thallium	mg/kg	NE	1.3	0.366	-	-	-	-	0.366	J	-	-	-	-
Vanadium	mg/kg	39	40.9	26.3	20.4		26.3		20.2		21.1		23	
Zinc	mg/kg	2,300	321.75	72.3	34	J	50.9	J	65.2	J	46.9	J	48.7	J
GENERAL CHEMISTRY														
Total organic carbon	mg/kg	NE	NE	3,260	3,260									

Table 4-2

Detected Analytes in Surface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines									
				LOCATION CODE	SL-SB06		SL-SB07						SL-SB08	
				SAMPLE NO	SL0073		SL0075		SL0076		SL0077		SL0079	
				SAMPLE DATE	13-Jan-09		14-Jan-09		14-Jan-09		14-Jan-09		14-Jan-09	
				DEPTH	0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft	
				SAMPLE PURPOSE	REG		REG		FD		FS		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives														
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	31.3	-	-	0.179	J	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	50.1	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	1.46	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.75	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.196	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	1,200	-	-	0.868		0.196	J	0.28		0.271	J
PCBs														
Aroclor 1016	mg/kg	0.39	NE	1.16	0.0828	J	-	-	-	-	-	-	0.0828	J
Aroclor 1260	mg/kg	0.22	NE	0.268	-	-	0.0265	J	0.268	J	-	-	-	-
SEMIVOLATILES														
Acenaphthylene	mg/kg	NE	NE	0.111	-	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg	1,700	NE	0.299	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	1.54	-	-	-	-	-	-	-	-	0.0581	J
Benzo(a)pyrene	mg/kg	0.015	NE	1.18	-	-	-	-	-	-	-	-	0.053	J
Benzo(b)fluoranthene	mg/kg	0.15	NE	2	-	-	-	-	-	-	-	-	0.0962	J
Benzo(ghi)perylene	mg/kg	NE	NE	0.69	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	0.54	-	-	-	-	-	-	-	-	-	-
Benzoic acid	mg/kg	24,000	NE	0.639	-	-	-	-	-	-			-	-
Bis(2-ethylhexyl)phthalate	mg/kg	35	NE	0.0869	-	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	15	NE	1.36	-	-	-	-	-	-	-	-	0.0794	J
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.196	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	4.42	0.0563	J	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	2.18	-	-	-	-	-	-	-	-	-	-
Fluoranthene	mg/kg	230	NE	3.05	-	-	0.0433	J	-	-	-	-	0.163	J
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	1.06	-	-	-	-	-	-	-	-	-	-
Nitroaniline, 3-	mg/kg	NE	NE	0.299	-	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg	NE	NE	0.392	-	-	-	-	-	-	-	-	0.102	J
Pyrene	mg/kg	170	NE	2.22	-	-	-	-	-	-	-	-	0.12	J

Table 4-2

Detected Analytes in Surface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines									
				LOCATION CODE	SL-SB06		SL-SB07						SL-SB08	
				SAMPLE NO	SL0073		SL0075		SL0076		SL0077		SL0079	
				SAMPLE DATE	13-Jan-09		14-Jan-09		14-Jan-09		14-Jan-09		14-Jan-09	
				DEPTH	0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft	
				SAMPLE PURPOSE	REG		REG		FD		FS		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS														
Aluminum	mg/kg	7,700	15,500	12400	9,020		7,890	J	7,110	J	8,820		8,280	J
Antimony	mg/kg	3.1	9.3	0.67	-	-	0.67	J	0.388	J	-	-	0.33	J
Arsenic	mg/kg	0.39	36.5	12.2	6.15	J	6.3		6.25		5.4		7.71	
Barium	mg/kg	1,500	826	84	51.2		51.2		47.9		45.9		46	
Beryllium	mg/kg	16	1	7.87	**5.88**	J	**5.94**		**5.43**		-	-	**6.36**	
Cadmium	mg/kg	7	NE	0.387	-	-	0.297	J	0.273	J	-	-	0.387	J
Calcium	mg/kg	NE	52,300	7330	4,210		4,350		3,630		3,680		4,510	
Chromium	mg/kg	0.29	29	16.5	13.5		11.9		10.7		12.5		12.6	
Cobalt	mg/kg	2.3	116	8.65	6.09		5.52		5.16		-	-	6.24	
Copper	mg/kg	310	56.2	27.8	17.1		17.5	J	14.7	J	14.1		19.7	J
Iron	mg/kg	5,500	234,000	25200	17,800		16,300	J	15,000	J	16,400		18,300	J
Lead	mg/kg	400	48.6	28.3	10.3		20.7		20.6		16.9		28.3	
Magnesium	mg/kg	NE	10,400	3500	2,260	J	2,000	J	1,780	J	1,990		2,110	J
Manganese	mg/kg	180	3,506	306	190		180		225		174		286	
Mercury	mg/kg	2.3	0.09	0.443	0.0348		0.0352		0.0276		-	-	0.0437	
Nickel	mg/kg	150	55.1	19.6	7	J	17.3		15.5		15.5		19.6	
Potassium	mg/kg	NE	3,390	900	485		489		433		896		682	
Selenium	mg/kg	39	2	0.8	0.51	J	-	-	-	-	0.8		0.517	J
Sodium	mg/kg	NE	NE	76.7	53.9		46.7		32		-	-	31.1	
Thallium	mg/kg	NE	1.3	0.366	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/kg	39	40.9	26.3	22.5		20.6		19		19.6		21.4	
Zinc	mg/kg	2,300	321.75	72.3	43.7	J	58.3		54.1		50.8		72.3	
GENERAL CHEMISTRY														
Total organic carbon	mg/kg	NE	NE	3,260										

Table 4-2

Detected Analytes in Surface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines											
				LOCATION CODE	SL-SB05R		SL-SB11						SL-SB12		SL-SB13	
				SAMPLE NO	SL0233		SL0234		SL0235		SL0236		SL0237		SL0238	
				SAMPLE DATE	23-Aug-11		23-Aug-11		23-Aug-11		23-Aug-11		23-Aug-11		23-Aug-11	
				DEPTH	0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft	
				SAMPLE PURPOSE	REG		REG		FD		FS		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives																
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	31.3	15.9		0.154	J	0.1	J	-	-	31.3		0.147	J
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	50.1	15.6		-	-	0.0958	J	-	-	50.1		0.172	J
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	1.46	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.75	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.196	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	1,200	287		-	-	0.275		-	-	1,200		0.109	J
PCBs																
Aroclor 1016	mg/kg	0.39	NE	1.16												
Aroclor 1260	mg/kg	0.22	NE	0.268												
SEMIVOLATILES																
Acenaphthylene	mg/kg	NE	NE	0.111												
Anthracene	mg/kg	1,700	NE	0.299												
Benzo(a)anthracene	mg/kg	0.15	NE	1.54												
Benzo(a)pyrene	mg/kg	0.015	NE	1.18												
Benzo(b)fluoranthene	mg/kg	0.15	NE	2												
Benzo(ghi)perylene	mg/kg	NE	NE	0.69												
Benzo(k)fluoranthene	mg/kg	1.5	NE	0.54												
Benzoic acid	mg/kg	24,000	NE	0.639												
Bis(2-ethylhexyl)phthalate	mg/kg	35	NE	0.0869												
Chrysene	mg/kg	15	NE	1.36												
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.196												
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	4.42												
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	2.18												
Fluoranthene	mg/kg	230	NE	3.05												
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	1.06												
Nitroaniline, 3-	mg/kg	NE	NE	0.299												
Phenanthrene	mg/kg	NE	NE	0.392												
Pyrene	mg/kg	170	NE	2.22												

Table 4-2

Detected Analytes in Surface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines											
				LOCATION CODE	SL-SB05R		SL-SB11						SL-SB12		SL-SB13	
				SAMPLE NO	SL0233		SL0234		SL0235		SL0236		SL0237		SL0238	
				SAMPLE DATE	23-Aug-11		23-Aug-11		23-Aug-11		23-Aug-11		23-Aug-11		23-Aug-11	
				DEPTH	0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft	
				SAMPLE PURPOSE	REG		REG		FD		FS		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS																
Aluminum	mg/kg	7,700	15,500	12400												
Antimony	mg/kg	3.1	9.3	0.67												
Arsenic	mg/kg	0.39	36.5	12.2												
Barium	mg/kg	1,500	826	84												
Beryllium	mg/kg	16	1	7.87												
Cadmium	mg/kg	7	NE	0.387												
Calcium	mg/kg	NE	52,300	7330												
Chromium	mg/kg	0.29	29	16.5												
Cobalt	mg/kg	2.3	116	8.65												
Copper	mg/kg	310	56.2	27.8												
Iron	mg/kg	5,500	234,000	25200												
Lead	mg/kg	400	48.6	28.3												
Magnesium	mg/kg	NE	10,400	3500												
Manganese	mg/kg	180	3,506	306												
Mercury	mg/kg	2.3	0.09	0.443												
Nickel	mg/kg	150	55.1	19.6												
Potassium	mg/kg	NE	3,390	900												
Selenium	mg/kg	39	2	0.8												
Sodium	mg/kg	NE	NE	76.7												
Thallium	mg/kg	NE	1.3	0.366												
Vanadium	mg/kg	39	40.9	26.3												
Zinc	mg/kg	2,300	321.75	72.3												
GENERAL CHEMISTRY																
Total organic carbon	mg/kg	NE	NE	3,260												

Table 4-2

Detected Analytes in Surface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines											
				LOCATION CODE	SL-SB14		SL-SB23		SL-SB24		SL-SB25		SL-SB26		SL-SB27	
				SAMPLE NO	SL0239		SL0248		SL0249		SL0250		SL0251		SL0252	
				SAMPLE DATE	23-Aug-11		22-Sep-11		22-Sep-11		22-Sep-11		22-Sep-11		22-Sep-11	
				DEPTH	0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives																
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	31.3	2.04		-	-	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	50.1	1.63		-	-	0.444		-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	1.46	-	-	-	-	0.51		-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.75	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.196	0.196	J	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	1,200	18		-	-	0.639		-	-	-	-	-	-
PCBs																
Aroclor 1016	mg/kg	0.39	NE	1.16												
Aroclor 1260	mg/kg	0.22	NE	0.268												
SEMIVOLATILES																
Acenaphthylene	mg/kg	NE	NE	0.111												
Anthracene	mg/kg	1,700	NE	0.299												
Benzo(a)anthracene	mg/kg	0.15	NE	1.54												
Benzo(a)pyrene	mg/kg	0.015	NE	1.18												
Benzo(b)fluoranthene	mg/kg	0.15	NE	2												
Benzo(ghi)perylene	mg/kg	NE	NE	0.69												
Benzo(k)fluoranthene	mg/kg	1.5	NE	0.54												
Benzoic acid	mg/kg	24,000	NE	0.639												
Bis(2-ethylhexyl)phthalate	mg/kg	35	NE	0.0869												
Chrysene	mg/kg	15	NE	1.36												
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.196												
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	4.42												
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	2.18												
Fluoranthene	mg/kg	230	NE	3.05												
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	1.06												
Nitroaniline, 3-	mg/kg	NE	NE	0.299												
Phenanthrene	mg/kg	NE	NE	0.392												
Pyrene	mg/kg	170	NE	2.22												

Table 4-2

Detected Analytes in Surface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines											
				LOCATION CODE	SL-SB14		SL-SB23		SL-SB24		SL-SB25		SL-SB26		SL-SB27	
				SAMPLE NO	SL0239		SL0248		SL0249		SL0250		SL0251		SL0252	
				SAMPLE DATE	23-Aug-11		22-Sep-11		22-Sep-11		22-Sep-11		22-Sep-11		22-Sep-11	
				DEPTH	0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS																
Aluminum	mg/kg	7,700	15,500	12400												
Antimony	mg/kg	3.1	9.3	0.67												
Arsenic	mg/kg	0.39	36.5	12.2												
Barium	mg/kg	1,500	826	84												
Beryllium	mg/kg	16	1	7.87												
Cadmium	mg/kg	7	NE	0.387												
Calcium	mg/kg	NE	52,300	7330												
Chromium	mg/kg	0.29	29	16.5												
Cobalt	mg/kg	2.3	116	8.65												
Copper	mg/kg	310	56.2	27.8												
Iron	mg/kg	5,500	234,000	25200												
Lead	mg/kg	400	48.6	28.3												
Magnesium	mg/kg	NE	10,400	3500												
Manganese	mg/kg	180	3,506	306												
Mercury	mg/kg	2.3	0.09	0.443												
Nickel	mg/kg	150	55.1	19.6												
Potassium	mg/kg	NE	3,390	900												
Selenium	mg/kg	39	2	0.8												
Sodium	mg/kg	NE	NE	76.7												
Thallium	mg/kg	NE	1.3	0.366												
Vanadium	mg/kg	39	40.9	26.3												
Zinc	mg/kg	2,300	321.75	72.3												
GENERAL CHEMISTRY																
Total organic carbon	mg/kg	NE	NE	3,260												

Table 4-2

Detected Analytes in Surface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines													
				LOCATION CODE	SL-SB28		SL-SB29		SL-SB30		SL-SB31		SL-SB32		SL-SB32		SL-SB32	
				SAMPLE NO	SL0253		SL0254		SL0255		SL0256		SL0257		SL0259		SL0258	
				SAMPLE DATE	22-Sep-11		22-Sep-11		22-Sep-11		22-Sep-11		22-Sep-11		22-Sep-11		28-Sep-11	
				DEPTH	0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		FS		FD	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives																		
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	31.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	50.1	0.254		-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	1.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.196	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	1,200	0.723		-	-	-	-	-	-	-	-	-	-	-	-
PCBs																		
Aroclor 1016	mg/kg	0.39	NE	1.16														
Aroclor 1260	mg/kg	0.22	NE	0.268														
SEMIVOLATILES																		
Acenaphthylene	mg/kg	NE	NE	0.111														
Anthracene	mg/kg	1,700	NE	0.299														
Benzo(a)anthracene	mg/kg	0.15	NE	1.54														
Benzo(a)pyrene	mg/kg	0.015	NE	1.18														
Benzo(b)fluoranthene	mg/kg	0.15	NE	2														
Benzo(ghi)perylene	mg/kg	NE	NE	0.69														
Benzo(k)fluoranthene	mg/kg	1.5	NE	0.54														
Benzoic acid	mg/kg	24,000	NE	0.639														
Bis(2-ethylhexyl)phthalate	mg/kg	35	NE	0.0869														
Chrysene	mg/kg	15	NE	1.36														
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.196														
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	4.42														
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	2.18														
Fluoranthene	mg/kg	230	NE	3.05														
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	1.06														
Nitroaniline, 3-	mg/kg	NE	NE	0.299														
Phenanthrene	mg/kg	NE	NE	0.392														
Pyrene	mg/kg	170	NE	2.22														

Table 4-2

Detected Analytes in Surface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines													
				LOCATION CODE	SL-SB28		SL-SB29		SL-SB30		SL-SB31		SL-SB32		SL-SB32		SL-SB32	
				SAMPLE NO	SL0253		SL0254		SL0255		SL0256		SL0257		SL0259		SL0258	
				SAMPLE DATE	22-Sep-11		22-Sep-11		22-Sep-11		22-Sep-11		22-Sep-11		22-Sep-11		28-Sep-11	
				DEPTH	0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		FS		FD	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS																		
Aluminum	mg/kg	7,700	15,500	12400														
Antimony	mg/kg	3.1	9.3	0.67														
Arsenic	mg/kg	0.39	36.5	12.2														
Barium	mg/kg	1,500	826	84														
Beryllium	mg/kg	16	1	7.87														
Cadmium	mg/kg	7	NE	0.387														
Calcium	mg/kg	NE	52,300	7330														
Chromium	mg/kg	0.29	29	16.5														
Cobalt	mg/kg	2.3	116	8.65														
Copper	mg/kg	310	56.2	27.8														
Iron	mg/kg	5,500	234,000	25200														
Lead	mg/kg	400	48.6	28.3														
Magnesium	mg/kg	NE	10,400	3500														
Manganese	mg/kg	180	3,506	306														
Mercury	mg/kg	2.3	0.09	0.443														
Nickel	mg/kg	150	55.1	19.6														
Potassium	mg/kg	NE	3,390	900														
Selenium	mg/kg	39	2	0.8														
Sodium	mg/kg	NE	NE	76.7														
Thallium	mg/kg	NE	1.3	0.366														
Vanadium	mg/kg	39	40.9	26.3														
Zinc	mg/kg	2,300	321.75	72.3														
GENERAL CHEMISTRY																		
Total organic carbon	mg/kg	NE	NE	3,260														

Table 4-2

Detected Analytes in Surface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

BSC - Background screening concentration.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
mg/kg - Milligrams per kilogram.
NE - Not established (RBSCs), not evaluated (BSCs).
Shaded cell indicates value is greater than RBSC.
RBSC - Risk-based screening concentration. Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
Bold text indicates value is greater than BSC.
Blank cell means that parameter was not analyzed.
"-" - Not detected.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
QJ - Analyte detected but was estimated due to instrument response below method criteria.

Table 4-3

Detected Analytes in Test Pit Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines											
				LOCATION CODE	TNTA-SL-TP03		TNTA-SL-TP04		TNTA-SL-TP21		TNTA-SL-TP22					
				SAMPLE NO	SL0003		SL0004		SL0025		SL0026		SL0027		SL0028	
				SAMPLE DATE	4-Dec-08		4-Dec-08		5-Dec-08		5-Dec-08		5-Dec-08		5-Dec-08	
				DEPTH	5 - 5_5 Ft		4 - 4_5 Ft		4 - 4_5 Ft		4 - 4_5 Ft		4 - 4_5 Ft		4 - 4_5 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		FD		FS	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives																
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	3.78	0.267	J	-	-	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	9.98	0.401		-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	3.25	0.624		-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.584	0.217	J	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	1.51	0.567		-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	1380	0.68		-	-	-	-	-	-	-	-	-	-

Table 4-3

Detected Analytes in Test Pit Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines									
				LOCATION CODE	TNTA-SL-TP23		TNTA-SL-TP24		TNTA-SL-TP25		TNTA-SL-TP26		TNTA-SL-TP27	
				SAMPLE NO	SL0029		SL0030		SL0031		SL0032		SL0033	
				SAMPLE DATE	5-Dec-08		5-Dec-08		5-Dec-08		4-Dec-08		4-Dec-08	
				DEPTH	4 - 4_5 Ft		4 - 4_25 Ft		4 - 4_25 Ft		4 - 4_3 Ft		3 - 3_5 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives														
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	3.78	-	-	-	-	0.268	J	-	-	3.78	
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	9.98	-	-	-	-	0.476		-	-	9.98	
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	3.25	-	-	-	-	-	-	-	-	3.25	
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.584	-	-	-	-	-	-	-	-	0.526	
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	1.51	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	1380	-	-	-	-	-	-	-	-	3.35	

Table 4-3

Detected Analytes in Test Pit Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines											
				LOCATION CODE	TNTA-SL-TP28						TNTA-SL-TP29		TNTA-SL-TP30		TNTA-SL-TP32	
				SAMPLE NO	SL0034		SL0035		SL0036		SL0037		SL0038		SL0040	
				SAMPLE DATE	4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08	
				DEPTH	3 - 3_25 Ft		3 - 3_25 Ft		3 - 3_25 Ft		5 - 5_5 Ft		5 - 5_25 Ft		5 - 5_5 Ft	
				SAMPLE PURPOSE	REG		FD		FS		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives																
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	3.78	-	-	-	-	-	-	-	-	1.67		-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	9.98	-	-	-	-	-	-	-	-	3.16		-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	3.25	-	-	-	-	-	-	-	-	0.896		-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.584	-	-	-	-	-	-	-	-	0.529		-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	1.51	-	-	-	-	-	-	-	-	0.978		-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	1380	-	-	0.251	J	-	-	-	-	77.8		-	-

Table 4-3

Detected Analytes in Test Pit Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines									
				LOCATION CODE	TNTA-SL-TP33		TNTA-SL-TP34		TNTA-SL-TP35		TNTA-SL-TP36		TNTA-SL-TP37	
				SAMPLE NO	SL0041		SL0042		SL0043		SL0044		SL0045	
				SAMPLE DATE	4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08		4-Dec-08	
				DEPTH	5 - 5_5 Ft		5 - 5_5 Ft		5 - 5_25 Ft		5 - 5_5 Ft		4 - 4_25 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives														
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	3.78	-	-	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	9.98	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	3.25	1.76		-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.584	0.584		-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	1.51	1.51		-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	1380	1,380		0.149	J	-	-	-	-	1.09	J

BSC - Background screening concentration.
mg/kg - Milligrams per kilogram.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
NE - Not established (RBSCs), not evaluated (BSCs).
Shaded cell indicates value is greater than RBSC.
RBSC - Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
"-" - Not detected.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.

Table 4-4

Detected Analytes in 2009 and 2011 Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines											
				LOCATION CODE	SL-SB01		SL-SB02						SL-SB03		SL-SB04	
				SAMPLE NO	SL0062		SL0064		SL0065		SL0066		SL0068		SL0070	
				SAMPLE DATE	13-Jan-09		12-Jan-09		12-Jan-09		12-Jan-09		13-Jan-09		13-Jan-09	
				DEPTH	4 - 6 Ft		8 - 10 Ft		8 - 10 Ft		8 - 10 Ft		5 - 6 Ft		3.4 - 5.4 Ft	
				SAMPLE PURPOSE	REG		REG		FD		FS		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives																
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	0.209	-	-	-	-	-	-	-	-	-	-	0.209	J
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	0.163	-	-	-	-	-	-	-	-	-	-	0.149	J
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.533	-	-	-	-	-	-	-	-	-	-	0.201	J
Bold text indicates value is g	mg/kg	220	NE	1.98	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	0.549	-	-	-	-	-	-	-	-	-	-	-	-
PCBs																
Aroclor 1016	mg/kg	0.39	NE	0.0553	0.0553	0.1	0.0553	0.1	-	-	-	-	-	-	0.0553	J
Aroclor 1221	mg/kg	0.14	NE	0.199	-	-	-	-	0.199	QJ	-	-	-	-	-	-
SEMIVOLATILES																
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.434	-	-	-	-	-	-	-	-	-	-	0.104	J
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.128	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg	NE	NE	0.0898	-	-	0.0854	J	0.0408	J	-	-	-	-	-	-

Table 4-4

Detected Analytes in 2009 and 2011 Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines											
				LOCATION CODE	SL-SB01		SL-SB02						SL-SB03		SL-SB04	
				SAMPLE NO	SL0062		SL0064		SL0065		SL0066		SL0068		SL0070	
				SAMPLE DATE	13-Jan-09		12-Jan-09		12-Jan-09		12-Jan-09		13-Jan-09		13-Jan-09	
				DEPTH	4 - 6 Ft		8 - 10 Ft		8 - 10 Ft		8 - 10 Ft		5 - 6 Ft		3.4 - 5.4 Ft	
				SAMPLE PURPOSE	REG		REG		FD		FS		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS																
Aluminum	mg/kg	7,700	15,500	10,300	7,040		7,070		8,490		8,470		7,740		9,430	
Antimony	mg/kg	3.1	9.3	0.572	0.391	J	0.311	J	0.259	J	-	-	0.448	J	0.517	J
Arsenic	mg/kg	0.39	36.5	20.3	13.8	J	12.8	J	14.6	J	14.9		12.6	J	14.2	J
Barium	mg/kg	1,500	826	116	41.7		35		26.3		41.7		70.2		57.7	
Beryllium	mg/kg	16	1	10.3	**6.99**	J	**6.79**	J	**6.87**	J	-	-	**10.3**	J	**8.69**	J
Cadmium	mg/kg	7	NE	0.559	0.234	J	-	-	0.306	J	-	-	0.275	J	0.285	J
Calcium	mg/kg	NE	52,300	46,600	27,800		45,100		43,400		46,600		23,200		2,790	
Chromium	mg/kg	0.29	29	15.9	10.8		10.3		12		13.6		12.7		15.3	
Cobalt	mg/kg	2.3	116	17.3	9.15		8.55		10.6		11.6		8.57		16.4	
Copper	mg/kg	310	56.2	37	36.3		35.3		33.7		31.8		30.4		31	
Iron	mg/kg	5,500	234,000	65,600	26,600		23,600		23,800		25,900		65,600		33,900	
Lead	mg/kg	400	48.6	16.4	14		12.5		13.8		13.5		14.1		15	
Magnesium	mg/kg	NE	10,400	11,400	5,470	J	**10,900**	J	**10,600**	J	**11,400**		5,040	J	3,600	J
Manganese	mg/kg	180	3,506	833	326		426		386		431		499		504	
Mercury	mg/kg	2.3	0.09	0.02	0.0164	J	0.017	J	0.0186	J	-	-	0.0153	J	0.02	J
Nickel	mg/kg	150	55.1	39.7	14.6	J	11.4	J	17.6	J	30.1		-	-	19.2	J
Potassium	mg/kg	NE	3,390	2,180	775		1,050		1,280		2,180		1,020		986	
Selenium	mg/kg	39	2	1.32	-	-	-	-	-	-	0.72		1.32	J	0.818	J
Sodium	mg/kg	NE	NE	188	82.7		143		154		-	-	122		71.5	
Thallium	mg/kg	NE	1.3	0.697	0.414		0.271	J	0.315	J	-	-	0.496		0.484	
Vanadium	mg/kg	39	40.9	27	15.5		15.7		17.1		17.5		27		21.7	
Zinc	mg/kg	2,300	321.75	261	88.1	J	54.5	J	131	J	68.2		65	J	80.3	J

Table 4-4

Detected Analytes in 2009 and 2011 Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines											
				LOCATION CODE	SL-SB05		SL-SB06		SL-SB07		SL-SB08		SL-SB09			
				SAMPLE NO	SL0072		SL0074		SL0078		SL0080		SL0081		SL0082	
				SAMPLE DATE	13-Jan-09		13-Jan-09		14-Jan-09		14-Jan-09		12-Jan-09		12-Jan-09	
				DEPTH	8 - 10 Ft		5 - 6 Ft		5 - 6 Ft		7.1 - 9.1 Ft		5 - 6 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives																
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	0.209	-	-	-	-	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	0.163	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.533	-	-	0.404		-	-	-	-	-	-	-	-
Bold text indicates value is g	mg/kg	220	NE	1.98	-	-	1.31		1.75		-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	0.549	0.371		0.21	J	-	-	-	-	-	-	-	-
PCBs																
Aroclor 1016	mg/kg	0.39	NE	0.0553	-	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1221	mg/kg	0.14	NE	0.199	0.0175	QJ	-	-	-	-	0.134		-	-	0.0651	QJ
SEMIVOLATILES																
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.434	-	-	0.434		0.0818	J	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.128	-	-	0.128	J	0.0411	J	-	-	-	-	-	-
Phenanthrene	mg/kg	NE	NE	0.0898	0.0515	J	-	-	-	-	-	-	0.0504	J	0.0898	J

Table 4-4

Detected Analytes in 2009 and 2011 Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines											
				LOCATION CODE	SL-SB05		SL-SB06		SL-SB07		SL-SB08		SL-SB09			
				SAMPLE NO	SL0072		SL0074		SL0078		SL0080		SL0081		SL0082	
				SAMPLE DATE	13-Jan-09		13-Jan-09		14-Jan-09		14-Jan-09		12-Jan-09		12-Jan-09	
				DEPTH	8 - 10 Ft		5 - 6 Ft		5 - 6 Ft		7.1 - 9.1 Ft		5 - 6 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS																
Aluminum	mg/kg	7,700	15,500	10,300	10,300		9,100		8,920	J	7,980	J	8,870		10,200	
Antimony	mg/kg	3.1	9.3	0.572	0.252	J	0.294	J	0.572		0.376	J	0.487	J	0.31	J
Arsenic	mg/kg	0.39	36.5	20.3	12.7	J	14.3	J	14.9		12.4		20.3	J	11.2	J
Barium	mg/kg	1,500	826	116	16.2		38		116		27		37.8		36.2	
Beryllium	mg/kg	16	1	10.3	**7.29**	J	**6.95**	J	**8**		**7.03**		**8.72**	J	**7.03**	J
Cadmium	mg/kg	7	NE	0.559	0.559		-	-	0.323	J	-	-	-	-	-	-
Calcium	mg/kg	NE	52,300	46,600	45,100		32,100		25,700		45,800		31,500		43,400	
Chromium	mg/kg	0.29	29	15.9	15.9		13.4		14		13		13.1		14.7	
Cobalt	mg/kg	2.3	116	17.3	14.5		9.25		17.3		10.6		11.2		11.2	
Copper	mg/kg	310	56.2	37	37		34.2		33.6	J	27.7	J	35.5		31.3	
Iron	mg/kg	5,500	234,000	65,600	29,500		24,200		30,300	J	24,300	J	33,200		24,000	
Lead	mg/kg	400	48.6	16.4	12.7		13.8		16.4		11.9		14.4		13.5	
Magnesium	mg/kg	NE	10,400	11,400	9,530	J	7,810	J	6,600	J	8,720	J	9,980	J	**10,700**	J
Manganese	mg/kg	180	3,506	833	443		371		833		410		285		381	
Mercury	mg/kg	2.3	0.09	0.02	0.0127	J	0.0174	J	-	-	-	-	0.0154	J	0.0157	J
Nickel	mg/kg	150	55.1	39.7	29.1	J	14.1	J	39.7		32.9		16	J	19.2	J
Potassium	mg/kg	NE	3,390	2,180	1,480		1,130		1,070		1,090		1,080		1,670	
Selenium	mg/kg	39	2	1.32	-	-	-	-	0.453	J	-	-	0.536	J	-	-
Sodium	mg/kg	NE	NE	188	188		99.1		83.8		139		94.7		162	
Thallium	mg/kg	NE	1.3	0.697	-	-	0.295	J	0.697		0.265	J	0.378	J	0.294	J
Vanadium	mg/kg	39	40.9	27	17.2		17.6		18.4		16.6		18.7		18.4	
Zinc	mg/kg	2,300	321.75	261	261	J	64.1	J	99.4		69.7		67.3	J	53	J

Table 4-4

Detected Analytes in 2009 and 2011 Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines											
				LOCATION CODE	SL-SB10				SL-SB02R		SL-SB15		SL-SB16		SL-SB17	
				SAMPLE NO	SL0083		SL0084		SL0232		SL0240		SL0241		SL0242	
				SAMPLE DATE	12-Jan-09		12-Jan-09		22-Aug-11		22-Aug-11		22-Aug-11		22-Aug-11	
				DEPTH	5 - 6 Ft		8 - 10 Ft		5 - 7 Ft		5 - 7 Ft		5 - 7 Ft		5 - 7 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives																
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	0.209	-	-	-	-	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	0.163	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.533	-	-	-	-	-	-	-	-	-	-	-	-
Bold text indicates value is g	mg/kg	220	NE	1.98	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	0.549	-	-	-	-	0.0793	J	-	-	-	-	-	-
PCBs																
Aroclor 1016	mg/kg	0.39	NE	0.0553	-	-	-	-								
Aroclor 1221	mg/kg	0.14	NE	0.199	-	-	-	-								
SEMIVOLATILES																
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.434	-	-	-	-								
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.128	-	-	-	-								
Phenanthrene	mg/kg	NE	NE	0.0898	-	-	0.0749	J								

Table 4-4

Detected Analytes in 2009 and 2011 Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines											
				LOCATION CODE	SL-SB10				SL-SB02R		SL-SB15		SL-SB16		SL-SB17	
				SAMPLE NO	SL0083		SL0084		SL0232		SL0240		SL0241		SL0242	
				SAMPLE DATE	12-Jan-09		12-Jan-09		22-Aug-11		22-Aug-11		22-Aug-11		22-Aug-11	
				DEPTH	5 - 6 Ft		8 - 10 Ft		5 - 7 Ft		5 - 7 Ft		5 - 7 Ft		5 - 7 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS																
Aluminum	mg/kg	7,700	15,500	10,300	10,300		7,580									
Antimony	mg/kg	3.1	9.3	0.572	0.468	J	0.376	J								
Arsenic	mg/kg	0.39	36.5	20.3	16.8	J	12.7	J								
Barium	mg/kg	1,500	826	116	58		29.1									
Beryllium	mg/kg	16	1	10.3	**9.71**	J	**6.56**	J								
Cadmium	mg/kg	7	NE	0.559	-	-	-	-								
Calcium	mg/kg	NE	52,300	46,600	18,800		41,300									
Chromium	mg/kg	0.29	29	15.9	15.5		11.4									
Cobalt	mg/kg	2.3	116	17.3	11.8		9.8									
Copper	mg/kg	310	56.2	37	35.8		35.6									
Iron	mg/kg	5,500	234,000	65,600	37,200		22,600									
Lead	mg/kg	400	48.6	16.4	14.4		13.6									
Magnesium	mg/kg	NE	10,400	11,400	5,360	J	**10,500**	J								
Manganese	mg/kg	180	3,506	833	293		391									
Mercury	mg/kg	2.3	0.09	0.02	0.019	J	0.0145	J								
Nickel	mg/kg	150	55.1	39.7	14.5	J	15.9	J								
Potassium	mg/kg	NE	3,390	2,180	1,060		1,250									
Selenium	mg/kg	39	2	1.32	-	-	-	-								
Sodium	mg/kg	NE	NE	188	68.3		145									
Thallium	mg/kg	NE	1.3	0.697	0.292	J	0.319	J								
Vanadium	mg/kg	39	40.9	27	20.7		15.7									
Zinc	mg/kg	2,300	321.75	261	75.7	J	62.8	J								

Table 4-4

Detected Analytes in 2009 and 2011 Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines									
				LOCATION CODE	SL-SB18		SL-SB19		SL-SB20		SL-SB21		SL-SB22	
				SAMPLE NO	SL0243		SL0244		SL0245		SL0246		SL0247	
				SAMPLE DATE	22-Aug-11		22-Aug-11		22-Aug-11		22-Aug-11		22-Aug-11	
				DEPTH	5 - 7 Ft		5 - 7 Ft		5 - 7 Ft		5 - 7 Ft		5 - 7 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives														
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	0.209	0.168	J	0.138	J	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	0.163	0.163	J	0.128	J	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.533	-	-	0.533		-	-	-	-	-	-
Bold text indicates value is g	mg/kg	220	NE	1.98	0.194	J	0.208	J	1.98		-	-	1.17	
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	0.549	0.411		0.211		0.101	J	-	-	0.549	
PCBs														
Aroclor 1016	mg/kg	0.39	NE	0.0553										
Aroclor 1221	mg/kg	0.14	NE	0.199										
SEMIVOLATILES														
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.434										
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.128										
Phenanthrene	mg/kg	NE	NE	0.0898										

Table 4-4

Detected Analytes in 2009 and 2011 Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines									
				LOCATION CODE	SL-SB18		SL-SB19		SL-SB20		SL-SB21		SL-SB22	
				SAMPLE NO	SL0243		SL0244		SL0245		SL0246		SL0247	
				SAMPLE DATE	22-Aug-11		22-Aug-11		22-Aug-11		22-Aug-11		22-Aug-11	
				DEPTH	5 - 7 Ft		5 - 7 Ft		5 - 7 Ft		5 - 7 Ft		5 - 7 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS														
Aluminum	mg/kg	7,700	15,500	10,300										
Antimony	mg/kg	3.1	9.3	0.572										
Arsenic	mg/kg	0.39	36.5	20.3										
Barium	mg/kg	1,500	826	116										
Beryllium	mg/kg	16	1	10.3										
Cadmium	mg/kg	7	NE	0.559										
Calcium	mg/kg	NE	52,300	46,600										
Chromium	mg/kg	0.29	29	15.9										
Cobalt	mg/kg	2.3	116	17.3										
Copper	mg/kg	310	56.2	37										
Iron	mg/kg	5,500	234,000	65,600										
Lead	mg/kg	400	48.6	16.4										
Magnesium	mg/kg	NE	10,400	11,400										
Manganese	mg/kg	180	3,506	833										
Mercury	mg/kg	2.3	0.09	0.02										
Nickel	mg/kg	150	55.1	39.7										
Potassium	mg/kg	NE	3,390	2,180										
Selenium	mg/kg	39	2	1.32										
Sodium	mg/kg	NE	NE	188										
Thallium	mg/kg	NE	1.3	0.697										
Vanadium	mg/kg	39	40.9	27										
Zinc	mg/kg	2,300	321.75	261										

Table 4-4

Detected Analytes in 2009 and 2011 Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

BSC - Background screening concentration.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
mg/kg - Milligrams per kilogram.
NE - Not established (RBSCs), not evaluated (BSCs).
Shaded cell indicates value is greater than RBSC.
RBSC - Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
Bold text indicates value is greater than BSC.
Blank cell means that parameter was not analyzed.
"-" - Not detected.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
QJ - Analyte detected but was estimated due to instrument response below method criteria.

Table 4-5

Detected Analytes in 2010 Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines													
				LOCATION CODE	TNTA-45AL		TNTA-46BL		TNTA-48AL		TNTA-53BL		45A 1N-5N		45A 1S-5S		45A CL-1	
				SAMPLE NO	TNTA-45AL		TNTA-46BL		TNTA-48AL		TNTA-53BL		45A 1N-5N		45A 1S-5S		45A CL-1	
				SAMPLE DATE	22-Oct-10		21-Oct-10		21-Oct-10		22-Oct-10		4-Nov-10		4-Nov-10		4-Nov-10	
				DEPTH	4.3 - 4.8 Ft		4 - 4.5 Ft		4.5 - 5 Ft		3.6 - 4.1 Ft		8 - 10 Ft		8 - 10 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives																		
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	1.04	-	-	0.378	J	-	-	1.04		-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	4.73	0.157		0.753		-	-	4.73		-	-	-	-	-	-
Dinitrobenzene, 1,3-	mg/kg	0.61	NE	0.142	-	-	-	-	-	-	0.142	J	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	2.39	-	-	2.12	J	-	-	2.39		-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.667	-	-	0.667		-	-	0.494		-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	2.72	0.107	J	0.455		-	-	2.72		-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	10.3	0.156		10.3	J	-	-	9.67		-	-	-	-	-	-

Table 4-5

Detected Analytes in 2010 Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines													
				LOCATION CODE	45A CL-2		45A CL-3		53B 1N-5N		53B 1S-5S		53B CL-1		53B CL-2		53B CL-3	
				SAMPLE NO	45A CL-2		45A CL-3		53B 1N-5N		53B 1S-5S		53B CL-1		53B CL-2		53B CL-3	
				SAMPLE DATE	4-Nov-10		4-Nov-10		5-Nov-10		5-Nov-10		5-Nov-10		5-Nov-10		5-Nov-10	
				DEPTH	8 - 10 Ft		8 - 10 Ft		8 - 10 Ft		8 - 10 Ft		8 - 10 Ft		8 - 10 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives																		
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	1.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	4.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrobenzene, 1,3-	mg/kg	0.61	NE	0.142	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	2.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.667	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	2.72	0.0911	J	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	10.3	0.0895	J	-	-	-	-	-	-	-	-	0.487		-	-

Table 4-5

Detected Analytes in 2010 Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

BSC - Background screening concentration.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
mg/kg - Milligrams per kilogram.
NE - Not established (RBSCs), not evaluated (BSCs).
Shaded cell indicates value is greater than RBSC.
RBSC - Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
Bold text indicates value is greater then BSC.
Blank cell means that parameter was not analyzed.
"-" - Not detected.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
QJ - Analyte detected but was estimated due to instrument response below method criteria.

Table 4-6

Detections Above RBSCs and/or BSCs in Temporary Piezometer Groundwater - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	TNTA/WWTP1 Sewer Lines											
				LOCATION CODE	SL-PZ02						SL-PZ05		SL-PZ08		SL-PZ09	
				SAMPLE NO	SL3003		SL3001		SL3002		SL3006		SL3009		SL3010	
				SAMPLE DATE	27-Jan-09		27-Jan-09		27-Jan-09		30-Jan-09		26-Jan-09		26-Jan-09	
				DEPTH	6_44 - 6_73 Ft		6_44 - 6_73 Ft		6_44 - 6_73 Ft		10_09 - Ft		5_02 - Ft		5_9 - 6 Ft	
				SAMPLE PURPOSE	REG		FD		FS		REG		REG		REG	
				LOW-FLOW SAMPLED	Yes		Yes		Yes		Yes		Yes		Yes	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives																
Amino-2,6-dinitrotoluene, 4-	µg/L	7.3	NE	2.07	1.31		1.52		1.1		-	-	2.07		1.59	
Amino-4,6-dinitrotoluene, 2-	µg/L	7.3	NE	2.03	1.03		1.2		1		-	-	-	-	2.03	
Dinitrotoluene, 2,4-	µg/L	0.099	NE	0.503	-	-	-	-	-	-	-	-	0.503		-	-
Tetryl	µg/L	15	NE	0.24	-	-	-	-	-	-	-	-	0.24	J	-	-
Trinitrotoluene, 2,4,6-	µg/L	1.8	NE	59.9	0.576		0.697		0.57		-	-	59.9		11.2	
Water Quality Parameters																
Alkalinity	µg/L	NE	NE	300000	121,000		116,000		300,000		180,000		90,500		95,600	
Chloride	µg/L	NE	NE	4200	1,490	J	1,510	J	-	-	4,200		2,830		2,990	
Hardness	µg/L	NE	NE	424000	348,000		351,000		410,000		224,000		424,000		230,000	
Nitrate-Nitrite	µg/L	NE	NE	180	-	-	34	J			-	-	61		180	
Sulfate	µg/L	NE	NE	122000	90,300		91,800		106,000		8,220		122,000		122,000	
Total dissolved solids	µg/L	NE	NE	846000	503,000		533,000		420,000		238,000		846,000		441,000	
Total suspended solids	µg/L	NE	NE	3E+06	-	-	6,000		6,000		55,000		3,180,000		9,000	
Turbidity	NTU	NE	NE	591	5.48		6.35		2.5		55.6	J	591	J	22.1	J

BSC - Background screening concentration.
RBSC - Values reflect an incremental lifetime cancer risk (ILCR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
Shaded cell indicates value is greater than RBSC.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
NE - Not established (RBSCs), not evaluated (BSCs).
"-" - Not detected.
µg/L - Micrograms per liter.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.

Table 4-7

Detections Above RBSCs and/or BSCs in Overburden/Shale Groundwater - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

(Page 1 of 2)

				LOCATION	TNTA/WWTP1 Sewer Lines									
				LOCATION CODE	1SLA-MW01		1SLA-MW02				1SLA-MW03			
				SAMPLE NO	SL3090		SL3081		SL3091		SL3082		SL3092	
				SAMPLE DATE	9-Nov-09		8-May-09		10-Nov-09		6-May-09		10-Nov-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
				LOW-FLOW SAMPLED	Yes		No		No		Yes		Yes	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
VOLATILES														
Carbon disulfide	µg/L	100	NE	1	-	-	-	-	-	-	1	J	-	-
Ethylbenzene	µg/L	1.5	0.87	0.57	-	-	-	-	-	-	0.57	J	-	-
Toluene	µg/L	230	1.7	1	-	-	-	-	-	-	1		-	-
Xylenes, total	µg/L	20	5.5	2.1	-	-	-	-	-	-	2.1	J	-	-
METALS (UNFILTERED)														
Aluminum	µg/L	3,700	309	497	112	J	117	J	**497**		**353**		**317**	
Iron	µg/L	2,600	1,550	737	-	-	-	-	737	J	520		568	J
Lead	µg/L	NE	NE	2.7	-	-	2.7	J	-	-	-	-	-	-
Magnesium	µg/L	NE	217,000	137000	137,000		132,000		126,000		13,500		17,100	
Manganese	µg/L	88	636	401	401		112		186		111		350	
Nickel	µg/L	73	8.6	73.8	**73.8**		**23.1**	J	**34.6**	J	-	-	2.4	J
Potassium	µg/L	NE	116,000	101000	44,800	J	89,900		101,000	J	3,890	J	11,800	J
Selenium	µg/L	18	NE	6.7	6.7	J	4.7	J	-	-	-	-	-	-
Sodium	µg/L	NE	1,390,000	677000	188,000		650,000		677,000		8,980	J	41,700	
Thallium	µg/L	NE	NE	4.4	4.4	J	-	-	-	-	-	-	-	-
Vanadium	µg/L	18	NE	1.7	-	-	0.99	J	1.7	J	1	J	1.2	J
Zinc	µg/L	1,100	507	13.4	-	-	13.4	J	-	-	10.9	B	8.1	J
METALS (FILTERED)														
Aluminum	µg/L	3,700	309	46	11.6	J	17.9	J	46	J	-	-	-	-
Barium	µg/L	730	11,800	122	51.8	J	116	J	122	J	13	J	76.2	J
Calcium	µg/L	NE	316,000	283000	283,000		175,000		163,000		56,800		53,100	
Cobalt	µg/L	1.1	12.1	22.3	**22.3**	J	7.3	J	6.5	J	-	-	-	-
Magnesium	µg/L	NE	217,000	141000	141,000		134,000		122,000		13,300		16,700	
Manganese	µg/L	88	636	409	409		131		145		108		364	
Nickel	µg/L	73	8.6	75	**75**		**33.7**	J	**31.5**	J	-	-	-	-
Potassium	µg/L	NE	116,000	99700	48,400	J	99,700		92,200	J	3,550	J	11,300	J
Selenium	µg/L	18	NE	6.4	6.4	J	4.7	J	-	-	-	-	-	-
Sodium	µg/L	NE	1,390,000	644000	188,000		644,000		641,000		8,370	J	38,200	
Vanadium	µg/L	18	NE	1.2	-	-	1.2	J	-	-	-	-	-	-
Zinc	µg/L	1,100	507	14.2	9	J	14.2	J	7.6	J	7.5	J	-	-
WATER QUALITY PARAMETERS														
Alkalinity	µg/L	NE	NE	518000	470,000		341,000		518,000		188,000		245,000	
Chloride	µg/L	NE	NE	1720000	367,000	J	1,340,000		1,720,000	J	11,300		86,700	J
Cyanide, total	µg/L	73	NE	16	-	-	16		-	-	46	B	-	-
HARDNESS (as CaCO3)	µg/L	NE	NE	975000			975,000				198,000			
Nitrate-Nitrite	µg/L	NE	NE	45	45	J	39	J	36	J	-	-	-	-
Sulfate	µg/L	NE	NE	1270000	1,270,000		38,200		26,000	J	8,500		16,000	
Total dissolved solids	µg/L	NE	NE	3900000	3,900,000		2,790,000		2,630,000		213,000		362,000	
Total suspended solids	µg/L	NE	NE	22000	5,000	J	13,000		22,000		11,000		12,000	
Turbidity	NTU	NE	NE	7.2	2.3	J	3.5		7.1	J	7.2		5.4	J

Table 4-7

Detections Above RBSCs and/or BSCs in Overburden/Shale Groundwater - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Bold text indicates value is greater than the BSC.
BSC - Background screening concentration.
RBSC - Values reflect an incremental lifetime cancer risk (ILCR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
µg/L - Micrograms per liter.
NA - Not Analyzed.
NE - Not established (RBSCs), not evaluated (BSCs).
NM - Not measured.
Shaded cell indicates value is greater than RBSC.
WWTP1 - Waste Water Treatment Plant No. 1.
"-" - Not Detected.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
B - The analyte was not detected significantly above the levels found in the associated method blank or field blanks.

Table 4-8

Detections Above RBSCs and/or BSCs in Bedrock Groundwater - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	TNTA/WWTP1 Sewer Lines						TNTA/WWTP1 Sewer Lines					
				LOCATION	1SLA-BEDGW-002		1SLA-BEDGW-003		1SLA-BEDGW-002		1SLA-BEDGW-003		1SLA-BEDGW-003		1SLA-BEDGW-003	
				SAMPLE NO	SL3084		SL3085		SL3094		SL3095		SL3096		SL3097	
				SAMPLE DATE	7-May-09		6-May-09		11-Nov-09		10-Nov-09		10-Nov-09		10-Nov-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		FD		FS	
				LOW-FLOW SAMPLED	Yes		Yes		Yes		Yes		Yes		Yes	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
EXPLOSIVES																
Amino-4,6-dinitrotoluene, 2-	µg/L	7.3	NE	0.2	-	-	-	-	-	-	-	-	-	-	0.2	J
Nitrobenzene	µg/L	0.12	NE	1.8	-	-	-	-	-	-	-	-	-	-	1.8	
VOLATILES																
Acetone	µg/L	2,200	NE	139	-	-	-	-	106	J	130	J	139	J	-	-
Benzene	µg/L	0.41	2.4	175	**16.7**		**114**		**12.3**		**175**		**119**		**170**	
Butanone, 2-	µg/L	710	NE	33.5	-	-	-	-	33.5		-	-	-	-	-	-
Carbon disulfide	µg/L	100	NE	6.5	-	-	6.5	J	-	-	-	-	4.1	J	-	-
Chloroform	µg/L	0.19	NE	15.3	-	-	15.3		-	-	-	-	16.6	B	-	-
Chloromethane	µg/L	19	NE	467	-	-	-	-	-	-	394		467		-	-
Cyclohexane	µg/L	1,300	NE	360											360	
Dichloropropene, trans-1,3-	µg/L	NE	NE	2.9	-	-	-	-	2.9		-	-	-	-	-	-
Ethylbenzene	µg/L	1.5	0.87	160	**151**		**128**		**148**		**144**		**160**		**140**	
Methylcyclohexane	µg/L	NE	NE	120											120	
Methylene chloride	µg/L	4.8	NE	0	6.7	B	-	-	-	-	-	-	-	-	-	-
Tetrachloroethane, 1,1,2,2-	µg/L	0.067	NE	0	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	µg/L	230	1.7	625	**399**		**516**		**352**		**586**	J	**625**		**540**	
Xylenes, total	µg/L	20	5.5	849	**740**		**680**		**710**		**775**		**849**		**760**	
SEMIVOLATILES																
3-Methylphenol and 4-Methylphenol	µg/L	NE	NE	4.1	-	-	2.8	J	-	-	4	J	4.1	J		
Chloro-3-methylphenol, 4-	µg/L	370	NE	9.8	-	-	-	-	9.8	J	-	-	-	-	-	-
Dimethylphenol, 2,4-	µg/L	73	NE	10.1	3.2	J	6.8		4.8	J	9.2		10.1		-	-
Methylnaphthalene, 2-	µg/L	15	NE	33.8	18.1		9.7		33.8		10.8	J	22.1	J	-	-
Methylphenol, 2-	µg/L	180	NE	6.6	1.2	J	4.8		-	-	6.1		6.6		-	-
Naphthalene	µg/L	0.14	NE	32	18.3		13		32		16.4	J	24.5	J	-	-
Phenol	µg/L	1,100	NE	1.1	-	-	-	-	-	-	1.1	J	-	-	-	-
METALS (UNFILTERED)																
Aluminum	µg/L	3,700	309	1970	64	B	**441**		70.4	J	**1,590**		**1,900**		**1,970**	
Arsenic	µg/L	0.045	7.4	83.5	**34.9**		**50.3**		-	-	**57.9**	J	**83.5**	J	**50.1**	
Barium	µg/L	730	11,800	1570	317		1,310		228		1,570		1,520		1,470	
Calcium	µg/L	NE	316,000	700000	231,000		**598,000**		238,000	J	**684,000**		**693,000**		**700,000**	
Chromium	µg/L	0.043	NE	4.6	-	-	-	-	-	-	3.4	J	4.6	J	-	-
Copper	µg/L	150	19.8	7.8	-	-	-	-	-	-	-	-	7.8	J	-	-
Iron	µg/L	2,600	1,550	3870	-	-	677		-	-	**2,610**	J	**3,870**	J	**2,880**	
Lead	µg/L	NE	NE	0	-	-	5.7	B	-	-	-	-	-	-	-	-
Magnesium	µg/L	NE	217,000	504000	133,000		**442,000**		134,000		**504,000**		**494,000**		**472,000**	
Manganese	µg/L	88	636	506	256		506		15.2		288		376		247	
Mercury	µg/L	1.1	NE	0.23	-	-	-	-	0.23	J	-	-	-	-	-	-
Nickel	µg/L	73	8.6	8.3	-	-	7.9	J	-	-	6.9	J	8.3	J	-	-
Potassium	µg/L	NE	116,000	139000	48,200		**117,000**		58,300		**134,000**	J	**139,000**	J	92,100	
Selenium	µg/L	18	NE	30.3	4.1	J	10.7	J	8.1	J	28.2	J	30.3	J	-	-
Sodium	µg/L	NE	1,390,000	1530000	340,000		1,350,000		334,000		**1,510,000**		**1,530,000**		**1,530,000**	
Vanadium	µg/L	18	NE	4.6	1.4	J	2.2	J	2.1	J	4.6	J	3.4	J	-	-
Zinc	µg/L	1,100	507	16.9	10.8	J	16.7	B	9.1	J	13.2	J	16.9	J	-	-

Table 4-8

Detections Above RBSCs and/or BSCs in Bedrock Groundwater - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	TNTA/WWTP1 Sewer Lines						TNTA/WWTP1 Sewer Lines					
				LOCATION	1SLA-BEDGW-002		1SLA-BEDGW-003		1SLA-BEDGW-002		1SLA-BEDGW-003		1SLA-BEDGW-003		1SLA-BEDGW-003	
				SAMPLE NO	SL3084		SL3085		SL3094		SL3095		SL3096		SL3097	
				SAMPLE DATE	7-May-09		6-May-09		11-Nov-09		10-Nov-09		10-Nov-09		10-Nov-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		FD		FS	
				LOW-FLOW SAMPLED	Yes		Yes		Yes		Yes		Yes		Yes	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS (FILTERED)																
Aluminum	µg/L	3,700	309	60.4	19.6	J	28.7	J	23	J	21	J	60.4	J	-	-
Arsenic	µg/L	0.045	7.4	93.1	**33.7**		**52.8**		-	-	**93.1**	J	**32.5**	J	**41.1**	
Barium	µg/L	730	11,800	1780	312		1,430		229		1,540		1,690		1,780	
Calcium	µg/L	NE	316,000	736000	222,000		**633,000**		240,000	J	**664,000**		**669,000**		**736,000**	
Iron	µg/L	2,600	1,550	71.1	-	-	-	-	-	-	71.1	J	-	-	-	-
Lead	µg/L	NE	NE	5.3	-	-	5.3	J	-	-	-	-	-	-	-	-
Magnesium	µg/L	NE	217,000	537000	134,000		**489,000**		137,000		**496,000**		**518,000**		**537,000**	
Manganese	µg/L	88	636	510	232		510		6.1	J	235	J	149	J	139	
Potassium	µg/L	NE	116,000	140000	47,700		**124,000**		59,200		**130,000**	J	**140,000**	J	107,000	
Selenium	µg/L	18	NE	25.7	5.1	J	6.9	J	8.3	J	23.6	J	25.7	J	-	-
Sodium	µg/L	NE	1,390,000	1690000	337,000		1,380,000		344,000		**1,490,000**		**1,580,000**		**1,690,000**	
Vanadium	µg/L	18	NE	1.9	1.2	J	1.4	J	1.9	J	0.92	J	-	-	-	-
Zinc	µg/L	1,100	507	7.6	7.6	J	-	-	-	-	-	-	-	-	-	-
WATER QUALITY PARAMETERS																
Alkalinity	µg/L	NE	NE	1040000	805,000		606,000		1,040,000		670,000		600,000		580,000	
Chloride	µg/L	NE	NE	6230000	753,000		4,410,000		18,600		6,070,000	J	4,410,000	J	6,230,000	
Cyanide, total	µg/L	73	NE	1300	41	J			-	-	-	-	-	-	1,300	
Hardness	µg/L	NE	NE	4100000											4,100,000	
HARDNESS (as CaCO3)	µg/L	NE	NE	3350000	1,120,000		3,350,000		1,150,000							
Nitrate-Nitrite	µg/L	NE	NE	1500	93	J	-	-	1,500		150	J	200	J		
Sulfate	µg/L	NE	NE	42300	42,300		17,600		2,100	J	-	-	-	-	5,900	
Total dissolved solids	µg/L	NE	NE	1.2E+07	2,250,000		8,270,000		2,600,000		12,200,000		9,520,000		10,000,000	
Total suspended solids	µg/L	NE	NE	190000	6,000	J	190,000		30,000		145,000		113,000		94,000	
Turbidity	NTU	NE	NE	98.4	98.4	J	29.4		44	J	51.8	J	32.8	J	80	

Shaded cell indicates value is greater than RBSC.
Bold text indicates value is greater than the BSC.
BSC - Background screening concentration.
RBSC - Values reflect an incremental lifetime cancer risk (ILCR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
NE - Not established (RBSCs), not evaluated (BSCs).
µg/L - Micrograms per liter.
"-" - Not Detected.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
B - The analyte was not detected significantly above the levels found in the associated method blank or field blanks.

Table 4-9

Detections Above RBSCs in Sediment - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

			LOCATION	TNTA/WWTP1 Sewer Line															
			LOCATION CODE	1SLA-SD01		1SLA-SD02		1SLA-SD03		1SLA-SD04		1SLA-SD05		1SLA-SD06		1SLA-SD06		1SLA-SD06	
			SAMPLE NO	SL1000		SL1001		SL1002		SL1003		SL1004		SL1005		SL1006		SL1007	
			SAMPLE DATE	30-Oct-09		30-Oct-09		30-Oct-09		30-Oct-09		30-Oct-09		30-Oct-09		30-Oct-09		30-Oct-09	
			DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
			SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG		FD		FS	
Parameter	Units	RBSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
PCBs																			
Aroclor 1254	mg/kg	0.22	0.215	-	-	0.0513		0.184		0.093		0.215		0.0398		0.0419		-	-

MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
"-" - Not detected.
mg/kg - Milligrams per kilogram.
Shaded cell if present, indicates value is greater than RBSC.
RBSC - Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
VQ - Validation Qualifier.

Table 4-10

COPC Summary for Surface Soil (0 to 1 Foot) - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values (mg/kg) Detected Concentrations Minimum	VQ	Maximum	VQ	Method Detection Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Inorganics														
Aluminum	8 / 8	100	7.50E+03	J/J	1.24E+04		1.01E+00	2.19E+00	9.09E+03	1.55E+04	7.70E+03	N (b)		---
Antimony	3 / 8	38	3.30E-01	J	5.29E-01	J/J	2.31E-01	2.74E-01	3.14E-01	9.30E+00	3.10E+00	N (a)		---
Arsenic	8 / 8	100	4.80E+00	J	1.22E+01	J	4.62E-01	5.48E-01	6.87E+00	3.65E+01	3.90E-01	N (b)		---
Barium	8 / 8	100	4.60E+01		8.40E+01		9.23E-02	1.10E-01	5.49E+01	8.26E+02	1.50E+03	N (a)		---
Beryllium	8 / 8	100	5.22E+00	J	7.87E+00	J	9.23E-02	1.10E-01	6.28E+00	1.00E+00	1.60E+01	N (a)		---
Cadmium	2 / 8	25	2.85E-01	J/J	3.87E-01	J	2.31E-01	2.74E-01	2.79E-01	NA	7.00E+00	N (a)		---
Calcium	8 / 8	100	3.99E+03		7.33E+03		2.52E+00	5.48E+00	5.02E+03	5.23E+04	Nutrient	N (c)		---
Chromium	8 / 8	100	1.70E+00		1.65E+01		2.31E-01	2.74E-01	1.18E+01	2.90E+01	2.90E-01	N (b)		---
Cobalt	8 / 8	100	4.19E+00		8.65E+00		9.20E-02	2.03E-01	6.12E+00	1.16E+02	2.30E+00	N (b)		---
Copper	8 / 8	100	1.54E+01		2.78E+01		2.31E-01	2.74E-01	2.06E+01	5.62E+01	3.10E+02	N (a)		---
Iron	8 / 8	100	1.46E+04		2.52E+04		9.23E-01	2.03E+00	1.83E+04	2.34E+05	5.50E+03	N (b)		---
Lead	8 / 8	100	1.03E+01		2.83E+01		2.31E-01	2.74E-01	1.63E+01	4.86E+01	4.00E+02	N (a)		---
Magnesium	8 / 8	100	1.61E+03	J	3.50E+03	J	9.23E-01	1.10E+00	2.35E+03	1.04E+04	Nutrient	N (c)		---
Manganese	8 / 8	100	1.37E+02		3.06E+02		9.23E-02	1.10E-01	2.05E+02	3.51E+03	1.80E+02	N (b)		---
Mercury	8 / 8	100	3.14E-02		4.43E-01		1.16E-02	1.29E-02	9.10E-02	8.50E-02	2.30E+00	N (a)		---
Nickel	8 / 8	100	2.68E+00	J	1.96E+01		1.39E-01	1.64E-01	1.05E+01	5.51E+01	1.50E+02	N (a)		---
Potassium	8 / 8	100	4.61E+02		9.00E+02		1.15E+01	1.37E+01	6.22E+02	3.39E+03	Nutrient	N (c)		---
Selenium	3 / 8	38	5.10E-01	J	6.08E-01	J	4.62E-01	5.48E-01	5.30E-01	2.00E+00	3.90E+01	N (a)		---
Sodium	8 / 8	100	3.11E+01		7.67E+01		5.05E+00	1.10E+01	5.27E+01	NA	Nutrient	N (c)		---
Thallium	1 / 8	13	3.66E-01	J	3.66E-01	J	2.31E-01	2.74E-01	2.71E-01	1.30E+00	7.80E-02	N (b)		---
Vanadium	8 / 8	100	1.98E+01		2.63E+01		9.23E-02	1.10E-01	2.18E+01	4.09E+01	3.90E+01	N (a)		---
Zinc	8 / 8	100	3.40E+01	J	7.23E+01		1.15E+00	1.37E+00	5.22E+01	3.22E+02	2.30E+03	N (a)		---
Polychlorinated biphenyls (PCB)														
Aroclor 1016	6 / 8	75	1.91E-02	J	1.16E+00	J	8.21E-03	9.24E-03	1.92E-01		3.90E-01	Y	8.14E-01	8.14E-01
Aroclor 1260	1 / 8	13	1.47E-01	J/J	1.47E-01	J/J	8.21E-03	9.24E-03	2.60E-02		2.20E-01	N (a)		---
Explosives														
Amino-2,6-dinitrotoluene, 4-	5 / 12	42	1.63E-01	J/U	3.13E+01		7.40E-02	8.00E+00	4.34E+00		1.50E+01	Y	1.10E+01	1.10E+01
Amino-4,6-dinitrotoluene, 2-	4 / 12	33	6.05E-01		5.01E+01		7.40E-02	8.00E+00	5.78E+00		1.50E+01	Y	2.17E+01	2.17E+01
Dinitrotoluene, 2,4- [g]	1 / 12	8	1.93E+00	/U	1.93E+00	/U	9.00E-02	9.70E+00	1.08E+00		7.20E-01	Y	4.56E+00	1.93E+00
Dinitrotoluene, 2,6- [g]	1 / 12	8	1.48E+00	/U	1.48E+00	/U	8.10E-02	8.70E+00	9.56E-01		7.20E-01	Y	4.06E+00	1.48E+00
Trinitrobenzene, 1,3,5-	1 / 12	8	1.96E-01	J	1.96E-01	J	7.40E-02	8.00E+00	8.72E-01		2.20E+02	N (a)		---
Trinitrotoluene, 2,4,6-	5 / 12	42	2.71E-01	J	1.20E+03		7.40E-02	8.00E+00	1.19E+02		3.60E+00	Y	3.11E+02	3.11E+02
Semivolatile Organic Compounds														
Acenaphthylene	1 / 8	13	1.11E-01	J	1.11E-01	J	4.97E-03	2.58E-02	2.10E-02		3.40E+02 [h]	N (a)		---
Anthracene	1 / 8	13	2.99E-01	J	2.99E-01	J	8.95E-03	4.65E-02	5.02E-02		1.70E+03	N (a)		---
Benzo(a)anthracene	3 / 8	38	4.70E-02	J	1.54E+00		2.72E-02	1.41E-01	2.37E-01		1.50E-01	Y	1.17E+00	1.17E+00
Benzo(a)pyrene	2 / 8	25	5.30E-02	J	1.18E+00		2.72E-02	1.41E-01	1.89E-01		1.50E-02	Y	1.01E+00	1.01E+00
Benzo(b)fluoranthene	3 / 8	38	7.13E-02	J	2.00E+00		6.90E-02	3.58E-01	3.51E-01		1.50E-01	Y	1.52E+00	1.52E+00
Benzo(ghi)perylene	1 / 8	13	6.90E-01		6.90E-01		1.01E-01	5.24E-01	2.31E-01		1.70E+02 [i]	N (a)		---
Benzo(k)fluoranthene	1 / 8	13	5.40E-01		5.40E-01		1.25E-01	6.52E-01	2.48E-01		1.50E+00	N (a)		---
Benzoic acid	2 / 8	25	5.37E-01		6.39E-01	QJ	1.01E-01	5.24E-01	2.79E-01		2.40E+04	N (a)		---
Bis(2-ethylhexyl)phthalate	1 / 8	13	8.69E-02	J	8.69E-02	J	3.83E-02	1.99E-01	6.58E-02		3.50E+01	N (a)		---

Table 4-10

COPC Summary for Surface Soil (0 to 1 Foot) - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values (mg/kg) Detected Concentrations Minimum	VQ	Maximum	VQ	Method Detection Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Chrysene	3 / 8	38	6.32E-02	J	1.36E+00		1.64E-02	8.53E-02	2.07E-01		1.50E+01	N (a)		---
Dibenz(a,h)anthracene	1 / 8	13	1.96E-01	J	1.96E-01	J	9.36E-02	4.86E-01	1.59E-01		1.50E-02	Y	3.69E-01	1.96E-01
Dinitrotoluene, 2,4-	3 / 8	38	5.63E-02	J	4.42E+00		1.45E-02	7.56E-02	5.77E-01		7.20E-01	Y	3.33E+00	3.33E+00
Dinitrotoluene, 2,6-	1 / 8	13	2.18E+00		2.18E+00		9.94E-03	5.17E-02	2.82E-01		7.20E-01	Y	3.60E+02	2.18E+00
Fluoranthene	4 / 8	50	2.61E-02	J/U	3.05E+00		8.95E-03	4.65E-02	4.28E-01		2.30E+02	N (a)		---
Indeno(1,2,3-cd)pyrene	1 / 8	13	1.06E+00		1.06E+00		1.34E-01	6.98E-01	3.25E-01		1.50E-01	Y	8.73E-01	8.73E-01
Nitroaniline, 3-	1 / 8	13	2.99E-01	J	2.99E-01	J	1.40E-02	7.30E-02	5.03E-02		6.10E+01 [j]	N (a)		---
Phenanthrene	3 / 8	38	4.27E-02	J	3.92E-01	J	1.01E-02	5.23E-02	7.88E-02		1.70E+02 [i]	N (a)		---
Pyrene	3 / 8	38	7.26E-02	J	2.22E+00		1.65E-02	8.59E-02	3.21E-01		1.70E+02	N (a)		---

COPC - Chemical of potential concern.
BSC - Background screening concentration.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed
Q - estimated due to instrument response below method criteria.
/U - The compound/analyte was positively identified in one sample averaged with a field duplicate that was nondetect (U qualified)
mg/kg - Milligrams per kilogram.

[a] IT Corporation (IT), 1998, *Site Investigation of Acid Areas*, *Plum Brook Ordnance Works, Sandusky, Ohio*, August.
[b] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (November 2011) residential soil values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[c] N - Chemical is not chosen as a COPC:
(a) - Maximum detected concentration is less than the RBSC.
(b) - Maximum detected concentration is less than the BSC.
(c) - Essential nutrient.
[d] Y - Chemical is chosen as COPC.
[e] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.1 (EPA, 2011, ProUCL Version 4.1, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm.
[f] Concentration used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower. The EPC used to evaluate lead using the Lead Model (see text for details) is equal to the arithmetic mean.
[g] Results from the semivolatiles analysis, rather than the explosives analysis, were used in the risk assessment.
[h] RBSC based on acenaphthene.
[i] RBSC based on pyrene.
[j] RBSC based on 2-nitroaniline.

Table 4-11

COPC Summary for Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values (mg/kg) Detected Concentrations Minimum	VQ	Maximum	VQ	Method Detection Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Inorganics														
Aluminum	12 / 12	100	7.04E+03		1.03E+04		8.77E-01	1.99E+00	8.77E+03	1.55E+04	7.70E+03	N (b)		---
Antimony	12 / 12	100	2.52E-01	J	5.72E-01		2.05E-01	2.49E-01	3.98E-01	9.30E+00	3.10E+00	N (a)		---
Arsenic	12 / 12	100	1.12E+01	J	2.03E+01	J	4.10E-01	4.98E-01	1.41E+01	3.65E+01	3.90E-01	N (b)		---
Barium	12 / 12	100	1.62E+01		1.16E+02		8.20E-02	9.96E-02	4.65E+01	8.26E+02	1.50E+03	N (a)		---
Beryllium	12 / 12	100	6.56E+00	J	1.03E+01	J	8.20E-02	9.96E-02	7.84E+00	1.00E+00	1.60E+01	N (a)		---
Cadmium	6 / 12	50	2.34E-01	J	5.59E-01		2.05E-01	2.49E-01	2.76E-01	NA	7.00E+00	N (a)		---
Calcium	12 / 12	100	2.79E+03		4.58E+04		2.19E+00	4.98E+00	3.18E+04	5.23E+04	Nutrient	N (c)		---
Chromium	12 / 12	100	1.08E+01		1.59E+01		2.05E-01	2.49E-01	1.34E+01	2.90E+01	2.90E-01	N (b)		---
Cobalt	12 / 12	100	8.57E+00		1.73E+01		8.20E-02	1.78E-01	1.16E+01	1.16E+02	2.30E+00	N (b)		---
Copper	12 / 12	100	2.77E+01	J	3.70E+01		2.05E-01	2.49E-01	3.36E+01	5.62E+01	3.10E+02	N (a)		---
Iron	12 / 12	100	2.26E+04		6.56E+04		8.73E-01	4.52E+00	3.13E+04	2.34E+05	5.50E+03	N (b)		---
Lead	12 / 12	100	1.19E+01		1.64E+01		2.05E-01	2.49E-01	1.39E+01	4.86E+01	4.00E+02	N (a)		---
Magnesium	12 / 12	100	3.60E+03	J	1.08E+04	J/J	8.20E-01	9.96E-01	7.84E+03	1.04E+04	Nutrient	N (c)		---
Manganese	12 / 12	100	2.85E+02		8.33E+02		8.20E-02	9.96E-02	4.29E+02	3.51E+03	1.80E+02	N (b)		---
Mercury	10 / 12	83	1.27E-02	J	2.00E-02	J	9.52E-03	1.23E-02	1.55E-02	8.50E-02	2.30E+00	N (a)		---
Nickel	11 / 12	92	1.41E+01	J	3.97E+01		1.23E-01	1.49E-01	1.92E+01	5.51E+01	1.50E+02	N (a)		---
Potassium	12 / 12	100	7.75E+02		1.67E+03		1.02E+01	1.24E+01	1.15E+03	3.39E+03	Nutrient	N (c)		---
Selenium	4 / 12	33	4.53E-01	J	1.32E+00	J	4.10E-01	4.98E-01	5.60E-01	2.00E+00	3.90E+01	N (a)		---
Sodium	12 / 12	100	6.83E+01		1.88E+02		4.38E+00	9.96E+00	1.17E+02	NA	Nutrient	N (c)		---
Thallium	11 / 12	92	2.65E-01	J	6.97E-01		2.05E-01	2.49E-01	3.71E-01	1.30E+00	7.80E-02	N (b)		---
Vanadium	12 / 12	100	1.55E+01		2.70E+01		8.20E-02	9.96E-02	1.87E+01	4.09E+01	3.90E+01	N (a)		---
Zinc	12 / 12	100	5.30E+01	J	2.61E+02	J	1.02E+00	1.24E+00	8.99E+01	3.22E+02	2.30E+03	N (a)		---
Polychlorinated biphenyls (PCB)														
Aroclor 1016	1 / 12	8	5.53E-02	J	5.53E-02	J	7.27E-03	8.06E-03	1.17E-02		3.90E-01	N (a)		---
Aroclor 1221	4 / 12	33	1.75E-02	QJ	1.34E-01		7.27E-03	8.06E-03	3.19E-02		1.40E-01	N (a)		---
Explosives														
Amino-2,6-dinitrotoluene, 4-	5 / 38	13	2.09E-01	J	3.78E+00		5.60E-02	1.55E-01	2.73E-01		1.50E+01	N (a)		---
Amino-4,6-dinitrotoluene, 2-	5 / 38	13	1.49E-01	J	9.98E+00		5.60E-02	7.18E-01	4.83E-01		1.50E+01	N (a)		---
Dinitrotoluene, 2,4-	6 / 38	16	2.01E-01	J	3.25E+00		6.80E-02	1.55E-01	2.75E-01		7.20E-01	Y		3.25E+00
Dinitrotoluene, 2,6-	4 / 38	11	2.17E-01	J	5.29E-01		6.10E-02	1.60E-01	1.60E-01		7.20E-01	N (a)		---
Trinitrobenzene, 1,3,5-	7 / 38	18	9.11E-02	J	1.75E+00		5.60E-02	1.55E-01	2.82E-01		2.20E+02	N (a)		---
Trinitrotoluene, 2,4,6-	12 / 38	32	8.95E-02	J	6.90E+02	J	5.60E-02	3.89E+01	2.05E+01		3.60E+00	Y		6.90E+02
Semivolatile Organic Compounds														
Dinitrotoluene, 2,4-	3 / 12	25	8.18E-02	J	4.34E-01		1.29E-02	1.41E-02	6.18E-02		7.20E-01	N (a)		---
Dinitrotoluene, 2,6-	2 / 12	17	4.11E-02	J	1.28E-01	J	8.81E-03	9.64E-03	2.18E-02		7.20E-01	N (a)		---
Phenanthrene	5 / 12	42	5.04E-02	J	8.98E-02	J	8.92E-03	9.76E-03	3.31E-02		1.70E+02 h	N (a)		---

COPC - Chemical of potential concern.
BSC - Background screening criterion.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed
Q - Estimated due to instrument response below method criteria.
/ - Averaged samples; showing both qualifiers.

Table 4-11

COPC Summary for Subsurface Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

mg/kg - Milligrams per kilogram.

[a] IT Corporation (IT), 1998, *Site Investigation of Acid Areas*, *Plum Brook Ordnance Works, Sandusky, Ohio*, August.
[b] Risk-Based Screening Concentrations based on U. S. Environmental Protection Agency (EPA) Regional Screening Level Table (November 2011) residential soil values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[c] N - Chemical is not chosen as a COPC:
(a) - Maximum detected concentration is less than the RBSC.
(b) - Maximum detected concentration is less than the BSC.
(c) - Essential nutrient.
[d] Y - Chemical is chosen as COPC.
[e] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.1 (EPA, 2011, ProUCL Version 4.1, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm).
[f] Concentration used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower. The EPC used to evaluate lead using the Lead Model is equal to the arithmetic mean.
[g] RBSC based on acenaphthene.
[h] RBSC based on pyrene.
[i] RBSC based on 2-nitroaniline.

Table 4-12

COPC Summary for Total Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values (mg/kg) Detected Concentrations Minimum	VQ	Maximum	VQ	Method Detection Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Inorganics														
Aluminum	20 / 20	100	7.04E+03		1.24E+04		8.77E-01	2.19E+00	8.90E+03	1.55E+04	7.70E+03	N (b)		---
Antimony	15 / 20	75	2.52E-01	J	5.72E-01		2.05E-01	2.74E-01	3.64E-01	9.30E+00	3.10E+00	N (a)		---
Arsenic	20 / 20	100	4.80E+00	J	2.03E+01	J	4.10E-01	5.48E-01	1.12E+01	3.65E+01	3.90E-01	N (b)		---
Barium	20 / 20	100	1.62E+01		1.16E+02		8.20E-02	1.10E-01	4.99E+01	8.26E+02	1.50E+03	N (a)		---
Beryllium	20 / 20	100	5.22E+00	J	1.03E+01	J	8.20E-02	1.10E-01	7.22E+00	1.00E+00	1.60E+01	N (a)		---
Cadmium	8 / 20	40	2.34E-01	J	5.59E-01		2.05E-01	2.74E-01	2.77E-01	NA	7.00E+00	N (a)		---
Calcium	20 / 20	100	2.79E+03		4.58E+04		2.19E+00	5.48E+00	2.11E+04	5.23E+04	Nutrient	N (c)		---
Chromium	20 / 20	100	1.70E+00		1.65E+01		2.05E-01	2.74E-01	1.28E+01	2.90E+01	2.90E-01	N (b)		---
Cobalt	20 / 20	100	4.19E+00		1.73E+01		8.20E-02	2.03E-01	9.41E+00	1.16E+02	2.30E+00	N (b)		---
Copper	20 / 20	100	1.54E+01		3.70E+01		2.05E-01	2.74E-01	2.84E+01	5.62E+01	3.10E+02	N (a)		---
Iron	20 / 20	100	1.46E+04		6.56E+04		8.73E-01	4.52E+00	2.61E+04	2.34E+05	5.50E+03	N (b)		---
Lead	20 / 20	100	1.03E+01		2.83E+01		2.05E-01	2.74E-01	1.49E+01	4.86E+01	4.00E+02	N (a)		---
Magnesium	20 / 20	100	1.61E+03	J	1.08E+04	JJ	8.20E-01	1.10E+00	5.64E+03	1.04E+04	Nutrient	N (c)		---
Manganese	20 / 20	100	1.37E+02		8.33E+02		8.20E-02	1.10E-01	3.39E+02	3.51E+03	1.80E+02	N (b)		---
Mercury	18 / 20	90	1.27E-02	J	4.43E-01		9.52E-03	1.29E-02	4.57E-02	8.50E-02	2.30E+00	N (a)		---
Nickel	19 / 20	95	2.68E+00	J	3.97E+01		1.23E-01	1.64E-01	1.57E+01	5.51E+01	1.50E+02	N (a)		---
Potassium	20 / 20	100	4.61E+02		1.67E+03		1.02E+01	1.37E+01	9.38E+02	3.39E+03	Nutrient	N (c)		---
Selenium	7 / 20	35	4.53E-01	J	1.32E+00	J	4.10E-01	5.48E-01	5.48E-01	2.00E+00	3.90E+01	N (a)		---
Sodium	20 / 20	100	3.11E+01		1.88E+02		4.38E+00	1.10E+01	9.13E+01	NA	Nutrient	N (c)		---
Thallium	12 / 20	60	2.65E-01	J	6.97E-01		2.05E-01	2.74E-01	3.31E-01	1.30E+00	7.80E-02	N (b)		---
Vanadium	20 / 20	100	1.55E+01		2.70E+01		8.20E-02	1.10E-01	1.99E+01	4.09E+01	3.90E+01	N (a)		---
Zinc	20 / 20	100	3.40E+01	J	2.61E+02	J	1.02E+00	1.37E+00	7.49E+01	3.22E+02	2.30E+03	N (a)		---
Polychlorinated biphenyls (PCB)														
Aroclor 1016	7 / 20	35	1.91E-02	J	1.16E+00	J	7.27E-03	9.24E-03	8.37E-02		3.90E-01	Y	2.31E-01	2.31E-01
Aroclor 1221	4 / 20	20	1.75E-02	QJ	1.34E-01		7.27E-03	9.24E-03	2.26E-02		1.40E-01	N (a)		---
Aroclor 1260	1 / 20	5	1.47E-01	JJ	1.47E-01	JJ	7.27E-03	9.24E-03	1.51E-02		2.20E-01	N (a)		---
Explosives														
Amino-2,6-dinitrotoluene, 4-	10 / 50	20	1.63E-01	J/U	3.13E+01		5.60E-02	8.00E+00	1.25E+00		1.50E+01	Y	2.51E+00	2.51E+00
Amino-4,6-dinitrotoluene, 2-	9 / 50	18	1.49E-01	J	5.01E+01		5.60E-02	8.00E+00	1.75E+00		1.50E+01	Y	3.63E+00	3.63E+00
Dinitrotoluene, 2,4- [g]	7 / 50	14	2.01E-01	J	3.25E+00		6.80E-02	9.70E+00	4.68E-01		7.20E-01	Y	7.91E-01	7.91E-01
Dinitrotoluene, 2,6-	5 / 50	10	2.17E-01	J	1.48E+00	/U	6.10E-02	8.70E+00	3.51E-01		7.20E-01	Y	5.48E-01	5.48E-01
Trinitrobenzene, 1,3,5-	8 / 50	16	9.11E-02	J	1.75E+00		5.60E-02	8.00E+00	4.23E-01		2.20E+02	N (a)		---
Trinitrotoluene, 2,4,6-	17 / 50	34	8.95E-02	J	1.20E+03		5.60E-02	3.89E+01	4.42E+01		3.60E+00	Y	1.67E+02	1.67E+02
Semivolatile Organic Compounds														
Acenaphthylene	1 / 20	5	1.11E-01	J	1.11E-01	J	4.40E-03	2.58E-02	1.12E-02		3.40E+02 [h]	N (a)		---
Anthracene	1 / 20	5	2.99E-01	J	2.99E-01	J	7.93E-03	4.65E-02	2.51E-02		1.70E+03	N (a)		---
Benzo(a)anthracene	3 / 20	15	4.70E-02	J	1.54E+00		2.41E-02	1.41E-01	1.10E-01		1.50E-01	Y	5.11E-01	5.11E-01
Benzo(a)pyrene	2 / 20	10	5.30E-02	J	1.18E+00		2.41E-02	1.41E-01	9.10E-02		1.50E-02	Y	4.48E-01	4.48E-01
Benzo(b)fluoranthene	3 / 20	15	7.13E-02	J	2.00E+00		6.11E-02	3.58E-01	1.79E-01		1.50E-01	Y	6.71E-01	6.71E-01
Benzo(ghi)perylene	1 / 20	5	6.90E-01		6.90E-01		8.94E-02	5.24E-01	1.49E-01		1.70E+02 [i]	N (a)		---
Benzo(k)fluoranthene	1 / 20	5	5.40E-01		5.40E-01		1.11E-01	6.52E-01	1.69E-01		1.50E+00	N (a)		---
Benzoic acid	2 / 20	10	5.37E-01		6.39E-01	QJ	8.94E-02	5.24E-01	1.68E-01		2.40E+04	N (a)		---

Table 4-12

COPC Summary for Total Soil - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values (mg/kg) Detected Concentrations Minimum	VQ	Maximum	VQ	Method Detection Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Bis(2-ethylhexyl)phthalate	1 / 20	5	8.69E-02	J	8.69E-02	J	3.39E-02	1.99E-01	4.77E-02		3.50E+01	N (a)		---
Chrysene	3 / 20	15	6.32E-02	J	1.36E+00		1.45E-02	8.53E-02	9.20E-02		1.50E+01	N (a)		---
Dibenz(a,h)anthracene	1 / 20	5	1.96E-01	J	1.96E-01	J	8.29E-02	4.86E-01	1.16E-01		1.50E-02	Y	1.54E-01	1.54E-01
Dinitrotoluene, 2,4-	6 / 20	30	5.63E-02	J	4.42E+00		1.29E-02	7.56E-02	2.68E-01		7.20E-01	Y	1.31E+00	1.31E+00
Dinitrotoluene, 2,6- [j]	3 / 20	15	4.11E-02	J	2.18E+00		8.81E-03	5.17E-02	1.26E-01		7.20E-01	Y	3.73E-01	3.73E-01
Fluoranthene	4 / 20	20	2.61E-02	JU	3.05E+00		7.93E-03	4.65E-02	1.76E-01		2.30E+02	N (a)		---
Indeno(1,2,3-cd)pyrene	1 / 20	5	1.06E+00		1.06E+00		1.19E-01	6.98E-01	2.05E-01		1.50E-01	Y	4.37E-01	4.37E-01
Nitroaniline, 3-	1 / 20	5	2.99E-01	J	2.99E-01	J	1.24E-02	7.30E-02	2.80E-02		6.10E+01 k	N (a)		---
Phenanthrene	8 / 20	40	4.27E-02	J	3.92E-01	J	8.92E-03	5.23E-02	5.14E-02		1.70E+02 i	N (a)		---
Pyrene	3 / 20	15	7.26E-02	J	2.22E+00		1.46E-02	8.59E-02	1.38E-01		1.70E+02	N (a)		---

COPC - Chemical of potential concern.
BSC - Background screening criterion.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed
Q - Estimated due to instrument response below method criteria.
/U - The compound/analyte was positively identified in one sample averaged with a field duplicate that was nondetect (U qualified)
mg/kg - Milligrams per kilogram.

[a] IT Corporation (IT), 1998, *Site Investigation of Acid Areas*, *Plum Brook Ordnance Works, Sandusky, Ohio*, August.
[b] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (November 2011) residential soil values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[c] N - Chemical is not chosen as a COPC:
(a) - Maximum detected concentration is less than the RBSC.
(b) - Maximum detected concentration is less than the BSC.
(c) - Essential nutrient.
[d] Y - Chemical is chosen as COPC.
[e] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.1 (EPA, 2011, ProUCL Version 4.1, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm).
[f] Concentration used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower. The EPC used to evaluate lead using the Lead Model is equal to the arithmetic mean.
[g] Results from the semivolatiles analysis, rather than the explosives analysis, were used in the risk assessment.
[h] RBSC based on acenaphthene.
[i] RBSC based on pyrene.
[k] RBSC based on 2-nitroaniline.
[j] Results from the explosives, rather than the semivolatiles analysis, was used in the risk assessment.

Table 4-13

COPC Summary for Bedrock Groundwater - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent hits	Range of values (µg/L) Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Arithmetic Mean µg/L	BSC [a] µg/L	RBSC [b] µg/L	COPC? [c,d]	EPC [e] µg/L
Inorganics - Unfiltered													
Aluminum	3 / 3 [f]	100	7.04E+01	J	1.75E+03		1.10E+01	1.65E+01	7.52E+02	3.09E+02	1600	Y	1.75E+03
Arsenic	3 / 4	75	3.49E+01		7.07E+01	J/J	3.60E+00	7.20E+00	3.99E+01	7.40E+00	0.045	Y	7.07E+01
Barium	4 / 4	100	2.28E+02		1.55E+03		5.00E+00	5.00E+00	8.50E+02	1.18E+04	290	N (b)	---
Calcium	4 / 4	100	2.31E+05		6.89E+05		1.00E+02	2.00E+02	4.39E+05	3.16E+05	Nutrient	N (c)	---
Chromium	1 / 4	25	4.00E+00	J/J	4.00E+00	J/J	1.60E+00	1.60E+00	2.20E+00	NA	0.031	Y	4.00E+00
Copper	1 / 4	25	4.95E+00	U/J	4.95E+00	U/J	2.10E+00	2.10E+00	2.81E+00	1.98E+01	62	N (a)	---
Iron	2 / 4	50	6.77E+02		3.24E+03	J/J	2.30E+01	3.45E+01	9.91E+02	1.55E+03	1100	Y	3.24E+03
Magnesium	4 / 4	100	1.33E+05		4.99E+05		1.00E+02	1.50E+02	3.02E+05	2.17E+05	Nutrient	N (c)	---
Manganese	4 / 4	100	1.52E+01		5.06E+02		5.00E-01	7.50E-01	2.77E+02	6.36E+02	32	N (b)	---
Mercury	1 / 4	25	2.30E-01	J	2.30E-01	J	1.40E-01	1.40E-01	1.63E-01	NA	0.43	N (a)	---
Nickel	2 / 4	50	7.60E+00	J/J	7.90E+00	J	2.30E+00	2.30E+00	5.03E+00	8.60E+00	30	N (a)	---
Potassium	4 / 4	100	4.82E+04		1.37E+05	J/J	1.00E+02	5.00E+02	9.00E+04	1.16E+05	Nutrient	N (c)	---
Selenium	4 / 4	100	4.10E+00	J	2.93E+01	J/J	3.10E+00	6.20E+00	1.30E+01	NA	7.8	Y	2.93E+01
Sodium	4 / 4	100	3.34E+05		1.52E+06		5.00E+03	2.00E+04	8.86E+05	1.39E+06	Nutrient	N (c)	---
Vanadium	4 / 4	100	1.40E+00	J	4.00E+00	J/J	6.60E-01	9.80E-01	2.43E+00	NA	7.8	N (a)	---
Zinc	3 / 3 [f]	100	9.10E+00	J	1.51E+01	J/J	3.80E+00	3.80E+00	1.17E+01	5.01E+02	470	N (a)	---
Semivolatile Organic Compounds													
3-Methylphenol and 4-Methylpheno	2 / 4	50	2.80E+00	J	4.05E+00	J/J	9.55E-01	3.90E+00	2.93E+00		67	N (a)	---
Chloro-3-methylphenol, 4-	1 / 4	25	9.80E+00	J	9.80E+00	J	9.55E-01	3.90E+00	3.17E+00		110	N (a)	---
Dimethylphenol, 2,4-	4 / 4	100	3.20E+00	J	9.65E+00		1.15E+00	4.70E+00	6.11E+00		27	N (a)	---
Methylnaphthalene, 2-	4 / 4	100	9.70E+00		3.38E+01		9.55E-01	3.90E+00	1.95E+01		2.7	Y	3.38E+01
Methylphenol, 2-	3 / 4	75	1.20E+00	J	6.35E+00		9.55E-01	3.90E+00	4.06E+00		72	N (a)	---
Naphthalene	4 / 4	100	1.30E+01		3.20E+01		9.55E-01	3.90E+00	2.09E+01		0.14	Y	3.20E+01
Phenol	1 / 4	25	1.03E+00	J/U	1.03E+00	J/U	9.55E-01	3.90E+00	1.71E+00		450	N (a)	---

Table 4-13

COPC Summary for Bedrock Groundwater - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent hits	Range of values (µg/L) Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Arithmetic Mean µg/L	BSC [a] µg/L	RBSC [b] µg/L	COPC? [c,d]	EPC [e] µg/L
Volatile Organic Compounds													
Acetone	2 / 3 [f]	67	1.06E+02	J	1.35E+02	J/J	1.00E+01	1.00E+02	1.14E+02		1200	N (a)	---
Benzene	4 / 4	100	1.23E+01		1.47E+02		4.00E-01	4.00E+00	7.25E+01		0.39	Y	1.47E+02
Butanone, 2-	1 / 4	25	3.35E+01		3.35E+01		2.00E+00	2.00E+01	2.09E+01		490	N (a)	---
Carbon disulfide	2 / 4	50	4.05E+00	U/J	6.50E+00	J	4.00E-01	4.00E+00	3.24E+00		72	N (a)	---
Chloroform	1 / 4	25	1.53E+01		1.53E+01		2.80E-01	2.80E+00	4.95E+00		0.19	Y	1.53E+01
Chloromethane	1 / 4	25	4.31E+02		4.31E+02		3.10E+00	6.10E+00	1.11E+02		19	Y	4.31E+02
Dichloropropene, trans-1,3-	1 / 4	25	2.90E+00		2.90E+00		2.10E-01	2.10E+00	2.05E+00		0.41	Y	2.90E+00
Ethylbenzene	4 / 4	100	1.28E+02		1.52E+02		2.20E+00	4.30E+00	1.45E+02		1.3	Y	1.52E+02
Toluene	4 / 4	100	3.52E+02		6.06E+02	J	1.80E+00	3.50E+00	4.68E+02		86	Y	6.06E+02
Xylenes, total	4 / 4	100	6.80E+02		8.12E+02		5.80E+00	1.20E+01	7.36E+02		19	Y	8.12E+02
General Chemistry													
Chloride	4 / 4	100	1.86E+04		5.24E+06	J/J	1.00E+03	1.00E+05	2.61E+06		Nutrient	N (c)	---
Cyanide, total	1 / 3 [f]	33	4.10E+01	J	4.10E+01	J	5.00E+00	2.50E+01	2.37E+01		31	Y	4.10E+01
Nitrate-Nitrite	3 / 4	75	9.30E+01	J	1.50E+03		3.00E+01	3.70E+02	5.35E+02		1000 [h]	Y	1.50E+03
Sulfate	3 / 4	75	2.10E+03	J	4.23E+04		1.00E+03	1.00E+05	4.05E+04		250,000 [i]	N (a)	---

BSC - Background screening concentration.
COPC - Chemical of potential concern.
RBSC - Risk-based screening concentration.
µg/L - Micrograms per liter.
VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed
/U - The compound/analyte was positively identified in one sample averaged with a field duplicate that was nondetect (U qualified)

[a] Shaw Environmental, Inc. (Shaw), 2005, *2004 Groundwater Data Summary and Evaluation Report*, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, April.
[b] Risk-Based Screening Concentrations based on EPA Regional Screening Level Table (November 2011) tap water values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[c] N - Chemical is not chosen as a COPC:
(a) - Maximum detected concentration is less than the RBSC.
(b) - Maximum detected concentration is less than the BSC.
(c) - Essential nutrient.
[d] Y - Chemical is chosen as COPC.
[e] Exposure point concentration (EPC) used in risk assessment equal to maximum detected concentration.
[f] Some samples were excluded from the data set because of blank contamination.
[g] Screening criteria for lead based on the action level of 15 µg/L (EPA, 1996, *Drinking Water Regulations and Health Advisories*, Office of Water, Washington, D.C., October).
[h] Because no Regional Screening Level exists for nitrate-nitrite, 0.1 X the nitrate-nitrite MCL (10 mg/L) is used for screening
[i] U.S. Environmental Protection Agency (EPA), 2009, *2009 Edition of the Drinking Water Standards and Health Advisories*, Office of Water, October, EPA 822-R-09-011.

Table 4-14

COPC Summary for Overburden Groundwater - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent hits	Range of values (µg/L) Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Arithmetic Mean µg/L	BSC [a] µg/L	RBSC [b] µg/L	COPC? [c,d]	95% UCL [e] µg/L	EPC [f] µg/L
Inorganics - Unfiltered														
Aluminum	5 / 5	100	1.12E+02	J	4.97E+02		1.10E+01	1.10E+01	2.79E+02	3.09E+02	1600	N (a)		---
Barium	5 / 5	100	1.54E+01	J	1.26E+02	J	5.00E+00	5.00E+00	8.02E+01	1.18E+04	290	N (a)		---
Calcium	5 / 5	100	5.25E+04		2.78E+05		1.00E+02	1.00E+02	1.47E+05	3.16E+05	Nutrient	N (c)		---
Cobalt	3 / 5	60	4.60E+00	J	2.18E+01	J	8.30E-01	8.30E-01	7.29E+00	1.21E+01	0.47	Y	1.66E+01	1.66E+01
Iron	3 / 5	60	5.20E+02		7.37E+02	J	2.30E+01	2.30E+01	3.74E+02	1.55E+03	1100	N (a)		---
Lead	1 / 5	20	2.70E+00	J	2.70E+00	J	2.00E+00	2.00E+00	2.14E+00	NA	15 [h]	N (a)		---
Magnesium	5 / 5	100	1.35E+04		1.37E+05		1.00E+02	1.00E+02	8.51E+04	2.17E+05	Nutrient	N (c)		---
Manganese	5 / 5	100	1.11E+02		4.01E+02		5.00E-01	5.00E-01	2.32E+02	6.36E+02	32	N (b)		---
Nickel	4 / 5	80	2.40E+00	J	7.38E+01		2.30E+00	2.30E+00	2.72E+01	8.60E+00	30	Y	5.63E+01	5.63E+01
Potassium	5 / 5	100	3.89E+03	J	1.01E+05	J	1.00E+02	2.00E+02	5.03E+04	1.16E+05	Nutrient	N (c)		---
Selenium	2 / 5	40	4.70E+00	J	6.70E+00	J	3.10E+00	3.10E+00	4.14E+00	NA	7.8	N (a)		---
Sodium	5 / 5	100	8.98E+03	J	6.77E+05		5.00E+02	1.00E+04	3.13E+05	1.39E+06	Nutrient	N (c)		---
Thallium	1 / 5	20	4.40E+00	J	4.40E+00	J	3.40E+00	3.40E+00	3.60E+00	NA	0.016	Y	4.06E+00	4.06E+00
Vanadium	4 / 5	80	9.90E-01	J	1.70E+00	J	6.60E-01	6.60E-01	1.11E+00	NA	7.8	N (a)		---
Zinc	2 / 4 [g]	50	8.10E+00	J	1.34E+01	J	3.80E+00	3.80E+00	7.28E+00	5.01E+02	470	N (a)		---
Volatile Organic Compounds														---
Carbon disulfide	1 / 5	20	1.00E+00	J	1.00E+00	J	4.00E-01	4.00E-01	5.20E-01		72	N (a)		---
Ethylbenzene	1 / 5	20	5.70E-01	J	5.70E-01	J	4.30E-01	4.30E-01	4.58E-01		1.3	N (a)		---
Toluene	1 / 5	20	1.00E+00		1.00E+00		3.50E-01	3.50E-01	4.80E-01		86	N (a)		---
Xylenes, total	1 / 5	20	2.10E+00	J	2.10E+00	J	1.20E+00	1.20E+00	1.38E+00		19	N (a)		---
General Chemistry														---
Chloride	5 / 5	100	1.13E+04		1.72E+06	J	1.00E+03	5.00E+04	7.05E+05		Nutrient	N (c)		---
Cyanide, total	1 / 4 [g]	25	1.60E+01		1.60E+01		5.00E+00	5.00E+00	7.75E+00		31	N (a)		---
Nitrate-Nitrite	3 / 5	60	3.60E+01	J	4.50E+01	J	3.00E+01	3.70E+02	1.04E+02		1000 [i]	N (a)		---
Sulfate	5 / 5	100	8.50E+03		1.27E+06		1.00E+03	2.50E+04	2.72E+05		250,000 [j]	Y	1.36E+06	1.27E+06

BSC - Background screening concentration.
COPC - Chemical of potential concern.
RBSC - Risk-based screening concentration.
µg/L - Micrograms per liter.
VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.

[a] Shaw Environmental, Inc. (Shaw), 2005, *2004 Groundwater Data Summary and Evaluation Report* , Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, April.
[b] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (November 2011) tap water values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.

Table 4-14

COPC Summary for Overburden Groundwater - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

[c] N - Chemical is not chosen as a COPC:
(a) - Maximum detected concentration is less than the RBSC.
(b) - Maximum detected concentration is less than the BSC.
(c) - Essential nutrient.
[d] Y - Chemical is chosen as COPC.
[e] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.1 (EPA, 2011, ProUCL Version 4.1, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm).
[f] Concentration used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower.
[g] Some samples were excluded from the data set because of blank contamination.
[n] Screening criteria for lead based on the action level of 15 µg/L (EPA, 1996, *Drinking Water Regulations and Health Advisories* , Office of Water, Washington, D.C., October).
i Because no Regional Screening Level exists for nitrate-nitrite, 0.1 X the nitrate-nitrite MCL (10 mg/L) is used for screening.
j U.S. Environmental Protection Agency (EPA), 2009, *2009 Edition of the Drinking Water Standards and Health Advisories* , Office of Water, October, EPA 822-R-09-011.

Table 4-15

COPC Summary for Sediment - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

			Range of Values (mg/kg)										
	Detection	Percent	Detected Concentrations				Method Detection Limits		Mean	RBSC [a]		95% UCL [d]	EPC [e]
Chemical	Frequency	Detection	Minimum	VQ	Maximum	VQ	Minimum	Maximum	mg/kg	mg/kg	COPC? [b,c]	mg/kg	mg/kg
Polychlorinated biphenyls													
Aroclor 1254	5 / 6	83	4.09E-02		2.15E-01		1.00E-02	1.40E-02	9.92E-02	1.10E-01	Y	1.69E-01	1.69E-01

RBSC - Risk-based screening concentration.
COPC - Chemical of potential concern.
mg/kg - Milligrams per kilogram.
VQ - Validation qualifier.

[a] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (November 2011) residential soil and are based on a ris
level of 1.0E-06 and a hazard index of 1.
[b] N - Chemical is not chosen as a COPC:
(a) - Maximum detected concentration is less than the RBSC.
[c] Y - Chemical is chosen as COPC.
[d] 95% UCL determined using ProUCL Version 4.1 (EPA, 2011, ProUCL Version 4.1, Office of Research and Development,
Technology Support Center Characterization and Monitoring Branch, Las Vegas, Nevada, February, on line at http://www.epa.gov/esd/tsc/form.htm).
[e] Concentration used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower.

Table 4-16

Summary of Risk for All Receptors - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

	Groundskeeper [a]		Construction Worker		Indoor Worker		Resident			Hunter		Hunter's Child	
	Total ILCR	Total HI	Total ILCR	Total HI	Total ILCR	Total HI	Total ILCR	Total Adult - HI	Total Child - HI	Total ILCR	Total HI	Total ILCR	Total HI
Bedrock Groundwater Use													
Exposure Media													
Surface Soil	1.36E-05	0.78	NE	NE	4.28E-06	0.32	NE	NE	NE	9.11E-07	0.044	2.28E-12	0.00001
Total Soil	6.51E-06	0.41	3.45E-07	1.2	NE	NE	2.17E-05	0.48	4.3	NE	NE	NE	NE
Groundwater	4.03E-04	4.0	NE	NE	4.03E-04	4.0	1.73E-03	12	27	NE	NE	NE	NE
Sediment	NE	NE	1.11E-08	0.04	NE	NE	5.64E-08	0.001	0.01	NE	NE	NE	NE
Surface Water	NE	NE	NA	NA	NE	NE	NA	NA	NA	NE	NE	NE	NE
Total ILCR or HI	**4.E-04**	**4**	**4.E-07**	**1**	**4.E-04**	**4**	**2.E-03**	**12**	**32**	**9.E-07**	**0.04**	**2.E-12**	**0.00001**
Overburden Groundwater Use													
Exposure Media													
Surface Soil	1.36E-05	0.78	NE	NE	4.28E-06	0.320	NE	NE	NE	9.11E-07	0.044	2.28E-12	0.00001
Total Soil	6.51E-06	0.4	3.45E-07	1.2	NE	NE	2.17E-05	0.48	4.3	NE	NE	NE	NE
Groundwater	NA	4.6	NE	NE	NA	4.6	NA	12.7	29.7	NE	NE	NE	NE
Sediment	NE	NE	1.11E-08	0.04	NE	NE	5.64E-08	0.001	0.01	NE	NE	NE	NE
Surface Water	NE	NE	NA	NA	NE	NE	NA	NA	NA	NE	NE	NE	NE
Total ILCR or HI	**7.E-06**	**5**	**4.E-07**	**1**	**4.E-06**	**5**	**2.E-05**	**13**	**34**	**9.E-07**	**0.04**	**2.E-12**	**0.00001**

HI - Hazard index.
ILCR - Incremental lifetime cancer risk.
NA - No chemicals of potential concern available for exposure evaluation; risk/hazard is regarded as negligible.
NE - Pathway not evaluated for this receptor.

Note:
[a] Total ILCR and total HI values for the groundskeeper reflect the respective totals for the future groundskeeper assumed to use either bedrock or overburden groundwater. The total ILCR and HI values for the current groundskeeper are simply those shown for surface soil. The current groundskeeper rounded ILCR is 1E-5 and the rounded HI is 0.8

Table 4-17

Summary of Risk for Receptors Excluding Exposure to Groundwater - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

	Future Groundskeeper		Indoor Worker		Resident		
	Total ILCR	Total HI	Total ILCR	Total HI	Total ILCR	Total Adult - HI	Total Child - HI
Exposure Media							
Surface Soil	1.36E-05	0.78	4.28E-06	0.32	NE	NE	NE
Total Soil	6.51E-06	0.41	NE	NE	2.17E-05	0.48	4.34
Sediment	NE	NE	NE	NE	2.15E-06	0.004	0.04
Surface Water	NE	NE	NE	NE	NA	NA	NA
Total ILCR or HI	**7.E-06**	**0.4**	**4.E-06**	**0.3**	**2.E-05**	**0.5**	**4**

HI - Hazard index.
ILCR - Incremental lifetime cancer risk.
NA - No chemicals of potential concern available for exposure evaluation.
NE - Pathway not evaluated for this receptor.

Note:
The above receptors are those which were evaluated for groundwater exposure. Groundwater use is regarded as implausible because of insufficiently low yield and naturally poor quality.

Table 4-18

Risk-Based Remediation Concentrations for Total Soil at the TP-27 Hot Spot - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical of Concern (COC)	Total Soil EPC (mg/kg)	ILCR at EPC[b]	Cancer-Based RBRC with ILCR at[c]: 1.E-06 (mg/kg)	Cancer-Based RBRC with ILCR at[c]: 1.E-05 (mg/kg)	HQ at EPC[d]	Noncancer-Based RBRC with HQ at[e]: 0.1 (mg/kg)	Noncancer-Based RBRC with HQ at[e]: 1 (mg/kg)
Residential-Based COCs/Values							
2,4,6-Trinitotoluene	167	7.86E-06	**21**	**212**	4.23	**3.9**	**39**

mg/kg - milligram(s) per kilogram; RBRC - risk-based remediation concentration; ILCR - incremental lifetime cancer risk; HQ - hazard quotient.

Notes:
[a]The chemicals of concern, exposure point concentrations (EPC), and associated values are based on the results for resident presented in Section 5.3.5 of the BHHRA text.
[b]Value shown is the ILCR at the EPC associated with this receptor for total soil.
[c]Values shown are the RBRCs that are back-calculated from the BHHRA, assuming a cancer risk level of 1E-6 or 1E-5.
[d]Value shown is the HQ at the EPC associated with this receptor for total soil.
[e]Values shown are the RBRCs that are back-calculated from the BHHRA, assuming a noncancer HQ of 0.1 or 1.0.

Table 4-19

Summary of Samples Evaluated in the Ecological Risk Assessment - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Location	Sample Number	Sample Purpose	Sample Date	Depth (ft)	Analyses
Soil Samples					
SL-SB01	SL0061	REG	13-Jan-09	0 - 1	Exp, Metals, PCB, SVOC
SL-SB01	SL0062	REG	13-Jan-09	4 - 6	Exp, Metals, PCB, SVOC
SL-SB02	SL0063	REG	12-Jan-09	0 - 1	Exp, Metals, PCB, SVOC
SL-SB02	SL0232	REG	22-Aug-11	5 - 7	Exp
SL-SB03	SL0067	REG	13-Jan-09	0 - 1	Exp, Metals, PCB, SVOC
SL-SB03	SL0068	REG	13-Jan-09	5 - 6	Exp, Metals, PCB, SVOC
SL-SB04	SL0069	REG	13-Jan-09	0 - 1	Exp, Metals, PCB, SVOC
SL-SB04	SL0070	REG	13-Jan-09	3.4 - 5.4	Exp, Metals, PCB, SVOC
SL-SB05	SL0071	REG	13-Jan-09	0 - 1	Exp, Metals, PCB, SVOC
SL-SB05	SL0233	REG	23-Aug-11	0 - 1	Exp
SL-SB06	SL0073	REG	13-Jan-09	0 - 1	Exp, Metals, PCB, SVOC
SL-SB06	SL0074	REG	13-Jan-09	5 - 6	Exp, Metals, PCB, SVOC
SL-SB07	SL0075	REG	14-Jan-09	0 - 1	Exp, Metals, PCB, SVOC
SL-SB07	SL0076	FD	14-Jan-09	0 - 1	Exp, Metals, PCB, SVOC
SL-SB07	SL0078	REG	14-Jan-09	5 - 6	Exp, Metals, PCB, SVOC
SL-SB08	SL0079	REG	14-Jan-09	0 - 1	Exp, Metals, PCB, SVOC
SL-SB09	SL0081	REG	12-Jan-09	5 - 6	Exp, Metals, PCB, SVOC
SL-SB10	SL0083	REG	12-Jan-09	5 - 6	Exp, Metals, PCB, SVOC
SL-SB12	SL0237	REG	23-Aug-11	0 - 1	Exp
SL-SB14	SL0239	REG	23-Aug-11	0 - 1	Exp
SL-SB15	SL0240	REG	22-Aug-11	5 - 7	Exp
SL-SB22	SL0247	REG	22-Aug-11	5 - 7	Exp
SL-SB23	SL0248	REG	22-Sep-11	0 - 1	Exp
SL-SB27	SL0252	REG	22-Sep-11	0 - 1	Exp
TNTA-SL-TP03	SL0003	REG	4-Dec-08	5 - 5.5	Exp
TNTA-SL-TP04	SL0004	REG	4-Dec-08	4 - 4.5	Exp
TNTA-SL-TP21	SL0025	REG	5-Dec-08	4 - 4.5	Exp
TNTA-SL-TP22	SL0026	REG	5-Dec-08	4 - 4.5	Exp
TNTA-SL-TP22	SL0027	FD	5-Dec-08	4 - 4.5	Exp
TNTA-SL-TP23	SL0029	REG	5-Dec-08	4 - 4.5	Exp
TNTA-SL-TP24	SL0030	REG	5-Dec-08	4 - 4.25	Exp
TNTA-SL-TP25	SL0031	REG	5-Dec-08	4 - 4.25	Exp
TNTA-SL-TP26	SL0032	REG	4-Dec-08	4 - 4.3	Exp
TNTA-SL-TP27	SL0033	REG	4-Dec-08	3 - 3.5	Exp
TNTA-SL-TP28	SL0034	REG	4-Dec-08	3 - 3.25	Exp
TNTA-SL-TP28	SL0035	FD	4-Dec-08	3 - 3.25	Exp
TNTA-SL-TP29	SL0037	REG	4-Dec-08	5 - 5.5	Exp
TNTA-SL-TP30	SL0038	REG	4-Dec-08	5 - 5.25	Exp
TNTA-SL-TP32	SL0040	REG	4-Dec-08	5 - 5.5	Exp
TNTA-SL-TP33	SL0041	REG	4-Dec-08	5 - 5.5	Exp
TNTA-SL-TP34	SL0042	REG	4-Dec-08	5 - 5.5	Exp
TNTA-SL-TP35	SL0043	REG	4-Dec-08	5 - 5.25	Exp
TNTA-SL-TP36	SL0044	REG	4-Dec-08	5 - 5.5	Exp
TNTA-SL-TP37	SL0045	REG	4-Dec-08	4 - 4.25	Exp
Sediment Samples					
1SLA-SD01	SL1000	REG	30-Oct-09	0 - 0	Exp, PCBs
1SLA-SD02	SL1001	REG	30-Oct-09	0 - 0	Exp, PCBs
1SLA-SD03	SL1002	REG	30-Oct-09	0 - 0	Exp, PCBs
1SLA-SD04	SL1003	REG	30-Oct-09	0 - 0	Exp, PCBs
1SLA-SD05	SL1004	REG	30-Oct-09	0 - 0	Exp, PCBs
1SLA-SD06	SL1005	REG	30-Oct-09	0 - 0	Exp, PCBs
1SLA-SD06	SL1006	FD	30-Oct-09	0 - 0	Exp, PCBs

Table 4-19

Summary of Samples Evaluated in the Ecological Risk Assessment - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Location	Sample Number	Sample Purpose	Sample Date	Depth (ft)	Analyses
Surface Water Samples					
1SLA-SW01	SL2000	REG	30-Oct-09	0 - 0	Exp
1SLA-SW02	SL2001	REG	30-Oct-09	0 - 0	Exp
1SLA-SW03	SL2002	REG	30-Oct-09	0 - 0	Exp
1SLA-SW04	SL2003	REG	30-Oct-09	0 - 0	Exp
1SLA-SW05	SL2004	REG	30-Oct-09	0 - 0	Exp
1SLA-SW06	SL2005	REG	30-Oct-09	0 - 0	Exp
1SLA-SW06	SL2006	FD	30-Oct-09	0 - 0	Exp

Exp - Explosives.
FD - Field duplicate.
NA - Not applicable.
PCB - Polychlorinated biphenyls.
SVOC - Semivolatile organic compounds.

[a] Samples were collected for delineating 2,4,6-trinitrotoluene. See text for details.

Table 4-20

COPEC Summary for Soil[a] - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean (mg/kg)	BSC [b] (mg/kg)	ESV [c] (mg/kg)	COPEC? [d,e]	Distribution [f]	95% UCL [g] (mg/kg)	EPC [h] (mg/kg)	UCL 0-1' soil depth [f] (mg/kg)	MDC 0-1' soil depth [h] (mg/kg)	EPC 0-1' soil depth [h] (mg/kg)
Inorganics																		
Aluminum	15 / 15	100	7.04E+03		1.24E+04		8.77E-01	2.19E+00	8.94E+03	1.55E+04	pH Dependent	N (b)						
Antimony	10 / 15	67	2.94E-01	J	5.72E-01		2.05E-01	2.74E-01	3.79E-01	9.30E+00	0.27	N (b)						
Arsenic	15 / 15	100	4.80E+00	J	2.03E+01	J	4.10E-01	5.48E-01	1.08E+01	3.65E+01	18	N (b)						
Barium	15 / 15	100	3.78E+01		1.16E+02		8.20E-02	1.10E-01	5.72E+01	8.26E+02	330	N (a)						
Beryllium	15 / 15	100	5.22E+00	J	1.03E+01	J	8.20E-02	1.10E-01	7.31E+00	1.00E+00	21	N (a)						
Cadmium	6 / 15	40	2.34E-01	J	3.87E-01	J	2.05E-01	2.74E-01	2.70E-01	NA	0.36	Y	Normal	2.99E-01	2.99E-01	3.30E-01	3.87E-01	3.30E-01
Calcium	15 / 15	100	2.79E+03		3.21E+04		2.19E+00	5.48E+00	1.35E+04	5.23E+04	Nutrient	N (c)						
Chromium	15 / 15	100	1.70E+00		1.65E+01		2.05E-01	2.74E-01	1.26E+01	2.90E+01	26	N (a)						
Cobalt	15 / 15	100	4.19E+00		1.73E+01		8.20E-02	2.03E-01	8.84E+00	1.16E+02	13	N (b)						
Copper	15 / 15	100	1.54E+01		3.63E+01		2.05E-01	2.74E-01	2.68E+01	5.62E+01	28	N (b)						
Iron	15 / 15	100	1.46E+04		6.56E+04		8.98E-01	4.52E+00	2.65E+04	2.34E+05	pH Dependent	N (b)						
Lead	15 / 15	100	1.03E+01		2.83E+01		2.05E-01	2.74E-01	1.55E+01	4.86E+01	11	N (b)						
Magnesium	15 / 15	100	1.61E+03	J	9.98E+03	J	8.20E-01	1.10E+00	4.18E+03	1.04E+04	Nutrient	N (c)						
Manganese	15 / 15	100	1.37E+02		8.33E+02		8.20E-02	1.10E-01	3.17E+02	3.51E+03	220	N (b)						
Mercury	14 / 15	93	1.53E-02	J	4.43E-01		1.08E-02	1.29E-02	5.62E-02	8.50E-02	0.00051	Y	Nonparametric	1.78E-01	1.78E-01	3.10E-01	4.43E-01	3.10E-01
Nickel	14 / 15	93	2.68E+00	J	3.97E+01		1.23E-01	1.64E-01	1.35E+01	5.51E+01	38	N (b)						
Potassium	15 / 15	100	4.61E+02		1.13E+03		1.02E+01	1.37E+01	8.06E+02	3.39E+03	Nutrient	N (c)						
Selenium	7 / 15	47	4.53E-01	J	1.32E+00	J	4.10E-01	5.48E-01	5.82E-01	2.00E+00	0.52	N (b)						
Sodium	15 / 15	100	3.11E+01		1.22E+02		4.38E+00	1.10E+01	6.96E+01	NA	Nutrient	N (c)						
Thallium	8 / 15	53	2.92E-01	J	6.97E-01		2.05E-01	2.74E-01	3.48E-01	1.30E+00	1	N (a)						
Vanadium	15 / 15	100	1.55E+01		2.70E+01		8.20E-02	1.10E-01	2.10E+01	4.09E+01	7.8	N (b)						
Zinc	15 / 15	100	3.40E+01	J	9.94E+01		1.02E+00	1.37E+00	6.39E+01	3.22E+02	46	N (b)						
Polychlorinated biphenyls (PCB)																		
Aroclor 1016	7 / 15	47	1.91E-02	J	1.16E+00	J	7.68E-03	9.24E-03	1.09E-01		0.371	Y	Lognormal	2.88E-01	2.88E-01	8.14E-01	1.16E+00	8.14E-01
Aroclor 1260	1 / 15	7	1.47E-01	J/J	1.47E-01	J/J	7.68E-03	9.24E-03	1.76E-02		0.371	N (a)						
Explosives																		
1,3,5-Trinitrobenzene	7 / 39	18	1.96E-01	J	1.75E+00		7.30E-02	8.00E+00	5.13E-01		0.376	Y	Normal	8.73E-01	8.73E-01	NA	1.96E-01	1.96E-01
2,4,6-Trinitrotoluene	14 / 39	36	1.49E-01	J	1.20E+03		7.30E-02	3.89E+01	5.66E+01		NSV	Y	Nonparametric	2.14E+02	2.14E+02	3.11E+02	1.20E+03	3.11E+02
2,4-Dinitrotoluene	7 / 39	18	2.01E-01	J	3.25E+00		8.80E-02	9.70E+00	5.69E-01		1.28	Y	Normal	8.58E-01	8.58E-01	4.56E+00	1.93E+00	1.93E+00
2,6-Dinitrotoluene	5 / 39	13	2.17E-01	J	1.48E+00	/U	7.90E-02	8.70E+00	4.18E-01		0.0328	Y	Normal	5.53E-01	5.53E-01	4.06E+00	1.48E+00	1.48E+00
2-Amino-4,6-dinitrotoluene	9 / 39	23	1.49E-01	J	5.01E+01		7.30E-02	8.00E+00	2.22E+00		0.0328	Y	Gamma	4.61E+00	4.61E+00	2.17E+01	5.01E+01	2.17E+01
4-Amino-2,6-dinitrotoluene	10 / 39	26	1.63E-01	J/U	3.13E+01		7.30E-02	8.00E+00	1.57E+00		0.0328	Y	Gamma	3.17E+00	3.17E+00	1.10E+01	3.13E+01	1.10E+01
Semivolatile Organic Compounds																		
Acenaphthylene	1 / 15	7	1.11E-01	J	1.11E-01	J	4.62E-03	2.58E-02	1.34E-02		29	N (a)						
Anthracene	1 / 15	7	2.99E-01	J	2.99E-01	J	8.32E-03	4.65E-02	3.08E-02		29	N (a)						
Benzo(a)anthracene	3 / 15	20	4.70E-02	J	1.54E+00		2.53E-02	1.41E-01	1.39E-01		1.1	Y	Lognormal	6.60E-01	6.60E-01	1.17E+00	1.54E+00	1.17E+00
Benzo(a)pyrene	2 / 15	13	5.30E-02	J	1.18E+00		2.53E-02	1.41E-01	1.13E-01		1.1	Y	Nonparametric	5.76E-01	5.76E-01	1.01E+00	1.18E+00	1.01E+00
Benzo(b)fluoranthene	3 / 15	20	7.13E-02	J	2.00E+00		6.41E-02	3.58E-01	2.18E-01		1.1	Y	Lognormal	8.64E-01	8.64E-01	1.52E+00	2.00E+00	1.52E+00
Benzo(ghi)perylene	1 / 15	7	6.90E-01		6.90E-01		9.38E-02	5.24E-01	1.68E-01		1.1	N (a)						
Benzo(k)fluoranthene	1 / 15	7	5.40E-01		5.40E-01		1.17E-01	6.52E-01	1.88E-01		1.1	N (a)						
Benzoic acid	2 / 15	13	5.37E-01		6.39E-01	QJ	9.38E-02	5.24E-01	1.94E-01		NSV	Y	Nonparametric	5.60E-01	5.60E-01	5.82E-01	6.39E-01	5.82E-01
Bis(2-ethylhexyl)phthalate	1 / 15	7	8.69E-02	J	8.69E-02	J	3.56E-02	1.99E-01	5.21E-02		0.925	N (a)						
Chrysene	3 / 15	20	6.32E-02	J	1.36E+00		1.53E-02	8.53E-02	1.18E-01		1.1	Y	Lognormal	5.96E-01	5.96E-01	1.36E+00	1.36E+00	1.36E+00
Dibenz(a,h)anthracene	1 / 15	7	1.96E-01	J	1.96E-01	J	8.70E-02	4.86E-01	1.26E-01		1.1	N (a)						
2,4-Dinitrotoluene [i]	*6 / 15*	*40*	*5.63E-02*	*J*	*4.42E+00*		*1.35E-02*	*7.56E-02*	*3.53E-01*		*1.28*	*Y*	*Lognormal*	*1.72E+00*	*1.72E+00*	*3.33E+00*	*4.42E+00*	*3.33E+00*
2,6-Dinitrotoluene [i]	*3 / 15*	*20*	*4.11E-02*	*J*	*2.18E+00*		*9.24E-03*	*5.17E-02*	*1.65E-01*		*0.0328*	*Y*	*Normal*	*4.86E-01*	*4.86E-01*	*3.60E+02*	*2.18E+00*	*2.18E+00*
Fluoranthene	4 / 15	27	2.61E-02	J/U	3.05E+00		8.32E-03	4.65E-02	2.32E-01		1.1	Y	Gamma	6.37E-01	6.37E-01	1.20E+00	3.05E+00	1.20E+00
Indeno(1,2,3-cd)pyrene	1 / 15	7	1.06E+00		1.06E+00		1.25E-01	6.98E-01	2.33E-01		1.1	N (a)						
Nitroaniline, 3-	1 / 15	7	2.99E-01	J	2.99E-01	J	1.31E-02	7.30E-02	3.31E-02		3.16	N (a)						
Phenanthrene	4 / 15	27	4.27E-02	J	3.92E-01	J	9.36E-03	5.23E-02	4.92E-02		29	N (a)						
Pyrene	3 / 15	20	7.26E-02	J	2.22E+00		1.54E-02	8.59E-02	1.78E-01		1.1	Y	Lognormal	9.56E-01	9.56E-01	1.68E+00	2.22E+00	1.68E+00

BSC - Background screening concentration.
COPEC - Chemical of potential ecological concern.
EPC - Exposure point concentration.
ESV - Ecological screening value.
mg/kg - Nilligrams per kilogram.

Table 4-20

COPEC Summary for Soil[a] - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

NA - Not available.
NSV - No screening value.
UCL - Upper confidence limit.
VQ - Validation qualifier (a "/" indicates combined VQs for a regular and field duplicate sample pair)
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed
QJ- Concentration estimated due to instrument response below method criteria.
U - Not detected.

[a] Samples greater than 6 feet in depth were included if at least half their sampling interval was below 6 feet. See text for details
[b] IT Corporation (IT), 1998, *Site Investigation of Acid Areas* , *Plum Brook Ordnance Works, Sandusky, Ohio* , August.
[c] ESVs and their sources are in Appendix B.
[d] N = Chemical is not chosen as a COPEC:
(a) = Maximum detected concentration is less than the ESV.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
[e] Y = Chemical is chosen as COPEC.
[f] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.1 (U.S. Environmental Protection Agency [EPA], 2011, ProUCL Version 4.1, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/software.htm).
[g] Concentration used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower
[h] The EPC for the COPEC at the surface soil depth range is used as the exposure concentration for some ecological receptors.
[i] Results from the explosives analysis, rather than the semivolatiles analysis, were used in the risk assessment. See text for details

Table 4-21

COPEC Summary for Sediment - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	ESV [a] mg/kg	COPEC? [b,c]	Distribution [d]	95% UCL [d] mg/kg	EPC [e] mg/kg
Polychlorinated biphenyls														
Aroclor 1254	5 / 6	83	4.09E-02		2.15E-01		1.00E-02	1.40E-02	9.92E-02	5.98E-02	Y	Normal	1.69E-01	1.69E-01

COPEC - Chemical of potential ecological concern.
EPC - Exposure point concentration.
ESV - Ecological screening value.
mg/kg - Milligrams per kilogram.
NA - Not available.
NSV - No screening value available.
VQ - Validation qualifier.

[a] ESVs and their sources are in Appendix B.
[b] N = Chemical is not chosen as a COPEC:
(a) = Maximum detected concentration is less than the ESV.
[c] Y = Chemical is chosen as COPEC.
[d] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.1 (U.S. Environmental Protection Agency [EPA], 2011, ProUCL Version 4.1 User Guide [Draft] Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations, EPA/600/R-07/041, Office of Research and Development, Washington, DC, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/osp/hstl/tsc/ProUCL_v4.1_user.pdf).
[e] Concentration used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower.

Table 4-22

Wildlife Hazard Quotients for All Assessment Receptors - TNTA/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

COPEC	Deer Mouse		Short-tailed Shrew		Cottontail Rabbit		Marsh Wren		White-tailed Deer		Raccoon		Red-Tailed Hawk		Muskrat	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Metals																
Cadmium	2.94E-01	2.94E-02	4.70E-01	4.70E-02	3.06E-02	3.06E-03	6.87E-01	4.98E-02	2.52E-05	2.52E-06	4.47E-04	4.47E-05	1.04E-05	NA[1]	0.00E+00	0.00E+00
Mercury	5.90E-03	5.90E-04	7.00E-03	7.00E-04	1.38E-03	1.38E-04	4.77E-01	2.39E-01	8.64E-07	8.64E-08	1.11E-04	2.22E-05	1.25E-05	NA[1]	0.00E+00	0.00E+00
Polychlorinated biphenyls (PCB)																
Aroclor 1016	6.88E-01	2.75E-01	4.84E-01	1.93E-01	4.18E-03	1.67E-03	***2.05E+01***	***2.05E+00***	6.46E-07	2.58E-07	1.12E-03	4.46E-04	8.28E-06	NA[1]	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.29E-05	4.65E-06	0.00E+00	NA[1]	1.45E-03	2.94E-04
All PCBs (summed)	***6.88E-01***	***2.75E-01***	***4.84E-01***	***1.93E-01***	***4.18E-03***	***1.67E-03***	***2.05E+01***	***2.05E+00***	***6.46E-07***	***2.58E-07***	***1.14E-03***	***4.51E-04***	***8.28E-06***	***NA[1]***	***1.45E-03***	***2.94E-04***
Nitroaromatics																
1,3,5-Trinitrobenzene	2.38E-02	4.76E-03	1.27E-01	2.55E-02	7.05E-03	1.41E-03	***1.79E+00***	3.58E-01	2.82E-05	5.65E-06	3.05E-05	6.10E-06	4.49E-05	NA[1]	0.00E+00	0.00E+00
2,4,6-Trinitrotoluene	***1.33E+01***	***2.67E+00***	***1.23E+01***	***2.46E+00***	***3.27E+00***	6.53E-01	***1.25E+02***	***2.50E+01***	2.02E-03	4.03E-04	1.78E-02	3.55E-03	5.49E-05	NA[1]	0.00E+00	0.00E+00
2,4,6-Trinitrotoluene [a]	***4.48E+00***	*8.96E-01*	*1.85E-01*	*3.69E-02*	***3.27E+00***	*6.53E-01*	*1.11E+00*	*2.22E-01*	*2.02E-03*	*4.03E-04*	*3.44E-03*	*6.88E-04*	*5.49E-05*	*NA[1]*	*0.00E+00*	*0.00E+00*
2,4-Dinitrotoluene	6.02E-01	8.02E-02	1.28E-01	1.71E-02	4.15E-01	5.53E-02	6.89E-03	1.38E-03	1.53E-04	2.04E-05	6.52E-04	8.70E-05	3.40E-07	NA[1]	0.00E+00	0.00E+00
2,6-Dinitrotoluene	4.01E-01	5.34E-02	8.27E-02	1.10E-02	2.73E-01	3.65E-02	5.26E-03	1.05E-03	8.38E-05	1.12E-05	4.56E-04	6.08E-05	2.60E-07	NA[1]	0.00E+00	0.00E+00
2-Amino-4,6-dinitrotoluene	9.57E-01	1.79E-01	1.53E-02	2.87E-03	6.96E-01	1.31E-01	7.74E-02	1.55E-02	1.32E-04	2.48E-05	7.46E-04	1.40E-04	3.82E-06	NA[1]	0.00E+00	0.00E+00
4-Amino-2,6-dinitrotoluene	4.86E-01	9.11E-02	1.05E-02	1.98E-03	3.54E-01	6.63E-02	3.93E-02	7.86E-03	9.11E-05	1.71E-05	3.79E-04	7.10E-05	1.94E-06	NA[1]	0.00E+00	0.00E+00
All Nitrotoluenes (summed)	***1.58E+01***	***3.07E+00***	***1.25E+01***	***2.50E+00***	***5.00E+00***	***9.42E-01***	***1.25E+02***	***2.51E+01***	***2.48E-03***	***4.76E-04***	***2.00E-02***	***3.91E-03***	***6.12E-05***	***NA[1]***	***0.00E+00***	***0.00E+00***
Semivolatile Organics																
Benzo(a)anthracene	3.69E-01	7.38E-02	3.89E-01	7.79E-02	7.31E-02	1.46E-02	2.90E-01	5.80E-02	2.95E-05	5.90E-06	6.38E-04	1.28E-04	2.86E-06	NA[1]	0.00E+00	0.00E+00
Benzo(a)pyrene	5.27E-02	5.27E-03	4.76E-02	4.76E-03	1.62E-02	1.62E-03	1.40E-01	2.80E-02	6.60E-06	6.60E-07	8.46E-05	8.46E-06	1.73E-06	NA[1]	0.00E+00	0.00E+00
Benzo(b)fluoranthene	2.09E-02	4.18E-03	9.95E-03	1.99E-03	1.20E-02	2.40E-03	7.23E-01	1.45E-01	5.48E-06	1.10E-06	2.64E-05	5.28E-06	1.86E-05	NA[1]	0.00E+00	0.00E+00
Benzoic Acid	1.99E-01	1.99E-02	2.78E-01	2.78E-02	4.03E-02	4.03E-03	NA	NA	3.46E-05	3.46E-06	2.78E-04	2.78E-05	NA	NA[1]	0.00E+00	0.00E+00
Chrysene	4.09E-01	8.19E-02	3.36E-01	6.73E-02	8.27E-02	1.65E-02	2.25E-01	4.50E-02	2.75E-05	5.51E-06	7.13E-04	1.43E-04	2.34E-06	NA[1]	0.00E+00	0.00E+00
Fluoranthene	7.38E-03	1.48E-03	2.35E-03	4.69E-04	4.58E-03	9.15E-04	2.02E-03	2.02E-04	2.04E-06	4.07E-07	8.19E-06	1.64E-06	5.21E-08	NA[1]	0.00E+00	0.00E+00
Pyrene	2.69E-02	5.39E-03	1.04E-02	2.07E-03	1.49E-02	2.98E-03	5.81E-03	5.81E-04	7.25E-06	1.45E-06	2.97E-05	5.94E-06	7.32E-08	NA[1]	0.00E+00	0.00E+00

COPEC - Chemical of potential ecological concern.
LOAEL - Lowest-observed-adverse-effect level.
NA - No toxicity data available; hazard quotients not calculated.
NA[1] - Because the Red-Tailed Hawk represents the northern harrier, a Threatened and Endangered Species observed at the site, only hazard quotients based on the NOAEL are calculated.
NOAEL - No-observed-adverse-effect level.

[a] Hazard quotients calculated using a soil-to-terrestrial invertebrates uptake factor of 0.1; see text for details.

Shaded cells indicate a hazard quotient greater than 1, when rounded.

Table 5-1

Summary of Water Level Measurements - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Well Identification	Coordinates (Ohio Plane)[a] Northing (y)	Easting (x)	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (ft msl)			
WWTP1/TNTB Sewer Lines								
							27-Oct-09	
							DTW	Elevation
Temporary Piezometer[c]								
TNTB-SL-PZ01 (DP01)	623,784.26	1,919,669.52	NS	640.62	--	--	--	--
TNTB-SL-PZ02 (DP02)	NS	NS	NS	NS	--	--	--	--
TNTB-SL-PZ03 (DP03)	622,783.27	1,919,268.01	NS	641.23	--	--	--	--
TNTB-SL-PZ06 (DP06)	621,390.07	1,918,751.95	NS	647.76	--	--	--	--
Overburden/Shale Monitoring Well								
1SLB-MW01	623473.540	1919549.170	644.99	642.43	--	--	9.45	635.54
1SLB-MW02	622790.820	1919271.370	643.90	641.46	--	--	8.15	635.75

Notes:

[a]Northings and Eastings are scaled to the Ohio State Plane Coordinate System (North Zone), NAD 1983, Vertical datum to National Geodetic Vertical Datum 1929.

[b]Piezometers were abandoned.

[c]Temporary Piezometer - Survey data taken from associated test pit, piezometers not surveyed.

DTW - Depth to water. NM - Not measured.

ft msl - Feet above mean sea level.

NA - Not applicable. NS - Not surveyed.

Table 5-2

Detections Above RBSCs in Test Pit Soil - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines									
				LOCATION CODE	TNTB-SL-TP01		TNTB-SL-TP02		TNTB-SL-TP03		TNTB-SL-TP04		TNTB-SL-TP05	
				SAMPLE NO	SL0085		SL0086		SL0087		SL0088		SL0089	
				SAMPLE DATE	28-Jul-09		28-Jul-09		28-Jul-09		29-Jul-09		29-Jul-09	
				DEPTH	2 - 3 Ft		2 - 3 Ft		2 - 3 Ft		2 - 3 Ft		2 - 3 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives														
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	1.2	1.2		0.182		0.184		-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	1.05	1.05		0.21		0.17		-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.173	0.173		-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.101	0.101	J	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.0739	0.0739	J	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	3.65	3.65		-	-	0.064	J	-	-	-	-

Table 5-2

Detections Above RBSCs in Test Pit Soil - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines									
				LOCATION CODE	TNTB-SL-TP06		TNTB-SL-TP07		TNTB-SL-TP07		TNTB-SL-TP07		TNTB-SL-TP08	
				SAMPLE NO	SL0090		SL0091		SL0092		SL0093		SL0094	
				SAMPLE DATE	29-Jul-09		29-Jul-09		29-Jul-09		29-Jul-09		29-Jul-09	
				DEPTH	2 - 3 Ft		2 - 3 Ft		2 - 3 Ft		2 - 3 Ft		2 - 3 Ft	
				SAMPLE PURPOSE	REG		REG		FD		FS		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives														
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	1.2	-	-	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	1.05	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.173	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.101	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.0739	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	3.65	-	-	-	-	-	-	-	-	-	-

Table 5-2

Detections Above RBSCs in Test Pit Soil - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines									
				LOCATION CODE	TNTB-SL-TP09		TNTB-SL-TP10		TNTB-SL-TP10		TNTB-SL-TP10		TNTB-SL-TP11	
				SAMPLE NO	SL0095		SL0096		SL0097		SL0098		SL0099	
				SAMPLE DATE	29-Jul-09		29-Jul-09		29-Jul-09		29-Jul-09		29-Jul-09	
				DEPTH	2 - 3 Ft		2 - 3 Ft		0 - 0 Ft		0 - 0 Ft		1_5 - 2 Ft	
				SAMPLE PURPOSE	REG		REG		FD		FS		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives														
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	1.2	-	-	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	1.05	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.173	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.101	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.0739	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	3.65	-	-	-	-	-	-	-	-	-	-

Table 5-2

Detections Above RBSCs in Test Pit Soil - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines									
				LOCATION CODE	TNTB-SL-TP12		TNTB-SL-TP13		TNTB-SL-TP14		TNTB-SL-TP15		TNTB-SL-TP16	
				SAMPLE NO	SL0100		SL0101		SL0102		SL0103		SL0104	
				SAMPLE DATE	29-Jul-09		29-Jul-09		29-Jul-09		30-Jul-09		30-Jul-09	
				DEPTH	1_5 - 2 Ft		1_5 - 2 Ft		1_5 - 2 Ft		1_5 - 2 Ft		1_5 - 2 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives														
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	1.2	-	-	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	1.05	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.173	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.101	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.0739	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	3.65	-	-	-	-	-	-	-	-	-	-

Table 5-2

Detections Above RBSCs in Test Pit Soil - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines							
				LOCATION CODE	TNTB-SL-TP17		TNTB-SL-TP18		TNTB-SL-TP19		TNTB-SL-TP20	
				SAMPLE NO	SL0105		SL0106		SL0107		SL0108	
				SAMPLE DATE	30-Jul-09		30-Jul-09		30-Jul-09		30-Jul-09	
				DEPTH	1_5 - 2 Ft		1_5 - 2 Ft		1_5 - 2 Ft		1_5 - 2 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives												
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	1.2	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	1.05	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.173	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.101	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.0739	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	3.65	-	-	-	-	-	-	0.0991	J

Shaded cell indicates value is greater than RBSC.
BSC - Background screening concentration.
MDC - Maximum detected concentration for the area of concern
("B"-qualified data not included).
mg/kg - Milligrams per kilogram.
NE - Not established (RBSCs), not evaluated (BSCs).
RBSC - Risk-based screening concentrations. Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
"-" - Not Detected.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.

Table 5-3

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil -TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines															
				LOCATION CODE	TNTB-SL-DP01		TNTB-SL-DP01		TNTB-SL-DP01		TNTB-SL-DP01		TNTB-SL-DP02		TNTB-SL-DP02		TNTB-SL-DP03		TNTB-SL-DP03	
				SAMPLE NO	DP0100		DP0101		DP0102		DP0103		DP0104		DP0105		DP0106		DP0107	
				SAMPLE DATE	20-Aug-09		20-Aug-09		20-Aug-09		20-Aug-09		20-Aug-09		20-Aug-09		21-Aug-09		21-Aug-09	
				DEPTH	0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		8 - 10 Ft		0 - 1 Ft		8 - 10 Ft		0 - 1 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		FD		FS		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
EXPLOSIVES																				
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	0.278	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.104	J
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	0.336	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.145	J
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.0846	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.098	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.101	-	-	-	-	-	-	-	-	-	-	0.0534	J	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	1.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.192	
PCBs																				
Aroclor 1260	mg/kg	0.22	NE	0.0295	0.0295	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEMIVOLATILES																				
Acenaphthene	mg/kg	340	NE	0.12	0.12	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	mg/kg	NE	NE	0.829	0.829	J	0.325	p	-	-	0.0491	J	-	-	-	-	-	-	-	-
Anthracene	mg/kg	1,700	NE	1.2	1.2	J	0.227	J	-	-	0.044	J	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	2.43	2.43	J	0.804	J	1.9		0.151	J	-	-	-	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.015	NE	1.96	1.96	J	0.785	J	-	-	0.13	J	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	2.8	2.8	J	1.09	J	2.1		0.183	J	0.0528	J	-	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	NE	NE	0.94	0.94	J	0.357	J	-	-	0.0568	J	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	1.07	1.07	J	0.383	J	-	-	0.07	J	-	-	-	-	-	-	-	-
Carbazole	mg/kg	NE	NE	0.603	0.603	J	0.0872	J	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	15	NE	2.25	2.25	J	0.744	J	1.7		0.132	J	0.0403	J	-	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.247	0.247	J	0.0917	J	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	mg/kg	7.8	NE	0.376	0.376	J	0.0407	J	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-butyl phthalate	mg/kg	610	NE	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	mg/kg	230	NE	6.57	6.57	J	1.76	J	5.5		0.351		0.0763	J	-	-	-	-	-	-
Fluorene	mg/kg	230	NE	0.755	0.755	J	0.0937	J	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	1.12	1.12	J	0.431	J	-	-	0.0668	J	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	mg/kg	31	NE	0.259	0.0487	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	3.6	NE	0.0765	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg	NE	NE	5.62	5.62	J	0.833	J	4.3		0.105	J	0.0504	J	-	-	-	-	-	-
Pyrene	mg/kg	170	NE	4.35	4.35	J	1.33	J	3.6		0.257		0.0569	J	-	-	-	-	-	-

Table 5-3

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil -TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines															
				LOCATION CODE	TNTB-SL-DP01		TNTB-SL-DP01		TNTB-SL-DP01		TNTB-SL-DP01		TNTB-SL-DP02		TNTB-SL-DP02		TNTB-SL-DP03		TNTB-SL-DP03	
				SAMPLE NO	DP0100		DP0101		DP0102		DP0103		DP0104		DP0105		DP0106		DP0107	
				SAMPLE DATE	20-Aug-09		20-Aug-09		20-Aug-09		20-Aug-09		20-Aug-09		20-Aug-09		21-Aug-09		21-Aug-09	
				DEPTH	0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		8 - 10 Ft		0 - 1 Ft		8 - 10 Ft		0 - 1 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		FD		FS		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS																				
Aluminum	mg/kg	7,700	15,500	8570	5,130	J	5,780	J	5,680		3,160	J	5,470	J	2,130	J	3,880	J	3,210	J
Antimony	mg/kg	3.1	9.3	1.9	-	-	0.39	J	-	-	0.39	J	0.27	J	-	-	-	-	-	-
Arsenic	mg/kg	0.39	36.5	15.3	3.4		2.9		3		3.9		5		1.1		3.7		3.9	
Barium	mg/kg	1,500	826	46.8	22.3	J	24.7	J	26.7		13.3	J	29.5	J	7.4	J	11.1	J	16	J
Beryllium	mg/kg	16	1	0.81	0.34		0.36		-	-	0.23	J	0.4		0.19	J	0.47	J	0.24	J
Cadmium	mg/kg	7	NE	0.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calcium	mg/kg	NE	52,300	47200	38,700	J	5,510	J	6,270		26,200	J	1,170	J	35,700	J	2,050	J	47,200	J
Chromium	mg/kg	0.29	29	13.8	6.5		7.3		7.6		5.4		8.1		4.7		6.2		5.6	
Cobalt	mg/kg	2.3	116	18.2	2.2	J	2.3	J	-	-	3.2		4.2		2.3	J	4.1	J	3	J
Copper	mg/kg	310	56.2	46.4	4.5		3.9		4.6		6.3		11.3		3.8		4.3	J	6.1	
Iron	mg/kg	5,500	234,000	45200	7,110	J	7,820	J	9,530		5,950	J	12,300	J	4,220	J	10,900	J	6,720	J
Lead	mg/kg	40	48.6	17.7	6.9	J	6.2		7.3		3.1	J	7.7		2.3	J	4.3	J	3.9	J
Magnesium	mg/kg	NE	10,400	13300	4,980	J	1,050	J	1,130		7,980	J	728	J	8,870	J	832	J	**13,300**	J
Manganese	mg/kg	180	3,506	1040	142	J	127	J	143		140	J	113	J	136	J	206	J	172	J
Mercury	mg/kg	2.3	0.09	0.078	0.031	J	0.02	J	-	-	-	-	0.031	J	-	-	0.022	J	-	-
Nickel	mg/kg	150	55.1	34.4	5		5.1		5.7		8.2		9.2		5.1		7.6	J	7.7	
Potassium	mg/kg	NE	3,390	1980	441	J	343	J	-	-	861	J	420	J	523	J	382	J	999	J
Selenium	mg/kg	39	2	2.3	0.8	J	0.46	J	-	-	0.51	J	0.68	J	0.67	J	-	-	0.59	J
Silver	mg/kg	39	11.1	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium	mg/kg	NE	NE	254	139	J	162	J	-	-	195	J	155	J	254	J	-	-	227	J
Thallium	mg/kg	NE	1.3	1.4	-	-	-	-	-	-	-	-	0.24	J	-	-	-	-	-	-
Vanadium	mg/kg	39	40.9	27.5	12.8	J	15.4	J	15.7		10.5	J	16.7	J	7.9	J	19.1	J	10.1	J
Zinc	mg/kg	2,300	321.75	74.1	21.6	J	23.1	J	25.7		20.9	J	19	J	14.4	J	20.3	J	21.5	J
GENERAL CHEMISTRY																				
Total organic carbon	mg/kg	NE	NE	0.29	0.29	J														

Table 5-3

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil -TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines															
				LOCATION CODE	TNTB-SL-DP04		TNTB-SL-DP04		TNTB-SL-DP05		TNTB-SL-DP05		TNTB-SL-DP06		TNTB-SL-DP06		TNTB-SL-DP06		TNTB-SL-DP06	
				SAMPLE NO	DP0108		DP0109		DP0110		DP0111		DP0112		DP0113		DP0114		DP0115	
				SAMPLE DATE	24-Aug-09		24-Aug-09		24-Aug-09		24-Aug-09		24-Aug-09		24-Aug-09		24-Aug-09		24-Aug-09	
				DEPTH	0 - 1 Ft		8 - 10 Ft		0 - 1 Ft		8 - 10 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		9 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		FD		FS		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
EXPLOSIVES																				
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	0.278	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	0.336	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.0846	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.098	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	1.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCBs																				
Aroclor 1260	mg/kg	0.22	NE	0.0295	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEMIVOLATILES																				
Acenaphthene	mg/kg	340	NE	0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	mg/kg	NE	NE	0.829	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg	1,700	NE	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	2.43	-	-	-	-	-	-	-	-	0.0534	J	0.041	J	-	-	-	-
Benzo(a)pyrene	mg/kg	0.015	NE	1.96	-	-	-	-	-	-	-	-	0.0524	J	0.0428	J	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	2.8	-	-	-	-	-	-	-	-	0.0739	J	0.0622	J	-	-	-	-
Benzo(ghi)perylene	mg/kg	NE	NE	0.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	1.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbazole	mg/kg	NE	NE	0.603	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	15	NE	2.25	-	-	-	-	-	-	-	-	0.0568	J	0.0407	J	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.247	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	mg/kg	7.8	NE	0.376	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-butyl phthalate	mg/kg	610	NE	0.15	0.15	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	mg/kg	230	NE	6.57	-	-	-	-	0.044	J	-	-	0.11	J	0.0718	J	-	-	-	-
Fluorene	mg/kg	230	NE	0.755	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	1.12	-	-	-	-	-	-	-	-	0.0392	J	-	-	-	-	-	-
Methylnaphthalene, 2-	mg/kg	31	NE	0.259	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	3.6	NE	0.0765	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg	NE	NE	5.62	-	-	-	-	-	-	0.0424	J	0.0404	J	-	-	-	-	-	-
Pyrene	mg/kg	170	NE	4.35	-	-	-	-	-	-	-	-	0.0825	J	0.0565	J	-	-	-	-

Table 5-3

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil -TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines															
				LOCATION CODE	TNTB-SL-DP04		TNTB-SL-DP04		TNTB-SL-DP05		TNTB-SL-DP05		TNTB-SL-DP06		TNTB-SL-DP06		TNTB-SL-DP06		TNTB-SL-DP06	
				SAMPLE NO	DP0108		DP0109		DP0110		DP0111		DP0112		DP0113		DP0114		DP0115	
				SAMPLE DATE	24-Aug-09		24-Aug-09		24-Aug-09		24-Aug-09		24-Aug-09		24-Aug-09		24-Aug-09		24-Aug-09	
				DEPTH	0 - 1 Ft		8 - 10 Ft		0 - 1 Ft		8 - 10 Ft		0 - 1 Ft		0 - 1 Ft		0 - 1 Ft		9 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		FD		FS		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS																				
Aluminum	mg/kg	7,700	15,500	8570	6,370	J	8,570	J	4,910	J	7,820	J	4,390	J	4,610	J	4,990		2,090	J
Antimony	mg/kg	3.1	9.3	1.9	0.37	J	0.51	J	-	-	0.59	J	-	-	-	-	-	-	-	-
Arsenic	mg/kg	0.39	36.5	15.3	3.7	J	11.8	J	3	J	12	J	2.9	J	3	J	3.7		3.3	J
Barium	mg/kg	1,500	826	46.8	39	J	23.7	J	26.2	J	31.3	J	16.7	J	17.1	J	-	-	6.3	J
Beryllium	mg/kg	16	1	0.81	0.68		0.51		0.49		0.48		0.29		0.3		-	-	0.18	J
Cadmium	mg/kg	7	NE	0.24	0.16	J	0.24	J	0.17	J	0.19	J	0.18	J	0.19	J	-	-	0.085	J
Calcium	mg/kg	NE	52,300	47200	3,610	J	25,300	J	3,720	J	45,100	J	1,680	J	1,580	J	1,680		43,200	J
Chromium	mg/kg	0.29	29	13.8	10.2	J	13.8	J	8.5	J	13.1	J	6.4	J	6.7	J	8.1		4.4	J
Cobalt	mg/kg	2.3	116	18.2	5.8	J	13.1	J	4.8	J	11.5	J	2.8	J	3	J	-	-	3.3	J
Copper	mg/kg	310	56.2	46.4	9.6	J	30.2	J	8.2	J	21	J	4.2	J	4.2	J	4.9		4.5	J
Iron	mg/kg	5,500	234,000	45200	11,200	J	23,300	J	9,890	J	22,300	J	7,900	J	8,290	J	10,400		4,590	J
Lead	mg/kg	40	48.6	17.7	9.8	J	17.7	J	7.6	J	11.6	J	12.2	J	12	J	14.4		3.2	J
Magnesium	mg/kg	NE	10,400	13300	1,160	J	8,200	J	1,050	J	7,800	J	683	J	708	J	766		8,240	J
Manganese	mg/kg	180	3,506	1040	130	J	371	J	102	J	458	J	140	J	141	J	157		139	J
Mercury	mg/kg	2.3	0.09	0.078	0.035	J	-	-	0.037	J	-	-	0.038	J	0.046	J	-	-	-	-
Nickel	mg/kg	150	55.1	34.4	16.2	J	34.4	J	9.9	J	29	J	5.5	J	5.7	J	6.7		7.5	J
Potassium	mg/kg	NE	3,390	1980	549	J	1,790	J	421	J	1,980	J	347	J	354	J	-	-	678	J
Selenium	mg/kg	39	2	2.3	0.39	J	-	-	0.28	J	-	-	-	-	0.35	J	-	-	-	-
Silver	mg/kg	39	11.1	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium	mg/kg	NE	NE	254	-	-	125	J	-	-	166	J	-	-	-	-	-	-	119	J
Thallium	mg/kg	NE	1.3	1.4	-	-	0.42	J	-	-	0.51	J	-	-	-	-	-	-	-	-
Vanadium	mg/kg	39	40.9	27.5	16.4	J	14.1	J	15.4	J	12.3	J	12.9	J	13.8	J	17.7		6.4	J
Zinc	mg/kg	2,300	321.75	74.1	40.2	J	65.2	J	38.2	J	45.5	J	58.8	J	62.9	J	74.1		17.1	J
GENERAL CHEMISTRY																				
Total organic carbon	mg/kg	NE	NE	0.29																

Table 5-3

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil -TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines															
				LOCATION CODE	TNTB-SL-DP07		TNTB-SL-DP07		TNTB-SL-DP08		TNTB-SL-DP08		TNTB-SL-DP09		TNTB-SL-DP09		TNTB-SL-DP10		TNTB-SL-DP10	
				SAMPLE NO	DP0116		DP0117		DP0118		DP0119		DP0120		DP0121		DP0122		DP0123	
				SAMPLE DATE	24-Aug-09		24-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09	
				DEPTH	0 - 1 Ft		4 - 6 Ft		0 - 1 Ft		2 - 4 Ft		0 - 1 Ft		2 - 4 Ft		0 - 1 Ft		2 - 3_5 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
EXPLOSIVES																				
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	0.278	-	-	-	-	-	-	-	-	0.224		0.278		0.2		0.0637	J
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	0.336	-	-	-	-	-	-	-	-	0.222		0.336		0.329		-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.0846	-	-	-	-	-	-	-	-	0.0517	J	0.0827	J	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.098	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.101	-	-	-	-	-	-	-	-	-	-	0.101	J	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	1.02	-	-	-	-	-	-	-	-	0.179		1.02		0.908		0.065	J
PCBs																				
Aroclor 1260	mg/kg	0.22	NE	0.0295	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEMIVOLATILES																				
Acenaphthene	mg/kg	340	NE	0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	mg/kg	NE	NE	0.829	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg	1,700	NE	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	2.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.015	NE	1.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	2.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	NE	NE	0.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	1.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbazole	mg/kg	NE	NE	0.603	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	15	NE	2.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.247	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	mg/kg	7.8	NE	0.376	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-butyl phthalate	mg/kg	610	NE	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	mg/kg	230	NE	6.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	mg/kg	230	NE	0.755	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	1.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	mg/kg	31	NE	0.259	-	-	-	-	-	-	-	-	-	-	0.259		0.0658	J	-	-
Naphthalene	mg/kg	3.6	NE	0.0765	-	-	-	-	-	-	-	-	-	-	0.0765	J	-	-	-	-
Phenanthrene	mg/kg	NE	NE	5.62	-	-	-	-	-	-	-	-	-	-	0.124	J	-	-	-	-
Pyrene	mg/kg	170	NE	4.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-3

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil -TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines															
				LOCATION CODE	TNTB-SL-DP07		TNTB-SL-DP07		TNTB-SL-DP08		TNTB-SL-DP08		TNTB-SL-DP09		TNTB-SL-DP09		TNTB-SL-DP10		TNTB-SL-DP10	
				SAMPLE NO	DP0116		DP0117		DP0118		DP0119		DP0120		DP0121		DP0122		DP0123	
				SAMPLE DATE	24-Aug-09		24-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09	
				DEPTH	0 - 1 Ft		4 - 6 Ft		0 - 1 Ft		2 - 4 Ft		0 - 1 Ft		2 - 4 Ft		0 - 1 Ft		2 - 3_5 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS																				
Aluminum	mg/kg	7,700	15,500	8570	3,260	J	4,040	J	5,440	J	6,160	J	8,190	J	6,600	J	6,560	J	6,710	J
Antimony	mg/kg	3.1	9.3	1.9	-	-	-	-	-	-	-	-	-	-	1.9	J	0.38	J	0.43	J
Arsenic	mg/kg	0.39	36.5	15.3	2.3	J	3.5	J	3.1	J	2.4	J	7.9	J	15.3	J	6.4	J	12.8	J
Barium	mg/kg	1,500	826	46.8	28.5	J	46.8	J	14.8	J	19.2	J	32.8	J	24.2	J	19.9	J	19.4	J
Beryllium	mg/kg	16	1	0.81	0.33		0.42	J	0.46		0.71		0.37		0.35		0.4		0.71	
Cadmium	mg/kg	7	NE	0.24	0.11	J	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calcium	mg/kg	NE	52,300	47200	1,930	J	3,050	J	407	J	573	J	271	J	168	J	258		126	J
Chromium	mg/kg	0.29	29	13.8	4.4	J	6.1	J	8.7	J	8.3	J	11	J	11.9	J	9	J	9.7	J
Cobalt	mg/kg	2.3	116	18.2	3	J	4.6	J	6	J	3.8	J	4.2	J	2.9	J	5.8	J	9.9	J
Copper	mg/kg	310	56.2	46.4	5.1	J	8.7	J	11.6	J	7.3	J	30.5	J	46.4	J	20.8	J	42.8	J
Iron	mg/kg	5,500	234,000	45200	9,040	J	16,300	J	11,400	J	8,760	J	18,500	J	45,200	J	15,700	J	24,700	J
Lead	mg/kg	40	48.6	17.7	7.2	J	9.3	J	7.3	J	7.1	J	13.3	J	15.8	J	11.6	J	15.2	J
Magnesium	mg/kg	NE	10,400	13300	831	J	1,230	J	533	J	548	J	544	J	306	J	574	J	916	J
Manganese	mg/kg	180	3,506	1040	673	J	1,040	J	114	J	48.7	J	24.1	J	10.1	J	79.8	J	58.7	J
Mercury	mg/kg	2.3	0.09	0.078	0.018	J	0.03	J	0.041	J	0.038	J	0.034	J	0.049	B	0.05	J	0.078	J
Nickel	mg/kg	150	55.1	34.4	8.5	J	19	J	14.8	J	17.8	J	14.5	J	12.7	J	17.4	J	22.8	J
Potassium	mg/kg	NE	3,390	1980	242	J	349	J	225	J	165	J	462	J	720	J	414	J	740	J
Selenium	mg/kg	39	2	2.3	-	-	-	-	0.27	J	0.32	J	0.61	J	**2.3**	J	0.49	J	0.4	J
Silver	mg/kg	39	11.1	0.11	-	-	-	-	-	-	-	-	-	-	0.11	J	-	-	-	-
Sodium	mg/kg	NE	NE	254	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium	mg/kg	NE	1.3	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/kg	39	40.9	27.5	7.8	J	11.4	J	17.4	J	15.6	J	24.2	J	25.5	J	19.4	J	22.9	J
Zinc	mg/kg	2,300	321.75	74.1	30.5	J	55.3	J	25.9	J	29.9	J	14.1	J	9.3	J	22.9	J	54.8	J
GENERAL CHEMISTRY																				
Total organic carbon	mg/kg	NE	NE	0.29																

Table 5-3

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil -TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines											
				LOCATION CODE	TNTB-SL-DP11		TNTB-SL-DP12		TNTB-SL-DP13		TNTB-SL-DP14		TNTB-SL-DP14		TNTB-SL-DP14	
				SAMPLE NO	DP0124		DP0125		DP0126		DP0127		DP0130		DP0131	
				SAMPLE DATE	20-Aug-09		20-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09	
				DEPTH	8 - 10 Ft		8 - 10 Ft		2 - 3_5 Ft		2 - 3_5 Ft		2 - 3_5 Ft		2 - 3_5 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		FD		FS	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
EXPLOSIVES																
Amino-2,6-dinitrotoluene, 4-	mg/kg	15	NE	0.278	-	-	-	-	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene, 2-	mg/kg	15	NE	0.336	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	mg/kg	0.71	NE	0.0846	-	-	0.0846	J	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	mg/kg	0.71	NE	0.098	-	-	0.098	J	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	mg/kg	220	NE	0.101	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrotoluene, 2,4,6-	mg/kg	3.6	NE	1.02	-	-	-	-	-	-	-	-	-	-	-	-
PCBs																
Aroclor 1260	mg/kg	0.22	NE	0.0295	-	-	-	-	-	-	-	-	-	-	-	-
SEMIVOLATILES																
Acenaphthene	mg/kg	340	NE	0.12	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	mg/kg	NE	NE	0.829	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg	1,700	NE	1.2	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	2.43	-	-	0.0413	J	-	-	-	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.015	NE	1.96	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	2.8	-	-	0.045	J	-	-	-	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	NE	NE	0.94	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	1.07	-	-	-	-	-	-	-	-	-	-	-	-
Carbazole	mg/kg	NE	NE	0.603	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	15	NE	2.25	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.247	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	mg/kg	7.8	NE	0.376	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-butyl phthalate	mg/kg	610	NE	0.15	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	mg/kg	230	NE	6.57	-	-	0.117	J	-	-	-	-	-	-	-	-
Fluorene	mg/kg	230	NE	0.755	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	1.12	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	mg/kg	31	NE	0.259	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	3.6	NE	0.0765	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg	NE	NE	5.62	-	-	0.132	J	-	-	-	-	-	-	-	-
Pyrene	mg/kg	170	NE	4.35	-	-	0.0757	J	-	-	-	-	-	-	-	-

Table 5-3

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil -TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines											
				LOCATION CODE	TNTB-SL-DP11		TNTB-SL-DP12		TNTB-SL-DP13		TNTB-SL-DP14		TNTB-SL-DP14		TNTB-SL-DP14	
				SAMPLE NO	DP0124		DP0125		DP0126		DP0127		DP0130		DP0131	
				SAMPLE DATE	20-Aug-09		20-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09	
				DEPTH	8 - 10 Ft		8 - 10 Ft		2 - 3_5 Ft		2 - 3_5 Ft		2 - 3_5 Ft		2 - 3_5 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		FD		FS	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS																
Aluminum	mg/kg	7,700	15,500	8570	2,820	J	4,460	J	6,770	J	6,300	J	5,610	J	6,400	
Antimony	mg/kg	3.1	9.3	1.9	-	-	0.57	J	0.49	J	0.29	J	0.38	J	-	-
Arsenic	mg/kg	0.39	36.5	15.3	1.5		10.3		11.7	J	6.2	J	6.7	J	14	
Barium	mg/kg	1,500	826	46.8	8.1	J	21.1	J	14.2	J	20.2	J	18.6	J	26.4	
Beryllium	mg/kg	16	1	0.81	0.23	J	0.3		0.81		0.62		0.62		-	-
Cadmium	mg/kg	7	NE	0.24	-	-	-	-	-	-	-	-	-	-	-	-
Calcium	mg/kg	NE	52,300	47200	17,000	J	33,800	J	449		590		539		608	
Chromium	mg/kg	0.29	29	13.8	6.2		6.2		10.1	J	9.9	J	9.1	J	10.5	
Cobalt	mg/kg	2.3	116	18.2	2.5	J	5.3		13.8	J	11.2	J	8.8	J	18.2	
Copper	mg/kg	310	56.2	46.4	3.7		12.4		33.4	J	25.6	J	26.5	J	30.2	
Iron	mg/kg	5,500	234,000	45200	5,520	J	10,300	J	27,000	J	20,000	J	19,200	J	23,200	
Lead	mg/kg	40	48.6	17.7	3.2	J	6.3	J	11.8	J	11.1	J	12	J	14.5	
Magnesium	mg/kg	NE	10,400	13300	4,990	J	8,360	J	715	J	786	J	769	J	866	
Manganese	mg/kg	180	3,506	1040	138	J	184	J	94.8	J	98.1	J	89.1	J	226	
Mercury	mg/kg	2.3	0.09	0.078	-	-	0.018	J	0.034	J	0.045	J	0.04	J	-	-
Nickel	mg/kg	150	55.1	34.4	5.5		14.4		23.8	J	17.2	J	16.9	J	21.6	
Potassium	mg/kg	NE	3,390	1980	515	J	1,380	J	601	J	558	J	575	J	686	
Selenium	mg/kg	39	2	2.3	0.49	J	0.46	J	0.39	J	-	-	0.34	J	0.69	
Silver	mg/kg	39	11.1	0.11	-	-	-	-	-	-	-	-	-	-	-	-
Sodium	mg/kg	NE	NE	254	234	J	225	J	-	-	-	-	-	-	-	-
Thallium	mg/kg	NE	1.3	1.4	-	-	-	-	-	-	-	-	-	-	**1.4**	
Vanadium	mg/kg	39	40.9	27.5	11.3	J	10	J	27.5	J	21.1	J	20.4	J	24.2	
Zinc	mg/kg	2,300	321.75	74.1	15.8	J	67.6	J	31.9	J	26.2	J	26.4	J	31.1	
GENERAL CHEMISTRY																
Total organic carbon	mg/kg	NE	NE	0.29												

Table 5-3

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil -TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

BSC - Background screening concentration.
FD- Field duplicate.
FS - Field split.
NE - Not established (RBSCs), not evaluated (BSCs).
Shaded cell indicates value is greater than RBSC.
Bold text indicates value is greater than the BSC.
RBSC - Risk-based screening concentration. Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
"-" - Not detected.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.

Table 5-4

Detections Above RBSCs and/or BSCs in Piezometer Groundwater - WWTP1/TNTB Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines											
				LOCATION CODE	TNTB-SL-PZ01		TNTB-SL-PZ02		TNTB-SL-PZ03						TNTB-SL-PZ06	
				SAMPLE NO	PZ0100		PZ0101		PZ0102		PZ0103		PZ0104		PZ0107	
				SAMPLE DATE	25-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09		25-Aug-09		26-Aug-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG		FD		FS		REG	
				LOW-FLOW SAMPLED	No		Yes		Yes		Yes		Yes		Yes	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
EXPLOSIVES																
Amino-2,6-dinitrotoluene, 4-	µg/L	7.3	NE	1	-	-	-	-	0.84		1				-	-
Amino-4,6-dinitrotoluene, 2-	µg/L	7.3	NE	1.3	-	-	-	-	0.85		0.96		1.3		-	-
Dinitrotoluene, 2,4-	µg/L	0.099	NE	0	-	-	-	-	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	µg/L	0.099	NE	0	-	-	-	-	-	-	-	-	-	-	-	-
Tetryl	µg/L	15	NE	0	-	-	-	-	-	-	-	-	-	-	-	-
Trinitrobenzene, 1,3,5-	µg/L	110	NE	0.45	-	-	0.45		0.21		0.28		-	-	-	-
Trinitrotoluene, 2,4,6-	µg/L	1.8	NE	2.2	-	-	0.29		1.5	J	2.1	J	2.2		-	-

BSC - Background screening concentration.
MDC - Maximum detected concentration.
µg/L - Micrograms per liter.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.

Table 5-5

Detections Above RBSCs and/or BSCs in Overburden/Shale Groundwater - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines							
				LOCATION CODE	1SLB-MW01				1SLB-MW02			
				SAMPLE NO	SL3102		SL3100		SL3103		SL3101	
				SAMPLE DATE	4-May-10		18-Nov-09		4-May-10		17-Nov-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG	
				LOW-FLOW SAMPLED	Yes		Yes		Yes		Yes	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ
EXPLOSIVES												
Amino-2,6-dinitrotoluene,	µg/L	7.3	NE	0	-	-	-	-	-	-	-	-
Amino-4,6-dinitrotoluene,	µg/L	7.3	NE	0	-	-	-	-	-	-	-	-
Dinitrobenzene, 1,3-	µg/L	0.37	NE	0	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,4-	µg/L	0.099	NE	0	-	-	-	-	-	-	-	-
Dinitrotoluene, 2,6-	µg/L	0.099	NE	0	-	-	-	-	-	-	-	-
Nitrotoluene, 2-	µg/L	0.31	NE	0.18	-	-	-	-	0.18	J	-	-
Trinitrotoluene, 2,4,6-	µg/L	1.8	NE	0	-	-	-	-	-	-	-	-
VOLATILES												
Acetone	µg/L	2,200	NE	0	-	-	-	-	-	-	-	-
Butanone, 2-	µg/L	710	NE	0	-	-	-	-	-	-	-	-
Carbon disulfide	µg/L	100	NE	0	-	-	-	-	-	-	-	-
Ethylbenzene	µg/L	1.5	0.87	0	-	-	-	-	-	-	-	-
Toluene	µg/L	230	1.7	0	-	-	-	-	-	-	-	-
Xylenes, total	µg/L	20	5.5	0	-	-	-	-	-	-	-	-
SEMIVOLATILES												
Bis(2-ethylhexyl)phthalat	µg/L	4.8	NE	0	-	-	-	-	-	-	-	-
Diethyl phthalate	µg/L	2,900	NE	5.3	-	-	5.3		-	-	-	-
METALS (UNFILTERED)												
Aluminum	µg/L	3,700	309	69.8	-	-	24.6	J	-	-	69.8	J
Arsenic	µg/L	0.045	7.4	0	-	-	-	-	-	-	-	-
Barium	µg/L	730	11,800	98.2	23.6	J	98.2	J	22.3	J	22.7	J
Calcium	µg/L	NE	316,000	94100	94,100		88,600	J	58,200		63,400	J
Cobalt	µg/L	1.1	12.1	0	-	-	-	-	-	-	-	-
Copper	µg/L	150	19.8	0	-	-	-	-	-	-	-	-
Iron	µg/L	2,600	1,550	41.4	-	-	-	-	41.4	J	-	-
Lead	µg/L	NE	NE	2.4	-	-	-	-	-	-	2.4	B
Magnesium	µg/L	NE	217,000	18000	13,700		18,000		10,700		11,200	
Manganese	µg/L	88	636	163	-	-	163		6.2	J	21.4	
Mercury	µg/L	1.1	NE	0	-	-	-	-	-	-	-	-

Table 5-5

Detections Above RBSCs and/or BSCs in Overburden/Shale Groundwater - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines							
				LOCATION CODE	1SLB-MW01				1SLB-MW02			
				SAMPLE NO	SL3102		SL3100		SL3103		SL3101	
				SAMPLE DATE	4-May-10		18-Nov-09		4-May-10		17-Nov-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG	
				LOW-FLOW SAMPLED	Yes		Yes		Yes		Yes	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Nickel	µg/L	73	8.6	2.4	-	-	2.4	J	-	-	-	-
Potassium	µg/L	NE	116,000	11100	1,520	J	11,100		855	J	1,260	J
Selenium	µg/L	18	NE	4.9	2.9	J	3.6	J	-	-	4.9	J
Sodium	µg/L	NE	1,390,000	18300	5,180	U	18,300	J	5,100	J	3,160	J
Thallium	µg/L	NE	NE	0	-	-	-	-	-	-	-	-
Vanadium	µg/L	18	NE	0	-	-	-	-	-	-	-	-
Zinc	µg/L	1,100	507	0	-	-	-	-	-	-	-	-
METALS (FILTERED)												
Aluminum	µg/L	3,700	309	23.2	-	-	22.4	B	-	-	23.2	J
Arsenic	µg/L	0.045	7.4	0	-	-	-	-	-	-	-	-
Barium	µg/L	730	11,800	101	25.6	J	101	J	22.5	J	23	J
Calcium	µg/L	NE	316,000	97800	97,800		84,300	J	56,200		60,000	J
Cobalt	µg/L	1.1	12.1	0	-	-	-	-	-	-	-	-
Iron	µg/L	2,600	1,550	101	-	-	101	J	-	-	28.2	J
Lead	µg/L	NE	NE	0	-	-	-	-	-	-	-	-
Magnesium	µg/L	NE	217,000	17700	14,600		17,700	J	10,200		10,800	J
Manganese	µg/L	88	636	162	-	-	162		6.2	J	20.3	
Nickel	µg/L	73	8.6	4.2	-	-	4.2	J	-	-	-	-
Potassium	µg/L	NE	116,000	12100	1,600	J	12,100	J	834	J	1,670	B
Selenium	µg/L	18	NE	3.5	-	-	-	-	2.1	J	3.5	J
Sodium	µg/L	NE	1,390,000	20500	5,330	U	20,500		4,850	J	4,030	J
Vanadium	µg/L	18	NE	1.1	-	-	1.1	J	-	-	-	-
Zinc	µg/L	1,100	507	0	-	-	-	-	-	-	-	-

Table 5-5

Detections Above RBSCs and/or BSCs in Overburden/Shale Groundwater - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION	WWTP1-TNTB Sewer Lines							
				LOCATION CODE	1SLB-MW01				1SLB-MW02			
				SAMPLE NO	SL3102		SL3100		SL3103		SL3101	
				SAMPLE DATE	4-May-10		18-Nov-09		4-May-10		17-Nov-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG	
				LOW-FLOW SAMPLED	Yes		Yes		Yes		Yes	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ
WATER QUALITY PARAMETERS												
Alkalinity	µg/L	NE	NE	275000	252,000		275,000		176,000		190,000	
Chloride	µg/L	NE	NE	18100	6,700		18,100		4,400	J	5,400	
Cyanide, total	µg/L	73	NE	0	-	-	-	-	-	-	-	-
HARDNESS (as CaCO3)	µg/L	NE	NE	295000	291,000		295,000		189,000		204,000	
Nitrate-Nitrite	µg/L	NE	NE	230	14	J	230		-	-	44	J
Sulfate	µg/L	NE	NE	61400	61,400		60,400		18,900	J	21,900	
Total dissolved solids	µg/L	NE	NE	369000	342,000		369,000	J	204,000		234,000	J
Total suspended solids	µg/L	NE	NE	0	-	-	-	-	-	-	-	-
Turbidity	NTU	NE	NE	2.5	-	-	1.8		1.9		2.5	

BSC - Background screening concentration.
MDC - Maximum detected concentration.
µg/L - Micrograms per liter.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.

Table 5-6

COPC Summary for Surface Soil - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Method Detection Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Inorganics														
Aluminum	10 / 10	100	3.26E+03	J	8.19E+03	J	5.40E-01	2.40E+00	5.40E+03	1.55E+04	7.70E+03	N (b)		---
Antimony	4 / 10	40	2.70E-01	J	4.50E-01	UJ/J	2.20E-01	1.00E+00	3.69E-01	9.30E+00	3.10E+00	N (b)		---
Arsenic	10 / 10	100	2.30E+00	J	7.90E+00	J	1.80E-01	8.00E-01	4.12E+00	3.65E+01	3.90E-01	N (b)		---
Barium	10 / 10	100	1.11E+01	J	3.90E+01	J	2.50E-01	1.10E+00	2.42E+01	8.26E+02	1.50E+03	N (b)		---
Beryllium	10 / 10	100	2.95E-01		6.80E-01		4.90E-02	2.20E-01	4.25E-01	1.00E+00	1.60E+01	N (b)		---
Cadmium	4 / 10	40	1.10E-01	J	1.85E-01	J/J	4.90E-02	2.65E-01	1.33E-01	NA	7.00E+00	N (a)		---
Calcium	10 / 10	100	2.58E+02		2.21E+04	J/J	4.90E+00	2.20E+01	3.72E+03	5.23E+04	Nutrient	N (c)		---
Chromium	10 / 10	100	4.40E+00	J	1.10E+01	J	7.90E-02	3.60E-01	7.96E+00	2.90E+01	2.90E-01	N (b)		---
Cobalt	10 / 10	100	2.25E+00	J/J	6.00E+00	J	4.10E-02	1.80E-01	4.31E+00	1.16E+02	2.30E+00	N (b)		---
Copper	10 / 10	100	4.20E+00	J/J	3.05E+01	J	1.00E-01	4.70E-01	1.10E+01	5.62E+01	3.10E+02	N (b)		---
Iron	10 / 10	100	7.47E+03	J/J	1.85E+04	J	1.10E+00	5.10E+00	1.14E+04	2.34E+05	5.50E+03	N (b)		---
Lead	10 / 10	100	4.30E+00	J	1.33E+01	J	9.80E-02	4.50E-01	8.75E+00	4.86E+01	4.00E+02	N (b)		---
Magnesium	10 / 10	100	5.33E+02	J	3.02E+03	J/J	4.90E+00	2.20E+01	9.96E+02	1.04E+04	Nutrient	N (c)		---
Manganese	10 / 10	100	2.41E+01	J	6.73E+02	J	2.50E-02	1.30E-01	1.72E+02	3.51E+03	1.80E+02	N (b)		---
Mercury	10 / 10	100	1.80E-02	J	5.00E-02	J	1.10E-02	1.50E-02	3.36E-02	8.50E-02	2.30E+00	N (b)		---
Nickel	10 / 10	100	5.05E+00		1.74E+01	J	1.10E-01	5.10E-01	1.09E+01	5.51E+01	1.50E+02	N (b)		---
Potassium	10 / 10	100	2.25E+02	J	5.49E+02	J	4.90E+00	2.20E+01	3.86E+02	3.39E+03	Nutrient	N (c)		---
Selenium	8 / 10	80	2.55E-01	UJ/J	6.80E-01	J	1.50E-01	6.90E-01	4.46E-01	2.00E+00	3.90E+01	N (b)		---
Sodium	2 / 10	20	1.51E+02	J/J	1.55E+02	J	2.50E+01	1.10E+02	6.07E+01	NA	Nutrient	N (c)		---
Thallium	1 / 10	10	2.40E-01	J	2.40E-01	J	1.80E-01	3.80E+00	1.29E+00	1.30E+00	7.80E-02	N (b)		---
Vanadium	10 / 10	100	7.80E+00	J	2.42E+01	J	3.20E-02	1.50E-01	1.64E+01	4.09E+01	3.90E+01	N (b)		---
Zinc	10 / 10	100	1.41E+01	J	6.09E+01	J/J	1.90E-01	8.50E-01	2.94E+01	3.22E+02	2.30E+03	N (b)		---
Polychlorinated biphenyls (PCB)														
Aroclor 1260	1 / 10	10	1.94E-02	J/U	1.94E-02	J/U	9.00E-03	1.00E-02	1.05E-02		2.20E-01	N (a)		---
Explosives														
Amino-2,6-dinitrotoluene, 4-	2 / 10	20	2.00E-01		2.24E-01		4.00E-02	4.80E-02	7.62E-02		1.50E+01	N (a)		---
Amino-4,6-dinitrotoluene, 2-	2 / 10	20	2.22E-01		3.29E-01		8.70E-02	1.00E-01	1.28E-01		1.50E+01	N (a)		---
Dinitrotoluene, 2,4- exp	1 / 10	10	5.17E-02	J	5.17E-02	J	4.80E-02	5.70E-02	5.05E-02		7.10E-01	N (a)		---
Trinitrotoluene, 2,4,6-	2 / 10	20	1.79E-01		9.08E-01		4.00E-02	4.80E-02	1.43E-01		3.60E+00	N (a)		---
Semivolatile Organic Compounds														
Acenaphthene	1 / 10	10	7.85E-02	J/U	7.85E-02	J/U	3.60E-02	4.20E-02	4.22E-02		3.40E+02	N (a)		---
Acenaphthylene	1 / 10	10	5.77E-01	J/J	5.77E-01	J/J	3.60E-02	4.20E-02	9.20E-02		3.40E+02	N (a)		---
Anthracene	1 / 10	10	7.14E-01	J/J	7.14E-01	J/J	3.60E-02	4.20E-02	1.06E-01		1.70E+03	N (a)		---
Benzo(a)anthracene	2 / 10	20	4.72E-02	J/J	1.62E+00	J/J	3.60E-02	4.20E-02	1.97E-01		1.50E-01	Y	1.12E+00 *	1.12E+00
Benzo(a)pyrene	2 / 10	20	4.76E-02	J/J	1.37E+00	J/J	3.60E-02	4.20E-02	1.73E-01		1.50E-02	Y	9.55E-01 *	9.55E-01
Benzo(b)fluoranthene	3 / 10	30	5.28E-02	J	1.95E+00	J/J	3.60E-02	4.20E-02	2.33E-01		1.50E-01	Y	1.20E+00 *	1.20E+00
Benzo(ghi)perylene	1 / 10	10	6.49E-01	J/J	6.49E-01	J/J	3.60E-02	4.20E-02	9.92E-02		1.70E+02 g	N (a)		---
Benzo(k)fluoranthene	1 / 10	10	7.27E-01	J/J	7.27E-01	J/J	3.60E-02	4.20E-02	1.07E-01		1.50E+00	N (a)		---

Table 5-6

COPC Summary for Surface Soil - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

			Range of Values, mg/kg											
	Detection	Percent	Detected Concentrations				Method Detection Limits		Mean	BSC [a]	RBSC [b]		95% UCL [e]	EPC [f]
Chemical	Frequency	Detection	Minimum	VQ	Maximum	VQ	Minimum	Maximum	mg/kg	mg/kg	mg/kg	COPC? [c,d]	mg/kg	mg/kg
Carbazole	1 / 10	10	3.45E-01	J/J	3.45E-01	J/J	3.60E-02	4.20E-02	6.88E-02		2.40E+01	N (a)		---
Chrysene	3 / 10	30	4.03E-02	J	1.50E+00	J/J	3.60E-02	4.20E-02	1.85E-01		1.50E+01	N (a)		---
Dibenz(a,h)anthracene	1 / 10	10	1.69E-01	J/J	1.69E-01	J/J	3.60E-02	4.20E-02	5.12E-02		1.50E-02	Y	7.75E-02	7.75E-02
Dibenzofuran	1 / 10	10	2.08E-01	J/J	2.08E-01	J/J	3.60E-02	4.20E-02	5.51E-02		7.80E+00	N (a)		---
Di-n-butyl phthalate	1 / 10	10	1.50E-01	J	1.50E-01	J	7.20E-02	8.40E-02	8.33E-02		6.10E+01	N (a)		---
Fluoranthene	4 / 10	40	4.40E-02	J	4.17E+00	J/J	3.60E-02	5.65E-02	4.61E-01		2.30E+02	N (a)		---
Fluorene	1 / 10	10	4.24E-01	J/J	4.24E-01	J/J	3.60E-02	4.20E-02	7.67E-02		2.30E+01	N (a)		---
Indeno(1,2,3-cd)pyrene	2 / 10	20	3.86E-02	J/U	7.76E-01	J/J	3.60E-02	4.20E-02	1.12E-01		1.50E-01	Y	5.43E-01 *	5.43E-01
Methylnaphthalene, 2-	2 / 10	20	4.29E-02	J/U	6.58E-02	J	3.60E-02	4.20E-02	4.16E-02		3.10E+01	N (a)		---
Phenanthrene	3 / 10	30	3.92E-02	J/U	3.23E+00	J/J	3.60E-02	5.65E-02	3.58E-01		1.70E+02 [g]	N (a)		---
Pyrene	3 / 10	30	5.69E-02	J	2.84E+00	J/J	3.60E-02	4.20E-02	3.23E-01		1.70E+02	N (a)		---

BSC - Background screening concentration.
COPC - Chemical of potential concern.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.
mg/kg - Milligrams per kilogram.
RBSC - Risk-based screening concentration.
U - The compound/analyte was not detected.
UJ/J - The compound/analyte was positively identified in one sample and was averaged with a field duplicate that was nondetect with a potential low bias (UJ qualified).
VQ - Validation qualifier.
x/x - A "/" in the VQ column indicates the value is based on the average of duplicate sample results. The VQ of each duplicate is shown, separated by the "/".

[a] IT Corporation (IT), 1998, *Site Investigation of Acid Areas* , *Plum Brook Ordnance Works, Sandusky, Ohio* , August.
[b] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (June 2011) residential soil values and are based on a risk level of 1.0E-(
[c] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
[d] Y = Chemical is chosen as COPC.
[e] 95% Upper Confidence Limit (UCL) determined using EPA, 2010, ProUCL Version 4.1 User Guide (Draft) Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations, EPA/600/R-07/041, Office of Research and Development, Washington, DC, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/osp/hstl/tsc/ProUCL_v4.1_user.pdf. The recommended UCL was used unless the recommendation was the 97.5% or 99% Chebyshev UCL. In those cases, the 95% Chebyshev UCL was used (*). If more than one UCL was recommended, the more conservative UCL was selected.
[f] Concentration used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower.
[g] RBSC based on pyrene.

Table 5-7

COPC Summary for Subsurface Soil - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

			Range of Values, mg/kg									
	Detection	Percent	Detected Concentrations				Method Detection Limits		Mean	BSC [a]	RBSC [b]	
Chemical	Frequency	Detection	Minimum	VQ	Maximum	VQ	Minimum	Maximum	mg/kg	mg/kg	mg/kg	COPC? [c,d]
Inorganics												
Aluminum	14 / 14	100	2.09E+03	J	8.57E+03	J	5.10E-01	1.10E+00	5.04E+03	1.55E+04	7.70E+03	N (b)
Antimony	8 / 14	57	3.35E-01	J/J	1.90E+00	J	2.25E-01	5.60E-01	5.69E-01	9.30E+00	3.10E+00	N (b)
Arsenic	14 / 14	100	1.10E+00		1.53E+01	J	1.80E-01	4.50E-01	7.14E+00	3.65E+01	3.90E-01	N (b)
Barium	14 / 14	100	6.30E+00	J	4.68E+01	J	2.30E-01	5.00E-01	1.93E+01	8.26E+02	1.50E+03	N (b)
Beryllium	14 / 14	100	1.80E-01	J	8.10E-01		4.70E-02	1.00E-01	4.27E-01	1.00E+00	1.60E+01	N (b)
Cadmium	3 / 14	21	8.50E-02	J	2.40E-01	J	4.70E-02	9.70E-01	1.53E-01	NA	7.00E+00	N (a)
Calcium	14 / 14	100	1.26E+02	J	4.72E+04	J	4.80E+00	1.30E+01	1.99E+04	5.23E+04	Nutrient	N (c)
Chromium	14 / 14	100	4.40E+00	J	1.38E+01	J	7.40E-02	2.00E-01	8.21E+00	2.90E+01	2.90E-01	N (b)
Cobalt	14 / 14	100	2.30E+00	J	1.38E+01	J	3.90E-02	8.30E-02	6.37E+00	1.16E+02	2.30E+00	N (b)
Copper	14 / 14	100	3.70E+00		4.64E+01	J	9.80E-02	2.10E-01	1.80E+01	5.62E+01	3.10E+02	N (b)
Iron	14 / 14	100	4.22E+03	J	4.52E+04	J	1.10E+00	2.30E+00	1.60E+04	2.34E+05	5.50E+03	N (b)
Lead	14 / 14	100	2.30E+00	J	1.77E+01	J	1.00E-01	2.50E-01	8.72E+00	4.86E+01	4.00E+02	N (b)
Magnesium	14 / 14	100	3.06E+02	J	1.33E+04	J	4.70E+00	1.00E+01	5.16E+03	1.04E+04	Nutrient	N (c)
Manganese	14 / 14	100	1.01E+01	J	1.04E+03	J	2.45E-02	2.50E-01	2.20E+02	3.51E+03	1.80E+02	N (b)
Mercury	6 / 13	46	1.80E-02	J	7.80E-02	J	1.10E-02	1.50E-02	2.59E-02	8.50E-02	2.30E+00	N (b)
Nickel	14 / 14	100	5.10E+00		3.44E+01	J	1.10E-01	2.30E-01	1.61E+01	5.51E+01	1.50E+02	N (b)
Potassium	14 / 14	100	1.65E+02	J	1.98E+03	J	4.70E+00	1.00E+01	8.48E+02	3.39E+03	Nutrient	N (c)
Selenium	10 / 14	71	2.50E-01	UJ/J	2.30E+00	J	1.50E-01	3.90E-01	5.35E-01	2.00E+00	3.90E+01	N (a)
Silver	1 / 14	7	1.10E-01	J	1.10E-01	J	5.60E-02	1.20E-01	7.71E-02	1.11E+01	3.90E+01	N (b)
Sodium	8 / 14	57	1.19E+02	J	2.54E+02	J	2.30E+01	5.00E+01	1.25E+02	NA	Nutrient	N (c)
Thallium	2 / 14	14	4.20E-01	J	5.10E-01	J	1.60E-01	3.40E+00	8.97E-01	1.30E+00	7.80E-02	N (b)
Vanadium	14 / 14	100	6.40E+00	J	2.75E+01	J	3.10E-02	6.60E-02	1.47E+01	4.09E+01	3.90E+01	N (b)
Zinc	14 / 14	100	9.30E+00	J	6.76E+01	J	1.80E-01	3.80E-01	3.40E+01	3.22E+02	2.30E+03	N (b)
Explosives												
Amino-2,6-dinitrotoluene, 4-	6 / 34	18	6.37E-02	J	1.20E+00		3.50E-02	4.70E-02	9.24E-02		1.50E+01	N (a)
Amino-4,6-dinitrotoluene, 2-	5 / 34	15	1.45E-01	J	1.05E+00		7.60E-02	1.00E-01	1.31E-01		1.50E+01	N (a)
Dinitrotoluene, 2,4-	3 / 34	9	8.27E-02	J	1.73E-01		4.20E-02	5.60E-02	5.45E-02		7.20E-01	N (a)
Dinitrotoluene, 2,6-	2 / 34	6	9.80E-02	J	1.01E-01	J	3.70E-02	4.90E-02	4.63E-02		7.20E-01	N (a)
Trinitrobenzene, 1,3,5-	3 / 34	9	5.34E-02	J	1.01E-01	J	3.50E-02	4.70E-02	4.36E-02		2.20E+02	N (a)
Trinitrotoluene, 2,4,6-	6 / 34	18	6.40E-02	J	3.65E+00		3.50E-02	1.50E-01	1.86E-01		3.60E+00	Y

Table 5-7

COPC Summary for Subsurface Soil - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Method Detection Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg		COPC? [c,d]
Semivolatile Organic Compounds													
Acenaphthylene	1 / 14	7	4.91E-02	J	4.91E-02	J	3.60E-02	4.20E-02	3.96E-02		3.40E+02		N (a)
Anthracene	1 / 14	7	4.40E-02	J	4.40E-02	J	3.60E-02	4.20E-02	3.93E-02		1.70E+03		N (a)
Benzo(a)anthracene	2 / 14	14	4.13E-02	J	1.51E-01	J	3.60E-02	4.20E-02	4.71E-02		1.50E-01		Y
Benzo(a)pyrene	1 / 14	7	1.30E-01	J	1.30E-01	J	3.60E-02	4.20E-02	4.54E-02		1.50E-02		Y
Benzo(b)fluoranthene	2 / 14	14	4.50E-02	J	1.83E-01	J	3.60E-02	4.20E-02	4.96E-02		1.50E-01		Y
Benzo(ghi)perylene	1 / 14	7	5.68E-02	J	5.68E-02	J	3.60E-02	4.20E-02	4.02E-02		1.70E+02	e	N (a)
Benzo(k)fluoranthene	1 / 14	7	7.00E-02	J	7.00E-02	J	3.60E-02	4.20E-02	4.11E-02		1.50E+00		N (a)
Chrysene	1 / 14	7	1.32E-01	J	1.32E-01	J	3.60E-02	4.20E-02	4.55E-02		1.50E+01		N (a)
Fluoranthene	2 / 14	14	1.17E-01	J	3.51E-01		3.60E-02	4.20E-02	6.68E-02		2.30E+02		N (a)
Indeno(1,2,3-cd)pyrene	1 / 14	7	6.68E-02	J	6.68E-02	J	3.60E-02	4.20E-02	4.09E-02		1.50E-01		N (a)
Methylnaphthalene, 2-	1 / 14	7	2.59E-01		2.59E-01		3.60E-02	4.20E-02	5.48E-02		3.10E+01		N (a)
Naphthalene	1 / 14	7	7.65E-02	J	7.65E-02	J	3.60E-02	4.20E-02	4.17E-02		3.60E+00		N (a)
Phenanthrene	4 / 14	29	4.24E-02	J	1.32E-01	J	3.60E-02	4.20E-02	5.68E-02		1.70E+02	e	N (a)
Pyrene	2 / 14	14	7.57E-02	J	2.57E-01		3.60E-02	4.20E-02	5.71E-02		1.70E+02		N (a)

BSC - Background screening concentration.
COPC - Chemical of potential concern.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.
mg/kg - Milligrams per kilogram.
RBSC - Risk-based screening concentration.
UJ/J - The compound/analyte was positively identified in one sample and was averaged with a field duplicate that was nondetect with a potential low bias (UJ qualified).
VQ - Validation qualifier.
x/x - A "/" in the VQ column indicates the value is based on the average of duplicate sample results. The VQ of each duplicate is shown, separated by the "/".

[a] IT Corporation (IT), 1998, *Site Investigation of Acid Areas*, *Plum Brook Ordnance Works, Sandusky, Ohio*, August.
[b] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (June 2011) residential soil values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[c] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
[d] Y = Chemical is chosen as COPC.
[e] RBSC based on pyrene.

Table 5-8

COPC Summary for Total Soil - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Method Detection Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Inorganics														
Aluminum	24 / 24	100	2.09E+03	J	8.57E+03	J	5.10E-01	2.40E+00	5.19E+03	1.55E+04	7.70E+03	N (b)		---
Antimony	12 / 24	50	2.70E-01	J	1.90E+00	J	2.20E-01	1.00E+00	4.86E-01	9.30E+00	3.10E+00	N (b)		---
Arsenic	24 / 24	100	1.10E+00		1.53E+01	J	1.80E-01	8.00E-01	5.88E+00	3.65E+01	3.90E-01	N (b)		---
Barium	24 / 24	100	6.30E+00	J	4.68E+01	J	2.30E-01	1.10E+00	2.14E+01	8.26E+02	1.50E+03	N (b)		---
Beryllium	24 / 24	100	1.80E-01	J	8.10E-01		4.70E-02	2.20E-01	4.26E-01	1.00E+00	1.60E+01	N (b)		---
Cadmium	7 / 24	29	8.50E-02	J	2.40E-01	J	4.70E-02	9.70E-01	1.44E-01	NA	7.00E+00	N (a)		---
Calcium	24 / 24	100	1.26E+02	J	4.72E+04	J	4.80E+00	2.20E+01	1.31E+04	5.23E+04	Nutrient	N (c)		---
Chromium	24 / 24	100	4.40E+00	J	1.38E+01	J	7.40E-02	3.60E-01	8.11E+00	2.90E+01	2.90E-01	N (b)		---
Cobalt	24 / 24	100	2.25E+00	J/J	1.38E+01	J	3.90E-02	1.80E-01	5.51E+00	1.16E+02	2.30E+00	N (b)		---
Copper	24 / 24	100	3.70E+00		4.64E+01	J	9.80E-02	4.70E-01	1.51E+01	5.62E+01	3.10E+02	N (b)		---
Iron	24 / 24	100	4.22E+03	J	4.52E+04	J	1.10E+00	5.10E+00	1.41E+04	2.34E+05	5.50E+03	N (b)		---
Lead	24 / 24	100	2.30E+00	J	1.77E+01	J	9.80E-02	4.50E-01	8.73E+00	4.86E+01	4.00E+02	N (b)		---
Magnesium	24 / 24	100	3.06E+02	J	1.33E+04	J	4.70E+00	2.20E+01	3.42E+03	1.04E+04	Nutrient	N (c)		---
Manganese	24 / 24	100	1.01E+01	J	1.04E+03	J	2.45E-02	2.50E-01	2.00E+02	3.51E+03	1.80E+02	N (b)		---
Mercury	16 / 23	70	1.80E-02	J	7.80E-02	J	1.10E-02	1.50E-02	2.92E-02	8.50E-02	2.30E+00	N (b)		---
Nickel	24 / 24	100	5.05E+00		3.44E+01	J	1.10E-01	5.10E-01	1.39E+01	5.51E+01	1.50E+02	N (b)		---
Potassium	24 / 24	100	1.65E+02	J	1.98E+03	J	4.70E+00	2.20E+01	6.55E+02	3.39E+03	Nutrient	N (c)		---
Selenium	18 / 24	75	2.50E-01	UJ/J	2.30E+00	J	1.50E-01	6.90E-01	4.98E-01	2.00E+00	3.90E+01	N (a)		---
Silver	1 / 24	4	1.10E-01	J	1.10E-01	J	5.60E-02	2.70E-01	8.07E-02	1.11E+01	3.90E+01	N (b)		
Sodium	10 / 24	42	1.19E+02	J	2.54E+02	J	2.30E+01	1.10E+02	9.80E+01	NA	Nutrient	N (c)		---
Thallium	3 / 24	13	2.40E-01	J	5.10E-01	J	1.60E-01	3.80E+00	1.06E+00	1.30E+00	7.80E-02	N (b)		---
Vanadium	24 / 24	100	6.40E+00	J	2.75E+01	J	3.10E-02	1.50E-01	1.54E+01	4.09E+01	3.90E+01	N (b)		---
Zinc	24 / 24	100	9.30E+00	J	6.76E+01	J	1.80E-01	8.50E-01	3.21E+01	3.22E+02	2.30E+03	N (b)		---
Polychlorinated biphenyls (PCB)														
Aroclor 1260	1 / 24	4	1.94E-02	J/U	1.94E-02	J/U	8.80E-03	1.00E-02	1.00E-02		2.20E-01	N (a)		---
Explosives														
Amino-2,6-dinitrotoluene, 4-	8 / 44	18	6.37E-02	J	1.20E+00		3.50E-02	4.80E-02	8.87E-02		1.50E+01	N (a)		---
Amino-4,6-dinitrotoluene, 2-	7 / 44	16	1.45E-01	J	1.05E+00		7.60E-02	1.00E-01	1.31E-01		1.50E+01	N (a)		---
Dinitrotoluene, 2,4- exp	4 / 44	9	5.17E-02	J	1.73E-01		4.20E-02	5.70E-02	5.36E-02		7.20E-01	N (a)		---
Dinitrotoluene, 2,6- exp	2 / 44	5	9.80E-02	J	1.01E-01	J	3.70E-02	5.00E-02	4.59E-02		7.20E-01	N (a)		
Trinitrobenzene, 1,3,5-	3 / 44	7	5.34E-02	J	1.01E-01	J	3.50E-02	4.80E-02	4.33E-02		2.20E+02	N (a)		
Trinitrotoluene, 2,4,6-	8 / 44	18	6.40E-02	J	3.65E+00		3.50E-02	1.50E-01	1.76E-01		3.60E+00	Y	3.44E-01	3.44E-01
Semivolatile Organic Compounds														
Acenaphthene	1 / 24	4	7.85E-02	J/U	7.85E-02	J/U	3.60E-02	4.20E-02	4.03E-02		3.40E+02	N (a)		---
Acenaphthylene	2 / 24	8	4.91E-02	J	5.77E-01	J/J	3.60E-02	4.20E-02	6.14E-02		3.40E+02	N (a)		---
Anthracene	2 / 24	8	4.40E-02	J	7.14E-01	J/J	3.60E-02	4.20E-02	6.69E-02		1.70E+03	N (a)		---
Benzo(a)anthracene	4 / 24	17	4.13E-02	J	1.62E+00	J/J	3.60E-02	4.20E-02	1.10E-01		1.50E-01	Y	2.39E-01	2.39E-01
Benzo(a)pyrene	3 / 24	13	4.76E-02	J/J	1.37E+00	J/J	3.60E-02	4.20E-02	9.84E-02		1.50E-02	Y	2.20E-01	2.20E-01
Benzo(b)fluoranthene	5 / 24	21	4.50E-02	J	1.95E+00	J/J	3.60E-02	4.20E-02	1.26E-01		1.50E-01	Y	2.80E-01	2.80E-01

Table 5-8

COPC Summary for Total Soil - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Detected Concentrations Maximum	VQ	Method Detection Limits Minimum	Method Detection Limits Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Benzo(ghi)perylene	2 / 24	8	5.68E-02	J	6.49E-01	J/J	3.60E-02	4.20E-02	6.47E-02		1.70E+02 [g]	N (a)		---
Benzo(k)fluoranthene	2 / 24	8	7.00E-02	J	7.27E-01	J/J	3.60E-02	4.20E-02	6.85E-02		1.50E+00	N (a)		---
Carbazole	1 / 24	4	3.45E-01	J/J	3.45E-01	J/J	3.60E-02	4.20E-02	5.14E-02		2.40E+01	N (a)		---
Chrysene	4 / 24	17	4.03E-02	J	1.50E+00	J/J	3.60E-02	4.20E-02	1.04E-01		1.50E+01	N (a)		---
Dibenz(a,h)anthracene	1 / 24	4	1.69E-01	J/J	1.69E-01	J/J	3.60E-02	4.20E-02	4.41E-02		1.50E-02	Y	5.43E-02	5.43E-02
Dibenzofuran	1 / 24	4	2.08E-01	J/J	2.08E-01	J/J	3.60E-02	4.20E-02	4.57E-02		7.80E+00	N (a)		---
Di-n-butyl phthalate	1 / 24	4	1.50E-01	J	1.50E-01	J	7.20E-02	8.50E-02	8.03E-02		6.10E+01	N (a)		---
Fluoranthene	6 / 24	25	4.40E-02	J	4.17E+00	J/J	3.60E-02	5.65E-02	2.31E-01		2.30E+02	N (a)		---
Fluorene	1 / 24	4	4.24E-01	JJ	4.24E-01	J/J	3.60E-02	4.20E-02	5.47E-02		2.30E+01	N (a)		---
Indeno(1,2,3-cd)pyrene	3 / 24	13	3.86E-02	J/U	7.76E-01	J/J	3.60E-02	4.20E-02	7.05E-02		1.50E-01	Y	1.34E-01	1.34E-01
Methylnaphthalene, 2-	3 / 24	13	4.29E-02	J/U	2.59E-01		3.60E-02	4.20E-02	4.93E-02		3.10E+01	N (a)		---
Naphthalene	1 / 24	4	7.65E-02	J	7.65E-02	J	3.60E-02	4.20E-02	4.02E-02		3.60E+00	N (a)		
Phenanthrene	7 / 24	29	3.92E-02	J/U	3.23E+00	J/J	3.60E-02	5.65E-02	1.82E-01		1.70E+02 [g]	N (a)		---
Pyrene	5 / 24	21	5.69E-02	J	2.84E+00	J/J	3.60E-02	4.20E-02	1.68E-01		1.70E+02	N (a)		---

BSC - Background screening concentration.
COPC - Chemical of potential concern.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.
mg/kg - Milligrams per kilogram.
RBSC - Risk-based screening concentration.
U - The compound/analyte was not detected.
UJ/J - The compound/analyte was positively identified in one sample averaged with a field duplicate that was nondetect with a potential low bias (UJ qualified).
VQ - Validation qualifier.
x/x - A "/" in the VQ column indicates the value is based on the average of duplicate sample results. The VQ of each duplicate is shown, separated by the "/".

[a] IT Corporation (IT), 1998, *Site Investigation of Acid Areas* , *Plum Brook Ordnance Works, Sandusky, Ohio* , August.
[b] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (June 2011) residential soil values and are based on a risk level of 1.0E-(
[c] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
[d] Y = Chemical is chosen as COPC.
[e] 95% Upper Confidence Limit (UCL) determined using EPA, 2010, ProUCL Version 4.1 User Guide (Draft) Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations, EPA/600/R-07/041, Office of Research and Development, Washington, DC, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/osp/hstl/tsc/ProUCL_v4.1_user.pdf. The recommended UCL was used unless the recommendation was the 97.5% or 99% Chebyshev UCL. In those cases, the 95% Chebyshev UCL was used (*). If more than one UCL was recommended, the more conservative UCL was selected.
[f] Concentration used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower.
[g] RBSC based on pyrene.

Table 5-9

COPC Summary for Overburden Groundwater - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent hits	Range of values, µg/L: Detected Concentrations Minimum	VQ	Maximum	VQ	Method Detection Limits Minimum	Maximum	Arithmetic Mean µg/L	RBSC [a] µg/L	COPC? [b,c]	EPC [d] µg/L
Inorganics-Unfiltered												
Aluminum	2 / 4	50	2.46E+01	J	6.98E+01	J	1.10E+01	2.00E+01	3.36E+01	3700	N (a)	---
Barium	4 / 4	100	2.23E+01	J	9.82E+01	J	5.00E+00	5.00E+00	4.17E+01	730	N (a)	---
Calcium	4 / 4	100	5.82E+04		9.41E+04		1.00E+02	1.00E+02	7.61E+04	Nutrient	N (b)	---
Iron	1 / 4	25	4.14E+01	J	4.14E+01	J	2.30E+01	3.00E+01	2.94E+01	2600	N (a)	---
Magnesium	4 / 4	100	1.07E+04		1.80E+04		1.00E+02	1.00E+02	1.34E+04	Nutrient	N (b)	---
Manganese	3 / 4	75	6.20E+00	J	1.63E+02		5.00E-01	1.00E+00	4.79E+01	88	Y	1.63E+02
Nickel	1 / 4	25	2.40E+00	J	2.40E+00	J	1.00E+00	2.30E+00	1.68E+00	73	N (a)	---
Potassium	4 / 4	100	8.55E+02	J	1.11E+04		1.00E+02	5.00E+02	3.68E+03	Nutrient	N (b)	---
Selenium	3 / 4	75	2.90E+00	J	4.90E+00	J	2.00E+00	3.10E+00	3.35E+00	18	N (a)	---
Sodium	3 / 4	75	3.16E+03	J	1.83E+04	J	5.00E+02	7.50E+02	6.83E+03	Nutrient	N (b)	---
Nitroaromatics												
Nitrotoluene, 2-	1 / 4	25	1.80E-01	J	1.80E-01	J	6.20E-02	8.60E-02	9.78E-02	0.31	N (a)	---
Semivolatile Organic Compounds												
Diethyl phthalate	1 / 4	25	5.30E+00		5.30E+00		1.90E+00	2.00E+00	2.78E+00	2900	N (a)	---
General Chemistry												
Chloride	4 / 4	100	4.40E+03	J	1.81E+04		1.00E+03	1.00E+03	8.65E+03	Nutrient	N (b)	---
Nitrate-Nitrite	3 / 4	75	1.40E+01	J	2.30E+02		3.00E+01	1.00E+02	9.70E+01	1000 [f]	N (a)	---
Sulfate	4 / 4	100	1.89E+04	J	6.14E+04		1.00E+03	1.00E+03	4.07E+04	250,000 [g]	N (a)	---

RBSC - Risk-based screening concentration.
COPC - Chemical of potential concern.
µg/L - Micrograms per liter.
VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.

[a] Risk-Based Screening Concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (June 2011) tap water values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.

[b] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Essential nutrient.

[c] Y = Chemical is chosen as COPC.

[d] Concentration used in risk assessment equal to the maximum detected concentration.

[e] Some samples were excluded from the data set because of blank contamination.

[f] Because no Regional Screening Level exists for nitrate-nitrite, 0.1 X the nitrate-nitrite maximum contaminant limit (10 milligrams per liter) (EPA, 2011) is used for screening.

[g] Screening-level based on the Secondary Drinking Water Regulation (EPA, 2011).

Reference: U.S. Environmental Protection Agency (EPA), 2011, *2011 Edition of the Drinking Water Standards and Health Advisories,* Office of Water, Washington, D.C., January, EPA-822-R-11-002).

Table 5-10

Summary of Risk for All Receptors - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

	Groundskeeper [a]		Construction Worker		Indoor Worker		Resident			Hunter		Hunter's Child	
	Total ILCR	Total HI	Total ILCR	Total HI	Total ILCR	Total HI	Total ILCR	Total Adult - HI	Total Child - HI	Total ILCR	Total HI	Total ILCR	Total HI
Overburden Groundwater Use													
Exposure Media													
Surface Soil	6.28E-06	NA	NE	NE	1.68E-06	NA	NE	NE	NE	4.20E-07	NA	NA	NA
Total Soil	1.62E-06	0.001	8.03E-08	0.002	NE	NE	5.49E-06	0.001	0.01	NE	NE	NE	NE
Groundwater	NA	0.04	NE	NE	NA	0.04	NA	0.1	0.2	NE	NE	NE	NE
Total ILCR or HI	**2.E-06**	**0.04**	**8.E-08**	**0.002**	**2.E-06**	**0.04**	**5.E-06**	**0.1**	**0.2**	**4.E-07**	**NA**	**NA**	**NA**

HI - Hazard index.
ILCR - Incremental lifetime cancer risk.
NA - No chemicals of potential concern available for exposure evaluation
NE - Pathway not evaluated for this receptor.

Note:
[a]Total ILCR and total HI values for the groundskeeper reflect the respective totals for the future groundskeeper assumed to use overburden groundwater. The total ILCR and HI values for the current groundskeeper are simply those shown for surface soil. The rounded current groundskeeper ILCR is 6E-6 and no HI could be calculated (NA)

Table 5-11

Summary of Samples Evaluated in the Ecological Risk Assessment - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Location	Sample Number	Sample Purpose	Sample Date	Depth (ft bgs)	Analyses
Soil Samples					
TNTB-SL-DP01	DP0100	REG	20-Aug-09	0 - 1	Exp, Gen Chem, Metals, Pest, PCB, SVOC
TNTB-SL-DP01	DP0101	FD	20-Aug-09	0 - 1	Exp, Gen Chem, Metals, Pest, PCB, SVOC
TNTB-SL-DP02	DP0104	REG	20-Aug-09	0 - 1	Exp, Gen Chem, Metals, Pest, PCB, SVOC
TNTB-SL-DP03	DP0106	REG	21-Aug-09	0 - 1	Exp, Gen Chem, Metals, Pest, PCB, SVOC
TNTB-SL-DP04	DP0108	REG	24-Aug-09	0 - 1	Exp, Gen Chem, Metals, Pest, PCB, SVOC
TNTB-SL-DP05	DP0110	REG	24-Aug-09	0 - 1	Exp, Gen Chem, Metals, Pest, PCB, SVOC
TNTB-SL-DP06	DP0112	REG	24-Aug-09	0 - 1	Exp, Gen Chem, Metals, Pest, PCB, SVOC
TNTB-SL-DP06	DP0113	FD	24-Aug-09	0 - 1	Exp, Gen Chem, Metals, Pest, PCB, SVOC
TNTB-SL-DP07	DP0116	REG	24-Aug-09	0 - 1	Exp, Gen Chem, Metals, Pest, PCB, SVOC
TNTB-SL-DP07	DP0117	REG	24-Aug-09	4 - 6	Exp, Gen Chem, Metals, PCB, SVOC
TNTB-SL-DP08	DP0118	REG	25-Aug-09	0 - 1	Exp, Gen Chem, Metals, Pest, PCB, SVOC
TNTB-SL-DP08	DP0119	REG	25-Aug-09	2 - 4	Exp, Gen Chem, Metals, PCB, SVOC
TNTB-SL-DP09	DP0120	REG	25-Aug-09	0 - 1	Exp, Gen Chem, Metals, Pest, PCB, SVOC
TNTB-SL-DP09	DP0121	REG	25-Aug-09	2 - 4	Exp, Gen Chem, Metals, PCB, SVOC
TNTB-SL-DP10	DP0122	REG	25-Aug-09	0 - 1	Exp, Gen Chem, Metals, Pest, PCB, SVOC
TNTB-SL-DP10	DP0123	REG	25-Aug-09	2 - 3.5	Exp, Gen Chem, Metals, PCB, SVOC
TNTB-SL-DP13	DP0126	REG	25-Aug-09	2 - 3.5	Exp, Gen Chem, Metals, PCB, SVOC
TNTB-SL-DP14	DP0127	REG	25-Aug-09	2 - 3.5	Exp, Gen Chem, Metals, PCB, SVOC
TNTB-SL-DP14	DP0130	FD	25-Aug-09	2 - 3.5	Exp, Gen Chem, Metals, PCB, SVOC
TNTB-SL-TP01	SL0085	REG	28-Jul-09	2 - 3	Exp
TNTB-SL-TP02	SL0086	REG	28-Jul-09	2 - 3	Exp
TNTB-SL-TP03	SL0087	REG	28-Jul-09	2 - 3	Exp
TNTB-SL-TP04	SL0088	REG	29-Jul-09	2 - 3	Exp
TNTB-SL-TP05	SL0089	REG	29-Jul-09	2 - 3	Exp
TNTB-SL-TP06	SL0090	REG	29-Jul-09	2 - 3	Exp
TNTB-SL-TP07	SL0091	REG	29-Jul-09	2 - 3	Exp
TNTB-SL-TP07	SL0092	FD	29-Jul-09	2 - 3	Exp
TNTB-SL-TP08	SL0094	REG	29-Jul-09	2 - 3	Exp
TNTB-SL-TP09	SL0095	REG	29-Jul-09	2 - 3	Exp
TNTB-SL-TP10	SL0096	REG	29-Jul-09	2 - 3	Exp
TNTB-SL-TP10	SL0097	FD	29-Jul-09	2 - 3	Exp
TNTB-SL-TP11	SL0099	REG	29-Jul-09	1.5 - 2	Exp
TNTB-SL-TP12	SL0100	REG	29-Jul-09	1.5 - 2	Exp
TNTB-SL-TP13	SL0101	REG	29-Jul-09	1.5 - 2	Exp
TNTB-SL-TP14	SL0102	REG	29-Jul-09	1.5 - 2	Exp
TNTB-SL-TP15	SL0103	REG	30-Jul-09	1.5 - 2	Exp
TNTB-SL-TP16	SL0104	REG	30-Jul-09	1.5 - 2	Exp
TNTB-SL-TP17	SL0105	REG	30-Jul-09	1.5 - 2	Exp
TNTB-SL-TP18	SL0106	REG	30-Jul-09	1.5 - 2	Exp
TNTB-SL-TP19	SL0107	REG	30-Jul-09	1.5 - 2	Exp
TNTB-SL-TP20	SL0108	REG	30-Jul-09	1.5 - 2	Exp

ft bgs - Feet below ground surface.
FD - Field duplicate; the field duplicate is averaged with the regular sample at the same location to create one result
REG - Regular sample.
Exp - Explosives.
Gen Chem - General chemistry.
Metals - Metals analysis performed on unfiltered samples unless otherwise noted
PCB - Polychlorinated biphenyls
SVOC - Semivolatile organic compounds

Table 5-12

COPEC Summary for Soil[a] - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Method Detection Limits Minimum	Maximum	Mean (mg/kg)	BSC [a] (mg/kg)	ESV [b] (mg/kg)	COPEC? [c,d]	Distribution [e]	95% UCL [e] (mg/kg)	EPC [f] (mg/kg)	UCL 0-1' soil depth [g] (mg/kg)	MDC 0-1' soil depth [g] (mg/kg)	EPC 0-1' soil depth [g] (mg/kg)
Inorganics																		
Aluminum	16 / 16	100	3.26E+03	J	8.19E+03	J	5.30E-01	2.40E+00	5.64E+03	1.55E+04	pH Dependent	N (a)			---			---
Antimony	8 / 16	50	2.70E-01	J	1.90E+00	J	2.20E-01	1.00E+00	4.83E-01	9.30E+00	0.27	N (b)			---			---
Arsenic	16 / 16	100	2.30E+00	J	1.53E+01	J	1.80E-01	8.00E-01	5.83E+00	3.65E+01	18	N (a)			---			---
Barium	16 / 16	100	1.11E+01	J	4.68E+01	J	2.40E-01	1.10E+00	2.41E+01	8.26E+02	330	N (a)			---			---
Beryllium	16 / 16	100	2.95E-01		8.10E-01		4.80E-02	2.20E-01	4.92E-01	1.00E+00	21	N (a)			---			---
Cadmium	4 / 16	25	1.10E-01	J	1.85E-01	J/J	4.90E-02	9.70E-01	1.66E-01	NA	0.36	N (a)			---			---
Calcium	16 / 16	100	1.26E+02	J	2.21E+04	J/J	4.80E+00	2.20E+01	2.63E+03	5.23E+04	Nutrient	N (c)			---			---
Chromium	16 / 16	100	4.40E+00	J	1.19E+01	J	7.70E-02	3.60E-01	8.45E+00	2.90E+01	26	N (a)			---			---
Cobalt	16 / 16	100	2.25E+00	J/J	1.38E+01	J	4.00E-02	1.80E-01	5.50E+00	1.16E+02	13	N (b)			---			---
Copper	16 / 16	100	4.20E+00	J/J	4.64E+01	J	1.00E-01	4.70E-01	1.72E+01	5.62E+01	28	N (b)			---			---
Iron	16 / 16	100	7.47E+03	J/J	4.52E+04	J	1.10E+00	5.10E+00	1.60E+04	2.34E+05	Nutrient	N (c)			---			---
Lead	16 / 16	100	4.30E+00	J	1.58E+01	J	9.80E-02	4.50E-01	9.89E+00	4.86E+01	11	N (b)			---			---
Magnesium	16 / 16	100	3.06E+02	J	3.02E+03	J/J	4.80E+00	2.20E+01	9.03E+02	1.04E+04	Nutrient	N (c)			---			---
Manganese	16 / 16	100	1.01E+01	J	1.04E+03	J	2.45E-02	2.50E-01	1.91E+02	3.51E+03	220	N (b)			---			---
Mercury	15 / 15	100	1.80E-02	J	7.80E-02	J	1.10E-02	1.50E-02	3.72E-02	8.50E-02	0.00051	N (b)			---			---
Nickel	16 / 16	100	5.05E+00		2.38E+01	J	1.10E-01	5.10E-01	1.39E+01	5.51E+01	38	N (a)			---			---
Potassium	16 / 16	100	1.65E+02	J	7.40E+02	J	4.80E+00	2.20E+01	4.37E+02	3.39E+03	Nutrient	N (c)			---			---
Selenium	13 / 16	81	2.50E-01	UJ/J	2.30E+00	J	1.50E-01	6.90E-01	5.26E-01	2.00E+00	0.52	N (d)			---			---
Silver	1 / 16	6	1.10E-01	J	1.10E-01	J	5.80E-02	2.70E-01	8.73E-02	1.11E+01	4.2	N (a)			---			
Sodium	2 / 16	13	1.51E+02	J/J	1.55E+02	J	2.40E+01	1.10E+02	5.05E+01	NA	Nutrient	N (c)			---			---
Thallium	1 / 16	6	2.40E-01	J	2.40E-01	J	1.80E-01	3.80E+00	1.20E+00	1.30E+00	1	N (a)			---			---
Vanadium	16 / 16	100	7.80E+00	J	2.75E+01	J	3.20E-02	1.50E-01	1.80E+01	4.09E+01	7.8	N (b)			---			---
Zinc	16 / 16	100	9.30E+00	J	6.09E+01	J/J	1.80E-01	8.50E-01	3.14E+01	3.22E+02	46	N (b)			---			---
Polychlorinated biphenyls (PCB)																		---
Aroclor 1260	1 / 16	6	1.94E-02	J/U	1.94E-02	J/U	8.80E-03	1.00E-02	1.01E-02		0.371	N (a)			---			---
Explosives																		
1,3,5-Trinitrobenzene	2 / 36	6	7.39E-02	J	1.01E-01	J	3.50E-02	4.80E-02	4.35E-02		0.376	N (a)			---			---
2,4,6-Trinitrotoluene	7 / 36	19	6.40E-02	J	3.65E+00		3.50E-02	1.50E-01	2.02E-01		NSV	Y	Gamma	4.05E-01	4.05E-01	5.18E-01	9.08E-01	5.18E-01
2,4-Dinitrotoluene	3 / 36	8	5.17E-02	J	1.73E-01		4.20E-02	5.70E-02	5.36E-02		1.28	N (a)			---			---
2,6-Dinitrotoluene	1 / 36	3	1.01E-01	J	1.01E-01	J	3.70E-02	5.00E-02	4.49E-02		0.0328	Y [h]	Nonparametric	4.80E-02	4.80E-02	NA	ND	NA
2-Amino-4,6-dinitrotoluene	6 / 36	17	1.70E-01		1.05E+00		7.60E-02	1.00E-01	1.39E-01		0.0328	Y	Gamma	2.52E-01	2.52E-01	2.59E-01	3.29E-01	2.59E-01
4-Amino-2,6-dinitrotoluene	7 / 36	19	6.37E-02	J	1.20E+00		3.50E-02	4.80E-02	9.77E-02		0.0328	Y	Lognormal	2.50E-01	2.50E-01	2.08E-01	2.24E-01	2.08E-01
Semivolatile Organic Compounds																		
Acenaphthene	1 / 16	6	7.85E-02	J/U	7.85E-02	J/U	3.60E-02	4.20E-02	4.06E-02		29	N (a)			---			---
Acenaphthylene	1 / 16	6	5.77E-01	J/J	5.77E-01	J/J	3.60E-02	4.20E-02	7.17E-02		29	N (a)			---			---
Anthracene	1 / 16	6	7.14E-01	J/J	7.14E-01	J/J	3.60E-02	4.20E-02	8.03E-02		29	N (a)			---			---
Benzo(a)anthracene	2 / 16	13	4.72E-02	J/J	1.62E+00	J/J	3.60E-02	4.20E-02	1.37E-01		1.1	Y	Nonparametric	7.31E-01	7.31E-01	1.12E+00	1.62E+00	1.12E+00
Benzo(a)pyrene	2 / 16	13	4.76E-02	J/J	1.37E+00	J/J	3.60E-02	4.20E-02	1.22E-01		1.1	Y	Nonparametric	6.25E-01	6.25E-01	9.55E-01	1.37E+00	9.55E-01
Benzo(b)fluoranthene	3 / 16	19	5.28E-02	J	1.95E+00	J/J	3.60E-02	4.20E-02	1.60E-01		1.1	Y	Lognormal	7.83E-01	7.83E-01	1.20E+00	1.95E+00	1.20E+00
Benzo(ghi)perylene	1 / 16	6	6.49E-01	J/J	6.49E-01	J/J	3.60E-02	4.20E-02	7.62E-02		1.1	N (a)			---			---
Benzo(k)fluoranthene	1 / 16	6	7.27E-01	J/J	7.27E-01	J/J	3.60E-02	4.20E-02	8.11E-02		1.1	N (a)			---			---
Carbazole	1 / 16	6	3.45E-01	J/J	3.45E-01	J/J	3.60E-02	4.20E-02	5.72E-02		NSV	Y	Nonparametric	1.41E-01	1.41E-01	2.03E-01	3.45E-01	2.03E-01
Chrysene	3 / 16	19	4.03E-02	J	1.50E+00	J/J	3.60E-02	4.20E-02	1.30E-01		1.1	Y	Lognormal	6.02E-01	6.02E-01	9.24E-01	1.50E+00	9.24E-01
Dibenz(a,h)anthracene	1 / 16	6	1.69E-01	J/J	1.69E-01	J/J	3.60E-02	4.20E-02	4.62E-02		1.1	N (a)			---			---
Dibenzofuran	1 / 16	6	2.08E-01	J/J	2.08E-01	J/J	3.60E-02	4.20E-02	4.87E-02		NSV	Y	Nonparametric	6.91E-02	6.91E-02	1.29E-01	2.08E-01	1.29E-01
Di-n-butyl phthalate	1 / 16	6	1.50E-01	J	1.50E-01	J	7.20E-02	8.40E-02	8.07E-02		200	N (a)			---			---
Fluoranthene	4 / 16	25	4.40E-02	J	4.17E+00	J/J	3.60E-02	5.65E-02	3.02E-01		1.1	Y	Lognormal	1.56E+00	1.56E+00	2.43E+00	4.17E+00	2.43E+00
Fluorene	1 / 16	6	4.24E-01	JJ	4.24E-01	J/J	3.60E-02	4.20E-02	6.22E-02		1.1	N (a)			---			---
Indeno(1,2,3-cd)pyrene	2 / 16	13	3.86E-02	J/U	7.76E-01	J/J	3.60E-02	4.20E-02	8.42E-02		1.1	N (a)			---			---
Methylnaphthalene, 2-	3 / 16	19	4.29E-02	J/U	2.59E-01		3.60E-02	4.20E-02	5.40E-02		3.24	N (a)			---			---
Naphthalene	1 / 16	6	7.65E-02	J	7.65E-02	J	3.60E-02	4.20E-02	4.04E-02		29	N (a)			---			---
Phenanthrene	4 / 16	25	3.92E-02	J/U	3.23E+00	J/J	3.60E-02	5.65E-02	2.44E-01		29	N (a)			---			---
Pyrene	3 / 16	19	5.69E-02	J	2.84E+00	J/J	3.60E-02	4.20E-02	2.16E-01		1.1	Y	Lognormal	1.13E+00	1.13E+00	1.75E+00	2.84E+00	1.75E+00

BSC - Background screening concentration.
COPEC - Chemical of potential ecological concern.
EPC - Exposure point concentration.
ESV - Ecological screening value.
mg/kg - Milligrams per kilogram.
NA - Not available or nonapplicable; ND - Not detected.
NSV - No screening value.
UCL - Upper confidence limit.
VQ - Validation qualifier (a "/" indicates combined VQs for a regular and field duplicate sample pair):

Table 5-12

COPEC Summary for Soil[a] - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.
U - Not detected.

[a] IT Corporation (IT), 1998, *Site Investigation of Acid Areas, Plum Brook Ordnance Works, Sandusky, Ohio* , August.
[b] ESVs and their sources are in Appendix B.
[c] N = Chemical is not chosen as a COPEC:
(a) = Maximum detected concentration is less than the ESV.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
(d) = Statistical test shows site data are below or equal to background; see Appendix C.
(e) = Infrequently detected (fewer than 5 percent of all samples).
[d] Y = Chemical is chosen as COPEC.
[e] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.1 (U.S. Environmental Protection Agency, 2010, ProUCL Version 4.1, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/software.htm).
[f] Concentration used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower.
[g] The EPC for the COPEC at the surface soil depth range is used as the exposure concentration for some ecological receptors.

Table 5-13

Wildlife Hazard Quotients for All Assessment Receptors - TNTB/WWTP1 Sewer Lines
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

COPEC	Deer Mouse		Short-tailed Shrew		Cottontail Rabbit		Marsh Wren		White-tailed Deer		Red-tailed Hawk	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Explosives												
2,4,6-Trinitrotoluene	2.08E-02	4.16E-03	2.11E-02	4.21E-03	5.43E-03	1.09E-03	1.88E-01	NA[1]	3.18E-06	6.35E-07	7.61E-08	1.52E-08
2,6-Dinitrotoluene	0.00E+00	0.00E+00	7.18E-03	9.57E-04	0.00E+00	0.00E+00	0.00E+00	NA[1]	6.06E-06	8.07E-07	0.00E+00	0.00E+00
2-Amino-4,6-dinitrotoluene	1.14E-02	2.14E-03	8.38E-04	1.57E-04	8.32E-03	1.56E-03	9.24E-04	NA[1]	6.04E-06	1.13E-06	3.80E-08	7.61E-09
4-Amino-2,6-dinitrotoluene	9.18E-03	1.72E-03	8.31E-04	1.56E-04	6.68E-03	1.25E-03	7.42E-04	NA[1]	5.99E-06	1.12E-06	3.05E-08	6.11E-09
All nitrotoluenes (sum)	***4.14E-02***	***8.02E-03***	***2.99E-02***	***5.48E-03***	***2.04E-02***	***3.90E-03***	***1.90E-01***	NA[1]	***2.13E-05***	***3.70E-06***	***1.45E-07***	***2.89E-08***
Semivolatile Organics												
Benzo(a)anthracene	3.56E-01	7.12E-02	4.31E-01	8.63E-02	7.09E-02	1.42E-02	2.79E-01	NA[1]	2.64E-05	5.27E-06	2.29E-06	4.59E-07
Benzo(a)pyrene	5.01E-02	5.01E-03	5.17E-02	5.17E-03	1.54E-02	1.54E-03	1.33E-01	NA[1]	5.95E-06	5.95E-07	1.37E-06	2.73E-07
Benzo(b)fluoranthene	1.65E-02	3.31E-03	9.01E-03	1.80E-03	9.50E-03	1.90E-03	5.72E-01	NA[1]	4.14E-06	8.27E-07	1.23E-05	2.46E-06
Carbazole	**1.38E+03**	**1.38E+02**	**1.21E+03**	**1.21E+02**	**4.44E+02**	**4.44E+01**	NA	NA[1]	2.16E-01	2.16E-02	NA	NA
Chrysene	2.84E-01	5.69E-02	3.40E-01	6.79E-02	6.08E-02	1.22E-02	1.53E-01	NA[1]	2.31E-05	4.62E-06	1.32E-06	2.65E-07
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA[1]	NA	NA	NA	NA
Fluoranthene	1.50E-02	2.99E-03	5.75E-03	1.15E-03	9.27E-03	1.85E-03	4.10E-03	NA[1]	4.16E-06	8.31E-07	8.80E-08	8.80E-09
Pyrene	2.79E-02	5.59E-03	1.22E-02	2.45E-03	1.54E-02	3.09E-03	6.02E-03	NA[1]	7.14E-06	1.43E-06	6.33E-08	6.33E-09

COPEC - Chemical of potential ecological concern.
LOAEL - Lowest-observed-adverse-effect level.
NA - No toxicity data available; hazard quotients not calculated.
NA[1] - Because the marsh wren represents a Threatened and Endangered Species observed at the site (golden-winged warbler), only hazard quotients based on the NOAEL are calculated.
NOAEL - No-observed-adverse-effect level.

Shaded cells indicate a hazard quotient greater than 1, when rounded.

Table 6-1

Summary of Water Level Measurements - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Well Identification	Coordinates (Ohio Plane)[a] Northing (y)	Easting (x)	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (feet above mean sea level [msl]) 26-May-09 DTW	26-May-09 Elevation	27-Oct-09 DTW	27-Oct-09 Elevation
Waste Water Treatment Plant 3								
					18-May-09 DTW	18-May-09 Elevation	10-Nov-09 DTW	10-Nov-09 Elevation
Temporary Piezometer								
PZ01	623,616.33	1,914,460.24	639.66	637.20	riser bent	--	[c]Abandoned	--
PZ02	623,575.37	1,914,357.85	638.43	636.30	8.13	630.30	[c]Abandoned	--
PZ03	623,389.04	1,914,335.44	639.36	637.20	6.80	632.56	[c]Abandoned	--
PZ04	623,377.78	1,914,453.57	639.72	637.30	6.10	633.62	[c]Abandoned	--
PZ05	623,438.28	1,914,458.72	637.54	636.90	4.51	633.03	[c]Abandoned	--
PZ06	623,455.74	1,914,416.30	640.12	637.30	7.67	632.45	[c]Abandoned	--
SG03[b]	623,748.43	1,914,383.75	631.00	627.3[d]	3.27	627.73	3.47	627.53
Overburden/Shale Monitoring Well								
WTP3-MW01	623,391.43	1,914,527.69	640.00	637.00	6.11	633.89	13.93	626.07
WTP3-MW02	623,447.80	1,914,416.55	640.91	637.70	8.23	632.68	11.89	629.02
WTP3-MW03	623,501.39	1,914,372.79	637.90	635.60	6.64	631.26	8.15	629.75
Delaware Limestone Monitoring Well								
WTP3-BEDGW-001	623,382.22	1,914,531.86	640.15	637.10	37.10	603.05	36.31	603.84
WTP3-BEDGW-002	623,453.92	1,914,407.33	640.90	637.60	37.26	603.64	36.44	604.46
WTP3-BEDGW-003	623,532.48	1,914,302.59	640.21	637.10	36.63	603.58	35.85	604.36

Notes:

[a]Northings and Eastings are scaled to the Ohio State Plane Coordinate System (North Zone), NAD 1983.
Vertical datum to National Geodetic Vertical Datum 1929.
[b]Staff gauge to measure water level in unnamed drainage ditch.
[c]Piezometers were abandoned.
[d]Creek bottom.
[e]Temporary Piezometer - Survey data taken from associated test pit, piezometers not surveyed.
DTW - Depth to water. NM - Not measured.
NA - Not applicable. NS - Not surveyed.
ft msl - Feet above mean sea level.

Table 6-2

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP3-SB01		WWTP3-SB01		WWTP3-SB01		WWTP3-SB01		WWTP3-SB01		WWTP3-SB02		WWTP3-SB02	
				SAMPLE NO	WW0034		WW0035		WW0036		WW0037		WW0065A		WW0038		WW0039	
				SAMPLE DATE	10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08	
				DEPTH	0.7 - 1.7 Ft		5 - 5.7 Ft		8 - 10 Ft		8 - 10 Ft		8 - 10 Ft		0.5 - 1.5 Ft		5 - 5.5 Ft	
				SAMPLE PURPOSE	REG		REG		REG		FD		FS		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
PCBS																		
Aroclor 1016	mg/kg	0.39	NE	0.1	-	-	-	-							-	-	0.1	J
Aroclor 1260	mg/kg	0.22	NE	0.229	0.18	J	-	-							-	-	-	-
SEMIVOLATILES																		
Acenaphthene	mg/kg	340	NE	0.643	0.478		-	-	-	-	-	-	-	-	0.643	J	0.0592	J
Acenaphthylene	mg/kg	NE	NE	3.23	0.209	J	-	-	-	-	-	-	-	-	3.23		0.0788	J
Anthracene	mg/kg	1,700	NE	4.53	1.5		-	-	-	-	-	-	-	-	4.53		0.263	J
Benzo(a)anthracene	mg/kg	0.15	NE	11.9	3.25		-	-	-	-	-	-	-	-	11.9		0.309	J
mg/kg - Milligram per kilogram.	mg/kg	0.015	NE	10	2.41		-	-	-	-	-	-	-	-	10		0.306	J
Benzo(b)fluoranthene	mg/kg	0.15	NE	13.9	3.58		-	-	-	-	-	-	-	-	13.9		0.409	
Benzo(ghi)perylene	mg/kg	NE	NE	5.57	1.54		-	-	-	-	-	-	-	-	5.57		0.18	J
Benzo(k)fluoranthene	mg/kg	1.5	NE	4.49	1.08		-	-	-	-	-	-	-	-	4.49		0.136	J
Bis(2-ethylhexyl)phthalate	mg/kg	35	NE	0.041	-	-	-	-	-	-	-	-	-	-	-	-	-	-
J - The analyte was positively ide	mg/kg	NE	NE	1.12	0.432		-	-	-	-	-	-	-	-	1.12	J	0.0443	J
Chrysene	mg/kg	15	NE	10.3	2.98		-	-	-	-	-	-	-	-	10.3		0.276	J
Dibenz(a,h)anthracene	mg/kg	0.015	NE	1.46	0.397	J	-	-	-	-	-	-	-	-	1.46	J	-	-
Dibenzofuran	mg/kg	7.8	NE	1.35	0.436		-	-	-	-	-	-	-	-	1.35	J	0.078	J
Fluoranthene	mg/kg	230	NE	24.8	6.82		-	-	-	-	-	-	-	-	24.8		0.816	
Fluorene	mg/kg	230	NE	1.78	0.581		-	-	-	-	-	-	-	-	1.78	J	0.114	J
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	8.1	2.14		-	-	-	-	-	-	-	-	8.1		0.436	
Methylnaphthalene, 2-	mg/kg	31	NE	1.57	0.721		-	-	-	-	-	-	-	-	1.57	J	-	-
Naphthalene	mg/kg	3.6	NE	1.38	0.677		-	-	-	-	-	-	-	-	1.38	J	-	-
Phenanthrene	mg/kg	NE	NE	13.9	4.49		-	-	-	-	-	-	-	-	13.9		0.845	
Pyrene	mg/kg	170	NE	18.1	4.58		-	-	-	-	-	-	-	-	18.1		0.584	

Table 6-2

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP3-SB01		WWTP3-SB01		WWTP3-SB01		WWTP3-SB01		WWTP3-SB01		WWTP3-SB02		WWTP3-SB02	
				SAMPLE NO	WW0034		WW0035		WW0036		WW0037		WW0065A		WW0038		WW0039	
				SAMPLE DATE	10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08	
				DEPTH	0.7 - 1.7 Ft		5 - 5.7 Ft		8 - 10 Ft		8 - 10 Ft		8 - 10 Ft		0.5 - 1.5 Ft		5 - 5.5 Ft	
				SAMPLE PURPOSE	REG		REG		REG		FD		FS		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS																		
Aluminum	mg/kg	7,700	15,500	10500	8,510		7,830		7,810		7,980		8,310		7,070		10,500	
Antimony	mg/kg	3.1	9.3	0.457	0.396	J	0.274	J	0.245	J	0.3	J	-	-	0.296	J	0.324	J
Arsenic	mg/kg	0.39	36.5	20.8	20.8		5.03		5.92		6.29		7.4		14.4		9.56	
Barium	mg/kg	1,500	826	197	52.2		47		51		61.9		53.1		54.1		197	
Beryllium	mg/kg	16	1	8.44	**8.44**		**5.32**		**5.58**		**5.5**		-	-	**8.44**		**8.08**	
Cadmium	mg/kg	7	NE	1.01	0.247	J	-	-	0.23	J	-	-	-	-	0.364	J	1.01	
Calcium	mg/kg	NE	52,300	54100	9,040		23,600		42,800		46,300		**54,100**		17,200		3,710	
Chromium	mg/kg	0.29	29	17.8	13.9		12.7		11.6		12.3		13.6		11.5		17.8	
Cobalt	mg/kg	2.3	116	22.1	9.78		6.2		8.09		7.21		-	-	6.38		22.1	
Copper	mg/kg	310	56.2	29.4	22		19.4		25.8		24		19.3		24.5		28.4	
Iron	mg/kg	5,500	234,000	29000	29,000		15,700		18,400		17,300		18,200		28,000		28,000	
Lead	mg/kg	400	48.6	134	21.5		10.2		13		11.1		9.1		34.6		15.9	
Magnesium	mg/kg	NE	10,400	19000	4,420		8,480		**16,300**		**17,800**		**17,200**		4,160		3,850	
Manganese	mg/kg	180	3,506	2520	226		260		389		368		274		428		2,520	
Mercury	mg/kg	2.3	0.09	0.597	**0.597**		0.0163	J	0.0177	J	0.0221	J	-	-	0.074		0.0223	J
Nickel	mg/kg	150	55.1	57.1	24.1		17.5		21.3		20.8		16.2		17.5		**57.1**	
Potassium	mg/kg	NE	3,390	1650	494		458		813		829		1,650		422		735	
Selenium	mg/kg	39	2	2	0.628	J	-	-	0.436	J	-	-	**2**		0.695	J	-	-
Sodium	mg/kg	NE	NE	178	57		66.1		97.3		103		-	-	47.7		48.9	
Thallium	mg/kg	NE	1.3	0.292	0.266	J	-	-	0.216	J	-	-	-	-	-	-	0.292	J
Vanadium	mg/kg	39	40.9	28.5	23.2		18.9		19.3		19.2		19		18.3		28.5	
Zinc	mg/kg	2,300	321.75	90.1	74.4		51.1		58.8		56.6		48		90.1		78.5	
GENERAL CHEMISTRY																		
Total organic carbon	mg/kg	NE	NE	33.5	33.5	B												

Table 6-2

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP3-SB02		WWTP3-SB03		WWTP3-SB03		WWTP3-SB03		WWTP3-SB03		WWTP3-SB03		WWTP3-SB05		WWTP3-SB05		WWTP3-SB05	
				SAMPLE NO	WW0040		WW0041		WW0042		WW0043		WW0068		WW0044		WW0048		WW0049		WW0050	
				SAMPLE DATE	10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08		11-Dec-08		4-Dec-08		11-Dec-08	
				DEPTH	8 - 10 Ft		0 - 1 Ft		3 - 5 Ft		3 - 5 Ft		3 - 5 Ft		8 - 10 Ft		0 - 1 Ft		3 - 5 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		REG		FD		FS		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
PCBS																						
Aroclor 1016	mg/kg	0.39	NE	0.1			-	-	-	-	-	-	-	-			-	-	-	-		
Aroclor 1260	mg/kg	0.22	NE	0.229			-	-	-	-	-	-	-	-			0.229		0.0667	J		
SEMIVOLATILES																						
Acenaphthene	mg/kg	340	NE	0.643	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	mg/kg	NE	NE	3.23	-	-	-	-	-	-	-	-	-	-	-	-	0.0541	J	-	-	-	-
Anthracene	mg/kg	1,700	NE	4.53	-	-	-	-	-	-	0.0902	J	-	-	-	-	0.0504	J	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	11.9	-	-	-	-	-	-	0.254	J	-	-	-	-	0.276	J	0.0398	J	-	-
mg/kg - Milligram per kilogram.	mg/kg	0.015	NE	10	-	-	-	-	-	-	0.193	J	-	-	-	-	0.289	J	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	13.9	-	-	-	-	-	-	0.307	J	-	-	-	-	0.438		-	-	-	-
Benzo(ghi)perylene	mg/kg	NE	NE	5.57	-	-	-	-	-	-	0.108	J	-	-	-	-	0.178	J	-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	4.49	-	-	-	-	-	-	-	-	-	-	-	-	0.127	J	-	-	-	-
Bis(2-ethylhexyl)phthalate	mg/kg	35	NE	0.041	-	-	-	-	0.041	J	-	-	-	-	-	-	-	-	-	-	-	-
J - The analyte was positively ide	mg/kg	NE	NE	1.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	15	NE	10.3	-	-	-	-	-	-	0.243	J	-	-	-	-	0.282	J	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	1.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	mg/kg	7.8	NE	1.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	mg/kg	230	NE	24.8	-	-	-	-	0.0402	J	0.604	J	-	-	-	-	0.4	J	0.0505	J	-	-
Fluorene	mg/kg	230	NE	1.78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	8.1	-	-	-	-	-	-	0.369	J	-	-	-	-	0.45		-	-	-	-
Methylnaphthalene, 2-	mg/kg	31	NE	1.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	3.6	NE	1.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg	NE	NE	13.9	-	-	-	-	-	-	0.35	J	-	-	-	-	0.0722	J	-	-	-	-
Pyrene	mg/kg	170	NE	18.1	-	-	-	-	-	-	0.416		-	-	-	-	0.35	J	0.0406	J	-	-

Table 6-2

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP3-SB02		WWTP3-SB03		WWTP3-SB03		WWTP3-SB03		WWTP3-SB03		WWTP3-SB03		WWTP3-SB05		WWTP3-SB05		WWTP3-SB05	
				SAMPLE NO	WW0040		WW0041		WW0042		WW0043		WW0068		WW0044		WW0048		WW0049		WW0050	
				SAMPLE DATE	10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08		10-Dec-08		11-Dec-08		4-Dec-08		11-Dec-08	
				DEPTH	8 - 10 Ft		0 - 1 Ft		3 - 5 Ft		3 - 5 Ft		3 - 5 Ft		8 - 10 Ft		0 - 1 Ft		3 - 5 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		REG		FD		FS		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS																						
Aluminum	mg/kg	7,700	15,500	10500	9,240		7,990		7,740		7,020		8,430		8,680		6,490		6,650		8,370	
Antimony	mg/kg	3.1	9.3	0.457	0.392	J	-	-	0.287	J	-	-	-	-	0.436	J	0.413	J	0.367	J	0.322	J
Arsenic	mg/kg	0.39	36.5	20.8	7.25		4.64		6.32		4.51		7.2		15.6		6.29		9.18		6.01	
Barium	mg/kg	1,500	826	197	89.3		65.8		35.7		46.8		57.6		70		48.4		42.5		54.7	
Beryllium	mg/kg	16	1	8.44	**7.48**		**5.35**		**5.13**		**5.05**		-	-	**7.5**		**4.59**	J	**5.73**	J	**6.17**	J
Cadmium	mg/kg	7	NE	1.01	0.383	J	0.252	J	-	-	-	-	-	-	0.281	J	0.244	J	0.317	J	-	-
Calcium	mg/kg	NE	52,300	54100	42,200		3,290		14,000	J	37,200	J	32,300		45,500		28,900	J	35,200	J	46,700	J
Chromium	mg/kg	0.29	29	17.8	14.1		11.1		9.22		10.2		13.3		14.2		9.68		9.86		12.8	
Cobalt	mg/kg	2.3	116	22.1	10.4		5.25		5.06		7.13		8.8		11.9		6.31	J	8.44	J	9.62	J
Copper	mg/kg	310	56.2	29.4	29.4		15.9		13.9		17.7		21.7		26.7		18.9		20.7		24.8	
Iron	mg/kg	5,500	234,000	29000	24,600		14,200		14,400		15,000		20,400		25,100		13,800	J	18,500	J	19,900	J
Lead	mg/kg	400	48.6	134	16		13		9.51		10.2		11.7		12.8		**134**	J	**82.9**	J	12.9	J
Magnesium	mg/kg	NE	10,400	19000	**13,500**		2,010		5,070	J	**11,700**	J	10,000		**16,500**		8,750	J	**11,800**	J	**16,900**	J
Manganese	mg/kg	180	3,506	2520	696		294		211	J	423	J	439		495		322	J	466	J	494	J
Mercury	mg/kg	2.3	0.09	0.597	0.0185	J	0.0511		0.0208	J	0.0331		-	-	0.0261		0.0698	J	**0.18**	J	0.0202	J
Nickel	mg/kg	150	55.1	57.1	30.9		13.3		14.3		17.1		21.4		27.6		15.4	J	23.9	J	24.9	J
Potassium	mg/kg	NE	3,390	1650	860		522		371		448		942		919		642		491		1,080	
Selenium	mg/kg	39	2	2	-	-	0.602	J	-	-	-	-	-	-	0.507	J	-	-	-	-	-	-
Sodium	mg/kg	NE	NE	178	88.8		25		40	J	69.8	J	-	-	130		64.6		79.5		170	
Thallium	mg/kg	NE	1.3	0.292	0.281	J	-	-	-	-	-	-	-	-	0.259	J	-	-	-	-	0.268	J
Vanadium	mg/kg	39	40.9	28.5	23.2		17.7		17.7		18.6		20.9		22.2		17.8		20.3		21.7	
Zinc	mg/kg	2,300	321.75	90.1	72.2		51		44		43.7		52.4		66.8		75.9		62		61.1	
GENERAL CHEMISTRY																						
Total organic carbon	mg/kg	NE	NE	33.5																		

Table 6-2

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP3-SB06		WWTP3-SB06		WWTP3-SB06		WWTP3-SB07		WWTP3-SB07		WWTP3-SB07	
				SAMPLE NO	WW0051		WW0052		WW0053		WW0054		WW0055		WW0056	
				SAMPLE DATE	11-Dec-08		11-Dec-08		11-Dec-08		11-Dec-08		11-Dec-08		11-Dec-08	
				DEPTH	0 - 1 Ft		3 - 3.7 Ft		8 - 10 Ft		0 - 1 Ft		3 - 5 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
PCBS																
Aroclor 1016	mg/kg	0.39	NE	0.1	-	-	-	-			-	-	-	-		
Aroclor 1260	mg/kg	0.22	NE	0.229	-	-	-	-			-	-	-	-		
SEMIVOLATILES																
Acenaphthene	mg/kg	340	NE	0.643	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	mg/kg	NE	NE	3.23	0.0942	J	0.0577	J	-	-	-	-	-	-	-	-
Anthracene	mg/kg	1,700	NE	4.53	0.183	J	0.0617	J	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	11.9	0.607		0.238	J	-	-	0.101	J	-	-	-	-
mg/kg - Milligram per kilogram.	mg/kg	0.015	NE	10	0.538		0.209	J	-	-	0.0909	J	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	13.9	0.756		0.3	J	-	-	0.14	J	-	-	-	-
Benzo(ghi)perylene	mg/kg	NE	NE	5.57	0.321	J	0.12	J	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	4.49	0.291	J	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	mg/kg	35	NE	0.041	-	-	-	-	-	-	-	-	-	-	-	-
J - The analyte was positively ide	mg/kg	NE	NE	1.12	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	15	NE	10.3	0.556		0.228	J	-	-	0.0925	J	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	1.46	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	mg/kg	7.8	NE	1.35	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	mg/kg	230	NE	24.8	1.12		0.464		-	-	0.187	J	-	-	-	-
Fluorene	mg/kg	230	NE	1.78	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	8.1	0.62		0.388	J	-	-	0.305	J	-	-	-	-
Methylnaphthalene, 2-	mg/kg	31	NE	1.57	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	3.6	NE	1.38	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg	NE	NE	13.9	0.363	J	0.293	J	-	-	0.0677	J	-	-	-	-
Pyrene	mg/kg	170	NE	18.1	0.865		0.337	J	-	-	0.157	J	-	-	-	-

Table 6-2

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP3-SB06		WWTP3-SB06		WWTP3-SB06		WWTP3-SB07		WWTP3-SB07		WWTP3-SB07	
				SAMPLE NO	WW0051		WW0052		WW0053		WW0054		WW0055		WW0056	
				SAMPLE DATE	11-Dec-08		11-Dec-08		11-Dec-08		11-Dec-08		11-Dec-08		11-Dec-08	
				DEPTH	0 - 1 Ft		3 - 3.7 Ft		8 - 10 Ft		0 - 1 Ft		3 - 5 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS																
Aluminum	mg/kg	7,700	15,500	10500	4,950		7,230		7,920		5,870		7,800		7,730	
Antimony	mg/kg	3.1	9.3	0.457	0.275	J	0.261	J	0.32	J	0.321	J	0.378	J	0.338	J
Arsenic	mg/kg	0.39	36.5	20.8	4.35		5.64		4.35		5.18		10.4		4.43	
Barium	mg/kg	1,500	826	197	32.1		56.7		53.3		35.9		56.6		48.1	
Beryllium	mg/kg	16	1	8.44	**3.88**	J	**4.72**	J	**5.78**	J	**4.25**	J	**6.22**	J	**5.42**	J
Cadmium	mg/kg	7	NE	1.01	-	-	0.252	J	0.283	J	-	-	0.248	J	0.266	J
Calcium	mg/kg	NE	52,300	54100	8,960	J	12,000	J	50,800	J	24,700	J	16,200	J	46,200	J
Chromium	mg/kg	0.29	29	17.8	6.9		9.49		12.2		8.34		11.8		11.7	
Cobalt	mg/kg	2.3	116	22.1	3.97	J	5.69	J	8.93	J	5.14	J	9.75	J	8.57	J
Copper	mg/kg	310	56.2	29.4	11.4		12.9		24.8		13.8		23.2		24.2	
Iron	mg/kg	5,500	234,000	29000	10,200	J	13,000	J	18,700	J	12,100	J	19,200	J	17,500	J
Lead	mg/kg	400	48.6	134	21.6	J	39.4	J	12.5	J	19.2	J	12.4	J	12.4	J
Magnesium	mg/kg	NE	10,400	19000	3,190	J	4,010	J	**19,000**	J	5,900	J	7,450	J	**17,500**	J
Manganese	mg/kg	180	3,506	2520	192	J	241	J	554	J	287	J	485	J	511	J
Mercury	mg/kg	2.3	0.09	0.597	0.061	J	0.0305	J	0.0183	J	**0.12**	J	0.0237	J	0.0212	J
Nickel	mg/kg	150	55.1	57.1	9.37	J	13.5	J	23.5	J	12.4	J	22.1	J	22.6	J
Potassium	mg/kg	NE	3,390	1650	363		321		1,040		443		394		1,020	
Selenium	mg/kg	39	2	2	-	-	-	-	-	-	0.483	J	-	-	-	-
Sodium	mg/kg	NE	NE	178	40.8		53.5		178		45.8		162		133	
Thallium	mg/kg	NE	1.3	0.292	-	-	-	-	0.282	J	0.277	J	-	-	0.261	J
Vanadium	mg/kg	39	40.9	28.5	13.8		19		21.1		16.6		23.5		20.1	
Zinc	mg/kg	2,300	321.75	90.1	41.9		45		60.1		41.9		56.2		57.8	
GENERAL CHEMISTRY																
Total organic carbon	mg/kg	NE	NE	33.5												

Table 6-2

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP3-SB09		WWTP3-SB09		WWTP3-SB09		WWTP3-SB09		WWTP3-SB09	
				SAMPLE NO	WW0060		WW0061		WW0063		WW0065		WW0062	
				SAMPLE DATE	11-Dec-08		11-Dec-08		11-Dec-08		11-Dec-08		11-Dec-08	
				DEPTH	0.2 - 1.6 Ft		3 - 5 Ft		3 - 5 Ft		3 - 5 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		FD		FS		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
PCBS														
Aroclor 1016	mg/kg	0.39	NE	0.1	-	-	-	-	-	-	-	-		
Aroclor 1260	mg/kg	0.22	NE	0.229	-	-	-	-	-	-	-	-		
SEMIVOLATILES														
Acenaphthene	mg/kg	340	NE	0.643	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	mg/kg	NE	NE	3.23	-	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg	1,700	NE	4.53	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	11.9	-	-	-	-	-	-	-	-	-	-
mg/kg - Milligram per kilogram.	mg/kg	0.015	NE	10	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	13.9	-	-	-	-	-	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	NE	NE	5.57	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	4.49	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	mg/kg	35	NE	0.041	-	-	-	-	-	-	-	-	-	-
J - The analyte was positively ide	mg/kg	NE	NE	1.12	-	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	15	NE	10.3	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	1.46	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	mg/kg	7.8	NE	1.35	-	-	-	-	-	-	-	-	-	-
Fluoranthene	mg/kg	230	NE	24.8	-	-	-	-	-	-	-	-	-	-
Fluorene	mg/kg	230	NE	1.78	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	8.1	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	mg/kg	31	NE	1.57	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	3.6	NE	1.38	-	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg	NE	NE	13.9	-	-	-	-	-	-	-	-	-	-
Pyrene	mg/kg	170	NE	18.1	-	-	-	-	-	-	-	-	-	-

Table 6-2

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP3-SB09		WWTP3-SB09		WWTP3-SB09		WWTP3-SB09		WWTP3-SB09	
				SAMPLE NO	WW0060		WW0061		WW0063		WW0065		WW0062	
				SAMPLE DATE	11-Dec-08		11-Dec-08		11-Dec-08		11-Dec-08		11-Dec-08	
				DEPTH	0.2 - 1.6 Ft		3 - 5 Ft		3 - 5 Ft		3 - 5 Ft		8 - 10 Ft	
				SAMPLE PURPOSE	REG		REG		FD		FS		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS														
Aluminum	mg/kg	7,700	15,500	10500	7,780		8,410		9,940		7,070		8,440	
Antimony	mg/kg	3.1	9.3	0.457	0.303	J	0.457	J	0.371	J	-	-	0.321	J
Arsenic	mg/kg	0.39	36.5	20.8	7.23		6.49		6.06		7.1		4.78	
Barium	mg/kg	1,500	826	197	52.6		50.1		59.7		45.1		51.2	
Beryllium	mg/kg	16	1	8.44	**5.75**	J	**7.14**	J	**6.45**	J	-	-	**6.05**	J
Cadmium	mg/kg	7	NE	1.01	0.224	J	-	-	-	-	-	-	-	-
Calcium	mg/kg	NE	52,300	54100	29,600	J	5,270	J	6,090	J	4,460		45,300	J
Chromium	mg/kg	0.29	29	17.8	12		14.4		15.5		11.5		12.8	
Cobalt	mg/kg	2.3	116	22.1	7.21		6.67	J	7.35	J	-	-	9.32	J
Copper	mg/kg	310	56.2	29.4	20.5		19.8		19.3		19.6		25.3	
Iron	mg/kg	5,500	234,000	29000	17,100	J	21,600	J	19,400	J	20,700		19,800	J
Lead	mg/kg	400	48.6	134	13.3		11.7	J	11.7	J	8.2		12	J
Magnesium	mg/kg	NE	10,400	19000	8,750		3,330	J	3,790	J	2,820		**15,900**	J
Manganese	mg/kg	180	3,506	2520	377		277	J	430	J	270		473	J
Mercury	mg/kg	2.3	0.09	0.597	0.02	J	0.0241	J	0.0312	J	-	-	0.02	J
Nickel	mg/kg	150	55.1	57.1	19.6		21.4	J	23.3	J	17.2		24.7	J
Potassium	mg/kg	NE	3,390	1650	567		414		463		-	-	1,090	
Selenium	mg/kg	39	2	2	-	-	0.531	J	-	-	-	-	-	-
Sodium	mg/kg	NE	NE	178	60.1		79		78.5		-	-	148	
Thallium	mg/kg	NE	1.3	0.292	0.221	J	0.269	J	-	-	-	-	0.252	J
Vanadium	mg/kg	39	40.9	28.5	19.1		25.5		23.2		20.1		20.9	
Zinc	mg/kg	2,300	321.75	90.1	58.8		58.7		59.3		39.4		62	
GENERAL CHEMISTRY														
Total organic carbon	mg/kg	NE	NE	33.5										

Table 6-2

Detections Above RBSCs and/or BSCs in Surface and Subsurface Soil Samples - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

FD- Field duplicate.
FS - Field split.
NE - Not established (RBSCs), not evaluated (BSCs).
Shaded cell indicates value is greater than RBSC.
Bold text indicates value is greater than the BSC.
RBSC - Risk-based screening concentration. Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC. RBSCs were derived from the May 2010 RSLs
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
BSC - Background screening concentration.
"-" - Not Detected.
mg/kg - Milligram per kilogram.
PCB - Polychlorinated biphenyl.
WWTP3 - Waste Water Treatment Plant 3.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
B - Analyte was not detected significantly above the levels found in the associated method blank or field blanks.

Table 6-3

Detections Above RBSCs and/or BSCs in Piezometer Groundwater - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

(Page 1 of 2)

				LOCATION CODE	WWTP3					
				LOCATION	WWTP3-PZ01		WWTP3-PZ02		WWTP3-PZ03	
				SAMPLE NO	WW3007		WW3008		WW3009	
				SAMPLE DATE	16-Dec-08		7-Dec-08		17-Dec-08	
				DEPTH	18 - 18 Ft		15 - 15 Ft		21 - 21 Ft	
				SAMPLE PURPOSE	REG		REG		REG	
				LOW-FLOW SAMPLED	Yes		Yes		Yes	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ
METALS (UNFILTERED)										
Aluminum	µg/L	3,700	309	599000	**42,200**	J	**136,000**	J	**599,000**	
Antimony	µg/L	1.5	NE	6.26	-	-	4.42	J	6.26	
Arsenic	µg/L	0.045	7.4	210	**19**		**95.9**		**210**	
Barium	µg/L	730	11,800	2460	261		726		2,460	
Beryllium	µg/L	7.3	NE	170	19.4		67.8		170	
Cadmium	µg/L	NE	NE	8.22	-	-	-	-	8.22	
Calcium	µg/L	NE	316,000	3080000	265,000	J	**666,000**	J	**3,080,000**	
Chromium	µg/L	0.043	NE	618	50.4		163		618	
Cobalt	µg/L	1.1	12.1	217	**22**		**73.5**		**217**	
Copper	µg/L	150	19.8	1070	**68.2**		**256**		**1,070**	
Iron	µg/L	2,600	1,550	814000	**53,500**	J	**190,000**	J	**814,000**	
Lead	µg/L	NE	NE	467	33.4		148		467	
Magnesium	µg/L	NE	217,000	1050000	104,000		186,000		**1,050,000**	
Manganese	µg/L	88	636	18400	**3,460**		**4,990**		**18,400**	
Mercury	µg/L	1.1	NE	0.276	-	-	0.126	J	0.276	
Nickel	µg/L	73	8.6	599	**36.5**		**108**		**599**	
Potassium	µg/L	NE	116,000	174000	13,100		36,700		**174,000**	
Selenium	µg/L	18	NE	8.45	-	-	8.45	J	-	-
Sodium	µg/L	NE	1,390,000	27400	26,800		8,060		27,400	
Thallium	µg/L	NE	NE	14.1	-	-	5.09	J	14.1	
Vanadium	µg/L	18	NE	1290	95.9		326		1,290	
Zinc	µg/L	1,100	507	2020	145		485		**2,020**	
METALS (FILTERED)										
Arsenic	µg/L	0.045	7.4	20	6.95	J	**13.9**		**20**	
Barium	µg/L	730	11,800	313	51.1		76.2		313	
Calcium	µg/L	NE	316,000	141000	141,000	J	108,000	J	104,000	
Iron	µg/L	2,600	1,550	926	926		480		324	
Lead	µg/L	15	NE	3.06	-	-	3.06	J	-	-
Magnesium	µg/L	NE	217,000	56700	56,700	J	32,500	J	41,600	
Manganese	µg/L	88	636	2360	**2,360**	J	189	J	172	
Potassium	µg/L	NE	116,000	2330	284	J	725		2,330	
Selenium	µg/L	18	NE	7.44	-	-	7.44	J	-	-
Sodium	µg/L	NE	1,390,000	25600	25,600		5,400		17,000	
WATER QUALITY PARAMETERS										
Alkalinity	µg/L	NE	NE	239000	239,000		128,000		166,000	
Chloride	µg/L	NE	NE	5970	5,970		5,100		3,930	
Hardness	µg/L	NE	NE	12000000	1,090,000		2,430,000		12,000,000	
HARDNESS (as CaCO3)	µg/L	NE	NE	7690000	663,000	J	1,660,000	J	7,690,000	
Nitrate-Nitrite	µg/L	NE	NE	40	-	-	40		-	-
Sulfate	µg/L	NE	NE	179000	127,000		179,000		83,100	
Total dissolved solids	µg/L	NE	NE	2110000	855,000		2,110,000		1,640,000	
Total suspended solids	µg/L	NE	NE	31300000	775,000		31,300,000		25,600,000	
Turbidity	NTU	NE	NE	993	465		583		993	

Table 6-3

Detections Above RBSCs and/or BSCs in Piezometer Groundwater - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

NE - Not established (RBSCs), not evaluated (BSCs).
NA - Not Analyzed.
Shaded cell indicates value is greater than RBSC.
Bold text indicates value is greater than the BSC.
RBSC - Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC. RBSCs were derived from the May 2010 RSLs as described in Section 4.2.1 of the text.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
BSC - Background screening concentration.
"-" - Not detected.
µg/L - Parts per billion.
WWTP3 - Waste Water Treatment Plant 3.
NTU - Nephelometric turbidity units.

Validation Qualifiers (VQ)
J - The analyte was postively identified; the reported value is estimated.
B - The analyte was not detected significantly above the levels found in the associated method blank or field blanks.

Table 6-4

Detections Above RBSCs and/or BSCs in Overburden/Shale Groundwater - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP3											
				LOCATION	WTP3-MW01		WTP3-MW01		WTP3-MW02		WTP3-MW02		WTP3-MW03		WTP3-MW03	
				SAMPLE NO	WW3021		WW3032		WW3022		WW3033		WW3023		WW3034	
				SAMPLE DATE	19-May-09		11-Nov-09		21-May-09		12-Nov-09		21-May-09		12-Nov-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG	
				LOW-FLOW SAMPLED	No		No		No		No		No		No	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
EXPLOSIVES																
Dinitrobenzene, 1,3-	µg/L	0.37	NE	0.15	-	-	-	-	-	-	-	-	0.15	J	0.13	J
Dinitrotoluene, 2,4-	µg/L	0.099	NE	0.19	-	-	-	-	-	-	-	-	0.19	J	0.16	J
Trinitrobenzene, 1,3,5-	µg/L	110	NE	0.29	-	-	-	-	-	-	-	-	0.29		0.14	J
METALS (UNFILTERED)																
Aluminum	µg/L	3,700	309	1190	87.6	J	**1,190**		109	J	95.3	J	91.9	J	96.2	J
Arsenic	µg/L	0.045	7.4	15.8	-	-	**15.8**		**10.4**		**10.4**		-	-	-	-
Barium	µg/L	730	11,800	411	165	J	411		203		264		162	J	249	
Calcium	µg/L	NE	316,000	123000	123,000		86,900	J	108,000		105,000	J	112,000		106,000	J
Chromium	µg/L	0.043	NE	2.9	-	-	2.9	J	-	-	-	-	-	-	-	-
Cobalt	µg/L	1.1	12.1	3	-	-	3	J	-	-	-	-	-	-	1.4	J
Iron	µg/L	2,600	1,550	2870	-	-	**2,870**		59.9	J	130	J	-	-	-	-
Lead	µg/L	NE	NE	4.8	-	-	4.8	B	-	-	-	-	-	-	2.3	B
Magnesium	µg/L	NE	217,000	44500	39,000		44,500		41,800		41,600		34,400		35,800	
Manganese	µg/L	88	636	521	30		482		125		181		521		466	
Mercury	µg/L	1.1	NE	0.21	-	-	-	-	-	-	0.21	J	-	-	-	-
Nickel	µg/L	73	8.6	4.5	2.4	J	4.5	J	2.3	J	-	-	3.3	J	3.1	J
Potassium	µg/L	NE	116,000	4850	2,080	J	4,850	J	2,460	J	3,790	J	1,760	J	3,200	J
Selenium	µg/L	18	NE	5.2	-	-	5.2	J	-	-	3.4	J	-	-	4.5	J
Sodium	µg/L	NE	1,390,000	28000	17,000		24,900		23,800		28,000		19,400		24,600	
Vanadium	µg/L	18	NE	2.5	0.94	J	2.5	J	0.9	J	-	-	-	-	-	-
Zinc	µg/L	1,100	507	13.1	10.9	B	13.1	J	7.4	B	-	-	-	-	-	-
METALS (FILTERED)																
Aluminum	µg/L	3,700	309	25.8	25.8	J	-	-	13.4	J	-	-	19.9	J	-	-
Arsenic	µg/L	0.045	7.4	11.7	-	-	5.9	J	**11.7**		**7.7**	J	-	-	-	-
Barium	µg/L	730	11,800	372	136	J	372		197	J	262		186	J	242	
Calcium	µg/L	NE	316,000	123000	123,000		76,700	J	108,000		104,000	J	114,000		112,000	J
Cobalt	µg/L	1.1	12.1	1.2	-	-	1.1	J	-	-	-	-	-	-	1.2	J
Lead	µg/L	15	NE	2.6	-	-	-	-	-	-	2.6	B	-	-	-	-
Magnesium	µg/L	NE	217,000	41700	37,700		41,700		41,700		41,700		36,400		37,400	
Manganese	µg/L	88	636	489	24.5		398		95.2		166		489		473	
Nickel	µg/L	73	8.6	3.3	2.9	J	-	-	2.5	J	-	-	3.3	J	3.1	J
Potassium	µg/L	NE	116,000	4240	1,870	J	4,240	J	2,430	J	3,800	J	1,950	J	3,270	J
Selenium	µg/L	18	NE	5.2	-	-	5.2	J	-	-	-	-	3.7	J	-	-
Sodium	µg/L	NE	1,390,000	28400	16,900		23,200		23,400		28,400		20,500		25,800	
Zinc	µg/L	1,100	507	19.1	19.1	B	-	-	12.3	J	9.5	J	13.7	J	12	J

Table 6-4

Detections Above RBSCs and/or BSCs in Overburden/Shale Groundwater - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP3											
				LOCATION	WTP3-MW01		WTP3-MW01		WTP3-MW02		WTP3-MW02		WTP3-MW03		WTP3-MW03	
				SAMPLE NO	WW3021		WW3032		WW3022		WW3033		WW3023		WW3034	
				SAMPLE DATE	19-May-09		11-Nov-09		21-May-09		12-Nov-09		21-May-09		12-Nov-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG		REG	
				LOW-FLOW SAMPLED	No		No		No		No		No		No	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
WATER QUALITY PARAMETERS																
Alkalinity	µg/L	NE	NE	1060000	431,000		485,000		438,000		1,060,000		392,000		485,000	
Chloride	µg/L	NE	NE	20600	11,200		8,400		8,300		7,200		20,600		20,300	
Cyanide, total	µg/L	73	NE	23	-	-	-	-	13		-	-	23		-	-
HARDNESS (as CaCO3)	µg/L	NE	NE	465000	465,000		398,000		441,000		440,000		421,000		413,000	
Nitrate-Nitrite	µg/L	NE	NE	350	-	-	350		-	-	240		-	-	320	
Sulfate	µg/L	NE	NE	83600	41,100		37,300	J	60,900		83,600	J	72,000		81,000	
Total dissolved solids	µg/L	NE	NE	721000	615,000		494,000		488,000		721,000		606,000		539,000	
Total suspended solids	µg/L	NE	NE	56000	13,000		56,000		10,000		27,000		17,000		22,000	
Turbidity	NTU	NE	NE	36.5	3.2	J	36.5	J	3.8		6.5	J	5		5.8	J

NE - Not established (RBSCs), not evaluated (BSCs).
NA - Not Analyzed.
Shaded cell indicates value is greater than RBSC.
Bold text indicates value is greater than the BSC.
RBSC - Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1.
For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC. RBSCs were derived from the May 2010 RSLs.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
BSC - Background screening concentration.
"-" - Not detected.
µg/L - Parts per billion.
WWTP3 - Waste Water Treatment Plant 3.
NTU - Nephelometric turbidity units.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
B - The analyte was not detected significantly above the levels found in the associated method blank or field blanks.

Table 6-5

Detections Above RBSCs and/or BSCs in Bedrock Groundwater - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP3															
				LOCATION	WTP3-BEDGW-001		WTP3-BEDGW-001		WTP3-BEDGW-002		WTP3-BEDGW-002		WTP3-BEDGW-003		WTP3-BEDGW-003		WTP3-BEDGW-003		WTP3-BEDGW-003	
				SAMPLE NO	WW3024		WW3035		WW3025		WW3036		WW3026		WW3027		WW3028		WW3037	
				SAMPLE DATE	22-May-09		13-Nov-09		23-May-09		13-Nov-09		22-May-09		22-May-09		22-May-09		12-Nov-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG[a]		FD[a]		FS[a]		REG	
				LOW-FLOW SAMPLED	No		No		No		No		No		No		No		Yes	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
VOLATILES																				
Benzene	µg/L	0.41	2.4	16	**4.6**		**3.1**		2.1		**3.2**		0.98	J	**16**	J	-	-	**15.4**	
Butanone, 2-	µg/L	710	NE	14.4	9.2		10.7		-	-	14.4		-	-	10.2		-	-	-	-
Carbon disulfide	µg/L	100	NE	30	-	-	-	-	-	-	-	-	-	-	-	-	30	J	-	-
Ethylbenzene	µg/L	1.5	0.87	6	**3.8**		**4.6**		**1.4**	J	**1.2**		0.75	J	**6**	J	-	-	**3.4**	
Methylene chloride	µg/L	4.8	NE	3.8	-	-	-	-	3.8	B	-	-	-	-	-	-	-	-	-	-
Toluene	µg/L	230	1.7	16.4	**5.7**		**7.4**		**1.8**	B	**2.7**		1.4	B	**16.4**	J	-	-	**12.5**	
Xylenes, total	µg/L	20	5.5	46.2	**24.4**		**34.6**		**7.7**		**7.8**		4.9	J	**46.2**	J	-	-	**24.7**	
SEMIVOLATILES																				
Methylnaphthalene, 2-	µg/L	15	NE	2.8	1.8	J	2.8	J	2.2	J	1.1	J	-	-	1.3	J	-	-	-	-
Naphthalene	µg/L	0.14	NE	1.9	1.1	J	1.9	J	1.1	J	-	-	-	-	1.7	J	-	-	-	-
METALS (UNFILTERED)																				
Aluminum	µg/L	3,700	309	125	97.4	J	125	J	73	J	23.4	B	28	J	35.8	J	-	-	24.7	B
J - The analyte was positiv	µg/L	0.045	7.4	123	**26.8**		-	-	**123**		-	-	**23.5**		**18**		**17.7**		-	-
Barium	µg/L	730	11,800	766	643		766		417		314		238		241		238		245	
Calcium	µg/L	NE	316,000	150000	120,000		121,000	J	150,000		121,000	J	91,700		90,600		84,500		84,600	J
Iron	µg/L	2,600	1,550	296	-	-	296	J	-	-	-	-	-	-	-	-	187		-	-
Lead	µg/L	15	NE	3.3	3.3	J	-	-	-	-	-	-	2.3	J	-	-	-	-	-	-
Magnesium	µg/L	NE	217,000	86400	73,600		82,100		76,200		86,400		59,800		58,800		56,800		57,100	
Manganese	µg/L	88	636	663	186		43.1		**663**		15.9		106		88.8		95.9		13.5	J
Potassium	µg/L	NE	116,000	47300	35,900		46,800		24,800		42,400		45,400		44,100		33,600		47,300	
Selenium	µg/L	18	NE	4.7	-	-	4.4	J	4.7	J	-	-	-	-	3.4	J	-	-	-	-
Sodium	µg/L	NE	1,390,000	270000	228,000		243,000		107,000		211,000		250,000		247,000		283,000		270,000	
Vanadium	µg/L	18	NE	1.9	1.9	J	1.7	J	1.6	J	1.9	J	1.2	J	-	-	-	-	1.1	J
Zinc	µg/L	1,100	507	12.2	9.7	B	8.9	J	12.2	B	-	-	8.2	B	7.7	B	-	-	-	-

Table 6-5

Detections Above RBSCs and/or BSCs in Bedrock Groundwater - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

				LOCATION CODE	WWTP3															
				LOCATION	WTP3-BEDGW-001		WTP3-BEDGW-001		WTP3-BEDGW-002		WTP3-BEDGW-002		WTP3-BEDGW-003		WTP3-BEDGW-003		WTP3-BEDGW-003		WTP3-BEDGW-003	
				SAMPLE NO	WW3024		WW3035		WW3025		WW3036		WW3026		WW3027		WW3028		WW3037	
				SAMPLE DATE	22-May-09		13-Nov-09		23-May-09		13-Nov-09		22-May-09		22-May-09		22-May-09		12-Nov-09	
				DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG[a]		FD[a]		FS[a]		REG	
				LOW-FLOW SAMPLED	No		No		No		No		No		No		No		Yes	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS (FILTERED)																				
Aluminum	µg/L	3,700	309	38.8	37.5	J	21.4	J	37.9	J	20.7	J	38.8	J	26.1	J	-	-	16	J
Arsenic	µg/L	0.045	7.4	132	**24.1**		-	-	**132**		-	-	6.3	J	**24**		20.6		-	-
Barium	µg/L	730	11,800	726	674		726		405		340		238		235		239		240	
Calcium	µg/L	NE	316,000	150000	122,000		107,000	J	150,000		122,000	J	89,600		87,800		87,700		82,600	J
Lead	µg/L	15	NE	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	B
Magnesium	µg/L	NE	217,000	87700	78,300		77,800		76,000		87,700		58,600		57,300		59,300		55,800	
Manganese	µg/L	88	636	644	154		14.8	J	**644**		17		31.1		98.2		104		10.3	J
Potassium	µg/L	NE	116,000	46200	38,500		45,300		24,200		43,200		44,900		43,200		34,800		46,200	
Selenium	µg/L	18	NE	54.9	3.8	J	54.9	J	6.1	J	-	-	-	-	-	-	-	-	-	-
Sodium	µg/L	NE	1,390,000	256000	224,000		244,000		110,000		208,000		244,000		242,000		294,000		256,000	
Vanadium	µg/L	18	NE	2.2	1.3	J	1.6	J	1.4	J	2.2	J	1.4	J	-	-	-	-	-	-
Zinc	µg/L	1,100	507	10.2	10.2	B	-	-	-	-	-	-	-	-	8	B	-	-	-	-
WATER QUALITY PARAMETERS																				
Alkalinity	µg/L	NE	NE	1210000	938,000		1,210,000		785,000		1,190,000		929,000		705,000		890,000		1,060,000	
Chloride	µg/L	NE	NE	163000	136,000		148,000		163,000		23,800		147,000		148,000		147,000		141,000	
Cyanide, total	µg/L	73	NE	620	29		-	-	53		-	-	76		13		620		-	-
HARDNESS (as CaCO3)	µg/L	NE	NE	691000	603,000		639,000		691,000		656,000		475,000		468,000		520,000		447,000	
Nitrate-Nitrite	µg/L	NE	NE	810	810	J	150		-	-	110		-	-	-	-	-	-	86	J
Sulfate	µg/L	NE	NE	40500	-	-	40,500		17,100		4,200	J	20,300		14,500	J	28,500		-	-
Total dissolved solids	µg/L	NE	NE	1790000	1,350,000		1,790,000		1,160,000		1,330,000		1,290,000		1,420,000		1,300,000		1,280,000	
Total suspended solids	µg/L	NE	NE	24000	5,000	J	24,000		6,000	J	13,000		-	-	8,000	J	7,000		9,000	J
Turbidity	NTU	NE	NE	217	75.5		74.8		36.4		11.6		217		83.5		190		129	

Table 6-5

Detections Above RBSCs and/or BSCs in Bedrock Groundwater - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

NE - Not established (RBSCs), not evaluated (BSCs).
NA - Not Analyzed.
Shaded cell indicates value is greater than RBSC.
Bold text indicates value is greater than the BSC.
RBSC - Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1.
For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC. RBSCs were derived from the May 2010 RSLs.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
BSC - Background screening concentration.
"-" - Not detected.
µg/L - Parts per billion.
WWTP3 - Waste Water Treatment Plant 3.
NTU - Nephelometric turbidity units.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
B - The analyte was not detected significantly above the levels found in the associated method blank or field blanks.

WWTP3-BEDGW-MW03 on May 22nd, 2009 at 8:40 AM. Non-target compounds co-eluted with target compounds in all three samples leading to considerable variability in the analytical results and elevated reporting limits due to dilutions. All target constituents of concern were diluted out.

Table 6-6

Detections Above RBSCs in Surface Water Samples - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

			LOCATION CODE	WWTP3-SW01		WWTP3-SW02		WWTP3-SW03		WWTP3-SW03		WWTP3-SW03	
			SAMPLE NO	WW2004		WW2005		WW2006		WW2007		WW2008	
			SAMPLE DATE	23-May-09		23-May-09		23-May-09		23-May-09		23-May-09	
			DEPTH	0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft		0 - 0 Ft	
			SAMPLE PURPOSE	REG		REG		REG		FD		FS	
Parameter	Units	RBSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS													
Aluminum	µg/L	37,000	12100	1,420		1,660		2,940	J	4,240	J	12,100	
Arsenic	µg/L	0.045	12.1	6.1	J	-	-	9.4	J	-	-	12.1	
Barium	µg/L	7,300	106	65.4	J	47	J	106	J	104	J	-	-
Calcium	µg/L	NE	130000	110,000		91,200		123,000		116,000		130,000	
Chromium	µg/L	0.043	16	2.1	J	2.5	J	4.4	J	6.9	J	16	
Cobalt	µg/L	11	6.2	2.1	J	1.6	J	6.2	J	5.7	J	-	-
Copper	µg/L	1,500	8.8	6.9	J	-	-	8.8	J	8	J	-	-
Iron	µg/L	26,000	27500	2,440		4,190		10,600		12,000		27,500	
Lead	µg/L	15	13.9	4.5	J	2.2	J	7.4		7		13.9	
Magnesium	µg/L	NE	34400	24,100		23,600		29,900		28,700		34,400	
Manganese	µg/L	880	2120	788		134		2,030		1,930		2,120	
Nickel	µg/L	730	4.8	-	-	-	-	3.4	J	4.8	J	-	-
Potassium	µg/L	NE	1630	776	J	703	J	1,300	J	1,630	J	-	-
Selenium	µg/L	180	4.9	-	-	-	-	4.3	J	4.9	J	-	-
Sodium	µg/L	NE	7040	4,480	J	3,850	J	4,810	J	5,100	J	7,040	
Vanadium	µg/L	180	10.6	5	J	4.7	J	8.7	J	10.6	J	-	-
Zinc	µg/L	11,000	82.9	21.7	B	19.4	B	36.3	B	38.5	B	82.9	

RBSC - Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1.
For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
RBSCs were derived from the May 2010 RSLs as described in Section 4.2.1 of the text.
MDC - Maximum detected concentration for the area of concern ("B" qualified data not included).
"-" - Not Detected.
Shaded cell indicates value is greater than RBSC.
FD - Field duplicate.
FS - Field split.
µg/L - Parts per billion.
WWTP3 - Waste Water Treatment Plant 3.

Validation Qualifiers (VQ)

J - The analyte was positively identified; the reported value is estimated.
B - Analyte was not detected significantly above the levels found in the associated method blank or field blanks.

Table 6-7

Detections Above RBSCs in Sediment Samples - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

			LOCATION CODE	WWTP3-SD01		WWTP3-SD01		WWTP3-SD01		WWTP3-SD02		WWTP3-SD03	
			SAMPLE NO	WW1004		WW1005		WW1006		WW1007		WW1008	
			SAMPLE DATE	23-May-09		23-May-09		23-May-09		23-May-09		23-May-09	
			DEPTH	0 - 0.5 Ft		0 - 0.5 Ft		0 - 0.5 Ft		0 - 0.5 Ft		0 - 0.5 Ft	
			SAMPLE PURPOSE	REG		FD		FS		REG		REG	
Parameter	Units	RBSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
SEMIVOLATILES													
Benzo(a)pyrene	mg/kg	0.015	0.12									0.12	J
Benzo(b)fluoranthene	mg/kg	0.15	0.191									0.191	J
Benzo(ghi)perylene	mg/kg	NE	0.105									0.105	J
Chrysene	mg/kg	15	0.103									0.103	J
Fluoranthene	mg/kg	2,300	0.156									0.156	J
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	0.11									0.11	J
Pyrene	mg/kg	1,700	0.138									0.138	J
METALS													
Aluminum	mg/kg	77,000	9000									9,000	
Arsenic	mg/kg	0.39	6.8									6.8	
Barium	mg/kg	15,000	82.5									82.5	
Beryllium	mg/kg	160	0.64									0.64	
Cadmium	mg/kg	70	0.86									0.86	
Calcium	mg/kg	NE	31300									31,300	
Chromium	mg/kg	0.29	15.1									15.1	
Cobalt	mg/kg	23	11.4									11.4	
Copper	mg/kg	3,100	26.4									26.4	
Iron	mg/kg	55,000	19300									19,300	
Lead	mg/kg	400	16.1									16.1	
Magnesium	mg/kg	NE	10400									10,400	
Manganese	mg/kg	1,800	1870									1,870	
Mercury	mg/kg	23	0.058									0.058	J
Nickel	mg/kg	1,500	23.7									23.7	
Potassium	mg/kg	NE	--									1,180	B
Selenium	mg/kg	390	2.8									2.8	J
Sodium	mg/kg	NE	172									172	J
Vanadium	mg/kg	390	24.3									24.3	
Zinc	mg/kg	23,000	71.9									71.9	
GENERAL CHEMISTRY													
Total organic carbon	mg/kg	NE	2.2									2.2	

FD - Field duplicate.
FS - Field split.
NE - Not established (RBSCs).
Shaded cell indicates value is greater than RBSC.
RBSC - Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC. RBSCs were derived from the May 2010 RSLs as described in Section 4.2.1 of the text.
MDC - Maximum detected concentration for the area of concern ("B"-qualified data not included).
Blank cell indicates that parameter was not analyzed.
mg/kg - Milligrams per kilogram.
WWTP3 - Waste Water Treatment Plant 3.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
B - Analyte was not detected significantly above the levels found in the associated method blank or field blanks.

Table 6-8

COPC Summary for Surface Soil - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg		COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Inorganics															
Aluminum	16 / 16	100	3.11E+03		9.47E+03		1.70E+00	2.40E+01	7.11E+03	1.55E+04	7700		N (b)		---
Antimony	6 / 16	38	2.75E-01	J	4.13E-01	J	4.24E-01	7.20E+00	2.05E+00	9.30E+00	3.1		N (b)		---
Arsenic	16 / 16	100	3.90E+00		2.08E+01		8.49E-01	1.20E+00	7.48E+00	3.65E+01	0.39		N (b)		---
Barium	16 / 16	100	2.97E+01		7.47E+01		1.74E-01	2.40E+01	5.31E+01	8.26E+02	1500		N (b)		---
Beryllium	9 / 16	56	5.90E-01		8.44E+00		1.70E-01	6.00E-01	2.74E+00	1.00E+00	16		N (a)		---
Cadmium	5 / 16	31	2.24E-01	J	3.64E-01	J	4.24E-01	6.00E-01	2.73E-01	NA	7		N (a)		---
Calcium	16 / 16	100	3.29E+03		6.07E+04		4.24E+00	6.00E+02	1.97E+04	5.23E+04	Nutrient		N (c)		---
Chromium	16 / 16	100	6.90E+00		1.49E+01		4.24E-01	1.20E+00	1.17E+01	2.90E+01	0.29		N (b)		---
Cobalt	14 / 16	88	3.97E+00	J	9.78E+00		1.70E-01	6.00E+00	6.16E+00	1.16E+02	2.3		N (b)		---
Copper	16 / 16	100	7.10E+00		2.45E+01		4.24E-01	3.00E+00	1.54E+01	5.62E+01	310		N (b)		---
Iron	16 / 16	100	1.02E+04	J	2.90E+04		1.70E+00	1.20E+01	1.62E+04	2.34E+05	5500		N (b)		---
Lead	16 / 16	100	9.60E+00		1.34E+02	J	3.10E-01	5.00E-01	3.11E+01	4.86E+01	400		N (a)		---
Magnesium	16 / 16	100	2.01E+03		8.75E+03	J	1.74E+00	6.00E+02	5.08E+03	1.04E+04	Nutrient		N (c)		---
Manganese	16 / 16	100	1.70E+02		6.06E+02		1.74E-01	1.80E+00	3.27E+02	3.51E+03	180		N (b)		---
Mercury	14 / 16	88	2.00E-02	J	5.97E-01		2.06E-02	4.00E-02	9.50E-02	8.50E-02	2.3		N (a)		---
Nickel	16 / 16	100	8.40E+00		2.41E+01		2.55E-01	4.80E+00	1.56E+01	5.51E+01	150		N (b)		---
Potassium	15 / 16	94	3.63E+02		9.36E+02		2.12E+01	6.00E+02	6.17E+02	3.39E+03	Nutrient		N (c)		---
Selenium	12 / 16	75	4.83E-01	J	1.10E+00		5.20E-01	1.00E+00	6.66E-01	2.00E+00	39		N (b)		---
Sodium	7 / 16	44	2.50E+01		6.46E+01		8.49E+00	6.00E+02	1.80E+02	NA	Nutrient		N (c)		---
Thallium	7 / 16	44	2.21E-01	J	1.10E+00		4.24E-01	1.20E+00	5.59E-01	1.30E+00	0.078		N (b)		---
Vanadium	16 / 16	100	1.38E+01		2.32E+01		1.70E-01	6.00E+00	1.91E+01	4.09E+01	39		N (b)		---
Zinc	16 / 16	100	3.38E+01		1.05E+02		2.10E+00	2.50E+00	5.77E+01	3.22E+02	2300		N (b)		---
Polychlorinated biphenyls (PCB)															
Aroclor 1016	2 / 9	22	1.40E-01	J	1.22E+00	J	4.02E-02	2.05E-01	2.12E-01		0.39		Y	7.64E-01	7.64E-01
Aroclor 1254	2 / 9	22	2.50E-01		1.00E+00	J	4.02E-02	2.05E-01	1.90E-01		0.11		Y	5.40E-01	5.40E-01
Aroclor 1260	2 / 9	22	1.80E-01	J	2.29E-01		4.02E-02	4.60E-01	1.22E-01		0.22		Y	2.04E-01	2.04E-01
Nitroaromatics															
Amino-2,6-dinitrotoluene, 4-	1 / 16	6	2.60E-01		2.60E-01		2.50E-01	3.11E-01	1.42E-01		15		N (a)		---
Amino-4,6-dinitrotoluene, 2-	1 / 16	6	2.28E-01	/U	2.28E-01	/U	2.50E-01	3.11E-01	1.40E-01		15		N (a)		---
Trinitrotoluene, 2,4,6-	1 / 16	6	8.80E-01		8.80E-01		2.50E-01	3.11E-01	1.81E-01		3.6		N (a)		---
Semivolatile Organic Compounds															
Acenaphthene	2 / 9	22	4.78E-01		6.43E-01	J	3.60E-01	2.00E+00	3.68E-01		340		N (a)		---
Acenaphthylene	5 / 9	56	5.41E-02	J	3.23E+00		3.60E-01	2.00E+00	6.97E-01		340	g	N (a)		---
Anthracene	5 / 9	56	5.04E-02	J	4.53E+00		3.60E-01	2.00E+00	1.06E+00		1700		N (a)		---
Benzo(a)anthracene	7 / 9	78	1.01E-01	J	1.19E+01		3.60E-01	2.00E+00	2.56E+00		0.15		Y	8.20E+00	8.20E+00
Benzo(a)pyrene	7 / 9	78	9.09E-02	J	1.00E+01		3.60E-01	2.00E+00	2.23E+00		0.015		Y	6.96E+00	6.96E+00
Benzo(b)fluoranthene	7 / 9	78	1.40E-01	J	1.39E+01		3.60E-01	2.00E+00	2.84E+00		0.15		Y	9.35E+00	9.35E+00
Benzo(ghi)perylene	6 / 9	67	1.78E-01	J	5.57E+00		3.60E-01	2.00E+00	1.35E+00		170	h	N (a)		---
Benzo(k)fluoranthene	6 / 9	67	1.27E-01	J	4.49E+00		3.60E-01	2.00E+00	1.28E+00		1.5		Y	2.21E+00	2.21E+00
Carbazole	2 / 7	29	4.32E-01		1.12E+00	J	4.00E-01	2.00E+00	4.81E-01		24	i	N (a)		---
Chrysene	7 / 9	78	9.25E-02	J	1.03E+01		3.60E-01	2.00E+00	2.29E+00		15		N (a)		---
Dibenz(a,h)anthracene	3 / 9	33	3.97E-01	J	1.46E+00	J	3.60E-01	2.00E+00	5.08E-01		0.015		Y	8.54E-01	8.54E-01
Dibenzofuran	2 / 9	22	4.36E-01		1.35E+00	J	3.60E-01	2.00E+00	4.42E-01		7.8		N (a)		---

Table 6-8

COPC Summary for Surface Soil - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Fluoranthene	7 / 9	78	1.87E-01	J	2.48E+01		3.60E-01	2.00E+00	5.06E+00		230	N (a)		---
Fluorene	3 / 9	33	5.81E-01		1.78E+00	J	3.60E-01	2.00E+00	5.52E-01		230	N (a)		---
Indeno(1,2,3-cd)pyrene	7 / 9	78	3.05E-01	J	8.10E+00		3.60E-01	2.00E+00	1.84E+00		0.15	Y	5.55E+00	5.55E+00
Methylnaphthalene, 2-	2 / 9	22	7.21E-01		1.57E+00	J	3.60E-01	2.00E+00	4.98E-01		23	N (a)		---
Naphthalene	2 / 9	22	6.77E-01		1.38E+00	J	3.60E-01	2.00E+00	4.72E-01		3.6	N (a)		---
Phenanthrene	7 / 9	78	6.77E-02	J	1.39E+01		3.60E-01	2.00E+00	2.79E+00		170 h	N (a)		---
Pyrene	7 / 9	78	1.57E-01	J	1.81E+01		3.60E-01	2.00E+00	3.93E+00		170	N (a)		---
Volatile Organic Compounds														
Methylene chloride	2 / 2	100	1.20E-02		1.30E-02		5.50E-03	6.00E-03	1.25E-02		36	N (a)		---

BSC - Background screening criterion.
COPC - Chemical of potential concern.
mg/kg - Milligrams per kilogram.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
/ - When in the VQ column, this separates two qualifiers where the concentration is the result of a sample averaged with a field duplicate.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.
U - The sample result was nondetect.

[a] IT Corporation, 2000, *TNT Area B Remedial Investigation, Volume II, Baseline Human Health Risk Assessment, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio* , August, and reports referenced therein.

[b] Risk-based screening concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (May 2012) residential soil values (unless otherwise no are based on a risk level of 1.0E-06 and a hazard index of 0.1.

[c] N = Chemical is not chosen as a COPC:

(a) = Maximum detected concentration is less than the RBSC.

(b) = Maximum detected concentration is less than the BSC.

(c) = Essential nutrient.

[d] Y = Chemical is chosen as a COPC.

[e] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.00.05 (EPA, 2010, ProUCL Version 4.00.05, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm).

[f] Exposure-point concentration (EPC) used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower.

[g] RBSC based on acenaphthene.

[h] RBSC based on pyrene.

[i] Because no RSL is available, the RBSC is based on the PRG (EPA, 2004). Note that the slope factor used for the PRG is the most current available.

Table 6-9

COPC Summary for Subsurface Soil - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg		COPC? [c,d]
Inorganics													
Aluminum	14 / 14	100	6.65E+03		1.05E+04		1.76E+00	2.05E+00	8.20E+03	1.55E+04	7700		N (b)
Antimony	14 / 14	100	2.61E-01	J	4.36E-01	J	4.40E-01	5.12E-01	3.35E-01	9.30E+00	3.1		N (b)
Arsenic	14 / 14	100	4.35E+00		1.56E+01		8.79E-01	1.02E+00	7.14E+00	3.65E+01	0.39		N (b)
Barium	14 / 14	100	4.13E+01		1.97E+02		1.77E-01	4.10E-01	6.56E+01	8.26E+02	1500		N (b)
Beryllium	14 / 14	100	4.72E+00	J	8.08E+00		1.76E-01	2.05E-01	6.14E+00	1.00E+00	16		N (a)
Cadmium	9 / 14	64	2.38E-01	U/J	1.01E+00		4.40E-01	5.12E-01	3.19E-01	NA	7		N (a)
Calcium	14 / 14	100	3.71E+03		5.08E+04	J	4.40E+00	5.12E+00	3.17E+04	5.23E+04	Nutrient		N (c)
Chromium	14 / 14	100	9.49E+00		1.78E+01		4.40E-01	5.12E-01	1.26E+01	2.90E+01	0.29		N (b)
Cobalt	14 / 14	100	5.69E+00	J	2.21E+01		1.76E-01	2.05E-01	9.41E+00	1.16E+02	2.3		N (b)
Copper	14 / 14	100	1.29E+01		2.94E+01		4.40E-01	5.12E-01	2.29E+01	5.62E+01	310		N (b)
Iron	14 / 14	100	1.30E+04	J	2.80E+04		1.76E+00	3.58E+00	1.95E+04	2.34E+05	5500		N (b)
Lead	14 / 14	100	9.86E+00		8.29E+01	J	4.40E-01	5.12E-01	1.95E+01	4.86E+01	400		N (a)
Magnesium	14 / 14	100	3.56E+03	J/J	1.90E+04	J	1.77E+00	4.10E+00	1.17E+04	1.04E+04	Nutrient		N (c)
Manganese	14 / 14	100	2.41E+02	J	2.52E+03		1.77E-01	4.10E-01	5.89E+02	3.51E+03	180		N (b)
Mercury	14 / 14	100	1.63E-02	J	1.80E-01	J	2.08E-02	2.51E-02	3.37E-02	8.50E-02	2.3		N (a)
Nickel	14 / 14	100	1.35E+01	J	5.71E+01		2.64E-01	3.07E-01	2.48E+01	5.51E+01	150		N (a)
Potassium	14 / 14	100	3.21E+02		1.09E+03		2.20E+01	2.56E+01	7.20E+02	3.39E+03	Nutrient		N (c)
Selenium	3 / 14	21	4.65E-01	U/J	5.07E-01	J	8.79E-01	1.02E+00	4.71E-01	2.00E+00	39		N (b)
Sodium	14 / 14	100	4.89E+01		1.78E+02		8.79E+00	1.02E+01	1.07E+02	NA	Nutrient		N (c)
Thallium	9 / 14	64	2.31E-01	U/J	2.92E-01	J	4.40E-01	5.12E-01	2.51E-01	1.30E+00	0.078		N (b)
Vanadium	14 / 14	100	1.82E+01		2.85E+01		1.76E-01	2.05E-01	2.15E+01	4.09E+01	39		N (b)
Zinc	14 / 14	100	4.39E+01		7.85E+01		2.20E+00	2.56E+00	5.95E+01	3.22E+02	2300		N (b)
Polychlorinated biphenyls (PCB)													
Aroclor 1016	1 / 7	14	1.00E-01	J	1.00E-01	J	3.99E-02	2.04E-01	7.75E-02		0.39		N (a)
Aroclor 1260	1 / 7	14	6.67E-02	J	6.67E-02	J	3.99E-02	2.04E-01	6.10E-02		0.22		N (a)
Semivolatile Organic Compounds													
Acenaphthene	1 / 14	7	5.92E-02	J	5.92E-02	J	3.92E-01	4.20E-01	1.94E-01		340		N (a)
Acenaphthylene	2 / 14	14	5.77E-02	J	7.88E-02	J	3.92E-01	4.20E-01	1.85E-01		340	g	N (a)
Anthracene	3 / 14	21	6.17E-02	J	2.63E-01	J	3.92E-01	4.20E-01	1.95E-01		1700		N (a)
Benzo(a)anthracene	4 / 14	29	3.98E-02	J	3.09E-01	J	3.92E-01	4.20E-01	2.05E-01		0.15		Y
Benzo(a)pyrene	3 / 14	21	1.96E-01	J/U	3.06E-01	J	3.92E-01	4.20E-01	2.12E-01		0.015		Y
Benzo(b)fluoranthene	3 / 14	21	2.53E-01	J/U	4.09E-01		3.92E-01	4.20E-01	2.30E-01		0.15		Y
Benzo(ghi)perylene	3 / 14	21	1.20E-01	J	1.80E-01	J	3.92E-01	4.20E-01	1.94E-01		170	h	N (a)
Benzo(k)fluoranthene	1 / 14	7	1.36E-01	J	1.36E-01	J	3.92E-01	4.20E-01	1.99E-01		1.5		N (a)
Bis(2-ethylhexyl)phthalate	1 / 14	7	1.21E-01	U/J	1.21E-01	U/J	3.92E-01	4.20E-01	1.98E-01		35		N (a)
Carbazole	1 / 14	7	4.43E-02	J	4.43E-02	J	3.92E-01	4.20E-01	1.93E-01		24	i	N (a)
Chrysene	3 / 14	21	2.21E-01	J/U	2.76E-01	J	3.92E-01	4.20E-01	2.13E-01		15		N (a)
Dibenzofuran	1 / 14	7	7.80E-02	J	7.80E-02	J	3.92E-01	4.20E-01	1.95E-01		7.8		N (a)

Table 6-9

COPC Summary for Subsurface Soil - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg		COPC? [c,d]
Fluoranthene	4 / 14	29	5.05E-02	J	8.16E-01		3.92E-01	4.20E-01	2.65E-01		230		N (a)
Fluorene	1 / 14	7	1.14E-01	J	1.14E-01	J	3.92E-01	4.20E-01	1.98E-01		230		N (a)
Indeno(1,2,3-cd)pyrene	3 / 14	21	2.84E-01	J/U	4.36E-01		3.92E-01	4.20E-01	2.40E-01		0.15		Y
Phenanthrene	3 / 14	21	2.75E-01	J/U	8.45E-01		3.92E-01	4.20E-01	2.62E-01		170	h	N (a)
Pyrene	4 / 14	29	4.06E-02	J	5.84E-01		3.92E-01	4.20E-01	2.37E-01		170		N (a)

BSC - Background screening concentration.
COPC - Chemical of potential concern.
mg/kg - Milligrams per kilogram.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
/ - When in the VQ column, this separates two qualifiers where the concentration is the result of a sample averaged with a field duplicate.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.
U - The sample result was nondetect.

[a] IT Corporation, 2000, *TNT Area B Remedial Investigation, Volume II, Baseline Human Health Risk Assessment, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio* , August, and reports referenced therein.
[b] Risk-based screening concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (May 2012) residential soil values (unless are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[c] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
[d] Y = Chemical is chosen as a COPC.
[e] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.00.05 EPA, 2010, ProUCL Version 4.00.05, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm).
[f] Exposure-point concentration (EPC) used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower.
[g] RBSC based on acenaphthene.
[h] RBSC based on pyrene.
[i] Because no RSL is available, the RBSC is based on the PRG (EPA, 2004). Note that the slope factor used for the PRG is the most current available.

Table 6-10

COPC Summary for Total Soil - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Inorganics														
Aluminum	30 / 30	100	3.11E+03		1.05E+04		1.70E+00	2.40E+01	7.62E+03	1.55E+04	7700	N (b)		---
Antimony	20 / 30	67	2.61E-01	J	4.36E-01	J	4.24E-01	7.20E+00	1.25E+00	9.30E+00	3.1	N (b)		---
Arsenic	30 / 30	100	3.90E+00		2.08E+01		8.49E-01	1.20E+00	7.32E+00	3.65E+01	0.39	N (b)		---
Barium	30 / 30	100	2.97E+01		1.97E+02		1.74E-01	2.40E+01	5.90E+01	8.26E+02	1500	N (b)		---
Beryllium	23 / 30	77	5.90E-01		8.44E+00		1.70E-01	6.00E-01	4.33E+00	1.00E+00	16	N (a)		---
Cadmium	14 / 30	47	2.24E-01	J	1.01E+00		4.24E-01	6.00E-01	2.94E-01	NA	7	N (a)		---
Calcium	30 / 30	100	3.29E+03		6.07E+04		4.24E+00	6.00E+02	2.53E+04	5.23E+04	Nutrient	N (c)		---
Chromium	30 / 30	100	6.90E+00		1.78E+01		4.24E-01	1.20E+00	1.21E+01	2.90E+01	0.29	N (b)		---
Cobalt	28 / 30	93	3.97E+00	J	2.21E+01		1.70E-01	6.00E+00	7.67E+00	1.16E+02	2.3	N (b)		---
Copper	30 / 30	100	7.10E+00		2.94E+01		4.24E-01	3.00E+00	1.89E+01	5.62E+01	310	N (b)		---
Iron	30 / 30	100	1.02E+04	J	2.90E+04		1.70E+00	1.20E+01	1.78E+04	2.34E+05	5500	N (b)		---
Lead	30 / 30	100	9.60E+00		1.34E+02	J	3.10E-01	5.12E-01	2.57E+01	4.86E+01	400	N (a)		---
Magnesium	30 / 30	100	2.01E+03		1.90E+04	J	1.74E+00	6.00E+02	8.17E+03	1.04E+04	Nutrient	N (c)		---
Manganese	30 / 30	100	1.70E+02		2.52E+03		1.74E-01	1.80E+00	4.49E+02	3.51E+03	180	N (b)		---
Mercury	28 / 30	93	1.63E-02	J	5.97E-01		2.06E-02	4.00E-02	6.64E-02	8.50E-02	2.3	N (a)		---
Nickel	30 / 30	100	8.40E+00		5.71E+01		2.55E-01	4.80E+00	1.99E+01	5.51E+01	150	N (a)		---
Potassium	29 / 30	97	3.21E+02		1.09E+03		2.12E+01	6.00E+02	6.65E+02	3.39E+03	Nutrient	N (c)		---
Selenium	15 / 30	50	4.65E-01	U/J	1.10E+00		5.20E-01	1.02E+00	5.75E-01	2.00E+00	39	N (b)		---
Sodium	21 / 30	70	2.50E+01		1.78E+02		8.49E+00	6.00E+02	1.46E+02	NA	Nutrient	N (c)		---
Thallium	16 / 30	53	2.21E-01	J	1.10E+00		4.24E-01	1.20E+00	4.15E-01	1.30E+00	0.078	N (b)		---
Vanadium	30 / 30	100	1.38E+01		2.85E+01		1.70E-01	6.00E+00	2.02E+01	4.09E+01	39	N (b)		---
Zinc	30 / 30	100	3.38E+01		1.05E+02		2.10E+00	2.56E+00	5.85E+01	3.22E+02	2300	N (b)		---
Polychlorinated biphenyls (PCB)														
Aroclor 1016	3 / 16	19	1.00E-01	J	1.22E+00	J	3.99E-02	2.05E-01	1.53E-01		0.39	Y	3.21E-01	3.21E-01
Aroclor 1254	2 / 16	13	2.50E-01		1.00E+00	J	3.99E-02	2.05E-01	1.36E-01		0.11	Y	4.09E-01	4.09E-01
Aroclor 1260	3 / 16	19	6.67E-02	J	2.29E-01		3.99E-02	4.60E-01	9.52E-02		0.22	Y	1.30E-01	1.30E-01
Nitroaromatics														
Amino-2,6-dinitrotoluene, 4-	1 / 30	3	2.60E-01		2.60E-01		2.50E-01	3.14E-01	1.44E-01		15	N (a)		---
Amino-4,6-dinitrotoluene, 2-	1 / 30	3	2.28E-01	/U	2.28E-01	/U	2.50E-01	3.14E-01	1.43E-01		15	N (a)		---
Trinitrotoluene, 2,4,6-	1 / 30	3	8.80E-01		8.80E-01		2.50E-01	3.14E-01	1.65E-01		3.6	N (a)		---
Semivolatile Organic Compounds														
Acenaphthene	3 / 23	13	5.92E-02	J	6.43E-01	J	3.60E-01	2.00E+00	2.62E-01		340	N (a)		---
Acenaphthylene	7 / 23	30	5.41E-02	J	3.23E+00		3.60E-01	2.00E+00	3.86E-01		340 [g]	N (a)		---
Anthracene	8 / 23	35	5.04E-02	J	4.53E+00		3.60E-01	2.00E+00	5.34E-01		1700	N (a)		---
Benzo(a)anthracene	11 / 23	48	3.98E-02	J	1.19E+01		3.60E-01	2.00E+00	1.13E+00		0.15	Y	2.05E+00	2.05E+00
Benzo(a)pyrene	10 / 23	43	9.09E-02	J	1.00E+01		3.60E-01	2.00E+00	1.00E+00		0.015	Y	1.78E+00	1.78E+00
Benzo(b)fluoranthene	10 / 23	43	1.40E-01	J	1.39E+01		3.60E-01	2.00E+00	1.25E+00		0.15	Y	2.34E+00	2.34E+00
Benzo(ghi)perylene	9 / 23	39	1.20E-01	J	5.57E+00		3.60E-01	2.00E+00	6.44E-01		170 [h]	N (a)		---
Benzo(k)fluoranthene	7 / 23	30	1.27E-01	J	4.49E+00		3.60E-01	2.00E+00	6.21E-01		1.5	Y	1.13E+00	1.13E+00
Bis(2-ethylhexyl)phthalate	1 / 23	4	1.21E-01	U/J	1.21E-01	U/J	3.60E-01	2.00E+00	2.68E-01		35	N (a)		---
Carbazole	3 / 21	14	4.43E-02	J	1.12E+00	J	3.92E-01	2.00E+00	2.89E-01		24 [i]	N (a)		---
Chrysene	10 / 23	43	9.25E-02	J	1.03E+01		3.60E-01	2.00E+00	1.03E+00		15	N (a)		---
Dibenz(a,h)anthracene	3 / 23	13	3.97E-01	J	1.46E+00	J	3.60E-01	2.00E+00	3.23E-01		0.015	Y	5.62E-01	5.62E-01
Dibenzofuran	3 / 23	13	7.80E-02	J	1.35E+00	J	3.60E-01	2.00E+00	2.92E-01		7.8	N (a)		---

Table 6-10

COPC Summary for Total Soil - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]	95% UCL [e] mg/kg	EPC [f] mg/kg
Fluoranthene	11 / 23	48	5.05E-02	J	2.48E+01		3.60E-01	2.00E+00	2.14E+00		230	N (a)		---
Fluorene	4 / 23	17	1.14E-01	J	1.78E+00	J	3.60E-01	2.00E+00	3.36E-01		230	N (a)		---
Indeno(1,2,3-cd)pyrene	10 / 23	43	2.84E-01	J/U	8.10E+00		3.60E-01	2.00E+00	8.68E-01		0.15	Y	1.53E+00	1.53E+00
Methylnaphthalene, 2-	2 / 23	9	7.21E-01		1.57E+00	J	3.60E-01	2.00E+00	3.19E-01		23	N (a)		---
Naphthalene	2 / 25	8	6.77E-01		1.38E+00	J	5.50E-03	2.00E+00	2.84E-01		3.6	N (a)		---
Phenanthrene	10 / 23	43	6.77E-02	J	1.39E+01		3.60E-01	2.00E+00	1.25E+00		170 [h]	N (a)		---
Pyrene	11 / 23	48	4.06E-02	J	1.81E+01		3.60E-01	2.00E+00	1.68E+00		170	N (a)		---
Volatile Organic Compounds														
Methylene chloride	2 / 2	100	1.20E-02		1.30E-02		5.50E-03	6.00E-03	1.25E-02		36	N (a)		---

BSC - Background screening concentration.
COPC - Chemical of potential concern.
mg/kg - Milligrams per kilogram.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
/ - When in the VQ column, this separates two qualifiers where the concentration is the result of a sample averaged with a field duplicate.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.
U - The sample result was nondetect.

[a] IT Corporation, 2000, *TNT Area B Remedial Investigation, Volume II, Baseline Human Health Risk Assessment, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio* , August, and reports referenced therein.
[b] Risk-based screening concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (May 2012) residential soil values (unless otherwise noted), an are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[c] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
[d] Y = Chemical is chosen as a COPC.
[e] 95% UCL (upper confidence limit) determined using ProUCL Version 4.00.05 (EPA, 2010, ProUCL Version 4.00.05, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm).
[f] Exposure-point concentration (EPC) used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower.
[g] RBSC based on acenaphthene.
[h] RBSC based on pyrene.
[i] Because no RSL is available, the RBSC is based on the PRG (EPA, 2004). Note that the slope factor used for the PRG is the most current available.

Table 6-11

COPC Summary for Bedrock Groundwater - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent hits	Range of values, µg/L: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Arithmetic Mean µg/L	BSC [a] µg/L	RBSC [b] µg/L	COPC? [c,d]	95% UCL [e] µg/L	EPC [f] µg/L
Inorganics - Unfiltered														
Aluminum	4 / 4 [g]	100	3.19E+01	JJ	1.25E+02	J	2.00E+02	2.00E+02	8.18E+01	3.09E+02	1600	N (a)		---
Arsenic	3 / 6	50	2.08E+01		1.23E+02		1.00E+01	1.00E+01	3.09E+01	7.40E+00	0.045	Y	7.68E+01	7.68E+01
Barium	6 / 6	100	2.40E+02		7.66E+02		2.00E+02	2.00E+02	4.37E+02	1.18E+04	290	N (b)		---
Calcium	6 / 6	100	8.46E+04	J	1.50E+05		1.00E+03	1.00E+03	1.15E+05	3.16E+05	Nutrient	N (c)		---
Iron	1 / 6	17	2.96E+02	J	2.96E+02	J	3.00E+02	3.00E+02	1.74E+02	1.55E+03	1100	N (a)		---
Lead	2 6	33	3.30E+00	J	3.65E+00	U/J	1.00E+01	1.00E+01	4.49E+00	NA	15 [h]	N (a)		---
Magnesium	6 / 6	100	5.71E+04		8.64E+04		5.00E+03	5.00E+03	7.25E+04	2.17E+05	Nutrient	N (c)		---
Manganese	6 / 6	100	1.35E+01	J	6.63E+02		1.50E+01	1.50E+01	1.70E+02	6.36E+02	32	Y	NA	6.63E+02
Potassium	6 / 6	100	2.48E+04		4.73E+04		1.00E+04	2.00E+04	4.03E+04	1.16E+05	Nutrient	N (c)		---
Selenium	3 / 6	50	4.20E+00	J/U	4.70E+00	J	1.00E+01	1.00E+01	4.72E+00	NA	7.8	N (a)		---
Sodium	6 / 6	100	1.07E+05		2.70E+05		5.00E+04	1.00E+05	2.18E+05	1.39E+06	Nutrient	N (c)		---
Vanadium	6 / 6	100	1.10E+00	J	1.31E+01	U/J	5.00E+01	5.00E+01	3.55E+00	NA	7.8	Y	1.19E+01	1.19E+01
Zinc	1 / 3 [g]	33	8.90E+00	J	8.90E+00	J	2.00E+01	2.00E+01	9.63E+00	5.01E+02	470	N (a)		---
Semivolatile Organic Compounds														
Methylnaphthalene, 2-	5 / 6	83	1.10E+00	J	2.80E+00	J	4.80E+00	5.00E+00	2.03E+00		2.7	Y	2.51E+00	2.51E+00
Naphthalene	4 / 6	67	1.10E+00	J	2.05E+00	J/U	4.80E+00	5.00E+00	1.83E+00		0.14	Y	1.98E+00	1.98E+00
Volatile Organic Compounds														
Benzene	6 / 6	100	2.10E+00		1.54E+01		1.00E+00	2.00E+00	6.15E+00		0.39	Y	1.03E+01	1.03E+01
Butanone, 2-	4 / 6	67	6.35E+00	/U	1.44E+01		5.00E+00	1.00E+01	8.03E+00		490	N (a)		---
Ethylbenzene	6 / 6	100	1.20E+00		4.60E+00		1.00E+00	2.00E+00	2.96E+00		1.3	Y	4.08E+00	4.08E+00
Toluene	6 / 6	100	2.70E+00		1.64E+01	J	1.00E+00	1.00E+00	1.02E+01		86	N (a)		---
Xylenes, total	6 / 6	100	7.70E+00		3.46E+01		3.00E+00	6.00E+00	2.08E+01		19	Y	2.97E+01	2.97E+01
General Chemistry														
Chloride	6 / 6	100	2.38E+04		1.63E+05		2.00E+03	2.00E+04	1.27E+05		Nutrient	N (c)		---
Cyanide, total	3 / 6	50	2.90E+01		5.30E+01		1.00E+01	1.00E+01	2.36E+01		0.93	Y	4.53E+01	4.53E+01
Nitrate-Nitrite	4 / 6	67	8.60E+01	J	8.10E+02	J	1.00E+02	4.00E+03	6.93E+02		1000 [i]	N (a)		---
Sulfate	4 / 6	67	4.20E+03	J	4.05E+04		2.00E+03	2.00E+04	1.57E+04		250,000 [j]	N (a)		---

BSC - Background screening concentration.
COPC - Chemical of potential concern.
RBSC - Risk-based screening concentration.
µg/L - Micrograms per liter.
VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed
/ - Indicates result is from two samples, regular and field duplicate, averaged and reflects both qualifiers.

[a] Shaw Environmental, Inc. (Shaw), 2005, *2004 Groundwater Data Summary and Evaluation Report, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio* , April.
[b] Risk-based screening concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (April 2012) tap water values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[c] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.

Table 6-11

COPC Summary for Bedrock Groundwater - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

[d] Y = Chemical is chosen as COPC.
[e] 95% UCL (upper confidence limit) determined using ProUCL Version 4.1 (EPA, 2011, ProUCL Version 4.1, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm).
[f] Concentration used in risk assessment equal to 95% upper confidence limit or maximum detected concentration, whichever is lower.
[g] Some samples were excluded from the data set because of blank contamination.
[h] Screening criteria for lead based on the action level of 15 µg/L (EPA, 1996, *Drinking Water Regulations and Health Advisories*, Office of Water, Washington, DC, October).
[i] Because no Regional Screening Level exists for nitrate-nitrite, 0.1 X the nitrate-nitrite maximum contaminant level (10 milligrams per liter) is used for screening.
[j] US Environmental Protection Agency (EPA), 2012, 2012 *Edition of the Drinking Water Standards and Health Advisories*, Office of Water, October, April, EPA 822-S-12-001.

Table 6-12

COPC Summary for Overburden Monitoring Well Groundwater - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent hits	Range of values, µg/L: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Arithmetic Mean µg/L	RBSC [a] µg/L	COPC? [b,c]	95% UCL [d] µg/L
Inorganics-Unfiltered												
Aluminum	6 / 6	100	8.76E+01	J	1.19E+03		2.00E+02	2.00E+02	2.78E+02	1600	N (a)	
Arsenic	3 / 6	50	1.04E+01		1.58E+01		1.00E+01	1.00E+01	8.60E+00	0.045	Y	1.33E+01
Barium	6 / 6	100	1.62E+02	J	4.11E+02		2.00E+02	2.00E+02	2.42E+02	290	Y	3.19E+02
Calcium	6 / 6	100	8.69E+04	J	1.23E+05		1.00E+03	1.00E+03	1.07E+05	Nutrient	N (b)	
Chromium	1 / 6	17	2.90E+00	J	2.90E+00	J	1.00E+01	1.00E+01	4.65E+00	0.031	Y	NA
Cobalt	2 / 6	33	1.40E+00	J	3.00E+00	J	5.00E+01	5.00E+01	1.74E+01	0.47	Y	NA
Iron	3 / 6	50	5.99E+01	J	2.87E+03		3.00E+02	3.00E+02	5.85E+02	1100	Y	1.60E+03
Magnesium	6 / 6	100	3.44E+04		4.45E+04		5.00E+03	5.00E+03	3.95E+04	Nutrient	N (b)	
Manganese	6 / 6	100	3.00E+01		5.21E+02		1.50E+01	1.50E+01	3.01E+02	32	Y	4.76E+02
Mercury	1 / 6	17	2.10E-01	J	2.10E-01	J	1.00E+00	1.00E+00	4.52E-01	0.43	N (a)	
Nickel	5 / 6	83	2.30E+00	J	4.50E+00	J	4.00E+01	4.00E+01	5.93E+00	30	N (a)	
Potassium	6 / 6	100	1.76E+03	J	4.85E+03	J	1.00E+04	2.00E+04	3.02E+03	Nutrient	N (b)	
Selenium	3 / 6	50	3.40E+00	J	5.20E+00	J	1.00E+01	1.00E+01	4.68E+00	7.8	N (a)	
Sodium	6 / 6	100	1.70E+04		2.80E+04		1.00E+04	1.00E+04	2.30E+04	Nutrient	N (b)	
Vanadium	3 / 6	50	9.00E-01	J	2.50E+00	J	5.00E+01	5.00E+01	1.32E+01	7.8	N (a)	
Zinc	1 / 4 [f]	25	1.31E+01	J	1.31E+01	J	2.00E+01	2.00E+01	1.08E+01	470	N (a)	
Nitroaromatics												
Dinitrobenzene, 1,3-	2 / 6	33	1.30E-01	J	1.50E-01	J	1.90E-01	2.00E-01	1.11E-01	0.15	Y	1.50E-01
Dinitrotoluene, 2,4-	2 / 6	33	1.60E-01	J	1.90E-01	J	1.90E-01	2.00E-01	1.23E-01	0.092	Y	1.81E-01
Trinitrobenzene, 1,3,5-	2 / 6	33	1.40E-01	J	2.90E-01		1.90E-01	2.00E-01	1.36E-01	46	N (a)	
General Chemistry												
Chloride	6 / 6	100	7.20E+03		2.06E+04		2.00E+03	2.00E+03	1.27E+04	Nutrient	N (b)	
Cyanide, total	2 / 6	33	1.30E+01		2.30E+01		1.00E+01	1.00E+01	9.33E+00	0.93	Y	1.90E+01
Nitrate-Nitrite	3 / 6	50	2.40E+02		3.50E+02		1.00E+02	2.00E+03	3.35E+02	1000 [g]	N (a)	
Sulfate	6 / 6	100	3.73E+04	J	8.36E+04	J	2.00E+03	2.00E+03	6.27E+04	250,000 [h]	N (a)	

µg/L - Micrograms per liter.
COPC - Chemical of potential concern.
NA - Not applicable; UCL is not calculated due to low frequency of detection and elevated reporting limits.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.

[a] Risk-based screening concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (May 2012) tap water values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[b] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.

Table 6-12

COPC Summary for Overburden Monitoring Well Groundwater - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

(b) = Essential nutrient.
[c] Y = Chemical is chosen as COPC.
[d] 95% UCL (upper confidence limit) determined using ProUCL Version 4.00.05 (EPA, 2010, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm). Calculated only for COPC.
[e] Concentration used in risk assessment equal to 95% upper confidence limit or maximum detected concentration, whichever is lower.
[f] Some samples were excluded from the data set because of blank contamination.
[g] Because no regional screening level exists for nitrate-nitrite, 0.1 X the nitrate-nitrite maximum contaminant level (10 milligrams per liter) is used for screening.
[h] U.S. Environmental Protection Agency (EPA), 2012, *2012 Edition of the Drinking Water Standards and Health Advisories, Office of Water, April* , EPA 822-S-12-001.

Table 6-13

COPC Summary for Sediment - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	RBSC [a] mg/kg	COPC? [b,c]	EPC [d] mg/kg
Inorganics												
Aluminum	3 / 3	100	8.41E+03		9.58E+03		2.10E+01	2.54E+01	9.00E+03	7.70E+04	N (a)	---
Arsenic	3 / 3	100	6.40E+00		7.20E+00		8.50E-01	1.30E+00	6.80E+00	3.90E-01	Y	7.20E+00
Barium	3 / 3	100	5.86E+01		8.25E+01		2.10E+01	2.54E+01	6.91E+01	1.50E+04	N (a)	---
Beryllium	1 / 3	33	6.40E-01		6.40E-01		5.30E-01	6.30E-01	4.20E-01	1.60E+02	N (a)	---
Cadmium	1 / 3	33	8.60E-01		8.60E-01		4.20E-01	6.30E-01	4.93E-01	7.00E+01	N (a)	---
Calcium	3 / 3	100	7.24E+03		3.30E+04		5.30E+02	6.35E+02	2.38E+04	Nutrient	N (b)	---
Chromium	3 / 3	100	1.41E+01		1.51E+01		1.10E+00	1.30E+00	1.45E+01	2.90E-01	Y	1.51E+01
Cobalt	3 / 3	100	7.10E+00		1.14E+01		5.30E+00	6.30E+00	8.90E+00	2.30E+01	N (a)	---
Copper	3 / 3	100	1.79E+01		2.64E+01		2.60E+00	3.20E+00	2.11E+01	3.10E+03	N (a)	---
Iron	3 / 3	100	1.83E+04		1.93E+04		1.10E+01	1.27E+01	1.87E+04	5.50E+04	N (a)	---
Lead	3 / 3	100	9.40E+00		1.86E+01		3.60E-01	1.10E+01	1.47E+01	4.00E+02	N (a)	---
Magnesium	3 / 3	100	3.78E+03		1.10E+04		5.30E+02	6.35E+02	8.39E+03	Nutrient	N (b)	---
Manganese	3 / 3	100	1.42E+02		1.87E+03		1.80E+00	1.60E+01	8.01E+02	1.80E+03	Y	1.87E+03
Mercury	2 / 3	67	4.70E-02		5.80E-02	J	4.00E-02	1.80E-01	4.17E-02	2.30E+01	N (a)	---
Nickel	3 / 3	100	1.91E+01		2.37E+01		4.20E+00	5.10E+00	2.11E+01	1.50E+03	N (a)	---
Potassium	2 / 2	100	8.77E+02		9.98E+02		6.05E+02	6.35E+02	9.38E+02	Nutrient	N (b)	---
Selenium	3 / 3	100	7.10E-01		2.80E+00	J	6.10E-01	1.10E+01	1.50E+00	3.90E+02	N (a)	---
Sodium	1 / 3	33	1.72E+02	J	1.72E+02	J	6.05E+02	2.20E+03	2.64E+02	Nutrient	N (b)	---
Thallium	1 / 3	33	1.20E+00		1.20E+00		1.20E+00	4.40E+00	1.35E+00	7.80E-01	Y	1.20E+00
Vanadium	3 / 3	100	2.20E+01		2.45E+01		5.30E+00	6.30E+00	2.36E+01	3.90E+02	N (a)	---
Zinc	3 / 3	100	5.26E+01		7.19E+01		2.10E+00	2.50E+00	6.32E+01	2.30E+04	N (a)	---
Semivolatile Organic Compounds												
Benzo(a)pyrene	1 / 3	33	1.20E-01	J	1.20E-01	J	3.50E-01	4.20E-01	1.77E-01	1.50E-02	Y	1.20E-01
Benzo(b)fluoranthene	1 / 3	33	1.91E-01	J	1.91E-01	J	3.50E-01	4.20E-01	2.00E-01	1.50E-01	Y	1.91E-01
Benzo(ghi)perylene	1 / 3	33	1.05E-01	J	1.05E-01	J	3.50E-01	4.20E-01	1.72E-01	1.70E+03 e	N (a)	---
Chrysene	1 / 3	33	1.03E-01	J	1.03E-01	J	3.50E-01	4.20E-01	1.71E-01	1.50E+01	N (a)	---
Fluoranthene	1 / 3	33	1.56E-01	J	1.56E-01	J	3.50E-01	4.20E-01	1.89E-01	2.30E+03	N (a)	---
Indeno(1,2,3-cd)pyrene	1 / 3	33	1.10E-01	J	1.10E-01	J	3.50E-01	4.20E-01	1.73E-01	1.50E-01	N (a)	---
Pyrene	1 / 3	33	1.38E-01	J	1.38E-01	J	3.50E-01	4.20E-01	1.83E-01	1.70E+03	N (a)	---

RBSC - Risk-based screening concentration.
COPC - Chemical of potential concern.
mg/kg - Milligrams per kilogram.

Table 6-13

COPC Summary for Sediment - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.

[a] Risk-based screening concentrations based on EPA Regional Screening Level Table (May 2012) residential soil and are based on a risk level of 1.0E-06 and a hazard index of 1.
[b] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Essential nutrient.
[c] Y = Chemical is chosen as a COPC.
[d] Exposure-point concentration (EPC) used in risk assessment equal to maximum detected concentration.
[e] RBSC based on pyrene.

Table 6-14

COPC Summary for Surface Water - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent hits	Range of values, µg/L: Detected Conc Minimum	VQ	Detected Conc Maximum	VQ	Reporting Limits Minimum	Reporting Limits Maximum	Arithmetic Mean µg/L	RBSC [a] µg/L		COPC? [b,c]	EPC [d] µg/L
Metals													
Aluminum	3 / 3	100	1420		3590	J/J	200	200	2.22E+03	1.60E+04		N (a)	---
Arsenic	2 / 3	67	6.1	J	7.2	J/U	10	10	6.10E+00	4.50E-02		Y	7.20E+00
Barium	3 / 3	100	47	J	105	J/J	200	200	7.25E+01	2.90E+03		N (a)	---
Calcium	3 / 3	100	91200		119500		1000	1000	1.07E+05	Nutrient		N (b)	---
Chromium	3 / 3	100	2.1	J	5.65	J/J	10	10	3.42E+00	3.10E-02		Y	5.65E+00
Cobalt	3 / 3	100	1.6	J	5.95	J/J	50	50	3.22E+00	4.70E+00		Y	5.95E+00
Copper	2 / 3	67	6.9	J	8.4	J/J	25	25	9.27E+00	6.20E+02		N (a)	---
Iron	3 / 3	100	2440		11300		300	300	5.98E+03	1.10E+04		Y	1.13E+04
Lead	3 / 3	100	2.2	J	7.2		5	5	4.63E+00	1.50E+01	e	N (a)	---
Magnesium	3 / 3	100	23600		29300		5000	5000	2.57E+04	Nutrient		N (b)	---
Manganese	3 / 3	100	134		1980		15	15	9.67E+02	3.20E+02		Y	1.98E+03
Nickel	1 / 3	33	4.1	J/J	4.1	J/J	40	40	1.47E+01	3.00E+02		N (a)	---
Potassium	3 / 3	100	703	J	1465	J/J	20000	20000	9.81E+02	Nutrient		N (b)	---
Selenium	1 / 3	33	4.6	J/J	4.6	J/J	10	10	4.87E+00	7.80E+01		N (a)	---
Sodium	3 / 3	100	3850	J	4955	J/J	20000	20000	4.43E+03	Nutrient		N (b)	---
Vanadium	3 / 3	100	4.7	J	9.65	J/J	50	50	6.45E+00	7.80E+01		N (a)	---

RBSC - Risk-based screening concentration.
COPC - Chemical of potential concern.
µg/L - Micrograms per liter.
VQ - Validation qualifier.
/ - When in the VQ column, this separates two qualifiers where the concentration is the result of a sample averaged with a field duplicate.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed
U - The sample result was nondetect.

[a] Risk-based screening concentrations based on U.S. Environmental Protection Agency (EPA) Regional Screening Level Table (May 2012) tap water values are based on a risk level of 1. and a hazard index of 1.
[b] N = Chemical is not chosen as a COPC:
(a) = Maximum detected concentration is less than the RBSC.
(b) = Essential nutrient.
[c] Y = Chemical is chosen as COPC.
[d] Exposure-point concentration (EPC) used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower. The EPC for lead is the mean.
[e] Screening criteria for lead based on the action level of 15 µg/L (EPA, 2012, 2012 Edition of the Drinking Water Standards and Health Advisories, Office of Water, April, EPA 822-S-12-001).

Table 6-15

Summary of Risk for All Receptors - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

	Groundskeeper [a]		Construction Worker		Indoor Worker		Resident			Hunter		Hunter's Child	
	Total ILCR	Total HI	Total ILCR	Total HI	Total ILCR	Total HI	Total ILCR	Total Adult - HI	Total Child - HI	Total ILCR	Total HI	Total ILCR	Total HI
Bedrock Groundwater Use													
Exposure Media													
Surface Soil	4.94E-05	0.07	NE	NE	1.32E-05	0.02	NE	NE	NE	3.30E-06	0.004	1.59E-10	0.00004
Total Soil	1.48E-05	0.05	7.31E-07	0.1	NE	NE	4.64E-05	0.05	0.4	NE	NE	NE	NE
Groundwater	4.06E-04	3.5	NE	NE	4.06E-04	3.5	1.76E-03	10	24.0	NE	NE	NE	NE
Sediment	NE	NE	3.04E-07	0.6	NE	NE	1.88E-06	0.025	0.24	NE	NE	NE	NE
Surface Water	NE	NE	9.96E-09	0.1	NE	NE	2.32E-07	0.05	0.09	NE	NE	NE	NE
Total ILCR or HI	**4.E-04**	**4**	**1.E-06**	**0.9**	**4.E-04**	**3**	**2.E-03**	**10**	**25**	**3.E-06**	**0.004**	**2.E-10**	**0.00004**
Overburden Groundwater Use													
Exposure Media													
Surface Soil	4.94E-05	0.07	NE	NE	1.32E-05	0.019	NE	NE	NE	3.30E-06	0.004	1.59E-10	0.00004
Total Soil	1.48E-05	0.05	7.31E-07	0.1	NE	NE	4.64E-05	0.05	0.4	NE	NE	NE	NE
Groundwater	7.05E-05	1.0	NE	NE	7.05E-05	1.0	3.00E-04	2.8	6.6	NE	NE	NE	NE
Sediment	NE	NE	3.04E-07	0.6	NE	NE	1.88E-06	0.025	0.24	NE	NE	NE	NE
Surface Water	NE	NE	9.96E-09	0.1	NE	NE	2.32E-07	0.05	0.09	NE	NE	NE	NE
Total ILCR or HI	**9.E-05**	**1**	**1.E-06**	**0.9**	**8.E-05**	**1**	**3.E-04**	**3**	**7**	**3.E-06**	**0.004**	**2.E-10**	**0.00004**

HI - Hazard index.
ILCR - Incremental lifetime cancer risk.
NA - No chemicals of potential concern available for exposure evaluation.
NE - Pathway not evaluated for this receptor.

Note:
[a] Total ILCR and total HI values for the groundskeeper reflect the respective totals for the future groundskeeper assumed to use either bedrock or overburden groundwater. The total ILCR and HI values for the current groundskeeper are simply those shown for soil. The rounded current groundskeeper ILCR is 5E-5 and the rounded HI is 0.07.

Table 6-16

Summary of Risk for Receptors[a] Excluding Exposure to Groundwater[b] - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

	Future Groundskeeper		Indoor Worker		Resident		
	Total ILCR	Total HI	Total ILCR	Total HI	Total ILCR	Total Adult - HI	Total Child - HI
Exposure Media							
Surface Soil	NE	NE	1.32E-05	0.02	NE	NE	NE
Total Soil	1.48E-05	0.05	NE	NE	4.64E-05	0.05	0.41
Sediment	NE	NE	NE	NE	1.88E-06	0.025	0.24
Surface Water	NE	NE	NE	NE	2.32E-07	0.05	0.09
Total ILCR or HI	**1.E-05**	**0.05**	**1.E-05**	**0.02**	**5.E-05**	**0.1**	**0.7**

HI - Hazard index.
ILCR - Incremental lifetime cancer risk.
NA - No chemicals of potential concern available for exposure evaluation.
NE - Pathway not evaluated for this receptor.

Notes:
[a] The above receptors are those which were evaluated for groundwater exposure.
[b] Groundwater use is not regarded as plausible because of low yield and naturally poor quality in the in the overburden and bedrock units.

Table 6-17

Cancer Risks for Current Groundskeeper and Future Resident Based on Re-Evaluation of Soil[a,b] - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SL, TNTB/WWTP1 SL, and WWTP3
Former PBOW, Sandusky, Ohio

	Current Groundskeeper ILCR	Future Resident ILCR
Exposure Media		
Surface Soil	6.79E-06	NE
Total Soil	NE	1.05E-05
Sediment	NE	1.88E-06
Surface Water	NE	2.32E-07
Total ILCR	**7.E-06**	**1.E-05**

PAH - Polycyclic aromatic hydrocarbon.
ILCR - Incremental lifetime cancer risk.
NE - Pathway not evaluated for this receptor.

Notes:
[a] The above two receptors are those which have ILCR values exceeding the PBOW cancer risk goal of 1E-5 based on soil exposure using the full data set. Note that no groundwater exposure is assumed based on low water yield in the overburden and bedrock units and naturally poor water quality in the bedrock unit.
[b] The soil samples with the three highest PAH concentrations are excluded. The two surface soil samples (SB-01 and SB-02) located immediately beside the NASA K-Site control building are excluded because they are within the area where NASA has demolished the building and removed associated PAH-contaminated soil. A third high-PAH soil sample (SSW-303) was collected immediately east of the access road and was excluded from this evaluation because it is interpreted to represent anthropogenic background sources (i.e., petroleum constituents of the asphalt and vehicle emissions).

Table 6-18

Summary of Samples Evaluated in the Ecological Risk Assessment - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Location	Sample Number	Sample Purpose	Sample Date	Depth (ft)	Analyses
Soil Samples					
PBOW99-SSW301	PBOW99SSW301	REG	2-Sep-99	0 - 0	Explosives, Gen Chem, Metals
PBOW99-SSW302	PBOW99SSW302	REG	2-Sep-99	0 - 0	Explosives, Gen Chem, Metals, PCB, SVOC, VOC
PBOW99-SSW303	PBOW99SSW303	REG	2-Sep-99	0 - 0	Explosives, Gen Chem, Metals, PCB, SVOC, VOC
PBOW99-SSW304	PBOW99SSW304	REG	2-Sep-99	0 - 0	Explosives, Gen Chem, Metals
PBOW99-SSW305	PBOW99SSW305	REG	2-Sep-99	0 - 0	Explosives, Gen Chem, Metals
PBOW99-SSW306	PBOW99SSW306	REG	2-Sep-99	0 - 0	Explosives, Gen Chem, Metals
PBOW99-SSW307	PBOW99SSW307	REG	2-Sep-99	0 - 0	Explosives, Gen Chem, Metals
PBOW99-SSW307	PBOW99SSW308	FD	2-Sep-99	0 - 0	Explosives, Gen Chem, Metals
PBOW99-SSW309	PBOW99SSW309	REG	2-Sep-99	0 - 0	Explosives, Gen Chem, Metals
PBOW99-SSW310	PBOW99SSW310	REG	2-Sep-99	0 - 0	Explosives, Gen Chem, Metals
WWTP3-SB01	WW0034	REG	10-Dec-08	0.7 - 1.7	Explosives, Gen Chem, Metals, PCB, SVOC
WWTP3-SB01	WW0035	REG	10-Dec-08	5 - 5.7	Explosives, Metals, PCB, SVOC
WWTP3-SB02	WW0038	REG	10-Dec-08	0.5 - 1.5	Explosives, Metals, PCB, SVOC
WWTP3-SB02	WW0039	REG	10-Dec-08	5 - 5.5	Explosives, Metals, PCB, SVOC
WWTP3-SB03	WW0041	REG	10-Dec-08	0 - 1	Explosives, Metals, PCB, SVOC
WWTP3-SB03	WW0042	REG	10-Dec-08	3 - 5	Explosives, Metals, PCB, SVOC
WWTP3-SB03	WW0043	FD	10-Dec-08	3 - 5	Explosives, Metals, PCB, SVOC
WWTP3-SB05	WW0048	REG	11-Dec-08	0 - 1	Explosives, Metals, PCB, SVOC
WWTP3-SB05	WW0049	REG	11-Dec-08	3 - 5	Explosives, Metals, PCB, SVOC
WWTP3-SB06	WW0051	REG	11-Dec-08	0 - 1	Explosives, Metals, PCB, SVOC
WWTP3-SB06	WW0052	REG	11-Dec-08	3 - 3.7	Explosives, Metals, PCB, SVOC
WWTP3-SB07	WW0054	REG	11-Dec-08	0 - 1	Explosives, Metals, PCB, SVOC
WWTP3-SB07	WW0055	REG	11-Dec-08	3 - 5	Explosives, Metals, PCB, SVOC
WWTP3-SB09	WW0060	REG	11-Dec-08	0.2 - 1.6	Explosives, Metals, PCB, SVOC
WWTP3-SB09	WW0061	REG	11-Dec-08	3 - 5	Explosives, Metals, PCB, SVOC
WWTP3-SB09	WW0063	FD	11-Dec-08	3 - 5	Explosives, Metals, PCB, SVOC
Sediment Samples					
PBOW99-SDW301	PBOW99SDW301	REG	2-Sep-99	0 - 0	Explosives, Gen Chem, Metals, SVOC
PBOW99-SDW302	PBOW99SDW302	REG	2-Sep-99	0 - 0	Explosives, Gen Chem, Metals, SVOC
WWTP3-SD01	WW1004	REG	23-May-09	0 - 0.5	Gen Chem, PCB
WWTP3-SD01	WW1005	FD	23-May-09	0 - 0.5	Gen Chem, PCB
WWTP3-SD02	WW1007	REG	23-May-09	0 - 0.5	Gen Chem, PCB
WWTP3-SD03	WW1008	REG	23-May-09	0 - 0.5	Explosives, Gen Chem, Metals, PCB, SVOC
Surface Water Samples					
WWTP3-SW01	WW2004	REG	23-May-09	NA	Explosives, Metals, SVOC
WWTP3-SW02	WW2005	REG	23-May-09	NA	Explosives, Metals, SVOC
WWTP3-SW03	WW2006	REG	23-May-09	NA	Explosives, Metals, SVOC
WWTP3-SW03	WW2007	FD	23-May-09	NA	Explosives, Metals, SVOC

FD - Field duplicate; averaged with the regular sample at the same location to create one result.
Gen Chem - General chemistry.
NA - Not applicable.
PCB - Polychlorinated biphenyls.
REG - Regular sample.
SVOC - Semivolatile organic compounds.
VOC - Volatile organic compounds.

Table 6-19

COPEC Summary for Soil[a] - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

(Page 1 of 2)

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean (mg/kg)	BSC [a] (mg/kg)	ESV [b] (mg/kg)	COPEC? [c,d]	Distribution [e]	95% UCL [e] (mg/kg)	EPC [f] (mg/kg)	UCL 0-1' soil depth [g] (mg/kg)	MDC 0-1' soil depth [g] (mg/kg)	EPC 0-1' soil depth [g] (mg/kg)
Inorganics																		
Aluminum	23 / 23	100	3.11E+03		1.05E+04		1.70E+00	2.40E+01	7.41E+03	1.55E+04	pH Dependent	N (b)			---			---
Antimony	13 / 23	57	2.61E-01	J	4.14E-01	J/J	4.24E-01	7.20E+00	1.52E+00	9.30E+00	0.27	N (b)			---			---
Arsenic	23 / 23	100	3.90E+00		2.08E+01		8.49E-01	1.20E+00	7.44E+00	3.65E+01	18	N (b)			---			---
Barium	23 / 23	100	2.97E+01		1.97E+02		1.74E-01	2.40E+01	5.85E+01	8.26E+02	330	N (a)			---			---
Beryllium	16 / 23	70	5.90E-01		8.44E+00		1.70E-01	6.00E-01	3.73E+00	1.00E+00	21	N (a)			---			---
Cadmium	9 / 23	39	2.24E-01	J	1.01E+00		4.24E-01	6.00E-01	2.99E-01	NA	0.36	Y	Nonparametric	3.64E-01	3.64E-01	3.10E-01	3.64E-01	3.10E-01
Calcium	23 / 23	100	3.29E+03		6.07E+04		4.24E+00	6.00E+02	1.90E+04	5.23E+04	Nutrient	N (c)			---			---
Chromium	23 / 23	100	6.90E+00		1.78E+01		4.24E-01	1.20E+00	1.19E+01	2.90E+01	26	N (a)			---			---
Cobalt	21 / 23	91	3.97E+00	J	2.21E+01		1.70E-01	6.00E+00	7.12E+00	1.16E+02	13	N (b)			---			---
Copper	23 / 23	100	7.10E+00		2.84E+01		4.24E-01	3.00E+00	1.68E+01	5.62E+01	28	N (b)			---			---
Iron	23 / 23	100	1.02E+04	J	2.90E+04		1.70E+00	1.20E+01	1.69E+04	2.34E+05	pH Dependent	N (b)			---			---
Lead	23 / 23	100	9.60E+00		1.34E+02	J	3.10E-01	5.00E-01	2.96E+01	4.86E+01	11	Y	Nonparametric	5.75E+01	5.75E+01	6.70E+01	1.34E+02	6.70E+01
Magnesium	23 / 23	100	2.01E+03		1.18E+04	J	1.74E+00	6.00E+02	5.60E+03	1.04E+04	Nutrient	N (c)			---			---
Manganese	23 / 23	100	1.70E+02		2.52E+03		1.74E-01	1.80E+00	4.29E+02	3.51E+03	220	N (b)			---			---
Mercury	21 / 23	91	1.63E-02	J	5.97E-01		2.06E-02	4.00E-02	8.03E-02	8.50E-02	0.00051	Y	Lognormal	1.91E-01	1.91E-01	2.48E-01	5.97E-01	2.48E-01
Nickel	23 / 23	100	8.40E+00		5.71E+01		2.55E-01	4.80E+00	1.84E+01	5.51E+01	38	N (d)			---			---
Potassium	22 / 23	96	3.21E+02		9.36E+02		2.12E+01	6.00E+02	5.71E+02	3.39E+03	Nutrient	N (c)			---			---
Selenium	13 / 23	57	4.83E-01	J	1.10E+00		5.20E-01	1.00E+00	6.03E-01	2.00E+00	0.52	N (b)			---			---
Sodium	14 / 23	61	2.50E+01		1.62E+02		8.49E+00	6.00E+02	1.49E+02	NA	Nutrient	N (c)			---			---
Thallium	9 / 23	39	2.21E-01	J	1.10E+00		4.24E-01	1.20E+00	4.62E-01	1.30E+00	1	N (b)			---			---
Vanadium	23 / 23	100	1.38E+01		2.85E+01		1.70E-01	6.00E+00	1.99E+01	4.09E+01	7.8	N (b)			---			---
Zinc	23 / 23	100	3.38E+01		1.05E+02		2.10E+00	2.50E+00	5.73E+01	3.22E+02	46	N (b)			---			---
Polychlorinated biphenyls (PCB)																		
Aroclor 1016	3 / 16	19	1.00E-01	J	1.22E+00	J	3.99E-02	2.05E-01	1.53E-01		0.371	Y	Normal	3.21E-01	3.21E-01	7.64E-01	1.22E+00	7.64E-01
Aroclor 1254	2 / 16	13	2.50E-01		1.00E+00	J	3.99E-02	2.05E-01	1.36E-01		0.371	Y	Nonparametric	4.09E-01	4.09E-01	5.40E-01	1.00E+00	5.40E-01
Aroclor 1260	3 / 16	19	6.67E-02	J	2.29E-01		3.99E-02	4.60E-01	9.52E-02		0.371	N (a)			---			---
Explosives																		
2,4,6-Trinitrotoluene	1 / 23	4	8.80E-01		8.80E-01		2.50E-01	3.14E-01	1.70E-01		NSV	Y [h]	Nonparametric	2.31E-01	2.31E-01	2.70E-01	8.80E-01	2.70E-01
2-Amino-4,6-dinitrotoluene	1 / 23	4	2.28E-01	/U	2.28E-01	/U	2.50E-01	3.14E-01	1.42E-01		0.0328	Y [h]	Nonparametric	1.50E-01	1.50E-01	1.52E-01	2.28E-01	1.52E-01
4-Amino-2,6-dinitrotoluene	1 / 23	4	2.60E-01		2.60E-01		2.50E-01	3.14E-01	1.43E-01		0.0328	Y [h]	Nonparametric	1.54E-01	1.54E-01	1.58E-01	2.60E-01	1.58E-01
Semivolatile Organic Compounds																		
Acenaphthene	3 / 16	19	5.92E-02	J	6.43E-01	J	3.60E-01	2.00E+00	2.87E-01		29	N (a)			---			---
Acenaphthylene	7 / 16	44	5.41E-02	J	3.23E+00		3.60E-01	2.00E+00	4.64E-01		29	N (a)			---			---
Anthracene	8 / 16	50	5.04E-02	J	4.53E+00		3.60E-01	2.00E+00	6.77E-01		29	N (a)			---			---
Benzo(a)anthracene	11 / 16	69	3.98E-02	J	1.19E+01		3.60E-01	2.00E+00	1.53E+00		1.1	Y	Gamma	2.82E+00	2.82E+00	8.20E+00	1.19E+01	8.20E+00
Benzo(a)pyrene	10 / 16	63	9.09E-02	J	1.00E+01		3.60E-01	2.00E+00	1.35E+00		1.1	Y	Gamma	2.67E+00	2.67E+00	6.96E+00	1.00E+01	6.96E+00
Benzo(b)fluoranthene	10 / 16	63	1.40E-01	J	1.39E+01		3.60E-01	2.00E+00	1.71E+00		1.1	Y	Gamma	3.29E+00	3.29E+00	9.35E+00	1.39E+01	9.35E+00
Benzo(ghi)perylene	9 / 16	56	1.20E-01	J	5.57E+00		3.60E-01	2.00E+00	8.36E-01		1.1	Y	Gamma	1.46E+00	1.46E+00	2.45E+00	5.57E+00	2.45E+00
Benzo(k)fluoranthene	7 / 16	44	1.27E-01	J	4.49E+00		3.60E-01	2.00E+00	8.03E-01		1.1	Y	Normal	1.42E+00	1.42E+00	2.21E+00	4.49E+00	2.21E+00
Bis(2-ethylhexyl)phthalate	1 / 16	6	1.21E-01	U/J	1.21E-01	U/J	3.60E-01	2.00E+00	2.95E-01		0.925	N (a)			---			---
Carbazole	3 / 14	21	4.43E-02	J	1.12E+00	J	3.92E-01	2.00E+00	3.30E-01		NSV	Y	Normal	3.35E-01	3.35E-01	8.34E-01	1.12E+00	8.34E-01
Chrysene	10 / 16	63	9.25E-02	J	1.03E+01		3.60E-01	2.00E+00	1.38E+00		1.1	Y	Gamma	2.58E+00	2.58E+00	7.16E+00	1.03E+01	7.16E+00
Dibenz(a,h)anthracene	3 / 16	19	3.97E-01	J	1.46E+00	J	3.60E-01	2.00E+00	3.74E-01		1.1	Y	Normal	6.40E-01	6.40E-01	8.54E-01	1.46E+00	8.54E-01
Dibenzofuran	3 / 16	19	7.80E-02	J	1.35E+00	J	3.60E-01	2.00E+00	3.29E-01		NSV	Y	Normal	3.66E-01	3.66E-01	8.31E-01	1.35E+00	8.31E-01
Fluoranthene	11 / 16	69	5.05E-02	J	2.48E+01		3.60E-01	2.00E+00	2.99E+00		1.1	Y	Gamma	5.76E+00	5.76E+00	1.70E+01	2.48E+01	1.70E+01
Fluorene	4 / 16	25	1.14E-01	J	1.78E+00	J	3.60E-01	2.00E+00	3.93E-01		1.1	Y	Normal	8.08E-01	8.08E-01	1.05E+00	1.78E+00	1.05E+00
Indeno(1,2,3-cd)pyrene	10 / 16	63	2.84E-01	J/U	8.10E+00		3.60E-01	2.00E+00	1.16E+00		1.1	Y	Appr. Gamma	2.10E+00	2.10E+00	5.55E+00	8.10E+00	5.55E+00
Methylnaphthalene, 2-	2 / 16	13	7.21E-01		1.57E+00	J	3.60E-01	2.00E+00	3.68E-01		3.24	N (a)			---			---
Naphthalene	2 / 16	13	6.77E-01		1.38E+00	J	3.60E-01	2.00E+00	3.54E-01		29	N (a)			---			---
Phenanthrene	10 / 16	63	6.77E-02	J	1.39E+01		3.60E-01	2.00E+00	1.71E+00		29	N (a)			---			---
Pyrene	11 / 16	69	4.06E-02	J	1.81E+01		3.60E-01	2.00E+00	2.33E+00		1.1	Y	Gamma	4.42E+00	4.42E+00	1.27E+01	1.81E+01	1.27E+01
Volatile Organic Compounds																		
Methylene chloride	2 / 2	100	1.20E-02		1.30E-02		5.50E-03	6.00E-03	1.25E-02		4.05	N (a)			---			---

Table 6-19

COPEC Summary for Soil[a] - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean (mg/kg)	BSC [a] (mg/kg)	ESV [b] (mg/kg)	COPEC? [c,d]	Distribution [e]	95% UCL [e] (mg/kg)	EPC [f] (mg/kg)	UCL 0-1' soil depth [g] (mg/kg)	MDC 0-1' soil depth [g] (mg/kg)	EPC 0-1' soil depth [g] (mg/kg)

BSC - Background screening concentration.
COPEC - Chemical of potential ecological concern.
EPC - Exposure point concentration.
ESV - Ecological screening value.
mg/kg - Milligrams per kilogram.
NA - Not available.
NSV - No screening value.
UCL - Upper confidence limit.
VQ - Validation qualifier (a "/" indicates combined VQs for a regular and field duplicate sample pair):
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed
U - Not detected.

[a] IT Corporation (IT), 1998, *Site Investigation of Acid Areas*, *Plum Brook Ordnance Works, Sandusky, Ohio*, August.
[b] ESVs and their sources are in Appendix B.
[c] N = Chemical is not chosen as a COPEC:
(a) = Maximum detected concentration is less than the ESV.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
(d) = Statistical test shows background and site data to be the same; see Appendix C.
(e) = Infrequently detected (fewer than 5 percent of all samples).
[d] Y = Chemical is chosen as COPEC.
[e] 95% UCL (Upper confidence limit) determined using ProUCL Version 4.00.05 (U.S. Environmental Protection Agency, 2010, ProUCL Version 4.00.05, Office of Research and Development, Las Vegas, Nevada, and Technology Support Center, Atlanta, GA, May, on line at http://www.epa.gov/esd/tsc/TSC_form.htm).
[f] Concentration used in risk assessment equal to 95% UCL or maximum detected concentration, whichever is lower.
[g] The EPC for the COPEC at the surface soil depth range is used as the exposure concentration for some ecological receptors. Note that the end depth of the surface soil data set is extended beyond 1 foot due to the presence of fill material (see text for details).
[h] The chemical may be a site-related contaminant, and was included as a COPEC even though it was infrequently detected.

Table 6-20

COPEC Summary for Surface Water - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of values, µg/L Detected Conc Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Arithmetic Mean µg/L	ESV [a] µg/L	COPEC? [b,c]	EPC [d] µg/L
Metals												
Aluminum	3 / 3	100	1420		3590	JJ	200	200	2.22E+03	8.70E+01	Y	3.59E+03
Arsenic	2 / 3	67	6.1	J	7.2	JU	10	10	6.10E+00	3.10E+00	Y	7.20E+00
Barium	3 / 3	100	47	J	105	JJ	200	200	7.25E+01	4.00E+00	Y	1.05E+02
Calcium	3 / 3	100	91200		119500		1000	1000	1.07E+05	Nutrient	N (b)	---
Chromium	3 / 3	100	2.1	J	5.65	JJ	10	10	3.42E+00	4.20E+01	N (a)	---
Cobalt	3 / 3	100	1.6	J	5.95	JJ	50	50	3.22E+00	2.30E+01	N (a)	---
Copper	2 / 3	67	6.9	J	8.4	JJ	25	25	9.27E+00	1.58E+00	Y	8.40E+00
Iron	3 / 3	100	2440		11300		300	300	5.98E+03	Nutrient	N (b)	---
Lead	3 / 3	100	2.2	J	7.2		5	5	4.63E+00	1.17E+00	Y	7.20E+00
Magnesium	3 / 3	100	23600		29300		5000	5000	2.57E+04	Nutrient	N (b)	---
Manganese	3 / 3	100	134		1980		15	15	9.67E+02	1.20E+02	Y	1.98E+03
Nickel	1 / 3	33	4.1	JJ	4.1	JJ	40	40	1.47E+01	2.89E+01	N (a)	---
Potassium	3 / 3	100	703	J	1465	JJ	20000	20000	9.81E+02	Nutrient	N (b)	---
Selenium	1 / 3	33	4.6	JJ	4.6	JJ	10	10	4.87E+00	3.90E-01	Y	4.60E+00
Sodium	3 / 3	100	3850	J	4955	JJ	20000	20000	4.43E+03	Nutrient	N (b)	---
Vanadium	3 / 3	100	4.7	J	9.65	JJ	50	50	6.45E+00	1.20E+01	N (a)	---

ESV - Ecological screening value.
EPC - Exposure point concentration.
COPEC - Chemical of potential ecological concern.
µg/L - Micrograms per liter.
VQ - Validation qualifier.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.

[a] ESVs and their sources are in Appendix B.
[b] N = Chemical is not chosen as a COPEC:
(a) = Maximum detected concentration is less than the ESV.
(b) = Essential nutrient.
[c] Y = Chemical is chosen as COPEC.
[d] Concentration used in risk assessment equal to maximum detected concentration.

Table 6-21

COPEC Summary for Sediment - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	ESV [b] mg/kg	COPC? [c,d]
Inorganics												
Aluminum	3 / 3	100	8.41E+03		9.58E+03		2.10E+01	2.54E+01	9.00E+03	1.55E+04	NSV	N (b)
Arsenic	3 / 3	100	6.40E+00		7.20E+00		8.50E-01	1.30E+00	6.80E+00	3.65E+01	9.79E+00	N (a)
Barium	3 / 3	100	5.86E+01		8.25E+01		2.10E+01	2.54E+01	6.91E+01	8.26E+02	NSV	N (b)
Beryllium	1 / 3	33	6.40E-01		6.40E-01		5.30E-01	6.30E-01	4.20E-01	1.00E+00	NSV	N (b)
Cadmium	1 / 3	33	8.60E-01		8.60E-01		4.20E-01	6.30E-01	4.93E-01	NA	9.90E-01	N (a)
Calcium	3 / 3	100	7.24E+03		3.30E+04		5.30E+02	6.35E+02	2.38E+04	5.23E+04	Nutrient	N (c)
Chromium	3 / 3	100	1.41E+01		1.51E+01		1.10E+00	1.30E+00	1.45E+01	2.90E+01	4.34E+01	N (a)
Cobalt	3 / 3	100	7.10E+00		1.14E+01		5.30E+00	6.30E+00	8.90E+00	1.16E+02	5.00E+01	N (a)
Copper	3 / 3	100	1.79E+01		2.64E+01		2.60E+00	3.20E+00	2.11E+01	5.62E+01	3.16E+01	N (a)
Iron	3 / 3	100	1.83E+04		1.93E+04		1.10E+01	1.27E+01	1.87E+04	2.34E+05	Nutrient	N (c)
Lead	3 / 3	100	9.40E+00		1.86E+01		3.60E-01	1.10E+01	1.47E+01	4.86E+01	3.58E+01	N (a)
Magnesium	3 / 3	100	3.78E+03		1.10E+04		5.30E+02	6.35E+02	8.39E+03	1.04E+04	Nutrient	N (c)
Manganese	3 / 3	100	1.42E+02		1.87E+03		1.80E+00	1.60E+01	8.01E+02	3.51E+03	4.60E+02	N (b)
Mercury	2 / 3	67	4.70E-02		5.80E-02	J	4.00E-02	1.80E-01	4.17E-02	8.50E-02	1.80E-01	N (a)
Nickel	3 / 3	100	1.91E+01		2.37E+01		4.20E+00	5.10E+00	2.11E+01	5.51E+01	2.27E+01	N (b)
Potassium	2 / 2	100	8.77E+02		9.98E+02		6.05E+02	6.35E+02	9.38E+02	3.39E+03	Nutrient	N (c)
Selenium	3 / 3	100	7.10E-01		2.80E+00	J	6.10E-01	1.10E+01	1.50E+00	2.00E+00	NSV	Y
Sodium	1 / 3	33	1.72E+02	J	1.72E+02	J	6.05E+02	2.20E+03	2.64E+02	NA	Nutrient	N (c)
Thallium	1 / 3	33	1.20E+00		1.20E+00		1.20E+00	4.40E+00	1.35E+00	1.30E+00	NSV	N (b)
Vanadium	3 / 3	100	2.20E+01		2.45E+01		5.30E+00	6.30E+00	2.36E+01	4.09E+01	NSV	N (b)
Zinc	3 / 3	100	5.26E+01		7.19E+01		2.10E+00	2.50E+00	6.32E+01	3.22E+02	1.21E+02	N (a)
Semivolatiles Organic Compounds												
Benzo(a)pyrene	1 / 3	33	1.20E-01	J	1.20E-01	J	3.50E-01	4.20E-01	1.77E-01		1.50E-01	N (a)
Benzo(b)fluoranthene	1 / 3	33	1.91E-01	J	1.91E-01	J	3.50E-01	4.20E-01	2.00E-01		1.04E+01	N (a)
Benzo(ghi)perylene	1 / 3	33	1.05E-01	J	1.05E-01	J	3.50E-01	4.20E-01	1.72E-01		1.70E-01	N (a)
Chrysene	1 / 3	33	1.03E-01	J	1.03E-01	J	3.50E-01	4.20E-01	1.71E-01		1.66E-01	N (a)
Fluoranthene	1 / 3	33	1.56E-01	J	1.56E-01	J	3.50E-01	4.20E-01	1.89E-01		4.23E-01	N (a)
Indeno(1,2,3-cd)pyrene	1 / 3	33	1.10E-01	J	1.10E-01	J	3.50E-01	4.20E-01	1.73E-01		2.00E-01	N (a)
Pyrene	1 / 3	33	1.38E-01	J	1.38E-01	J	3.50E-01	4.20E-01	1.83E-01		1.95E-01	N (a)

BSC - Background screening concentration. The soil BSC is used for sediment in this evaluation. See text for details.
COPEC - Chemical of potential ecological concern.
EPC - Exposure point concentration.
ESV - Ecological screening value.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.
mg/kg - Milligrams per kilogram.

Table 6-21

COPEC Summary for Sediment - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

NA - Not available.
NSV - No screening value available.
VQ - Validation qualifier.

[a] Soil background screening concentrations are used for sediment. See text for details.
[b] ESVs and their sources are in Appendix B.
[c] N = Chemical is not chosen as a COPEC:
(a) = Maximum detected concentration is less than the ESV.
(b) = Maximum detected concentration is less than the BSC.
(c) = Essential nutrient.
[d] Y = Chemical is chosen as COPEC.

Table 6-22

Wildlife Hazard Quotients for all Assessment Receptors - WWTP3
RI Report - WWTP1, TNTA/WWTP1 SLs, TNTB/WWTP1 SLs, and WWTP3
Former PBOW, Sandusky, Ohio

COPEC	Deer Mouse		Short-tailed Shrew		Cottontail Rabbit		Marsh Wren		White-tailed Deer		Raccoon		Red-Tailed Hawk		Muskrat	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Metals																
Aluminum	2.77E-01	2.77E-02	2.85E-01	2.85E-02	7.08E-02	7.08E-03	8.81E-03	8.81E-04	2.86E-04	2.86E-05	1.27E-02	1.27E-03	2.80E-06	2.80E-07	1.74E-01	1.74E-02
Arsenic	8.49E-03	8.49E-04	8.76E-03	8.76E-04	2.17E-03	2.17E-04	3.78E-04	1.51E-04	8.78E-06	8.78E-07	1.17E-04	1.17E-05	1.20E-07	4.82E-08	5.35E-03	5.35E-04
Barium	3.06E-03	7.88E-04	3.16E-03	8.13E-04	7.84E-04	2.02E-04	1.36E-03	6.80E-04	3.16E-06	8.15E-07	3.74E-05	9.64E-06	4.34E-07	2.16E-07	1.93E-03	4.97E-04
Cadmium	2.80E-01	2.80E-02	5.49E-01	5.49E-02	1.15E-02	1.15E-03	6.54E-01	4.74E-02	2.81E-05	2.81E-06	4.25E-04	4.25E-05	1.01E-05	7.29E-07	0.00E+00	0.00E+00
Copper	1.07E-04	8.25E-05	1.10E-04	8.51E-05	2.73E-05	2.11E-05	4.83E-05	3.68E-05	1.10E-07	8.53E-08	7.38E-06	5.70E-06	1.54E-08	1.17E-08	6.73E-05	5.20E-05
Lead	2.93E-01	2.93E-02	4.98E-01	4.98E-02	2.92E-02	2.92E-03	**6.49E+00**	6.49E-01	3.59E-05	3.59E-06	5.60E-04	5.60E-05	1.85E-04	1.85E-05	8.43E-05	8.43E-06
Manganese	3.34E-03	1.04E-03	3.45E-03	1.07E-03	8.56E-04	2.65E-04	5.47E-04	5.47E-05	3.46E-06	1.07E-06	5.89E-05	1.83E-05	1.74E-07	1.74E-08	2.11E-03	6.53E-04
Mercury	5.40E-03	5.40E-04	7.18E-03	7.18E-04	4.75E-04	4.75E-05	4.43E-01	2.21E-01	8.98E-07	8.98E-08	1.01E-04	2.03E-05	1.00E-05	5.02E-06	0.00E+00	0.00E+00
Selenium	3.42E-03	2.07E-03	3.53E-03	2.14E-03	8.75E-04	5.30E-04	2.48E-03	1.24E-03	3.53E-06	2.14E-06	7.35E-03	4.45E-03	8.98E-07	2.63E-07	**2.38E+00**	1.44E+00
PCBs																
Aroclor 1016	6.45E-01	2.58E-01	5.40E-01	2.16E-01	1.54E-03	6.14E-04	**1.92E+01**	**1.92E+00**	7.20E-07	2.88E-07	1.05E-03	4.19E-04	7.77E-06	7.77E-07	0.00E+00	0.00E+00
Aroclor 1254	**9.41E+00**	9.41E-01	**1.42E+01**	1.42E+00	1.77E-02	1.77E-03	**1.39E+01**	1.39E+00	1.11E-05	1.11E-06	7.43E-03	1.51E-03	5.49E-06	5.49E-07	0.00E+00	0.00E+00
All PCBs (summed)	**1.01E+01**	***1.20E+00***	**1.48E+01**	**1.64E+00**	***1.92E-02***	***2.38E-03***	**3.32E+01**	**3.32E+00**	***1.18E-05***	***1.40E-06***	***8.48E-03***	***1.93E-03***	***1.33E-05***	***1.33E-06***	***0.00E+00***	***0.00E+00***
Nitroaromatics																
2,4,6-Trinitrotoluene	1.07E-02	2.17E-03	1.19E-02	2.40E-03	1.10E-03	2.22E-04	9.81E-02	1.96E-02	2.16E-06	4.35E-07	1.41E-05	2.84E-06	4.76E-08	9.52E-09	0.00E+00	0.00E+00
2-Amino-4,6-dinitrotoluene	6.71E-03	1.26E-03	4.99E-04	9.35E-05	1.91E-03	3.59E-04	5.43E-04	1.09E-04	4.31E-06	8.08E-07	5.23E-06	9.81E-07	2.68E-08	5.36E-09	0.00E+00	0.00E+00
4-Amino-2,6-dinitrotoluene	6.97E-03	1.31E-03	5.12E-04	9.60E-05	1.99E-03	3.73E-04	5.64E-04	1.13E-04	4.43E-06	8.30E-07	5.44E-06	1.02E-06	2.78E-08	5.57E-09	0.00E+00	0.00E+00
All Nitrotoluenes (summed)	***2.44E-02***	***4.73E-03***	***1.29E-02***	***2.59E-03***	***5.00E-03***	***9.53E-04***	***9.92E-02***	***1.98E-02***	***1.09E-05***	***2.07E-06***	***2.48E-05***	***4.84E-06***	***1.02E-07***	***2.04E-08***	***0.00E+00***	***0.00E+00***
Semivolatile Organics																
Benzo(a)anthracene	**2.40E+00**	4.81E-01	**1.67E+00**	3.33E-01	1.46E-01	2.93E-02	**2.04E+00**	4.08E-01	8.14E-05	1.63E-05	4.35E-03	8.70E-04	2.01E-05	4.03E-06	0.00E+00	0.00E+00
Benzo(a)pyrene	3.60E-01	3.60E-02	2.21E-01	2.21E-02	4.26E-02	4.26E-03	9.69E-01	1.94E-01	2.96E-05	2.96E-06	5.82E-04	5.82E-05	1.20E-05	2.39E-06	0.00E+00	0.00E+00
Benzo(b)fluoranthene	1.29E-01	2.57E-02	3.78E-02	7.57E-03	2.90E-02	5.79E-03	**4.46E+00**	8.91E-01	2.08E-05	4.17E-06	1.63E-04	3.25E-05	1.15E-04	2.30E-05	0.00E+00	0.00E+00
Benzo(ghi)perylene	3.20E-02	3.20E-03	1.80E-02	1.80E-03	5.94E-03	5.94E-04	3.69E-01	7.37E-02	6.89E-06	6.89E-07	3.97E-05	3.97E-06	4.20E-06	8.40E-07	0.00E+00	0.00E+00
Benzo(k)fluoranthene	1.55E-02	1.55E-03	1.66E-02	1.66E-03	1.69E-03	1.69E-04	3.14E-01	6.28E-02	1.97E-06	1.97E-07	2.55E-05	2.55E-06	3.79E-06	7.59E-07	0.00E+00	0.00E+00
Carbazole	**5.67E+03**	**5.67E+02**	**2.87E+03**	**2.87E+02**	**7.14E+02**	**7.14E+01**	NA	NA	6.16E-01	6.16E-02	**7.64E+00**	7.64E-01	NA	NA	0.00E+00	0.00E+00
Chrysene	**2.01E+00**	4.03E-01	1.45E+00	2.91E-01	1.30E-01	2.60E-02	1.18E+00	2.37E-01	7.62E-05	1.52E-05	3.65E-03	7.30E-04	1.23E-05	2.46E-06	0.00E+00	0.00E+00
Dibenz(a,h)anthracene	7.93E-02	7.93E-03	1.08E-01	1.08E-02	4.12E-03	4.12E-04	3.57E-01	7.13E-02	5.55E-06	5.55E-07	1.28E-04	1.28E-05	1.47E-06	2.93E-07	0.00E+00	0.00E+00
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	1.04E-01	2.09E-02	2.12E-02	4.25E-03	2.54E-02	5.07E-03	2.86E-02	2.86E-03	1.84E-05	3.68E-06	1.16E-04	2.32E-05	7.38E-07	7.38E-08	0.00E+00	0.00E+00
Fluorene	1.59E-03	3.18E-04	2.47E-03	4.94E-04	1.86E-05	3.72E-06	7.70E-01	1.54E-01	1.28E-08	2.55E-09	2.67E-06	5.34E-07	1.81E-06	3.62E-07	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	4.17E-02	8.34E-03	2.62E-02	5.24E-03	4.43E-03	8.86E-04	8.53E-01	1.71E-01	2.91E-06	5.81E-07	6.83E-05	1.37E-05	9.53E-06	1.91E-06	0.00E+00	0.00E+00
Pyrene	2.04E-01	4.08E-02	4.78E-02	9.57E-03	4.41E-02	8.83E-03	4.39E-02	4.39E-03	3.35E-05	6.69E-06	2.25E-04	4.49E-05	5.54E-07	5.54E-08	0.00E+00	0.00E+00

COPEC - Chemical of potential ecological concern.
LOAEL - Lowest-observed-adverse-effect level.
NA - No toxicity data available; hazard quotients not calculated.
NOAEL - No-observed-adverse-effect level.

Shaded cells indicate a hazard quotient greater than 1, when rounded.

FIGURES

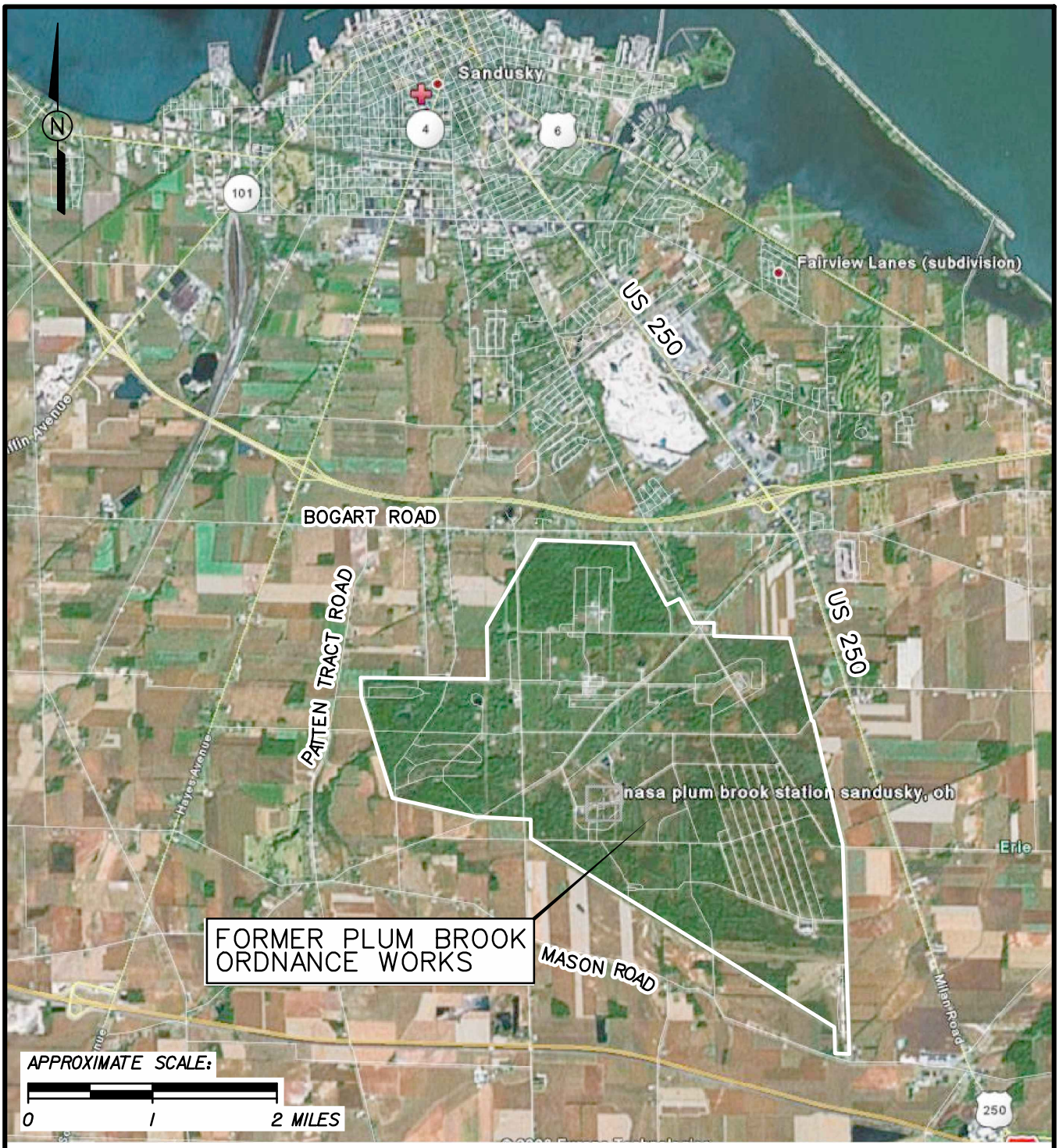

FIGURE 1-1
PBOW VICINITY MAP

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINES, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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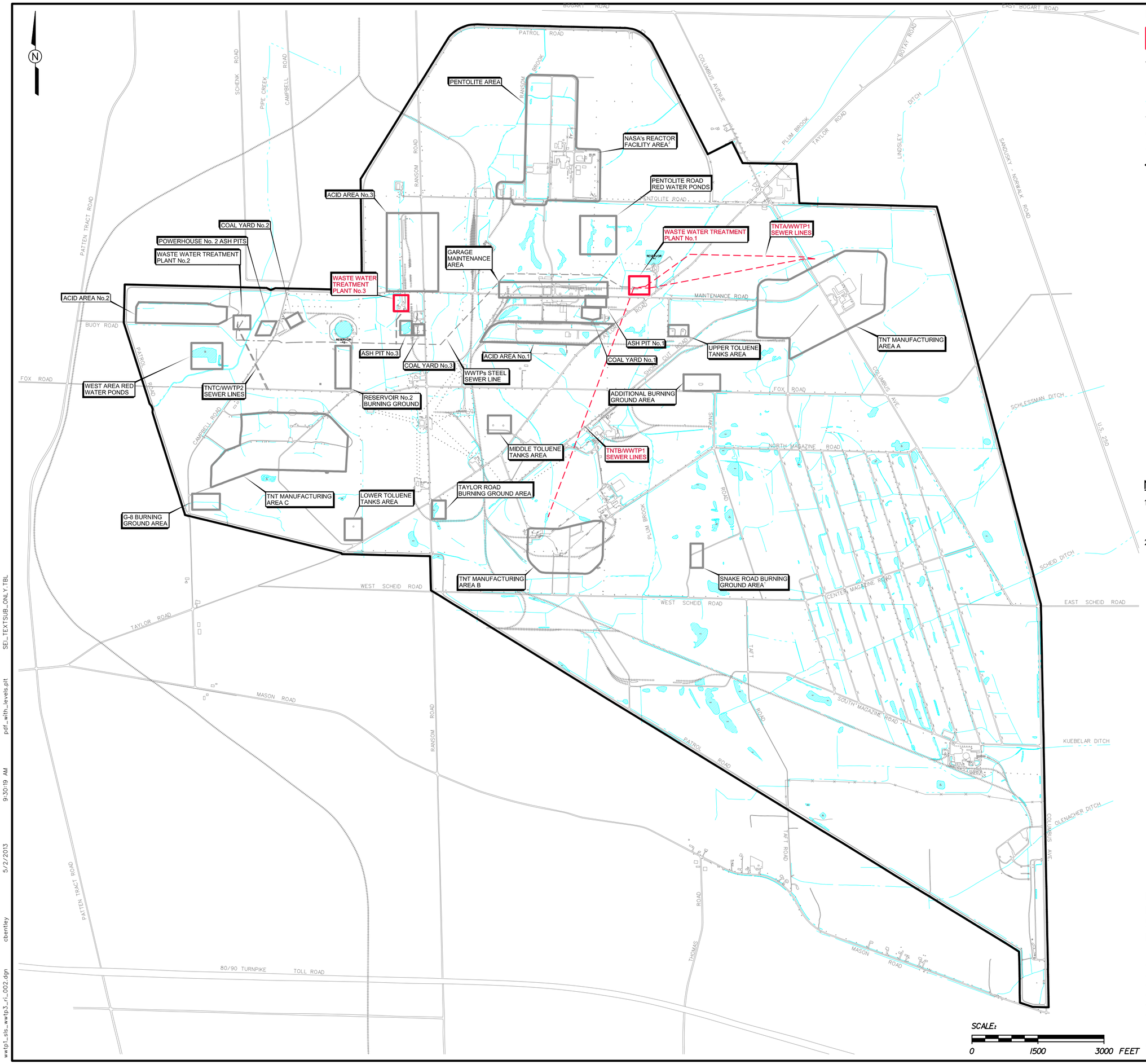
wwtp1_sls_wwtp3_ri_001.dgn cbentley 5/2/2013 9:29:21 AM pdf_with_levels.plt SEI_TEXTSUB_ONLY.TBL



LEGEND:

- AREA OF CONCERN
- APPROXIMATE LOCATION OF TNTA/WWTP1 AND TNTB/WWTP1 SEWER LINES
- POND
- CREEK, DITCH, CONVEYANCE
- RAILROAD
- ROAD
- FENCE
- FACILITY BOUNDARY

NOTES:

1. SNAKE ROAD BURNING GROUND AREA WAS ALSO REFERRED TO AS "SNAKE ROAD BURN PIT", "SCHEID ROAD BURNING GROUNDS", AND "DISPOSAL AREA THREE".
2. REACTOR FACILITY CONSTRUCTED BY NASA POST WWII AND IS IDENTIFIED FOR LOCATION PURPOSES ONLY.

FIGURE 1-2

LOCATION OF WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINES, AND WWTP3 AT PBOW

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINES, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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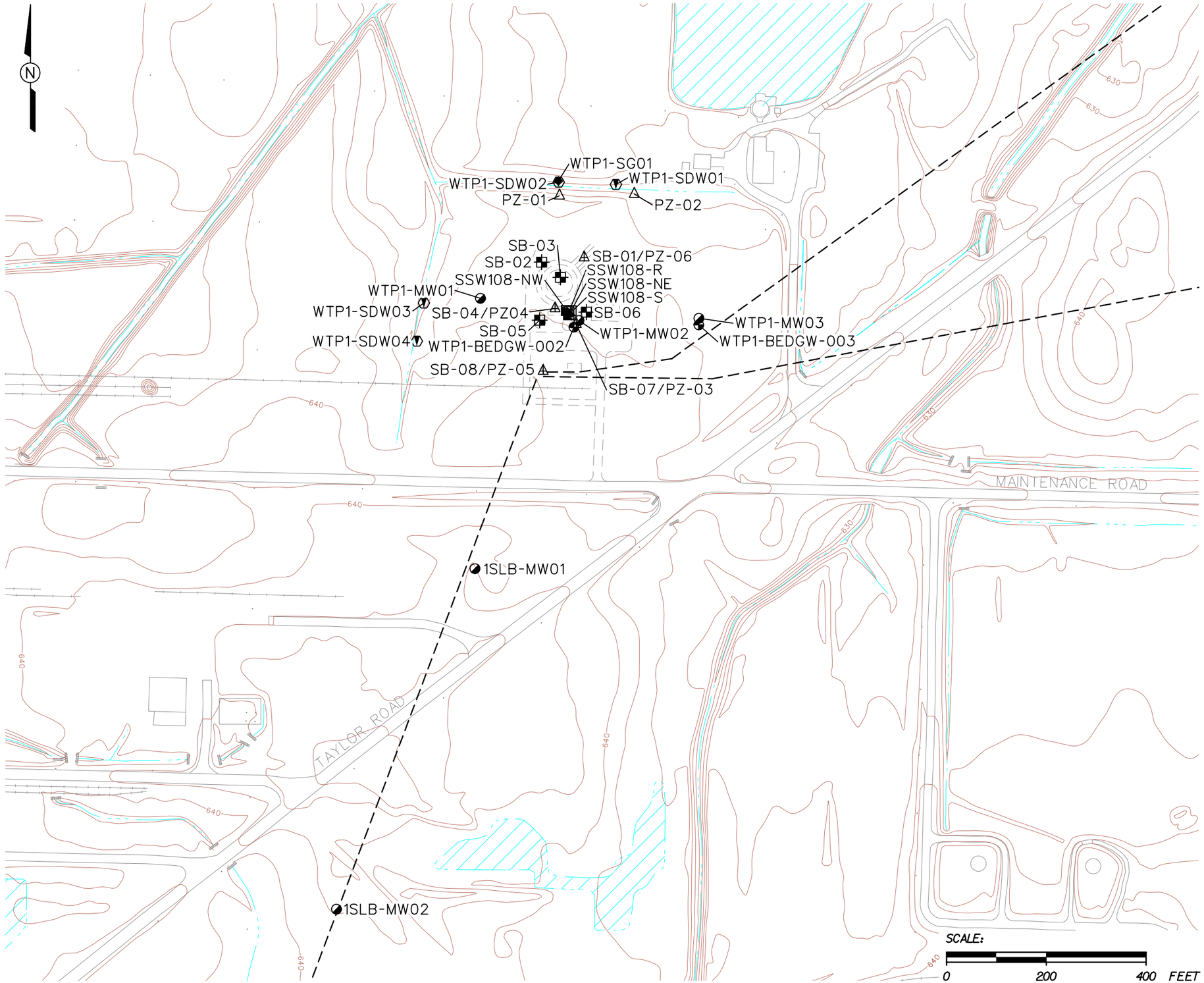

LEGEND:

- OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- SURFACE SOIL SAMPLE
- SOIL BORING
- SOIL BORING / PIEZOMETER
- PIEZOMETER
- SURFACE WATER / SEDIMENT SAMPLE
- STAFF GUAGE
- POND
- CREEK, DITCH, CONVEYANCE
- ROAD
- 640 TOPOGRAPHIC CONTOUR (2 FT. INTERVAL)
- APPROXIMATE LOCATION OF SEWER LINES

FIGURE 3-1
GENERAL SITE FEATURES OF WWTP1 WITH SITE TOPOGRAPHY AND SAMPLING LOCATIONS

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINES, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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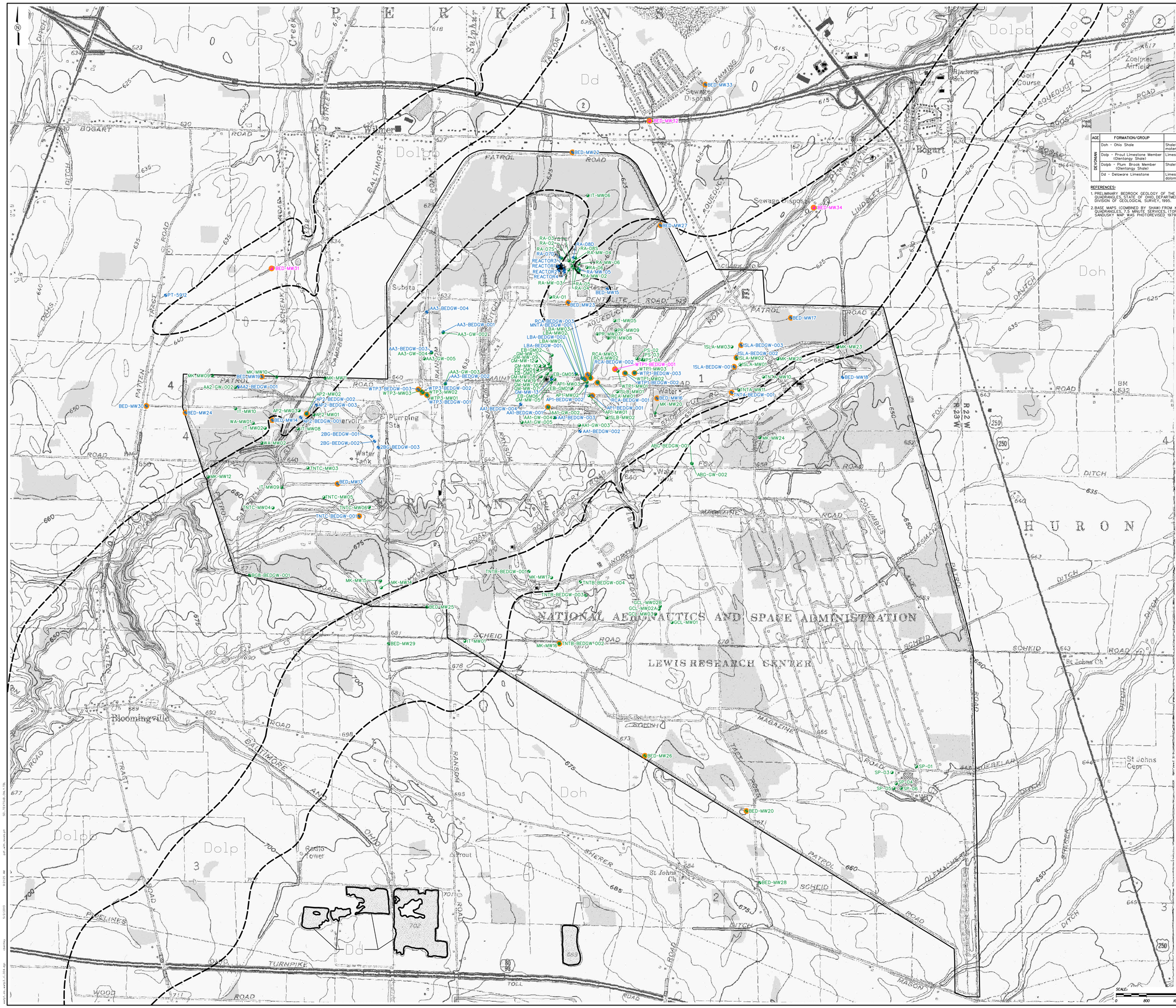

LEGEND:

- OVERBURDEN MONITORING WELL (SCREENED IN SHALE)
- BEDROCK MONITORING WELL (SCREENED IN SHALE)
- BEDROCK MONITORING WELL (SCREENED IN LIMESTONE)
- ABANDONED OVERBURDEN MONITORING WELL (SCREENED IN SHALE)
- ABANDONED BEDROCK MONITORING WELL (SCREENED IN LIMESTONE)
- ABANDONED BEDROCK WELL BORING
- H_2S AND/OR NATURAL GAS, AND/OR PETROLEUM HYDROCARBON WERE NOTED DURING BEDROCK DRILLING
- GEOLOGIC CONTACT: SOLID WHERE EXPOSED, DASHED WHERE CONCEALED BY SEDIMENTS

AGE	FORMATION/GROUP	ROCK DESCRIPTION
DEVONIAN	Doh - Ohio Shale	Shale: black, thin-bedded with bituminous and carboneous material, pyrite, natural gas pockets.
	Dolp - Prout Limestone Member (Olentangy Shale)	Limestone: light gray, calcareous.
	Dolpb - Plum Brook Member (Olentangy Shale)	Shale: dark gray, thin-bedded.
	Dd - Delaware Limestone	Limestone: buff, earthy, interbedded with brown crystalline dolomite, fossiliferous, hydrogen sulfide, petroleum hydrocarbon.

REFERENCES:

1. PRELIMINARY BEDROCK GEOLOGY OF THE KIMBALL AND SANDUSKY, OHIO, QUADRANGLES, STATE OF OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SURVEY, 1995.
2. BASE MAPS (COMBINED BY SHAW) FROM KIMBALL AND SANDUSKY QUADRANGLES, 7.5 MINUTE SERVICES, (TOPOGRAPHIC), 1969. SANDUSKY MAP WAS PHOTOREVISED 1979.

NOTES:

1. GEOLOGIC CONTACT LINES WERE ADJUSTED BASED ON 2009 MONITORING WELLS/SOIL BORING DATA.

FIGURE 3-2
REGIONAL GEOLOGIC MAP WITH WELL LOCATIONS

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINES, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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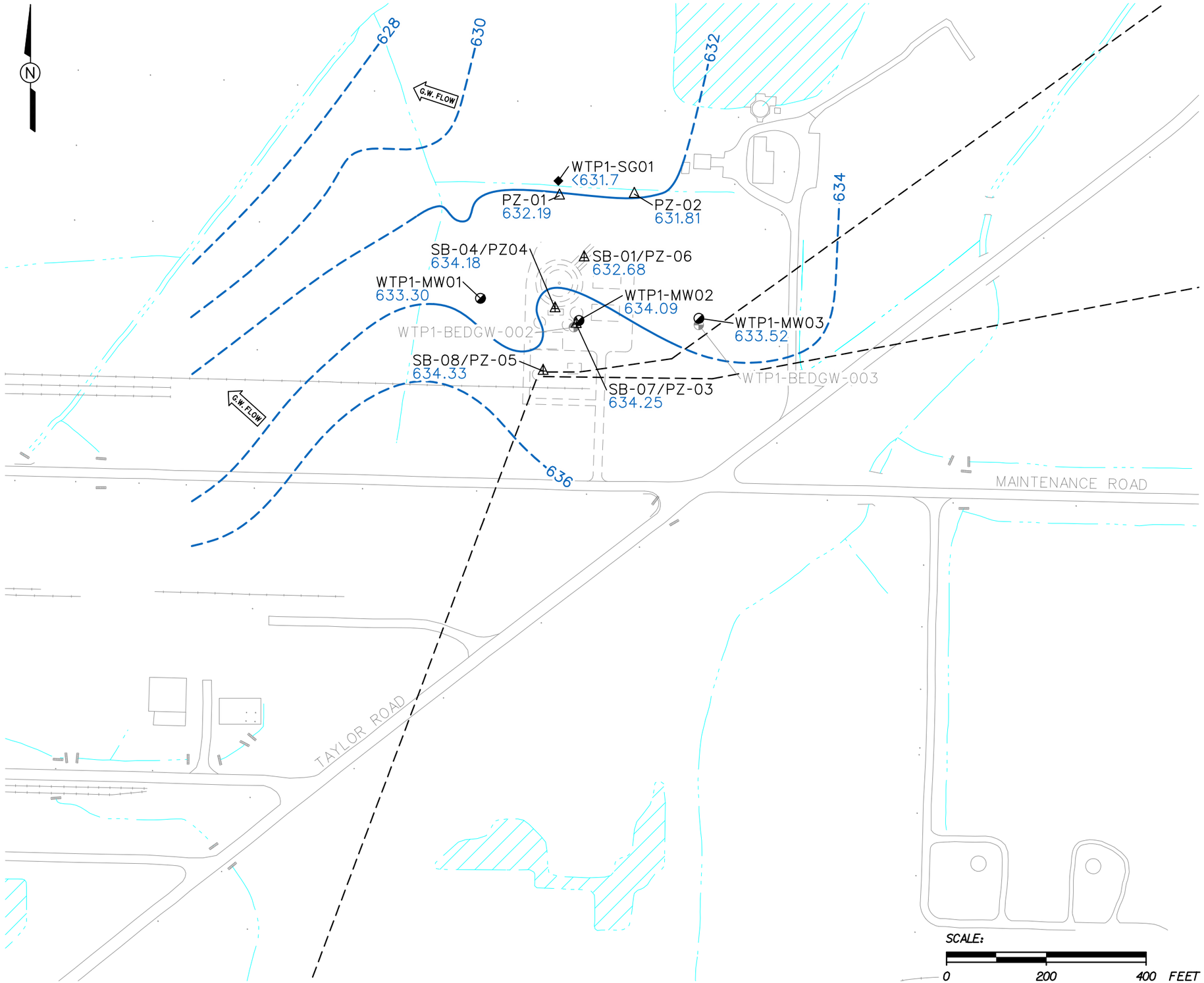

LEGEND:

- OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- SOIL BORING/PIEZOMETER
- PIEZOMETER
- STAFF GUAGE
- 633.52 GROUNDWATER ELEVATION (FT. MSL)
- —634— GROUNDWATER ELEVATION CONTOUR (FT. MSL) (DASHED WHERE INFERRED)
- G.W. FLOW GROUNDWATER FLOW DIRECTION
- — — — APPROXIMATE LOCATION OF SEWER LINES

NOTES:

1. SURFACE ELEVATION AT STAFF GUAGE WTP1-SG01 IS 631.7 FT. MSL; THEREFORE, THE GROUNDWATER ELEVATION IS LESS THAN THAT VALUE.

FIGURE 3-3
WWTP1 - OVERBURDEN/SHALE GROUNDWATER ELEVATION CONTOUR MAP (MAY 26, 2009)

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINES, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
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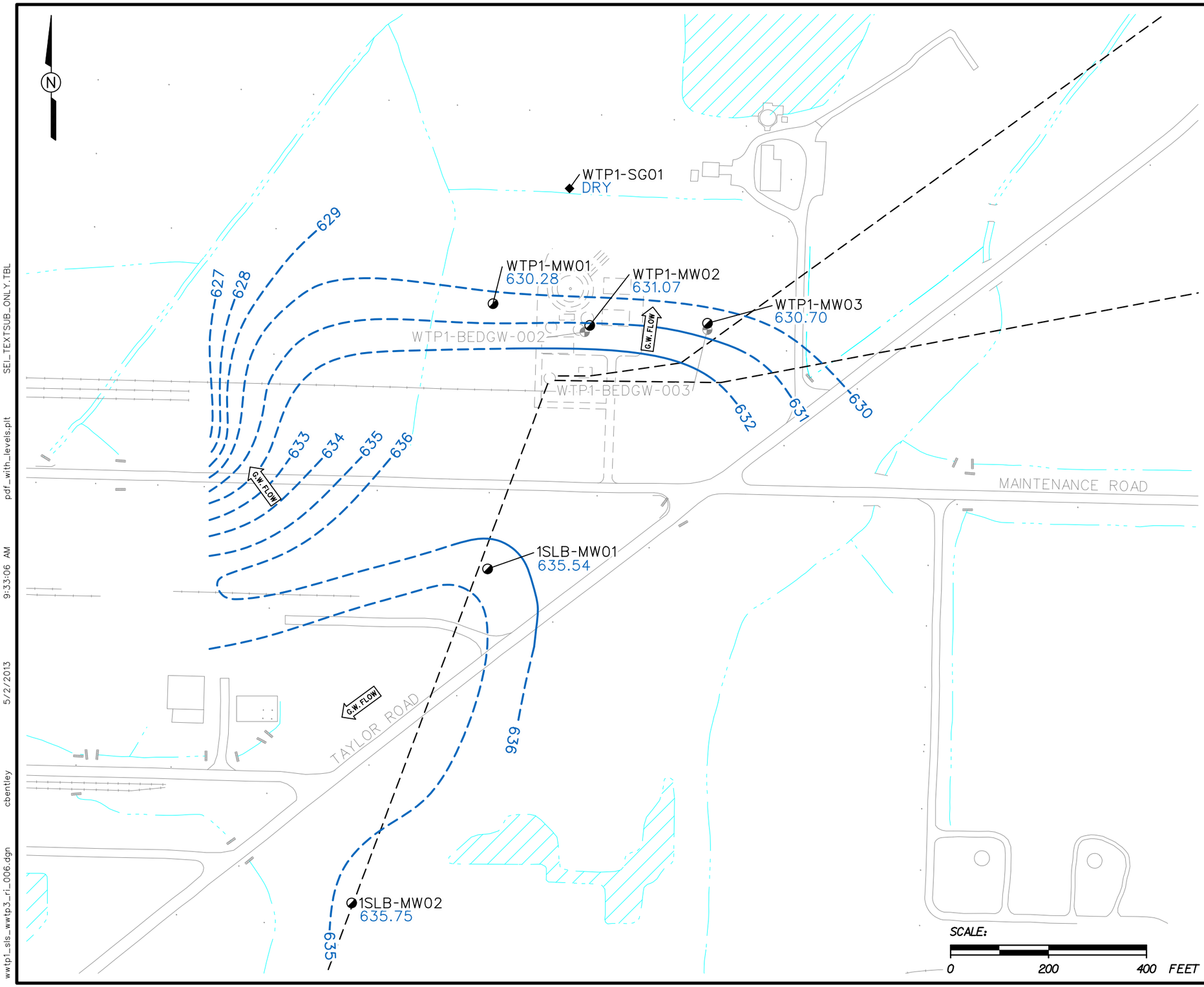

LEGEND:

- OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- STAFF GUAGE
- 623.18 GROUNDWATER ELEVATION (FT. MSL)
- —628— GROUNDWATER ELEVATION CONTOUR (FT. MSL) (DASHED WHERE INFERRED)
- G.W. FLOW GROUNDWATER FLOW DIRECTION
- — — — APPROXIMATE LOCATION OF SEWER LINES

FIGURE 3-4
WWTP1 - OVERBURDEN/SHALE GROUNDWATER ELEVATION CONTOUR MAP (OCTOBER 27, 2009)

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINES, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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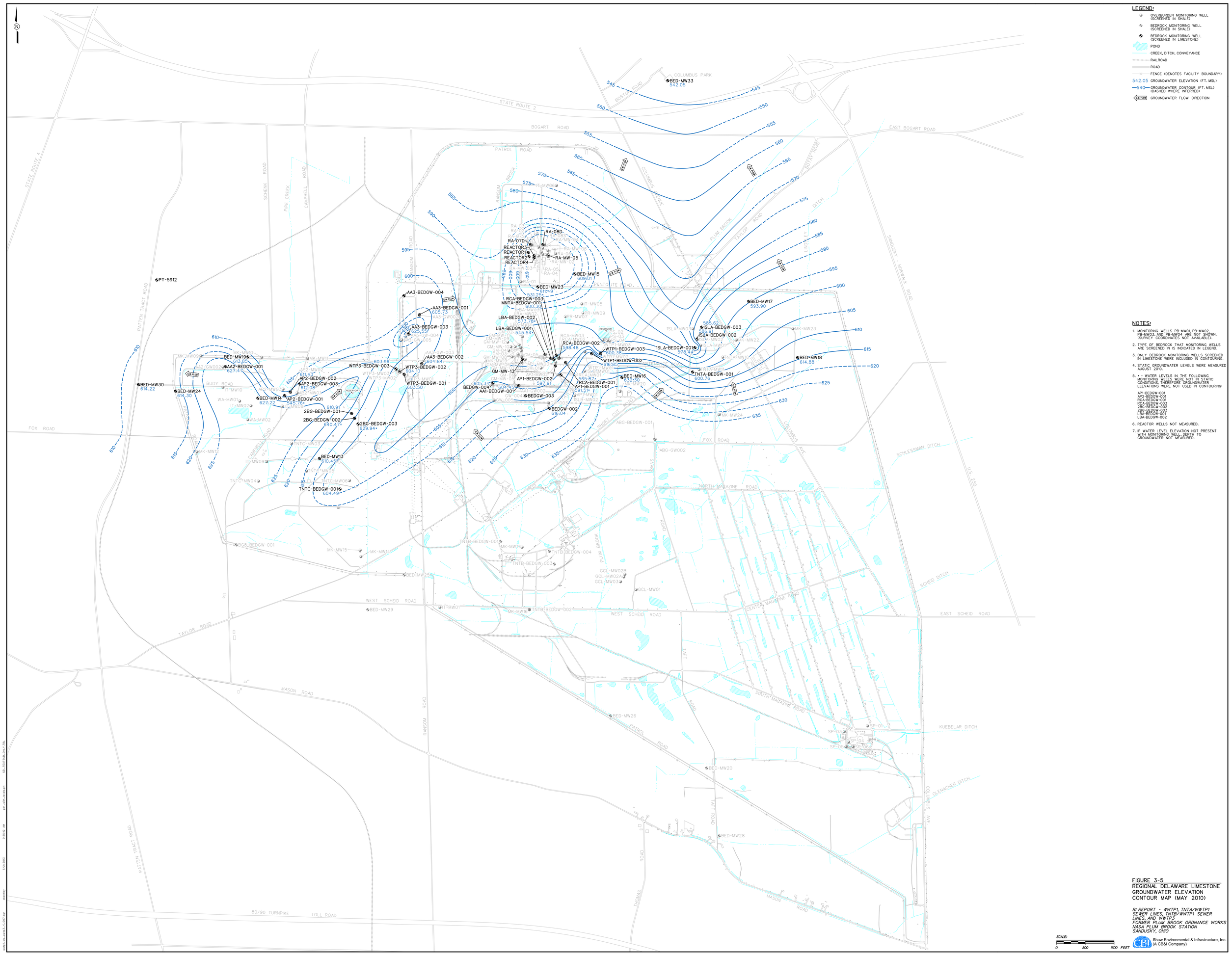


FIGURE 3-5
REGIONAL DELAWARE LIMESTONE
GROUNDWATER ELEVATION
CONTOUR MAP (MAY 2010)

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINES, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

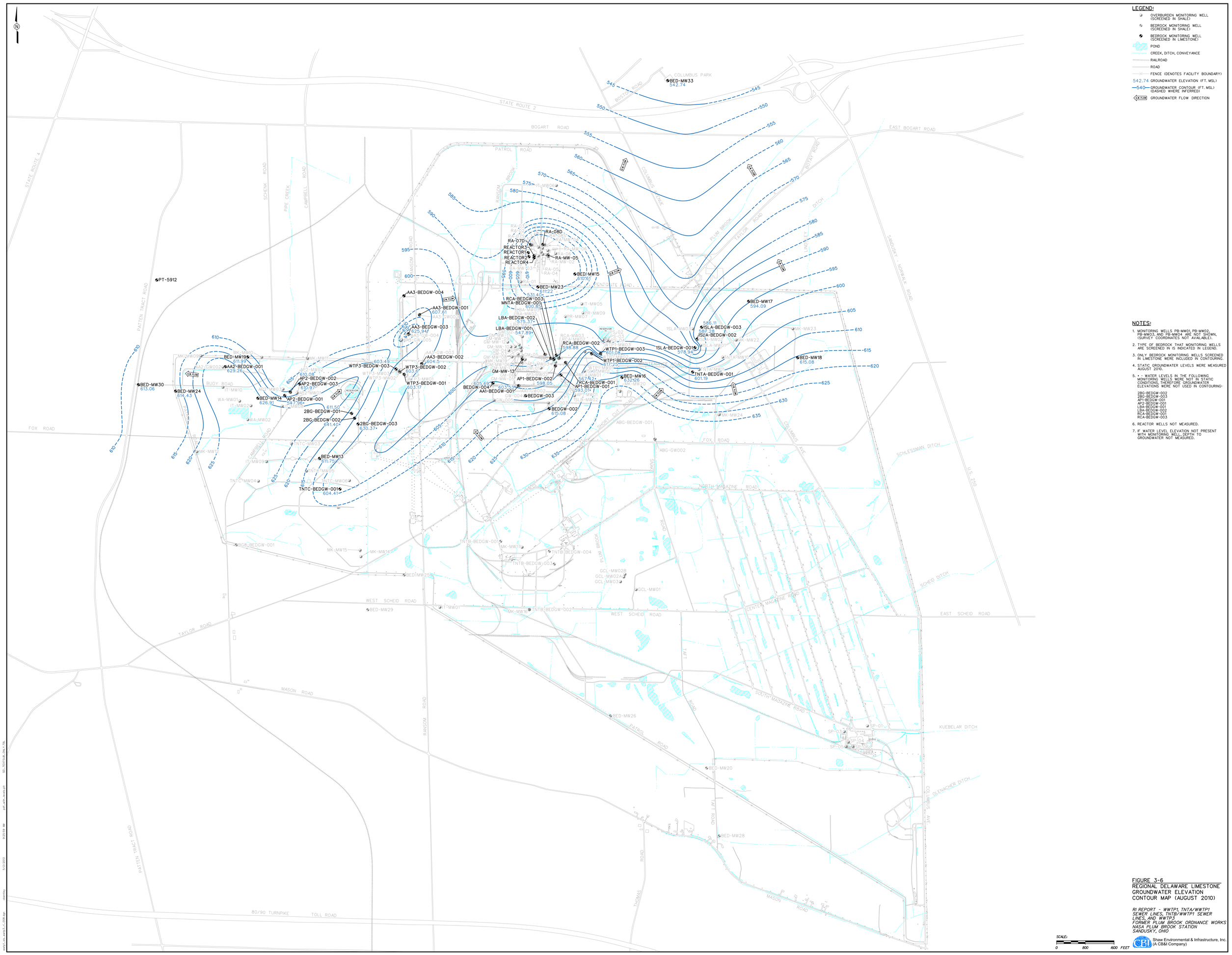
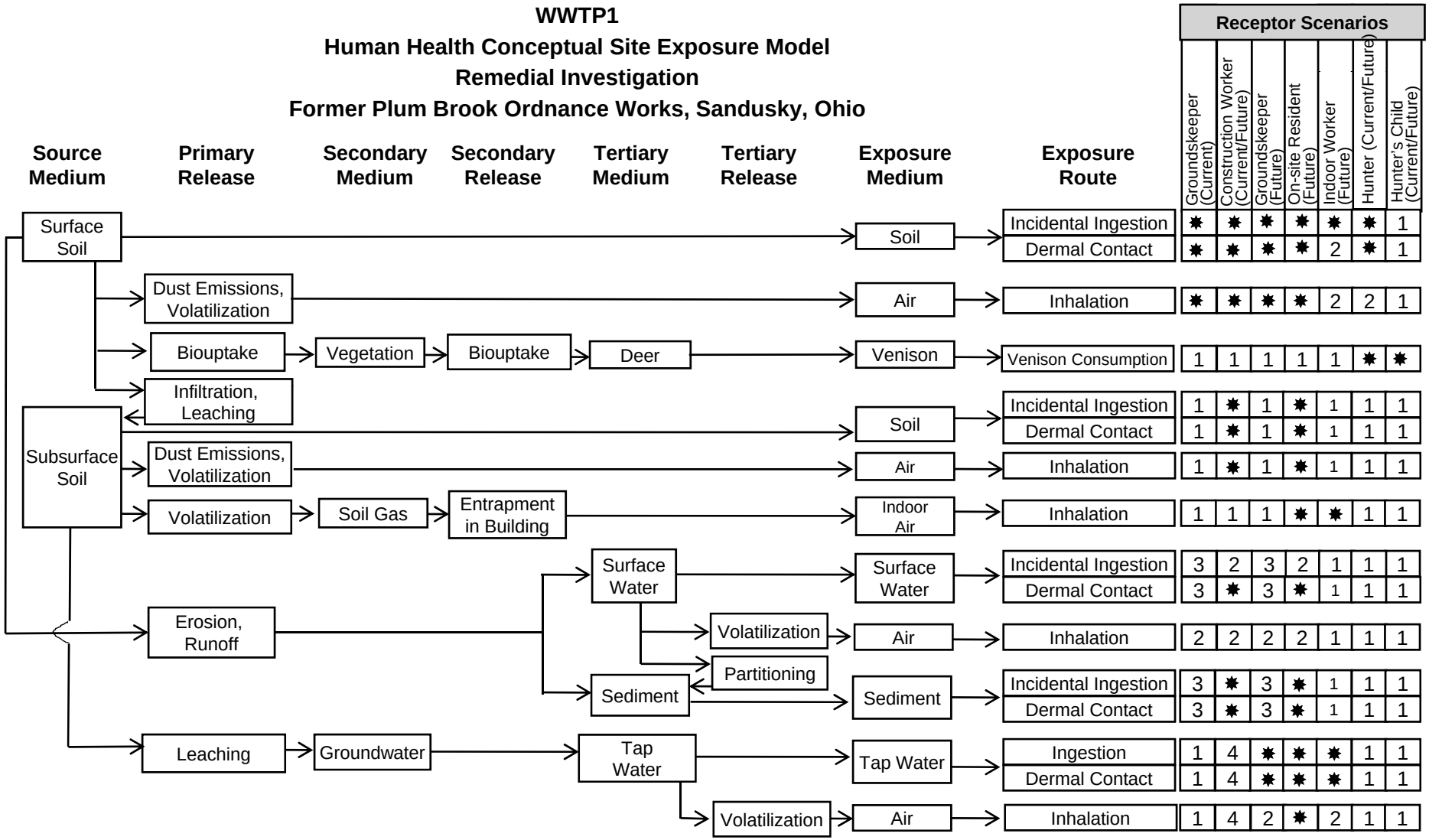


FIGURE 3-6
REGIONAL DELAWARE LIMESTONE
GROUNDWATER ELEVATION
CONTOUR MAP (AUGUST 2010)

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINES, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Figure 3-7

WWTP1
Human Health Conceptual Site Exposure Model
Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio



Exposure Route	Groundskeeper (Current)	Construction Worker (Current/Future)	Groundskeeper (Future)	On-site Resident (Future)	Indoor Worker (Future)	Hunter (Current/Future)	Hunter's Child (Current/Future)
Incidental Ingestion (Surface Soil → Soil)	✸	✸	✸	✸	✸	✸	1
Dermal Contact (Surface Soil → Soil)	✸	✸	✸	✸	2	✸	1
Inhalation (Dust Emissions, Volatilization → Air)	✸	✸	✸	✸	2	2	1
Venison Consumption (Biouptake → Vegetation → Biouptake → Deer → Venison)	1	1	1	1	1	✸	✸
Incidental Ingestion (Subsurface Soil → Soil)	1	✸	1	✸	1	1	1
Dermal Contact (Subsurface Soil → Soil)	1	✸	1	✸	1	1	1
Inhalation (Subsurface Soil → Dust Emissions, Volatilization → Air)	1	✸	1	✸	1	1	1
Inhalation (Subsurface Soil → Volatilization → Soil Gas → Entrapment in Building → Indoor Air)	1	1	1	✸	✸	1	1
Incidental Ingestion (Erosion, Runoff → Surface Water → Surface Water)	3	2	3	2	1	1	1
Dermal Contact (Erosion, Runoff → Surface Water → Surface Water)	3	✸	3	✸	1	1	1
Inhalation (Erosion, Runoff → Surface Water → Volatilization → Air)	2	2	2	2	1	1	1
Incidental Ingestion (Erosion, Runoff → Surface Water → Partitioning → Sediment → Sediment)	3	✸	3	✸	1	1	1
Dermal Contact (Erosion, Runoff → Surface Water → Partitioning → Sediment → Sediment)	3	✸	3	✸	1	1	1
Ingestion (Leaching → Groundwater → Tap Water → Tap Water)	1	4	✸	✸	✸	1	1
Dermal Contact (Leaching → Groundwater → Tap Water → Tap Water)	1	4	✸	✸	✸	1	1
Inhalation (Leaching → Groundwater → Tap Water → Volatilization → Air)	1	4	2	✸	2	1	1

✸ = Complete exposure route quantified in the risk assessment.
1 = There is no plausible pathway for exposure to this medium.
2 = Although theoretically complete, this pathway is not quantified as explained in text.
3 = Contact with this medium, although plausible, is not part of this receptor's normal or expected activities; therefore contact would be sporadic and is not quantified.
4 = For current use there is no plausible exposure pathway. For future use, the pathway is potentially complete, but is not quantified as explained in the text.

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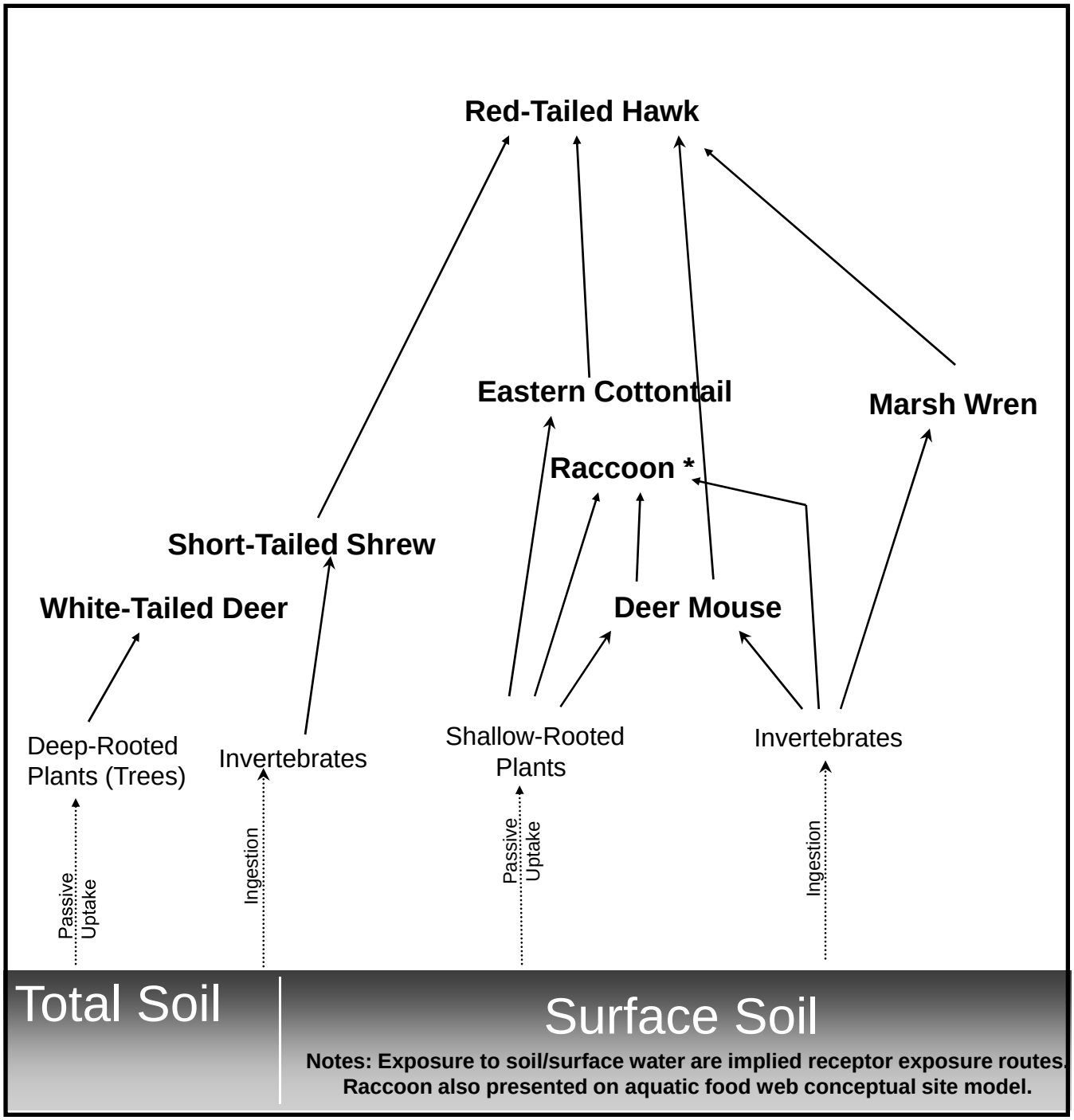
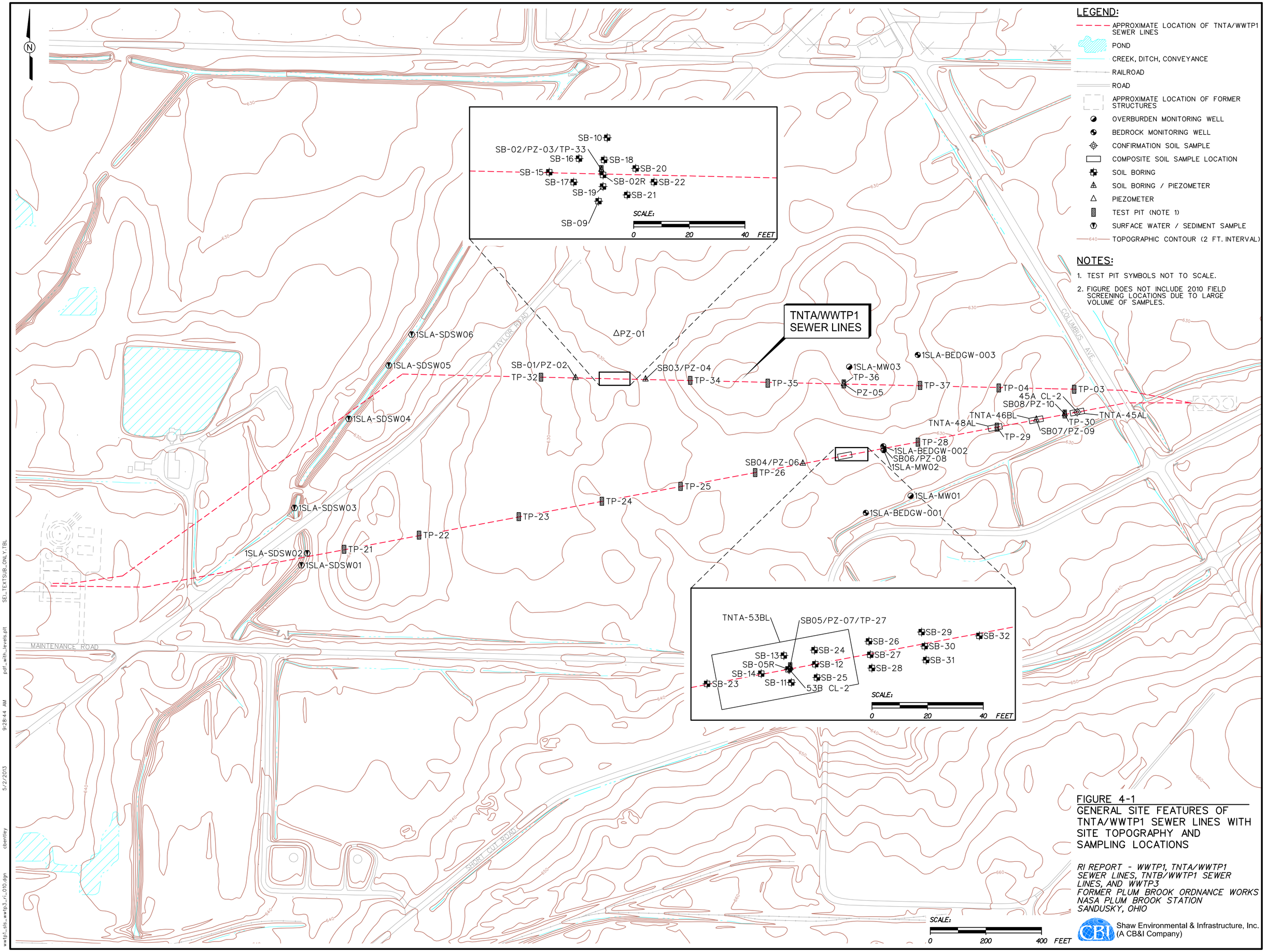
Figure 3-8

WWTP1
Simplified Terrestrial Food Web Conceptual Site Model
Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio



*** = The raccoon was not evaluated in the risk assessment.**


LEGEND:
APPROXIMATE LOCATION OF TNTA/WWTP1 SEWER LINES
POND
CREEK, DITCH, CONVEYANCE
RAILROAD
ROAD
APPROXIMATE LOCATION OF FORMER STRUCTURES
OVERBURDEN MONITORING WELL
BEDROCK MONITORING WELL
CONFIRMATION SOIL SAMPLE
COMPOSITE SOIL SAMPLE LOCATION
SOIL BORING
SOIL BORING / PIEZOMETER
PIEZOMETER
TEST PIT (NOTE 1)
SURFACE WATER / SEDIMENT SAMPLE
TOPOGRAPHIC CONTOUR (2 FT. INTERVAL)
NOTES:
1. TEST PIT SYMBOLS NOT TO SCALE.
2. FIGURE DOES NOT INCLUDE 2010 FIELD SCREENING LOCATIONS DUE TO LARGE VOLUME OF SAMPLES.
TNTA/WWTP1 SEWER LINES
SCALE:
0 20 40 FEET
SB-10
SB-02/PZ-03/TP-33
SB-16
SB-18
SB-20
SB-15
SB-17
SB-02R
SB-22
SB-19
SB-21
SB-09
TNTA-53BL
SB05/PZ-07/TP-27
SB-29
SB-32
SB-26
SB-30
SB-24
SB-13
SB-27
SB-31
SB-05R
SB-12
SB-28
SB-14
SB-25
SB-23
SB-11
53B CL-2
1SLA-SDSW06
1SLA-SDSW05
1SLA-SDSW04
1SLA-SDSW03
1SLA-SDSW02
1SLA-SDSW01
PZ-01
SB-01/PZ-02
TP-32
SB03/PZ-04
TP-34
TP-35
1SLA-MW03
TP-36
PZ-05
TP-37
1SLA-BEDGW-003
TP-04
TP-03
45A CL-2
SB08/PZ-10
TNTA-46BL
TNTA-45AL
TP-30
TNTA-48AL
SB07/PZ-09
TP-29
TP-28
1SLA-BEDGW-002
SB06/PZ-08
1SLA-MW02
SB04/PZ-06A
TP-26
TP-25
TP-24
TP-23
TP-22
TP-21
1SLA-MW01
1SLA-BEDGW-001
TAYLOR ROAD
COLUMBUS AVE
MAINTENANCE ROAD
SHORT CUT ROAD
SCALE:
0 200 400 FEET
FIGURE 4-1
GENERAL SITE FEATURES OF TNTA/WWTP1 SEWER LINES WITH SITE TOPOGRAPHY AND SAMPLING LOCATIONS
RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINES, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO
Shaw Environmental & Infrastructure, Inc.
(A CB&I Company)
wwtp1_sls_wwtp3_ri_010.dgn
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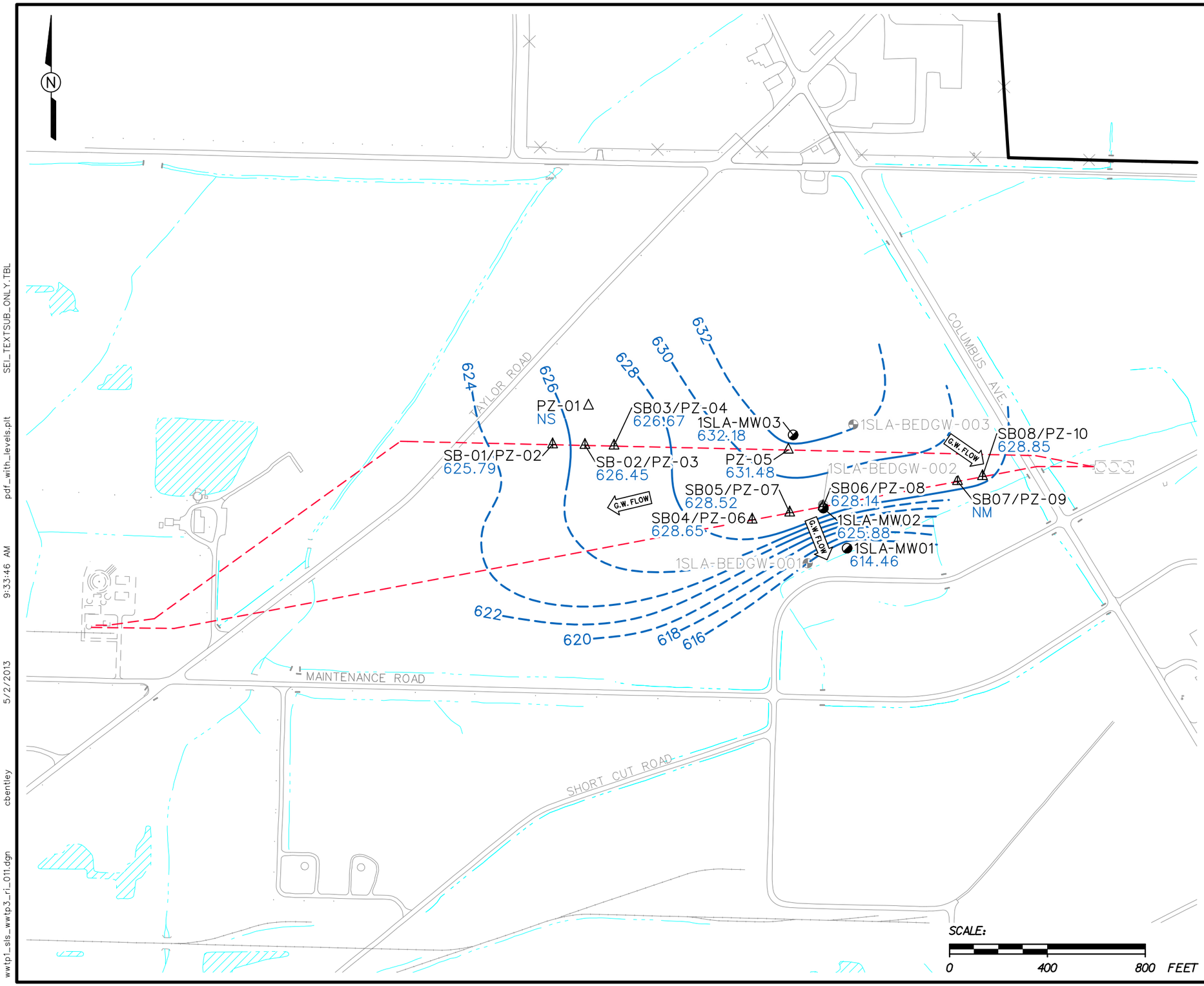

LEGEND:

- APPROXIMATE LOCATION OF TNTA/WWTP1 SEWER LINES
- OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- SOIL BORING/PIEZOMETER
- PIEZOMETER
- 628.85 GROUNDWATER ELEVATION (FT. MSL)
- —628— GROUNDWATER ELEVATION CONTOUR (FT. MSL) (DASHED WHERE INFERRED)
- G.W. FLOW GROUNDWATER FLOW DIRECTION
- NS NOT SURVEYED
- NM NOT MEASURED

FIGURE 4-2

TNTA/WWTP1 SEWER LINES - OVERBURDEN/SHALE GROUNDWATER ELEVATION CONTOUR MAP (MAY 26, 2009)

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINE, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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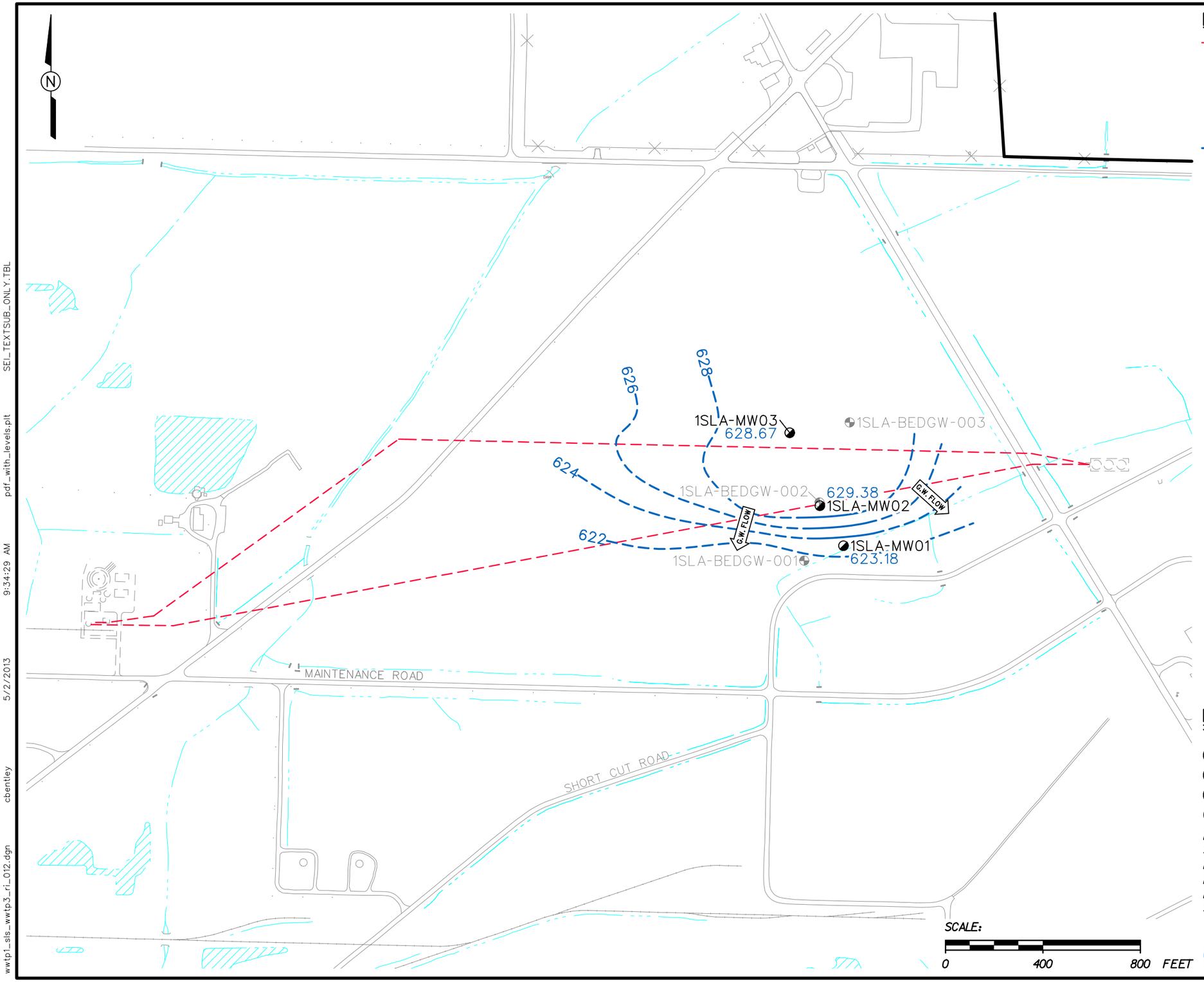
wwtp1_sls_wwtp3_ri_011.dgn cbentley 5/2/2013 9:33:46 AM pdf_with_levels.plt SEL_TEXTSUB_ONLY_TBL



LEGEND:

- APPROXIMATE LOCATION OF TNTA/WWTP1 SEWER LINES
- OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- 628.85 GROUNDWATER ELEVATION (FT. MSL)
- —628— GROUNDWATER ELEVATION CONTOUR (FT. MSL) (DASHED WHERE INFERRED)
- G.W. FLOW GROUNDWATER FLOW DIRECTION

FIGURE 4-3

TNTA/WWTP1 SEWER LINES - OVERBURDEN/SHALE GROUNDWATER ELEVATION CONTOUR MAP (OCTOBER 27, 2009)

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINE, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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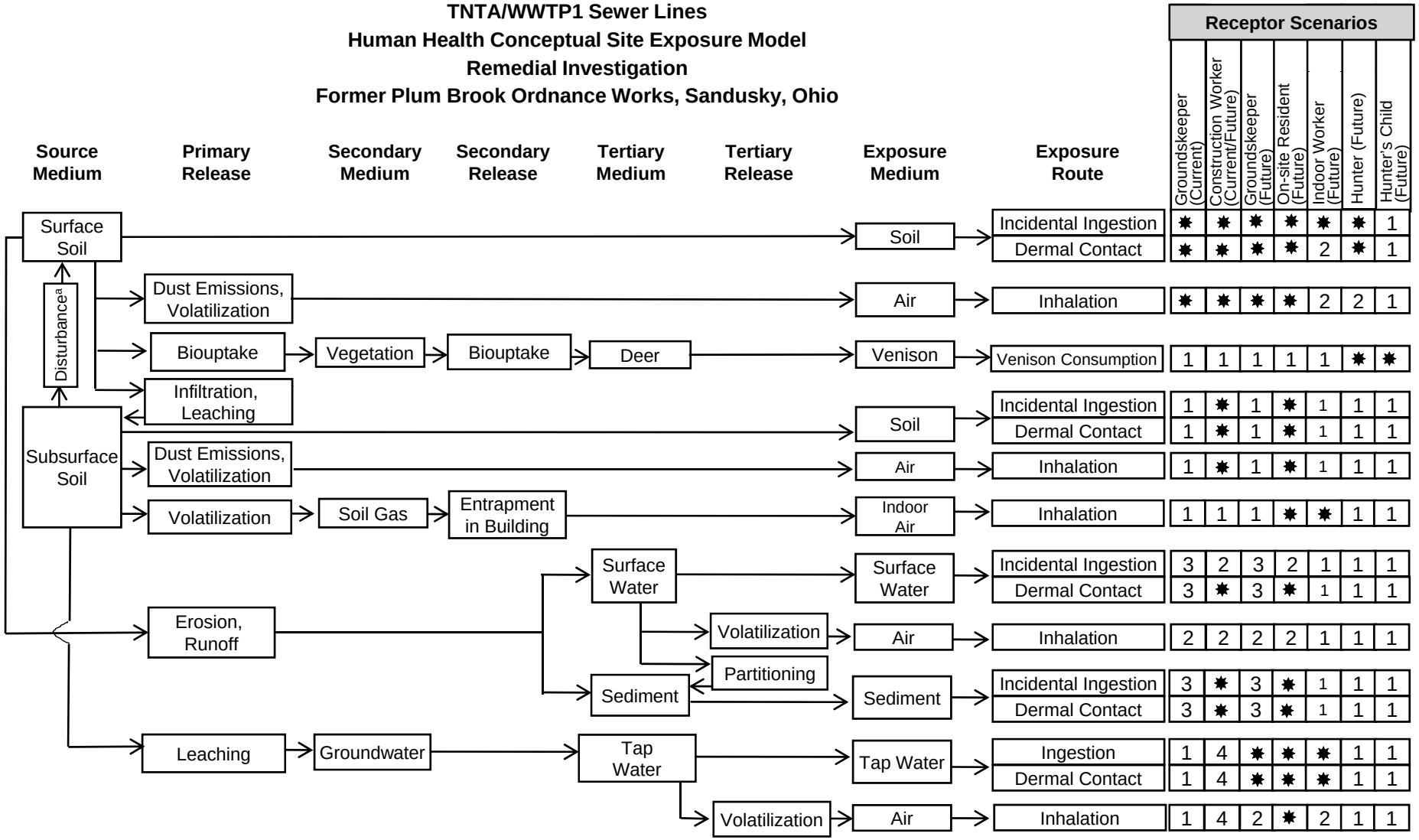
Figure 4-4

TNTA/WWTP1 Sewer Lines
Human Health Conceptual Site Exposure Model
Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio



[a] = Current surface soil may have been impacted by subsurface soil during sewer line removal.
✸ = Complete exposure route quantified in the risk assessment.
1 = There is no plausible pathway for exposure to this medium.
2 = Although theoretically complete, this pathway is not quantified as explained in text.
3 = Contact with this medium, although plausible, is not part of this receptor's normal or expected activities; therefore contact would be sporadic and is not quantified.
4 = For current use there is no plausible exposure pathway. For future use, the pathway is potentially complete, but is not quantified as explained in the text.

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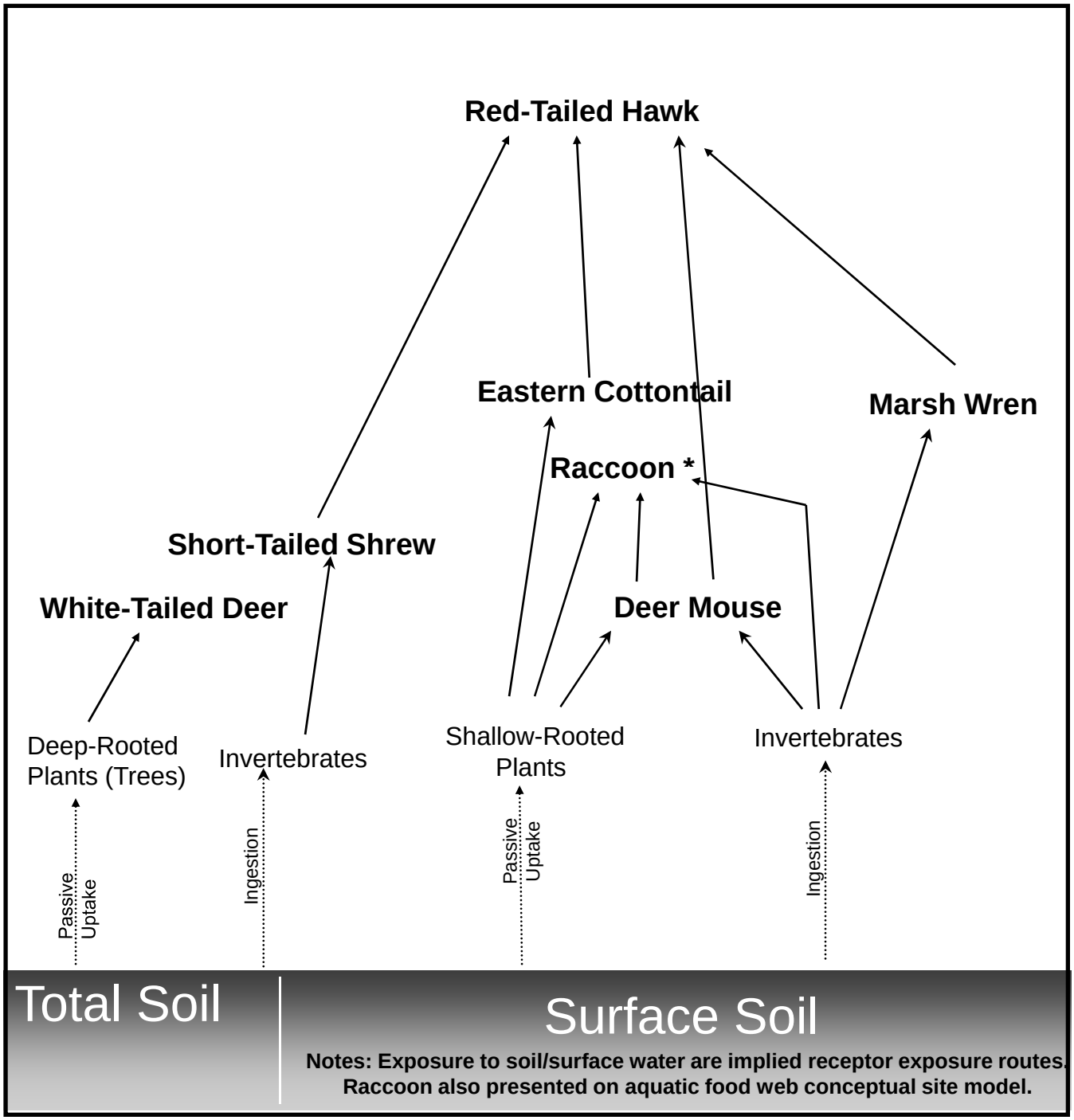
Figure 4-5

TNTA/WWTP1 Sewer Lines
Simplified Terrestrial Food Web Conceptual Site Model
Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio



*** = The raccoon was not evaluated in the risk assessment.**

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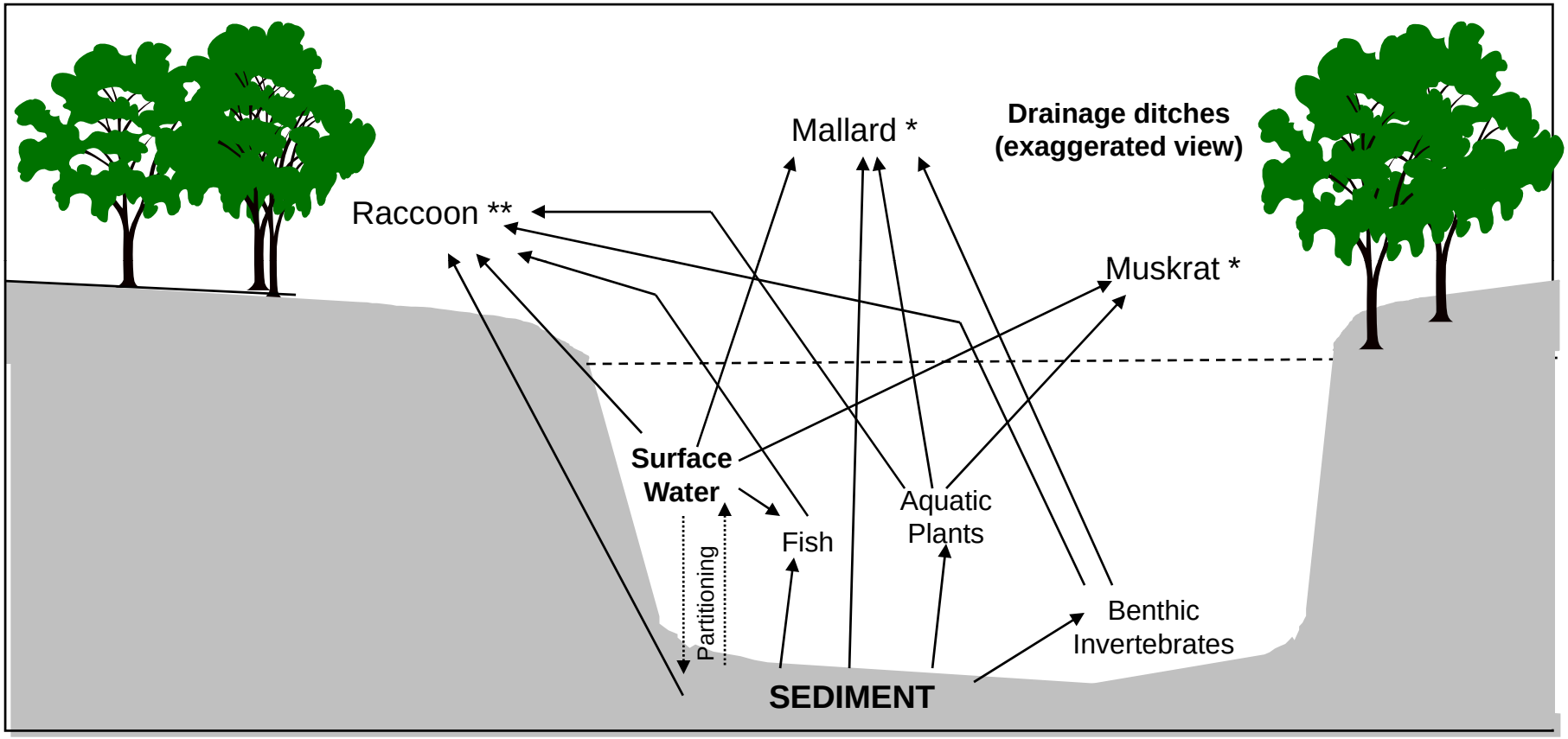
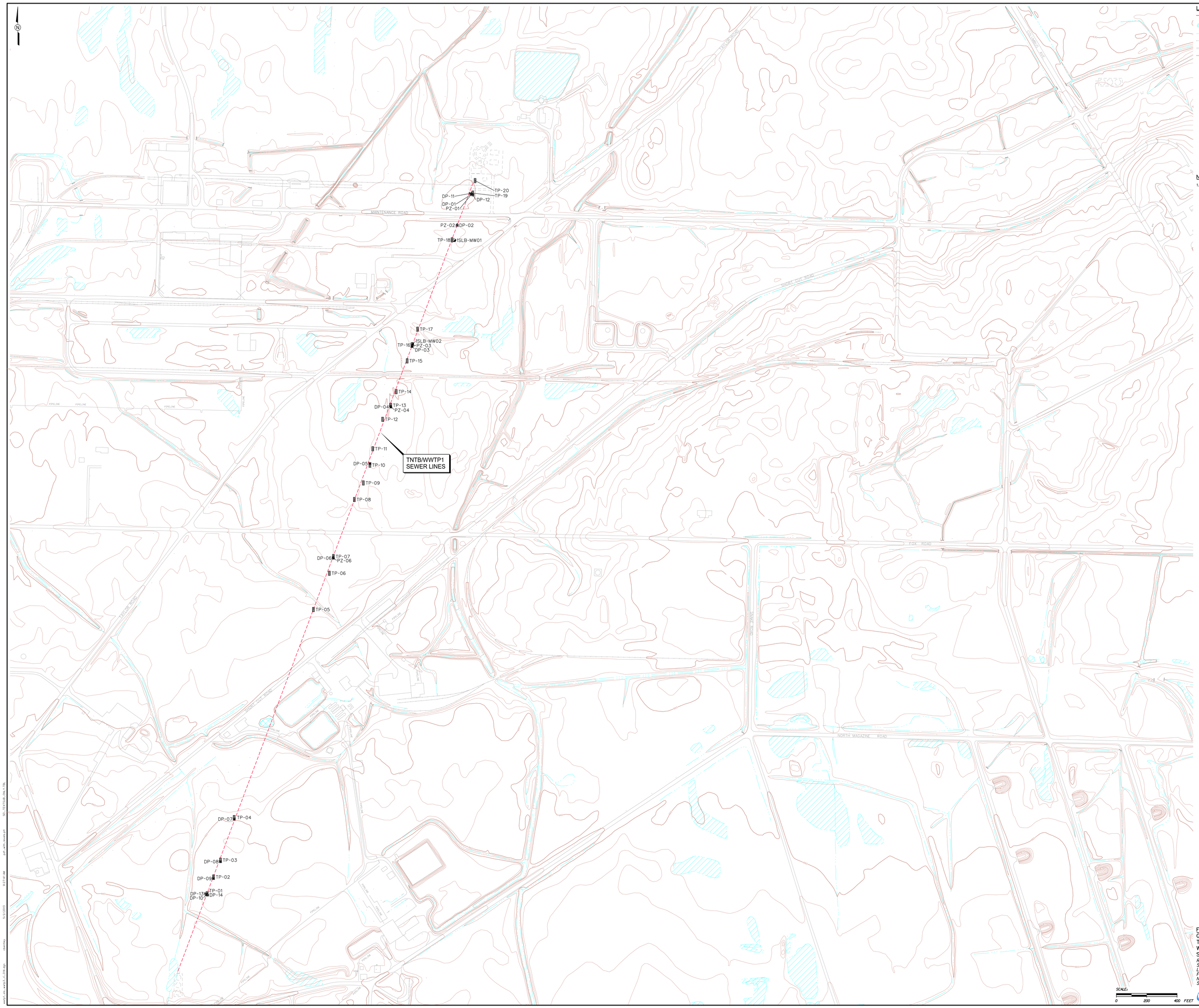
Figure 4-6

TNTA/WWTP1 Sewer Lines
Simplified Aquatic Food Web Conceptual Site Model
Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio



Note: The raccoon is also presented on terrestrial food web conceptual site model.

*** = The mallard and the muskrat are not evaluated in the risk assessment due to the lack of aquatic habitat.**
**** = Because no contaminants were identified in sediment, the raccoon is not evaluated in the risk assessment.**



LEGEND:

- APPROXIMATE LOCATION OF TNTB/WWTP1 SEWER LINES
- POND
- CREEK, DITCH, CONVEYANCE
- RAILROAD
- ROAD
- TOPOGRAPHIC CONTOUR (2 FT. INTERVAL)
- APPROXIMATE LOCATION OF FORMER STRUCTURES
- OVERBURDEN MONITORING WELL
- PIEZOMETER
- TEST PIT (NOTE 1)
- DIRECT-PUSH LOCATION

NOTES:

1. TEST PIT SYMBOLS NOT TO SCALE.

FIGURE 5-1
GENERAL SITE FEATURES OF TNTB/WWTP1 SEWER LINES WITH SITE TOPOGRAPHY AND SAMPLING LOCATIONS

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINE, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
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SANDUSKY, OHIO

SCALE:
0 200 400 FEET

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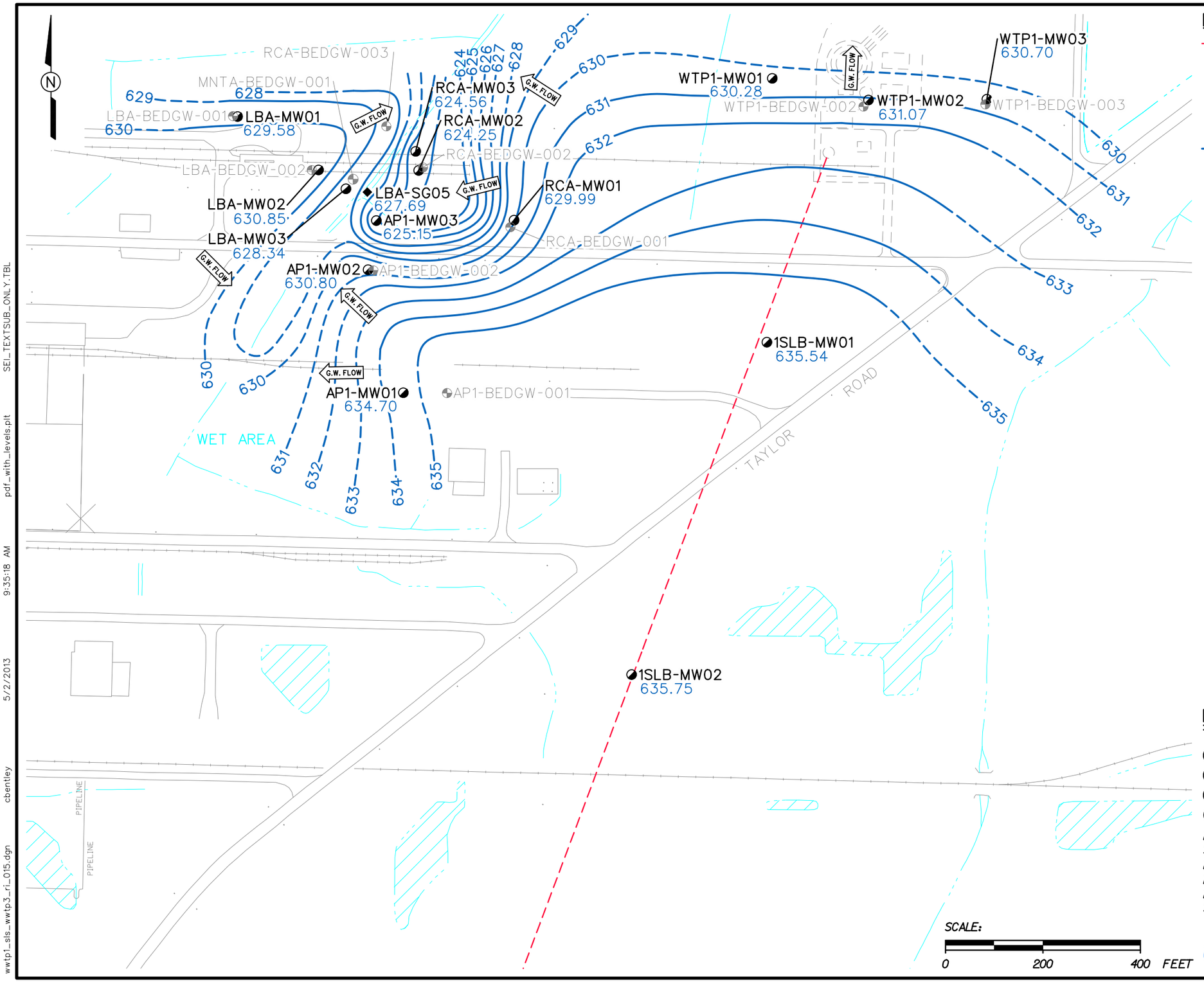

LEGEND:

- APPROXIMATE LOCATION OF TNTB/WWTP1 SEWER LINES
- OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- 630.70 GROUNDWATER ELEVATION (FT. MSL)
- —630— GROUNDWATER ELEVATION CONTOUR (FT. MSL) (DASHED WHERE INFERRED)
- G.W. FLOW GROUNDWATER FLOW DIRECTION

SCALE:

0 200 400 FEET

FIGURE 5-2

TNTB/WWTP1 SEWER LINES - OVERBURDEN/SHALE GROUNDWATER ELEVATION CONTOUR MAP (OCTOBER 27, 2009)

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINE, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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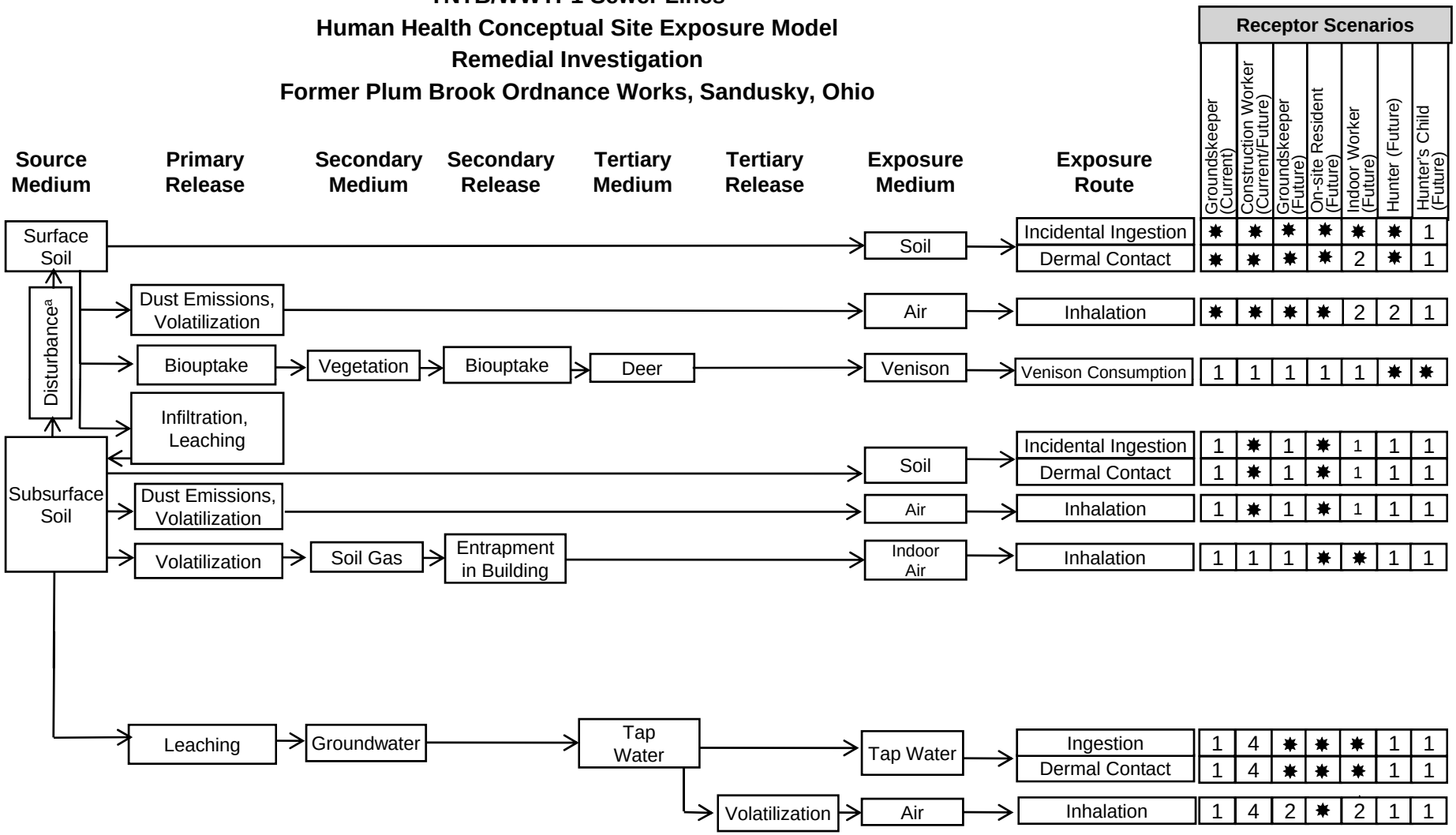
wwtp1_sls_wwtp3_ri_015.dgn cbentley 5/2/2013 9:35:18 AM pdf_with_levels.plt SEL_TEXTSUB_ONLY.TBL

Figure 5-3

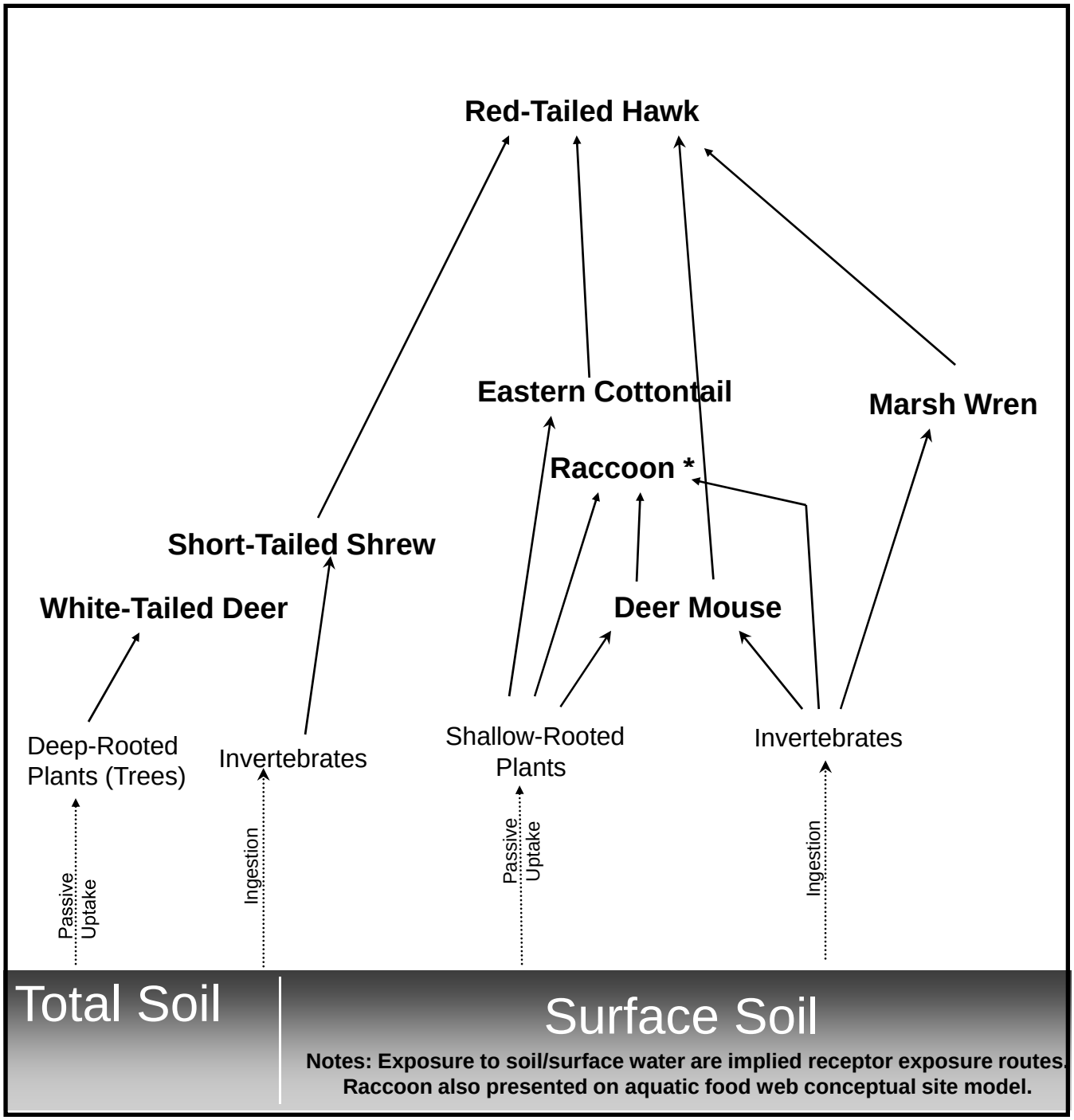
TNTB/WWTP1 Sewer Lines
Human Health Conceptual Site Exposure Model
Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio



✸Current surface soil may have been historically affected by subsurface soil during sewer line removal.
= Complete exposure route quantified in the risk assessment.
1 = There is no plausible pathway for exposure to this medium.
2 = Although theoretically complete, this pathway is not quantified as explained in text.
3 = Contact with this medium, although plausible, is not part of this receptor's normal or expected activities; therefore contact would be sporadic and is not quantified.
4 = For current use there is no plausible exposure pathway. For future use, the pathway is potentially complete, but is not quantified as explained in the text.

Figure 5-4

TNTB/WWTP1 Sewer Lines
Simplified Terrestrial Food Web Conceptual Site Model
Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio



*** = The raccoon was not evaluated in the risk assessment.**

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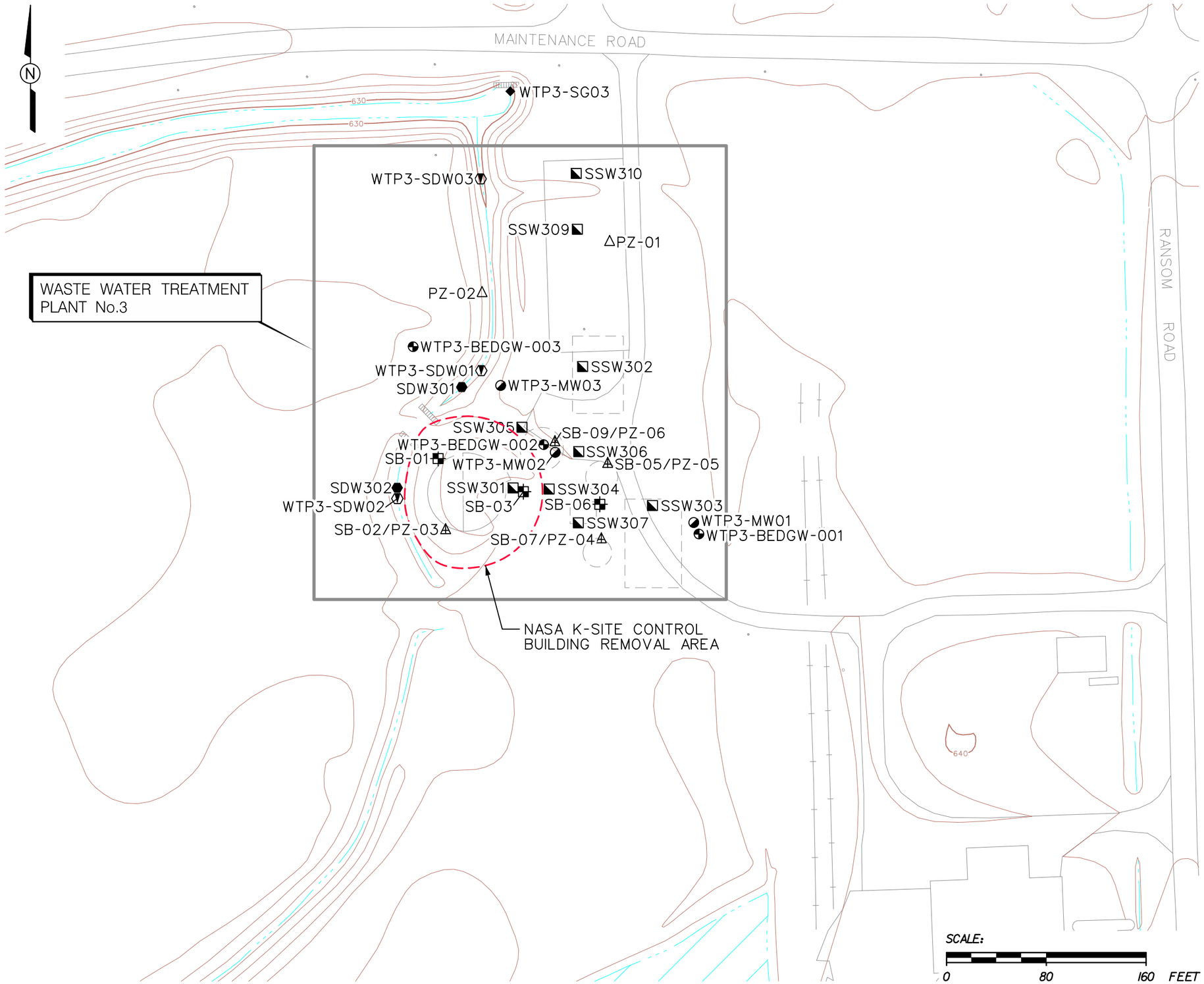

LEGEND:

- AREA OF CONCERN
- POND
- CREEK, DITCH, CONVEYANCE
- ROAD
- 640 TOPOGRAPHIC CONTOUR (2 FT. INTERVAL)
- APPROXIMATE LOCATION OF FORMER WWTP3 STRUCTURES
- OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- 1999 SURFACE SOIL SAMPLE (USACE, 2000)
- 1999 SEDIMENT SAMPLE (USACE, 2000)
- SOIL BORING
- SOIL BORING/PIEZOMETER
- PIEZOMETER
- STAFF GUAGE
- SURFACE WATER / SEDIMENT SAMPLE
- BOUNDARY OF BUILDING REMOVAL AREA

NOTES:

1. NASA HAS ACCEPTED RESPONSIBILITY FOR THE REMOVAL OF THE K-SITE CONTROL BUILDING AND THE ASSOCIATED AREA. THIS AREA EXTENDS TO THE CREST OF A BERM WHICH PARTIALLY SURROUNDS THE BUILDING.
2. THE NASA K-SITE CONTROL BUILDING REMOVAL AREA IS NOT PART OF THE DERP-FUDS PROJECT.

FIGURE 6-1

GENERAL SITE FEATURES OF WWTP3 WITH SITE TOPOGRAPHY AND SAMPLING LOCATIONS

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINE, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
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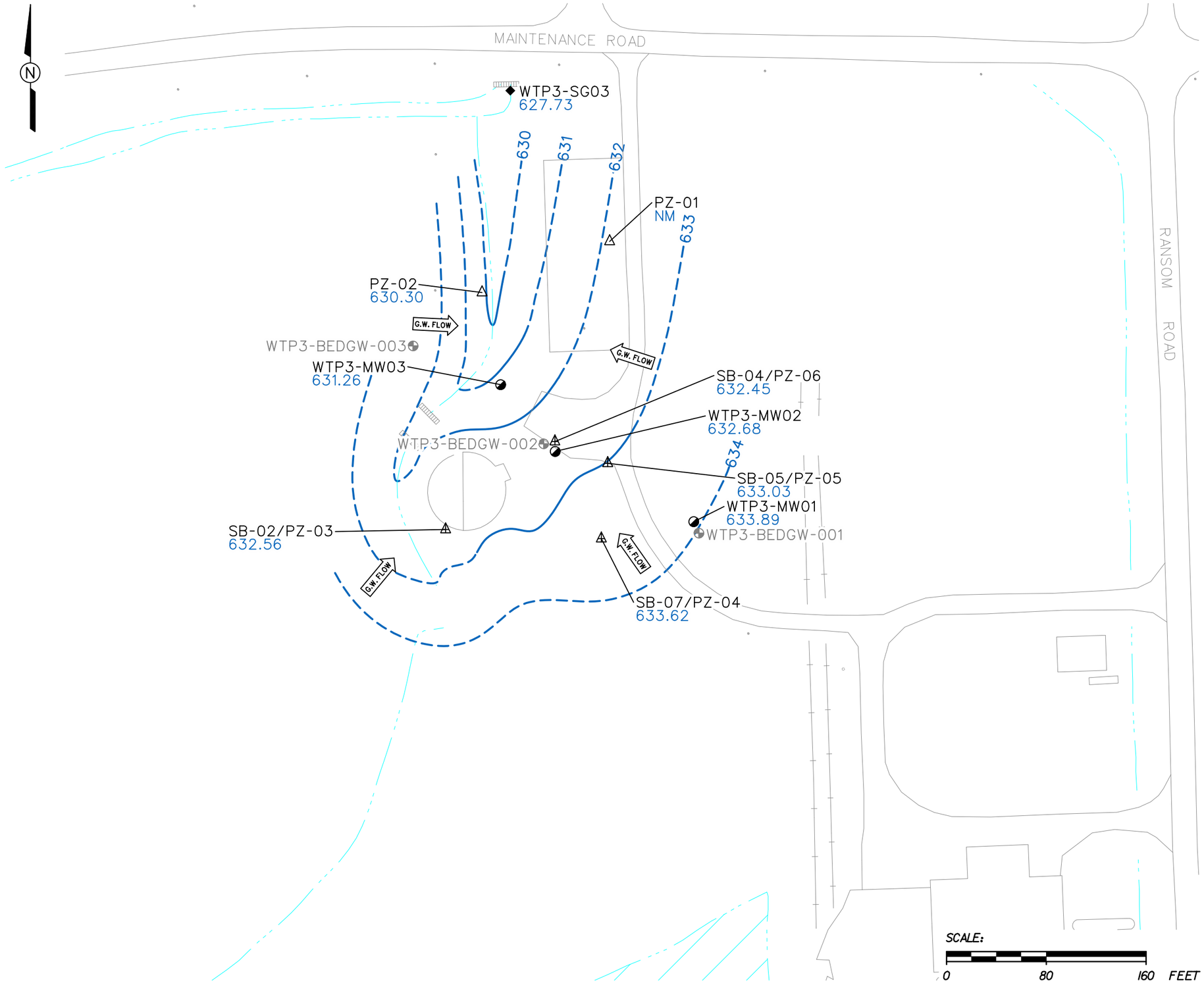
wwtp1_sls_wwtp3_ri_017.dgn cbentley 5/2/2013 9:37:50 AM pdf_with_levels.plt SEL_TEXTSUB_ONLY.TBL



LEGEND:

- OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- SOIL BORING/PIEZOMETER
- PIEZOMETER
- STAFF GUAGE
- 633.89 GROUNDWATER ELEVATION (FT. MSL)
- —634— GROUNDWATER ELEVATION CONTOUR (FT. MSL) (DASHED WHERE INFERRED)
- G.W. FLOW GROUNDWATER FLOW DIRECTION
- NM NOT MEASURED

FIGURE 6-2

WWTP3 - OVERBURDEN/SHALE GROUNDWATER ELEVATION CONTOUR MAP (MAY 18, 2009)

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINE, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
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SANDUSKY, OHIO

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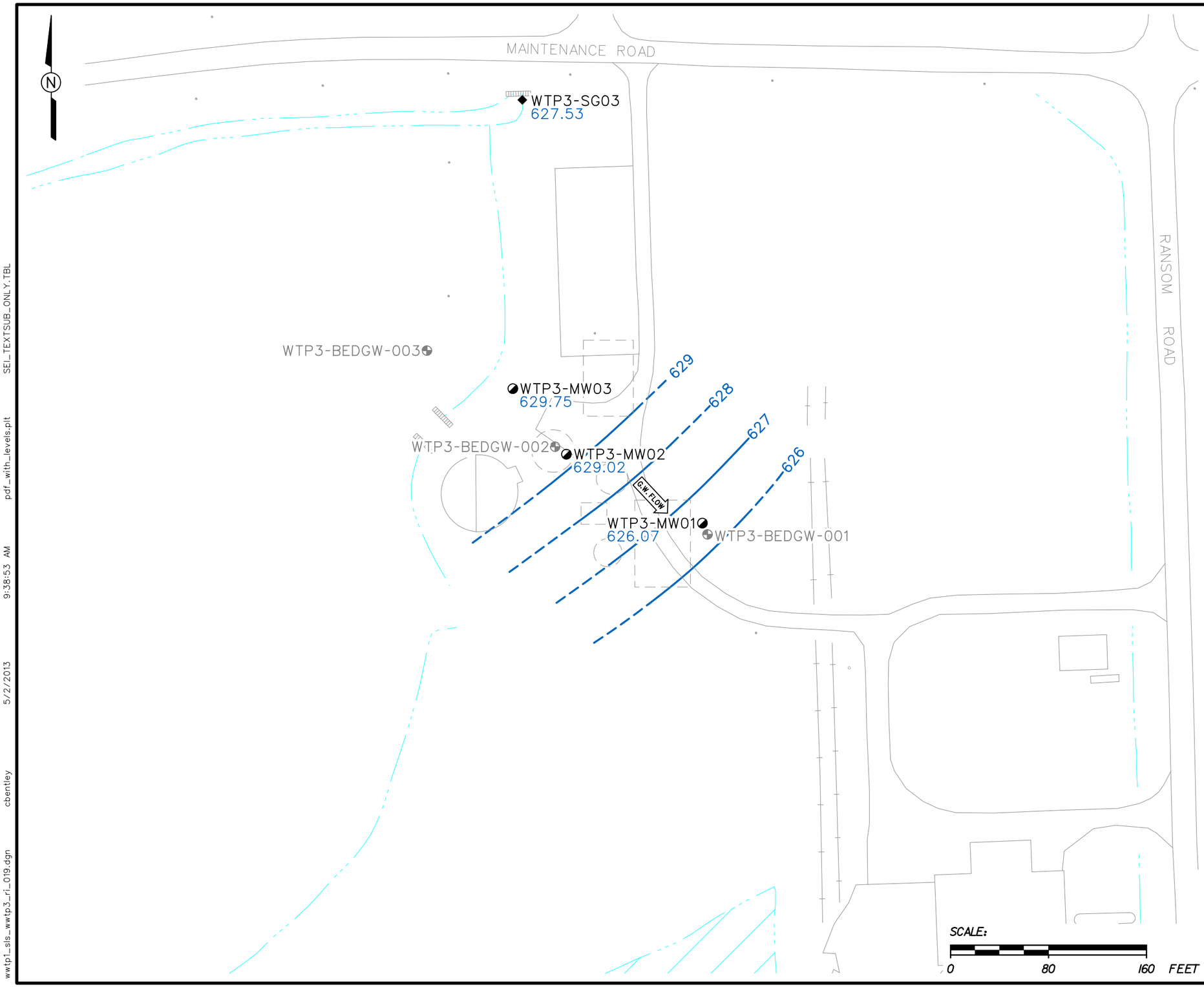

LEGEND:

- OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- STAFF GUAGE
- 626.07 GROUNDWATER ELEVATION (FT. MSL)
- —626— GROUNDWATER ELEVATION CONTOUR (FT. MSL) (DASHED WHERE INFERRED)
- G.W. FLOW GROUNDWATER FLOW DIRECTION

FIGURE 6-3

WWTP3 - OVERBURDEN/SHALE GROUNDWATER ELEVATION CONTOUR MAP (NOVEMBER 10, 2009)

RI REPORT - WWTP1, TNTA/WWTP1 SEWER LINES, TNTB/WWTP1 SEWER LINE, AND WWTP3
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Environmental & Infrastructure, Inc.
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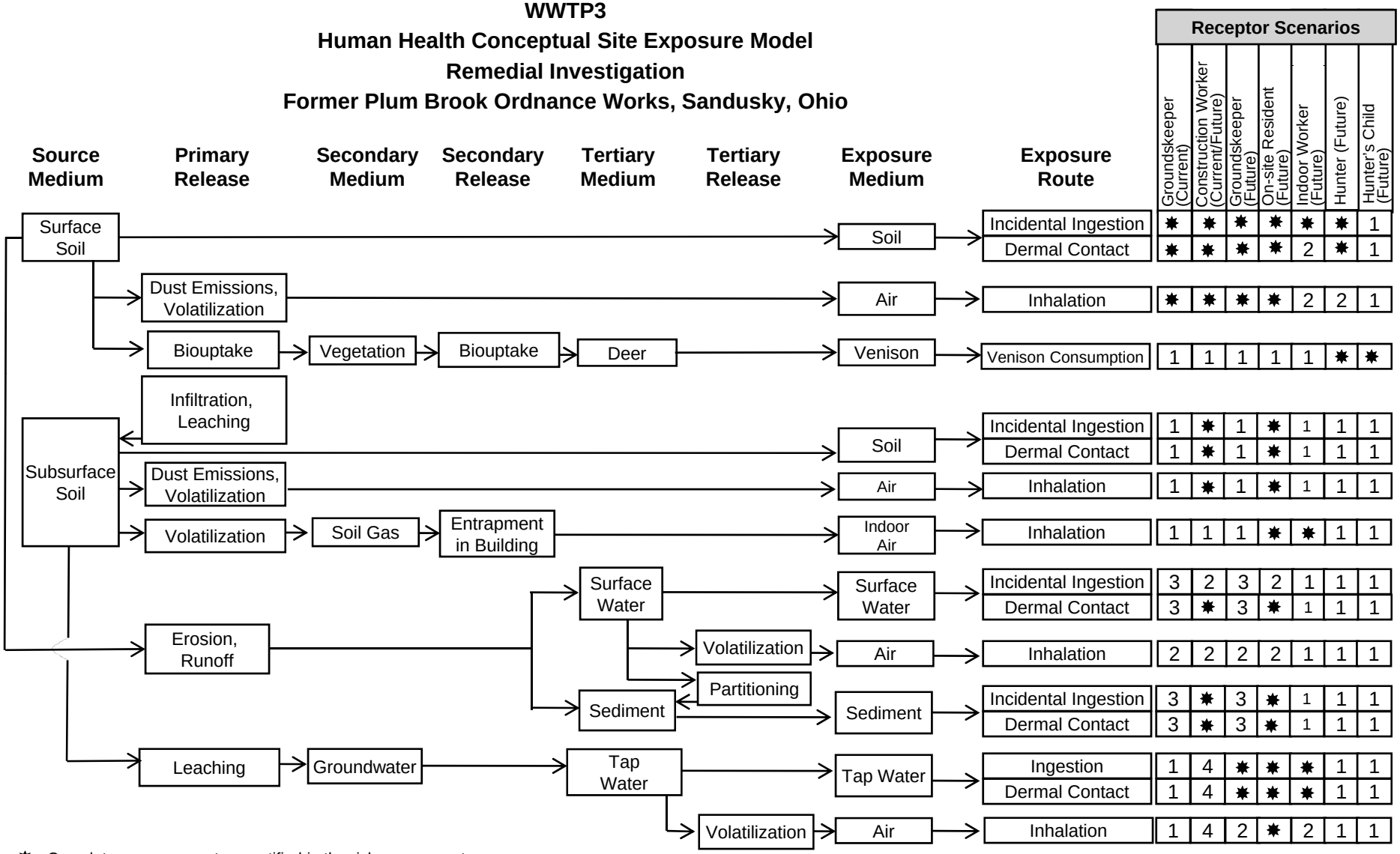
wwtp1_sls_wwtp3_ri_019.dgn cbentley 5/2/2013 9:38:53 AM pdf_with_levels.plt SEL_TEXTSUB_ONLY.TBL

Figure 6-4

WWTP3
Human Health Conceptual Site Exposure Model
Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio



Receptor Scenarios	Groundskeeper (Current)	Construction Worker (Current/Future)	Groundskeeper (Future)	On-site Resident (Future)	Indoor Worker (Future)	Hunter (Future)	Hunter's Child (Future)
Surface Soil → Soil → Incidental Ingestion	✸	✸	✸	✸	✸	✸	1
Surface Soil → Soil → Dermal Contact	✸	✸	✸	✸	2	✸	1
Surface Soil → Dust Emissions, Volatilization → Air → Inhalation	✸	✸	✸	✸	2	2	1
Surface Soil → Biouptake → Vegetation → Biouptake → Deer → Venison → Venison Consumption	1	1	1	1	1	✸	✸
Subsurface Soil → Infiltration, Leaching → Soil → Incidental Ingestion	1	✸	1	✸	1	1	1
Subsurface Soil → Soil → Dermal Contact	1	✸	1	✸	1	1	1
Subsurface Soil → Dust Emissions, Volatilization → Air → Inhalation	1	✸	1	✸	1	1	1
Subsurface Soil → Volatilization → Soil Gas → Entrapment in Building → Indoor Air → Inhalation	1	1	1	✸	✸	1	1
Erosion, Runoff → Surface Water → Surface Water → Incidental Ingestion	3	2	3	2	1	1	1
Erosion, Runoff → Surface Water → Surface Water → Dermal Contact	3	✸	3	✸	1	1	1
Erosion, Runoff → Surface Water → Volatilization → Air → Inhalation	2	2	2	2	1	1	1
Erosion, Runoff → Surface Water → Partitioning → Sediment → Sediment → Incidental Ingestion	3	✸	3	✸	1	1	1
Erosion, Runoff → Surface Water → Partitioning → Sediment → Sediment → Dermal Contact	3	✸	3	✸	1	1	1
Leaching → Groundwater → Tap Water → Tap Water → Ingestion	1	4	✸	✸	✸	1	1
Leaching → Groundwater → Tap Water → Tap Water → Dermal Contact	1	4	✸	✸	✸	1	1
Leaching → Groundwater → Tap Water → Volatilization → Air → Inhalation	1	4	2	✸	2	1	1

✸ = Complete exposure route quantified in the risk assessment.
1 = There is no plausible pathway for exposure to this medium.
2 = Although theoretically complete, this pathway is not quantified as explained in text.
3 = Contact with this medium, although plausible, is not part of this receptor's normal or expected activities; therefore contact would be sporadic and is not quantified.
4 = For current use there is no plausible exposure pathway. For future use, the pathway is potentially complete, but is not quantified as explained in the text.

KN12\PBOW\WWTP3/Fig 6-4.ppt\5/3/2013 7:26 AM

Figure 6-5

WWTP3
Simplified Terrestrial Food Web Conceptual Site Model
Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

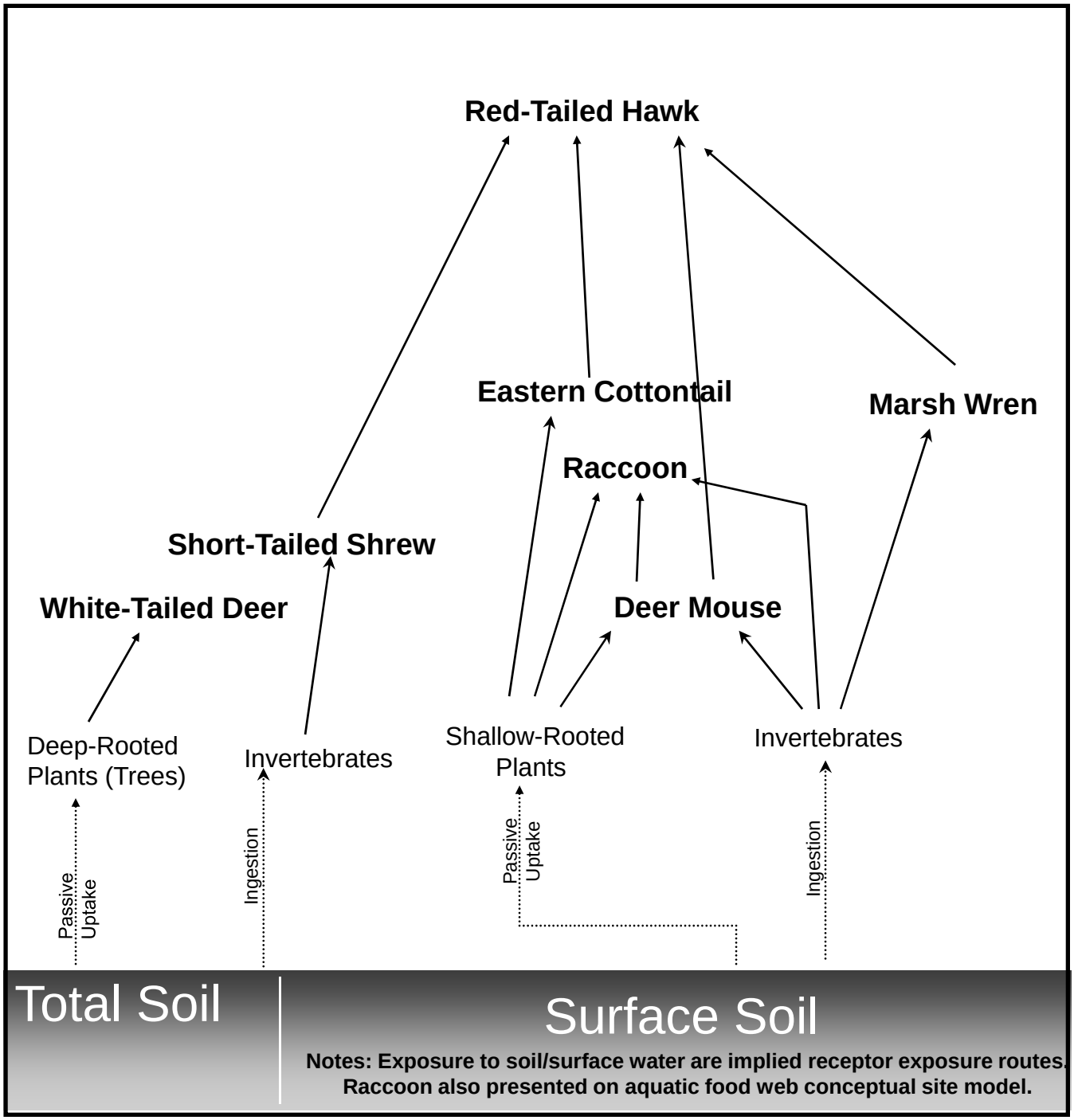
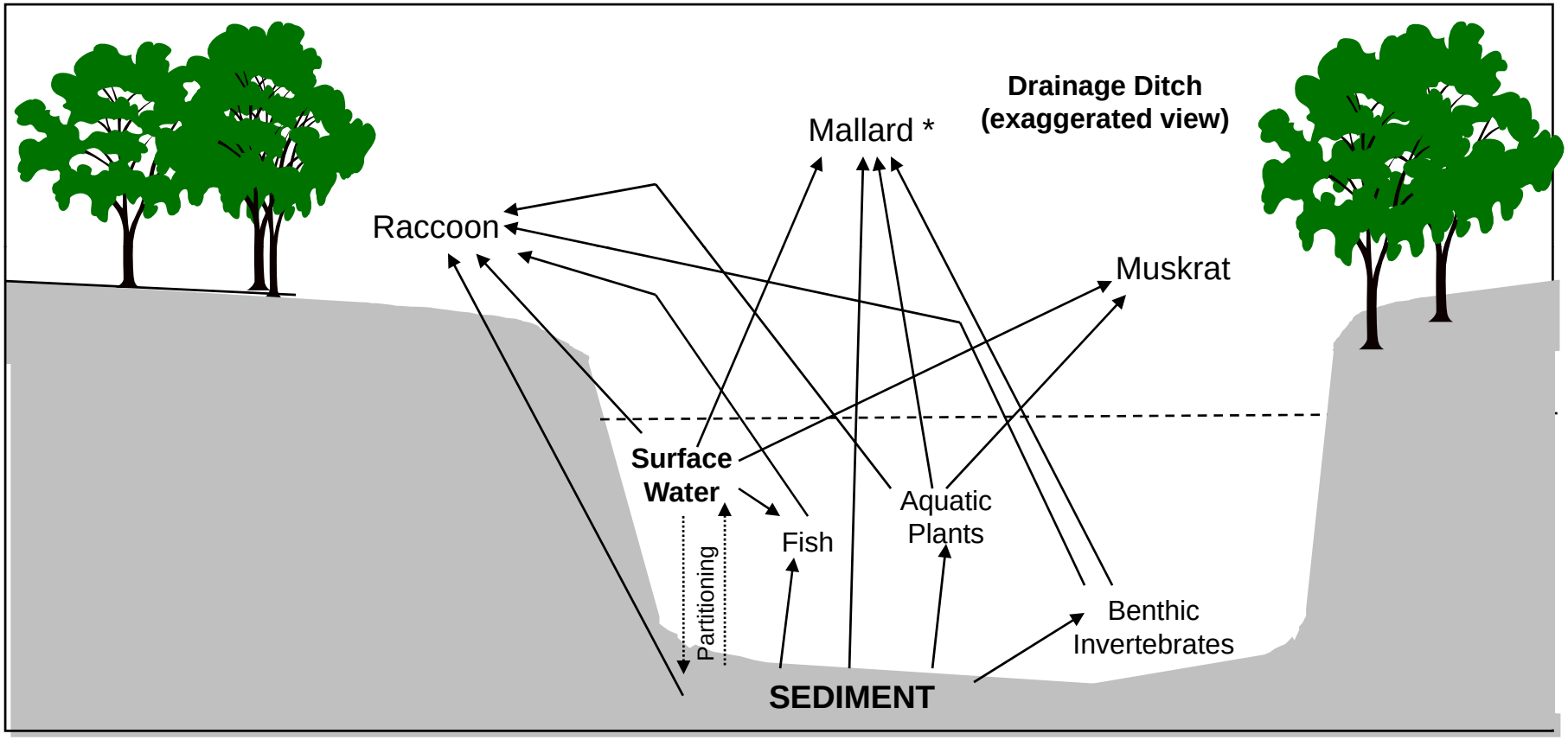


Figure 6-6

WWTP3
Simplified Aquatic Food Web Conceptual Site Model
Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio



Note: The raccoon is also presented on terrestrial food web conceptual site model.

*** = The mallard is not evaluated in the risk assessment.**

APPENDIX A THROUGH L

ELECTRONIC DELIVERABLE ONLY