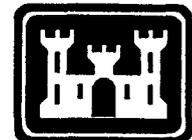


Summary

Sitewide Groundwater Remedial Investigation Plum Brook Ordnance Works Sandusky, Ohio

**Presented to
PBOW Restoration Advisory Board**

27 March 2002



Objectives of the Sitewide Groundwater Remedial Investigation

- Determine if hazardous substances are present at the site that may constitute unacceptable risk to human health and the environment
- Define site physical features and characteristics
- Evaluate fate and transport pathways
- Determine the nature and extent of source areas
- Define current and future routes of exposure
- Determine whether contaminant distribution is consistent with DOD activities



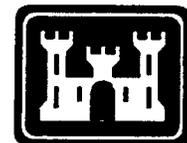
Background Information Used to Scope the Remedial Investigation

- Groundwater RI built on the findings from previous studies
 - Sitewide Groundwater Monitoring (1996 and 1998)
 - TNT Areas Investigations (1997-2001)
 - Redwater Ponds Investigations (2000)



Summary of Proposed and Actual Fieldwork

- Direct push piezometers and groundwater samples
 - ➔ 45 samples for nitroaromatic explosives planned for each of the TNT Areas (A, B, and C)
 - ◆ TNT A - 13 piezometers installed, only two had sufficient water for analysis
 - ◆ TNT B - 5 piezometers installed, only two had sufficient water for analysis
 - ◆ TNT C - 14 piezometers installed, only two had sufficient water for analysis
 - ◆ USACE and Ohio EPA agreed the remaining overburden piezometers would not be installed due to dry conditions

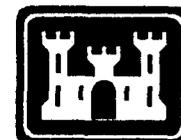


Summary of Proposed and Actual Fieldwork (continued)

- **Bedrock monitoring wells**
 - ➔ 10 bedrock monitoring wells were planned for the TNT Areas (A, B, and C), Pentolite Road Red Water Pond, perimeter (downgradient) monitoring and for determining background conditions

- **Groundwater sampling**
 - ➔ Sampling of 49 monitoring wells planned
 - ➔ 34 monitoring wells were actually sampled

- **Groundwater elevation surveys**
 - ➔ Collected quarterly by the USACE



Summary of Proposed and Actual Fieldwork (continued)

- Soil sampling
 - 24 soil samples were collected as planned
- Free-phase sampling - 2 unplanned samples collected
- Other activities included permeability testing, land surveying and IDW management



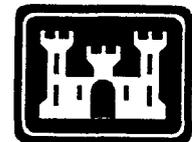
Analytical Program

- Groundwater (direct push sampling)
 - Nitroaromatics (screening analysis) and Volatile Organic Compounds
- Groundwater (monitoring well sampling)
 - Volatile organic compounds, semivolatile organic compounds, nitroaromatics, metals, and wet chemistry
- Free Phase
 - Volatile organic compounds, gasoline and diesel range organics



Analytical Program (continued)

- Soil
 - ➔ Volatile organic compounds, semivolatile organic compounds, nitroaromatics, metals, and SPLP nitroaromatics
- IDW
 - ➔ Volatile organic compounds, semivolatile organic compounds, metals, ignitability, corrosivity, and reactivity



Site Hydrogeology

- Overburden water-bearing zone
 - Discontinuous “pockets” of water present in 2001
 - Extent highly dependent on precipitation
 - Flow is to the north-northeast (mimics bedrock flow)
 - Data suggest there are varying degrees of connectivity with the bedrock water-bearing zone
 - ◆ Low degree of connectivity in the north and west portions of the site
 - ◆ High degree of connectivity in the south and central portions of the site



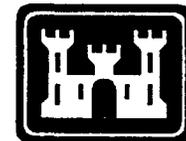
Site Hydrogeology (continued)

- Bedrock water-bearing zone
 - Continuous water-bearing zone across the site
 - Three geologic units identified at the site - the Ohio Shale, the Olentangy Shale, and the Delaware Limestone
 - Flow is to the north-northeast



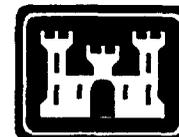
Summary of Analytical Results

Area	Analytes Exceeding Preliminary Remediation Goals in 2001 Sampling	
	Overburden Water Bearing Zone	Bedrock Water Bearing Zone
West Area Red Water Ponds	No samples collected	Arsenic and thallium
Penotolite Road Red Water Ponds	No samples collected	Benzene, methylene chloride, acetone, toluene, naphthalene, bis(2-ethylhexyl)thalate, arsenic and manganese
TNT Area A	2,4,6-TNT, 2,4-DNT, 2,6-DNT, 4A-2,6-DNT, 2A-4,6-DNT, arsenic and iron	Methylene chloride, benzene, toluene, xylenes, naphthalene, bis(2-ethylhexyl)phthalate, chrysene, 2,6-DNT, arsenic and manganese
TNT Area B	Acetone, ideno(1,2,3-cd)pyrene, 2,4,6-TNT, 2,4-DNT, 4A-2,6-DNT, 2A-4,6-DNT, arsenic, iron and manganese	Benzene, arsenic, iron, lead and manganese
TNT Area C	2,4,6-TNT, arsenic, iron, manganese and thallium	Benzene, methylene chloride, bis(2-ethylhexyl)phthalate, naphthalene, arsenic, and thallium



Summary of Analytical Results (continued)

Area	Analytes Exceeding Preliminary Remediation Goals in 2001 Sampling	
	Overburden Water Bearing Zone	Bedrock Water Bearing Zone
Acids Areas/Maintenance Shops	No samples collected	Benzene, bis(2-ethylhexyl)phthalate, chloromethane, methylene chloride, naphthalene, arsenic, manganese and thallium
Additional Burning Grounds	No samples collected	Benzo(a)pyrene, dibenzo(a,h)anthracene, and indeno(1,2,3-cy)pyrene.
Upper Toluene Tanks	No samples collected	Acetone, benzene, methylene chloride, xylenes, naphthalene, and thallium.
Downgradient Perimeter Wells	No samples collected	Benzene, methylene chloride, naphthalene, 2,4-DNT, 2,6-DNT, arsenic and iron
Background Monitoring Wells	No samples collected	Benzene, methylene chloride, chloroform, arsenic and barium



Conclusions

- Site-related contaminants have impacted the Overburden Water Bearing Zone to varying degrees across the site.
 - Based on historical data, it is apparent that water in the Overburden is discontinuous
- To a lesser degree, contaminants have also impacted the Bedrock Water Bearing Zone.
 - Analytical data indicates that low levels of nitroaromatics are migrating to offsite areas
 - Potential exists for continued leaching of nitroaromatics into the Bedrock Water Bearing zone, particularly in the central and southern portions of the site



Planned Activities

- Complete remaining two quarterly background sampling events of first annual (2001 - 2002) sampling program
- Evaluate all background samples after fourth quarter sampling to determine if data is sufficient to establish background metals concentrations or if additional year is required (2002 - 2003)
- Complete remaining “wet season” sampling event, currently planned for April 2002
- Complete sitewide groundwater model (2003)
- Complete sitewide groundwater risk assessment (2003)



Recommendations

- Conduct an off-site private well survey
- Evaluate off-site migration through private well sampling (if available) and potential discharge locations (i.e., springs)
- Evaluate/confirm detection of nitroaromatics in perimeter wells following April 2002 sampling event
- Collect additional data on Reactor sump well pumping to support groundwater modeling

