Public Health Assessment

Final Release

Evaluation of Environmental Concerns Related to the Velsicol Chemical Site

VELSICOL CHEMICAL SITE

ALTON PARK (CHATTANOOGA), HAMILITON COUNTY, TENNESSEE

EPA FACILITY ID: TND061314803

Prepared by
Tennessee Department of Health

FEBRUARY 27, 2014

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

PUBLIC HEALTH ASSESSMENT

Evaluation of Environmental Concerns Related to the Velsicol Chemical Site

VELSICOL CHEMICAL SITE

ALTON PARK (CHATTANOOGA), HAMILTON COUNTY, TENNESSEE

EPA FACILITY ID: TND061314803

Prepared by:

Tennessee Department of Health
Environmental Epidemiology Program
Under a Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Foreword

This document summarizes an environmental public health investigation performed by the State of Tennessee Department of Health's Environmental Epidemiology Program. Our work is conducted under a Cooperative Agreement with the federal Agency for Toxic Substances and Disease Registry. In order for the Health Department to answer an environmental public health question, several actions are performed:

Evaluate Exposure: Tennessee health assessors begin by reviewing available information about environmental conditions at a site. We interpret environmental data, review site reports, and talk with environmental officials. Usually, we do not collect our own environmental sampling data. We rely on information provided by the Tennessee Department of Environment and Conservation, U.S. Environmental Protection Agency, and other government agencies, businesses, or the general public. We work to understand how much contamination may be present, where it is located on a site, and how people might be exposed to it. We look for evidence that people may have been exposed to, are being exposed to, or in the future could be exposed to harmful substances.

Evaluate Health Effects: If people could be exposed to contamination, then health assessors take steps to determine if it could be harmful to human health. We base our health conclusions on exposure pathways, risk assessment, toxicology, cleanup actions, and the scientific literature.

Make Recommendations: Based on our conclusions, we will recommend that any potential health hazard posed by a site be reduced or eliminated. These actions will prevent possible harmful health effects. The role of Environmental Epidemiology in dealing with hazardous waste sites is to be an advisor. Often, our recommendations will be action items for other agencies. However, if there is an urgent public health hazard, the Tennessee Department of Health can issue a public health advisory warning people of the danger, and will work with other agencies to resolve the problem.

Table of Contents

Summary

Introduction

On February 2, 2011, the Agency for Toxic Substances and Disease Registry (ATSDR) received a letter from a community member of the Alton Park Community, Chattanooga, Hamilton County, petitioning the agency for assistance. The petitioner asked ATSDR to help with determining if the planned revision to Velsicol Chemical LLC's Corrective Action Permit to add a site-wide final remedy was protective of public health. The citizen was also concerned about how Velsicol managed its stormwater and groundwater at the site. Therefore, the citizen asked ATSDR to look into their concerns.

Because ATSDR has a cooperative agreement with the Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP), ATSDR asked EEP to respond to the petition. EEP wrote this Public Health Assessment to answer the petitioner's questions. It documents EEP's evaluation of environmental data, the proposed final remedy, and water treatment activities.

The Velsicol Chemical Site is located at 4902 Central Avenue in the Alton Park area of Chattanooga, Tennessee. The site encompasses a former chemical company complex which stopped production activities in 2007. Many different chemicals were manufactured at the site over many years of operation. Only two site buildings and one wastewater containment structure remain. All other site buildings have been demolished. Only their concrete floor slabs remain.

Chemicals were released to site soils from spills and leaks from chemical manufacturing on-site, past chemical disposal practices, past chemical transfer activities, and other previous historical activities. Chemicals migrated through the soil and reached shallow groundwater. The groundwater travels away from the site to both the northeast and the southeast. Both on-site and off-site groundwater in the northeastern portion of the site is collected by a recovery well. The water is then piped offsite to the City of Chattanooga's Moccasin Bend Wastewater Treatment Plant where it is treated. On-site and off-site groundwater in the southeastern portion of the site discharges at Piney Woods Spring. Piney Woods Spring is piped to the sewer system and is treated at the wastewater treatment plant.

The Tennessee Department of Environment and Conservation and the U.S. Environmental Protection Agency (EPA) are overseeing the remediation activities at this site. The Velsicol Site has a required Resource Conservation and Recovery Act (RCRA) permit, is conducting remedial measures for site remediation, and community environmental education activities as required conditions of that permit.

Many local, state, and federal agencies have worked in the Alton Park Community for many years to understand the public health implications of decades of heavy industry interspersed with residential areas. The Chattanooga-Hamilton County Regional Planning Agency has developed a plan for the redevelopment of the area, the Alton Park / Piney Woods Community Plan. Consideration of this plan should be a high priority in any redevelopment plans. The cleanup of environmental sites in Alton Park should be consistent. Having uniform remediation strategies across environmental regulatory programs will better help the community with their long-term land use planning. In addition, clean-up plans should result in a property that can be reused in a way that is in accordance with the long-term land use plan for the Alton Park.

Conclusions

Conclusion 1	EEP concludes that past, current, or future exposure to contamination in on-site soil is not expected to harm the health of residents of the community.
Basis for Decision	People in the community were not likely to have been exposed to contamination in on-site soils in the past nor are they likely to be exposed to contamination in on-site soils currently or in the future. The site was securely fenced and guarded when Velsicol was operating, and it is now securely fenced. All wastes on the site have been removed. Residual soil contamination will be covered with two feet of vegetated soil and the site will remain fenced.
Conclusion 2	EEP concludes that the health of future site workers is not likely to be harmed from exposure to residual contamination remaining in soil, unless excavation takes place.
Basis for Decision	If any redevelopment were to occur, the Division of Solid and Hazardous Waste Management would require a new permit or a major permit modification, further sampling and analysis of site soils, and a site health and safety plan that would ensure the safety of on-site workers. The site will always require a RCRA permit.
Conclusion 3	EEP concludes that the health of community members in the future will not be harmed from exposure to volatile air pollutants emitted from contaminated soil at the Velsicol Site.
Basis for Decision	All hazardous wastes have been removed. The remaining residual soil contamination will be covered with clean soil and a vegetative cover. Soil with remaining contamination covers a portion of the site, with small areas with higher concentrations. Any pollutants that would get into the air will be diluted in ambient air. If new buildings are constructed on the site, vapor intrusion and other issues of site safety will be addressed in a new RCRA permit or major permit modification.
Conclusion 4	EEP concludes that the health of community members was not, and is not, likely to be harmed by exposure to groundwater.
Basis for Decision	The groundwater near the Velsicol Site is 5 to 24 feet deep and the community has no known exposures to the groundwater contaminants. Groundwater at the site is being recovered in two areas. Areas where it is being recovered are at Recovery Well RW-1 in the northeastern portion of the site and at Piney Woods Spring in the southeastern portion of the site. Recovered groundwater from these two locations is being transferred to the City of Chattanooga

	wastewater treatment plant. We do not know if all groundwater at the site is captured at these two locations. Because the City of Chattanooga has had an excellent water treatment system for decades, groundwater has not been, and is not being, used for a potable water source in that area of Chattanooga. It is highly unlikely that anyone would install a private well in the community.
Conclusion 5	EEP cannot conclude whether the health of community members in the past was, currently is, or in the future will be harmed by exposure to volatile air pollutants in homes built over the groundwater plume traveling under the Velsicol Site and migrating to Piney Woods Spring.
Basis for Decision	Inadequate environmental sampling and analysis has been conducted to evaluate the vapor intrusion pathway.
Next Steps	EEP recommends that the appropriate agency develop a plan for determination of the likelihood of vapor intrusion in homes above the plume of contamination flowing from the Velsicol Site to Piney Woods Spring.
Conclusion 6	EEP cannot conclude whether the health of on-site workers in the past or in the future will be harmed by exposure to volatile air pollutants in buildings built over contaminated groundwater.
Basis for Decision	Inadequate environmental sampling and analysis has been conducted to evaluate the vapor intrusion pathway.
Next Steps	EEP recommends that, if the site is redeveloped, Velsicol, or any new permittee, investigate the potential for vapor intrusion into on-site buildings before redevelopment of the site. If new buildings are constructed on the site, vapor intrusion and other issues of site safety will be addressed in a new RCRA permit or permit modification.
Conclusion 7	EEP could not conclude whether past exposure to surface water in the Piney Woods Spring may have harmed the health of people exposed.
Basis for Decision	In the past, community members could have been exposed to Piney Woods Spring when the area around the spring was used as a ballpark, before the spring discharge was connected to the sewer system. EEP cannot determine the frequency or duration of past exposures. Water from the spring was not sampled and analyzed routinely until 1993. Therefore, EEP is unable to determine the likelihood of past health risks before the late 1980s when the spring was covered by a manhole and water discharged to the sewer system.
Conclusion 8	EEP concludes that the health of people is not being harmed now and will not be harmed in the future by exposure to chemicals in the

	Piney Woods Spring.
Basis for Decision	The spring is now enclosed and piped to the City of Chattanooga sewer system.
Conclusion 9	EEP concludes that the final remedy, Alternative 1 – a soil cover, should be sufficient to prevent harmful exposures to residents of the Alton Park Community.
Basis for Decision	Based on our investigation of soil, groundwater, surface water, and air, the final remedy, Alternative 1, reduces or eliminates most exposure pathways on-site as long the Velsicol Site is secured and the vegetative cover is properly maintained. The site's RCRA permit has sufficient caveats to protect the community and future workers if the Velsicol Site is redeveloped. Vapor intrusion issues off-site were discussed in Conclusion 5.
Next Steps	EEP recommends that the TDEC, the TDH, and other appropriate parties continue to work together to see that public health is protected during cleanup of the Velsicol Site. Velsicol should investigate the potential for vapor intrusion in homes built over the groundwater contamination flowing to Piney Woods Spring. EEP recommends to TDEC that the final clean-up plan have sufficient contingencies to protect workers on the site should it be redeveloped. Institutional controls and precautions should be established for future worker safety and site redevelopment.

The Environmental Epidemiology Program reached several conclusions in the Public Health Assessment outside the scope of the Velsicol Site:

Conclusion 10	EEP cannot conclude whether a potential exposure pathway exists for future trespassers who may walk through the Heatec Stream area and who may unintentionally come into contact with the stream water.
Basis for Decision	When the dye study and sampling was done in 1998, contamination existed in the Heatec Stream. It is unknown if the contamination still exists.
Next Steps	TDEC should investigate the Heatec Stream to determine if it is still contaminated and the source(s) of the contamination if it is and should determine if Velsicol retains responsibility for maintenance of the fence around the erosional scour at the Heatec Stream.
Conclusion 11	The City of Chattanooga Moccasin Bend Wastewater Treatment Plant has sufficient capacity to handle the stormwater and groundwater flows from Recovery Well 1 on the Velsicol Site and from the Piney Woods Spring.

Basis for Decision	The concentrations of contaminants are very low and the remedial pumping and drainage flow rates from the Velsicol Site and the Piney Woods Spring are only a tiny fraction of the capacity of the treatment plant.
Conclusion 12	Occasional overflows of the sewer system containing the chemicals from the Velsicol Site at the designated overflow location in Alton Park should not harm the health of the community. Still, contact with this water should be avoided because of other possible contamination from harmful bacteria and viruses.
Basis for Decision	The City of Chattanooga has systems and plans in place to control overflows except in catastrophic situations. In those situations, the large volume of stormwater would effectively dilute any Velsicol Site chemical contaminants. Contact with sewer overflows should be avoided to prevent exposure to harmful bacteria and viruses.
Conclusion 13	EEP cannot conclude whether the health of community members was harmed in the past by exposure to hazardous air pollutants in outdoor air emitted from area industries.
Basis for Decision	No analyses of outdoor air are available for review. Heavy industries, such as coke ovens and chemical plants, were active in the Alton Park Community for decades before any environmental regulatory laws existed. In 1984 and in 1995, EEP conducted two cross-sectional health studies in the area. Results from the first study indicated an increased rate in self-reported respiratory symptoms and diseases in Piney Woods while the second study indicated no difference in these symptoms and diseases in Alton Park compared to a control area.
Conclusion 14	EEP concludes that it is unlikely that the health of community members is being harmed by current hazardous air pollutant emissions in the Alton Park Community.
Basis for Decision	Most of the heavy industry has ceased operation or will cease operation in the near future. There are currently three industries that are considered major sources of air emissions. The emissions from these three industries are minimal. In the 1990s, air pollution decreased significantly in Alton Park when Velsicol installed air pollution controls and when the coke ovens (Chattanooga Coke and Chemical, Tennessee Products) ceased operation.
Conclusion 15	EEP cannot conclude whether the health of community members was, currently is, or in the future will be harmed by exposure to contaminants in off-site soils.

Basis for Decision	Off-site residential surface soil sampling near the Velsicol Site has been limited.
Next Steps	The Tennessee Department of Environment and Conservation should ensure that off-site surface soil sampling in the vicinity of Velsicol, Tennessee Products, and other nearby industries has been protective of the residents who live in the area.

For More Information If you have any questions or concerns about your health, you should contact your healthcare provider. For more information on this environmental site call TDEC toll free at 1-888-891-8332. For more information on this health report, please call TDH EEP at 615-741-7247 or 1-800-404-3006 during normal business hours. You can also email TDH EEP at eep.health@tn.gov.

Background and History

On February 2, 2011, the Agency for Toxic Substances and Disease Registry (ATSDR) received a letter from a resident of the Alton Park, Chattanooga, Hamilton County, petitioning the agency for assistance. The petitioner asked ATSDR to help with determining if the planned revision to Velsicol Chemical LLC's Corrective Action Permit, TNHW-105, to add a site-wide final remedy was protective of public health. The citizen questioned whether the environment and the health of nearby residents would be protected by the proposed remedy for the site. The petitioner mentioned releases of chemicals that included benzene, toluene, chlorobenzene, acetone, barium, and lead. The citizen was also concerned about how Velsicol manages its stormwater and groundwater at the site. Therefore, the citizen asked ATSDR to look into their concerns.

Because the Tennessee Department of Health's Environmental Epidemiology Program (EEP) has a cooperative agreement with ATSDR, EEP responded to the request. ATSDR provides funding for EEP to conduct their work in Tennessee and technical assistance to EEP.

Objectives

The specific objectives of this Public Health Assessment (PHA) are as follows:

- To investigate the extent to which contamination at the Velsicol Site could result in exposure to people in the area. The investigation of exposure is to understand whether adverse health effects would be possible if exposure occurred.

- To evaluate whether the proposed remedies will be protective of the health of residents of the Alton Park near the Velsicol Site.

- To assess whether proposed remedial actions will be sufficient to prevent harmful exposures to contamination in:
  - stormwater that is collected from the Velsicol Site;
  - groundwater that is collected at the Piney Woods Spring southeast of the Velsicol Site; and
  - groundwater that is collected as part of the on-going remediation and product recovery for the former Reilly Tar parcel located in the northeast portion of the Velsicol Site.

Location and Property Details

The Velsicol Chemical LLC Site is located on Central Avenue, approximately 3.5 miles south of downtown Chattanooga in Hamilton County, Tennessee. The facility has an EPA Identification Number of TND 061314803 and map coordinates of latitude 34°59'34" North, longitude 85°18'50" West (Law 1994). The site is shown in Figure 1. The 52-acre facility is divided into three disconnected parcels. The Semi-Works, located at 4801 Central Avenue, occupies 5 acres along the west side of Central Avenue approximately 1,150 feet north of the main entrance to Velsicol. The former change house occupies an approximate 4 acre parcel in the southwestern section of the site, between the railroad track and Central Avenue. The chemical complex portion of the Velsicol Site, located at 4902 Central Avenue, occupies the remaining 43 acres along the east side of Central Avenue (Figure 2).

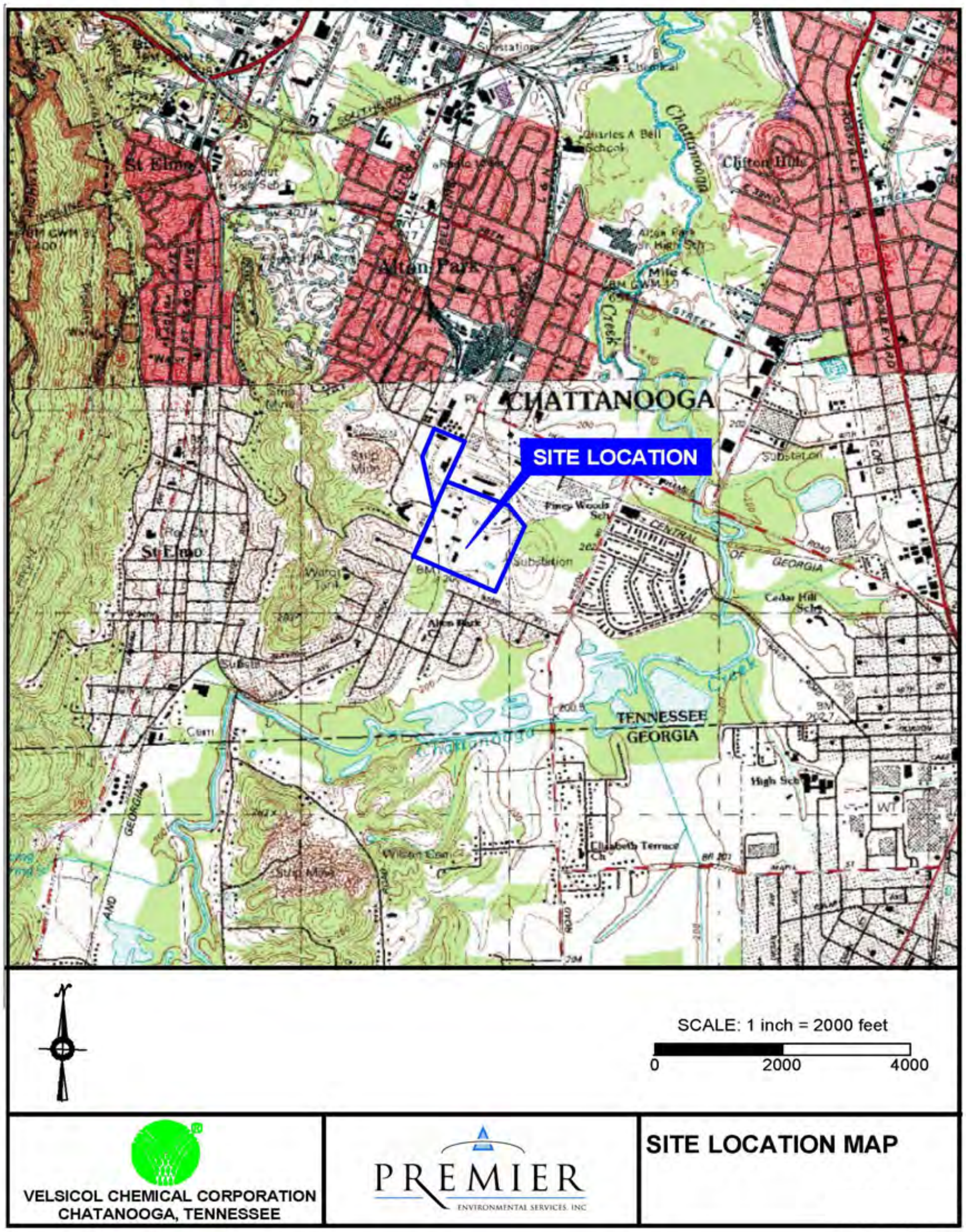


Figure 1. Topographic map showing the location of the Velsicol Chemical Corporation Site, Alton Park (Chattanooga), TN. Source: Memphis Environmental Center, 2007.

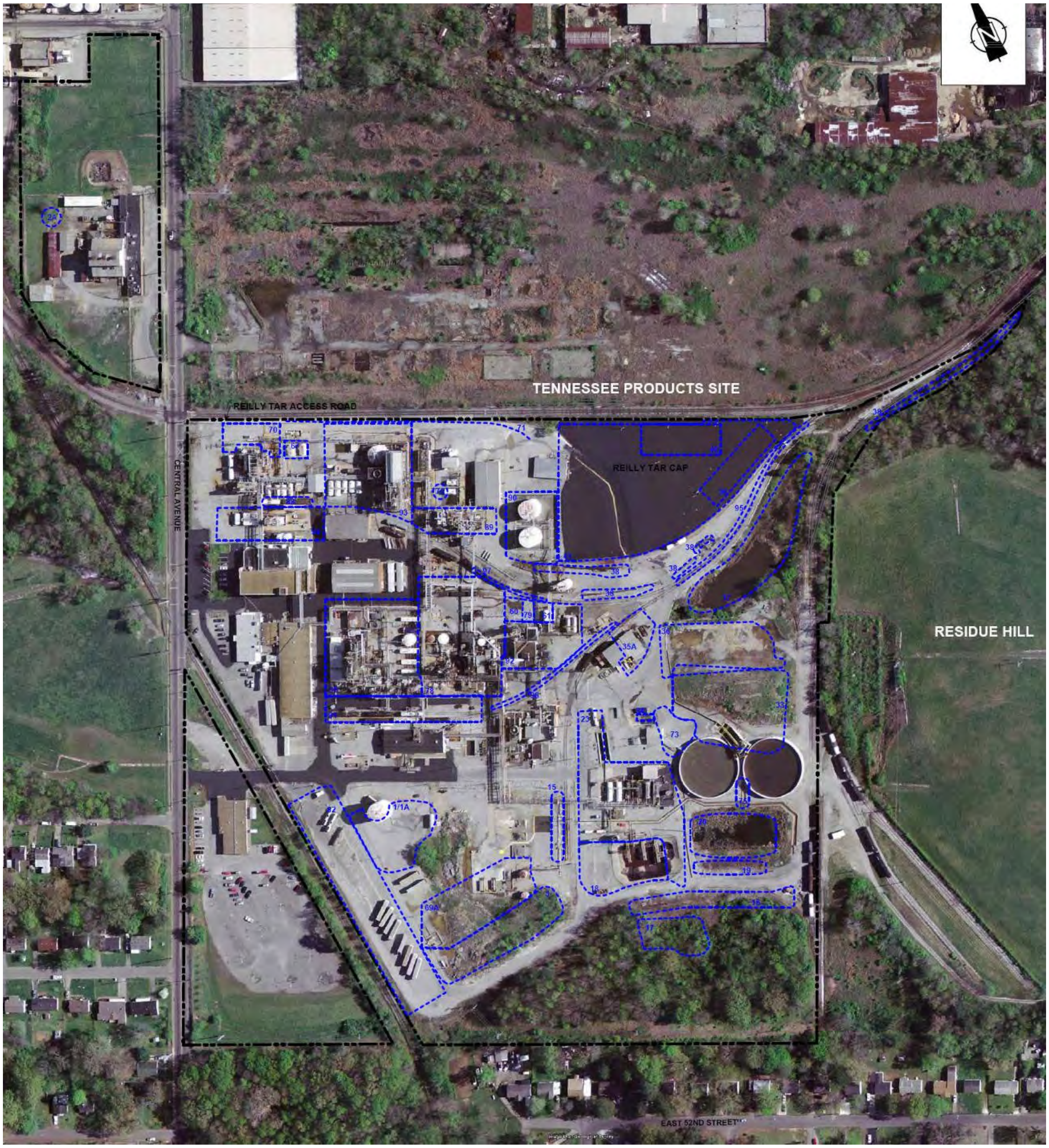


Figure 2. Aerial view of Velsicol Chemical Company Site, Alton Park, Chattanooga, TN. Black dashed and dotted line is the limits of the Velsicol property. Blue forms represent the outlines of solid waste management units (SWMUs). Only two onsite buildings remain. One surface water containment structure also remains. Most of the buildings and process equipment were removed during 2007 and 2008 with only concrete building floor slabs remaining from those buildings. Source: MEC 2011.

The Velsicol Site is located in an area zoned for commercial and industrial land use. It is bounded on the south by the Piney Woods neighborhood, on the west by Central Avenue and a residential neighborhood, on the east by Residue Hill and adjacent vacant land, and on the north by the abandoned Tennessee Products Coke and Chemical Plant (Law 1994). Emma Wheeler Homes, a public housing project, is located across Wilson Avenue, east of Residue Hill.

Regional Pollution and Cleanup

Since the early 20th century, the southern portion of Chattanooga has been an important industrial hub, with residential areas interspersed among the industries. Within the Alton Park Community, there are ongoing contamination issues associated with the Southern Wood Piedmont Facility, Velsicol, Morningside Chemicals, Residue Hill Landfill, the Chattanooga Coke and Chemical (Tennessee Products) facilities, and other smaller industrial facilities. All of these sites were located in the vicinity of the Chattanooga Creek. Much of the contamination near and in Chattanooga Creek was the result of Chattanooga Coke and Chemical (Tennessee Products) processes.

Chattanooga Creek has flooded after major precipitation events. When water levels have risen rapidly, the Tennessee River has at times temporarily flowed upstream into its tributaries and flooded low lying areas. This upstream flow was due to the manipulation of the Tennessee River by the Tennessee Valley Authority and/or flooding (Mr. Troy Keith, personal communication, April 5, 2011). Additionally, Chattanooga Creek has flowed upstream during significant flood events of the Tennessee River. This is important because contamination in Chattanooga Creek could have moved into adjacent flooded areas.

The U.S. Environmental Protection Agency (EPA) has cleaned up the coal tar contamination in Chattanooga Creek. Cleanup of area industrial wastes has been ongoing since the late 1980s.

History of Ownership of Velsicol and the Site

In 1914, Tennessee Products constructed the original facilities at the Velsicol Site. In 1963, Velsicol Chemical Corporation purchased the majority of the plant site, including the area that would later become Residue Hill, from Tennessee Products. In 1976, Velsicol purchased the remainder of the site, the former Reilly Tar area, from Reilly Tar and Chemical.

Northwest Industries was Velsicol Chemical Corporation's parent company. In 1986, Northwest Industries sold the current Velsicol plant site to True Specialty Corporation. Northwest Industries retained ownership of Residue Hill. In 2005, True Specialty Corporation sold the company (now called Velsicol Chemical LLC) to True Specialty LLC.

In 1986, Fruit of the Loom and a related company, NWI Land Management Corporation (NWI), bought out Northwest Industries. NWI took title to Residue Hill as well as to six other Velsicol sites in the U.S. The facilities had been contaminated while owned by Velsicol and other prior owners. As part of the buyout, Fruit of the Loom and NWI agreed to indemnify Velsicol for environmental liabilities in connection with these facilities. Fruit of the Loom declared bankruptcy in 1999. The bankruptcy was settled in 2002. At that time, Custodial Trust, Le Petomane II, Inc., was established to own and manage the Residue Hill Site. Velsicol retained ownership of the rest of the site.

Manufacturing Operations

The Velsicol Site has long been part of the Alton Park Community in Chattanooga. Tennessee Products owned and operated the coke ovens immediately north of the Velsicol Site. In 1948, the Tennessee Products constructed a facility on the Velsicol Site to expand toluene chlorination operations. Tennessee Products also operated a ferro-alloy facility at the site. In the 1950s, Tennessee Products produced benzoyl chloride, benzyl alcohol, benzotrichloride, benzonitrile, benzoguanamine, lindane (gamma-hexachlorocyclohexane or γ-BHC), benzoate esters, benzaldehyde, and sodium benzoate. In 1955, Tennessee Products began recovering muriatic acid (hydrochloric acid) from the chlorination and benzoyl chloride operations. Production of lindane ceased in 1957 (Law 1994). Production of other products continued into the early 1960s.

In 1963, Velsicol purchased the property from Tennessee Products. Velsicol stopped production of ferro-alloys in 1964 and demolished the complex in 1965. In the 1960s and 1970s, Velsicol increased production of its products and began the production of the herbicide, Banvel. BANVEL is a registered trademark of BASF Corporation. Production of Banvel continued until 1975. The Banvel plant was demolished in 1976.

Velsicol produced meta-methyl-chlorobenzoate (CBE) between 1976 and 1979. Velsicol purchased land, now in the northeast corner of the Velsicol Site, from Reilly Tar and Chemical Site in 1975 (Law 1998). The Reilly Tar property had been used to produce coal tar products from 1921 to 1972 (Law 1994). Velsicol did not use the former Reilly Tar Site for any chemical manufacturing (Gary Hermann, MEC, August 30, 2011).

In the 1980s, Velsicol's product line was reduced to benzoyl chloride, benzoic acid, muriatic acid, and benzoate esters. Velsicol began environmental work at the site, such as pH control and installation of spill separators and spill containment areas.

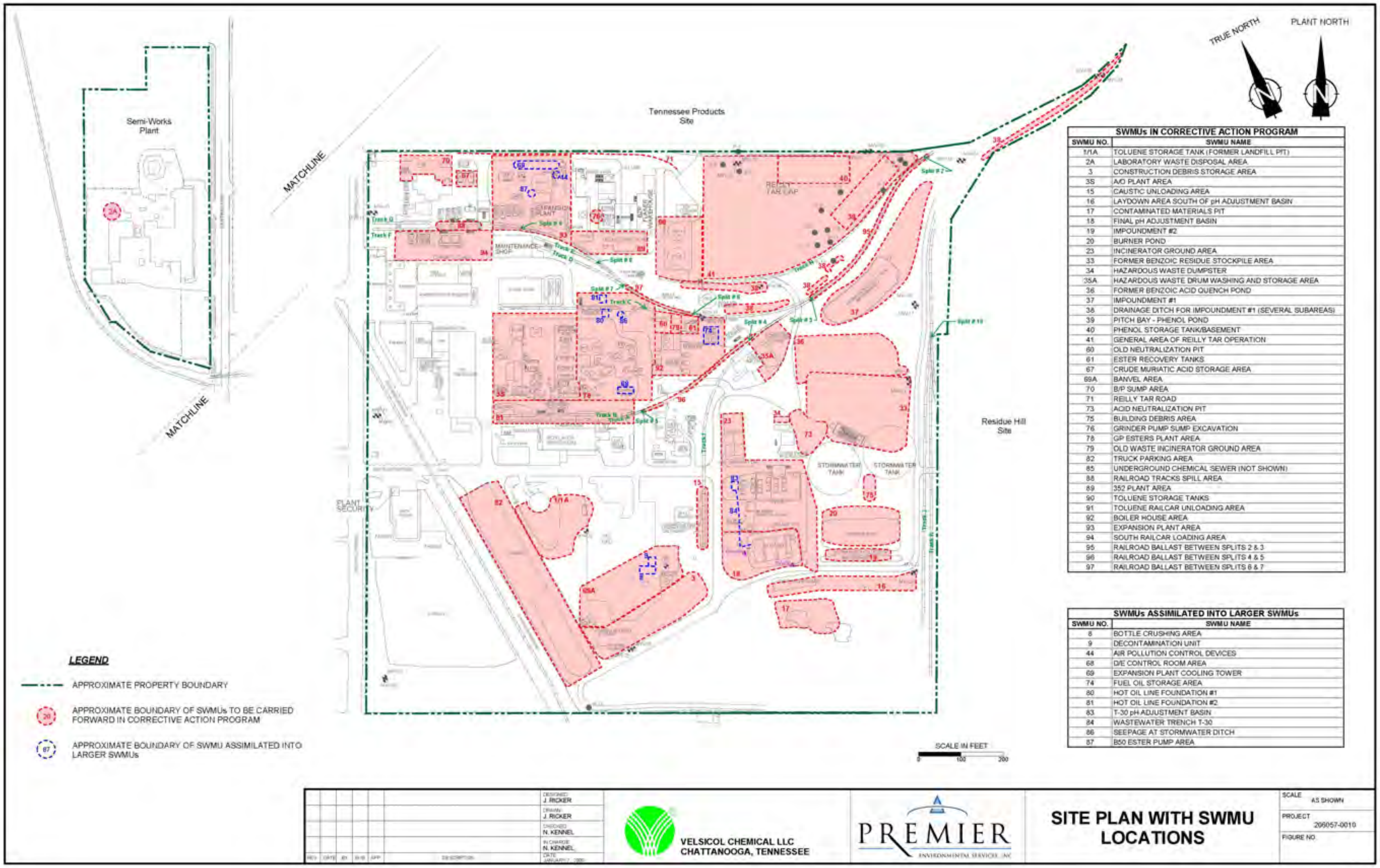
An area of the site located east of the current Velsicol Site and bordering Wilson Road was used for dumping of wastes. This site would later become known as Residue Hill.

In the 1990s, Velsicol continued to produce derivatives of benzoic acid and, in addition, diethylene glycol, dipropylene glycol, isodecyl alcohol, sodium hydroxide, and toluene (Law 1998). These products continued to be manufactured at Velsicol during the 2000's. Velsicol plant site operations ceased on March 15, 2007.

Environmental Regulatory History

A Resource Conservation and Recovery Act (RCRA) Corrective Action Program (CAP) is being performed under the direction of the Tennessee Department of Environment and Conservation's (TDEC) Division of Solid and Hazardous Waste Management (DSWM). Major milestones of the CAP, as taken from the Phase III RCRA Facility Investigation Report (MEC 2007), are presented in Appendix A. Environmental Investigations relating to the RCRA Facility Investigation process have been conducted from 1990 to the present. A total of 33 solid waste management units (SWMUs) have been investigated at the site. Figure 3 shows the locations of the SWMUs.

Figure 3. Velsicol Site Plan with all solid waste management unit (SWMU) locations, as of 2009. Velsicol Site, Chattanooga, Hamilton County, Tennessee. Source: MEC 2009.



SWMUs IN CORRECTIVE ACTION PROGRAM	
SWMU NO.	SWMU NAME
1/1A	TOLUENE STORAGE TANK (FORMER LANDFILL PIT)
2A	LABORATORY WASTE DISPOSAL AREA
3	CONSTRUCTION DEBRIS STORAGE AREA
3S	A/O PLANT AREA
15	CAUSTIC UNLOADING AREA
16	LAYDOWN AREA SOUTH OF pH ADJUSTMENT BASIN
17	CONTAMINATED MATERIALS PIT
18	FINAL pH ADJUSTMENT BASIN
19	IMPOUNDMENT #2
20	BURNER POND
23	INCINERATOR GROUND AREA
33	FORMER BENZOIC RESIDUE STOCKPILE AREA
34	HAZARDOUS WASTE DUMPSTER
35A	HAZARDOUS WASTE DRUM WASHING AND STORAGE AREA
36	FORMER BENZOIC ACID QUENCH POND
37	IMPOUNDMENT #1
38	DRAINAGE DITCH FOR IMPOUNDMENT #1 (SEVERAL SUBAREAS)
39	PITCH BAY - PHENOL POND
40	PHENOL STORAGE TANK/BASEMENT
41	GENERAL AREA OF REILLY TAR OPERATION
60	OLD NEUTRALIZATION PIT
61	ESTER RECOVERY TANKS
67	CRUDE MURIATIC ACID STORAGE AREA
69A	BANVEL AREA
70	B/P SUMP AREA
71	REILLY TAR ROAD
73	ACID NEUTRALIZATION PIT
75	BUILDING DEBRIS AREA
76	GRINDER PUMP SUMP EXCAVATION
78	GP ESTERS PLANT AREA
79	OLD WASTE INCINERATOR GROUND AREA
82	TRUCK PARKING AREA
85	UNDERGROUND CHEMICAL SEWER (NOT SHOWN)
88	RAILROAD TRACKS SPILL AREA
89	352 PLANT AREA
90	TOLUENE STORAGE TANKS
91	TOLUENE RAILCAR UNLOADING AREA
92	BOILER HOUSE AREA
93	EXPANSION PLANT AREA
94	SOUTH RAILCAR LOADING AREA
95	RAILROAD BALLAST BETWEEN SPLITS 2 & 3
96	RAILROAD BALLAST BETWEEN SPLITS 4 & 5
97	RAILROAD BALLAST BETWEEN SPLITS 6 & 7

SWMUs ASSIMILATED INTO LARGER SWMUs	
SWMU NO.	SWMU NAME
8	BOTTLE CRUSHING AREA
9	DECONTAMINATION UNIT
44	AIR POLLUTION CONTROL DEVICES
68	D/E CONTROL ROOM AREA
69	EXPANSION PLANT COOLING TOWER
74	FUEL OIL STORAGE AREA
80	HOT OIL LINE FOUNDATION #1
81	HOT OIL LINE FOUNDATION #2
83	T-30 pH ADJUSTMENT BASIN
84	WASTEWATER TRENCH T-30
86	SEEPAGE AT STORMWATER DITCH
87	B50 ESTER PUMP AREA

Land Use and Demographics

The Alton Park Community consists of several neighborhoods south of downtown Chattanooga in which a range of land uses are in close proximity. The area is bounded on the north and east by Chattanooga Creek, on the south by the Georgia state line, and on the west by Hawkins Ridge. The community fits into zip code 37410 and census tract 19 fairly well. The Piney Woods, Richmond, and Oak Hill neighborhoods are within the broader Alton Park Community. The St. Elmo Community adjoins Alton Park on the west. The term, Alton Park, will be used in this document to mean the whole of the area, including Piney Woods, Emma Wheeler Homes, Villages at Alton Park, Richmond, and Oak Hill neighborhoods.

The population of Alton Park has decreased at each census count since 1950. In 1990, 6,068 people lived in zip code 37410. In 2010, 3,886 people lived in the same zip code. Projections by the Chattanooga-Hamilton County Regional Planning Agency indicated that the loss of population may be leveling off (CHCRPA 2010). African Americans made up 90.4% of the population in 2010 (Census 2010). Some of the people lived through the years of change and still live in Alton Park. Other people have moved there and may not be aware of the history of environmental pollution.

In 2000, 55.7% of the adults, 25 years old or older, were a high school graduate or higher with 3.1% having a bachelor's degree or higher (Census 2000). The Alton Park Community is zoned for Calvin Donaldson Elementary, East Lake Elementary, Orchard Knob Middle, East Lake Academy, and the Howard School of Academics and Technology. Calvin Donaldson Elementary is the only school physically located with the boundaries of the Alton Park. Calvin Donaldson Environmental Science Academy has been designated as a magnet school and is the location of the Alton Park / St. Elmo Community and Teaching Garden Project (CHCRPA 2010).

In 2010, 31.1% of housing units were owner-occupied and 68.9% were renter-occupied. Of the 1,801 housing units, 13.9% were vacant. Forty-three percent of units were single-family detached homes. 97.9% of housing units had been built before 1980.

The Chattanooga-Hamilton County Regional Planning Agency has developed a land use plan for the community, called the Alton Park / Piney Woods Community Plan (CHCRPA 2010). The plan has a chapter that describes the environmental conditions of the community, including a discussion of Chattanooga Creek historical contamination and cleanup, Brownfield sites, and other sites. Discussion includes reuse of sites and Chattanooga Creek floodplain issues. Land use plans for the Velsicol Block are included. This portion of the Community Plan is included in Appendix B. The plan indicates that, "*Since the plant comprised over 40 acres of land, its possible reuse represents a source of uncertainty in the community. Since the property has rail access, it could be utilized for industrial purposes once again provided that subsequent owners of the site take care to prevent undue impact on nearby residential neighborhoods* [guidelines delineated in the plan]. *Possible future utilization could include subdivision into smaller mixed use industrial/warehouse/office parcels.*" Future decisions regarding cleanup and redevelopment of Alton Park Community should use this plan.

Community Involvement

In 1984, EEP conducted a cross-sectional, descriptive health study in the Piney Woods area of Alton Park, at the request of the Piney Woods Community Organization (EEP 1986). The Avondale area of Chattanooga served as the comparison group. Interviewers asked all participants about self-reported respiratory symptoms and diseases, using questions about respiratory symptoms taken from the American Thoracic Society's questionnaire (Ferris 1978) and questions about exposure written by EEP. EEP determined that self-reported respiratory symptoms, diseases, and itching after being outdoors were statistically increased in the Piney Woods population.

In 1995, EEP conducted a health study in the Alton Park Community (EEP 1999). The Avondale area of Chattanooga served as a comparison group. Trained interviewers interviewed each participant to determine the prevalence of health conditions and risk factors. Each participant also gave urine and blood samples for analysis for biomarkers of kidney, liver, and immune/hematological system function and participated in lung function tests. EEP detected no differences between community members of Alton Park and Avondale in self-reported symptoms or diseases, biomarkers of kidney, liver, and immune function, or lung function. The only statistical difference in the communities was that more people in Alton Park reported being worried about the environmental and chemical hazards in the area than did the people in Avondale.

In the years between the two studies, a major coke oven industry closed. Other heavy industry in the area also closed in the same time frame. It is unknown if this was related to the different results of the two studies.

There is considerable community interest in the Velsicol Site prior to site cleanup and in how the site will be remediated. EEP attended a public meeting hosted by the community organization, Stop Toxic Pollution (STOP), on April 19, 2011, to briefly explain its role and to answer questions. On May 10, 2011, EEP attended a meeting of private and government stakeholders involved in the Alton Park Community. The meeting was hosted by the Alton Park Development Corporation. At both meetings, EEP talked with many different people, representing diverse organizations which work in the community. EEP noted that most stakeholders were confused about the function and authority of the many different environmental regulatory organizations at work in Alton Park.

On September 15, 2011, EEP held a public meeting for the community and local and regional environmental regulatory programs to learn about the ATSDR public health assessment process.

On October 27, 2011, EEP held an open house for the community, representatives of the local planning commission, and the local health department to meet the environmental regulators. Local and state environmental regulatory divisions spoke about their individual work in the community. EEP supplied each agency with a map of the Alton Park community with the locations of the industries and sites for which they have authority. Agencies included the State and Regional offices of Solid and Hazardous Waste Management, the Regional offices of Remediation, Water Pollution Control, and Air Pollution Control, and the City of Chattanooga and Hamilton County agencies with authority for air, drinking water, and waste water.

Geology and Hydrogeology

Regional Geology and Hydrogeology

The geology and hydrogeology of the Velsicol Site was discussed in the Velsicol Phase I and II RFI Reports prepared by Law Engineering and Environmental Systems Inc. (Law 1994, 1998). Their information is summarized here. The geology and hydrogeology is important because it influences the probability that pollution in groundwater will move from the Velsicol Site to other nearby areas.

The Chattanooga area, including the Alton Park Community, is located in the Valley and Ridge Physiographic Province of the United States. The United States is divided into various Provinces, each with its own unique characteristics. The Valley and Ridge Province is distinguished by numerous northeast-southeast trending long valleys and ridges that are parallel to one another. They are made up of rocks that are mainly limestones, dolomites, shales, and sandstones. Harder layers of rock such as sandstone form ridges, while the valleys are formed from softer limestone, dolomite, and shale. Streams in the Valley and Ridge Province typically form a trellis drainage pattern, like a garden trellis used to grow vines. The rocks of the Valley and Ridge Province have gone through faulting and are usually folded so that the rocks are dipping at moderate to steep angles. Trellis drainage is usually found in areas of folded rocks. Various lineaments (linear features) were noted on the ridges and slopes near the site. Lineaments represent linear features in a landscape and are typically expressions of an underlying fault.

The ridges in the Valley and Ridge Province are generally about 1,000 feet in elevation. The highest elevation found near the site is Lookout Mountain, located approximately 0.65 miles west, at an elevation of 2,140 feet above mean sea level (msl). The lowest elevation near the site is the Tennessee River flood plain with an elevation at about 634 feet above msl (Law 1994).

Water typically moves through limestones in fractures and bedding planes. Water is usually found at the top of the bedrock where it comes into contact with the soil above. There are usually a high number of fractures and solution features in the top portion of bedrock (DeBuchananne and Richardson 1956). Wilson described the water-bearing characteristics of the rocks underlying the Velsicol Site as poor (Wilson 1979). This means that groundwater contamination will not move very far away from the site.

Site Geology and Hydrogeology

The western side of the Velsicol Site is underlain by soils composed of silty clays. Below the silty clays are thinly bedded calcareous silty shales, shaley limestone, and fine sandy limestone of the Sequatchie Formation. The silty clays are the result of weathering or breaking down of the bedrock that underlies the clays. The silty clays are typical soils for this area of Chattanooga, near Chattanooga Creek. The geology changes on the eastern side of the site. Thinly to medium-bedded limestones, massive limestones, shaley limestone, and dolomitic and fossiliferous limestone of the Cathey's Formation are present in this area below the soil cover (Law 1998). The investigations at the site found that both the Sequatchie and Cathey's formations do not have abundant groundwater moving through them. Groundwater flows from the western side of the site to both the northeast and southeast (Law 1998).

Native soils at the site have long been disturbed. Soils encountered on-site include brown silty clay and clayey silts. Soil thickness on-site is from 3 to 36 feet. On-site soils are the result of weathering of the parent bedrock. Rock fragments were encountered throughout the on-site soils. The amount of rock fragments increase with depth, until the soil-rock contact is found.

The top of bedrock on-site is uneven. Based on site information, the top of rock varies from an elevation of 660 feet above msl to 730 feet above msl. Rock is visible at the ground surface in the southern portion of the site.

The shallowest underground water-bearing zone, or aquifer, on the site was found to be two interconnected intervals; the soil water-bearing zone and the fractured rock water-bearing zone. The soil water-bearing zone is 3 to 36 feet thick. The fractured rock water-bearing zone is situated in the upper portion of the bedrock where fractures are located (Law 1998). This zone ranges in thickness from 10 to 50 feet. The "fresh rock" aquifer is below the uppermost aquifer and is made up of slightly weathered to fresh rock with few fractures. This zone is encountered between 23 and 70 feet below ground surface (bgs). Groundwater flows slowly through both the soil zone and the fractured bedrock zone at the site. For the "fresh" bedrock zone, water moves slowly though smaller fractures and through larger openings. Flow through the larger openings in the bedrock beneath the site is called Karst flow.

The direction of groundwater flow is divided at the Velsicol Site. The groundwater divide extends from the northwest corner of the site southeastward, toward Residue Hill (Figures 4 and 5). Groundwater flows to the northeast, toward Recovery Well 1 (RW-1) in the northern half of the site. RW-1 is pumped nearly constantly, thus causing groundwater to be pulled toward it. By pumping RW-1, much of the on-site chemicals found at the former Reilly Tar Site of the Velsicol property are captured. Groundwater flow in the southern portion of the Velsicol Site flows to the east-southeast, toward Piney Woods Spring. Groundwater across the site occurs between approximately 5 to 24 feet bgs (Law 1994).

The Piney Woods Spring, located southeast of the site serves as a natural collection point for groundwater flowing offsite to the southeast. Before the early 1980s, Piney Woods Spring was located in the center of an area used as a ball field. The spring is no longer accessible to the public and the water moving out of the spring is delivered directly to the City of Chattanooga's Moccasin Bend Wastewater Treatment Plant through an underground pipeline.

Investigations by Law (1998) showed the overall groundwater movement to be vertically downward. In other words, the water moves from the soil water-bearing zone to the fractured rock water-bearing zone. However, the vertical groundwater movement is different at Piney Woods Spring. At Piney Woods Spring the groundwater tends to migrate upward from the fractured rock water-bearing zone to the soil water-bearing zone. These observations are similar to regional groundwater flow observations. Vertical groundwater movement is typically downward in recharge areas on hills and upward in areas where the groundwater comes out onto the surface. These areas include springs and surface water bodies such as Chattanooga Creek (Law 1998).

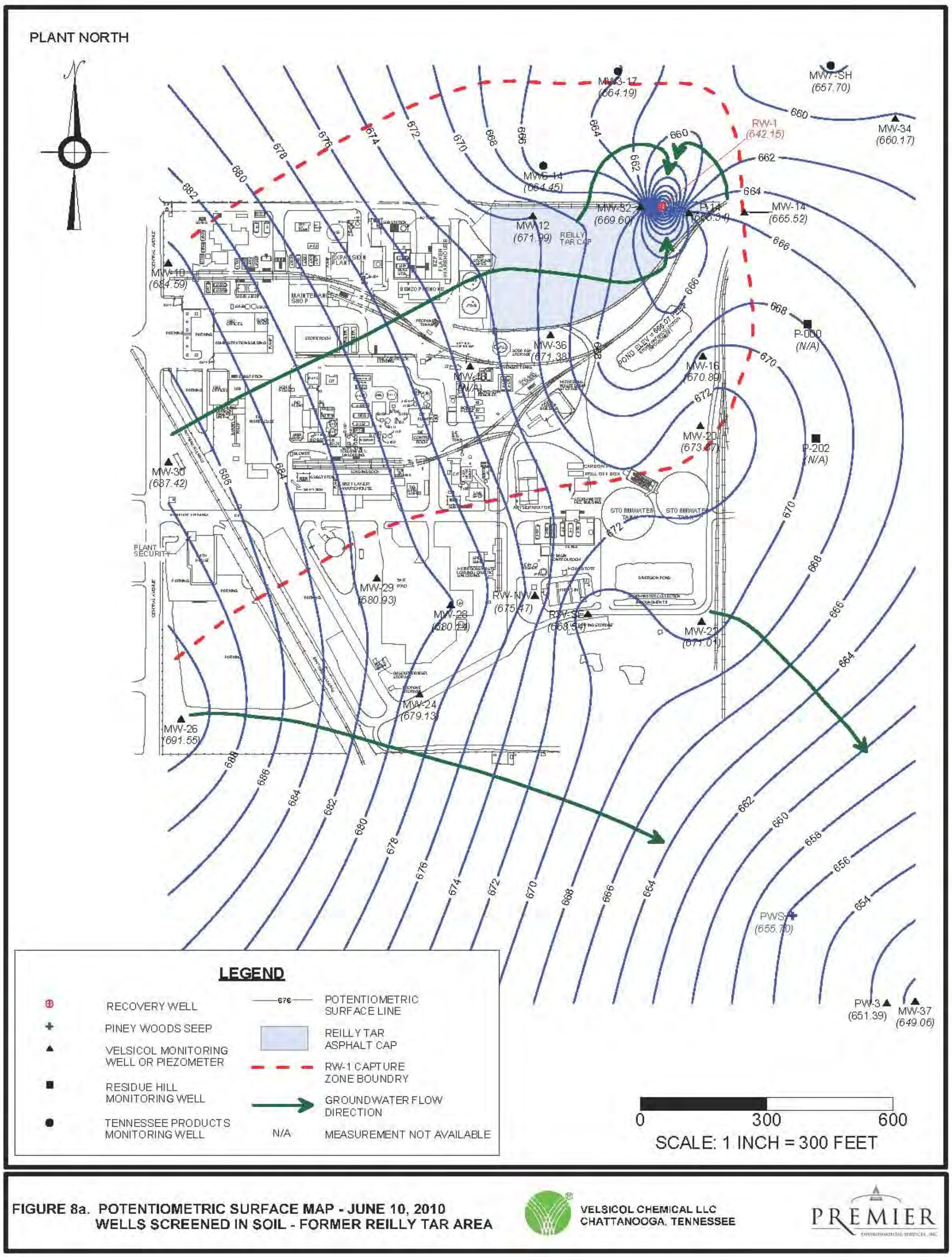


Figure 4. Soil interval groundwater surface map for the Velsicol Site. Groundwater flows to well RW-1 and Piney Woods Spring. Source: MEC 2011.

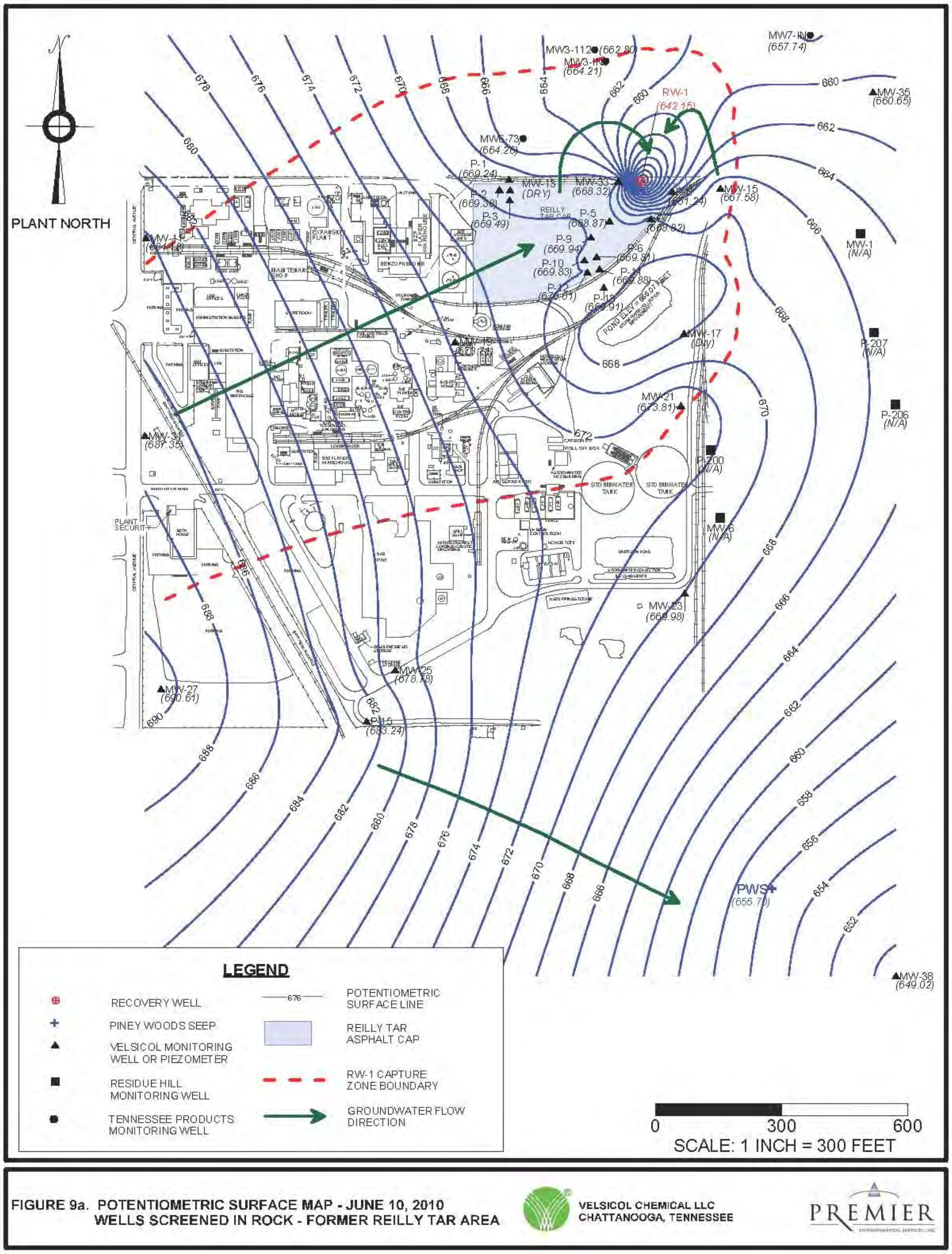


Figure 5. Bedrock interval groundwater surface map for the Velsicol Site. Like the groundwater in the soil interval, the groundwater in the bedrock also moves to well RW-1 and to Piney Woods Spring. Source: MEC 2011.

Water Use Near the Velsicol Site

The Tennessee American Water Company provides public drinking water to homeowners in the Alton Park area. The source of this water is the Tennessee River. Water is filtered and treated by Tennessee American before it is placed in the distribution pipes.

As part of Law's 1994 Phase I RFI investigation, TDEC water well records were searched and three homes located northwest of the Velsicol Site reportedly had private wells. These wells were reported to be located approximately one mile upgradient from the site. In other words, the wells were not located in the direction that groundwater flows to but the direction that groundwater flows from. Further investigation as part of the Phase II RFI conducted by Law (1998) noted that there were no drinking water wells within 1 mile of the Velsicol Site. Everyone in the Alton Park community has access to public water.

Environmental Sampling

Environmental sampling at the Velsicol Site has been ongoing since the early 1980's. Three phases of RCRA Facility Investigations (RFIs) have been conducted at the site since the early 1990's along with corrective measures studies and interim corrective action investigations. The Velsicol Site includes the former Reilly Tar area that has been investigated, stabilized, and had remedial actions undertaken.

Groundwater at the former Reilly Tar parcel of the Velsicol Site is sampled 2 times (semiannually) each year in accordance with the site-specific Sampling and Analysis Plan (SAP) (MEC 2010a). The SAP was previously approved by TDEC. Ten groundwater monitoring wells are included in the Reilly Tar area SAP. The 10 wells are sampled to understand the migration and degradation of site-related chemicals and to track the remedial progress (MEC 2010b). The groundwater near Piney Woods Spring is sampled one time each year (annually). Six groundwater monitoring wells are sampled as part of the on-going monitoring of site-related chemicals in this area. Site-related chemicals found in groundwater included volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, herbicides, total petroleum hydrocarbons, and metals.

Numerous soil samples have been collected across the Velsicol Site. Soil samples indicated that on-site soil is contaminated by VOCs, SVOCs, pesticides, herbicides, and some metals. These chemicals were released at the site from accidental chemical spills, chemicals leaking from valves or pipes, past waste disposal practices, etc. Since many investigation areas are composed of one or more solid waste management units (SWMUs), for the site investigation strategy, Velsicol took the approach of combining SWMUs into larger areas and concentrating on determining the releases from the larger areas. These larger areas that contained more than one SMWU, that were located near one another, had similar waste management practices, or had their releases comingled, were designated solid waste management areas, or SWMAs. Soil sample results indicated that releases have occurred at most of the SWMUs. The releases were not unexpected given past industry standard operating procedures (Law 1998).

A total of 67 SWMUs were identified at the Velsicol Site. TDEC has required remediation activities be undertaken at a total of 33 SWMUs. These 33 SWMUs were combined into 11 larger SWMAs in the main portion of the Velsicol Site (Figure 3).

In addition to groundwater monitoring wells that are sampled annually or semi-annually, select wells are monitored monthly for the presence of free product or dense, non-aqueous phase liquids (DNAPLs). Free product is actually the liquid form of the chemical itself that has collected in a monitoring well. Six additional groundwater piezometers and groundwater monitoring wells form the DNAPL recovery well network at the Reilly Tar Site area of the Velsicol Site.

Sediment and surface water have also been sampled both on- and off-site. As discussed earlier, Piney Woods Spring is sampled as part of the SAP for the site. A drainageway east of the Velsicol Site drains stormwater from the south and east surfaces of the closed Residue Hill landfill. The drainage crosses beneath Wilson Road (Figure 6). The drainageway changes to a braided drainage and eventually drains to Chattanooga Creek. Flow in this drainageway, also known as the Heatec Stream, is intermittent and is dependent on storm events (Law 1998). Standing water was sampled in the Heatec Stream drainageway as part of the Phase II RFI. The Heatec Stream still receives stormwater discharge from the surrounding land. A small section of this stream west of Wilson road is fenced to prevent access.

Sediment samples were collected from 0 to 0.5 feet below stream bed surface in the drainageway of the stream east of the Velsicol Site. A total of 5 sediment samples were collected from various locations in the drainageway. One additional sample was collected as a background sample, away from the potential impact of the Velsicol Site. The background sample was collected west of Central Avenue and north of the Velsicol Semi-Works plant.

Environmental Sampling Results

The results of the various soil, groundwater, surface water, and sediment samples collected as part of the three phases of site RFIs and the various interim corrective action investigations are discussed below. In some cases, the detection limits of samples analyzed as part of the site investigations were high and variable. These high detection limits were the result of high concentrations of some chemicals in the soil, groundwater, surface water and sediment samples. Therefore, while the major chemicals were identified in the samples, there may be other chemicals present in lower amounts that were not apparent due to the high detection limits

On-Site Soil

Spills, leaks from tanks and piping, housekeeping issues, and historic disposal methods likely led to the contamination of soil at the Velsicol Site. Because the site was used for chemical plant operations for a period of nearly 60 years, finding chemicals used and produced at the site in on-site soils is expected. In addition, there were no environmental laws that regulated the management of chemicals and disposal of waste when operations first began at this site. Many environmental laws that affect the Velsicol Site were not enacted until 1976.

Figure 6. Location of Heatec stream where sediment samples were collected as part of the Velsicol Site investigation. Note the relation of the stream with the Velsicol and Residue Hill Sites. Chemicals found in the stream may be from either site. Source: Google Earth.

Soil samples collected from the Velsicol Site during the Phase I RFI indicated that VOCs, SVOCs, pesticides, herbicides, and metals were present in concentrations above naturally-occurring background levels and screening levels. Phase I RFI soil sampling and analysis conducted in 1993 identified numerous site-related chemicals above action levels. These chemicals are specified in Table 1, below (Law 1994). This sampling and analysis was done before any removal or other cleanup activities.

Table 1 shows a wide variety of chemicals that were found in soil during the Phase I investigation. Volatile organic compounds such as benzene, toluene, xylenes, and carbon tetrachloride were found in soil samples analyzed. Semi-volatile compounds found in soil included 1,2,4-trichlorobenzene, benzoic acid, and hexachlorobenzene. The insecticides, alpha-, beta-, and gamma-BHC along with the pesticide 2,4,5-TP (Silvex) were also found. Polyaromatic hydrocarbons (PAHs) such as benz(a)anthracene and benzo(b)fluoranthene were found in soil samples. Various metals were found in site soil that included arsenic, barium, beryllium, chromium, cobalt, lead, nickel, vanadium, and zinc.

Soil sampling was not conducted as part of the Phase II RFI. More intensive soil sampling was done during the Phase III RFI. In 2007, soil was resampled at 3 Areas of Concern (AOCs) and 3 stand alone SWMUs. A total of 65 soil samples were collected using hand auger or direct push drilling techniques. The samples were analyzed for constituents of concern (COCs) that were based on previous investigation results and knowledge in accordance with the approved SAP (MEC 2007). This sampling and analysis was done after hazardous waste removal activities at certain areas. At other areas of sampling, removal activities had not been done.

Several chemicals were identified in soils during the Phase III RFI investigation of the site. These chemicals are specified in Table 2 below. Many of the same chemicals that were found in soil samples collected as part of the Phase I RFI were found in soil samples collected as part of the Phase III RFI. Detection limits were lower overall at the time of the Phase III RFI and therefore, more chemicals were identified in soil samples when compared to those of the Phase I RFI.

Soil samples collected in 1993 and 2007 showed that there were a number of chemicals remaining in the shallow soil on the site. The SWMUs that contained contamination with elevated levels underwent soil removal. However, in all SWMUs some areas still have soil with chemical concentrations above EPA's conservative industrial soil regional screening levels (RSLs).

Soil data reports reviewed by EEP for this PHA were incomplete. For example, no data were provided for test pits that were dug at some SWMUs. The soil data provided and reviewed for this PHA was thorough enough to be used to get an overall picture of the contamination present at the Velsicol Site.

Table 1. Chemicals found in soil during the Phase I RFI, Velsicol Site, 1993, Chattanooga, Hamilton County, Tennessee. All units are reported in milligrams per kilogram (mg/kg). Source: TDEC Files

Volatile Organic Compounds (VOCs)	Range of Concentrations	ATSDR Adult EMEG (non-cancer)	ATSDR CREG (10^{-6} excess cancer risk)	EPA Industrial RSL	EPA Residential RSL
Benzene	13.7	400	10	5.4	1.1
Carbon tetrachloride	0.632 – 7.07	3,000*	10	3	0.61
Toluene	0.661 – 9,480	60,000*	ngv	45,000	5,000
Xylenes	0.974 – 1,900	100,000	ngv	2,700	630
Semi-Volatile Organic Compounds (SVOCs)					
1,2,4-Trichlorobenzene	2,590 – 6,400	ngv	ngv	99	22
Benzoic acid	7,400 – 536,000	3,000,000*	ngv	2,500,000	240,000
Hexachlorobenzene	10.4	1,000	ngv	1.1	0.3
Pesticides					
α-BHC	0.0345 – 35	6,000	0.1	0.27	0.077
β-BHC	0.0567 – 23	400+	0.4	0.96	0.27
γ-BHC	6.4	200*	ngv	2.1	0.52
Herbicides					
2,4,5-TP (Silvex)	0.034.5 – 0.643	7,000	ngv	4,900	490
Polyaromatic Hydrocarbons (PAHs)					
Benz(a)anthracene	3.64 – 8.69	ngv	ngv	2.1	0.15
Benzo(b)fluoranthene	0.524 – 5.99	ngv	ngv	2.1	0.15
Metals					
Arsenic	4.8 – 12.6	200	0.5	1.6	0.39
Barium	55.9 - 244	100,000	ngv	190,000	15,000
Beryllium	0.5 – 1.5	1,000	ngv	6,900	1,400
Chromium	10.4 - 50	700#	ngv	ngv	ngv
Cobalt	7.9 – 46.9	7,000+	ngv	1,900	370
Lead	5.7 - 13	400***	ngv	800	400
Nickel	7.5 – 22.2	10,000+	ngv	69,000##	13,000##
Vanadium	8.8 – 34.3	7,000+	ngv	5,200	390
Zinc	40.8 – 1,020	200,000+	ngv	310,000	23,000

Notes:

mg/kg = milligrams per kilogram, equivalent to parts per million in soil.

ATSDR EMEG = Agency for Toxic Substances and Disease Registry Environmental Media Evaluation Guide (ATSDR 2012). Chronic non-cancer exposure comparison values for an exposure greater than 365 days used to determine if chemical concentrations warrant further health-based screening.

ATSDR CREG = Agency for Toxic Substances and Disease Registry Interim Cancer-Based Comparison Value Risk Evaluation Guide, February 2012. Cancer risk comparison values for cancer risk of 1 excess cancer in 1,000,000 people.

EPA RSL = Environmental Protection Agency Regional Screening Levels (EPA 2012). Industrial RSLs are for exposure to an on-site worker. Residential RSLs are for a lifetime exposure to a resident

400*** = EPA residential soil screening value.

ngv = No guidance value available.

* = ATSDR RMEG used as there was no Chronic EMEG available for the chemical.

+ = ATSDR intermediate exposure duration (15 to 364 days) EMEG used; Chronic EMEG unavailable.

= EMEG for Hexavalent Chromium used; Chronic EMEG for Cr^{+4} unavailable.

= RSL for Nickel soluble salts as RSL for elemental nickel unavailable.

Table 2. Chemicals found in soil during the Phase III RFI, Velsicol Site, 2007, Chattanooga, Hamilton County, Tennessee. All units are reported in milligrams per kilogram (mg/kg). Source: TDEC Files

Volatile Organic Compounds (VOCs)	Range of Concentrations	ATSDR Adult EMEG (non-cancer)	ATSDR CREG (10^{-6} excess cancer risk)	EPA Industrial RSL	EPA Residential RSL
Benzene	0.203 – 15.5	400	10	5.4	1.1
Chlorobenzene	0.225 – 100	10,000*	ngv	1,400	290
Tetrachloroethylene	4.93	4,200*	330	2.6	0.550
Toluene	0.251 – 121	60,000*	ngv	45,000	5,000
Xylenes	0.55 – 82	100,000	ngv	2,700	630
Semi-Volatile Organic Compounds (SVOCs)					
1,2-Dichlorobenzene	0.524 – 1.21	ngv	200,000	9,800	1,900
Benzoic acid	2.78 – 173	3,000,000*	ngv	2,500,000	240,000
Benzotrichloride	0.730	ngv	ngv	0.22	0.049
Bis(2)Chloroisopropyl ether	9.72	30,000+	ngv	22	3.1
1,2,4-Trichlorobenzene	0.409 – 713	ngv	ngv	99	22
Pesticides					
Aldrin	0.0516 – 12.9	0.04	20	0.10	0.029
α - BHC	0.0524 – 140	6,000	0.10	0.27	0.077
β-BHC	0.0505 – 366	400+	0.40	0.96	0.27
Technical Chlordane	5.84 – 106	400	2	6.5	0.16
4,4'-DDD	0.316 – 54.3	ngv	3	7.2	2
4,4'-DDE	0.063 – 85	ngv	2	5.1	1.4
4,4-DDT	0.100 – 2.16	400+	2	7	1.7
Dieldrin	0.0538 – 12.2	40	0.04	0.11	0.03
Heptachlor	0.0526 – 90.4	400+	0.20	0.38	0.11
Heptachlor epoxide	0.0149 – 1.41	9	0.08	0.19	0.053
Polyaromatic Hydrocarbons (PAHs)					
Benz(a)anthracene	0.553 – 13,700	ngv	ngv	2.1	0.15
Benzo(b)fluoranthene	0.415 – 14.4	ngv	ngv	2.1	0.15
Benzo(k)fluoranthene	0.509 – 232	ngv	ngv	21	1.5
Benzo(a)pyrene	1.85 – 371	ngv	0.10	0.21	0.015
Dibenzo(a,h)anthracene	0.619 – 123	ngv	ngv	2.1	0.015
Indeno(1,2,3-c,d)pyrene	0.505 – 456	ngv	ngv	2.1	0.15
Metals					
Antimony	2.6 – 18.3	300,000+	ngv	410	31
Arsenic	4.11 – 91.2	200	0.5	1.6	0.39
Barium	8.23 – 640	100,000	ngv	190,000	15,000
Beryllium	0.33 – 139	1,000	ngv	6,900	1,400
Cadmium	0.52 – 2.34	70,000	ngv	9,300[##]	1,800[##]
Chromium	2.09 – 1,590	700	ngv	ngv	ngv
Cobalt	2.37 – 1,210	7,000+	ngv	1,900	370
Lead	3.43 – 347	400***	ngv	800	400
Mercury	0.1 – 10.3	ngv	ngv	43	10
Nickel	13.6 – 60.2	10,000+	ngv	69,000[###]	13,000[###]
Selenium	3.06 – 4.81	4,000,000	ngv	5,100	390
Silver	6.6 – 21.2	4,000,000	ngv	5,100	390
Thallium	2.29 – 35	60,000[###]	ngv	10	0.78
Vanadium	4 – 57	7,000+	ngv	5,200	390
Zinc	11 – 1,200	200,000+	ngv	310,000	23,000

Notes:

mg/kg = milligrams per kilogram, equivalent to parts per million in soil.

ATSDR EMEG = Agency for Toxic Substances and Disease Registry Environmental Media Evaluation Guide (ATSDR 2012). Chronic non-cancer exposure comparison values for an exposure greater than 365 days used to determine if chemical concentrations warrant further health-based screening.

ATSDR CREG = Agency for Toxic Substances and Disease Registry Interim Cancer-Based Comparison Value Risk Evaluation Guide, February 2012. Cancer risk comparison values for cancer risk of 1 excess cancer in 1,000,000 people.

EPA RSL = Environmental Protection Agency Regional Screening Levels (EPA 2012)). Industrial RSLs are for exposure to an on-site worker. Residential RSLs are for a lifetime exposure to a resident.

400*** = EPA residential soil screening value.

ngv = No guidance value available.

* = ATSDR RMEG used as there was no Chronic EMEG available for the chemical.

+ = ATSDR intermediate exposure duration (15 to 364 days) EMEG used for the chemical; Chronic EMEG unavailable.

= EMEG for Hexavalent Chromium used; Chronic EMEG for Cr^{+4} unavailable.

= RSL for Cadmium is based on diet.

= RSL for Nickel soluble salts as RSL for elemental nickel unavailable.

Off-Site Soil

No soil sampling was done on off-site properties during the RFI's managed by Velsicol. The reasons given for this are as follows.

- Environmental conditions at the properties located immediately north and east of the Velsicol plant site (i.e., the Tennessee Products Site and the Residue Hill Site, respectively) have been addressed through State and Federal environmental programs and related investigations.

- The land located across Central Avenue, west of the Velsicol plant site, is at a higher elevation, such that contaminated soil migration from the Velsicol Site to the area via stormwater runoff is not possible.

- The land located south of the Velsicol plant site is protected from contaminated soil migration via stormwater runoff by two site features; a woodland hill and a concrete lined ditch that intercepts stormwater for subsequent discharge with plant site stormwater to the City of Chattanooga sewer system (Gary Hermann, personal communication March 21, 2012).

EEP found limited descriptions of off-site soil sampling in residential areas near the Velsicol Site. These may be either residential area or property line area samples. Surface soil samples were collected as part of other environmental investigations. Findings of these investigations are summarized below. Analytical data sheets for the properties that have had environmental investigations performed are presented in Appendix C. EEP located surface soil sampling data for:

- the Residue Hill Site located directly east of the site,

- the Bunge Oil/Lookout Oil northwest across Central Ave from the site,

- the former Chattanooga Coke Plant Site north of the site,
- the former Piney Woods Elementary School property located northeast of the site, and
- the former Piney Woods Park located southeast of the site.

The Residue Hill Landfill Site is east of the Velsicol Chemical Site. It was a disposal area for Velsicol many years ago. Many environmental investigations and actions have been done at Residue Hill over the years. Several surface soil samples were collected off-site in the vicinity of Residue Hill in the early 1990's (B&V 1993). Samples were collected in Piney Woods Park; to the north and south of Residue Hill, west of Wilson Road, but still on the Residue Hill property; and south of the Emma Wheeler Homes property east of Wilson Road. Several metals were found. Only magnesium was found at levels above naturally-occurring background level for the southeastern United States (B&V 1993). Several PAH's were found in the soil sample collected as the background sample for the Residue Hill Site. PAHs were also found in surface soil samples collected south of the Emma Wheeler Homes near Residue Hill. Pesticide compounds were also identified in one sample collected close to Residue Hill south of the Emma Wheeler Homes. In much lower amounts, pesticides were identified in samples taken south of Emma Wheeler Homes farther away from Residue Hill (B&V 1993). The pesticide levels were below EPA residential soil RSLs.

Surface soil samples were collected from a wooded area off-site and northeast of the Residue Hill Site by ENVIRON (2009). One sample was collected along Wilson Road just north of the Residue Hill Site. A second sample was collected east of the railroad spur leading into the Velsicol Chemical Site, east of the Reilly Tar area of the Velsicol Site. Analysis for VOCs, SVOCs, and pesticides, showed no environmental concerns (ENVIRON 2009).

At the Bunge Oil property, PAHs were found at levels exceeding 3 times background and EPA and ATSDR soil screening values (TDEC 2011a).

For the former Chattanooga Coke Plant Site, a Supplemental Risk Assessment (ERM 2008) included some on-site surface soil samples collected from the 0 to 2 foot depth. More samples were collected along the site's western and southeastern property lines. These sampling locations, closest to nearby residential areas, had non-detect to elevated levels of PAHs. No off-site soil sampling was indicated as part of this investigation.

The Piney Woods School property was sampled and low levels of PAHs were found in the surface soil samples collected (Troy Keith, personal communication April 11, 2013).

The Chattanooga and Hamilton County Regional Planning Agency (CHCRPA) contracted with an environmental consultant to sample soil in the Piney Woods Park southeast of the Velsicol Site (Aquaterra 2009). Environmental testing done in park represented a true residential location. Soil samples were analyzed for VOCs and SVOCs. Soil sample results showed no detections of chemicals above EPA residential soil RSLs.

Additionally, environmental investigations have been conducted along and in Chattanooga Creek as part of the Tennessee Products/Chattanooga Coke and Chemical Company State Superfund Site. While this sampling may help to address flooding concerns, it is beyond the neighborhoods adjacent to the Velsicol Site. Various PAHs and coal tar residue were found in the banks and bottom of the creek and in the associated floodplain. Metals, phenols, pesticides, polychlorinated biphenyls (PCBs), and VOCs were found in creek sediments. EPA did a Phase I removal action in 1997 and 1998 on a portion of Chattanooga Creek. Approximately 25,350 cubic yards of material were excavated from the creek along with trash, debris, and hundreds of car and truck tires (Trust for Public Land 2002). Phase II of the cleanup of Chattanooga Creek was done from 2005 to 2007. Approximately 80,000 cubic yards of stabilized sediment were dug from the creek channel and transported to an off-site landfill for disposal. A cap was placed over 5,750 feet of the creek channel to prevent potential recontamination from non-aqueous phase liquid that remains in the subsurface of the sediment (EPA 2013).

While there is some off-site surface soil data for residential areas near the Velsicol Site, EEP did not find enough data to make strong conclusions about past, present, or future exposure. It would be prudent to ensure that there is adequate off-site surface soil data to ensure that residential properties near this industrialized part of Alton Park in South Chattanooga meet residential cleanup guidelines. The concrete lined ditch and stormwater interceptor system for the Velsicol Site has been in place since 1976. In 1997, Velsicol modified the system to include the current lift station and storage tank system. Before that, contaminated soil or stormwater could have migrated off-site. Residue Hill is no longer a part of Velsicol; however, contaminants could have migrated from it toward Emma Wheeler Homes before it was capped and controlled.

Groundwater

Releases from SWMUs to on-site groundwater were evaluated during both the Phase I and Phase II RFIs. A total of 22 wells were installed during the Phase II investigation. Both the shallow soil and weathered bedrock and the deeper "fresh" rock aquifers were represented by these wells. Groundwater was sampled and various VOCs, pesticides, and herbicides were identified above background levels and/or EPA screening values (MCLs or, at the time, Subpart S action levels). The screening levels were used as action levels in this first step of investigation to understand if the site might pose a problem. The same or similar VOCs, pesticides, herbicides and PAHs were detected in groundwater as those found in shallow site soil investigations that were done as part of the Phase I and Phase III RFIs (Law 1998), based on limited monitoring well sampling results supplied to EEP. Recent offsite groundwater monitoring well data and sampling data from Piney Woods Spring was supplied and much of the groundwater discussion that follows is based on this data.

The focus of the Phase II RFI was to address the extent of migration of the on-site chemical releases to groundwater. As part of this study, off-site areas in the immediate vicinity downgradient from the site were investigated. During the Phase II RFI, conducted from February 1997 through January 1998, off-site areas to the northeast and southeast were investigated. Off-site groundwater sampling results showed the presence of VOCs, SVOCs, pesticides, herbicides, total petroleum hydrocarbons, and metals. Four off-site wells were installed during the Phase II RFI. In addition, Piney Woods Spring was sampled.

The public cannot enter the Velsicol Site and groundwater is not accessible in the general site area. Groundwater occurs at depths ranging from 5 to 24 feet below the ground surface. There are no drinking water wells located near the site according to previous water well surveys conducted as part of the Phase I and Phase II RFIs (Law 1994 and 1998).

Groundwater was not sampled as part of the Phase III RFI investigative activities. However, groundwater in the northeastern portion of the site is sampled semi-annually as part of site interim remedial activities and is evaluated by TDEC DSWM. Similarly, groundwater off-site to the southeast is sampled annually as part of the "Southeast Trough" area monitoring. Locations sampled as part of the Southeast Trough area include Piney Woods Spring and monitoring wells surrounding the spring and the sewer discharge line from the spring. The latest reports for each of these areas were obtained from Velsicol (Gary Hermann, MEC, personal communication, June 23, 2011).

The latest 2010 semi-annual sampling data for the monitoring wells located in the northeast section of the site suggest that concentrations of total SVOCs and total VOCs have varied greatly over the past six years. VOCs and SVOCs were not detected in the analytical data from September 2009 sampling event. Appendix D has summarized groundwater monitoring well sampling results for two well sampling events in 2010. The September 2010 total VOC concentration was 2.48 micrograms per liter (µg/L). The December 2010 total VOC concentration was 148.6 µg/L. Although this was higher compared to September 2010, it was still within the historical range for total VOC concentrations found in previous sampling events. The total SVOC concentrations for the September 2010 and December 2010 sampling were approximately 66 µg/L and 218 µg/L, respectively. These levels were within the historic range of SVOC levels found in previous sampling events (MEC 2011a).

The latest 2011 "Southeast Trough" area monitoring report (MEC 2011a), reflecting groundwater sampling on March 3, 2011, suggests that the data set does not reflect any large changes from other historical monitoring events. Appendix E has summarized groundwater monitoring well results for March 2011. Levels of site-related chemicals appear to be stable or decreasing slightly in the wells and Piney Woods Spring south of the site (MEC 2011a). Constituents noted include diesel range petroleum hydrocarbons; 1,2,4-trichlorobenzene; 1,4-dichlorobenzene; 4-chloro-3-methylphenol; chlorotoluene; benzene; chlorobenzene; ethylbenzene; m,p, and o-xylenes; toluene; beta BHC; and heptachlor.

Surface Water

A dye tracing study was done on the Velsicol Site to understand the flow of groundwater from the site (Law 1998). Dye was injected into four locations on the Velsicol Site. One dye injection location was in the northwestern corner of the site, a second in the northeastern corner, a third in the southeast corner, and a fourth in the southern portion of the site. As the result of the dye trace study one surface water body was discovered to be connected to the flow path of groundwater and associated chemicals coming from the Velsicol Site (Law 1998) in the Heatec stream. The study confirmed that Piney Woods Spring is part of the discharge system for the site.

Piney Woods Spring is located south of the Velsicol Site at the base of a small rock outcrop (Figure 7). The spring was located in a small park that had a ball field. The spring was covered in the early 1980's and its discharge was piped to the City of Chattanooga sewer system. Since being covered, the spring no longer discharges to the surface. The manhole opening is about 5 feet above the spring and all discharge is captured and routed to the sewer system at this level. Piney Woods Spring has been sampled since 1993. Chemical compounds found in the spring water include VOCs, SVOCs, pesticides, herbicides, total petroleum hydrocarbons (TPH) and lead. Since 2001, Piney Woods Spring is monitored annually as part of the "Southeast Trough" area at the Velsicol Site (MEC 2010). No air monitoring has been done around the former discharge area of the spring. The Heatec stream is located east of Velsicol, on the east side of Wilson Road. During the dye trace study, dye was detected in the surface water in the Heatec stream. This indicates that groundwater from the Velsicol Site exits near or into the Heatec stream. The Heatec stream also drains storm water from the south and east sides of Residue Hill. Although Residue Hill was part of the Velsicol Site when the dye study was conducted in 1998, it is no longer part of the Velsicol Site. Residue Hill is a separate site, and environmental activities there are being conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations. Residue Hill environmental samples are not evaluated in this public health assessment.

A groundwater seep was observed during the dye study in the drainage ditch south of Residue Hill. Groundwater was thought to discharge into the ditch at the seep and then flow overland in drainage to the Heatec stream. The ditch flows under Wilson Road through a culvert and drains eastward, becoming a wide braided ditch as it flows toward Chattanooga Creek. Flow in the Heatec stream is not continuous and is dependent on storm events. However, water collects in an erosional scour or depression on the east side of the Wilson Road culvert. The standing water in the scour was sampled. Chemicals found included alpha-BHC, beta-BHC, 2,4-D, dicamba, TPH, lead, and zinc. Alpha-BHC and beta-BHC were detected at levels above the Tennessee Division of Remediation guidance levels for water. During the sampling events conducted, water was not flowing in the drainage and a surface water sample further downstream could not be collected (Law 1998).

Because of the chemicals found in the standing water of the Heatec stream and to prevent public exposure to those chemicals, a barrier to prevent contact with the stream water was constructed in approximately 1998. Velsicol built a fence around the standing water to prevent public access and exposure. Velsicol also performed a health risk evaluation taking into account the levels of chemicals in the surface water in the Heatec stream. The conclusions of the risk evaluation determined that no further action was needed (Law 1998).

Sediment

Four sediment samples were collected along the Heatec stream drainage way, including the depression located on the east side of Wilson Road. An additional sediment sample was collected as a background sample on the west side of Central Avenue north of Velsicol's semi-works plant. Sediment samples were collected from the 0 to 6-inch interval below the surface of the bed of the stream and 0 to 6-inches below the soil surface for the background sample (Law 1998).

The sediment sample from the depression had the following site-related chemicals: bis(2-ethylhexyl)phthalate, alpha-BHC, beta-BHC, 2,4,5-TP (Silvex), 2,4-D, and the metals barium, chromium, cobalt, lead, nickel, selenium, and zinc. Table 3 shows the chemicals detected in the sediment samples collected as part of the Velsicol Phase II RFI.

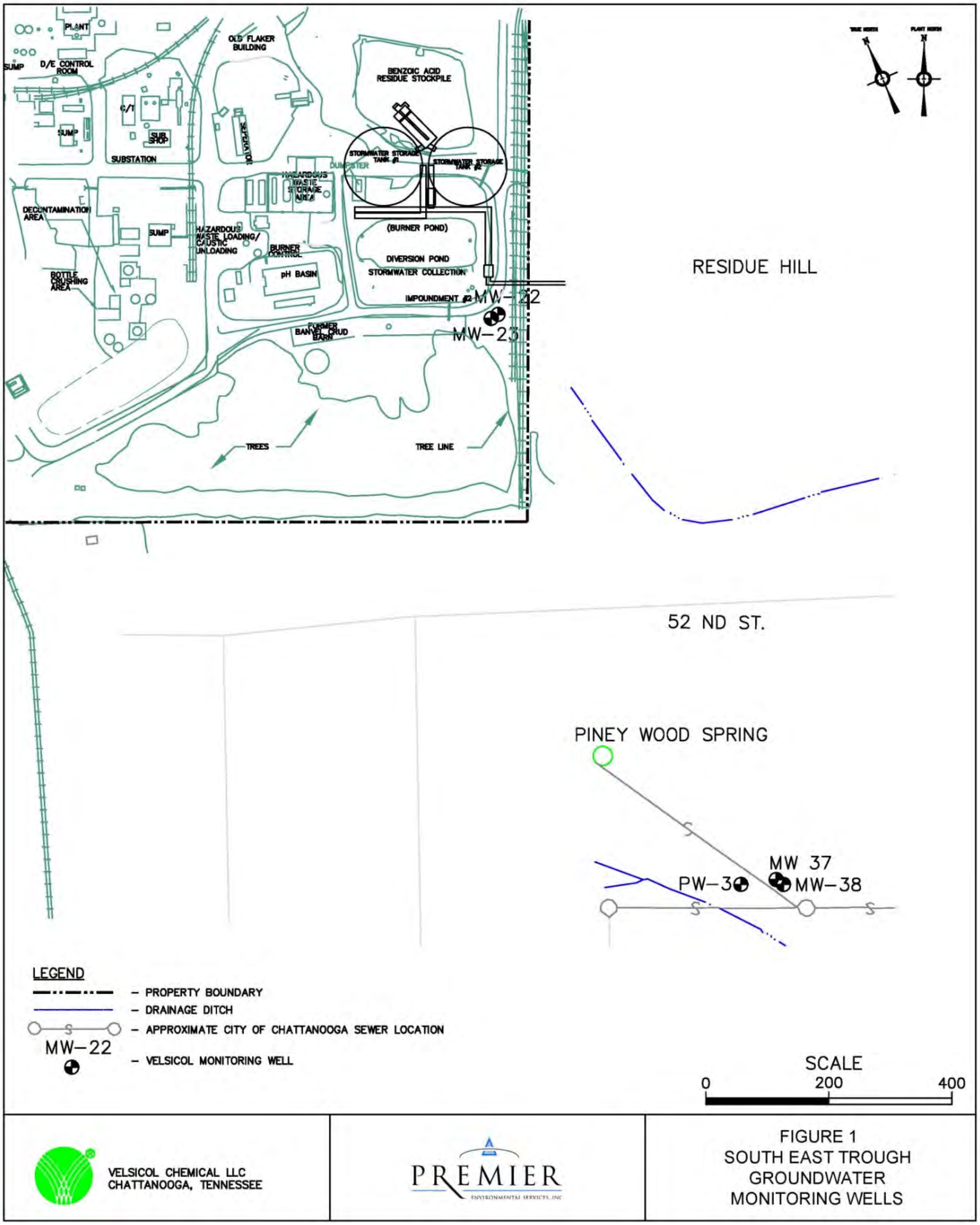


Figure 7. View showing the southeastern portion of the Velsicol Site and the locations of Residue Hill and Piney Woods Spring. The figure also shows the groundwater monitoring wells for the southeastern portion of the Velsicol Site and Piney Woods Spring are located. Source: MEC 2011.

Table 3. Sediment sample results. Background sample collected upstream from Velsicol Chemical Site. Sediment samples collected from Heatec Stream. All results are presented in milligrams per kilogram (mg/kg). The initial Heatec sediment sample was collected on November 12, 1997 and the soil resampling was collected on December 8, 1997. All other sediment samples collected in December 1997.

Chemical/Location	SED-BG	Initial Heatec-SED	Heatec Resample	SED-2	SED-3	SED-4	ATSDR non-cancer screening value	ATSDR cancer screening value[4]	EPA Industrial non-cancer RSL[5]	EPA Industrial cancer RSL[6]
methylene chloride	0.389	ND	ND	ND	ND	ND / ND	42,000[1]	350	960	310
bis(2-ethylhexyl) phthalate	ND	48.8J	6.27	4.09	8.23	ND / 0.462	420,000[1]	ngv	1,200	120
heptachlor epoxide	0.029	0.014	ND	ND	ND	ND / ND	9.1[2]	0.077	0.8	0.19
alpha-BHC	ND	0.041	0.558	0.038	0.643	0.265J / 0.933J	5,600[1]	0.11	490	0.27
beta-BHC	ND	0.080	0.838	0.251	0.734	0.200J / 0.881J	420[2]	0.39	ngv	0.96
2,4-D	ND	0.230	0.049J	0.144	ND	ND / ND	7,000[2]	ngv	770	ngv
2,4,5-TP (silvex)	0.0065J	0.211J	0.179J	0.033	0.315	0.210J / 0.125J	5,600[2]	ngv	620	ngv
arsenic	ND	3.58	ND	ND	ND	ND / ND	210[1]	0.47	38	2.4
barium	64	ND	ND	20	62	71 / 75	140,000[1]	ngv	19,000	ngv
chromium	ND	ND	ND	13 J	20 J	ND / ND	1,100,000[2]	ngv	150,000	ngv
cobalt	ND	ND	ND	ND	ND	51 / 52	7,000[3]	ngv	1,900	30
lead	47.5	90	32.3	56.4	59.2	38.4 / 45.8	400[4]	ngv	800	ngv
mercury	0.27	ND	ND	ND	ND	ND / ND	ngv	ngv	4.3	ngv
nickel	34	ND	ND	ND	ND	ND / ND	14,000[2]	ngv	64,000	990
selenium	ND	7.25	ND	ND	ND	ND / ND	3,500[1]	ngv	510	ngv

Table 3. Sediment sample results. Background sample collected upstream from Velsicol Chemical Site. Sediment samples collected from Heatec Stream. All results are presented in milligrams per kilogram (mg/kg). The initial Heatec sediment sample was collected on November 12, 1997 and the soil resampling was collected on December 8, 1997. All other sediment samples collected in December 1997.

Chemical/Location	SED-BG	Initial Heatec-SED	Heatec Resample	SED-2	SED-3	SED-4	ATSDR non-cancer screening value	ATSDR cancer screening value[4]	EPA Industrial non-cancer RSL[5]	EPA Industrial cancer RSL[6]
zinc	207	ND	ND	116	110	194 / 203	210,000[1]	ngv	31,000	ngv

Notes:

1 = Agency for Toxic Substances and Disease Registry Environmental Media Evaluation Guide (ATSDR 2013). Chronic non-cancer exposure comparison values (exposure greater than 365 days) used to determine if chemical concentrations warrant further health-based screening. These concentrations are not expected to result in adverse noncarcinogenic health effects based on ATSDR evaluation.

2 = Agency for Toxic Substances and Disease Registry Reference Dose Media Evaluation Guide (ATSDR 2013). RMEGs represent the concentration in soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects..

3 = Agency for Toxic Substances and Disease Registry Environmental Media Evaluation Guide (ATSDR 2013). Intermediate non-cancer exposure comparison values (15 to 364 days) used to determine if chemical concentrations warrant further health-based screening. . These concentrations are not expected to result in adverse noncarcinogenic health effects based on ATSDR evaluation.

4 = Agency for Toxic Substances and Disease Registry Cancer Risk Evaluation Guide (ATSDR 2012). Estimated contaminant concentration that would be expected to cause no more than one excess cancer in 1,000,000 people (10^{-6} risk) over a 70-year lifetime.

5 = Environmental Protection Agency Industrial Use Regional Screening Level for Non-Cancer Exposures (EPA 2013). The screening levels were developed for a Target Risk of $1x10^{-6}$ and a Target Hazard Quotient of 0.1 using risk assessment guidance from the EPA Superfund Program. RSLs are considered by EPA to be protective for humans (including sensitive groups) over a lifetime.

6 = Environmental Protection Agency Industrial Use Regional Screening Level for Cancer Exposures (EPA 2013). The screening levels were developed for a Target Risk of $1x10^{-6}$ and a Target Hazard Quotient of 0.1 using risk assessment guidance from the EPA Superfund Program. RSLs are considered by EPA to be protective for humans (including sensitive groups) over a lifetime.

Modifiers

0.389 = Amount of chemical in sample as analyzed by laboratory.

ND = Chemical not detected above method detection limits.

ND / ND = Original sample result / Duplicate sample result

ngv = No guidance value available for the chemical.

J = Laboratory reported estimated concentration of chemical.

Only one chemical, alpha-BHC (alpha-lindane), was detected in sediment samples above Tennessee Remediation guidance levels for soils (Law 1998). Velsicol developed a risk-based concentration for alpha-BHC based on site-specific exposures. The risk-based concentration was based on potential sediment exposure of children and adolescents who may play or wade in the Heatec stream. The risk-based concentration was 1.0 milligrams per kilogram (mg/kg). All alpha-BHC detections in the sediment samples were below this risk-based, site-specific value (Law 1998). The risk-based concentration of 1.0 mg/kg is more protective than ATSDR's environmental media evaluation guide concentration in soil of 400 mg/kg for a child and 5,600 mg/kg for an adult. It is however, higher than both ATSDR's cancer risk value for soil of 0.11 mg/kg and EPA's cancer risk value for soil of 0.27 mg/kg for an on-site worker, and 0.077 mg/kg for a resident.

Analysis of the background sediment sample found: methylene chloride, heptachlor epoxide, 2,4,5-TP (Silvex), TPH, and the metals zinc, barium, lead, mercury, nickel, and zinc. It was stated in the Phase II RFI that heptachlor epoxide and 2,4,5-TP (Silvex) were never used or handled at the Velsicol Site (Law 1998).

DNAPL Recovery

A Dense, Non-Aqueous Phase Liquid, or DNAPL is one of a group of organic chemicals that are relatively insoluble in water and denser than water. DNAPLs tend to sink vertically through underground aquifers to an underlying, less porous layer (EPA 2010).

As mentioned earlier, six groundwater piezometers or groundwater monitoring wells form the DNAPL recovery well network. During the latest monitoring period for which TDH EEP has reviewed data, from September 2010 through February 2011, a total of approximately 57 gallons (approximately 533 pounds at 9.35 pounds per gallon) of DNAPL were removed from the former Reilly Tar Area. From August 30, 1996, through February 28, 2011, a total of 4,248 gallons (39,718 pounds) of DNAPL have been recovered. Approximately 2,577 gallons of the total volume have been recovered from P-9, approximately 1,334 gallons have been recovered from P-11, approximately 175 gallons have been recovered from P-13, and approximately 137 gallons have been recovered from MW-13. Less than one gallon has been recovered from MW-32. According to MEC (2010a), overall, the recovery rate continues to be substantial as shown by the 55 gallons recovered during the 6 months ending February 28, 2011, the latest data available (MEC 2011a).

Since April 2007, the DNAPL thickness in P-11 has been higher than the previous five years of measurements. In addition, the DNAPL thickness at P-9 has shown a slowly decreasing trend since August 2008. The DNAPL thickness measurements for the remaining wells have remained generally consistent. These measurements indicate that the system has been and continues to be effective in recovering DNAPL at the site (MEC 2011a).

Site Wastewater Discharge

The City of Chattanooga's wastewater treatment plant is located in the Moccasin Bend area north of the central city portion of Chattanooga. The plant has the capacity to treat 140,000,000 gallons of wastewater per day. This amount includes the combined sewer flow and industrial wastewater flow. The sewer system was built in 1952 and serves the City of Chattanooga and seven suburban areas in Hamilton County, Tennessee and north Georgia. The service area has a population of approximately 400,000, and encompasses about 200 square miles.

The interceptor sewer system encompasses approximately 1,200 miles of sewer lines, 7 large custom-built pumping stations, 7 custom-built storm stations, 53 underground wet-well mounted, submersible pumping stations, approximately 130 residential/grinder stations, 7 combined sewer overflows (CSO) facilities, and the Moccasin Bend Wastewater Treatment Plant.

The Velsicol Site has two wastewater discharge permits (Rick Tate, City of Chattanooga, personal communication, August 31, 2011). Both permits have to be renewed yearly as part of Velsicol's on-going environmental stewardship of the site.

Permit Number 1010 is for discharge of contaminated stormwater from the closed main plant area. All stormwater is routed to and stored in a 1.5 million gallon stormwater storage tank on the Velsicol Site. Stormwater is then discharged to the sewer in Wilson Road from the storage tank. Stormwater does not flow directly into the Wilson Road sewer line.

The amount of water discharged as a condition of Permit 1010 varies depending on rainfall and snowfall throughout each year. For the time periods reviewed in August 2009 and March 2011, flow ranged from 7,000 gallons per day (gpd) to 73,000 gpd. The flow rate for permit 1013 ranged from 1.3 to 1.5 gallons per minute. This small flow rate equals a range from 1,870 to 2,160 gpd.

Permit 1010 requires monitoring of pollutants on a frequency of one representative discharge day per calendar quarter. Therefore, four times each year the Velsicol stormwater discharge is required to be sampled and the results reported to both the City of Chattanooga's Moccasin Bend Wastewater Treatment Plant and to TDEC. The results from two days in February 2011 are reported in Table 4. In addition to pollutant monitoring, the stormwater discharge flow rate is monitored continuously and reported monthly, while the pH is measured 1 day per calendar month and reported quarterly.

Table 4. Summary of sampling results for Permit 1010 for metals and organic chemicals found in stormwater discharged from the Velsicol Site, February 2011, Chattanooga, Hamilton County, Tennessee. All results are reported in milligrams per liter (mg/L). Source: City of Chattanooga, 2011.

Compound / Sample Dates	Permit Limit	02/22/2011	02/23/2011
Flow Rate	NA	8000 gal/day	7,000 gal/day
pH			
pH minimum	5.0	7.2	7.2
pH maximum	10.5	7.8	7.8
Metals			
Cadmium	1	0.005	0.009
Copper	5	0.008	0.008
Iron	NA	4.73	3.98
Lead	1.5	0.002	0.003
Manganese	NA	39.3	40.4
Nickel	5	0.065	0.049
Zinc	5	0.047	0.046
Mercury	0.1	0.0004	ND

Table 4. Summary of sampling results for Permit 1010 for metals and organic chemicals found in stormwater discharged from the Velsicol Site, February 2011, Chattanooga, Hamilton County, Tennessee. All results are reported in milligrams per liter (mg/L). Source: City of Chattanooga, 2011.

Compound / Sample Dates	Permit Limit	02/22/2011	02/23/2011
Volatile organic compounds (VOCs)			
Benzene	NA	0.0011	0.0019
Toluene	NA	ND	0.0234
Chlorobenzene	NA	0.0104	0.0094
Ethylbenzene	NA	ND	0.0014
o-Xylene	NA	ND	0.0012
1,4-Dichlorobenzene	NA	0.0051	0.0053
1,3-Dichlorobenzene	NA	ND	0.0012
1,2-Dichlorobenzene	NA	ND	0.0015
Semi-volatile organic compounds (SVOCs)			
Phenol	NA	0.010	0.040
1,2,4-Trichlorobenzene	NA	0.001	0.0042
Fluorene	NA	0.005	0.0372

Notes:

mg/L – milligrams per liter, equivalent to parts per million.

gal/day – gallons per day

NA – Not Applicable
ND – Not Detected

The second permit is permit number 1013. Permit 1013 is for discharge of contaminated groundwater from the RW-1 recovery well, used to capture the contaminated groundwater plume in the northeast portion of the site. The discharge is routed to the City of Chattanooga's sewer line in Central Avenue, immediately west of the site. The previous permit was issued October 15, 2010, and was up for renewal on September 29, 2011. The permit was renewed on that date.

Permit 1013 requires monitoring of pollutants on a frequency of one representative discharge day per calendar quarter. Four times each year the Velsicol contaminated groundwater discharge from well RW-1 is required to be sampled for VOCs, SVOCs, and pH. The results are reported to both the Moccasin Bend Wastewater Treatment Plant and to TDEC. The results from December 2010, March 2011, and June 2011 are reported in Table 5 below. In addition to pollutant monitoring, the contaminated RW-1 groundwater discharge flow rate is monitored continuously and reported each calendar month.

Table 5. Summary of sampling results for Permit 1013 for organic chemicals found in recovery well RW-1 groundwater from the Velsicol Site, Chattanooga, Hamilton County, Tennessee.. All results are reported in milligrams per liter (mg/L). Source: City of Chattanooga, 2011.

Compound/ Sample Dates	Permit Limit	12/09/2010	03/02/2011	06/08/2011
Flow Rate	NA	1.5 gpm	1.5 gpm	1.3 gpm
pH				
pH	5.0 - 10.5	7.1	9.9	6.6
Volatile organic compounds (VOCs)				
Benzene	NA	0.00755	0.00877	0.0087

Table 5. Summary of sampling results for Permit 1013 for organic chemicals found in recovery well RW-1 groundwater from the Velsicol Site, Chattanooga, Hamilton County, Tennessee.. All results are reported in milligrams per liter (mg/L). Source: City of Chattanooga, 2011.

Compound/ Sample Dates	Permit Limit	12/09/2010	03/02/2011	06/08/2011
Toluene	NA	0.0921	0.108	0.038
Chlorobenzene	NA	0.0445	0.0245	0.0144
Ethylbenzene	NA	0.00267	0.0024	0.0038
o-Xylene	NA	0.00182	0.0028	0.00101
Semi-volatile organic compounds (SVOCs)				
Acenaphthene	NA	0.00527	0.00877	0.00643
1,4-Dichlorobenzene	NA	0.0776	0.109	0.0982
1,3-Dichlorobenzene	NA	0.0102	0.0162	0.0125
Fluorene	NA	0.0023	0.00397	0.00231
Naphthalene	NA	0.00959	0.0117	ND
Phenanthrene	NA	0.0239	0.00281	ND
Phenol	NA	ND	0.0113	ND
2-Methylnaphthalene	NA	ND	0.0023	ND
1,2,4-Trichlorobenzene	NA	0.0802	0.0961	0.0875
Chlorotoluene	NA	0.0304	0.0576	0.0269

Notes:

mg/L = milligrams per liter, equivalent to parts per million.

gpm – gallons per minute

NA – Not Applicable
ND – Not Detected

At times of high amounts of precipitation, the sewer system uses seven combined sewer overflow (CSO) structures that are installed throughout the system. These overflow structures are underground storage areas used to store sewage during times of heavy precipitation. The stored sewage is then discharged as a controlled release to the system when the heavy precipitation event is over. All discharges to the system, such as those permitted from the Velsicol Site, are managed this way during large rainfall events. Therefore, unless there is a catastrophic precipitation event, which does happen, all sewage is captured and filtered through Chattanooga's wastewater treatment plant. If an overflow event does occur following a catastrophic precipitation event and sewage does migrate to the Tennessee River or its tributaries, the City of Chattanooga has to sample the discharges as a State requirement for their National Pollutant Discharge Elimination System (NPDES) permit and to report the results to TDEC. The huge volume of water from the precipitation event would dilute any contaminated water overflow to concentrations that are of no health or environmental consequence.

The results of the stormwater sampling requirement for Permit 1010 showed that metals concentrations were much lower than their respective permit limits. VOC and SVOC results, reported in micrograms per liter, are also very low. With a capacity of 140,000,000 gallons, the roughly 75,000 gallon contaminated surface water discharge for Permit 1010 was minor. The volume percentage of the surface water from Velsicol that is treated every day represents roughly 0.05% of the overall capacity of the wastewater treatment plant.

The results, reported in micrograms per liter, for the recovery well RW-1 sampling requirement for Permit 1013 showed that VOC and SVOC levels were very low. As mentioned above, the capacity of the Moccasin Bend Wastewater Treatment Plant is 140,000,000 gallons. The roughly 2,200 gallon per day contaminated groundwater discharge for Permit 1013 is very, very minor. The volume percentage of the water from RW-1 at Velsicol that is treated every day compared to the overall capacity of the wastewater treatment plant is roughly 0.002%.

Groundwater recovered from Piney Woods Spring is also discharged to the City of Chattanooga's sewer system. The spring is enclosed by a manhole structure and the discharge is piped to the sewer line in Wilson Road. The volume of the Piney Woods Spring discharge is very, very minor compared to the overall daily volume of the water treated by the treatment plant, and it should not harm the City's wastewater treatment plant.

Site Air Emissions

Air emissions from the Velsicol Site have not been studied by Velsicol or TDEC. It is not known if any chemicals volatilized into the air from on-site soil in the past. It is unknown if any volatilization from chemicals in on-site soil and/or groundwater have in the past migrated upwards and filtered into the ambient air.

Soil Gas Survey

As part of the Phase II RFI, a soil-gas survey was performed in 1997 in the area south of the site toward Chattanooga Creek and southeast of the site toward and immediately south of Piney Woods Spring. Soil-gas probes were analyzed for benzene, toluene, ethylbenzene, and xylenes only. Xylenes were found in the soil-gas, ranging in concentration from 2.1 to 30.2 nanograms of vapor (ng-V) by volume (Law 1998). The two highest levels found, 7.5 and 30.2 ng-V, were found in the right-of-way of 52nd Street southeast of the Velsicol Site. The next highest sample results of 7.4 ng-V was along the railroad right-of-way south of the site.

Discussion

Introduction to Chemical Exposure

To determine whether persons have been or are likely to be exposed to chemicals, TDH EEP evaluates ways that could lead to human exposure. Chemicals released into the environment have the potential to cause harmful health effects. Nevertheless, a release does not always result in exposure. People can only be exposed to a contaminant if they come into contact with it. If no one comes into contact with a contaminant, then no exposure occurs, and thus, no health effects could occur. An exposure pathway contains five parts:

- a source of contamination
- contaminant transport through an environmental medium
- a point of exposure
- a route of human exposure, and
- a receptor population.

An exposure pathway is considered complete if there is evidence that all five of these elements have been, are, or will be present at the site. An exposure pathway is considered incomplete if one of the five elements is missing.

The source of contamination is the place where the chemical was released. For this site, the source was spills and leaks from chemical storage tanks and chemical manufacturing processes conducted at the Velsicol Site over some 50 years of operation.

The environmental media transports the contaminants. Environmental media are groundwater, surface water, soils, or air. For this site, the chemicals are present in on-site soils at and near the surface and buried beneath the site and can be transported through the groundwater. The point of exposure is the place where people come into contact with the contaminated media. Site soils and on-site and off-site groundwater are the possible points of exposure for this site. In the past, the air might have been a point of exposure.

The route of exposure is the way the contaminant enters the body. Ways a contaminant can enter the body are through ingestion, inhalation, or dermal contact. For this site, all three can be routes of exposure. One could contact contaminated soil on-site by touching it. A person could come into contact with contaminated groundwater by touching it, getting it on their skin accidentally, or drinking it. A person could also inhale the vapors of on-site chemicals, either on-site or off-site, through inhalation or breathing of contaminated indoor air. Many exposures at this site are only possible if someone is on the site itself.

In the past, workers at the plant could have been exposed to hazardous chemicals as part of their jobs. Workers may have been protected by occupational safety and health practices and regulations after the 1970s when the Occupational Safety and Health Administration (OSHA) came into existence.

In the past, potentially exposed populations would have included residents near the Velsicol Site. Residents may have been exposed to chemicals moving from on-site to off-site areas. Potentially completed exposure pathways may have included inhalation of organic compounds and particulates in the air. In addition, contamination in soil and sediment at the Piney Woods ball field may have led to dermal exposure to, inhalation of, and incidental ingestion of contamination. We do not know when the contamination in the spring began.

In the late 1980s, the spring was connected to the City of Chattanooga sewer system. As part of the Brownfield process, the City of Chattanooga analyzed soil samples in the area of the old Piney Woods ball field (Troy Keith, TDEC CFO, personal communication, June 27, 2012). Sampling and analysis indicated that the soil in the old ball field is not contaminated.

We believe that there are no current on-site exposures because hazardous wastes have been removed, the site has been secured, and no one has access to the site. An off-site current receptor population may include people living between Piney Woods Spring and Velsicol who might be impacted by vapor intrusion from the contaminated plume. There has not been any recent data collected to assess the vapor intrusion pathway.

A future potentially exposed population could include construction workers who could be impacted by incidental ingestion, dermal exposure, and, possibly, inhalation of contaminated particulate matter.

Physical contact alone with a potentially harmful chemical in the environment by itself does not necessarily mean that a person will develop adverse health effects. A chemical's ability to affect health is controlled by a number of other factors, including:

- the amount of the chemical that a person is exposed to (dose)
- the length of time that a person is exposed to the chemical (duration)
- the number of times a person is exposed to the chemical (frequency)
- the person's age and health status, and
- the person's diet and nutritional habits.

Health Comparison Values

To evaluate exposure to a hazardous substance, health assessors often use comparison values. If the chemical concentrations are below the comparison value, then health assessors can be reasonably certain that no adverse health effects will occur in people who are exposed. If concentrations are above the comparison values for a particular chemical, then further evaluation is needed.

The Agency for Toxic Substances and Disease Registry (ATSDR) has derived a minimal risk level (MRL) for many chemicals (ATSDR 2012). From these MRLs, ATSDR has derived health guidance values, often called EMEGs (environmental media evaluation guides) for soil, air, and water. EMEGs serve as screening guidance to help scientists look more closely at the people who might be exposed to harmful levels of chemicals. To use these screening levels we must know how much of a chemical someone is exposed to, for how long that exposure has been or will be occurring, how frequent the exposure is or will be, and age of the exposed person. If concentrations are below the EMEG for a particular chemical, scientists can be reasonably certain that no adverse health effects will occur in people who are exposed.

EPA publishes toxicity information that is very similar to ATSDR's MRLs and has derived Regional Screening Levels (RSLs) that are analogous to ATSDR's EMEGs. EPA derives RSLs for residential exposures and for on-site industrial workers (EPA 2012).

If a chemical is a probable or known human carcinogen, EPA derives a cancer risk value for that chemical. This risk value represents the theoretical risk of excess cancer from exposure to the chemical over 24 hours per day, 7 days per week, 52 weeks per year for a 70 year lifetime. ATSDR uses EPA's cancer risk values to calculate levels of carcinogenic chemicals that might result in one additional cancer in a million people. ATSDR calls these levels cancer risk evaluation guides (CREGs) (ATSDR 2012). EPA and ATSDR generally consider a risk of one extra cancer case in one million people acceptable. The background lifetime risk of cancer is about one in two for men and one in three for women (ACS 2010).

Exposure Pathways

As mentioned previously, the 5 things to consider when deciding if a person may be exposed to a chemical, also known as the exposure pathway are: (1) where is the chemical coming from (source), (2) what in a person's environment has been contaminated (environmental medium), (3) is there a way a person might come into contact with the chemical (exposure point), (4) how they might come into contact with the chemical (exposure route), and (5) who might be exposed to it (exposed population), An exposure pathway is complete if it is expected or there is proof that all 5 elements are present. The exposure pathways at the Velsicol Site are discussed below and are described in Table 5.

Soil

The majority of the site was used as a chemical manufacturing plant for nearly 60 years. It was decommissioned in 2007. Soils on the Velsicol Site were contaminated with VOCs, SVOCs, pesticides, herbicides, and PAHs used and produced during industrial activities on the site. Since the site was a working industry, institutional controls (such as fencing and security) were in place during its operation to prevent trespassing and thus exposure to the general public who lived near the site. As such, there likely was no exposure to the general public to site soil. It is unlikely the public would have had skin contact with soil on the site in the past.

The Velsicol Site is fenced and secure. The general public does not have access to the site. Additionally, wastes in the various source areas across the site have been removed and properly disposed of (TDEC 2011b). Contamination remains in soil at levels above health comparison values in certain locations on the site; a soil barrier is required for these areas. Since the site is secured and fenced and the remaining soil contamination will be covered with clean soil and a vegetative cover, there should be no current or future exposure to the general public from contact with surface soils. The site is scheduled to be covered in late 2013.

Limited off-site soil sampling has occurred. Off-site surface soil sampling was summarized in the Environmental Sampling Results section of this document. Since many industries operated in the Alton Park Community for many decades, it would be difficult to attribute potential contaminants in off-site soils to any particular industry. It is unknown if residential soils in the immediate vicinity of Velsicol, Tennessee Products, and other near-by industries could have been impacted from past operations.

Table 5. Exposure pathways for the general public and onsite workers at the Velsicol Chemical Site.

Source	Environmental Medium	Exposure Point	Exposure Route	Exposed Population	Time Frame	Exposure
Chemicals remaining at the Velsicol Site	Soil	Contact with soil on the Velsicol Site	Ingestion, Dermal Contact	General Public.	Past Present Future	Incomplete[1] Incomplete Incomplete
				Onsite Workers	Past Present Future	Potential[2] Potential Potential
	Groundwater	Private well water	Ingestion, Dermal Contact, Inhalation	Residents and Visitors who use private well water	Past Present Future	Incomplete Potential Potential
		Groundwater Intrusion into excavations	Ingestion, Dermal Contact	Onsite Workers	Past Present Future	Potential Potential Potential
	Surface Water	Piney Woods Spring, Heatec Stream	Ingestion, Dermal Contact	Residents and Visitors who come into contact with Surface Water near the Site	Past Present Future	Potential Incomplete Incomplete
		Onsite Surface Water	Ingestion, Dermal Contact	Onsite Workers	Past Present Future	Potential Incomplete Incomplete
	Air	Emissions from chemicals in groundwater beneath the site or off-site	Inhalation	Residents of and Visitors to the site area,	Past Present Future	Potential Potential Potential
				Onsite Workers	Past Present Future	Potential Potential Potential
	Soil-Gas	Emissions from chemicals in soil or groundwater beneath the site or off-site	Inhalation	Residents of and Visitors to the site area,	Past Present Future	Potential Potential Potential

Table 5. Exposure pathways for the general public and onsite workers at the Velsicol Chemical Site.						
Source	Environmental Medium	Exposure Point	Exposure Route	Exposed Population	Time Frame	Exposure
				Onsite Workers	Past Present Future	Potential Potential Incomplete

[1] = Incomplete indicates that all 5 elements of the exposure pathway were not or are not present.

[2] = Potential indicates that all 5 elements of the exposure pathway may have occurred in the past or may occur in the future.

Potential exposure pathways from inhalation, incidental ingestion, and dermal exposure exist for future site construction workers. After the site is capped and closed in late 2013, there is potential for the site to be sold and/or redeveloped. Any redevelopment would likely include installing utilities or other digging for the construction of structural footings or similar activities, exposing construction workers to surface and subsurface soil. If redevelopment occurred, additional remedial activities would have to be done to ensure worker and site user safety. The RCRA permit specifies that, if land use on the site changes (such as for redevelopment), then the permit must be modified to ensure the safety of the public and on-site workers, regardless of reuse. The Site is zoned for industrial use by the City of Chattanooga.

Groundwater

Contaminants from the soil were carried downward to the groundwater beneath the site. This resulted in contaminated groundwater flowing from the site. It is unlikely that the general public would have had access to groundwater on the site or offsite in the past. Groundwater is approximately 5 to 24 feet deep at the site.

Groundwater was not and is not used as a drinking water source in the vicinity of the Velsicol Site. There are no drinking water wells in the vicinity of Velsicol (Law 1998). The Tennessee American Water (TAW) has provided drinking water for Alton Park, the surrounding area, and the City of Chattanooga (TAW 2011) for decades. Connection to the municipal water supply eliminated ingestion, inhalation, and dermal pathways for exposure to contaminated groundwater in the past, currently, and in the future.

TAW pumps water from the Tennessee River into its Citico water treatment plant at the mouth of Citico Creek. Chlorine is added to kill bacteria and other microorganisms and to oxidize certain chemical compounds for removal. Then the water travels through clarification basins to remove particles. The water then is filtered through sand and granular activated carbon to remove odors and any remaining particles. Before the water is pumped through the network of pipes to customers, a small amount of chlorine, fluoride to prevent tooth decay, and a food grade corrosion inhibitor to protect the lines in the customer's home are added to make sure water quality remains good until it comes out of the customer's faucets (TAW 2011). TAW ensures the drinking water the people of Chattanooga receive is as good as or better than EPA standards. TAW is regulated by both the EPA and the TDEC.

Groundwater is monitored at the Velsicol Site. The monitoring wells both on-site and off-site are not accessible to the public. No one drinks the water from these wells. They are used as conduits to allow water samples to be collected. TDEC has required Velsicol to implement a program to sample designated groundwater monitoring wells. Contractors hired by Velsicol sample wells at the former Reilly Tar Area two times per year and wells in the South East Trough area one time per year to monitor the amounts of chemicals in the groundwater. EEP will continue to study the data from this sampling as they are made available.

There are institutional controls or restrictions on use in place on the site that prohibit the installation of a drinking water well. On-site groundwater cannot be used as a drinking water source for the site at any time in the future.

A current and future potential exposure pathway exists should someone install a private water well in the groundwater flow path from the Velsicol Site to Piney Woods Spring. The likelihood of this happening is low as drinking water for all the neighborhoods surrounding the site is supplied by the TAW.

Surface Water

Chemicals found in soil and in groundwater beneath the Velsicol Site have been found in surface water in the area. The Velsicol Site was likely the source of these chemicals, probably by surface run-off over contaminated soils and/or discharge of contaminated groundwater passing through the site and up to the surface. A dye trace, initiated during one of the RCRA investigations for the site, showed two possible surface water discharge locations. These two locations are Piney Woods Spring southeast of the site and the Heatec stream east of the site. Piney Woods Spring was accessible to children playing at the ball park in the past. Completed past pathways existed for persons who may have had dermal contact with the contaminated water from Piney Woods Spring and the Heatec stream or breathed vapors from the contaminated water.

In the late 1980s, when contamination in the spring was identified, the spring was enclosed by a manhole and the spring discharge piped into the City of Chattanooga's sewer system. Currently Piney Woods Spring is inaccessible. Therefore, no current or future exposure pathway exists, because Piney Woods Spring water never reaches the surface. The general public does not come into contact with the spring water.

The Heatec stream had a small erosional scour or depression on the east side of the Wilson Road culvert where water accumulated. When sampled, this water had chemicals related to the site and to Residue Hill. Residue Hill was part of the Velsicol Site at the time of sampling, but it is no longer part of the Velsicol Site. The scour is now fenced off and inaccessible. EEP has not been able to convincingly determine who is responsible for maintaining the fence. See the Conclusions and Recommendations sections for further information.

Air

Volatile and semi-volatile chemicals in soil and groundwater may also volatilize to the outdoor air where people may breathe them. Groundwater may be discharged at the surface from springs, or into streams or rivers, providing an exposure point for breathing these chemicals moving from groundwater into the air. No air samples were collected near Piney Woods Spring or the Heatec stream. There is the potential that residents may have breathed the chemicals in the past while being in these areas. In the future, emissions of volatile and semi-volatile chemicals in soil to the outdoor air will be minimized because the site will be capped with two feet of clean soil. Capping will not address vapor intrusion issues in off-site areas, such as between the Velsicol Site and Piney Woods Spring.

Soil-Gas

Volatile and semi-volatile contaminants may volatilize (off-gas) from soil and groundwater, migrate through subsurface air spaces and enter buildings where they may be inhaled by occupants. Many variables influence the levels of chemicals entering a building through volatilization from contaminated soil or groundwater. These variables include the chemical's physical and chemical properties, seasonal variations, and building construction. As part of the Phase II RFI contractors found low levels of xylenes in the soil-gas near Piney Woods Spring and south of the Velsicol Site.

Based on the 1998 soil-gas data, the exposure potential from vapor intrusion is not known. ATSDR has a screening level of 50 ppb for xylenes in indoor air. EPA's RSL for xylenes is 23 ppb. These screening values cannot be compared to the values measured in soil-gas south and southeast of the Velsicol Site as the indoor air was not sampled and the units the results were reported in (nanograms of vapor by volume) are not conventional, based on current standard procedures. Updated soil-gas or indoor air measurements for the chemicals tested and additional chemicals should be done. With an updated investigation, more relevant data could be used to evaluate potential vapor intrusion from the contaminated groundwater along the flow path to Piney Woods Spring. Homes with the potential for vapor intrusion would likely be few in number and along a path from the southern portion of the site to the area of Piney Woods Spring. Pumping recovery well, RW-1, has decreased the flow of contaminated groundwater off-site while capturing much of the on-site chemical plume at the former Reilly Tar Area of the Velsicol property.

Vapor intrusion could potentially occur in on-site buildings if redevelopment should occur. The RCRA permit specifies that if land use on the site changes (such as for redevelopment), then the permit must be modified to ensure the safety of the public and on-site workers, including investigation of potential vapor intrusion issues.

Velsicol Corrective Measures Study

As part of Velsicol's RCRA permit, Velsicol was required to perform a Corrective Action Program (CAP) at the site. A total of 43 SWMUs have been identified at the site and have been addressed by the CAP. TDEC DSWM determined that some of the SWMUs did not require any further action. A total of 33 SWMUs were evaluated by the Corrective Measures Study (CMS) process. The SWMUs that did not require any further action were previously designated by

TDEC or were found to have soil contaminant levels below EPA's May 20, 2008, screening levels (MEC 2008).

The primary objective of the CMS was to manage the SWMUs. This includes soils and underlying groundwater so that conditions at the site are protective of human health and the environment (MEC 2008). A secondary objective of the CMS was to concurrently address most of the surface area of the site. This was so Velsicol would no longer have the need to capture stormwater across the site for discharge to the City of Chattanooga's wastewater treatment system (MEC 2008).

Velsicol Site Remedial Alternatives

Velsicol demolished all the buildings on the site (MEC 2011). Four remedial alternatives were developed and evaluated for final site closure (MEC 2008). In general, the four alternatives were:

1. placing a soil cover over the entire site,
2. excavating visibly-contaminated on-site soils with off-site disposal (landfilling) and then covering the site with clean imported soil,
3. excavating visibly-contaminated on-site soils with on-site treatment by low temperature thermal desorption (LTTD) and placing the desorbed soils back into the excavation areas, or
4. placing asphalt pavement over all SWMU areas and placing soil on remaining non-SWMU areas.

A general description of the remedial alternatives follows below. In general, the four alternatives are similar in that the site will be covered by a material that will prevent exposure to those who live near the site now or may use the site in the future. A chain link fence surrounding the entire site will secure the site. The fence will have locked gates and warning signs. All four alternatives are presented in more detail in Velsicol's CMS (MEC 2008).

If, after the completion of the corrective action, the permittee wants to change the land use of the site, the DSWM would require a new RCRA permit and a major permit modification, further sampling and analysis of site soils, a new risk assessment, and a site health and safety plan that would ensure the safety of on-site workers. The site is currently permitted only for industrial use by the City of Chattanooga; land use plans indicate that it will continue to be zoned for industrial use.

TDEC DSWM evaluated the remedial alternatives according to requirements set forth by EPA. The alternative chosen to remediate the site must adhere to the following:

1. assure protection of human health and the environment;
2. attain the media clean-up standards set by TDEC;
3. control the source of releases so as to reduce or eliminate, to the extent practicable, further releases that may pose a threat to human health and the environment;
4. comply with applicable standards for management of wastes;
5. demonstrate long-term reliability and effectiveness;
6. reduce the toxicity, mobility, or volume of wastes present;
7. demonstrate short-term effectiveness;

8. be able to be implemented; and,
9. have cost assurances for operation and maintenance of the alternative demonstrated by the responsible party.

The four alternatives considered for site closure were:

Alternative 1 – Soil Cover

Asphalt pavement, concrete floors, sumps, and foundations would remain and would be managed as part of this alternative. The site would be roughly graded to smooth the land surface. According to the CMS, all remaining concrete floors, pavements, and sumps would have holes installed in them on 10-foot centers. The holes would allow stormwater to drain into the underlying soil and would prevent erosion of the soil cover. A marker material would be placed on the rough-graded site surface before placement of imported soil. A minimum 24-inch thick soil cover would be placed over SWMU areas and paved non-SWMU areas. Twelve inches of soil would be placed over all other areas. The soil cover would be planted and maintained such that it has a vegetated surface. Stormwater control and conveyance would be installed to prevent erosion of the soil cover.

With this alternative, soils with residual pollutants and contaminated groundwater would remain beneath the site. Site groundwater would be actively recovered by pumping recovery well RW-1 in the Reilly Tar Area in the northeast portion of the site and through the recovery of groundwater at Piney Woods Spring, southeast of the site. The recovered groundwater is now and would continue to be routed to and treated by the City of Chattanooga's Moccasin Bend Wastewater Treatment Plant, regulated under two NPDES permits.

Other elements of this alternative include testing of impacted soils to confirm suitability for the intended use, site security fencing, and institutional controls. Deed restrictions would be used to limit future land use to commercial and/or industrial development, to require TDEC approval of any invasive soil excavation/construction plans, and to prevent installation of drinking water supply wells.

Alternative 2 – Excavation with Off-Site Landfill Disposal

Alternative 2 is similar to Alternative 1. The difference is that visibly contaminated soil would be excavated to a maximum depth of 12-inches in the SWMU areas. The excavated soil would be trucked to an off-site Subtitle D landfill for disposal. Alternative 2 would require that concrete and asphalt pavements be removed for access to underlying soils. These materials would also be trucked off-site and disposed of in a permitted Subtitle D landfill. Sediments present in the stormwater impoundments would also be excavated as part of this alternative. The alternative includes most of the site being covered with clean soil as in Alternative 1. As in Alternative 1, a marker material would be placed on the rough-graded site surface before placement of imported clean soil. A minimum 24-inch thick soil cover would be placed over SWMU areas and paved non-SWMU areas. Twelve inches of soil would be placed over all other areas.

Alternative 3 – Excavation with On-Site Low Temperature Thermal Desorption (LTTD) Treatment

Alternative 3 is similar to Alternative 2. The difference is that visibly-contaminated soil in SWMU areas would be excavated, treated on-site by low temperature thermal desorption, and returned to the excavated areas. The maximum depth of excavations would be 12-inches in the SWMU areas. Alternative 3 would also require that concrete and asphalt pavements be removed for access to underlying soils. These materials would also be trucked off-site and disposed of in a permitted Subtitle D landfill. Sediments present in the stormwater impoundments would also be excavated and treated as a part of this alternative. The alternative includes most of the site being covered with clean imported soil.

Alternative 4 – Asphalt Pavement Cover

All SWMU areas, estimated to be 12.3 acres, would be covered with 2 inches of asphalt pavement for this alternative. The asphalt would be placed over a base material thickness designed by a qualified engineer. The asphalt would be of the light duty variety, similar to what is used for parking lots. The 12.3 acres would be in addition to the already asphalt pavement-covered Reilly Tar Area. The remainder of the site (non-SWMU areas) would be covered with 12-inches of soil as in Alternative 1. Stormwater detention structures would be constructed as part of this alternative (MEC 2008).

Remedial Alternative Decision

The selected closure method for the Velsicol Site was Alternative 1, a soil cover. The cover will be 24 inches of clean imported soil placed over the SWMU areas. All other areas of the site will be covered with 12-inches of clean imported soil. Accordingly, the main purposes of the soil cover or “cap” over the SWMU areas and across the entire Velsicol Site, like on numerous sites across the U.S. (EPA 2001), will be to:

- Provide a barrier for preventing direct contact to surface and subsurface soils that still contain lesser levels of chemicals.
- Minimize vertical infiltration of water into wastes that would create more contaminated groundwater.
- Prevent the release of hazardous waste to the environment.
- Create a land surface that can support vegetation and/or be used for other purposes.

Capping is a common form of remediation because it cost effectively manages the human and ecological risks associated with a remediation site (EPA 2001).

The Velsicol Site is private property. The TDEC DSWM can only require Velsicol to follow the requirements of the Tennessee Rules for Hazardous Waste Management and the permit conditions that are in accordance with those rules (TDEC 2011b). According to the newly issued Class 3 permit (TDEC 2011b), Velsicol is required to maintain site conditions that provide adequate protection to human health and the environment. The remedy conditions, as specified in the permit modification for the Velsicol Site, require Velsicol to provide the necessary care to assure that that long-term protection is maintained. It includes provisions for site security, maintenance of the soil and asphalt caps, and groundwater and DNAPL monitoring and recovery. It also requires Velsicol to maintain financial assurance with the DSWM in an amount that at least meets the estimated cost of providing that long-term care.

Based on previous investigation results, the removal of the buildings and process equipment on-site, and removal of some of the wastes at the site, TDEC has determined that the Velsicol Site does not require a Resource Conservation and Recovery Act (RCRA) Subtitle C hazardous waste landfill cap. Except for the coal tar that remains underneath the asphalt cap of the Reilly Tar area, all source areas of wastes have been removed. Some amounts of chemicals remain in soil and groundwater beneath the site. Based on concerns voiced by the community, the DSWM has increased the soil cover proposed in the draft permit modification from 18 to 24 inches over areas determined to be contaminated (TDEC 2011b). This is being done to further protect the community and those who may in the future redevelop and reuse the Velsicol Site. To minimize settling and ponding of water, the barrier soil will be compacted during installation. The soil cover, which is primarily designed for areas with contaminants above industrial screening levels, should be protective of human health and the environment by eliminating exposure to the hazardous chemicals. TDEC selected this alternative and deemed it protective of human health and the environment because it provides a barrier to access to underground chemicals.

Site-Specific Remedy Decision Evaluation

Long-term effectiveness and permanence refers to expected residual risk and the management of that risk at a site. The remedy selected must reliably protect human health and the environment over time. TDEC has determined that the soil cap would provide long-term effectiveness through isolation of the residual contamination by capping and containment. Long-term maintenance and monitoring of the site, with sufficient financial assurance to sustain them, are parts of the remedy that ensure that the remedy maintains its ability to protect human health and the environment over time. Except for the coal tar that remains underneath the asphalt cap of the Reilly Tar Area, the major areas of chemical contamination at the site have been removed, according to TDEC (TDEC 2011b). Waste or “source” removal greatly reduces toxicity and mobility of the chemical contamination. Residual soil contaminants have been found remaining at the site. This residual soil contamination is at lower concentrations than the previously removed waste and is dispersed throughout the soil column (MEC 2007).

Impoundments at the Velsicol Site used to collect stormwater will be closed and roughly graded, then covered with 24 inches of soil. As an initial step, stormwater that has accumulated in the impoundments will be removed by pumping and disposed of as part of the stormwater that is discharged to the City of Chattanooga’s Moccasin Bend Wastewater Treatment Plant. The discharge is permitted under the City of Chattanooga Wastewater Discharge Permit No. 1010 as discussed previously. The impoundment areas will then be backfilled to match the rough grade elevation needed. Following the rough grading, the impoundment areas will be covered with 2 feet of vegetated soil barrier in the same fashion as the remainder of other SWMU areas at the site.

The planned soil cover should decrease the amount of surface water entering the groundwater system. This will impede the rate at which contaminants can leach to groundwater, as well as slow the rate of contaminant plume migration. The 24 inches of soil cap, part of which is compacted with a vegetative cover, has proven effective at other TDEC sites in Tennessee.

During the Corrective Measures Study to determine an appropriate remedy for the site, various remedies and the factors associated with those remedies were evaluated, including technical feasibility. Cost and the increased risk of exposure to contaminants released to the environment were the basic reasons for thermal treatment being ruled out. Thermal remediation is not the best available technology for treatment of very low concentrations of contaminants over a very large area (TDEC 2011b). Soil excavation and the extended length of time to implement this particular remedy could result in an increased risk to public health from exposure to residual contaminants in the soil that become air-borne. TDEC's selected Alternative 1 as the best alternative. This is because physical location of the contamination being scattered throughout the soil column at the site and the chemical characteristics of the contaminants present make it unlikely that all the contamination could be remediated at the site.

TDEC's final permit modification notice (2011) states, "In compliance with local zoning laws and pursuant to the deed restrictions filed with that local zoning authority, as required by the corrective action permit, the Velsicol Site will be available for future development." This means that Velsicol has the legal right to sell or lease their property. If Velsicol sells the property, Velsicol will continue to be responsible for maintaining the corrective action permit and implementing the remedy. Velsicol will be held responsible for all corrective actions unless Velsicol transfers the permit to a new owner; this includes the responsibility for the long-term care of the site. To transfer, the new owner must submit a permit modification request to the TDEC DSWM for a change of ownership. The process includes the requirement for public notice of the action, accompanied by a thirty-day public comment period. In addition to the terms and conditions of the permit, the new owner, before property transfer, would also have to provide financial assurance in an amount that would continue to cover the costs for the long-term care of the site (TDEC 2011b).

EEP believes Alternative 1, a minimum 24-inch thick, clean imported soil cover, should be protective of human health. Twenty-four inches of soil placed over SWMU areas and paved non-SWMU areas and 12 inches of soil over all other areas should act as a barrier to prevent dermal, incidental ingestion, and inhalation exposures. Velsicol will maintain vegetation on the soil cover. The public will have no access to the site. The site will be fenced and locked.

Deed Restrictions

As part of the TDEC RCRA corrective action permit for the site, the site will comply with local zoning laws and will have the necessary deed restrictions to protect human health and the environment as determined by TDEC. The likely future use of the site would be industrial or commercial (CHCRPA 2010), since past use has been industrial. The site will not be considered for future residential development. Rough grading will occur at the site prior to placing the final vegetative cover. Grading and compaction will be done for the proper installation of the vegetative cover. New construction may require changes to the final remedy, especially if footings would be required for the new construction, resulting in a major permit modification or issuance of a new permit.

Other Environmental Considerations

Vapor Intrusion

While the site closure plan appears to be protective of public health on the site, EEP identified a potential off-site concern. There is a groundwater plume migrating from the Velsicol Site to the southeast. The groundwater chemical plume travels to Piney Woods Spring. The groundwater chemical plume travels beneath some homes that are located between the site and Piney Woods Spring.

There has been previous soil-gas sampling done in the area in 1998. An updated soil-gas or indoor air investigation should be done to understand the potential for vapor intrusion from chemicals off-gassing from the groundwater and migrating into the indoor air of the homes. A potential exposure pathway exists for inhalation of volatile chemicals by residents living in homes above the groundwater chemical plume.

EEP determined that vapor intrusion could become an issue on-site if the site were redeveloped. This issue would need careful investigation before any redevelopment occurred. This would entail a major permit modification or a new permit.

Outdoor Air

Community members have complained about odors and air pollution for decades in Alton Park. Many different industries could have contributed to both odors and air pollution. Currently three industries are considered major air sources and have Title V permits under the Clean Air Act. The emissions from these three industries are minimal. In the 1990s, air pollution decreased significantly in the Alton Park when Velsicol installed air pollution controls and when the coke ovens ceased operation (personal communication, Alan Frazier, Senior Engineer, Chattanooga Hamilton County Air Pollution Control Bureau, March 6, 2012).

EEP does not know if community members were harmed in the past by exposure to hazardous air pollutants in outdoor air emitted from Alton Park area industries. In 1984 and in 1995, EEP conducted two cross-sectional health studies in the area. Results from the first study indicated an increase in respiratory symptoms and diseases in Piney Woods while the second study indicated no difference in these symptoms and diseases in Alton Park when compared to a control group. No analyses of outdoor air are available for review.

Off-Site Soil

It is unknown if Velsicol or other nearby industries have contributed to off-site surface soil contamination in Alton Park. Contaminants may have been carried from the by air emissions, dust from site activities, or by surface water runoff in the past.

A past exposure pathway may have existed from emissions from nearby industries as well as the Velsicol Site. These emissions could have been deposited on local off-site soil. Dust from site activities at these industries could also have generated particulates that could have been picked up by the air and deposited off-site.

A past exposure pathway likely existed for off-site chemical deposition from Piney Woods Spring. As part of the Brownfield process, the City of Chattanooga analyzed soil samples in the area of the old Piney Woods ball field (Troy Keith, TDEC CFO, personal communication, June 27, 2012). Sampling and analysis indicated that the surface soil in the old ball field does not have chemicals in amounts above EPA residential soil regional screening levels (Aquaterra 2009).

Surface soil samples from other nearby sites such as the Bunge Oil property, the Chattanooga Coke Plant Site, and the Residue Hill Site have been tested. Very limited off-site surface soil sampling was done near these sites. Several PAHs and other chemicals were found on these sites above EPA soil screening values. These sites are being addressed separately from the Velsicol Site by TDEC. Investigations at the Residue Hill Site did sample off-site surface soil. Chemicals tested for were found in some samples. Numerous samples were collected as part of the remediation plan for Chattanooga Creek. Both Phase I and Phase II cleanups have been finished at the creek. EEP is not aware of any other off-site surface soil sampling data that has been collected from the area around the Velsicol Site.

Neighborhood Land Use Plan

The Chattanooga-Hamilton County Regional Planning Agency has developed a land use plan for the community, called the Alton Park / Piney Woods Community Plan (CHCRPA 2010). The plan has a chapter that describes the environmental conditions of the community, including a discussion of Chattanooga Creek historical contamination and cleanup, Brownfield sites, and other sites. Discussion includes reuse of sites and Chattanooga Creek floodplain issues. Land use plans for the Velsicol Block are included. Future decisions regarding cleanup and redevelopment of Alton Park Community should use this plan.

The requirements for cleanup of environmental sites in Alton Park should be consistent across environmental regulatory programs, such as the RCRA and CERCLA programs. Having uniform remediation strategies will better help the community with their long-term land use planning. In addition, clean-up plans should result in a property that can be reused in a way that is in accordance with the long-term land use plan for the Alton Park.

Community Involvement

The community near the Velsicol Site has been involved with the plans for its clean-up. Community meetings were held on September 15, 2011 to explain the Public Health Assessment process, and on October 27, 2011 to show community members sites that TDEC is working on and aware of.

The Initial/Public Comment Release of this document was published on May 13, 2013. The document was distributed to the petitioner, members of the Alton Park community, the Chattanooga/Hamilton County Regional Planning Agency, local Chattanooga governmental officials, the Tennessee Department of Environment and Conservation, and the responsible party. Additionally, the Initial/Public Comment Release was posted on the Tennessee Department of Health's Environmental Epidemiology Program's website and the Agency for Toxic Substances website.

Child Health Considerations

The TDH EEP recognizes there are unique exposure risks concerning children that do not apply to adults. Children are at a greater risk than are adults to certain kinds of exposures to hazardous substances. Because they play outdoors and because they often carry food into contaminated areas, children are more likely to be exposed to contaminants in the environment. Children are shorter than adults and as a result, they are more likely to breathe more dust, soil, and heavy vapors that accumulate near the ground. They are also smaller, resulting in higher doses of chemical exposure per body weight. If toxic exposures occur during critical growth stages, the developing body systems of children can sustain permanent damage. Children depend on adults for risk identification and risk management, housing, and access to medical care. Thus, adults should be aware of public health risks in their community, so they can guide their children accordingly. Child-specific exposure situations and health effects were carefully considered.

There are no children at the Velsicol Site. The industrial site is undergoing remediation. No one is living on the site. Homes are nearby, however. There is a secure fence surrounding the site. Children typically would not come into contact with any on-site soils, groundwater, or air. Children would only come into contact with the on-site soil or air by trespassing. Trespassing by children at the site is highly unlikely given the security controls in place and those that are planned in the future as part of the security for the site. Therefore, no direct exposure to children from the site itself would occur.

Children may be living in the homes downgradient from the site. If vapor intrusion were an issue for the site, they may be exposed to chemicals in their indoor air. It is not known if vapor intrusion is occurring in homes above the offsite groundwater plume.

Conclusions

The specific objectives of this Public Health Assessment were:

- To investigate the extent to which contamination at the Velsicol Site could result in exposure to people in the area. The investigation of exposure is to understand whether adverse health effects would be possible if exposure occurred.

- To address public concerns as to whether the proposed site remedial alternative will be protective of the health of residents of the Alton Park near the Velsicol Site.

- To assess whether proposed remedial actions will be sufficient to prevent harmful exposures to contamination in:
    - the stormwater that is collected from the Velsicol Site;
    - the groundwater that is collected at the Piney Woods Spring southeast of the Velsicol Site; and
    - groundwater collected as part of the on-going remediation and product recovery for the former Reilly Tar parcel located in the northeast portion of the Velsicol Site.

EEP reached several conclusions in this public health assessment concerning the Velsicol Site:

1. EEP concludes that exposure to contamination in on-site soil was not in the past, and is not currently or in the future expected to harm the health of residents of the community. This is because people in the community were not likely to have been exposed to contamination in on-site soils in the past nor are they likely to be exposed to contamination in on-site soils currently or in the future. The site was securely fenced and guarded when Velsicol was operating, and it is now securely fenced. Wastes on the site have been removed. Residual soil contamination will be covered with two feet of vegetated soil, and the site will remain fenced.

2. EEP concludes that the health of future site workers is not likely to be harmed from exposure to residual contamination remaining in soil, unless excavation takes place. If redevelopment were to occur, the Division of Solid and Hazardous Waste Management would require a new permit or a major permit modification, further sampling and analysis of site soils, and a site health and safety plan that should help ensure the safety of on-site workers.

3. EEP concludes that the health of community members in the future will not be harmed from exposure to volatile air pollutants emitted from contaminated soil at the Velsicol Site. This is because all hazardous wastes have been removed. The remaining residual soil contamination will be covered with clean soil and a vegetative cover. Soil with remaining contamination covers a portion of the site, with small areas with higher concentrations. Any pollutants that would get into the air will be diluted in ambient air.

4. EEP concludes that the health of community members was not and is not likely to be harmed by exposure to groundwater. The groundwater near the Velsicol Site is 5 to 24 feet deep and the community has no known exposures to the groundwater contaminants. The City of Chattanooga has had an excellent water treatment system for decades. Groundwater has not

been and is not being used for a potable water source in that area of Chattanooga. It is highly unlikely that anyone would be allowed to install a private well in the community.

5. EEP cannot conclude whether the health of community members in the past was, currently is, or in the future will be harmed by exposure to volatile air pollutants in homes built over the groundwater plume traveling under the Velsicol Site and migrating to Piney Woods Spring. This is because inadequate environmental sampling has been conducted to evaluate the vapor intrusion pathway.

6. EEP cannot conclude whether the health of on-site workers in the past or in the future will be harmed by exposure to volatile air pollutants in buildings built over contaminated groundwater. This is because inadequate environmental sampling has been conducted to evaluate the vapor intrusion pathway.

7. EEP could not conclude whether past exposure to surface water in the Piney Woods Spring may have harmed the health of people exposed. In the past, community members could have been exposed to Piney Woods Spring when the area around the spring was used as a ballpark, before the spring discharge was connected to the sewer system. EEP cannot determine the frequency or duration of past exposures. Water from the spring was not sampled and analyzed routinely until 1993. Therefore, EEP is unable to determine the likelihood of past health risks before the late 1980s when the spring was covered by a manhole and water discharged to the sewer system.

8. EEP concludes that the health of people is not being harmed now and will not be harmed be harmed in the future by off-site residential exposure to chemicals in the Piney Woods Spring. This is because the spring is now enclosed and piped to the City of Chattanooga sewer system.

9. EEP concludes that the final remedy, Alternative 1 – a soil cover, should protect the health of residents of the Alton Park Community from on-site exposures. Based on our investigation of soil, groundwater, surface water, and air, the final remedy, Alternative 1, reduces or eliminates most exposure pathways on-site as long the Velsicol Site is secured and the vegetative cover is properly maintained. The site's RCRA permit has sufficient caveats to protect the community and future workers if the Velsicol Site is redeveloped. Vapor intrusion issues off-site were discussed in Conclusion 5.

EEP also reached several conclusions in this public health assessment outside the scope of the Velsicol Site:

10. EEP cannot conclude whether a potential exposure pathway exists for possible future exposures to trespassers who may be walking through the Heatec Stream area and who may unintentionally come into contact with the stream water. When the dye study and sampling was done in 1998, contamination existed in the Heatec Stream. It is unknown if the contamination still exists.

11. The City of Chattanooga Moccasin Bend Wastewater Treatment Plant has sufficient capacity to handle the stormwater and groundwater flows from Recovery Well 1 on the Velsicol Site and from the Piney Woods Spring. The concentrations of contaminants are very low and the remedial pumping and drainage flow rates from the Velsicol Site and the Piney Woods Spring are only a tiny fraction of the capacity of the treatment plant.

12. Occasional overflows of the sewer system containing chemicals from the Velsicol Site at the designated overflow location in Alton Park should not harm the health of the community. The City of Chattanooga has systems and plans in place to control overflows except in catastrophic situations. In those situations, the large volume of stormwater would effectively dilute any contaminants. Still, contact with sewer overflows should be avoided to prevent exposure to harmful bacteria and viruses.

13. EEP cannot conclude whether the health of community members was harmed in the past by exposure to hazardous air pollutants in outdoor air emitted from area industries. No analyses of outdoor air are available for review. Heavy industries, such as coke ovens and chemical plants, were active in the Alton Park Community for decades before any environmental regulatory laws existed. In 1984 and in 1995, EEP conducted two cross-sectional health studies in the area. Results from the first study indicated an increased rate in respiratory symptoms and diseases in Piney Woods while the second study indicated no difference in these symptoms and diseases in Alton Park compared to a control area.

14. EEP concludes that it is unlikely that the health of community members is being harmed by current hazardous air pollutant emissions in the Alton Park Community. Most of the heavy industry has ceased operation or will cease operation in the near future. There are currently three industries that are considered major air sources. The emissions from these three industries are minimal. In the 1990s, air pollution decreased significantly in Alton Park when Velsicol installed air pollution controls and when the coke ovens (Chattanooga Coke and Chemical/Tennessee Products) ceased operation.

15. EEP concludes that while there is some off-site surface soil data for residential areas near the Velsicol Site, EEP did not find enough data to make strong conclusions about past, present, or future exposure.

Recommendations

EEP has several recommendations to protect the public health. These recommendations follow from the conclusions:

1. EEP recommends that the TDEC, the TDH, and other appropriate parties continue to work together to see that public health is protected during clean-up of the Velsicol Site.

2. EEP recommends to TDEC that the final cleanup plan have sufficient contingencies to protect workers on the site should it be redeveloped. Institutional controls and precautions should be established for future worker safety and site redevelopment.

3. EEP recommended that the appropriate agency develop a plan for determination of the likelihood of vapor intrusion in homes above the plume of contamination flowing from the Velsicol Site to Piney Woods Spring. A vapor intrusion investigation was performed by the Memphis Environmental Center in the area of East 52nd Street in January 2013. The evaluation of the results of the investigation will be released as a separate ATSDR-reviewed Letter Health Consultation document.

4. EEP recommends that, if the site is redeveloped, Velsicol or any new permittee investigate the potential for vapor intrusion into new on-site buildings before redevelopment of the site.

5. Consideration of the Alton Park / Piney Woods Community Plan should be a high priority in any redevelopment plans. The cleanup of environmental sites in Alton Park should be consistent. Having uniform remediation strategies across environmental regulatory programs will better help the community with their long-term land use planning. In addition, clean-up plans should result in a property that can be reused in a way that is in accordance with the long-term land use plan for the Alton Park.

6. EEP recommends that the TDEC's Division of Remediation nvestigate the Heatec Stream to determine if it is still contaminated and the source(s) of the contamination if it is.

7. EEP recommends that the TDEC's Division of Solid Waste Management determine whose responsibility it is to maintain the fence around the erosional scour at the Heatec Stream.

8. EEP recommends that it would be prudent to ensure that there is adequate off-site surface soil data to ensure that residential properties near this industrialized part of Alton Park in South Chattanooga meet residential cleanup guidelines.

Public Health Action Plan

The public health action plan for the Velsicol Site contains a list of actions that have been or will be taken by EEP and other agencies. The purpose of the public health action plan is to ensure that this public health assessment identifies public health hazards and offers a plan of action designed to mitigate and prevent harmful health effects that result from breathing, coming into contact with, or ingesting hazardous substances in the environment. Included is a commitment on the part of EEP to follow up on this plan to ensure that it is implemented.

Public health actions that TDH EEP has taken include the following.

1. TDH EEP attended and spoke at a public meeting held by the community group, Stop Toxic Pollution (STOP). EEP informed attendees of the planned public health assessment and answered questions about TDH's involvement in the community.

2. TDH EEP attended a stakeholder meeting led by the Alton Park Development Corporation at which all stakeholders, both private and public, gave a brief overview of what progress they were making in improving the quality of life in the Alton Park. EEP informed stakeholders of its role in the assessment of the clean-up plan for Velsicol.

3. TDH EEP held a public meeting to inform the community and other stakeholders of the public health assessment process.

4. TDH EEP held a public meeting at which all the environmental regulatory programs presented facts about their role in the Alton Park Community. EEP provided each regulatory program with maps of those sites for which they have authority.

5. This Public Health Assessment was released as a draft document on May 13, 2013 to receive comments from stakeholders. EEP provided copies to interested stakeholders who previously attended previous public meetings that EEP held. One stakeholder provided comments.

Public health actions that EEP will take include:

1. TDH EEP will release this Public Health Assessment as a final document.

2. TDH EEP will participate in future public meetings to improve the understanding of the community and other stakeholders in the environmental regulatory process and in the improvements in the environment of Alton Park as a result of the regulatory process.

3. TDH EEP will take part in future public meetings related to the public health assessment. Copies of this final health assessment will be provided to interested stakeholders of the Alton Park Community and to state, federal, and local governments.

4. TDH EEP will maintain dialogue with TDEC, ATSDR, other government agencies, and interested stakeholders to safeguard public health in the Alton Park Community.

5. TDH EEP will be available to review additional future environmental data and provide interpretation of the data, as requested.

Glossary of Terms and Acronyms

acute exposure: Contact with a substance that occurs once or for only a short time (up to 14 days).

adverse health effect: A change in body function or cell structure that might lead to disease or health problems.

ambient: Surrounding (for example, *ambient* air).

ATSDR: Agency for Toxic Substances and Disease Registry.

background level: An average or expected amount of a substance in a specific environment, or typical amounts of substances that occur naturally in an environment.

cancer: Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

cancer risk: The theoretical excess risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower. The excess cancer risk is often expressed as $1x10^{-6}$ for one excess cancer in 1 million people.

Cancer Risk Evaluation Guide (CREG): CREGs are environmental media (water, soil, air) specific comparison values that are used to identify amounts of cancer-causing substances that are unlikely to result in an increase of cancer rates in people that have been exposed to the media.

CHCRPA: Chattanooga-Hamilton County Regional Planning Agency.

chronic exposure: Contact with a substance that occurs over a long time (more than 1 year).

comparison value (CV): Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

concentration: The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

contaminant: A substance that is either present in an environment where it does not belong.

detection limit: The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

DNAPL: A DNAPL is one of a group of organic substances that are relatively insoluble in water and more dense than water. DNAPLs tend to sink vertically through aquifers to an underlying, impenetrable layer.

Environmental Media Evaluation Guide (EMEG): EMEGs represent levels of substances in water, soil, and air, to which humans may be exposed during a specified amount of time (acute, intermediate, or chronic) without experiencing adverse health effects.

EPA: United States Environmental Protection Agency.

Epidemiology: The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

exposure: Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

exposure pathway: The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: 1. a source of contamination (such as an abandoned business), 2. an environmental media and transport mechanism (such as movement through ground water), 3. a point of exposure (such as a private well), 4. a route of exposure (eating, drinking, breathing, or touching), and 5. a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

groundwater: Water beneath the Earth's surface in the spaces between soil particles and between rock surfaces.

hazard: A source of potential harm from past, current, or future exposures.

health education: Programs designed with a community to help it know about health risks and how to reduce these risks.

inhalation: The act of breathing. A hazardous substance can enter the body this way.

intermediate exposure: Contact with a substance that occurs for more than 14 days and less than one year.

migration: Chemical movement from one location to another.

Minimal Risk Level (MRL): An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects.

National Pollutant Discharge Elimination System (NPDES): A permit issued by the U.S. EPA or a State regulatory agency that sets specific limits on the type and amount of pollutants that a municipality or industry can discharge to a receiving water. The typical permit also includes a compliance schedule for achieving those limits. NPDES permit program is authorized by the Clean Water Act and works to control water pollution by regulating point sources that discharge pollutants into waters of the United States. Industrial, municipal, and other facilities must obtain permits for any discharge into waters of the United States.

ppb: parts per billion.

plume: A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

ppm: parts per million.

Public Health Assessment (PHA): An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health.

public meeting: A public forum with community members for communication about a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA): This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

release: A release is defined as any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing (including the abandonment or discarding of barrels, containers and other closed receptacles containing any hazardous substance, pollutant, or contaminant) into the to the air water or land.

remediation: Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a site;

Remedial Investigation (RI): The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process of determining the type and extent of hazardous material contamination at a site.

risk: The probability that something will cause injury or harm. For non-carcinogen health effects, it is evaluated by comparing an exposure level over a period to a reference dose derived from experiments on animals. For carcinogenic health effects, risk is estimated as the incremental probability of an individual developing cancer over a lifetime (70 years) as a result of exposure to a potential carcinogen.

route of exposure: The way people come into contact with a hazardous substance. Three routes of exposure are breathing (inhalation), eating or drinking (ingestion), or contact with the skin (dermal contact).

sample: A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population. An environmental sample, such as a small amount of soil or water, might be collected to measure contamination in the environment at a specific location.

soil-gas: Gaseous elements and compounds in the small spaces between particles of earth and soil. Such gases can be moved or driven out under pressure.

solvent: A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

source area: The location of or the zone of highest soil or ground water concentrations, or both, of the chemical of concern. The source of contamination is the first part of an exposure pathway.

surface water: Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs.

Solid Waste Management Unit (SWMU): A solid waste management unit is any distinct unit at which solid wastes have been placed at any time, whether the unit was intended for the management of solid or hazardous waste or not.

Solid Waste Management Area (SWMA): A solid waste management area is any group of solid waste management units that are close to one another or have releases of chemicals that are alike. SWMUs are grouped together into SWMA's to make investigating them more efficient.

toxicological profile: An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology: The study of the harmful effects of substances on humans or animals.

Volatile Organic Compounds (VOCs): Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, dichloroethylene, toluene, trichloroethylene, methylene chloride, methyl chloroform, and vinyl chloride.

References

[ACS 2010] Cancer Facts & Figures 2010. American Cancer Society. Atlanta 2010.

[Aquaterra 2009] Limited Phase II Environmental Site Assessment, Alton Park Site 4, Piney Woods Park, Tax Parcel 167N E 037, Chattanooga, Tennessee. January 14, 2009. Aquaterra Engineering LLC, Chattanooga, TN.

[ATSDR 2012] Agency for Toxic Substances and Disease Registry. 2012. Air comparison values. U.S. Department of Health and Human Services. February 2012. Atlanta, Georgia.

[B&V 1993] B & V Waste Science and Technology Corporation. 1993. Site Inspection for Residue Hill, Chattanooga, Hamilton County, TN. EPA ID No. TND 987 782 505. September 24, 1993.

[Census 2000] DP-1. Profile of General Demographic Characteristics: 2000. Data Set: Census 2000 Summary File (SF 1) 100-Percent Data. Geographic Area: 37410 5-Digit ZCTA. Accessed: August 15, 2011. URL: http://www.census.gov.

[Census 2010] DP-1. Profile of General Demographic Characteristics: 2010. Data Set: Census 2010 Geographic Area: 37410 5-Digit ZCTA. Accessed: March 28, 2012. URL: http://factfinder2.census.gov.

[CHCRPA 2010] Chattanooga-Hamilton County Regional Planning Agency. 2010. Alton Park / Piney Woods Community Plan, Update: November 2010. Chattanooga, TN.

DeBuchananne, G.D. and R.M. Richardson, 1956. Ground-water resources of East Tennessee. Tennessee Department of Conservation, Division of Geology Bulletin 58, Part 1. 393 p. Nashville, TN.

[EEP 1986] Piney Woods Health Study, Chattanooga, Tennessee. January 15, 1986.

[EEP 1999] Final Report: Chattanooga Creek Area Cross-Sectional Health Study, Chattanooga, Hamilton County, Tennessee. July 1999. U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, Atlanta, GA.

[ENVIRON 2009] ENVIRON International Corporation. 2009. 2009 Annual report, Residue Hill Site, Chattanooga, Tennessee. Chicago, IL. April 2010.

[EPA, 1991] U.S. Environmental Protection Agency. OSWER Directive 9355.0-30. Role of the baseline risk assessment in superfund remedy selection decisions. Available at: www.epa.gov/oswer/riskassessment/baseline.htm

[EPA 1999] U.S. Environmental Protection Agency. Ecological screening values (ESVs). Environmental Restoration Division. EPD-AG-003. April 1999. Available online at: http://www.srs.gov/general/programs/soil/ffa/rdh/p71.PDF. Last accessed January 19, 2012.

[EPA 2001] U.S. Environmental Protection Agency. Reusing cleaned up Superfund sites: Recreational use of land above hazardous waste containment areas. EPA 816-F-09-0004. March 2001. Available at: www.cluin.org/download/toolkit/thirdednew/reuseclean.pdf. Last accessed May 14, 2012.

[EPA 2009] National Primary Drinking Water Regulations. EPA 540-K-01-002. May 2009. Available at: www.water.epa.gov/drink/contaminants/index.cfm#List. Last accessed August 9, 2011.

[EPA 2010] U.S. Environmental Protection Agency. 2010. Waste and cleanup risk assessment glossary: U.S. Environmental Protection Agency, access date August 15, 2011.

[EPA 2012] U.S. Environmental Protection Agency. 2012. Regional screening levels (RSL) for chemical contaminants at superfund sites. Mid-Atlantic Risk Assessment Branch. Last accessed: June 26, 2012. Available at: www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/

[EPA 2013] U.S. Environmental Protection Agency. 2013. Region 4 Superfund Tennessee Products Site. Available at: www.epa.gov/region4/superfund/sites/npl/tennessee/tennprotn.html#plan

[ERM 2008] Environmental Resources Management Corporation. 2008. Supplemental Risk Assessment for Surficial Soil, MeadWestvaco Corporation, Former Chattanooga Coke Plant, Chattanooga, TN. Atlanta, GA. July 2008.

Ferris B.G. Epidemiology standardization project. Am. Rev. Res. Dis. 1978;118:1-120.

Frazier, Alan. March 6, 2012. Personal communication. Chattanooga-Hamilton County Air Pollution Control Bureau. Chattanooga, TN.

Keith, Troy. Personal communication. Tennessee Department of Environment and Conservation, Division of Remediation. Chattanooga, TN.

Hermann, Gary. Personal communication. Memphis Environmental Center, Memphis, Tennessee.

[Law 1994] Law Environmental, Inc. 1994. Phase I RCRA Facility Investigation Report for the Velsicol Chemical Corporation, Chattanooga, Tennessee. Kennesaw, GA. January 1994.

[Law 1998] Law Environmental, Inc. 1998. Phase II RCRA Facility Investigation Report for the Velsicol Chemical Corporation, Chattanooga, Tennessee. Kennesaw, GA. May 1998.

[Law 2007] Law Environmental, Inc. 2007. Revised Phase III RCRA Facility Investigation Report for the Velsicol Chemical Corporation, Chattanooga, Tennessee. Kennesaw, GA. November 2007.

[MEC 2007] Memphis Environmental Center, Inc. 2007. Revised Phase III RCRA Facility Investigation Report, Velsicol Chemical Corporation, Chattanooga Facility, Facility Identification No. TND 061 314 803. Memphis, TN. November 2007.

[MEC 2008] Memphis Environmental Center, Inc. 2008. Revised Corrective Measures Study Report, Velsicol Chemical Corporation, Chattanooga Facility, Facility Identification No. TND 061 314 803. Memphis, TN. August 2008.

[MEC 2010] Memphis Environmental Center, Inc. 2010. Semi-annual interim measures performance report No. 28, Reilly Tar Area, Velsicol Chemical Corporation. Memphis, TN. October 2010.

[MEC 2011a] Memphis Environmental Center, Inc. 2011. Southeast Trough – 2011 Groundwater monitoring report, Velsicol Chemical LLC, Chattanooga, Tennessee. Memphis, TN. May 2011.

[MEC 2011b] Memphis Environmental Center, Inc. 2011. Semi-annual interim measures performance report No. 29, Reilly Tar Area, Velsicol Chemical Corporation. Memphis, TN. May 2011.

Tate, Rick. August 31, 2011. Personal communication. City of Chattanooga. Chattanooga, TN.

[TAW 2011] Tennessee American Water Company. 2011. Company website. Last accessed: March 6, 2012. Accessible at: http://www.amwater.com/tnaw/

[TDEC 2011a] Tennessee Department of Environment and Conservation. 2011. Pre-Cerclis screening assessment report, Potential Hazardous Waste Site, Lookout/Bunge Oil, Inc. 4608 Kirkland Avenue, Chattanooga, Hamilton County, Tennessee, TDoR Site: 33-710. Chattanooga, Tennessee. September 23, 2011.

[TDEC 2011b] Tennessee Department of Environment and Conservation. 2011. Notice of Final Decision to Approve a Permit Modification, Class 3 Permit Modification for Velsicol Chemical LLC; EPA ID Number: TND 06 131 4803. Nashville, TN. July 14, 2011.

Trust for Public Land. 2002. Tennessee Products Superfund Redevelopment Initiative, Reuse plans for the Tennessee Products Superfund Site and the Chattanooga Coke State Superfund Site. Chattanooga, TN. September 2002.

Wilson, J.M., and A.M.F. Johnson, 1979. Water use in Tennessee—Part D, Summary: Tennessee Division of Water Resources. Water-Use Series 5. Nashville, TN.

Appendix A. Summary of Environmental Regulatory History for the Velsicol Site

- In 1990, a contractor for Velsicol conducted a RCRA Facility Assessment (RFA). The RFA identified 67 Solid Waste Management Units (SWMUs) at the facility. During the RFA, it was determined that 38 of these initially identified SWMUs were either not subject to regulation or there was no evidence of contamination observed and no further action required. Thus, these 38 SWMUs were not included in the facility's Hazardous Waste Management Facility Permit (RCRA Permit). There were 29 SWMUs that were first investigated. Since the first investigation (Phase I RCRA Facility Investigation – RFI) 4 more SWMUs have been identified and added to make a total of 33 SWMUs that have been investigated. The SWMUs at the site are shown on Figure 3.

- In 1994, Velsicol submitted a Phase I RCRA Facility Investigation (RFI) Report prepared by Law Engineering and Environmental Services Inc. (Law) to TDEC and the EPA for the remaining SWMUs.

- In 1995, Velsicol developed a RCRA Corrective Action Strategy to address the continued investigation/corrective action approach for the Chattanooga facility. The strategy placed a priority on off-site assessment of, and Interim Measures (IM) for, groundwater flowing off-site to the northeast and southeast, Interim Measures for higher priority areas on-site, and continuation of the phased RFI approach for investigating identified SWMUs at the site.

- In 1998, Law conducted a Phase II RFI to address the extent of the releases detected off-site in the groundwater and sediment. Interim Corrective Measures (ICM) were developed to control off-site migration of site-specific constituents in groundwater flowing across the site and off-site to the northeast, and to provide contaminant source control/removal for dense non-aqueous phase liquid (DNAPL), soil, and groundwater in the former Reilly Tar Area (SWMUs 38, 39, 40, and 41).

- In 2000, stabilization measures were conducted where needed near SWMUs 1, 2A and 36. In a letter dated May 6, 2002, TDEC indicated that the Corrective Measures Objectives for SWMUs 1, 2A and 36 had been met. On August 24, 2004, Velsicol sent TDEC a letter proposing No Further Action (NFA) status for SWMUs 1, 2A and 36.

- Also as part of the interim stabilization measures in 1999 and 2000, limited contaminated soil and waste removals within specific SWMU's and other areas of concern (AOCs) occurred. The soil and waste removals were completed at SWMU 1/1A – Toluene Storage Tank (former Landfill Pit), SWMU 2A – Laboratory Waste Disposal Area, SWMU 36 – Former Benzoic Residue Stockpile Area, and the Reilly Tar area SWMUs – 38, 39, 40, and 41. According to Velsicol, approximately 24 million pounds of material was removed (MEC 2011).

- In 2002, the Memphis Environmental Center completed a Corrective Measures Study (CMS) for three former on-site stormwater collection impoundments (SWMUs 19, 20, and 37). The CMS recommended corrective measures, including sediment excavation and off-site disposal as non-hazardous waste, backfilling using on-site stockpiled materials and imported fill, and a vegetated cover. On March 7, 2002, TDEC approved the recommended corrective measures.

- Various SWMU Assessment Reports (SARs) were submitted to TDEC and EPA during the time period which followed the performance of the initial RFA and the submittal of the Phase I RFI. On April 4, 2004, TDEC sent Velsicol a letter to document the status of each of these SWMUs. The TDEC letter approved NFA status for 15 SWMUs.

- A Phase III RCRA Facility Investigation (RFI) Work Plan (work plan) was prepared by Premier Environmental Services Inc. (Premier) to advance the progress of the RCRA Corrective Action Program at the Chattanooga facility and to follow up on the results of the approved Phase I and II RFIs. This work plan was submitted to TDEC on January 12, 2007, and was approved on February 14, 2007.

- On March 15, 2007, production activities ceased at the Velsicol Chattanooga facility. Process equipment was decontaminated and removed from the site. Demolition of site buildings finished in May 2009. A limited staff remained on-site to manage permit requirements and maintain site security. No staff currently remains on-site, although regularly scheduled inspections are done to manage permit requirements and maintain site security.

- The Phase III RFI Report was prepared by Premier and originally submitted to TDEC on November 8, 2007. The Report included an evaluation of site data using U.S. Environmental Protection Agency (EPA) Region 9 Preliminary Remediation Goals (PRGs) for industrial land use. This evaluation resulted in 13 SWMUs/ESAs (Environmental Site Assessment) being recommended for additional evaluation since one or more constituents exceeded industrial preliminary remediation goal (PRG) criteria. Five SWMUs/ESAs were proposed for No Further Action (NFA) as they did not have constituent concentrations above the industrial PRG screening levels. In a letter dated November 20, 2007, TDEC conditionally approved the Phase III RFI Report. TDEC's conditional approval requested that Velsicol also evaluate and screen the data from each SWMU/ESA against residential PRGs. The November 8, 2007, Phase III RFI Report was revised to include this additional evaluation using residential PRGs. The residential screening evaluation was only conducted on those data from the 5 SWMUs/ESAs recommend for NFA since the previous screening effort had already recommended that the remaining 13 SWMUs/ESAs be evaluated further. Data from Area 16 were also evaluated using residential screening criteria. This evaluation only considered the data from those sampling locations which did not exceed industrial PRGs.

- The current hazardous waste permit, TNHW-105, was issued to Velsicol Chemical Corporation on September 28, 2001. The permit, effective until September 28, 2011, authorized the facility for container storage of hazardous wastes that were generated on-site. During 2005, the permit was modified to reflect a change of ownership from True Specialty Corporation to True Specialty LLC. On January 10, 2008, the permit was modified to reflect clean closure of the permitted hazardous waste container storage area, which occurred as the result of Velsicol ceasing manufacturing operations in March of 2007. Because of the need for continued corrective action at facility solid waste management units and areas of concern, the corrective action portion of the permit remains in effect. In October 2008, a permit modification was processed to change the name of the permittee to Velsicol Chemical LLC (TDEC 2010).

- TDEC received the Corrective Measures Study Report on April 8, 2008, from the Memphis Environmental Center (MEC) and Premier. The MEC was formed by Velsicol in 1979 and has been dedicated to the management of potential liabilities stemming from legacy environmental issues. After receiving comments from SWM and after a public meeting held on July 25, 2008, the Memphis Environmental Center submitted a Revised Corrective Measures Study Report on August 8, 2008.

- A public hearing was held on February 17, 2009, to present the intent to modify Velsicol Chemical's Corrective Action Permit and to approve a final remedy. A second public hearing was held on January 6, 2011, to discuss the proposed final remedy and permit modification.

Appendix B. Alton Park / Piney Woods Community Plan, Update: November 2010.

INDUSTRIAL AND MANUFACURING

BACKGROUND

Although most urban neighborhoods typically have a denser and (primarily) residential component, the Alton Park community has an extensive industrial presence. For many years, local industries provided stable jobs for area residents. In the decades following World War Two, structural changes occurred in the broader national economy. As a result, many of the formerly robust employers either implemented workforce reductions or ceased operations entirely.

In the early days of Alton Park's industrial history, environmental regulations were largely absent. Consequently, the legacy of a once vibrant center of manufacturing and employment is now one of environmental degradation and a residential population wary of potential contaminants remaining in the soil and water. Despite the efforts of local, state and federal authorities to study and clean certain contaminated sites along with a portion of Chattanooga Creek, residents are concerned about the impact that past manufacturing activities have had on the community. Looking forward, residents are understandably circumspect about how industrial land is used (and) reused in the neighborhood.

Historically, older industrial districts were primarily manufacturing operations that developed in close proximity to railroad lines. Residential communities often developed in close proximity to early manufacturers and served as a nearby source of labor. Since transportation options were limited to either walking or public transportation if available. Consequently, these older industrial/manufacturing areas typically had little or no land devoted to automobile parking.

The characteristics of these older industrial sites that made them suited to the pre-automobile railroad era render many of them functionally obsolete today. Urban core locations on relatively small sites make parking for today's auto-dependent labor force in short supply. Urban core locations such as Alton Park are often less convenient for truck access. Still, established industrial areas offer certain advantages over suburban sites. Alton Park is generally well-served with existing infrastructure needs such as water, electricity, sewer, close proximity to Interstate 24 and ample property that is already zoned for industrial use.

INDUSTRIAL FOCUS AREAS

North Alton Park

Located north of the Norfolk Southern rail viaduct over Alton Park Boulevard, this area consists of the most cohesive concentration of manufacturing zoning and uses within the study boundary. Virtually all of the land in this area is devoted to industrial uses. A small residential neighborhood along Tarlton and Delong Avenues is addressed in the Residential section of the plan.

Due to easy access to Interstate 24, a number of warehousing and distribution facilities are located in the sub-district. The completion of a $15 million FedEx Ground distribution facility in 2008 further emphasized the area's industrial importance. Generally, the future development in this area should build upon the industrial base already in place.

Velsicol Block

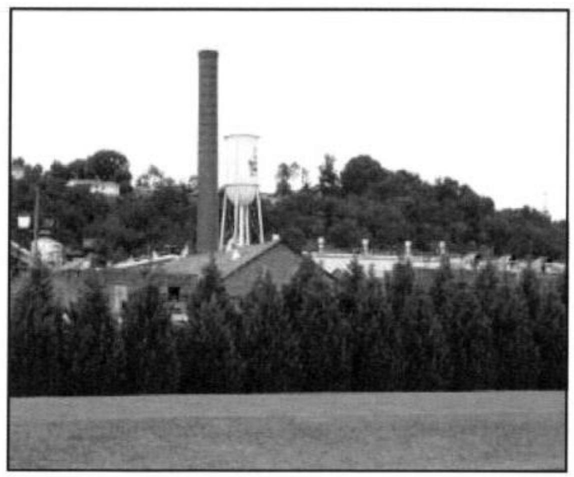
Located south of Central AltonPark, this focus area is bounded by Central Avenue to the west, Workman Road to the north, Wilson Road to the east and the Piney Woods neighborhood to the south. The northernmost portion of the focus area is predominately occupied by Schnitzer Steel Industries which recycles ferrous metals. Expansion of these uses should not cross to the north side of Workman Road to avoid impacting lower-intensity residential areas along Fagan and Dorris Streets.

The former site of the Tennessee Products and Chemical Company lies immediately to the south of Schnitzer. This 25-acre site was historically used to covert coal into coke. Operations persisted on the site until the 1980's. Over the years, massive amounts of coal tar residue were produced as a byproduct of coke production. Now owned by Hamilton County, the site is currently unused. Any future industrial use of the property will have to consider remediation of any contamination that may be found onsite.

Just north of the Piney Woods neighborhood, the Velsicol Chemical Corporation operated a plant at the site between 1963 and 2007. Crews recently dismantled the plant's infrastructure, though the company's long-term plans for the site are unclear. Since the plant comprised over 40 acres of land, its possible reuse represents a source of uncertainty in the community. Since the property has rail access, it could be utilized for industrial purposes once again provided that subsequent owners or users of the site take care to prevent undue impact on nearby residential neighborhoods. Possible future utilization could include subdivision into smaller mixed use industrial/warehouse/office parcels.

Regardless of whether the site is utilized as a whole, or divided into smaller parcels, industrial users should make sure that any reuse is done in a manner that respects the smaller, less-intense scale of the surrounding residential districts. In particular, more intense industrial or warehousing uses should be sited to the interior of the property. Access points to the property should be located away from residential areas. In the case of mixed office/warehouse use, the office component typically generates fewer vehicular trips and is likely to have operating hours more compatible with residential areas-making them more acceptable in close proximity to homes.

The Residue Hill landfill is located east of the former Velsicol site. Beginning in the late 1970s, community attention turned to the landfill as a source of chemical leachates turning up in nearby groundwater samples. The 48-acre property was used as a chemical dumping site for years before its closure in 1973. Residue Hill was eventually capped and is otherwise unused. Because of its extensive history as a chemical landfill, the site should remain in an undisturbed state.



Issue: Guidelines are needed to allow for a compatible transition from industrial development to other less intensive land uses.

These guidelines are needed for application throughout the study area including both established areas and those that may develop in the future.

Goal: Ensure compatible transition from industrial development to other less intensive land uses.

- Consider appropriate transitional methods at all locations where the development or expansion of industrial land abuts less intensive uses (either built or zoned). The following objectives will encourage a more compatible transition:

a. Site Orientation

(1) Site design should be oriented away from local neighborhood streets and toward primary streets.

(2) Site access should be limited to primary collector and arterial streets.

(3) Where appropriate, streets may be used as boundaries between industrial and commercial, office or higher-density residential land uses.

b. Building Orientation

(1) Industrial park activities, pedestrian access, and main building entrances should be oriented toward the street.

(2) The height and bulk of an industrial building and accessory structures should be oriented away from residential neighborhoods to avoid creating a negative visual effect.

c. Land Features:

(1) Promote the retention of stands of trees, natural vegetation, wetlands, stream corridors, and environmentally sensitive areas whenever possible to separate industrial park developments from residential land uses.

(2) Where possible, use existing topography to naturally separate industrial districts from residential areas.

d. Buffering and Landscaping

(1) Encourage the creative and extensive use of landscaping and berming techniques for effective buffering of residential and industrial land uses.

(2) Avoid the use of fences as a sole means of providing screening or buffering.

(3) Promote the use of existing land features, vegetation such as stands of trees and hedgerows, and stream corridors as natural buffers.

(4) Encourage the use of high quality materials in the construction of fencing and landscaping to reduce long-term maintenance costs and to decrease the likelihood that neglected, unsightly areas will occur.

e. Lighting

(1) Any lighting used to illuminate an off-street parking area, sign or other structure should be arranged as to deflect light away from any adjoining property or from public streets through fixture type, height and location.

(2) Exterior lighting of buildings should be limited to low level incandescent spotlights and similar illuminating devices shielded in such a manner that the direct beam of any such light source will not glare upon adjacent property or public streets.

- Encourage higher intensity and/or less compatible uses to locate to the interior of industrial sites or adjacent to major thoroughfares, but not adjacent or in close proximity to residential neighborhoods. A use may be considered less compatible because of height, bulk, parking, light, noise, traffic generation, or hours of operation.
- Ensure adequate screening of unsightly views of industrial developments (loading docks, rooftop equipment, parking areas, trash containers) through the use of extensive landscaping, berms, fencing, architectural design, open space, setbacks, building orientation, or any combination of these methods.
- Allow the use of low-intensity office development as a transitional use between business park developments and residential developments.
- Allow the use of commercial or office development as a transitional use between industrial developments and residential developments.
- Allow the use of medium to high intensity recreation facilities such as ball fields, court game areas, etc. as a transitional use so that joint use is made of parking facilities.
- Provide for adequate spacing for building(s), parking, and landscaped areas so that the site does not appear overdeveloped.

- Consider appropriate transitional methods at all locations where the development or expansion of a business park development abuts less intensive uses (either built or zoned):
  - o Building orientation
- Business park activities and parking, pedestrian access, and main building entrances should be oriented toward the street.
- The use of similar building height and roof forms should be utilized to enhance compatibility with surrounding development, especially adjacent residential neighborhoods.

Issue: Alton Park contains many underutilized industrial/ manufacturing properties

Goal: Re-use existing underutilized industrial/ manufacturing properties.

- Continue to pursue available grants for identification and cleanup of brownfield sites.
- Promote the assembly of small tracts to form larger, more cohesive parcels to enable well planned, and orderly light industrial/business park development to occur.
- In the case of larger industrial tracts of land, subdivision into smaller parcels for sale and use by smaller firms is encouraged as well.

Issue: Traffic concerns are often of major importance with much of the concern focused on ensuring safe and effective access and circulation at an acceptable level of service within and adjacent to light industrial/business park developments.

Goal: Promote a transportation system which provides or improves access and circulation within and adjacent to light industrial/business park areas.

- Discourage the expansion of existing or the inclusion of new light industrial/business park development in areas where, even with street and traffic signal improvements, the additional traffic generated by such development would exceed the handling capacity of the street system.
- Encourage convenient customer parking within light industrial/business park areas and discourage parking in adjacent areas.
- Provide for safe, continuous pedestrian networks to promote direct pedestrian access to neighboring residential, non-residential and public uses.
- Ensure adequate loading space within a building or in a side or rear yard, in such a way that all storage, standing and maneuvering of trucks will take place solely on private property.
- Ensure adequate ingress to and egress from light industrial/business park developments.
- Limit the number of driveways onto thoroughfares and coordinate these driveway locations with adjacent development to allow for shared access.
- Ensure adequate vehicular circulation within light industrial/business park developments that allows access to adjacent industrial buildings and developments without the need to drive to the public streets.
- Discourage the diversion of light industrial or business park traffic into residential neighbor-hoods.

Appendix C. Summary of Surface Soil Data from Nearby Properties. Data is presented by property name.

Residue Hill Site Surface Soil Sampling Locations and Analytical Data

Source: B&V 1993. Site Inspection for Residue Hill, Chattanooga, Hamilton County, TN. EPA ID No. TND 987 782 505.

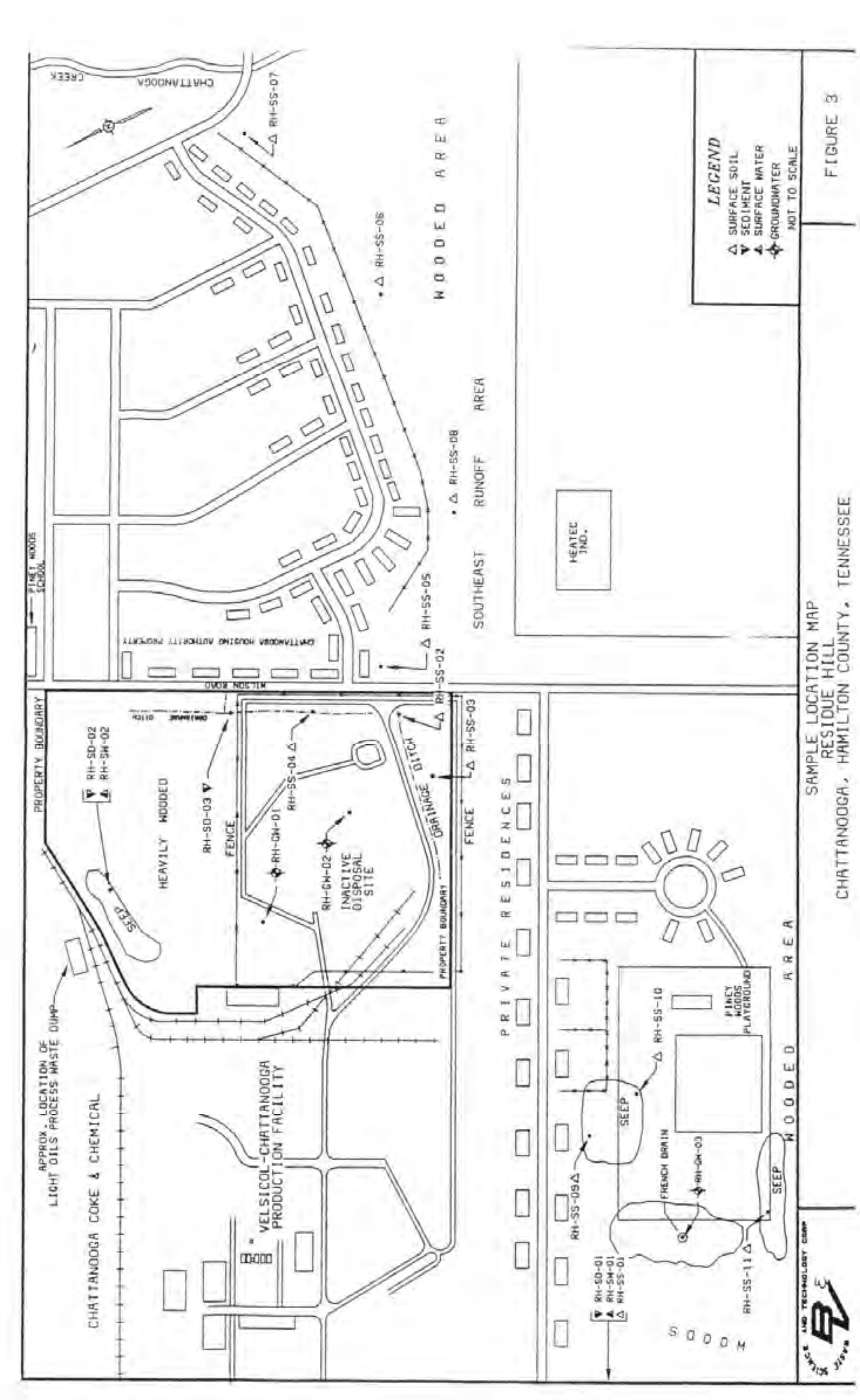

LEGEND
SURFACE SOIL
SEDIMENT
SURFACE WATER
GROUNDWATER
NOT TO SCALE
FIGURE 3
SAMPLE LOCATION MAP
RESIDUE HILL
CHATTANOOGA, HAMILTON COUNTY, TENNESSEE
CHATTANOOGA CREEK
WOODED AREA
SOUTHEAST RUNOFF AREA
HEATEC IND.
PINEY WOODS SCHOOL
CHATTANOOGA HOUSING AUTHORITY PROPERTY
WILSON ROAD
PROPERTY BOUNDARY
HEAVILY WOODED
SEEP
FENCE
DRAINAGE DITCH
INACTIVE DISPOSAL SITE
PRIVATE RESIDENCES
PINEY WOODS PLAYGROUND
FRENCH DRAIN
APPROX. LOCATION OF LIGHT OILS PROCESS WASTE DUMP
CHATTANOOGA COKE & CHEMICAL
VELSICOL-CHATTANOOGA PRODUCTION FACILITY
RH-SS-01
RH-SS-02
RH-SS-03
RH-SS-04
RH-SS-05
RH-SS-06
RH-SS-07
RH-SS-08
RH-SS-09
RH-SS-10
RH-SS-11
RH-SD-01
RH-SD-02
RH-SD-03
RH-SW-01
RH-SW-02
RH-GW-01
RH-GW-02
RH-GW-03

Table 9
Summary of Analytical Results
Organic Analysis Surface Soil Samples
Residue Hill
Chattanooga, Hamilton County, Tennessee

Parameters(ug/kg)	Background	Surface Soil Samples									
	SS-01	SS-02	SS-03	SS-04	SS-05	SS-06	SS-07	SS-08	SS-09	SS-10	SS-11
Purgeable Organics											
Tetrachloroethene	11UJ	11J	–	–	–	–	–	–	–	4J	NA
Extractable Organics											
1,2,4-trichlorobenzene	3,900U	680J	–	–	1,000J	–	–	–	–	–	NA
Anthracene	400J	–	–	–	–	–	–	–	–	–	NA
Benzo (A) anthracene	2,000J	1,600J	–	–	1,400J	540J	–	–	–	–	NA
Benzo (B and/or K) Flouranthene	3,100J	3,600J	–	–	2,800J	1,300J	–	1,700J	–	–	NA
Benzo (GHI) Perylene	1,300J	2,100J	–	–	980J	650J	–	930J	–	–	NA
Benzo – A – Pyrene	1,700J	1,800J	–	–	1,200J	710J	–	750J			NA
Chrysene	2,100J	2,400J	–	–	2,100J	750J	–	900J	–	–	NA
Fluoranthene	3,900J	2,200J	–	800J	2,300J	950J	–	1,900J	–	–	NA
Indeno (1,2,3-CD) Pyrene	1,400J	2,000J	–	–	1,000J	560J	–	660J	–	–	NA
Phenanthrene	2,300J	1,900J	–	–	1,900	510J	–	–	–	–	NA
Pyrene	3,000J	1,900J	–	–	2,000J	880J	–	1,700J	–	–	NA
Bis (2-Ethylhexyl) Phthalate	3,900U	–	–	–	100,000	–	–	–	–	–	NA
Miscellaneous Extractables											
Cyclopentaphenanthrene	1,000JN	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylphenanthrene	2,000JN	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloromethylbenzene	NA	10,000JN	NA	NA	2,000JN	NA	NA	NA	NA	NA	NA
[Oxybis(Methylene)] Bisbenzene	NA	2,000JN	NA	NA	2,000JN	NA	NA	NA	NA	NA	NA
Hexadecanoic Acid	NA	NA	NA	NA	6,000JN	NA	NA	NA	NA	NA	NA
Phosphoric Acid, Triphenyl Ester	NA	NA	NA	NA	10,000JN	NA	NA	NA	NA	NA	NA
Propylbenzamide (2 Isomers)	NA	10,000JN	NA	NA	20,000JN	NA	NA	NA	NA	NA	NA
Unidentified Phthalate Type Compounds/No.	NA	NA	NA	NA	300,000J/11	NA	NA	NA	NA	NA	NA
Unidentified Compounds/No.	NA	NA	NA	NA	20,000J/1	NA	NA	NA	NA	NA	NA
Petroleum Product	NA	NA	NA	NA	NA	N	NA	NA	NA	NA	NA

20

Table 9 (cont.)
Summary of Analytical Results
Organic Analysis Surface Soil Samples
Residue Hill
Chattanooga, Hamilton County, Tennessee

Parameters(ug/kg)	Background	Surface Soil Samples									
	SS-01	SS-02	SS-03	SS-04	SS-05	SS-06	SS-07	SS-08	SS-09	SS-10	SS-11
Pesticides/PCB's											
Alpha – BHC	9.3U	2,500	250	490	630	1.2J	–	110	0.54J	1.8J	NA
Beta – BHC	9.3U	5,300	210N	740	1,000N	–	–	–	–	–	NA
Delta – BHC	9.3U	170N	12N	18N	–	–	–	–	–	–	NA
Gamma – BHC (Lindane)	9.3U	180	17N	–	–	–	–	–	–	–	NA
Heptachlor	9.3U	100	–	9.3NJ	–	–	–	–	–	–	NA
4,4 – DDD (P,P – DDD)	18U	280	19	22J	53	–	–	–	–	–	NA
Alpha-Chlordane/2	9.3U	16J	–	–	–	–	–	–	1.2J	1.3J	NA
Endrin Ketone	18U	–	–	–	8.6J	–	–	–	–	–	NA
Heptachlor Epoxide	9.3U	–	–	–	–	–	–	–	0.51J	–	NA
Dieldrin	18U	–	–	–	–	–	–	–	2.2NJ	–	NA
4,4-DDE (P,P – DDE)	18U	–	–	–	–	–	–	–	0.87J	–	NA
Special Analytical (ug/kg)											
Benzoic Acid	NA	NA	8900U	NA	NA	9800U	NA	NA	15000U	NA	NA
Benzonitrile	NA	NA	4500U	NA	NA	4900U	NA	NA	7700U	NA	NA
Dicamba	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

– Material was analyzed for but not detected above the Sample Quantitation Limit(SQL)

U – Material was analyzed for but not detected.

J – Estimated Value

N – Presumptive evidence of prescence of material

NA – Not Analyzed For

[shaded box] 3 times background concentration or greater ter than or equal to SQL

21

Bunge Oil Site Surface Soil Sampling Locations and Analytical Data

Source: TDEC 2011. Pre-Cerclis screening assessment report assessment report, potential hazardous waste site, Lookout/Bunge Oil, Inc. 4608 Kirkland Avenue, Chattanooga, Hamilton County, Tennessee, TDoR Site: 33-710. Chattanooga, Tennessee

Bunge Oil onsite sampling as carried out May 11, 2011. TDoR Site: 33-710. Base map: http://maps.hamiltontn.gov/hcflex/.

		Sample	L001		L002		L003		L004		L005		L005D	
		Date sampled	11-May-11		11-May-11		11-May-11		11-May-11		11-May-11		11-May-11	
		Sample description	Grayish silt / slag soil 0-3". Black granulated slag 3-5"		Dark stony silt loam 0-6"		Black silt loam 0-6"		Black sandy loam, 0"-6"		Black loam, 0-2" Gray and yellow silty clay 2-7"		Black loam, 0-2" Gray and yellow silty clay 2-7"	
Analyte	EPA RSL's ug/kg Residential	EPA RSL's ug/kg Industrial	Result ug/kg dry	Qualifiers	Result ug/kg dry	Qualifiers	Result ug/kg dry	Qualifiers	Result ug/kg dry	Qualifiers	Result ug/kg dry	Qualifiers	Result ug/kg dry	Qualifiers
% Moisture	na	na	15%		19		21		15		26		23	
(3-and/or 4-)Methylphenol	?	?	200	U	210	U	210	U	200	U	230	U	220	U
1,1-Biphenyl	51000	210000	200	U	210	U	210	U	120	J,CLP01	230	U	220	U
1,2,4,5-Tetrachlorobenzene	18000	180000	200	U	210	U	210	U	200	U	230	U	220	U
2,3,4,6-Tetrachlorophenol	1800000	18000000	200	U	210	U	210	U	200	U	230	U	220	U
2,4,5-Trichlorophenol	6100000	62000000	200	U	210	U	210	U	200	U	230	U	220	U
2,4,6-Trichlorophenol	44000	160000	200	U	210	U	210	U	200	U	230	U	220	U
2,4-Dichlorophenol	180000	1800000	200	U	210	U	210	U	200	U	230	U	220	U
2,4-Dimethylphenol	1200000	12000000	200	U	210	U	210	U	200	U	230	U	220	U
2,4-Dinitrophenol	120000	1200000	390	U,J,QC-1	410	U,J,QC-1,CLP16	420	U,J,QC-1,CLP16	390	U,J,QC-1	450	U,J,QC-1	430	U,J,QC-1
2,4-Dinitrotoluene	1600	5500	200	U	210	U	210	U	200	U	230	U	220	U
2,6-Dinitrotoluene	61000	620000	200	U	210	U	210	U	200	U	230	U	220	U
2-Chloronaphthalene	6300000	82000000	200	U	210	U	210	U	200	U	230	U	220	U
2-Chlorophenol	390000	5100000	200	U	210	U	210	U	200	U	230	U	220	U
2-Methyl-4,6-dinitrophenol	?	?	390	U	410	U	420	U	390	U	450	U	430	U
2-Methylnaphthalene	?	?	200	U	210	U	210	U	390		130	J,CLP01	220	U
2-Methylphenol	?	?	200	U	210	U	210	U	200	U	230	U	220	U
2-Nitroaniline	610000	6000000	390	U	410	U	420	U	390	U	450	U	430	U
2-Nitrophenol	?	?	200	U	210	U	210	U	200	U	230	U	220	U
3,3'-Dichlorobenzidine	1100	3800	200	U	210	U	210	U	200	U	230	U	220	U
3-Nitroaniline	?	?	390	U	410	U	420	U	390	U	450	U	430	U
4-Bromophenyl phenyl ether	?	?	200	U	210	U	210	U	200	U	230	U	220	U
4-Chloro-3-methylphenol	?	?	200	U	210	U	210	U	200	U	230	U	220	U
4-Chloroaniline	?	?	200	U	210	U	210	U	200	U	230	U	220	U
4-Chlorophenyl phenyl ether	?	?	200	U	210	U	210	U	200	U	230	U	220	U
4-Nitroaniline	?	?	390	U,J,QC-1	410	U	420	U	390	U,J,QC-1	450	U,J,QC-1	430	U,J,QC-1
4-Nitrophenol	?	?	390	U	410	U	420	U	390	U	450	U	430	U
Acenaphthene	3400000	33000000	200	U	210	U	210	U	1500		420		220	U
Acenaphthylene	?	?	200	U	210	U	210	U	330		230	U	220	U
Acetophenone	7800000	100000000	200	U	210	U	210	U	200	U	230	U	220	U
Anthracene	17000000	170000000	200	U	210	U	210	U	3500		560		250	
Atrazine	2100	7500	200	U	210	U	210	U	200	U	230	U	220	U
Benzaldehyde	7800000	100000000	200	U	210	U	210	U	200	U	230	U	220	U
Benzo(a)anthracene	150	2100	220		210		200	J,CLP01	7100		1100		630	
Benzo(a)pyrene	15	210	270		220		220		6000		1100		560	
Benzo(b)fluoranthene	150	2100	290	J,QC-1	210		240		4900		800	J,QC-1	500	J,QC-1
Benzo(g,h,i)perylene	?	?	250		170	J,CLP01	170	J,CLP01	3800		810		390	
Benzo(k)fluoranthene	1500	21000	240		190	J,CLP01	200	J,CLP01	4300		880		450	
Benzyl butyl phthalate	?	?	200	U	210	U	210	U	200	U	230	U	220	U
Bis(2-chloroethoxy)methane	180000	1800000	200	U	210	U	210	U	200	U	230	U	220	U
bis(2-Chloroethyl) Ether	210	1000	200	U	210	U	210	U	200	U	230	U	220	U
Bis(2-chloroisopropyl) ether	?	?	200	U	210	U	210	U	200	U	230	U	220	U
Bis(2-ethylhexyl) phthalate	?	?	200	U	210	U	210	U	200	U	230	U	220	U
Caprolactam	31000000	310000000	200	U	210	U	210	U	200	U	230	U	220	U
Carbazole	?	?	200	U	210	U	210	U	700		310		220	U
Chrysene	15000	210000	250		240		240		7000		1100		610	
Di-n-butylphthalate	6100000	62000000	200	U	210	U	210	U	200	U	230	U	220	U
Di-n-octylphthalate	?	?	200	U	210	U	210	U	200	U	230	U	220	U
Dibenzo(a,h)anthracene	15	210	120	J,CLP01	210	U	210	U	1200		320		170	J,CLP01
Dibenzofuran	78	1000	200	U	210	U	210	U	890		310		220	U
Diethyl phthalate	49000000	490000000	200	U	210	U	210	U	200	U	230	U	220	U
Dimethyl phthalate	?	?	200	U	210	U	210	U	200	U	230	U	220	U
Fluoranthene	2300000	22000000	360		450		450		20000		3300		1500	
Fluorene	2300000	22000000	200	U	210	U	210	U	2200		230	J,CLP01	220	U
Hexachlorobenzene (HCB)	300	1100	200	U	210	U	210	U	200	U	230	U	220	U
Hexachlorobutadiene	6200	2200	200	U	210	U	210	U	200	U	230	U	220	U
Hexachlorocyclopentadiene (HCCP)	370000	3700000	200	U,J,QC-1,CLP16	210	U,J,QC-1	210	U,J,QC-1	200	U,J,QC-1,CLP16	230	U,J,QC-1,CLP16	220	U,J,QC-1,CLP16
Hexachloroethane	35000	120000	200	U	210	U	210	U	200	U	230	U	220	U
Indeno (1,2,3-cd) pyrene	150	2100	200		150	J,CLP01	160	J,CLP01	3700		700		340	
Isophorone	510000	1800000	200	U	210	U	210	U	200	U	230	U	220	U
n-Nitroso di-n-Propylamine	69	250	200	U	210	U	210	U	200	U	230	U	220	U
n-Nitrosodiphenylamine/Diphenylamine	99000	350000	200	U	210	U	210	U	200	U	230	U	220	U
Naphthalene	3600	18000	200	U	210	U	210	U	150	J,CLP01	230		220	U
Nitrobenzene			200	U	210	U	210	U	200	U	230	U	220	U
Pentachlorophenol	890	2700	390	U,J,QC-1	410	U	420	U	390	U,J,QC-1	450	U,J,QC-1	430	U,J,QC-1
Phenanthrene	?	?	89	J,CLP01	250		200	J,CLP01	16000		3100		940	
Phenol	18000000	180000000	200	U	210	U	210	U	200	U	230	U	220	U
Pyrene	1700000	17000000	300		430		350		14000		2100		990	
Tentatively identified compounds														
1-Naphthalenecarboxylic acid, 2-benzoyl-	?	?	700	NJ,CLP15										
Unidentified Compound(s)	?	?	1000	J,CLP15										
[illegible]	?	?			500	NJ,CLP15								
n-Hexadecanoic acid	?	?			500	NJ,CLP15								
Petroleum Product	?	?				N,CLP15								
Unidentified Compound(s)	?	?			800	J,CLP15								
beta.-Sitosterol	?	?					400	NJ,CLP15						
13-Methyl-Z-14-nonacosene	?	?					400	NJ,CLP15						
7-Hexadecene, (Z)-	?	?					500	NJ,CLP15						
E-14-Hexadecenal	?	?					600	NJ,CLP15						
n-Hexadecanoic acid	?	?					500	NJ,CLP15						
1,1'-Binaphthalene	?	?							400	NJ,CLP15				
Benzo[b]triphenylene	?	?							400	NJ,CLP15				
Benzo[e]pyrene	?	?							400	NJ,CLP15				
Naphthalene, 1,4,6-trimethyl-	?	?							400	NJ,CLP15				
Naphthalene, 1,5-dimethyl-	?	?							300	NJ,CLP15				
Naphthalene, 1,6,7-trimethyl-	?	?							400	NJ,CLP15				
Naphthalene, 1,6-dimethyl-	?	?							700	NJ,CLP15				
Naphthalene, 1-methyl-	?	?							700	NJ,CLP15				
Naphthalene, 2,3,6-trimethyl-	?	?							400	NJ,CLP15				
Naphthalene, 2,3-dimethyl-	?	?							800	NJ,CLP15				
Naphthalene, 2,7-dimethyl-	?	?							400	NJ,CLP15				
Petroleum Product	?	?								N,CLP15				
Pyrene, 1-methyl-	?	?							300	NJ,CLP15				
Unidentified Compound(s)	?	?							3000	J,CLP15				
11H-Benzo[a]fluoren-11-one	?	?									700	NJ,CLP15	500	NJ,CLP15
Dibenzo[def,mno]chrysene	?	?									500	NJ,CLP15	700	NJ,CLP15
Unidentified Compound(s)	?	?									2000	J,CLP15	500	J,CLP15

3 x bkg., but below residential RSL, or no RSL established

3 x bkg., and above residential RSL.

3 x bkg. and > industrial RSL

QUALIFIERS	QualifierDefinitions
U	The analyte was not detected at or above the reporting limit
CLP01	Concentration reported is less than the lowest standard on calibration curve
CLP15	TIC Results Reported as identified by Lab - IDs Not Verified
CLP16	Initial Calibration Response Erratic
J	The identification of the analyte is acceptable; the reported value is an estimate
N	There is presumptive evidence that the analyte is present; the analyte is reported as a tentative identification
NJ	Presumptive evidence that analyte is present; reported as a tentative identification with an estimated value
QC-1	Analyte concentration low in continuing calibration verification standard

Table 3. Summary of semivolatile organic compound analytical results, with documented releases and concentrations exceeding RSL's highlighted.

Chattanooga Coke Site Surface Soil Sampling Locations and Analytical Data

Source: ERM 2008. Supplemental Risk Assessment for Surficial Soil, Mead-Westvaco Corporation, Former Chattanooga Coke Plant, Chattanooga, TN

TABLE 3-1

SURFICIAL SOIL SAMPLE DESIGNATION SUMMARY AND LABORATORY ANALYSES
FORMER CHATTANOOGA COKE SITE
CHATTANOOGA, TENNESSEE

Chain-of-Custody Sample ID	Date Sampled	Revised Sample ID	Laboratory Analyses	Comment
01-031708-SB1 (0-2)	03/17/08	SS-0308-1 (0-2)	PAHs	
01-031708-SB2 (0-2)	03/17/08	SS-0308-2 (0-2)	PAHs	
02-031708-SB3 (0-2)	03/17/08	SS-0308-3 (0-2)	PAHs	
03-031808-SB4 (0-2)	03/18/08	SS-0308-4 (0-2)	PAHs	
05-031708-SB5 (0-2)	03/17/08	SS-0308-5 (0-2)	PAHs	
06-031808-SB6 (0-2)	03/18/08	SS-0308-6 (0-2)	PAHs	
14-031808-SB9 (0-2)	03/18/08	SS-0308-7 (0-2)	PAHs	
09-031808-SB8 (0-2)	03/18/08	SS-0308-8 (0-2)	PAHs	
09-031808-SB9 (0-2)	03/18/08	SS-0308-9 (0-2)	PAHs	
40-031908-SB32 (0-2)	03/19/08	SS-0308-10 (0-2)	PAHs	
24-031808-SB11 (0-2)	03/18/08	SS-0308-11 (0-2)	PAHs	
24-031808-SB12 (0-2)	03/18/08	SS-0308-12 (0-2)	PAHs	
031808-Dup 1	03/18/08	SS-0308-12 FD1	PAHs	Duplicate of SS-0308-12 (0-2)
23-031908-SB13 (0-2)	03/19/08	SS-0308-13 (0-2)	PAHs	
27-031808-SB14 (0-2)	03/18/08	SS-0308-14 (0-2)	PAHs	
27-031808-SB15 (0-2)	03/18/08	SS-0308-15 (0-2)	PAHs	
27-031808-SB15 (0-6")	03/18/08	SS-0308-15 (0-6 inch)	PAHs	
27-031808-SB16 (0-2)	03/18/08	SS-0308-16 (0-2)	PAHs	
27-031808-SB17 (0-2)	03/18/08	SS-0308-17 (0-2)	PAHs	
34-031808-SB18 (0-2)	03/18/08	SS-0308-18 (0-2)	PAHs	
031808-Dup 2	03/18/08	SS-0308-18 FD2	PAHs	Duplicate of SS-0308-18 (0-2)
34-031808-SB19 (0-6")	03/18/08	SS-0308-19 (0-6 inch)	PAHs	
34-031808-SB19 (0-2)	03/18/08	SS-0308-19 (0-2)	PAHs	
37-031808-SB20 (0-6")	03/18/08	SS-0308-20 (0-6 inch)	PAHs	
37-031808-SB20 (0-2)	03/18/08	SS-0308-20 (0-2)	PAHs	
47-031808-SB21 (0-2)	03/18/08	SS-0308-21 (0-2)	PAHs	
54-031808-SB22 (0-2)	03/18/08	SS-0308-22 (0-2)	PAHs	
57-031808-SB23 (0-2)	03/18/08	SS-0308-23 (0-2)	PAHs	
53-031908-SB24 (0-2)	03/19/08	SS-0308-24 (0-2)	PAHs	
53-031908-SB25 (0-2)	03/19/08	SS-0308-25 (0-2)	PAHs	
52-031908-SB26 (0-6")	03/19/08	SS-0308-26 (0-6 inch)	PAHs	
52-031908-SB26 (0-2)	03/19/08	SS-0308-26 (0-2)	PAHs	
031908-Dup 3	03/19/08	SS-0308-26 FD3	PAHs	Duplicate of SS-0308-26 (0-2)
52-031908-SB27 (0-2)	03/19/08	SS-0308-27 (0-2)	PAHs	
43-031908-SB28 (0-2)	03/19/08	SS-0308-28 (0-2)	PAHs	
43-031908-SB29 (0-2)	03/19/08	SS-0308-29 (0-2)	PAHs	
38-031908-SB30 (0-2)	03/19/08	SS-0308-30 (0-2)	PAHs	
38-031908-SB31 (0-2)	03/19/08	SS-0308-31 (0-2)	PAHs	
21-031908-SB33 (0-2')	03/19/08	SS-0308-32 (0-2)	PAHs	
09-031808-SB10 (0-2)	03/18/08	SB-0308-1 (0-2)	PAHs	
12-031908-SB39 (0-2)	03/19/08	SB-0308-2 (0-2)	VOCs, PAHs, As, Cr	
031808-EB1	03/18/08	EB-1 (031808)	PAHs	Equipment blank

PAHs = Polynuclear Aromatic Hydrocarbons (by EPA Method 8270)
VOCs = Volatile Organic Compounds (by EPA Method 8260)
As = Arsenic (by EPA Method 6010)
Cr = Chromium (by EPA Method 6010)

ERM Page 1 of 1 p:\meadwestvaco\67793\table 3-1 revised.xls

TABLE 4-1

SUMMARY OF SURFICIAL SOIL ANALYTICAL RESULTS
FORMER CHATTANOOGA COKE SITE
CHATTANOOGA, TENNESSEE

Sample Designation==>>	SS-0308-1 (0-2)	SS-0308-2 (0-2)	SS-0308-3 (0-2)	SS-0308-4 (0-2)	SS-0308-5 (0-2)	SS-0308-6 (0-2)	SS-0308-7 (0-2)	SS-0308-8 (0-2)	SS-0308-9 (0-2)	SS-0308-10 (0-2)	SS-0308-11 (0-2)
Date Collected ==>>	03/17/08	03/17/08	03/17/08	03/18/08	03/17/08	03/18/08	03/18/08	03/18/08	03/18/08	03/18/08	03/18/08
Volatiles (ug/kg)											
XYLENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL VOCs (ug/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Polynuclear Aromatic Hydrocarbons (ug/kg)											
ACENAPHTHENE	ND	ND	ND	ND	ND	55	2670	110	90	59	550
ACENAPHTHYLENE	ND	ND	ND	ND	310	460	22700	290	2790	610	610
ANTHRACENE	ND	ND	ND	ND	280	405	68900	450	2140	690	1090
BENZO [A] ANTHRACENE	57	200	ND	ND	910	1460	89500	2270	11300	2460	25700
BENZO [B] FLUORANTHENE	95	310	ND	ND	1250	1730	81900	3600	15600	3470	42800
BENZO [G,H,I] PERYLENE	ND	120	ND	ND	480	670	45300	1480	7080	1530	15400
BENZO [K] FLUORANTHENE	ND	120	ND	ND	430	630	38000	1100	5840	1080	17400
BENZO [A] PYRENE	ND	190	ND	ND	770	1100	60100	1840	11300	2940	19500
CHRYSENE	97	280	ND	ND	1080	1910	88600	2170	10900	3120	23700
DIBENZO [A,H] ANTHRACENE	ND	65	ND	ND	150	250	11500	530	2480	790	8750
FLUORANTHENE	84	290	ND	ND	1480	2110	220000	3330	15700	2760	13700
FLUORENE	ND	ND	ND	ND	100	220	30600	120	550	211	1290
INDENO [1,2,3-CD] PYRENE	ND	110	ND	ND	600	870	46200	1820	8610	2210	23600
NAPHTHALENE	85	ND	ND	ND	310	630	7130	102	560	1010	2390
PHENANTHRENE	220	98	ND	ND	1110	1080	224000	1720	3070	1790	4570
PYRENE	61	230	ND	ND	1140	1750	162000	2600	12200	2050	10700
TOTAL PAHs (mg/kg)	0.7	2.01	ND	ND	10.4	15.3	1200	23.5	110	26.8	212
Metals (mg/kg)											
ARSENIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
ND = Not Detected
NE = Not Established
NA = Not Analyzed
EB-1(031808) is an equipment blank; units are ug/l for volatiles and PAHs, mg/l for metals

ERM

Page 1 of 4

P:\MeadWestvaco\67793\MWV CC soil results 2.xls

TABLE 4-1

SUMMARY OF SURFICIAL SOIL ANALYTICAL RESULTS
FORMER CHATTANOOGA COKE SITE
CHATTANOOGA, TENNESSEE

Sample Designation=>>	SS-0308-12 (0-2)	SS-0308-12 FD1	SS-0308-13 (0-2)	SS-0308-14 (0-2)	SS-0308-15 (0-6")	SS-0308-15 (0-2)	SS-0308-16 (0-2)	SS-0308-17 (0-2)	SS-0308-18 (0-2)	SS-0308-18 FD2
Date Collected ==>>	03/18/08	03/18/08	03/19/08	03/18/08	03/18/08	03/18/08	03/18/08	03/18/08	03/18/08	03/18/08
Volatiles (ug/kg)										
XYLENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL VOCs (ug/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Polynuclear Aromatic Hydrocarbons (ug/kg)										
ACENAPHTHENE	ND	ND	ND	ND	ND	ND	71	ND	ND	ND
ACENAPHTHYLENE	170	130	300	ND	1460	1260	460	ND	180	190
ANTHRACENE	230	180	390	93	1590	840	480	ND	290	460
BENZO [A] ANTHRACENE	860	840	1290	370	2320	2280	970	ND	1960	3620
BENZO [B] FLUORANTHENE	1280	1290	2970	510	4030	3640	2080	ND	3480	5300
BENZO [G,H,I] PERYLENE	640	450	1120	180	1820	1890	920	ND	1740	2990
BENZO [K] FLUORANTHENE	400	400	1310	180	1490	1480	730	ND	1290	1850
BENZO [A] PYRENE	720	760	1390	330	3830	3540	1170	ND	2880	3970
CHRYSENE	880	940	1650	440	2470	3020	1530	ND	2440	3540
DIBENZO [A,H] ANTHRACENE	200	160	480	57	880	800	470	ND	500	280
FLUORANTHENE	1350	1070	1400	580	2320	2040	1490	ND	1420	1990
FLUORENE	63	ND	95	ND	1530	1050	54	ND	ND	ND
INDENO [1,2,3-CD] PYRENE	780	620	1310	240	2580	2630	1250	ND	2360	3200
NAPHTHALENE	140	130	1000	75	2080	1350	760	ND	200	350
PHENANTHRENE	970	660	1020	470	1650	1390	1460	61	560	1340
PYRENE	1040	830	1260	450	2090	1910	1200	ND	1380	1990
TOTAL PAHs (mg/kg)	9.72	8.46	17	3.98	32.1	29.1	15.1	0.06	20.7	31.1
Metals (mg/kg)										
ARSENIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
ND = Not Detected
NE = Not Established
NA = Not Analyzed
EB-1(031808) is an equipment blank; units are ug/l for volatiles and PAHs, mg/l for metals

TABLE 4-1

SUMMARY OF SURFICIAL SOIL ANALYTICAL RESULTS
FORMER CHATTANOOGA COKE SITE
CHATTANOOGA, TENNESSEE

Sample Designation=>>	SS-0308-19 (0-6")	SS-0308-19 (0-2)	SS-0308-20 (0-6")	SS-0308-20 (0-2)	SS-0308-21 (0-2)	SS-0308-22 (0-2)	SS-0308-23 (0-2)	SS-0308-24 (0-2)	SS-0308-25 (0-2)	SS-0308-26 (0-6")	SS-0308-26 (0-2)
Date Collected ==>>	3/18/2008	03/18/08	03/18/08	03/18/08	03/18/08	03/18/08	03/18/08	03/19/08	03/19/08	03/19/08	03/19/08
Volatiles (ug/kg)											
XYLENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL VOCs (ug/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Polynuclear Aromatic Hydrocarbons (ug/kg)											
ACENAPHTHENE	70	ND	210	ND	ND	ND	ND	ND	250	ND	310
ACENAPHTHYLENE	2230	670	3050	540	640	250	130	660	5510	900	1860
ANTHRACENE	1400	420	1720	380	510	170	150	370	4950	810	2330
BENZO [A] ANTHRACENE	3380	1240	4310	1190	1680	700	520	1930	10200	3210	6900
BENZO [B] FLUORANTHENE	6370	2150	6220	1690	2260	1100	660	2470	18900	4510	9280
BENZO [G,H,I] PERYLENE	2540	980	5610	730	880	440	220	1480	12500	2300	3580
BENZO [K] FLUORANTHENE	1700	690	1840	510	690	350	240	1030	9230	1680	4410
BENZO [A] PYRENE	4340	1590	4050	1320	1400	660	440	2190	12800	2900	6290
CHRYSENE	5100	1670	5310	1360	1970	850	650	1890	15400	3410	7940
DIBENZO [A,H] ANTHRACENE	1360	450	1520	300	400	170	92	480	4090	970	1650
FLUORANTHENE	4720	1570	5220	1720	2810	1000	780	2340	16100	3850	12300
FLUORENE	490	99	6640	110	170	ND	ND	55	1070	190	1210
INDENO [1,2,3-CD] PYRENE	3490	1330	5020	990	1200	560	310	1980	13900	2800	4960
NAPHTHALENE	15200	1600	13000	950	2520	580	140	400	15500	890	2000
PHENANTHRENE	3250	1090	3050	990	2180	560	680	1110	8890	1900	5800
PYRENE	3830	1250	3960	1300	2050	770	580	1980	13300	3230	9460
TOTAL PAHs (mg/kg)	59.5	16.8	70.7	14.1	21.4	8.16	5.59	20.4	163	33.6	80.3
Metals (mg/kg)											
ARSENIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
ND = Not Detected
NE = Not Established
NA = Not Analyzed
EB-1(031808) is an equipment blank; units are ug/l for volatiles and PAHs, mg/l for metals

TABLE 4-1

SUMMARY OF SURFICIAL SOIL ANALYTICAL RESULTS
FORMER CHATTANOOGA COKE SITE
CHATTANOOGA, TENNESSEE

Sample Designation=>>	SS-0308-26 FD3	SS-0308-27 (0-2)	SS-0308-28 (0-2)	SS-0308-29 (0-2)	SS-0308-30 (0-2)	SS-0308-31 (0-2)	SS-0308-32 (0-2)	SB-0308-1 (0-2)	SB-0308-2 (0-2)	EB-1(031808)
Date Collected ==>>	03/19/08	03/19/08	03/19/08	03/19/08	03/19/08	03/19/08	03/19/08	03/19/08	03/19/08	03/18/08
Volatiles (ug/kg)										
XYLENE	NA	NA	NA	NA	NA	NA	NA	NA	15	NA
TOTAL VOCs (ug/kg)	NA	NA	NA	NA	NA	NA	NA	NA	15	NA
Polynuclear Aromatic Hydrocarbons (ug/kg)										
ACENAPHTHENE	650	2410	170	ND	ND	ND	60	ND	2310	ND
ACENAPHTHYLENE	3990	20800	1060	ND	190	140	1130	331	4980	ND
ANTHRACENE	7220	35700	860	ND	210	120	1040	387	12900	ND
BENZO [A] ANTHRACENE	28100	105000	3250	70	2100	430	3370	2620	33900	ND
BENZO [B] FLUORANTHENE	33700	109000	3790	61	3630	880	7450	3990	25100	ND
BENZO [G,H,I] PERYLENE	12400	30000	2590	60	2150	500	3200	1610	13300	ND
BENZO [K] FLUORANTHENE	10700	34600	1630	ND	1420	390	3010	1230	12000	ND
BENZO [A] PYRENE	19800	50700	3150	67	2280	440	4040	2470	22900	ND
CHRYSENE	24500	82000	3410	68	1880	610	5860	2480	24700	ND
DIBENZO [A,H] ANTHRACENE	3980	13400	1060	ND	710	150	1460	559	1260	ND
FLUORANTHENE	37200	190000	3610	124	2260	610	4310	3600	48600	ND
FLUORENE	2130	25000	310	ND	ND	ND	120	74	9990	ND
INDENO [1,2,3-CD] PYRENE	13600	40000	3100	70	2390	480	3570	1980	12900	ND
NAPHTHALENE	2120	16800	2230	ND	560	240	530	81	17000	ND
PHENANTHRENE	20100	199000	2560	96	940	400	1930	1160	47400	ND
PYRENE	28100	134000	3180	92	1920	510	4670	3110	31800	ND
TOTAL PAHs (mg/kg)	248	1090	36	0.71	22.6	5.9	45.8	25.7	321	ND
Metals (mg/kg)										
ARSENIC	NA	NA	NA	NA	NA	NA	NA	NA	7	NA
CHROMIUM	NA	NA	NA	NA	NA	NA	NA	NA	12	NA

Notes:
ND = Not Detected
NE = Not Established
NA = Not Analyzed
EB-1(031808) is an equipment blank; units are ug/l for volatiles and PAHs, mg/l for metals

ERM

Page 4 of 4

P:\MeadWestvaco\67793\MWV CC soil results 2.xls

Troy Keith, TDEC, Piney Woods School Email, Chattanooga, TN

Source: Troy Keith, TDEC Division of Remediation Chattanooga Field Office Manager, April 11, 2013

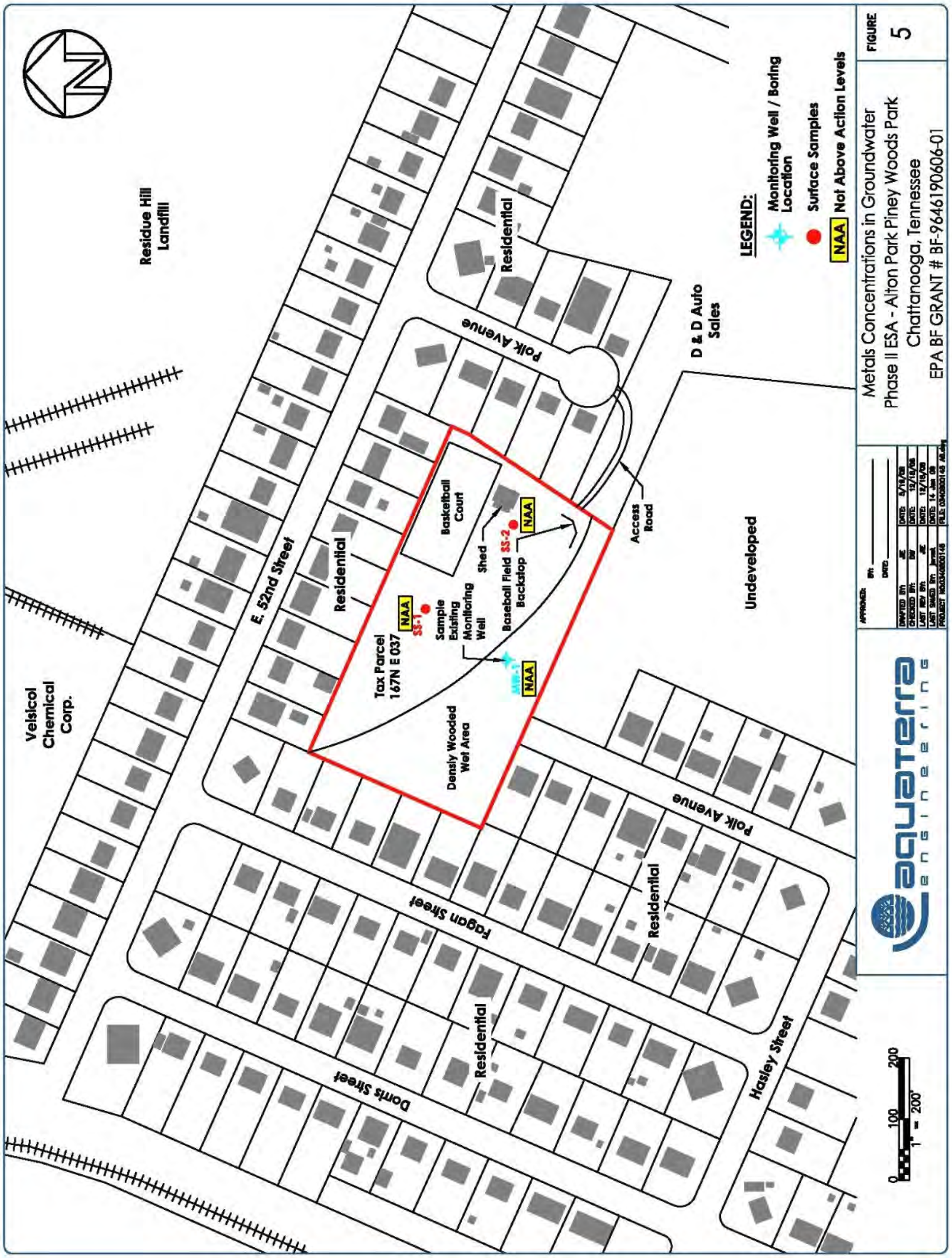
Joseph George

From:	Troy Keith
Sent:	Thursday, April 11, 2013 2:59 PM
To:	Joseph George
Cc:	Teresa Lewis
Subject:	RE: Off-site Soil Sampling Near Velsicol Chemical in Alton Park
Attachments:	LookoutOilPreCERCLAReportSS.pdf

The Tennessee products EPA RI has some data. To save a trip, check with Teresa and see if the CO has a copy. It should be Site ID 33-584, but may still be filed under 33-547. I did some sampling at the former Piney Woods School, which came back with low levels of PAH's. The former Charles A Bell school was impacted by PAH's (you guys did a consultation on it, so you should have it) but it may be too far away. I've attached a report for a facility a couple blocks up the road. We have a lot of data for the adjacent Coke Plant (33-547) and Residue Hill (33-527) sites. Outside of these, I don't think there is anything else.

Piney Woods Park Phase 2 Surface Soil Sampling Locations and Analytical Data

Source: Aquaterra 2009. Limited Phase II Environmental Site Assessment, Alton Park Sit3e 4, Piney Woods Park, located off Polk Avenue, Chattanooga, TN, January 14, 2009.


Residue Hill Landfill
Velsicol Chemical Corp.
E. 52nd Street
Residential
Polk Avenue
Basketball Court
Shed
Baseball Field Backstop
SS-2
NAA
SS-1
Sample Existing Monitoring Well
Tax Parcel 167N E 037
MW-1
Densly Wooded Wet Area
Access Road
D & D Auto Sales
Undeveloped
Fagan Street
Dorris Street
Hasley Street
LEGEND:
Monitoring Well / Boring Location
Surface Samples
NAA Not Above Action Levels
Metals Concentrations in Groundwater
Phase II ESA - Alton Park Piney Woods Park
Chattanooga, Tennessee
EPA BF GRANT # BF-9646190606-01
FIGURE
5
aquaterra
engineering
0
100
200
1" = 200'

aquaterra engineering

Table 2

Soil Analytical Data Summary - SVOC's and VOC's
Site 4 - Piney Woods Park - Phase II Environmental Site Assessment
Chattanooga, Tennessee

				PAH's			VOC's
Site ID	**Sample ID**	**Sample Depth**	**Sample Date**	Benzo(k)-fluoranthene	Fluoranthene	Pyrene	**None Detected**
Industrial Soil Action Levels				**21****	**22,000****	**17,000****	
Residential Soil Action Levels				**1.5****	**2,300****	**1,700****	
Site 4	SS-1	0-6"	11/4/2008	0.044	0.045	0.052	
Site 4	SS-2	0-6"	11/4/2008	< 0.033	< 0.033	< 0.033	
Site 4	Dup	0-6"	11/4/2008	< 0.033	< 0.033	< 0.033	

NOTE: *Background concentration as established by TDEC

**Regional Screening Levels as established by EPA and published May 2008

NE - Action Level Has Not Been Established

For clarity of data presentation, only parameters with laboratory detected concentrations are presented

0340800145 All results in parts-per-million (ppm) Table 2 Page 1 of 1

Appendix D. Summary of Reilly Tar Site Groundwater Monitoring Well Data for September and December 2010 (northeastern portion of the former Velsicol Site). Groundwater monitoring results presented in these tables are reported in micrograms per liter (µg/L).

Summary of Groundwater Analytical Data - September and December 2010

Parameter	MW-12 9/30/2010	MW-14 9/29/2010	MW-15 9/29/2010	MW-32 9/30/2010	MW-33 9/30/2010	MW-34 9/29/2010	MW-35 9/29/2010	MW-36 9/30/2010
Conventionals								
pH	NS	NS	NS	NS	NS	NS	NS	NS
Semi-volatile Organic Compounds (ug/L)								
Acenaphthene	167	<2	<2	73.7	3.87	<2	<2	143
Acenaphthylene	2.15	<2	<2	2.14	<2	<2	<2	3.88
Acetophenone	<5	<5	<5	<5	<5	<5	<5	7.1
Anthracene	44.9	<2	<2	16.3	<2	<2	<2	42.1
Bis(2-chloroethyl)ether	<5	<5	<5	<5	<5	<5	<5	<5
Bis(2-chloroisopropyl)ether	<5	<5	<5	<5	<5	<5	<5	<5
Bis(2-ethylhexyl)phthalate	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene	30.1	<2	<2	4.3	<2	<2	<2	32.2
Benzo(a)pyrene	20.3	<2	<2	3.24	<2	<2	<2	24.1
Benzo(b)fluoranthene	19.5	<2	<2	3.14	<2	<2	<2	26.2
Bis(2-chloroethoxy)methane	<5	<5	<5	<5	<5	<5	<5	<5
Benzaldehyde	<20	<20	<20	<20	<20	<20	<20	<20
Benzo(g,h,i)perylene	9.08	<2	<2	<2	<2	<2	<2	9.58
Benzo(k)fluoranthene	20.1	<2	<2	2.53	<2	<2	<2	21.3
Benzoic acid	<10	<10	<10	<10 R	<10	<10	<10	<10
Benzyl alcohol	<10	<10	<10	<10	<10	<10	<10	<10
Benzotrichloride	<10	<10	<10	<10	<10	<10	<10	<10
Benzyl Chloride	<10	<10	<10	<10	<10	<10	<10	<10
Benzoyl Chloride	<10	<10	<10	<10	<10	<10	<10	<10
4-Bromophenyl phenyl ether	<5	<5	<5	<5	<5	<5	<5	<5
Chrysene	26	<2	<2	3.79	<2	<2	<2	27.8
4-Chloro-3-methylphenol	<5	<5	<5	<5	<5	<5	<5	<5
4-Chloroaniline	<5	<5	<5	<5	<5	<5	<5	<5
Hexachlorobenzene	<5	<5	<5	<5	<5	<5	<5	<5
Hexachlorobutadiene	<5	<5	<5	<5	<5	<5	<5	<5
1,2-Dichlorobenzene	<5	<5	<5	<5	<5	<5	<5	<5
1,3-Dichlorobenzene	<5	<5	<5	<5	<5	<5	<5	<5
1,4-Dichlorobenzene	<5	<5	<5	<5	<5	<5	<5	<5
1,2,4-Trichlorobenzene	<5	<5	<5	<5	<5	<5	<5	<5
1,2,4,5-Tetrachlorobenzene	<5	<5	<5	<5	<5	<5	<5	<5
Pentachlorobenzene	<5	<5	<5	<5	<5	<5	<5	<5
3,3'-Dichlorobenzidine	<10	<10	<10	<10	<10	<10	<10	<10
Hexachloroethane	<5	<5	<5	<5	<5	<5	<5	<5
2-Chloronaphthalene	<5	<5	<5	<5	<5	<5	<5	<5
2-Chlorophenol	<5	<5	<5	<5	<5	<5	<5	<5
Pentachlorophenol	<10	<10	<10	<10	<10	<10	<10	<10
2,4-Dichlorophenol	<5	<5	<5	<5	<5	<5	<5	<5
2,6-Dichlorophenol	<5	<5	<5	<5	<5	<5	<5	<5
2,4,5-Trichlorophenol	<5	<5	<5	<5	<5	<5	<5	<5

NS = not sampled
NT = not tested
R = rejected
< = not detected at reporting limit shown

J = estimated concentration or reporting limit for undetected result was estimated
JL = estimated concentration with low bias
Highlighted Constituents Indicate Typical Coal Tar Constituents

Summary of Groundwater Analytical Data - September and December 2010

Parameter	MW-12 9/30/2010	MW-14 9/29/2010	MW-15 9/29/2010	MW-32 9/30/2010	MW-33 9/30/2010	MW-34 9/29/2010	MW-35 9/29/2010	MW-36 9/30/2010
2,4,6-Trichlorophenol	<5	<5	<5	<5	<5	<5	<5	<5
2,3,4,6-Tetrachlorophenol	<5	<5	<5	<5	<5	<5	<5	<5
Chlorotoluene	32.8	<10	<10	<10	<10	<10	<10	190
4-Chlorophenyl phenyl ether	<5	<5	<5	<5	<5	<5	<5	<5
Dibenz(a,h)anthracene	4.28	<2	<2	<2	<2	<2	<2	4.8
Dibenzofuran	94.1	<5	<5	47.7	<5	<5	<5	134
Fluoranthene	120	<2	<2	24.2	<2	<2	<2	111
Fluorene	121	<2	<2	68.1	<2	<2	<2	138
Indeno(1,2,3-cd)pyrene	9.78	<2	<2	2.15	<2	<2	<2	10.6
Isophorone	<5	<5	<5	<5	<5	<5	<5	<5
4,6-Dinitro-2-methylphenol	<10	<10	<10	<10	<10	<10	<10	<10
2-Methylnaphthalene	111	<2	<2	155	<2	<2	<2	585
2-Methylphenol	<5	<5	<5	<5	<5	<5	<5	13
3&4-Methylphenol	<5	<5	<5	<5	<5	<5	<5	13.5
2,4-Dimethylphenol	<5	<5	<5	12.4	<5	<5	<5	<5
Di-n-butylphthalate	<5	<5	<5	<5	5.66 B	<5	<5	<5
Di-n-octylphthalate	<5	<5	<5	<5	<5	<5	<5	<5
2-Nitroaniline	<5	<5	<5	<5	<5	<5	<5	<5
3-Nitroaniline	<10	<10	<10	<10	<10	<10	<10	<10
4-Nitroaniline	<5	<5	<5	<5	<5	<5	<5	<5
Naphthalene	10.6	<2	<2	359	2.84	14.4	11	5220
Nitrobenzene	<5	<5	<5	<5	<5	<5	<5	<5
N-Nitrosodiethylamine	<5	<5	<5	<5	<5	<5	<5	<5
N-Nitrosodi-n-propylamine	<5	<5	<5	<5	<5	<5	<5	<5
N-Nitrosodiphenylamine	<10	<10	<10	<10	<10	<10	<10	<10
2,4-Dinitrotoluene	<5	<5	<5	<5	<5	<5	<5	<5
2,6-Dinitrotoluene	<5	<5	<5	<5	<5	<5	<5	<5
2-Nitrophenol	<5	<5	<5	<5	<5	<5	<5	<5
4-Nitrophenol	<20	<20	<20	<20	<20	<20	<20	<20
2,4-Dinitrophenol	<5	<5	<5	<5	<5	<5	<5	<5
Phenanthrene	201	<2	<2	70.4	<2	<2	<2	204
Phenol	<5	<5	<5	<5	<5	<5	<5	5.22
Butyl benzyl phthalate	<5	<5	<5	<5	<5	<5	<5	<5
Diethylphthalate	<5	<5	<5	<5	<5	<5	<5	<5
Dimethylphthalate	<5	<5	<5	<5	<5	<5	<5	<5
Pyrene	75.9	<2	<2	17.9	<2	<2	<2	85.5
Total Coal tar Constituents	**1086.79**	**0.00**	**0.00**	**865.99**	**6.71**	**14.40**	**11.00**	**6854.78**

NS = not sampled
NT = not tested
R = rejected
< = not detected at reporting limit shown

J = estimated concentration or reporting limit for undetected result was estimated
JL = estimated concentration with low bias
Highlighted Constituents Indicate Typical Coal Tar Constituents

Summary of Groundwater Analytical Data - September and December 2010

Parameter	MW-12 9/30/2010	MW-14 9/29/2010	MW-15 9/29/2010	MW-32 9/30/2010	MW-33 9/30/2010	MW-34 9/29/2010	MW-35 9/29/2010	MW-36 9/30/2010
Volatile Organic Compounds (ug/L)								
Acetone	NS	NS	NS	NS	NS	NS	NS	NS
Acrylonitrile	NS	NS	NS	NS	NS	NS	NS	NS
Benzene	NS	NS	NS	NS	NS	NS	NS	NS
Bromodichloromethane	NS	NS	NS	NS	NS	NS	NS	NS
Bromomethane	NS	NS	NS	NS	NS	NS	NS	NS
Bromoform	NS	NS	NS	NS	NS	NS	NS	NS
2-Butanone (MEK)	NS	NS	NS	NS	NS	NS	NS	NS
Carbon tetrachloride	NS	NS	NS	NS	NS	NS	NS	NS
Chloroform	NS	NS	NS	NS	NS	NS	NS	NS
Chlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2,2-Tetrachloroethane	NS	NS	NS	NS	NS	NS	NS	NS
Chloroethane	NS	NS	NS	NS	NS	NS	NS	NS
1,1-Dichloroethane	NS	NS	NS	NS	NS	NS	NS	NS
1,2-Dichloroethane	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1-Trichloroethane	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2-Trichloroethane	NS	NS	NS	NS	NS	NS	NS	NS
Pentachloroethane	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,2-Dichloroethene	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,2-Dichloroethene	NS	NS	NS	NS	NS	NS	NS	NS
1,1-Dichloroethene	NS	NS	NS	NS	NS	NS	NS	NS
Trichloroethene	NS	NS	NS	NS	NS	NS	NS	NS
Tetrachloroethene	NS	NS	NS	NS	NS	NS	NS	NS
Chloromethane	NS	NS	NS	NS	NS	NS	NS	NS
Methylene chloride	NS	NS	NS	NS	NS	NS	NS	NS
1,2-Dichloropropane	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,3-Dichloropropene	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,3-Dichloropropene	NS	NS	NS	NS	NS	NS	NS	NS
Carbon disulfide	NS	NS	NS	NS	NS	NS	NS	NS
Ethylbenzene	NS	NS	NS	NS	NS	NS	NS	NS
4-Methyl-2-pentanone	NS	NS	NS	NS	NS	NS	NS	NS
2-Hexanone	NS	NS	NS	NS	NS	NS	NS	NS
Styrene	NS	NS	NS	NS	NS	NS	NS	NS
Toluene	NS	NS	NS	NS	NS	NS	NS	NS
Vinyl acetate	NS	NS	NS	NS	NS	NS	NS	NS
Vinyl chloride	NS	NS	NS	NS	NS	NS	NS	NS
m,p-Xylene	NS	NS	NS	NS	NS	NS	NS	NS
o-Xylene	NS	NS	NS	NS	NS	NS	NS	NS

NS = not sampled
NT = not tested
R = rejected
< = not detected at reporting limit shown

J = estimated concentration or reporting limit for undetected result was estimated
JL = estimated concentration with low bias

Summary of Groundwater Analytical Data - September and December 2010

Parameter	RW-1 9/30/2010	RW-1 DUP 9/30/2010	Field Blank 9/30/2010	TRIP BLANK 9/30/2010	MW-12 12/9/2010	MW-14 12/8/2010	MW-15 12/8/2010	MW-32 12/9/2010	MW-33 12/9/2010
Conventionals									
pH	7.8	NS	NS	NS	NS	NS	NS	NS	NS
Semi-volatile Organic Compounds (ug/L)									
Acenaphthene	<2	2.38	<2	NS	112	<2	<2	42.4	<2
Acenaphthylene	<2	<2	<2	NS	<2	<2	<2	<2	<2
Acetophenone	<5	<5	<5	NS	<5	<5	<5	<5	<5
Anthracene	<2	<2	<2	NS	14.6	<2	<2	10.2	<2
Bis(2-chloroethyl)ether	<5	<5	<5	NS	<5	<5	<5	<5	<5
Bis(2-chloroisopropyl)ether	<5	<5	<5	NS	<5	<5	<5	<5	<5
Bis(2-ethylhexyl)phthalate	<10	<10	<10	NS	<10	<10	<10	<10	<10
Benzo(a)anthracene	<2	<2	<2	NS	6.7	<2	<2	<2	<2
Benzo(a)pyrene	<2	<2	<2	NS	4.04	<2	<2	<2	<2
Benzo(b)fluoranthene	<2	<2	<2	NS	6.3	<2	<2	<2	<2
Bis(2-chloroethoxy)methane	<5	<5	<5	NS	<5	<5	<5	<5	<5
Benzaldehyde	<20	<20	<20	NS	<20	<20	<20	<20	<20
Benzo(g,h,i)perylene	<2	<2	<2	NS	<2	<2	<2	<2	<2
Benzo(k)fluoranthene	<2	<2	<2	NS	3.41	<2	<2	<2	<2
Benzoic acid	<10	<10	<10	NS	<10	<10	<10	<10	<10
Benzyl alcohol	<10	<10	<10	NS	<10	<10	<10	<10	<10
Benzotrichloride	<10	<10	<10	NS	<10	<10	<10	<10	<10
Benzyl Chloride	<10	<10	<10	NS	<10	<10	<10	<10	<10
Benzoyl Chloride	<10	<10	<10	NS	<10	<10	<10	<10	<10
4-Bromophenyl phenyl ether	<5	<5	<5	NS	<5	<5	<5	<5	<5
Chrysene	<2	<2	<2	NS	5.27	<2	<2	<2	<2
4-Chloro-3-methylphenol	<5	<5	<5	NS	<5	<5	<5	<5	<5
4-Chloroaniline	<5	<5	<5	NS	<5	<5	<5	<5	<5
Hexachlorobenzene	<5	<5	<5	NS	<5	<5	<5	<5	<5
Hexachlorobutadiene	<5	<5	<5	NS	<5	<5	<5	<5	<5
1,2-Dichlorobenzene	<5	<5	<5	NS	<5	<5	<5	<5	<5
1,3-Dichlorobenzene	<5	<5	<5	NS	<5	<5	<5	<5	<5
1,4-Dichlorobenzene	<5	<5	<5	NS	<5	<5	<5	<5	<5
1,2,4-Trichlorobenzene	<5	<5	<5	NS	<5	<5	<5	<5	<5
1,2,4,5-Tetrachlorobenzene	<5	<5	<5	NS	<5	<5	<5	<5	<5
Pentachlorobenzene	<5	<5	<5	NS	<5	<5	<5	<5	<5
3,3'-Dichlorobenzidine	<10	<10	<10	NS	<10	<10	<10	<10	<10
Hexachloroethane	<5	<5	<5	NS	<5	<5	<5	<5	<5
2-Chloronaphthalene	<5	<5	<5	NS	<5	<5	<5	<5	<5
2-Chlorophenol	<5	<5	<5	NS	<5	<5	<5	<5	<5
Pentachlorophenol	<10	<10	<10	NS	<10	<10	<10	<10	<10
2,4-Dichlorophenol	<5	<5	<5	NS	<5	<5	<5	<5	<5
2,6-Dichlorophenol	<5	<5	<5	NS	<5	<5	<5	<5	<5
2,4,5-Trichlorophenol	<5	<5	<5	NS	<5	<5	<5	<5	<5

NS = not sampled
NT = not tested
R = rejected
< = not detected at reporting limit shown

J = estimated concentration or reporting limit for undetected result was estimated
JL = estimated concentration with low bias
Highlighted Constituents Indicate Typical Coal Tar Constituents

Summary of Groundwater Analytical Data - September and December 2010

Parameter	RW-1 9/30/2010	RW-1 DUP 9/30/2010	Field Blank 9/30/2010	TRIP BLANK 9/30/2010	MW-12 12/9/2010	MW-14 12/8/2010	MW-15 12/8/2010	MW-32 12/9/2010	MW-33 12/9/2010
2,4,6-Trichlorophenol	<5	<5	<5	NS	<5	<5	<5	<5	<5
2,3,4,6-Tetrachlorophenol	<5	<5	<5	NS	<5	<5	<5	<5	<5
Chlorotoluene	<10	<10	<10	NS	17.1	<10	<10	<10	<10
4-Chlorophenyl phenyl ether	<5	<5	<5	NS	<5	<5	<5	<5	<5
Dibenz(a,h)anthracene	<2	<2	<2	NS	<2	<2	<2	<2	<2
Dibenzofuran	<5	<5	<5	NS	49.4	<5	<5	33.5	<5
Fluoranthene	<2	<2	<2	NS	29.5	<2	<2	6.63	<2
Fluorene	<2	<2	<2	NS	69.3	<2	<2	45.1	<2
Indeno(1,2,3-cd)pyrene	<2	<2	<2	NS	<2	<2	<2	<2	<2
Isophorone	<5	<5	<5	NS	<5	<5	<5	<5	<5
4,6-Dinitro-2-methylphenol	<10	<10	<10	NS	<10	<10	<10	<10	<10
2-Methylnaphthalene	6.48	11.6	<2	NS	58.8	3.53	7.48	86.1	4.34
2-Methylphenol	<5	<5	<5	NS	<5	<5	<5	<5	<5
3&4-Methylphenol	<5	<5	<5	NS	<5	<5	<5	<5	<5
2,4-Dimethylphenol	<5	<5	<5	NS	<5	<5	<5	16.3	<5
Di-n-butylphthalate	<5	<5	<5	NS	<5	<5	<5	<5	<5
Di-n-octylphthalate	<5	<5	<5	NS	<5	<5	<5	<5	<5
2-Nitroaniline	<5	<5	<5	NS	<5	<5	<5	<5	<5
3-Nitroaniline	<10	<10	<10	NS	<10	<10	<10	<10	<10
4-Nitroaniline	<5	<5	<5	NS	<5	<5	<5	<5	<5
Naphthalene	59.2	119	8.81	NS	59.5	36	49.4	394	50.1
Nitrobenzene	<5	<5	<5	NS	<5	<5	<5	<5	<5
N-Nitrosodiethylamine	<5	<5	<5	NS	<5	<5	<5	<5	<5
N-Nitrosodi-n-propylamine	<5	<5	<5	NS	<5	<5	<5	<5	<5
N-Nitrosodiphenylamine	<10	<10	<10	NS	<10	<10	<10	<10	<10
2,4-Dinitrotoluene	<5	<5	<5	NS	<5	<5	<5	<5	<5
2,6-Dinitrotoluene	<5	<5	<5	NS	<5	<5	<5	<5	<5
2-Nitrophenol	<5	<5	<5	NS	<5	<5	<5	<5	<5
4-Nitrophenol	<20	<20	<20	NS	<20	<20	<20	<20	<20
2,4-Dinitrophenol	<5	<5	<5	NS	<5	<5	<5	<5	<5
Phenanthrene	<2	<2	<2	NS	106	<2	<2	41	<2
Phenol	<5	<5	<5	NS	<5	<5	<5	<5	<5
Butyl benzyl phthalate	<5	<5	<5	NS	<5	<5	<5	<5	<5
Diethylphthalate	<5	<5	<5	NS	<5	<5	<5	<5	<5
Dimethylphthalate	<5	<5	<5	NS	<5	<5	<5	<5	<5
Pyrene	<2	<2	<2	NS	38.7	<2	<2	8.7	<2
Total Coal tar Constituents	**65.68**	**132.98**	**8.81**	**0.00**	**563.52**	**39.53**	**56.88**	**683.93**	**54.44**

NS = not sampled
NT = not tested
R = rejected
< = not detected at reporting limit shown

J = estimated concentration or reporting limit for undetected result was estimated
JL = estimated concentration with low bias
Highlighted Constituents Indicate Typical Coal Tar Constituents

Summary of Groundwater Analytical Data - September and December 2010

Parameter	RW-1 9/30/2010	RW-1 DUP 9/30/2010	Field Blank 9/30/2010	TRIP BLANK 9/30/2010	MW-12 12/9/2010	MW-14 12/8/2010	MW-15 12/8/2010	MW-32 12/9/2010	MW-33 12/9/2010
Volatile Organic Compounds (ug/L)									
Acetone	<20	<20	<20	<20	NS	NS	NS	NS	NS
Acrylonitrile	<20	<20	<20	<20	NS	NS	NS	NS	NS
Benzene	<1	<1	<1	<1	NS	NS	NS	NS	NS
Bromodichloromethane	<1	<1	<1	<1	NS	NS	NS	NS	NS
Bromomethane	<1	<1	<1	<1	NS	NS	NS	NS	NS
Bromoform	<1	<1	<1	<1	NS	NS	NS	NS	NS
2-Butanone (MEK)	<20	<20	<20	<20	NS	NS	NS	NS	NS
Carbon tetrachloride	<1	<1	<1	<1	NS	NS	NS	NS	NS
Chloroform	<1	<1	<1	<1	NS	NS	NS	NS	NS
Chlorobenzene	2.48	2.66	<1	<1	NS	NS	NS	NS	NS
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	NS	NS	NS	NS	NS
Chloroethane	<1	<1	<1	<1	NS	NS	NS	NS	NS
1,1-Dichloroethane	<1	<1	<1	<1	NS	NS	NS	NS	NS
1,2-Dichloroethane	<1	<1	<1	<1	NS	NS	NS	NS	NS
1,1,1-Trichloroethane	<1	<1	<1	<1	NS	NS	NS	NS	NS
1,1,2-Trichloroethane	<1	<1	<1	<1	NS	NS	NS	NS	NS
Pentachloroethane	<5	<5	<5	<5	NS	NS	NS	NS	NS
cis-1,2-Dichloroethene	<1	<1	<1	<1	NS	NS	NS	NS	NS
trans-1,2-Dichloroethene	<1	<1	<1	<1	NS	NS	NS	NS	NS
1,1-Dichloroethene	<1	<1	<1	<1	NS	NS	NS	NS	NS
Trichloroethene	<1	<1	<1	<1	NS	NS	NS	NS	NS
Tetrachloroethene	<1	<1	<1	<1	NS	NS	NS	NS	NS
Chloromethane	<1	<1	<1	<1	NS	NS	NS	NS	NS
Methylene chloride	<5	<5	<5	8.01 B	NS	NS	NS	NS	NS
1,2-Dichloropropane	<1	<1	<1	<1	NS	NS	NS	NS	NS
cis-1,3-Dichloropropene	<1	<1	<1	<1	NS	NS	NS	NS	NS
trans-1,3-Dichloropropene	<1	<1	<1	<1	NS	NS	NS	NS	NS
Carbon disulfide	<1	<1	<1	<1	NS	NS	NS	NS	NS
Ethylbenzene	<1	<1	<1	<1	NS	NS	NS	NS	NS
4-Methyl-2-pentanone	<5	<5	<5	<5	NS	NS	NS	NS	NS
2-Hexanone	<5	<5	<5	<5	NS	NS	NS	NS	NS
Styrene	<1	<1	<1	<1	NS	NS	NS	NS	NS
Toluene	<5	<5	<5	<5	NS	NS	NS	NS	NS
Vinyl acetate	<10	<10	<10	<10	NS	NS	NS	NS	NS
Vinyl chloride	<1	<1	<1	<1	NS	NS	NS	NS	NS
m,p-Xylene	<2	<2	<2	<2	NS	NS	NS	NS	NS
o-Xylene	<1	<1	<1	<1	NS	NS	NS	NS	NS

NS = not sampled
NT = not tested
R = rejected
< = not detected at reporting limit shown

J = estimated concentration or reporting limit for undetected result was estimated
JL = estimated concentration with low bias

Summary of Groundwater Analytical Data - September and December 2010

Parameter	MW-34 12/8/2010	MW-35 12/8/2010	MW-36 12/9/2010	RW-1 12/9/2010	RW-1 DUP 12/9/2010	FIELD BLANK 12/9/2010	TRIP BLANK 12/9/2010
Conventionals							
pH	NS	NS	NS	7.1	NS	NS	NS
Semi-volatile Organic Compounds (ug/L)							
Acenaphthene	<2	<2	77.1	5.27	5.18	<2	NS
Acenaphthylene	<2	<2	<2	<2	<2	<2	NS
Acetophenone	<5	<5	<5	<5	<5	<5	NS
Anthracene	<2	<2	7.86	<2	<2	<2	NS
Bis(2-chloroethyl)ether	<5	<5	<5	<5	<5	<5	NS
Bis(2-chloroisopropyl)ether	<5	<5	<5	<5	<5	<5	NS
Bis(2-ethylhexyl)phthalate	<10	<10	<10	<10	<10	<10	NS
Benzo(a)anthracene	<2	<2	<2	<2	<2	<2	NS
Benzo(a)pyrene	<2	<2	<2	<2	<2	<2	NS
Benzo(b)fluoranthene	<2	<2	<2	<2	<2	<2	NS
Bis(2-chloroethoxy)methane	<5	<5	<5	<5	<5	<5	NS
Benzaldehyde	<20	<20	<20	<20	<20	<20	NS
Benzo(g,h,i)perylene	<2	<2	<2	<2	<2	<2	NS
Benzo(k)fluoranthene	<2	<2	<2	<2	<2	<2	NS
Benzoic acid	<10	<10	<10	<10	<10	<10	NS
Benzyl alcohol	<10	<10	<10	<10	<10	<10	NS
Benzotrichloride	<10	<10	<10	<10	<10	<10	NS
Benzyl Chloride	<10	<10	<10	<10	<10	<10	NS
Benzoyl Chloride	<10	<10	<10	<10	<10	<10	NS
4-Bromophenyl phenyl ether	<5	<5	<5	<5	<5	<5	NS
Chrysene	<2	<2	<2	<2	<2	<2	NS
4-Chloro-3-methylphenol	<5	<5	<5	<5	<5	<5	NS
4-Chloroaniline	<5	<5	<5	<5	<5	<5	NS
Hexachlorobenzene	<5	<5	<5	<5	<5	<5	NS
Hexachlorobutadiene	<5	<5	<5	<5	<5	<5	NS
1,2-Dichlorobenzene	<5	<5	<5	<5	<5	<5	NS
1,3-Dichlorobenzene	<5	<5	<5	10.2	10.2	<5	NS
1,4-Dichlorobenzene	<5	<5	<5	77.6	77.4	<5	NS
1,2,4-Trichlorobenzene	<5	<5	<5	80.2	71.2	<5	NS
1,2,4,5-Tetrachlorobenzene	<5	<5	<5	<5	<5	<5	NS
Pentachlorobenzene	<5	<5	<5	<5	<5	<5	NS
3,3'-Dichlorobenzidine	<10	<10	<10	<10	<10	<10	NS
Hexachloroethane	<5	<5	<5	<5	<5	<5	NS
2-Chloronaphthalene	<5	<5	<5	<5	<5	<5	NS
2-Chlorophenol	<5	<5	<5	<5	<5	<5	NS
Pentachlorophenol	<10	<10	<10	<10	<10	<10	NS
2,4-Dichlorophenol	<5	<5	<5	<5	<5	<5	NS
2,6-Dichlorophenol	<5	<5	<5	<5	<5	<5	NS
2,4,5-Trichlorophenol	<5	<5	<5	<5	<5	<5	NS

NS = not sampled
NT = not tested
R = rejected
< = not detected at reporting limit shown

J = estimated concentration or reporting limit for undetected result was estimated
JL = estimated concentration with low bias
Highlighted Constituents Indicate Typical Coal Tar Constituents

Summary of Groundwater Analytical Data - September and December 2010

Parameter	MW-34 12/8/2010	MW-35 12/8/2010	MW-36 12/9/2010	RW-1 12/9/2010	RW-1 DUP 12/9/2010	FIELD BLANK 12/9/2010	TRIP BLANK 12/9/2010
2,4,6-Trichlorophenol	<5	<5	<5	<5	<5	<5	NS
2,3,4,6-Tetrachlorophenol	<5	<5	<5	<5	<5	<5	NS
Chlorotoluene	<10	<10	123	30.4	30.3	<10	NS
4-Chlorophenyl phenyl ether	<5	<5	<5	<5	<5	<5	NS
Dibenz(a,h)anthracene	<2	<2	<2	<2	<2	<2	NS
Dibenzofuran	<5	<5	63.2	<5	<5	<5	NS
Fluoranthene	<2	<2	7.26	<2	<2	<2	NS
Fluorene	<2	<2	59.5	2.3	2.38	<2	NS
Indeno(1,2,3-cd)pyrene	<2	<2	<2	<2	<2	<2	NS
Isophorone	<5	<5	<5	<5	<5	<5	NS
4,6-Dinitro-2-methylphenol	<10	<10	<10	<10	<10	<10	NS
2-Methylnaphthalene	<2	4.6	553	<2	<2	<2	NS
2-Methylphenol	<5	<5	<5	<5	<5	<5	NS
3&4-Methylphenol	<5	<5	<5	<5	<5	<5	NS
2,4-Dimethylphenol	<5	<5	<5	<5	<5	<5	NS
Di-n-butylphthalate	<5	<5	<5	<5	<5	<5	NS
Di-n-octylphthalate	<5	<5	<5	<5	<5	<5	NS
2-Nitroaniline	<5	<5	<5	<5	<5	<5	NS
3-Nitroaniline	<10	<10	<10	<10	<10	<10	NS
4-Nitroaniline	<5	<5	<5	<5	<5	<5	NS
Naphthalene	<2	49.4	4710	9.59	10.2	<2	NS
Nitrobenzene	<5	<5	<5	<5	<5	<5	NS
N-Nitrosodiethylamine	<5	<5	<5	<5	<5	<5	NS
N-Nitrosodi-n-propylamine	<5	<5	<5	<5	<5	<5	NS
N-Nitrosodiphenylamine	<10	<10	<10	<10	<10	<10	NS
2,4-Dinitrotoluene	<5	<5	<5	<5	<5	<5	NS
2,6-Dinitrotoluene	<5	<5	<5	<5	<5	<5	NS
2-Nitrophenol	<5	<5	<5	<5	<5	<5	NS
4-Nitrophenol	<20	<20	<20	<20	<20	<20	NS
2,4-Dinitrophenol	<5	<5	<5	<5	<5	<5	NS
Phenanthrene	<2	<2	64.1	2.39	2.42	<2	NS
Phenol	<5	<5	9.45	<5	<5	<5	NS
Butyl benzyl phthalate	<5	<5	<5	<5	<5	<5	NS
Diethylphthalate	<5	<5	<5	<5	<5	<5	NS
Dimethylphthalate	<5	<5	<5	<5	<5	<5	NS
Pyrene	<2	<2	213	<2	<2	<2	NS
Total Coal tar Constituents	**0.00**	**54.00**	**5764.47**	**19.55**	**20.18**	**0.00**	**0.00**

NS = not sampled
NT = not tested
R = rejected
< = not detected at reporting limit shown

J = estimated concentration or reporting limit for undetected result was estimated
JL = estimated concentration with low bias
Highlighted Constituents Indicate Typical Coal Tar Constituents

Premier Environmental Services, Inc.

Summary of Groundwater Analytical Data - September and December 2010

Parameter	MW-34 12/8/2010	MW-35 12/8/2010	MW-36 12/9/2010	RW-1 12/9/2010	RW-1 DUP 12/9/2010	FIELD BLANK 12/9/2010	TRIP BLANK 12/9/2010
Volatile Organic Compounds (ug/L)							
Acetone	NS	NS	NS	<20	<20	<20	<20
Acrylonitrile	NS	NS	NS	<20	<20	<20	<20
Benzene	NS	NS	NS	7.55	7.12	<1	<1
Bromodichloromethane	NS	NS	NS	<1	<1	<1	<1
Bromomethane	NS	NS	NS	<1	<1	<1	<1
Bromoform	NS	NS	NS	<1	<1	<1	<1
2-Butanone (MEK)	NS	NS	NS	<20	<20	<20	<20
Carbon tetrachloride	NS	NS	NS	<1	<1	<1	<1
Chloroform	NS	NS	NS	<1	<1	<1	<1
Chlorobenzene	NS	NS	NS	44.5	42.2	<1	<1
1,1,2,2-Tetrachloroethane	NS	NS	NS	<1	<1	<1	<1
Chloroethane	NS	NS	NS	<1	<1	<1	<1
1,1-Dichloroethane	NS	NS	NS	<1	<1	<1	<1
1,2-Dichloroethane	NS	NS	NS	<1	<1	<1	<1
1,1,1-Trichloroethane	NS	NS	NS	<1	<1	<1	<1
1,1,2-Trichloroethane	NS	NS	NS	<1	<1	<1	<1
Pentachloroethane	NS	NS	NS	<5	<5	<5	<5
cis-1,2-Dichloroethene	NS	NS	NS	<1	<1	<1	<1
trans-1,2-Dichloroethene	NS	NS	NS	<1	<1	<1	<1
1,1-Dichloroethene	NS	NS	NS	<1	<1	<1	<1
Trichloroethene	NS	NS	NS	<1	<1	<1	<1
Tetrachloroethene	NS	NS	NS	<1	<1	<1	<1
Chloromethane	NS	NS	NS	<1	<1	<1	<1
Methylene chloride	NS	NS	NS	<5	<5	<5	5.39 B
1,2-Dichloropropane	NS	NS	NS	<1	<1	<1	<1
cis-1,3-Dichloropropene	NS	NS	NS	<1	<1	<1	<1
trans-1,3-Dichloropropene	NS	NS	NS	<1	<1	<1	<1
Carbon disulfide	NS	NS	NS	<1	<1	<1	<1
Ethylbenzene	NS	NS	NS	2.67	2.51	<1	<1
4-Methyl-2-pentanone	NS	NS	NS	<5	<5	<5	<5
2-Hexanone	NS	NS	NS	<5	<5	<5	<5
Styrene	NS	NS	NS	<1	<1	<1	<1
Toluene	NS	NS	NS	92.1	84.9	<5	<5
Vinyl acetate	NS	NS	NS	<10	<10	<10	<10
Vinyl chloride	NS	NS	NS	<1	<1	<1	<1
m,p-Xylene	NS	NS	NS	<2	<2	<2	<2
o-Xylene	NS	NS	NS	1.82	1.63	<1	<1

NS = not sampled
NT = not tested
R = rejected
< = not detected at reporting limit shown

J = estimated concentration or reporting limit for undetected result was estimated
JL = estimated concentration with low bias

Appendix E. Summary of Southeast Trough Groundwater Monitoring Well Results for March 2011 (Off-site and Southeast of the Velsicol Site). Groundwater monitoring results presented in these tables are reported in micrograms per liter (µg/L).

Summary of SE Trough Analytical Results - March 2011

Parameter	ST03022011MW22 3/2/2011 MW-22	ST03022011MW23 3/2/2011 MW-23	ST03022011DUP 3/2/2011 MW-23 Dup	ST03032011MW37 3/3/2011 MW-37	ST03032011MW38 3/3/2011 MW-38
Diesel Range Organics (ug/L)					
Diesel Range Organics (C10-C28)	186	472	445	90 U	127
Metals (mg/L)					
Antimony	0.01 U	0.01 U	0.01 U	0.01 U	0.019
Arsenic	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Barium	0.032	0.245	0.26	0.093	1.29
Beryllium	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Chromium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Cobalt	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Lead	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Mercury	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Nickel	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Selenium	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Silver	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Vanadium	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Zinc	0.01 U	0.01 U	0.028	0.01 U	0.01 U
Semi-volatile Organic Compounds (ug/L)					
1,2,4,5-Tetrachlorobenzene	5 U	5 U	5 U	5 U	5 U
1,2,4-Trichlorobenzene	5 U	5.58	5.06	5 U	5 U
1,2-Dichlorobenzene	5 U	5 U	5 U	5 U	5 U
1,3-Dichlorobenzene	5 U	5 U	5 U	5 U	5 U
1,4-Dichlorobenzene	5 U	33.1	29.9	5 U	5 U
2,3,4,6-Tetrachlorophenol	5 U	5 U	5 U	5 U	5 U
2,4,5-Trichlorophenol	5 U	5 U	5 U	5 U	5 U
2,4,6-Trichlorophenol	5 U	5 U	5 U	5 U	5 U
2,4-Dichlorophenol	5 U	5 U	5 U	5 U	5 U
2,4-Dimethylphenol	5 U	5 U	5 U	5 U	5 U
2,4-Dinitrophenol	5 U	5 U	5 U	5 U	5 U
2,4-Dinitrotoluene	5 U	5 U	5 U	5 U	5 U
2,6-Dichlorophenol	5 U	5 U	5 U	5 U	5 U
2,6-Dinitrotoluene	5 U	5 U	5 U	5 U	5 U
2-Chloronaphthalene	5 U	5 U	5 U	5 U	5 U
2-Chlorophenol	5 U	5 U	5 U	5 U	5 U
2-Methylnaphthalene	2 U	2 U	2 U	2 U	2 U
2-Methylphenol	5 U	5 U	5 U	5 U	5 U
2-Nitroaniline	5 U	5 U	5 U	5 U	5 U
2-Nitrophenol	5 U	5 U	5 U	5 U	5 U
3&4-Methylphenol	5 U	5 U	5 U	5 U	5 U
3,3'-Dichlorobenzidine	10 U	10 U	10 U	10 U	10 U
3-Nitroaniline	10 U	10 U	10 U	10 U	10 U

Parameter	ST03022011MW22 3/2/2011 MW-22	ST03022011MW23 3/2/2011 MW-23	ST03022011DUP 3/2/2011 MW-23 Dup	ST03032011MW37 3/3/2011 MW-37	ST03032011MW38 3/3/2011 MW-38
Semi-volatile Organic Compounds Continued (ug/L)					
4,6-Dinitro-2-methylphenol	10 U	10 U	10 U	10 U	10 U
4-Bromophenyl phenyl ether	5 U	5 U	5 U	5 U	5 U
4-Chloro-3-methylphenol	5 U	7.65	7.29	5 U	5 U
4-Chloroaniline	5 U	5 U	5 U	5 U	5 U
4-Chlorophenyl phenyl ether	5 U	5 U	5 U	5 U	5 U
4-Nitroaniline	5 U	5 U	5 U	5 U	5 U
4-Nitrophenol	20 U	20 U	20 U	20 U	20 U
Acenaphthene	2.01	2 U	2 U	2 U	2 U
Acenaphthylene	2 U	2 U	2 U	2 U	2 U
Acetophenone	5 U	5 U	5 U	5 U	5 U
Anthracene	2 U	2 U	2 U	2 U	2 U
Benzaldehyde	20 U	20 U	20 U	20 U	20 U
Benzo(a)anthracene	2 U	2 U	2 U	2 U	2 U
Benzo(a)pyrene	2 U	2 U	2 U	2 U	2 U
Benzo(b)fluoranthene	2 U	2 U	2 U	2 U	2 U
Benzo(g,h,i)perylene	2 U	2 U	2 U	2 U	2 U
Benzo(k)fluoranthene	2 U	2 U	2 U	2 U	2 U
Benzoic acid	10 U	10 U	10 U	10 U	10 U
Benzotrichloride	10 U	10 U	10 U	10 U	10 U
Benzoyl Chloride	10 U	10 U	10 U	10 U	10 U
Benzyl alcohol	10 U	10 U	10 U	10 U	10 U
Benzyl Chloride	10 U	10 U	10 U	10 U	10 U
Bis(2-chloroethoxy)methane	5 U	5 U	5 U	5 U	5 U
Bis(2-chloroethyl)ether	5 U	5 U	5 U	5 U	5 U
Bis(2-chloroisopropyl)ether	5 U	5 U	5 U	5 U	5 U
Bis(2-ethylhexyl)phthalate	10 U	10 U	10 U	10 U	10 U
Butyl benzyl phthalate	5 U	5 U	5 U	5 U	5 U
Chlorotoluene	10.9 U	380 J	244 J	10 U	12.2 U
Chrysene	2 U	2 U	2 U	2 U	2 U
Dibenz(a,h)anthracene	2 U	2 U	2 U	2 U	2 U
Dibenzofuran	5 U	5 U	5 U	5 U	5 U
Diethylphthalate	5 U	5 U	5 U	5 U	5 U
Dimethylphthalate	5 U	5 U	5 U	5 U	5 U
Di-n-butylphthalate	5 U	5 U	5 U	5 U	5 U
Di-n-octylphthalate	5 U	5 U	5 U	5 U	5 U
Fluoranthene	2 U	2 U	2 U	2 U	2 U
Fluorene	2 U	2 U	2 U	2 U	2 U
Hexachlorobenzene	5 U	5 U	5 U	5 U	5 U
Hexachlorobutadiene	5 U	5 U	5 U	5 U	5 U
Hexachloroethane	5 U	5 U	5 U	5 U	5 U
Indeno(1,2,3-cd)pyrene	2 U	2 U	2 U	2 U	2 U
Isophorone	5 U	5 U	5 U	5 U	5 U
Naphthalene	2.38 U	2.08 U	3.18 U	3.85 U	2 U

Parameter	ST03022011MW22 3/2/2011 MW-22	ST03022011MW23 3/2/2011 MW-23	ST03022011DUP 3/2/2011 MW-23 Dup	ST03032011MW37 3/3/2011 MW-37	ST03032011MW38 3/3/2011 MW-38
Semi-volatile Organic Compounds Continued (ug/L)					
Nitrobenzene	5 U	5 U	5 U	5 U	5 U
N-Nitrosodiethylamine	5 U	5 U	5 U	5 U	5 U
N-Nitrosodi-n-propylamine	5 U	5 U	5 U	5 U	5 U
N-Nitrosodiphenylamine	10 U	10 U	10 U	10 U	10 U
Pentachlorobenzene	5 U	5 U	5 U	5 U	5 U
Pentachlorophenol	10 U	10 U	10 U	10 U	10 U
Phenanthrene	2 U	2 U	2 U	2 U	2 U
Phenol	5 U	5 U	5 U	5 U	5 U
Pyrene	2 U	2 U	2 U	2 U	2 U
Volatile Organic Compounds (ug/L)					
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U
2-Butanone (MEK)	20 U	20 U	20 U	20 U	20 U
2-Hexanone	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	5 U
Acetone	20 U	20 U	20 U	20 U	20 U
Acrylonitrile	20 U	20 U	20 U	20 U	20 U
Benzene	1 U	13.4	11.6	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U
Carbon disulfide	1 U	1 U	1 U	1 U	1 U
Carbon tetrachloride	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	195	166	15.8	3.05
Chloroethane	1 U	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U	1 U	1 U
Chloromethane	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	1 U	1 U	1 U	1 U	1 U
m,p-Xylene	2 U	11.3	9.8	2 U	2 U
Methylene chloride	5 U	5 U	5 U	5 U	5 U
o-Xylene	1 U	21.9	19.7	1.53	1 U
Pentachloroethane	5 U	5 U	5 U	5 U	5 U
Styrene	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	1 U	1 U	1 U	1 U	1 U
Toluene	5 U	5 U	5 U	5 U	5 U
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U

Parameter	ST03022011MW22 3/2/2011 MW-22	ST03022011MW23 3/2/2011 MW-23	ST03022011DUP 3/2/2011 MW-23 Dup	ST03032011MW37 3/3/2011 MW-37	ST03032011MW38 3/3/2011 MW-38
Volatile Organic Compounds Continued (ug/L)					
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U	1 U
Vinyl acetate	10 U	10 U	10 U	10 U	10 U
Vinyl chloride	1 U	1 U	1 U	1 U	1 U
Pesticides and Aroclors (ug/L)					
2,4,5-T	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2,4,5-TP (Silvex)	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
2,4-D	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDD	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDE	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
4,4'-DDT	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Aldrin	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
alpha-BHC	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
beta-BHC	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Chlordane	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
delta-BHC	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Dicamba	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
Dieldrin	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Endosulfan I	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Endosulfan II	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Endosulfan sulfate	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Endrin	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Endrin ketone	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
gamma-BHC	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Heptachlor	0.231 J	0.04 U	0.04 U	0.04 U	0.0914 U
Heptachlor epoxide	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Methoxychlor	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Toxaphene	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U

Parameter	ST03032011PW3 3/3/2011 PW-3	ST03032011Seep 3/3/2011 PWS	ST03032011TRIP 3/3/2011 Trip Blank	RT03032011 Field Blank 3/3/2011 Field Blank
Diesel Range Organics (ug/L)				
Diesel Range Organics (C10-C28)	90 U	210		90 U
Metals (mg/L)				
Antimony	0.01 U	0.01 U		0.01 U
Arsenic	0.01 U	0.01 U		0.01 U
Barium	0.111	0.086		0.01 U
Beryllium	0.001 U	0.001 U		0.001 U
Cadmium	0.002 U	0.002 U		0.002 U
Chromium	0.005 U	0.005 U		0.005 U
Cobalt	0.01 U	0.01 U		0.01 U
Lead	0.006 U	0.006 U		0.006 U
Mercury	0.0002 U	0.0002 U		0.0002 U
Nickel	0.005 U	0.005 U		0.005 U
Selenium	0.01 U	0.01 U		0.01 U
Silver	0.005 U	0.005 U		0.005 U
Thallium	0.02 U	0.02 U		0.02 U
Vanadium	0.01 U	0.01 U		0.01 U
Zinc	0.01 U	0.012		0.01 U
Semi-volatile Organic Compounds (ug/L)				
1,2,4,5-Tetrachlorobenzene	5 U	5 U		5 U
1,2,4-Trichlorobenzene	5 U	5 U		5 U
1,2-Dichlorobenzene	5 U	5 U		5 U
1,3-Dichlorobenzene	5 U	5 U		5 U
1,4-Dichlorobenzene	5 U	42.2		5 U
2,3,4,6-Tetrachlorophenol	5 U	5 U		5 U
2,4,5-Trichlorophenol	5 U	5 U		5 U
2,4,6-Trichlorophenol	5 U	5 U		5 U
2,4-Dichlorophenol	5 U	5 U		5 U
2,4-Dimethylphenol	5 U	5 U		5 U
2,4-Dinitrophenol	5 U	5 U		5 U
2,4-Dinitrotoluene	5 U	5 U		5 U
2,6-Dichlorophenol	5 U	5 U		5 U
2,6-Dinitrotoluene	5 U	5 U		5 U
2-Chloronaphthalene	5 U	5 U		5 U
2-Chlorophenol	5 U	5 U		5 U
2-Methylnaphthalene	2 U	2 U		2 U
2-Methylphenol	5 U	5 U		5 U
2-Nitroaniline	5 U	5 U		5 U
2-Nitrophenol	5 U	5 U		5 U
3&4-Methylphenol	5 U	5 U		5 U
3,3'-Dichlorobenzidine	10 U	10 U		10 U
3-Nitroaniline	10 U	10 U		10 U

Parameter	ST03032011PW3 3/3/2011 PW-3	ST03032011Seep 3/3/2011 PWS	ST03032011TRIP 3/3/2011 Trip Blank	RT03032011 Field Blank 3/3/2011 Field Blank
Semi-volatile Organic Compounds Continued (ug/L)				
4,6-Dinitro-2-methylphenol	10 U	10 U		10 U
4-Bromophenyl phenyl ether	5 U	5 U		5 U
4-Chloro-3-methylphenol	5 U	5 U		5 U
4-Chloroaniline	5 U	5 U		5 U
4-Chlorophenyl phenyl ether	5 U	5 U		5 U
4-Nitroaniline	5 U	5 U		5 U
4-Nitrophenol	20 U	20 U		20 U
Acenaphthene	2 U	2 U		2 U
Acenaphthylene	2 U	2 U		2 U
Acetophenone	5 U	5 U		5 U
Anthracene	2 U	2 U		2 U
Benzaldehyde	20 U	20 U		20 U
Benzo(a)anthracene	2 U	2 U		2 U
Benzo(a)pyrene	2 U	2 U		2 U
Benzo(b)fluoranthene	2 U	2 U		2 U
Benzo(g,h,i)perylene	2 U	2 U		2 U
Benzo(k)fluoranthene	2 U	2 U		2 U
Benzoic acid	10 U	10 U		10 U
Benzotrichloride	10 U	10 U		10 U
Benzoyl Chloride	10 U	10 U		10 U
Benzyl alcohol	10 U	10 U		10 U
Benzyl Chloride	10 U	10 U		10 U
Bis(2-chloroethoxy)methane	5 U	5 U		5 U
Bis(2-chloroethyl)ether	5 U	5 U		5 U
Bis(2-chloroisopropyl)ether	5 U	5 U		5 U
Bis(2-ethylhexyl)phthalate	10 U	10 U		10 U
Butyl benzyl phthalate	5 U	5 U		5 U
Chlorotoluene	14 U	64.1 U		26.9
Chrysene	2 U	2 U		2 U
Dibenz(a,h)anthracene	2 U	2 U		2 U
Dibenzofuran	5 U	5 U		5 U
Diethylphthalate	5 U	5 U		5 U
Dimethylphthalate	5 U	5 U		5 U
Di-n-butylphthalate	5 U	5 U		5 U
Di-n-octylphthalate	5 U	5 U		5 U
Fluoranthene	2 U	2 U		2 U
Fluorene	2 U	2 U		2 U
Hexachlorobenzene	5 U	5 U		5 U
Hexachlorobutadiene	5 U	5 U		5 U
Hexachloroethane	5 U	5 U		5 U
Indeno(1,2,3-cd)pyrene	2 U	2 U		2 U
Isophorone	5 U	5 U		5 U
Naphthalene	3.19 U	2 U		2 U

Parameter	ST03032011PW3 3/3/2011 PW-3	ST03032011Seep 3/3/2011 PWS	ST03032011TRIP 3/3/2011 Trip Blank	RT03032011 Field Blank 3/3/2011 Field Blank
Semi-volatile Organic Compounds Continued (ug/L)				
Nitrobenzene	5 U	5 U		5 U
N-Nitrosodiethylamine	5 U	5 U		5 U
N-Nitrosodi-n-propylamine	5 U	5 U		5 U
N-Nitrosodiphenylamine	10 U	10 U		10 U
Pentachlorobenzene	5 U	5 U		5 U
Pentachlorophenol	10 U	10 U		10 U
Phenanthrene	2 U	2 U		2 U
Phenol	5 U	5 U		5 U
Pyrene	2 U	2 U		2 U
Volatile Organic Compounds (ug/L)				
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U
2-Butanone (MEK)	20 U	20 U	20 U	20 U
2-Hexanone	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U
Acetone	20 U	20 U	20 U	20 U
Acrylonitrile	20 U	20 U	20 U	20 U
Benzene	1 U	14.5	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1.33
Bromoform	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U
Carbon disulfide	1 U	1 U	1 U	1 U
Carbon tetrachloride	1 U	1 U	1 U	1 U
Chlorobenzene	7.96	333	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U	1.45
Chloromethane	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U
Ethylbenzene	1 U	1.87	1 U	1 U
m,p-Xylene	2 U	15.1	2 U	2 U
Methylene chloride	5 U	5 U	5 U	5 U
o-Xylene	1.87	26.2	1 U	1 U
Pentachloroethane	5 U	5 U	5 U	5 U
Styrene	1 U	1 U	1 U	1 U
Tetrachloroethene	1 U	1 U	1 U	1 U
Toluene	5 U	17.8	5 U	5 U
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U

Parameter	ST03032011PW3 3/3/2011 PW-3	ST03032011Seep 3/3/2011 PWS	ST03032011TRIP 3/3/2011 Trip Blank	RT03032011 Field Blank 3/3/2011 Field Blank
Volatile Organic Compounds Continued (ug/L)				
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U
Vinyl acetate	10 U	10 U	10 U	10 U
Vinyl chloride	1 U	1 U	1 U	1 U
Pesticides and Aroclors (ug/L)				
2,4,5-T	0.2 U	0.2 U		0.2 U
2,4,5-TP (Silvex)	0.03 U	0.03 U		0.03 U
2,4-D	0.1 U	0.1 U		0.1 U
4,4'-DDD	0.1 U	0.1 U		0.1 U
4,4'-DDE	0.04 U	0.04 U		0.04 U
4,4'-DDT	0.04 U	0.04 U		0.04 U
Aldrin	0.1 U	0.1 U		0.1 U
alpha-BHC	0.04 U	0.04 U		0.04 U
beta-BHC	0.04 U	0.241 J		0.04 U
Chlordane	0.25 U	0.25 U		0.25 U
delta-BHC	0.04 U	0.04 U		0.04 U
Dicamba	0.8 U	0.8 U		0.8 U
Dieldrin	0.1 U	0.1 U		0.1 U
Endosulfan I	0.04 U	0.04 U		0.04 U
Endosulfan II	0.04 U	0.04 U		0.04 U
Endosulfan sulfate	0.04 U	0.04 U		0.04 U
Endrin	0.04 U	0.04 U		0.04 U
Endrin ketone	0.04 U	0.04 U		0.04 U
gamma-BHC	0.04 U	0.04 U		0.04 U
Heptachlor	0.04 U	0.189 J		0.04 U
Heptachlor epoxide	0.04 U	0.04 U		0.04 U
Methoxychlor	0.04 U	0.04 U		0.04 U
Toxaphene	0.3 U	0.3 U		0.3 U

Notes:
U = not detected at reporting limit shown or outside quality control range
UJ = estimated reporting limit
R = Rejected

Appendix F. Comments from the Public and Responses

The Agency for Toxic Substances and Disease Registry (ATSDR) and the Tennessee Department of Health's Environmental Epidemiology Program (EEP) released this Evaluation of Environmental Concerns Related to the Velsicol Chemical Site for public review and comment from May 13, 2013, through June 27, 2013. The Initial/Public Comment Release of the Public Health Assessment (PHA) was sent out to the petitioner, interested community members, elected city officials, and other interested parties to provide a chance for these stakeholders to comment on the document. One commenter responded. The comment received was logged and became part of the administrative record for the site.

Thank you to the individual for their comments and clarifications on the background and history of the site. Our responses to the comments are in italics following the comment. If comments prompted changes to the PHA, the page number on which the changes appear was noted.

Public Commenter 1

June 27, 2013

Environmental Epidemiology Program (EEP)
Tennessee Department of Health
1st Floor, Cordell Hull Building
425 5th Avenue North
Nashville, TN 37243

Re: Comments on Velsicol/Alton Park Public Health Assessment

Following are comments on the May 13, 2013 Initial/Public Comment Release of the Public Health Assessment (PHA).

<u>Conclusion 2, page 2.</u>

It is stated that a new RCRA Permit or a major permit modification would be required for re-development of the Site.

Please note that redevelopment as commercial and industrial use was contemplated for the Site as the Final Remedy construction is completed and is specifically provided for in Velsicol's RCRA Permit (TNHW-105). In additional, institutional controls in the form of Deed Restrictions are being established to control management of the barrier and underlying soils as related to such redevelopment.

Response: The Environmental Epidemiology Program (EEP) understands that any future reuse of the Velsicol Site would be limited through deed restrictions to "Industrial" purposes only, or as specified in Attachment 9.6 (Corrective Action Remedies) of Velsicol's operating permit. EEP reached out to the Tennessee Department of Environment and Conservation's (TDEC) Division of Solid and Hazardous Waste Management (DSWM) for further clarification with this question. According to the TDEC DSWM, any future construction on top of the Final Remedy soil cap, any *alteration of a solid waste management area (SWMU), or any type of disturbance to the Final Remedy, the facility's RCRA permit would need to be modified. Depending on the type of future use for the Velsicol Site or the type of disturbance to the Final Remedy soil cap, the permit modification would be either a minor or major modification.*

EEP also recognizes Deed Restrictions have been established as part of Velsicol's operating permit for management of the barrier and underlying soils if reuse of the site occurs.

<u>Conclusion 5, page 3.</u>

EEP recommended that an investigation be performed to determine the likelihood of vapor intrusion in homes above groundwater flowing to Piney Woods Spring.

The recommended investigation has already been completed as recommended by EEP. A soil vapor investigation of the subject area was performed by Velsicol under the direction and oversight of the Tennessee Department of Environment and Conservation – Division of Solid Waste Management (DSWM), with support from the Tennessee Department of Health (TDH). A report on the findings was submitted to TDEC and TDH on March 19, 2013. The investigation findings are summarized as follows:

- No target compounds were detected in any of the soil vapor samples.
- The subsurface soil across the study area is a low permeability, dense clay, which is not conducive to vapor migration.
- There is no complete pathway and, therefore, no potential for vapor intrusion risk.
- Investigations at the adjacent Residue Hill Site in 2009 and 2010, which were performed under the direction and oversight of the TDEC Division of Remediation, had similar findings indicating no risk to nearby residential properties and concluded that no further investigation was warranted.
- Given the above findings, the investigation determined that no further action was warranted with regard to vapor intrusion at the southeast corner of the Velsicol Site.

Response: Yes, a soil vapor investigation occurred while this Public Health Assessment was still in draft form. TDH EEP, along with TDEC DSWM, reviewed the work plan for the soil vapor investigation and suggested revisions which were accepted and a revised work plan was approved by TDEC DSWM. EEP also reviewed the results of the Confirmatory Soil Gas Sampling Report submitted to TDEC DSWM on March 18, 2013. The soil gas investigation was conducted by Geosyntec Consultants for the Memphis Environmental Center, Inc. the week of January 28, 2013.

EEP wrote a Letter Health Consultation evaluating the results of the soil gas investigation. It has been reviewed internally by EEP staff, by TDEC's Division of Remediation, and has been forwarded to the Agency for Toxic Substances and Disease Registry (ATSDR) for further review and comment. The Letter Health Consultation document will be published as an ATSDR-reviewed Letter Health Consultation and will be a companion document to this Public Health Assessment.

Conclusion 9, page 4.

The commenter acknowledges and supports EEP's conclusion that the Alternative 1 soil barrier Final Remedy, which TDEC approved by way of issuing the July 5, 2011 RCRA Permit Modification, will prevent harmful exposures to residents of the Alton Park Community.

In regard to EEP's recommendation that institutional controls should be established as a next step for future worker safety and site redevelopment; the Deed Restrictions noted in response to Conclusion 2 will provide for future worker safety as the site is redeveloped.

Response: As a condition of the Velsicol Site's RCRA operating permit, there are institutional controls relating to invasive activities, site security, and property use, among others. As a condition of the permit, if Velsicol performs and invasive activity that would make contact with or remove soils under the protective barrier soil marker, Velsicol will notify TDEC DSWM in writing with a demonstration made to the satisfaction of DSWM that any such invasive activity or soil removal will be performed in such a way as to not pose a danger to public health, safety, or the environment. This condition includes the health of site workers.

General Comments.

The Background and History section contain a few inaccuracies that should be corrected, please call to discuss.

Response: TDH EEP communicated with the commenter. EEP corrected the minor inaccuracies in the Background and History. The corrections have been incorporated into the text of the Summary and the Background and History sections of the document on pages 1, 7, 9 (Figure 2), and 10.

Copy to TDH EEP
6/27/13

Report Preparation

This Public Health Assessment for the Velsicol Chemical Corporation Site was prepared by the Tennessee Department of Health's Environmental Epidemiology Program under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented.

Authors

Mr. Joseph P. George, MS, PG, Environmental Health Assessor
Ms. Bonnie Bashor, MS, Director (retired)
Tennessee Department of Health (TDH)
Division of Communicable and Environmental Diseases and Emergency Preparedness (CEDEP)
Environmental Epidemiology Program (EEP)

State Reviewers

Mr. David M. Borowski, MS, Interim Director
Environmental Epidemiology Program
Tennessee Department of Health

Mr. Ahmet Bulbulkaya, MEM, Risk Assessor
Mr. Christopher Lagan, PG, Geologist
Division of Remediation
Tennessee Department of Environment and Conservation

Mr. Richard A. Whitson, P.E., Assistant Field Office Manager
Mr. William Krispin, Environmental Program Manager
Division of Solid and Hazardous Waste Management
Tennessee Department of Environment and Conservation

ATSDR Technical Project Officer

LCDR Trent LeCoultre, MSEH, REHS
ATSDR / DCHI / CB