Public Health Assessment

Initial - Public Comment Release

CSX TRANSPORTATION – RAIL YARD SITE

WAYCROSS, WARE COUNTY, GEORGIA

EPA FACILITY ID: GAD991275900

Prepared by
Georgia Department of Public Health

JUNE 7, 2018

COMMENT PERIOD ENDS: JULY 23, 2018

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

This Public Health Assessment-Public Comment Release was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR's Cooperative Agreement Partner has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR's Cooperative Agreement Partner will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has previously been provided to EPA and the affected state in an initial release, as required by CERCLA section 104 (i) (6) (H) for their information and review. Where necessary, it has been revised in response to comments or additional relevant information provided by them to ATSDR's Cooperative Agreement Partner. This revised document has now been released for a 45-day public comment period. Subsequent to the public comment period, ATSDR's Cooperative Agreement Partner will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude the public health assessment process for this site, unless additional information is obtained by ATSDR's Cooperative Agreement Partner which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

Use of trade names is for identification only and does not constitute endorsement by the U.S. Department of Health and Human Services.

Please address comments regarding this report to:

Agency for Toxic Substances and Disease Registry
Attn: Records Center
1600 Clifton Road, N.E., MS F-09
Atlanta, Georgia 30333

You May Contact ATSDR Toll Free at
1-800-CDC-INFO or
Visit our Home Page at: http://www.atsdr.cdc.gov

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Georgia Department of Public Health
Chemical Hazards Program
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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List of Acronyms

1,1-DCA: 1,1-dichloroethane
1,2-DCE: 1,1-dichloroethene
95UCL: 95 percent upper confidence limit
AGL: Atlanta Gas Light Company
ALSA: Acid-Lime Sludge Area
ASB: Alum Sludge Basin
ATSDR**:** Agency for Toxic Substances and
Disease Registry
bgs: below ground surface
CDC: Centers for Disease Control and Prevention
COC: Chemical of Concern
CREG: Cancer Risk Evaluation Guide
CSF: Cancer Slope Factor
CSX: CSX Rail Yard
CV: Comparison Value
DHHS: U.S. Department of Health and Human Services
DNR: Georgia Department of Natural Resources
DPH: Georgia Department of Public Health
EMEG: Environmental Medium Evaluation Guide
EPD: Georgia Environmental Protection Division
GC/MS: gas chromatography/mass spectroscopy
GWCC: groundwater contaminant concentrations
HAP: Hazardous Air Pollutant
HI: Hazard Index
HQ: Hazard Quotient
HWMU: Hazardous Waste Management Unit
HWW: Horizontal Recovery Well
IARC: International Agency for Research on Cancer
L: Liter
LOAEL: Lowest Observed Adverse Health Effect
LPABS: Locomotive Paint and Air Brake Shop
LSA: Locomotive Shop Area
mg/kg/day: milligrams per kilogram per day
MRL: Minimal Risk Level
MW: Monitoring Well
NOAEL: No Observed Adverse Effects Level
NPDES: National Pollutant Discharge and Elimination System
NTP: National Toxicology Program
OCVSP: Old Cleaning Vat Sludge Pits
ODSA: Old Drum Storage Area
OEH: Old Engine House
ORA-2: Old Refuse Area No. 2
ORPA: Old Runoff Pond Area

PAH: polycyclic aromatic hydrocarbon
Psig: pounds per square inch gauge
RCRA: Resource Conservation and Recovery Act
RfD: Reference Dose
RFI: RCRA Facility Investigation
RSL: Regional Screening Level
SEER: National Cancer Institute's Surveillance, Epidemiology, and End Results Program
SWMU: Solid Waste Management Unit
SVOC: Semi-Volatile Organic Compound
TCE: Trichloroethene
UCL: Upper Confidence Limit
µg/L: micrograms per liter
µg/m^3: micrograms per cubic meter
USEPA: U. S. Environmental Protection Agency
VC: Vinyl chloride
VOC: Volatile Organic Compound
WWTPA: Wastewater Treatment Plant/Grit Collection Area

1. Summary

A Waycross, Georgia-based grassroots organization named Silent Disaster petitioned the Agency for Toxic Substances and Disease Registry (ATSDR), to investigate potential health effects of toxic chemical releases from the Waycross, Georgia CSX Rail Yard. The Georgia Department of Public Health (DPH), under a cooperative agreement with ATSDR, conducted this health assessment of the site that included an extensive review of available data going back to the late 1980s.

CSX Rail Yard operations generated a variety of solid wastes including halogenated and non-halogenated spent solvents, waste paint, spent paint strippers, and caustics from degreasing, painting, and parts cleaning operations. This health assessment evaluates whether members of the neighboring Waycross community may have been exposed to chemicals from the CSX facility at concentrations that could harm their health based on available environmental data. The health assessment identifies data limitations and the public health actions needed to reduce harmful exposures, if these exposures are identified.

CSX addressed worker exposure to site-related contaminants in 2013 at the request of the Georgia Environmental Protection Division (EPD) and the results of this risk assessment investigation were reported in the Human Health and Ecological Risk Assessment conducted at the CSX Rail Yard. Additionally, at the request of EPD, CSX addressed worker exposure to indoor air contamination from vapor intrusion in the 2017 report: Vapor Intrusion Summary, CSXT Rice Yard Shop Area.

After onsite visits, interviews, and reviews of available data and reports, DPH reached the following conclusions about the CSX Rail Yard site:

Conclusion 1

Past and current exposures to chemicals in the surface water and sediment in the Waycross Canal are not likely to harm the health of children and adults who might wade or play in the area.

Basis for Conclusion 1

The concentrations of chemicals in surface water (1,1-dichloroethane, *cis*-1,2-dichloroethene, and trichloroethene) and sediment (arsenic and benzo(b)fluoranthene) that children and adults would come in contact with during recreational activities in the Waycross Canal are below levels expected to result in cancer and non-cancer health effects. It is important to note that there are no recreational sporting facilities or parks near the section on the Waycross Canal that runs along the southern boundary of the CSX facility making routine use of this area unlikely.

Conclusion 2

DPH cannot conclude whether breathing contaminants in outdoor air near the CSX Rail Yard site in the past, currently or in the future could harm people’s health.

Basis for Conclusion 2

Current and past ambient air sampling data from the rail yard or City of Waycross are not available. Without these data, DPH cannot currently evaluate whether the air emissions from the CSX Rail Yard site may impact the health of the community. However, the CSX Rail Yard is operating under an Air Quality Synthetic Minor Permit issued by the EPD for locomotive painting and sandblasting, and for emergency generators and firewater pumps. The permit requires CSX Rail Yard to calculate the amount of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) associated with paint usage on a monthly basis as well as the mass of emissions associated with the use of emergency generators and the firewater pump. In 2016, CSX reported 5.52 tons of VOCs and 1.54 tons of HAP emissions from facility operations; well below 100 tons of VOCs and 10 tons of HAPs emissions allowed by permit over a consecutive 12-month period.

Records indicate that chlorinated solvents have not been used at the CSX Rail Yard in the past 20 years. An air quality monitoring program for these compounds would not be effective because there are no current emissions, and present measurements would not provide any information about past exposure. Current emissions, including diesel exhaust, from the facility have not been characterized through air monitoring or modeling. Modeling of emissions using an accurate emissions inventory, or targeted air quality monitoring for compounds associated with diesel emissions would provide a better understanding of air quality in the area surrounding the CSX Rail Yard.

Conclusion 3

DPH cannot conclude whether people were exposed to chemicals in the indoor air of homes in the past as a result of soil vapor intrusion because these data are not available. However, based on extensive groundwater sampling results and continuous remediation activities at the rail yard, DPH does not expect vapor intrusion to be a source of volatile organic compound (VOC) exposure at concentrations that would lead to adverse health effects in the neighborhood south of the CSX Rail Yard.

Basis for Conclusion

DPH cannot evaluate whether people were exposed to site-related chemicals in the indoor air of homes in the past as a result of soil vapor intrusion because these data are not available. DPH's primary concern for vapor intrusion south of the CSX Rail Yard is related to the Locomotive Shop Area/Old Cleaning Vats Sludge Pond groundwater plume where over a five-year period (between March 2009 and September 2013), low levels of VOCs were detected in monitoring well-88. Sampling results showed that trichloroethene concentrations fluctuated between nondetect levels up to 38 micrograms per liter (µg/L) in September 2013, and then decreased to nondetect levels one month later in November 2013. Since November 2013, TCE or any other VOC has not been detected in monitoring well-88.

Based on groundwater velocity (hydraulic conductivity) measured in the Old Refuse Area Number 2/Old Runoff Pond groundwater plume located approximately 1000 feet east of monitoring well-88, groundwater sampled at a point in time in monitoring well-88 would have travelled over 6000 feet south/southeast of the Rail Yard in one year, being continuously diluted by shallow groundwater underlying the residential neighborhood south of the CSX Rail Yard and beyond.

For these reasons, DPH does not expect vapor intrusion to be a source of VOC exposure at concentrations that would lead to adverse health effects in the neighborhood south of the CSX Rail Yard.

In addition, CSX Rail Yard has an extensive groundwater monitoring network designed to detect offsite VOC migration and an extensive groundwater extraction system designed to capture volatile organic contaminants from the groundwater and direct this water to the groundwater treatment system. The corrective action systems are intended to prevent offsite migration of contaminated groundwater to the nearby neighborhood. For over 2 years, the groundwater monitoring system has not detected any VOCs off-site. Moreover, physical characteristics of the local soils indicate organic-rich sediments, which naturally break down volatile organic chemicals, might further control migration of the chemicals south of the Waycross Canal.

Conclusion 4

People in the Waycross community are not exposed to CSX Rail Yard site-related contaminants in their drinking water, which is derived from municipal water obtained from the Floridan aquifer. Waycross requires a municipal well connection for all residential properties within the city limits.

Basis for Conclusion 4

Since the 1890s, nearby residents receive their drinking water from the City of Waycross which is routinely monitored under the Safe Drinking Water Act to protect the public from harmful exposures. Although some private wells are located just south of the CSX Rail Yard and downgradient of shallow groundwater flow, all but one private well are located on properties connected to the municipal water system. This well is located approximately 3000 feet south of the CSX Rail Yard, and we have no evidence to suggest it has ever been impacted by the Site.

Next Steps

DPH recommends that:

1. CSX, under Georgia Environmental Protection Division (EPD) oversight, maintain the groundwater treatment system operating at the site and monitor the groundwater contamination plume to ensure that chemicals do not migrate off the site into the neighboring community. Maintenance of vertical and horizontal groundwater recovery wells should include preventive measures to preclude calcification and iron-fouling (such as well flushing and periodic redevelopment) of recovery well screens.
2. CSX, under EPD oversight, sample downgradient soil gas and shallow groundwater if site-related contaminants are once again detected in sentinel groundwater monitoring

wells to determine the extent of downgradient contaminant migration and take measures to prevent contaminant migration into nearby residential area. Sentinel monitoring well-88 is of particular concern because of the close proximity to residences lying downgradient in the direction of groundwater flow.
3. CSX establish deed restriction to limit site use to commercial/industrial purposes and to restrict site groundwater use for purposes other than monitoring.
4. CSX conduct periodic monitoring of indoor air and soil gas and take any necessary measures to protect the health of their workers, particularly as they relate to indoor air in buildings overlying the groundwater contamination plume and areas with extensive soil contamination. Although the results of indoor air sampling from CSX's vapor intrusion investigation reported that concentrations of trichloroethene, tetrachloroethene and associated hydrocarbons indicated no significant carcinogenic risk or non-cancer hazard to personnel that work within and around onsite building structures, significantly high concentrations of trichloroethene remain in sub-slab soil gas underneath the locomotive shop, which is a vapor intrusion and worker health concern.
5. EPD consider air modeling in the area surrounding the CSX Rail Yard to better characterize current diesel emissions and air quality.

DPH will:

- Distribute this health assessment and/or a fact sheet summarizing our findings to the petitioner, to EPD, and to any Waycross residents who request a copy of this health assessment or who request a fact sheet.
- Respond to public comments to this health assessment.
- Provide technical assistance to assess the health risks to workers in site occupied buildings resulting from vapor intrusion at the request of the EPD.
- Share this health assessment with the National Institute for Occupational Safety and Health and the Occupational Safety and Health Administration to inform them of the potential exposure pathways for workers.
- If a prolonged groundwater recovery system failure occurs and abatement is not prompt, DPH, if requested, will revisit its exposure evaluation.
- Collaborate with EPD on air modeling in the area surrounding the CSX Rail Yard at EPD's request.

For More Information

If you have questions or comments, call ATSDR toll-free at 1-800-CDC-INFO and ask for information on the CSX Transportation Rail Yard site in Waycross, Georgia.

2. Statement of Issues

On December 29, 2014, Silent Disaster, a Waycross, Georgia-based grassroots organization, petitioned the ATSDR to investigate the potential health effects of toxic chemical releases from the Waycross, Georgia CSX Rail Yard, the Seven Out Tank site, and the former Atlanta Gas Light Company Manufactured Gas Plant. Through an online survey, Silent Disaster collected reports of health conditions. According to Silent Disaster, the reports indicate that for Waycross community residents near the specified sites, the occurrence of cancer (particularly childhood cancers), tumors, metabolic disorders, and other diseases and symptoms were elevated.

On December 18, 2015, ATSDR accepted the petition to conduct public health assessment activities for the CSX Rail Yard and Atlanta Gas Light Company [DHHS 2015]. DPH had previously evaluated the public health implications of the Seven Out facility in two health consultations released in January [DPH 2014a] and April 2014 [DPH 2014b]. ATSDR reviewed these Seven Out Tank health consultations and agreed with DPH's evaluation approach and concluded that no further public health activities related to the Seven Out Tank facility were necessary.

For this health assessment, DPH did not review data related to the AGL site, but will review this data in a separate health assessment that is currently being developed. For this health assessment, DPH conducted an extensive review of available and relevant CSX Rail Yard data from the late 1980s through 2016. This health assessment therefore only evaluates:

Whether members of the neighboring Waycross community might have been exposed to chemicals from the CSX Rail Yard site at concentrations that could harm their health, and if such exposures are identified, what public health actions are needed to reduce harmful exposures at the CSX Rail Yard site.

The Georgia Environmental Protection Division (EPD) required CSX Rail Yard to address worker exposures to site-related contaminants and the results of this risk assessment investigation was reported in the Human Health and Ecological Risk Assessment conducted at the CSX Rail Yard in 2013 [ARCADIS 2013c]. In addition, CSX has more recently prepared the following report to address worker exposures associated with soil vapor intrusion: Vapor Intrusion Summary CSXT Rice Yard Shop Area [ARCADIS 2017b].

3. Background

3.1. Site Description

CSX Transportation, Inc. owns and operates CSX Rail Yard. The CSX Rail Yard site is the largest railroad switching and maintenance facility in the southeastern United States. In addition to switching and storage of rolling stock, CSX Rail Yard employees maintain and repair locomotives and train cars in several onsite buildings [DNR 2014b]. The 755-acre site extends approximately 5 miles along U.S. Highway 84 in Waycross, Ware County, Georgia. Figure I shows the topographic and surface drainage features, the location of the regulated hazardous waste management units, and the locations of the solid waste management units. The site is surrounded by woodlands, swamps, and only limited development. The areas just west and south of the site are primarily residential, while industrial, commercial, and residential properties are to the north and east [ARCADIS 2013a].

Since 1897, rail yard operations have occurred continuously at the site, albeit under several different corporate owners. Consequently, yard operations have generated large quantities of a variety of hazardous wastes:

- Halogenated and nonhalogenated spent solvents,
- Waste paint,
- Spent paint strippers, and
- Caustics from degreasing, painting, and parts cleaning operations.

Sludges from the treatment of process wastewaters have also contained listed solvents and hazardous constituents. Miscellaneous operations, such as waste oil refining, acetylene manufacturing, and equipment cleaning have also generated large volumes of a variety of hazardous and nonhazardous wastes [DNR 2014a].

Specifically, areas of the rail yard where hazardous wastes were released include the;

- Old Drum Storage Area (Figures I and V),
- Alum Sludge Basin (Figures I and V),
- Acid-Lime Sludge Area (Figures I, V and VI),
- Locomotive Shop Area (Figures I and V),
- Old Refuse Area Number 2/Old Runoff Pond Area (Figures I, and V),
- Locomotive Paint and Air Brake Shop (Figures I, V and VI),
- Old Engine House (Figures I, and V),
- Old Cleaning Vat Sludge Pits (Figures I, and V), and a
- Spill Incidence in 2013

A comprehensive corrective action program is ongoing at CSX Rail Yard and comprises a groundwater monitoring well network of 131 wells dispersed across the facility. Corrective action effectiveness monitoring is conducted two times per year. In addition to the monitoring well network, the corrective action program includes:

- A surface water monitoring network of 14 sample locations (Figure IX),
- Eight vertical recovery wells for the old drum storage area (Figures VI, and VIII,
- Ten vertical recovery wells for the locomotive shop area (Figures VI, and VIII),
- One horizontal recovery well for the locomotive paint and air brake shop (HWW-1) (Figure VII),
- One horizontal recovery well (HWW-2) and one recently added horizontal recovery well (HWW-3) for alum sludge basin (Figure VII), and
- Underground piping to a groundwater treatment system.

Monitoring well 3, the background well for the entire site, is to the northwest of the old drum storage area (Figures VI, VII, and VIII). Appendix A contains a description of historical and current facility operations responsible for environmental contamination of the rail yard as well as a brief regulatory history of the CSX Rail Yard. Appendix B provides more detail on the corrective action program as well as the effectiveness of the corrective action program. A review of Appendix B will help explain other contributing factors leading to DPH's conclusions about any exposure to site-related contaminants in neighborhoods near the site.

3.1.1. Topography, Site Drainage, and Prevailing Wind Direction

The CSX Rail Yard site and vicinity are on relatively flat land at an elevation of approximately 135 feet above mean sea level (Figure I). An engineered system of storm gates, storm sewers, and drainage canals control storm water and surface water. Drainage canals run along the entire length of both the northwest and southeast property boundaries. The storm sewer systems in the southeast portion of the site discharge into the Waycross Canal, the main drainage canal along the southeastern site boundary, and ultimately discharge into the Satilla River, approximately 4 miles northeast of the site [ARCADIS 2013a, 2013c].

The Waycross Canal flows both intermittently and perennially. Substrate in the Waycross Canal is sandy, and the canal typically includes a moderate amount of organic debris. Base flows were observed between 2 to 6 inches a week after any moderate rainfall as observed during ecological risk assessment activities [ARCADIS 2013c]. The observed wetted width is 4 to 8 feet, with 2 to 4 feet of channel incision within the excavated canal where it crosses the site's edge near Hamilton Avenue. Dominant vegetation near the Waycross Canal includes trees, shrubs, and woody vines. Beneath the dense canopy and dense, woody-vegetation underbrush, no edible herbs or forage plants were observed in the ground-level Waycross Canal stratum [ARCADIS 2013c].

Waycross wind direction and speed data collected by Iowa State University over a thirty-four-year period (1983 to 2017) show that the predominant wind direction over this period is from the southwest blowing northeast. Secondary predominant winds blow from the northeast to the southwest [ISU 2017]. Prevailing wind direction in Waycross is seasonal; from March through August, prevailing winds are from the southwest, and from September through November, prevailing winds are from the northeast [ISU 2017]. The average wind speed in Waycross is approximately 5 miles per hour (mph)

3.1.2. Geology/Hydrogeology

The CSX Rail Yard site is in the Atlantic Coastal Physiographic Province. The immediate stratigraphy that underlies most of the site to a depth of 55 to 65 feet below ground surface (bgs) consists of alluvial and terrace sand and clay deposits from the Pleistocene to Recent age. Within these deposits, geologists have identified five stratigraphic zones (I through V). Zones I (surface to 7 feet bgs and II (7 to 20 feet bgs) are the uppermost layers of relatively low transmissivity sediments. The uppermost aquifer at the site consists of the hydraulically-permeable sands of Zone III (20 to 30 feet bgs). The more impermeable clays of Zone IV (30 to 40 feet bgs) underlie Zone III, acting as a semi-confining layer to the more permeable sands of Zone V (40 to 60 feet bgs). Massive greenish-blue, impermeable, sandy clays of the Hawthorne Group underlie Zone V [DNR 2004, 2015; ARCADIS 2013a].

A notable exception to the hydrogeology described above occurs near the locomotive paint and air brake shops where the Zone IV clay is missing. Sand and clay lenses there are interfingered to a depth of approximately 80 feet bgs, below which impermeable clays are contiguous across the area [DNR 2004, 2015; ARCADIS 2013a].

Beneath the site, depth to groundwater is only about 6 to 10 feet bgs. The general groundwater flow direction is towards the south (Figure II). Flow direction is altered in some areas by the Waycross Canal and by operation of the groundwater recovery wells [DNR 2015; ARCADIS 2013a]. In general, this shallow groundwater from the site discharges into the Waycross Canal, which is defined in the RCRA[1] Facility Investigation [ARCADIS 2013a] as the southern extent of groundwater plume migration.

3.1.3. Site Security

For over 30 years, site perimeter fences have guarded the CSX Rail Yard site. Fences on the south portion of the property along Hamilton Avenue deter trespassers. Because this site is an active rail yard that operates 24 hours per day, 365 days per year, CSX personnel are trained to watch for people who do not belong on the property. CSX also maintains video surveillance of rail operations, and CSX special agents police the yard. To identify potential trespassers, employees conduct daily inspections (weekends included) of the remedial treatment areas.[2]

3.2. Area Demographics

Using 2010 U.S. Census data, ATSDR calculated population information for persons living within a 1-mile radius beyond the center of the site's operations yard. The population within 1 mile of the CSX Rail Yard site is approximately 3,862 persons in 1,867 households. The most sensitive persons within this 1 mile buffer include 837 women of child-bearing age, 386 elderly persons, and 533 children below age 6. Figure III shows detailed demographic information.

3.3. Natural Resources Use

When CSX contractors conducted a public and private well survey, they found approximately 100 wells within a 3.5-mile radius of the site. Approximately 2/3 of the households where these wells are located receive municipal water (Figure IV). Although only limited well depth information is available, data on 43 wells show that none of the wells draw from the shallow aquifer; rather, many draw from the Upper Floridan Aquifer[3], a much deeper, uncontaminated groundwater source.

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[1] RCRA: Resource Conservation and Recovery Act of 1976 is the principal federal law in the United States governing the disposal of solid waste and hazardous waste.

[2] Email correspondence on March 11, 2016 with Matthew Adkins, CSX Transportation, Inc. Manager of Environmental Remediation.

[3] Email correspondence on August 3, 2015 with Matthew Adkins, CSX Transportation, Inc. Manager of Environmental Remediation.

Most residences within this 3.5-mile radius receive water from the City of Waycross, which has operated its Waycross Water System since the 1890s. Waycross requires a municipal well connection for all residential properties within the city limits. The municipal system's water is a groundwater source pumped from the Upper Floridan Aquifer by three wells averaging approximately 700 feet bgs. One of the three wells has not been used in 20 years.[4] As required by federal and state law, the Waycross Water System routinely monitors for any constituents in drinking water. This system has been in compliance with federal and state drinking water standards for over 10 years. [5] Current and historic water quality data for the Waycross Water System are available at: www.gadrinkingwater.net identified as System ID #GA2990002.

4. Discussion

In this section, DPH reviews available environmental data, determines relevant exposure pathways, and assesses public health implications.

4.1. Conceptual Site Model

On the CSX Rail Yard site, large-scale industrial activity occurs almost continuously. CSX Rail Yard does not use its shallow groundwater as a potable (i.e., drinking) water source, nor will its shallow groundwater be a likely potable water source in the future because:

1. No potable water supply wells exist within the affected area or the affected aquifer, and currently, there are no plans to drill any such wells.
2. Two permitted wells approximately 750 feet bgs draw from the uncontaminated Floridan aquifer. These wells supply potable water to the City of Waycross residents and businesses, including the CSX Rail Yard site.

Moreover, investigators have found no evidence of faults or other connections between the contaminated shallow aquifer and the Floridan aquifer [ARCADIS 2013a]. According to city records, the residential area directly south of the site and the Waycross Canal has been part of the Waycross Water System since the 1890s. Thus, any residential wells in that neighborhood, regardless of the aquifer from which they draw, do not supply potable water.

4.2. Potential for Human Exposures

At the CSX Rail Yard site, DPH and ATSDR identified the following potential exposure groups and pathways [ARCADIS 2013c]:

- Past, current, and future site workers
  - Potential exposures to chemicals in surface soil via ingestion, dermal contact, and inhalation of volatiles, particulates, or dust in outdoor air

[4] Email correspondence on October 20, 2015 with Larry Yockachonis, ESG Operations, Inc., Waycross Project Director for the Waycross Water System.

[5] Email correspondence on October 26, 2015 with Larry Yockachonis, ESG Operations, Inc., Waycross Project Director for the Waycross Water System.

  - Potential exposures to chemicals in indoor air in buildings overlying the groundwater plume via inhalation of volatiles migrating from subsurface groundwater

- Youth Trespasser
  - Potential exposures to chemicals in sediment via dermal contact and to surface water via incidental ingestion and dermal contact while wading outside the fenced area

The Georgia Environmental Protection Division (EPD) required CSX Rail Yard to address worker exposures to site-related contaminants and the results of this risk assessment investigation was reported in the Human Health and Ecological Risk Assessment (HHERA) conducted at the CSX Rail Yard in 2013 [ARCADIS 2013c]. The chemicals of concern (COC) identified in the HHERA included volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals. The HHERA evaluated COC in soil, groundwater, and surface water for current and future site workers, hypothetical future construction workers, hypothetical trespassers, and hypothetical future residents.

Results indicated that the excess lifetime cancer risk of a current and/or future site worker, and trespasser is within USEPA's acceptable risk range and the noncancer hazard is either below or equal to a hazard quotient of 1 (under both current conditions and a future scenario involving soil redistribution). However, the estimated excess lifetime cancer risk of a hypothetical future construction worker exposed to vapors emanating from groundwater in a trench is above acceptable limits; therefore, it is recommended that a deed restriction is developed for the property to require a health and safety plan in the case of any trenching work at the Site in any area with groundwater impacts [ARCADIS 2013c].

Potential excess lifetime cancer risks for a hypothetical future resident are within or above the USEPA target risk range and noncancer hazards are generally above a hazard quotient of 1. Estimated excess lifetime cancer risks and noncancer hazards from the use of groundwater as a potable water supply are above acceptable limits; therefore, the HHERA report recommends that deed restrictions be implemented to limit site use to commercial/industrial purposes and to restrict groundwater use for purposes other than monitoring [ARCADIS 2013c].

In addition, CSX has more recently prepared the following report to address worker exposures associated with soil vapor intrusion: Vapor Intrusion Summary CSXT Rice Yard Shop Area [ARCADIS 2017b]. Investigation results for trichloroethene, tetrachloroethene and associated hydrocarbon concentrations found in indoor air indicate no significant carcinogenic risk or non-cancer hazard to personnel that work within and around onsite building structures. Additionally, the report states that the sampling results do not indicate a need to take further action to protect worker health [ARCADIS 2017b]. Though CSX found recent indoor air monitoring demonstrated that indoor air contamination from vapor intrusion was not occurring at levels of concern, elevated concentrations in soil gas could begin to migrate indoors if building conditions change, such as cracks forming in the slab or changes in ventilation.

Similarly, in this health assessment DPH will not assess youth trespasser exposure via 1) incidental ingestion of surface soil inside the fenced area of the CSX Rail Yard site, 2) dermal contact, 3) inhalation of volatiles, or 4) particulates or dust in outdoor air. DPH arrived at this decision for the following reasons:

- Site perimeter fencing at CSX Rail Yard has been in place for over 30 years.
- CSX is an active rail yard that operates 24 hours per day, 365 days per year, and CSX personnel are trained to recognize people who do not belong on the property.
- CSX Rail Yard captures video surveillance of rail operations and has agents who police the yard.
- CSX Rail Yard conducts daily inspections (weekends included) of the remedial treatment areas and can identify signs of potential trespassing
- The hazardous waste management units and solid waste management units currently in post-closure care are thickly vegetated[6]. Maintenance of the waste management units' vegetative cover caps is a permit requirement verified annually by EPD. The vegetation helps prevent direct contact with any onsite surface soil, and would help to mitigate the inhalation of dust from surface soil.

The above reasons would deter onsite trespassing and subsequent exposure. If trespassing should occur, it would likely be infrequent, episodic, and quickly detected.

The Conceptual Site Model in Figure 1 below shows exposure pathways for the site, including the source, environmental media, exposure points, completed and potentially completed exposure routes, and time frame relevant for this evaluation.

Exposure pathways are a means by which people in areas near the CSX Rail Yard site could have been or could currently be exposed to site-related contaminants. An exposure pathway consists of five elements:

1. Source of contamination,
2. Contaminated environmental medium (air, soil, water),
3. Location where someone contacts the contaminated medium (exposure point),
4. Exposure route, such as inhalation (breathing), dermal absorption (skin contact), or ingestion (swallowing or eating), and
5. Population that might be exposed.

An exposure pathway is complete when all five elements are present. Potentially completed exposure pathways are either 1) not currently complete but could be in the future, or 2) indeterminate because of a lack of information. Pathways are eliminated from further assessment if one or more elements are missing and are never likely to be present [ATSDR 2005].

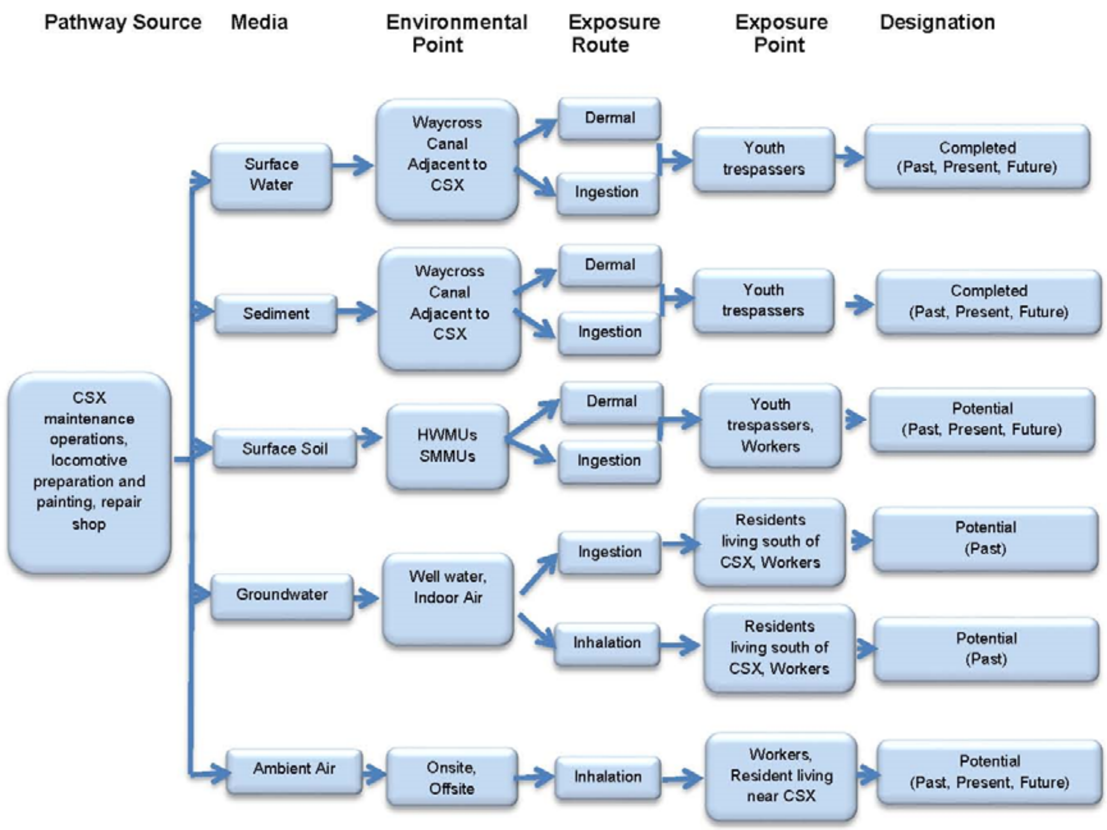
DPH identified and evaluated two completed pathways:

- Ingestion of surface water in the Waycross Canal, and

[6] DPH observation during a site visit of the CSX facility on August 11, 2015.

- Dermal absorption of surface water and sediment in the Waycross Canal by youth trespassers.

Figure 1: Conceptual Site Model for Relevant Exposure Pathways for the CSX Rail Yard



DPH also identified four potential pathways:

- Past ingestion of well water from drilled shallow wells in the residential area just south of the CSX Rail Yard site, although this exposure pathway is indeterminate because we have no well sampling data to verify this. Moreover, this residential neighborhood has been connected to the Waycross municipal water system since the 1890s.
- Past vapor intrusion of residential structures south of the CSX Rail Yard site in the direction of shallow groundwater flow, although we have no evidence of this based on past groundwater sampling results, and
- Inhalation of ambient air that may contain site related volatile organic compounds (VOCs), although this exposure pathway is indeterminate because we have no onsite/ offsite ambient air sampling data to verify this.

4.3. Environmental Sampling Data and Analyses

In accordance with EPA/EPD analytical laboratory requirements, all environmental sample results reviewed for this health assessment include laboratory quality assurance/quality control

(QA/QC) summaries for all sample submissions Where applicable, QC data summaries include method blank, blank spike, matrix spike and duplicate summaries, surrogate recovery summaries, instrument performance check. Long-standing EPA guidance controls when data can be merely reported, or have to be qualified. Certain data qualifiers (”J” for instance) do not impact usability of the data. However, QA/QC problems outside of established parameters generate an “R” qualifier; rejected. This data is unusable and re-sampling and/or re-analysis is required

4.3.1. Shallow Groundwater

Comprehensive and extensive groundwater sampling at the CSX Rail Yard site has fully delineated the extent of shallow groundwater contamination [ARCADIS 2013a, 2014b, 2016]. Appendix C contains an analysis of past and current groundwater trends at the site.
For this health assessment and its conclusions, in-depth analysis of the groundwater sample results and trends is essential, as is familiarity with the site’s topographical and geological characteristics. A review of Appendix C will explain the contributing factors leading to DPH’s conclusions about any exposure to site-related contaminants in neighborhoods near the CSX Rail Yard site.

4.3.1.1. Potential for Vapor Intrusion in the Neighborhood South of Hamilton Road

Groundwater investigation activities began in 1988, when EPD began to investigate the extent of shallow groundwater contamination under the CSX Rail Yard site. To date, as part of CSX’s groundwater monitoring network, 16 sentinel groundwater monitoring wells have been installed south of the Waycross Canal to monitor any breaches of extraction well containment. This network of sentinel groundwater monitoring wells extends from the old drum storage area to the old refuse area-1/old runoff pond area across the site’s southeastern boundary. Since CSX Rail Yard groundwater monitoring began, contaminated groundwater has migrated south of the Waycross Canal during the following periods at three locations:

1. In 2013, *cis*-1,2-dichloroethene (1,2-DCE), trichloroethene (TCE), and vinyl chloride (VC) from the old drum storage area groundwater plume were detected by monitoring well #73,
2. In 2001, TCE from the locomotive paint and air brake shop groundwater plume was detected by horizon-clustered monitoring well #112, and,
3. Between March 2009 and September 2013, *cis*-1,2-DCE and TCE from the locomotive shop area/old cleaning vat sludge pit groundwater plume were detected by monitoring well #88.

4.3.1.2.1 Old Drum Storage Area

In 2013 through 2015, some monitoring wells downgradient of the old drum storage area landfill (monitoring wells #34, #35, #36, #72, #73, and #76) recorded increasing VOC levels. In June 2013, contractors redeveloped currently operating vertical recovery wells #44 through #48 using chemical and physical methods [ARCADIS 2014b] in an effort to preclude further migration of dissolved VOCs south of the Waycross Canal and into the residential area located approximately 500 feet southeast of monitoring well #73.

Following recovery well redevelopment, contractors also conducted a downgradient soil and groundwater investigation at 15 downgradient locations on CSX Rail Yard and City of Waycross property to target permeable zones for depth-discrete groundwater sampling. Groundwater samples were collected from up to four depth intervals, coinciding with the more transmissive zones where VOC mass preferentially concentrates in areas downgradient from the old drum storage area source. Contractors used an iterative process, incorporating real-time spectrometer technology results from previous locations to determine/adjust subsequent sampling locations and fully delineate areas of elevated VOCs [ARCADIS 2014b]. Downgradient groundwater sample results showed that VOCs had migrated up to 50 feet south of monitoring well-73 and approximately 100 feet east of monitoring well-73. Sample results are shown in Table C.1 Appendix C.

Figure XII shows the lateral distribution of total VOCs in old drum storage area groundwater. VOCs appear concentrated between approximately 10 to 20 feet bgs, in a silty-sand transmissive zone.

One additional monitoring well—monitoring well #133—screened between 14–24 feet bgs was installed in January 2015. This monitoring well is approximately 100 feet southeast of monitoring well #73 and approximately 200 feet west of monitoring well #74. Two consecutive sampling events in March 2015 and March 2016 showed that VOCs were not detected [ARCADIS 2016]. In addition, sample result trends from monitoring well #73 showed TCE levels declining from 8.6 µg/L in March 2013 to below detection limits in March 2016, and levels of *cis*-1,2-DCE also declining from 340 µg/L in March 2013 to 21 µg/L in March 2016. Before detection of *cis*-1,2-DCE at a concentration of 1.4 µg/L in March 2012, no VOCs had been detected in monitoring well #74 since monitoring began in this well in November 1995.

4.3.1.2.2 Locomotive Paint and Air Brake Shop

As noted in the Geology/Hydrogeology section of this document, the clay layer (referred to as Zone IV), which is present over most of the site, is absent in locomotive paint and air brake shop area. Permeable sands (Zones III and V) fill the surface to approximately 59 feet bgs. Monitoring wells appear at various depths across this entire formation. Below 59 feet, discontinuous, impermeable clay, interbedded with sandy and sandy clay layers are found. Monitoring wells used to collect data are also completed in this zone.

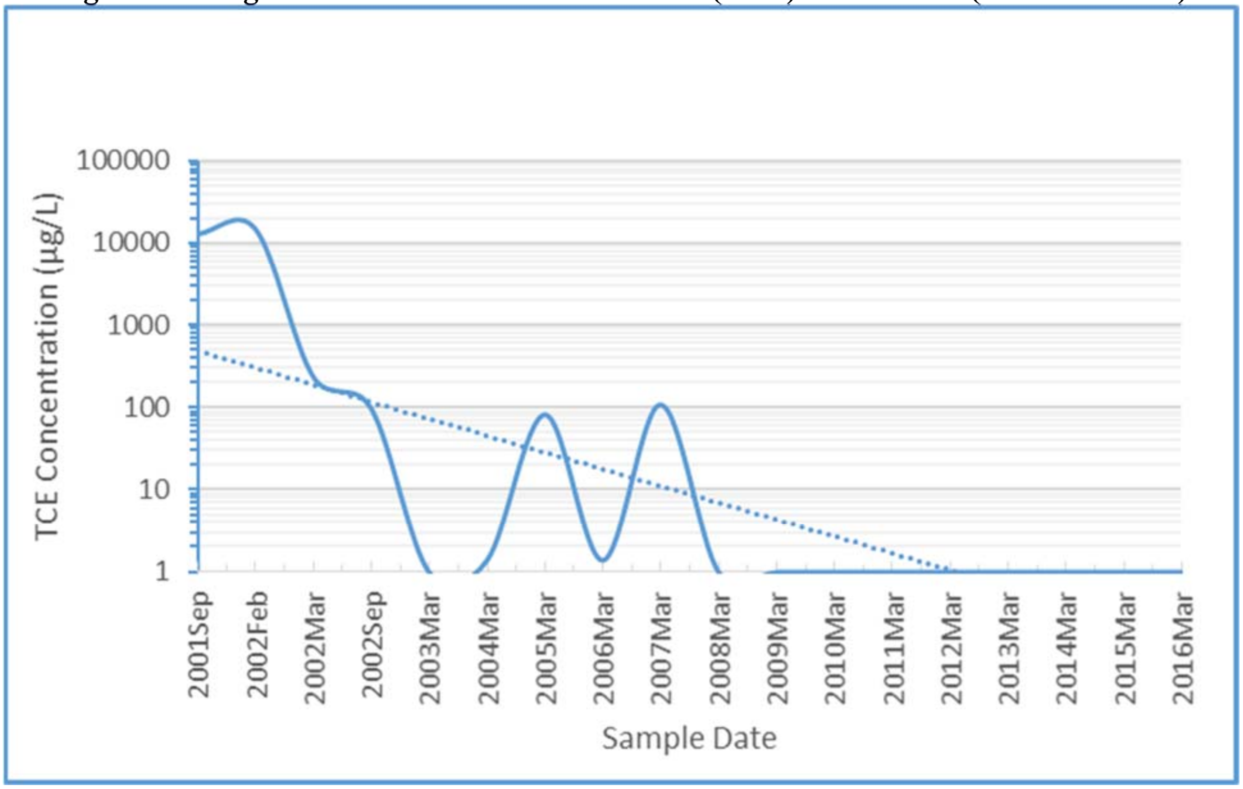
The surficial geology observed at the site could have resulted from alluvial and terrestrial deposition associated with a prograding river-mouth delta that grew southeast into Florida during the Plio-Pleistocene [ARCADIS 2013a]. The area of missing Zone IV clay appears to be a channel-like feature oriented from northwest to southeast that terminates approximately 400 feet slightly southeast of the locomotive paint and air brake shop/old engine house and across the Waycross Canal. Figure X's Cross section D-D' suggests a channel system cutting the Zone IV clay.

In September 2001, monitoring well-112, or MW-112 (30–50' horizon) to the south of the Waycross Canal detected groundwater concentrations of TCE as high as 13,000 µg/L. After the installation of horizontal recovery well #1 in December 2001, the TCE levels decreased substantially. Since 2008, TCE has not been detected in MW-112 [ARCADIS 2013a, 2016]. That said, however, since groundwater monitoring began at the CSX Rail Yard site, the TCE levels detected by MW-112 represent the farthest migration of any onsite shallow groundwater plume south of the site and south of the Waycross Canal.

Historical isopleth maps showing the TCE concentration in groundwater reveal the extent of TCE migration remaining within the CSX Rail Yard boundary in 1999. But by 2001 (Figure XI), migration had breached the property boundary and had invaded a nonresidential, wooded area owned by CSX. The nearest residences directly south of this wooded area (Figure V), are located approximately 300 feet south of MW-112. The closest private well is approximately 1,500 feet directly south of this southernmost extension of the locomotive paint and air brake shop/old engine house groundwater plume (P-82 shown in Figure IV). In this regard, however, note that state and federally regulated municipal facilities supply water to these residences.

Figure 2 below shows the concentrations (in µg/L) of TCE in MW-112 (30-50' horizon) over a 15-year period.

Figure 2: Long-Term Trend of Trichloroethene (TCE) in MW-112 (30-50' horizon)



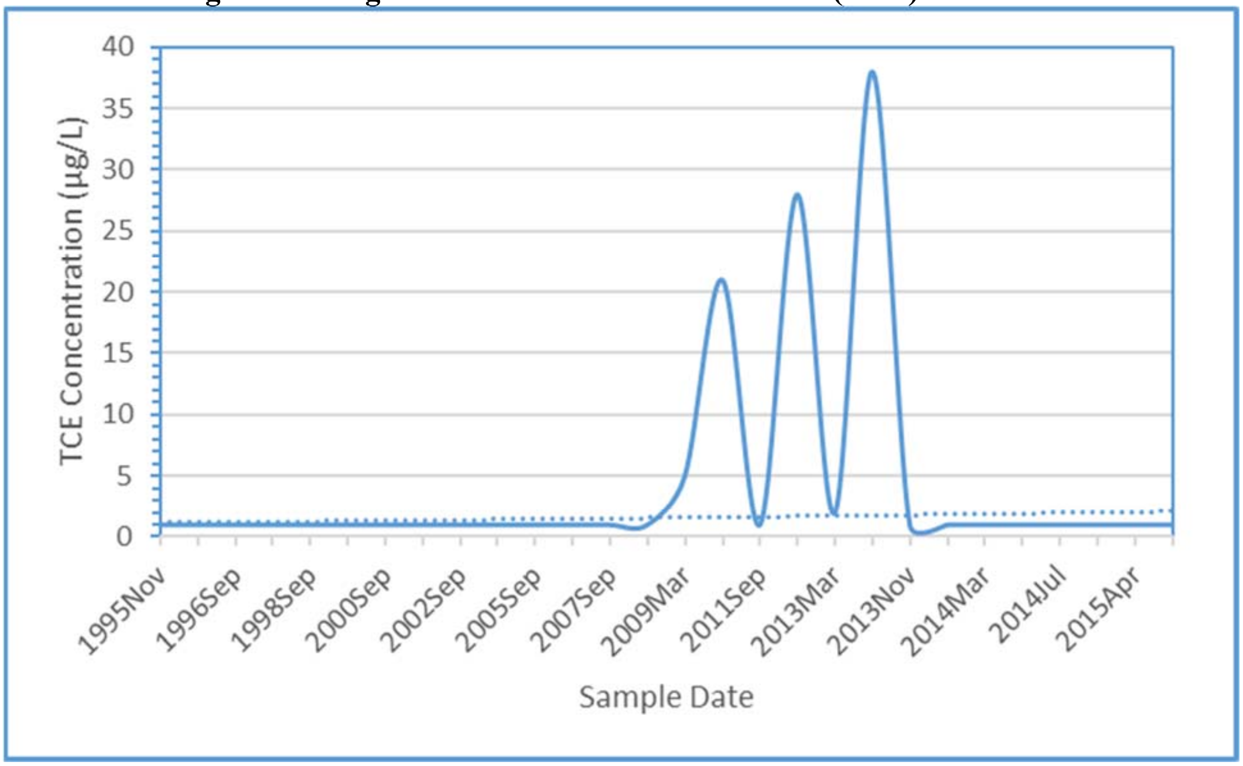
Note: dotted line is the exponential trend of TCE concentrations.
TCE: trichloroethene
MW-112: monitoring well-112
µg/L: micrograms of contaminant per liter of water

4.3.1.2.3 Locomotive Shop Area/Old Cleaning Vat Sludge Pits

A principal area of concern is downgradient from the old cleaning vat sludge pit unit. Monitoring wells 68, 69, 70, and sentinel monitoring well 88 are all near the Waycross Canal and Hamilton Road. For many years, these wells had no detectable TCE levels. However, various levels of TCE were found in these monitoring wells between September 2006 and September 2013. From March 2009 through September 2013, sentinel monitoring well-88 had TCE concentrations ranging from nondetect to 38 µg/L. But in November and December 2013, CSX contractors resampled MWs- 69, 70, and 88; all found chlorinated VOC concentrations below detection [DNR 2015]. Contractors sampled again in March, May, July, and September of 2014 and again reported that VOC concentrations were all below detection limits [ARCADIS 2015].

Figure 3 shows the concentrations (in µg/L) of TCE over a 20-year period. MW-88 (screened at 13–23 feet bgs) is south of the Waycross Canal in the direction of groundwater flow.

Figure 3: Long-Term Trend of Trichloroethene (TCE) in MW-88



Note: dotted line is the exponential trend of TCE concentrations
TCE: trichloroethene
MW-88: monitoring well-88
µg/L: micrograms of contaminant per liter of water

During the installation period for horizontal recovery well-3, or HWW-3 in 2015, five additional sentinel capture-zone monitoring wells (111, 130, 131, 132, and 133) were also installed along Hamilton Avenue. These installations were to improve the corrective action monitoring network associated with the locomotive shop area, the locomotive paint shop and air brake shop, and the old drum storage area. MWs-130 and 131 flank the previously installed locomotive shop area/old cleaning vat sludge pits sentinel wells. Samples taken in April and September 2015 found no detectable VOCs in these monitoring wells.

4.3.2. Surface Water

The shop area ditch, the Waycross Canal, and an unnamed drainage feature all undergo EPD mandated semiannual surface water sampling. Samples are analyzed for VOCs using U.S. EPA Method 8260. Figure IX shows surface water sample locations.

4.3.2.1. Shop Area Ditch

Since sampling first began in 1989, the highest levels of detected shop area ditch surface water contaminants were in sample location W-10, with TCE and *trans*-1,2-DCE detected at 330 and 410 µg/L, respectively. In the last 3 years, sampling indicated only very low concentrations of

TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and VC [DNR 2014; ARCADIS 2015]. No extraction wells are operational near the shop area ditch. The ditch flows into the Waycross Canal, with the confluence at sample location W-6. Table 1 below shows the highest concentrations detected in shop area ditch surface water samples from 2014:

Table 1: Contaminant Concentrations (in µg/L) in the Surface Water of the Shop Area Ditch at Sample Location W-6 from March 2012 to September 2014

Analyte	March-September 2014	March-September 2015	March 2016
TCE	4.9/<1	1.4/1.9	1.3
cis-1,2-DCE	16/1.1	1.5/3.2	1.9
trans-1,2-DCE	<1/<1	<1/<1	<1
Vinyl Chloride	<1/<1	<1/<1	<1

µg/L: micrograms of contaminant per liter of surface water.
TCE: trichloroethene
cis-1,2-DCE: *cis*-1,2-dichloroethene
trans-1,2-DCE: *trans*-1,2-dichloroethene
All groundwater samples were analyzed for select VOCs using USEPA Method 8260.

4.3.2.2. Waycross Canal

Hydraulically-connected vertical and horizontal extraction wells positively influence (i.e., reduce) groundwater contaminant levels near the Waycross Canal; however, shallow groundwater contamination continues to affect surface water.

Since 1987, when surface water sampling began at the Waycross Canal, the highest contaminant levels detected in the Waycross Canal were in 1997, at surface water sampling location W-33 downgradient from the locomotive paint and air brake shop and the old engine house. TCE, *cis*-1,2-DCE, and 1,1-DCE were detected at 3,100, 1,600, and 140 µg/L, respectively. In 2001, horizontal recovery well HWW-1 was installed, and by 2002 was operational. Since 2002, TCE and 1,1-DCE have not been detected at this sample location. But during five sampling events between March 2007 and March 2016, *cis*-1,2-DCE was detected ranging from 1.1 to 3.5 µg/L [DNR 2015; ARCADIS 2013a, 2016].

Appendix D, Table D.1 summarizes all past and current surface water sampling results from each surface water sampling location in the Waycross Canal near the CSX Rail Yard site. The table references initial sampling dates, the number of samples taken, the number of sampling events where a VOC exceeded a health-screening value, and the maximum concentration of chlorinated VOC concentrations found for each respective sampling location. [ARCADIS 2013a, 2013b, 2013c, 2014 a, and 2015].

For the first time since installation of horizontal recovery well-1, in September 2010, surface water samples collected at W-15, CW-1, 2, and C3, located hydraulically downgradient from multiple sources of contamination, results showed very low TCE concentrations (1 to 2.1 µg/L). Surface water sample location CW-1 is out of horizontal recovery well-1's area of influence, as shown in Figure VII. In March 2015, low concentrations of TCE ranging between 1.3 to 1.8 µg/L were found at surface water sampling locations CW-1, 2, and 3. Over the last three sampling events through March 2016, concentrations of *cis*-1,2-DCE ranging between 1.1 to 7 µg/L were found at surface water sample locations CW-1, 2, 3, and W-15 [ARCADIS 2016].

4.3.2.3. Unnamed Drainage Feature

Investigators regularly collect surface water samples at two locations (W-45 and W-48) along the unnamed drainage feature, which runs north/south on the CSX Rail Yard eastern property line. W-48 is collected at the northern end of the feature, but site-related contaminants have never been detected there. W-45 is collected at the confluence of the unnamed drainage feature and the City Drainage Canal, which effectively monitors any contamination that might leave the site via a surface water route (note, however, that this location is not at the facility boundary). Since 2002, TCE and *cis*-1,2-DCE have been detected in two sampling events: in September 2010 at concentrations of 2.9 and 1.6 µg/L, respectively, and again in March 2015 at concentrations of 1.1 and 4 µg/L, respectively [ARCADIS 2014a, 2016].

In summary, surface water sampling data suggest current groundwater recovery systems for the old drum storage area, alum sludge basin, locomotive shop area, and locomotive paint and air brake shop have been successful at reducing contaminant levels in shallow groundwater and at preventing measurable concentrations of volatile contaminants from discharging into surface water at the site. Nevertheless, low contaminant concentrations have been detected at multiple locations across the site, including a point near a site boundary.

4.3.3. Sediment

In March and November 2004, RFI sediment sampling occurred at 17 locations along the Waycross Canal. Investigators analyzed 13 sediment samples for VOCs and polycyclic aromatic hydrocarbons (PAHs), and analyzed 17 samples for RCRA Metals. Figure IX shows sediment sample locations.

In the sediment samples, acetone and methylene chloride were the only VOCs reported above detection limits. Acetone was detected in CW-2 and W-46 at 190 and 4,900 µg/kg, respectively, and methylene chloride was found in CW-1, 2, 3, W-30, and 45; with the highest concentration at 24 µg/kg. Investigators found no clear pattern of distribution, and all methylene chloride samples are comparable. In addition, both constituents are common laboratory contaminants. [ARCADIS 2013a].

One sediment sample, W-36, contained detectable levels of PAH constituents: chrysene (140 µg/kg), benzo(b)fluoranthene (360 µg/kg), and indeno(1,2,3-cd)pyrene (120 µg/kg). This sample is bracketed both upstream and downstream by no detectable PAH concentrations, which indicates that in the Waycross Canal sediment, PAHs have been fully delineated [ARCADIS 2013a].

In 13 of 17 samples, arsenic, barium, chromium, and lead were the only RCRA metals detected. Of these, arsenic was detected above the site-specific background concentration in sediment sample W-27, chromium was detected above the site-specific background concentration in W-36, and lead was detected above the site-specific background concentration in W-15. Table 2 below shows that the reported chromium and lead exceedances (in milligrams per kilogram (mg/kg)) are just above background concentrations. These samples are bracketed upstream and downstream by metal-containing samples below site-specific background concentrations, which further indicates that the extent of RCRA metals in the Waycross Canal sediment has been fully delineated [ARCADIS 2013a].

Table 2: RCRA Metals (in mg/kg) Detected in Waycross Canal Sediment above Site-Specific Background Concentrations

Analyte	Location	Sediment Concentration	Background concentration
Arsenic	W-27	208	7.1
Chromium	W-36	31	26
Lead	W-15	170	125

RCRA: Resource Conservation and Recovery Act, enacted in 1976, is the principal federal law in the United States governing the disposal of solid waste and hazardous waste.

mg/kg: milligrams of contaminant per kilogram of sediment

4.3.4 Ambient Air

No ambient air quality sampling results exist at the CSX Rail Yard. However, the facility is operating under an Air Quality Synthetic Minor Permit (Permit No. 4741-299-0017-S-04-0[7], effective June 12, 2015) issued by the EPD for the operation of a railyard and car repair facility. The Permit was issued for establishing practically enforceable emission limitations such that the facility will not be considered a major source with respect to Title V[8] of the Clean Air Act Amendments of 1990.

The CSX Rail Yard is permitted for locomotive painting and sandblasting, and for emergency generators and firewater pumps. The permit requires CSX Rail Yard to calculate the amount of VOCs and hazardous air pollutants (HAPs) associated with paint usage on a monthly basis as well as the mass of emissions associated with the use of emergency generators and the firewater pump. In 2016, CSX reported 5.52 tons of VOCs and 1.54 tons of HAP emissions[9] from facility operations; well below 100 tons of VOCs and 10 tons of HAPs emissions allowed by permit over a consecutive 12-month period.

Some degreasing does occur in facility operations; however, chlorinated solvents were prohibited from use over 20 years ago by CSX Transportation, Inc. Aside from the CSX Rail Yard being a minor emitter of VOCs and HAPs from facility operations, the rail yard is also the largest railroad switching facility in the southeastern United States, with concomitant diesel emissions from engine rail cars, which are not accounted for in the permit. Diesel exhaust is a complex mixture of thousands of gases and fine particles emitted by a diesel-fueled internal combustion engine. The composition will vary depending on engine type, operating conditions, fuel composition, lubricating oil, and whether an emission control system is present. The gaseous fraction is composed primarily of typical combustion gases such as nitrogen, oxygen, carbon

[7] http://permitsearch.gaepd.org/permit.aspx?id=PDF-OP-23251

[8] Title V of the Clean Air Act requires major sources of air pollutants, and certain other sources, to obtain and operate in compliance with an operating permit. Sources with these "title V permits" are required by the Act to certify compliance with the applicable requirements of their permits at least annually.

[9] Email correspondence on March 23, 2017 with Matthew Adkins, CSX Transportation, Inc. Manager of Environmental Remediation

dioxide, and water vapor. In addition, the gaseous fraction also contains air pollutants such as carbon monoxide (CO), sulfur oxides (SOx), nitrogen oxides (NOx), volatile hydrocarbons, and low-molecular weight polycyclic aromatic hydrocarbons (PAH) and PAH derivatives. Some of these gaseous components such as benzene, formaldehyde, 1,3-butadiene, and particulate matter such as arsenic and nickel, are suspected or known to cause cancer in humans [CARB 1998].

Diesel exhaust also includes substances that are listed by the U.S. EPA as hazardous air pollutants. However, because substance and site-specific data for ambient air in Waycross are not available, we could not estimate exposure to diesel exhaust.

4.4. Identification of Contaminants of Concern

Here, DPH reviews the screening method we use to identify for further evaluation contaminants of concern, or COCs, and how we determine whether contaminant levels in various environmental media may pose a health hazard for noncancer or cancer health effects.

As a preliminary step, DPH examines the types and concentrations of chemicals, which are then screened with comparison values generally established by ATSDR and EPA. Comparison Values (CVs) are concentrations of a contaminant that are not expected to be harmful to human health, assuming health-protective conditions of exposure. Concentrations greater than screening levels do not necessarily mean that people will become sick from exposures, but that further evaluation is necessary to evaluate the potential for health effects [ATSDR 2106].

CVs include ample uncertainty factors to ensure protection of sensitive populations. Because CVs do not represent thresholds of toxicity, exposure to contaminant concentrations above CVs will not necessarily lead to adverse health effects [ATSDR 2005]. DPH then considers how people may come into contact with the contaminants. Because the level of exposure depends on the route, frequency, and duration of exposure and the concentration of the contaminants, this exposure information is essential to determine if a public health hazard exists.

These values estimate contaminant concentrations unlikely to cause noncancer health effects, or estimate concentrations associated with low risk of cancer (i.e., 1 additional cancer in a million persons exposed). For the CSX Rail Yard site, DPH used the following CVs:

- ATSDR Environmental Media Evaluation Guidelines, or EMEGs. These guidelines are estimates of chemical concentrations of air, soil, and water not likely to cause an appreciable risk of harmful, noncancer health effects for fixed exposure durations. EMEGs reflect several temporal types of exposure: acute (1–14 days), intermediate (15–364 days), and chronic (365 days or more). EMEGs are based on ATSDR's Minimal Risk Levels, or MRLs [ATSDR 2005].
- ATSDR subsurface screening levels for vapor intrusion CVs, or SVI CVs. These subsurface screening levels for vapor intrusion provide screening-level concentrations for groundwater and soil gas to assist with evaluating vapor intrusion.
- ATSDR Cancer Risk Evaluation Guides, or CREGs. These guidelines are media-specific comparison values that identify concentrations of cancer-causing substances unlikely to result in a statistically significant increase in cancer rates in a population exposed over an

entire lifetime. CREGs are derived from U.S.EPA's cancer slope factors, which indicate the relative potency of cancer-causing chemicals. Note, however, that not all carcinogenic compounds have an EPA or state-based cancer slope factor, so not all carcinogens have a CREG [ATSDR 2005].

- EPA Regional Screening Levels, or RSLs. U.S. EPA's Regions III, VI, and IX publish RSLs—concentrations used in initial screening-level evaluations of environmental measurements that can be based on noncancer and cancer outcomes [USEPA 2016a]. These are used in ATSDR assessments when other ATSDR-derived CVs are unavailable.

4.4.1. Surface Water

In the absence of surface water CVs, drinking water CVs were used even though the surface water in the canal is shallow and only dermal contact is likely. At 9 of 10 Waycross Canal sampling locations, surface water TCE and its degradation products *cis*-1,2-DCE, and VC exceeded a drinking water CVs (Appendix D, Table D.1). A less common TCE degradation product, *trans*-1,2-DCE, exceeded its CV in 4 of 10 sample locations, and another less common TCE degradation product, 1,1-DCE, exceeded its CV at one sampling location (Appendix D, Table D.1). The highest historical concentrations of TCE (and degradation products) in the Waycross Canal were reported in a section of the canal approximately 400 feet downgradient from the locomotive paint and air brake shop/old engine house groundwater plume. This section of the Waycross Canal lies between surface water sampling locations W-15 and W-35 (Figure IX). The highest TCE concentrations were found between September 1997 and September 2001. Since March of 2002, however, when horizontal recovery well HWW-1 became operational, no VOCs have been detected in this Waycross Canal section.

Although 1,1-dichloroethane (1,1-DCA) is not a TCE degradation product, 1,1-DCA is a known degreaser and was detected at a low concentration that slightly exceeded cancer risk CVs for surface water (Appendix D, Table D.1). But this exceedance occurred only once in 1996 at surface water sample location W-12. 1,1-DCA has since been reported at less than the detection limit. Table 3 summarizes the chemicals of concern identified for further evaluation.

4.4.2. Sediment

All sediment samples were screened using the ATSDR soil CVs because no sediment CVs are available.

Benzo(b)fluoranthene was the only PAH detected in Waycross Canal sediment, which was sampled for PAHs during 2004 RFI activities. Benzo(b)fluoranthene was found at sample location W-36 (downgradient of the locomotive paint and air brake shop/old engine house groundwater plumes) at a concentration that exceeded the ATSDR CREG (Appendix D, Table D.2).

As part of the 2004 RFI, investigators conducted only one sediment sampling event in the Waycross Canal [ARCADIS 2013a]. Arsenic is the only RCRA metal found in canal sediment that exceeded a noncancer and cancer CV. Arsenic exceeded a CV at 9 of 17 sediment sample locations along the southern boundary of the CSX Rail Yard site (Appendix D, Table D.3).

Appendix D Tables D.1–D.3 show the sampling results for each medium and comparison values used. Table 3 below summarizes the chemicals of concern identified in surface water and sediment.

Table 3: Summary of Chemicals of Concern Evaluated for the CSX Rail Yard Site

Analyte	Surface Water	Sediment
Past, Present and Potential Future Exposure		
Trichloroethene	X	
cis-1,2-Dichloroethene	X	
trans-1,2-Dichlorethene	X	
Vinyl Chloride	X	
1,1-Dichloroethene	X	
1,1-Dichloroethane	X	
Benzo(b)fluoranthene		X
Arsenic		X

4.4.3. Potential for Offsite Vapor Intrusion into Residential Area South of the CSX Rail Yard

The potential remains for offsite migration of the CSX Rail Yard shallow groundwater contaminant plume. But from all the data reviewed for this health assessment (going back to the late 1980s), the groundwater contaminant plume has been primarily contained within the site, which includes property owned by CSX south of the Waycross Canal. The corrective action systems operating at CSX Rail Yard appear to control offsite migration of contaminated shallow groundwater, as noted by decreasing trends [ARCADIS 2015, 2015b, 2016]. For over 2 years, the groundwater monitoring results for the sentinel groundwater monitoring well network have shown no VOCs detected [ARCADIS 2016].

Table 4 below summarizes temporal sampling results in four sentinel groundwater monitoring wells, three of which in the past found VOC concentrations south of the Waycross Canal.

Table 4: Temporal Sample Results in Sentinel Groundwater Monitoring Wells (MW-73, MW-133, MW-112, and MW-88)

VOC	*Location*	*Depth*	*Concentration Range µg/L*	*Number of Samples*	*Mean* µg/L*	*Detected Date Range µg/L*	*CV*	*Type of CV µg/L*
TCE	ODSA MW-73	13-23 feet	1.5 to 8.6	8	3.7	Mar13-Mar15	5.21, 0.55	Groundwater VISL based on RfC, CREG
cis-1,2-DCE			ND to 340	10	93.2	Mar09-Mar16	none	N/A
Vinyl chloride			3.2 to 60	7	17.3	Mar12-Mar16	68, 0.096	Groundwater VISL based on iEMEG, CREG
TCE	ODSA MW-133	14-24 feet	ND	NA	N/A	N/A	5.21, 7.3	Groundwater VISL based on RfC, CREG
cis-1,2-DCE			ND	NA	N/A	N/A	none	N/A
Vinyl chloride			ND	NA	N/A	N/A	68, 0.096	Groundwater VISL based on iEMEG, CREG
TCE	LPABS MW-112	30-50 feet	ND to 15,000	12	2,398	Sep01-Mar08	5.21, 7.3	Groundwater VISL based on RfC, CREG
cis-1,2-DCE			ND to 7.6	12	3.4	Sep02-Mar12	none	N/A
1,1-DCE			7.1	1	7.1	Sep01	74	Groundwater VISL based on iEMEG
Vinyl chloride			ND	NA	N/A	N/A	68, 0.096	Groundwater VISL based on iEMEG, CREG
TCE	LPABS MW-110	30-50 feet	ND to 7.1	10	1.64	Sep01-Mar08	5.21, 7.3	Groundwater VISL based on RfC, CREG
None	LPABS MW-111	10-20 feet	ND	NA	N/A	N/A	N/A	N/A

<table>
<tr><th>VOC</th><th>Location</th><th>Depth</th><th>Concentration Range

µg/L</th><th>Number of Samples</th><th>Mean*

µg/L</th><th>Detected Date Range

µg/L</th><th>CV</th><th>Type of CV

µg/L</th></tr>
<tr><td>TCE</td><td>LPABS
MW-111</td><td>30-50
feet</td><td>ND to 5.7</td><td>3</td><td>4.1</td><td>Sep01-Sep02</td><td>5.21,
7.3</td><td>Groundwater VISL based on RfC,
CREG</td></tr>
<tr><td>TCE</td><td rowspan="2">LSA
MW-88</td><td rowspan="2">13-23
feet</td><td>5 to 38</td><td>6</td><td>15.8</td><td>Mar09-Sept13</td><td>5.21,
7.3</td><td>Groundwater VISL based on RfC,
CREG</td></tr>
<tr><td>cis-1,2-DCE</td><td>ND to 4.5</td><td>5</td><td>1.8</td><td>Sep10-Sept13</td><td>none</td><td>N/A</td></tr>
</table>

VOC: volatile organic compound
TCE: trichloroethene
cis-1,2-DCE: *cis*-1,2-dichloroethene
µg/L: micrograms of contaminant per liter of water
*Non-detects were included in the mean using the detection limit
CV: comparison value
ODSA: Old Drum Storage Area
LPABS: Locomotive Paint and Air Brake Shop
LSA: Locomotive Shop Area
Groundwater VISL: Groundwater Vapor Intrusion Screening Level = Air RfC, iEMEG, or CREG / (Henry's Law Constant x Groundwater Attenuation Factor [0.001] x Unit Conversion Factor [1000 L/m^3]) (ATSDR September 2016)
RfC: EPA reference concentration for air exposures (June 2017)
iEMEG: ATSDR Environmental Media Evaluation Guide for intermediate exposure to air (November 2016)
CREG: Cancer Risk Evaluation Guide (November 2016)
ND: not detected at the limit indicated
N/A: not applicable
Bolded values are above a comparison value.

4.4.3.1. Old Drum Storage Area

Above-CV detections of TCE, *cis*-1,2-DCE, and VC in groundwater monitoring well-73, or MW-73, were found between March 2010 and March 2016. Still, since the redevelopment of the old drum storage area vertical recovery wells in 2013, groundwater contaminant migration stemming from the old drum storage area south of the Waycross Canal appears substantially curtailed. VOC concentrations exceeding CVs in groundwater downgradient of the old drum storage area are contained on CSX Rail Yard property. And since sentinel groundwater monitoring well MW-133 was installed downgradient of MW-73, MW-133 has not detected any VOCs [ARCADIS 2015, 2015b, 2016].

Without the recovery system on, groundwater plume migration from the HPT-11A boring location (where the highest VOC concentrations were found in groundwater) would take approximately 3–4 years to migrate under the properties of nearby residents [ARCADIS 2014b]. That said, however, the capture zone of the existing old drum storage area recovery well system extends south of the Waycross Canal to monitoring wells MW-73 and 74, and the ongoing groundwater recovery efforts there preclude offsite migration [ARCADIS 2015, 2015b, 2016].

Moreover, physical characteristics of the subsurface soils and groundwater encountered during downgradient groundwater investigation indicate organic, rich sediments and reducing conditions in the subsurface south of the Waycross Canal. These conditions are normally conducive to natural reductive dechlorination of chlorinated VOCs and could further control VOC mass migration south of the Waycross Canal. During the last 10 years, *cis*-1,2-DCE and VOCs have increasingly appeared in many old drum storage area downgradient monitoring wells. Such increasing appearance is evidence that natural attenuation is occurring in the groundwater plume.

The lateral extent of groundwater contamination was fully characterized during the 2013 soil and groundwater investigation. DPH has found no evidence that the old drum storage area groundwater plume has ever migrated into the neighborhood south of the CSX Rail Yard facility. Thus DPH does not expect vapor intrusion would become a source of any future VOC exposure in that neighborhood.

4.4.3.2. Locomotive Paint and Air Brake Shop

After the December 2001 installation of horizontal recovery well-1, TCE levels decreased significantly. Since 2008, TCE has not been detected in MW-112 (30–50' horizon). Moreover, sentinel groundwater monitoring wells MW-109 and 110 (except for TCE detected one time at a concentration of 1.3 µg/L in March 2008) downgradient of MW-112, have not shown any TCE detections since horizontal recovery well #1 was installed. The increasing appearance of low *cis*-1,2-DCE concentrations (ranging from nondetect to 3.7 µg/L) from March 2007 to March 2012 is evidence that in this groundwater plume, natural attenuation is occurring.

The residences nearest the locomotive paint and air brake shop groundwater plume are directly south of a wooded area (Figure V) owned by CSX and approximately 300 feet south of MW-112. The closest private well is approximately 1,500 feet directly south of this southernmost breachment of the locomotive paint and air brake shop/old engine house groundwater plume (P-82 as shown in Figure IV). As noted, a municipal facility supplies potable water to residences in this area. Moreover, DPH has found no evidence that the locomotive paint and air brake shop groundwater plume has ever migrated into the neighborhood south of the CSX facility. Thus DPH does not expect vapor intrusion to be a source of any future VOC exposure in that neighborhood.

4.4.3.3. Locomotive Shop Area/ Old Cleaning Vats Sludge Pond

Since the installation of sentinel groundwater monitoring well-88 in 1995, annual sampling events detected no VOCs until March 2009, when TCE was detected at a concentration of 5 µg/L. Subsequent sampling events through September 2013 showed TCE detected at concentrations ranging from nondetect to 38 µg/L (with a mean TCE concentration of approximately 16 µg/L over this period), and *cis*-1,2-DCE concentrations ranging from nondetect to 4.5 µg/L. When TCE was detected at 38 µg/L in September 2013, follow-up sampling occurred at MW-88 in November and December 2013, and in March, May, and July of 2014. None these sampling events detected any VOCs. In one March 2013 sampling event, tetrachloroethene (PCE) was detected at a concentration of 13 µg/L, but overall, VOCs were detected in MW-88 in only five annual sampling events over a 21-year period. In eight sampling events since then, through September 2015, VOCs have not been detected at all.

The installation and operation of horizontal recovery well #3 appears to have prevented any continued migration of the locomotive shop area/old cleaning vat sludge pits groundwater contamination plume. Horizontal recovery well #3 has particularly stopped any migration south of the Waycross Canal. Because no sampling data south of MW-88 are extant, DPH cannot evaluate whether vapor intrusion from site related VOCs exist in a residence located approximately 100 feet south of MW-88. However, DPH does not expect vapor intrusion to be a source of VOC exposure at concentrations that would lead to adverse health effects in the neighborhood south of the CSX Rail Yard. This is because TCE concentrations in MW-88 would have likely been diluted in the underlying shallow aquifer to below vapor intrusion groundwater screening levels before reaching nearby residences south of the CSX Rail Yard. Additionally, incremental samples obtained from MW-88 one, two, five and six months after the highest TCE was detected (38 µg/L in September 2013) decreased to nondetect levels. Since that time no VOCs have been detected in MW-88 [ARCADIS 2016].

4.5 Exposure Assumptions

In this and any health assessment, evaluation assumptions could contribute to analytical uncertainty. Thus, to evaluate exposure to surface water and sediment in the Waycross Canal, DPH used reasonable, conservative exposure assumptions.

Photo showing a section of the Waycross Canal referred to in exposure assumptions. Photo taken in early December 2016 after a period of heavy rainfall. Photo credit to the Georgia District 9-2 Environmental Health Office.

Note, however, that no site-specific exposure data are available for the frequency, duration, or specific activities of people, and especially children, wading in the Waycross Canal. But in exposure scenarios, children are of particular importance. They usually spend more time outdoors and tend to ingest more soil and surface water than do adults. In fact, through increased hand-to-mouth behaviors, children are considered a high-risk and sensitive population. DPH spoke with a life-long Waycross resident. This resident remembered as a 6-year-old child playing in the Waycross Canal about 1 mile downstream of the CSX facility,[10] wading shoeless in the canal with friends to catch minnows and frogs. The water was only about 4 to 6 inches deep and never came up to his calves. Most of the time, the water level was just over his feet. He didn't play in it a lot, but remembers sloshing around in it after ball games. He said that today the canal seems to contain more vegetation than it did when he was a child, and the water level seems higher. Recent contractor measurements show that the Waycross Canal water level fluctuates from about 6 inches to 1 foot. But in heavy downpours during wet periods, this Waycross resident has seen the level probably rise to approximately 4 to 6 feet. Using this admittedly limited account of playing in the Waycross Canal as a representative sample, DPH evaluated

[10] October 6, 2015 e-mail correspondence with the Southeast District 9-2 (Waycross) Environmental Health Director, Georgia Department of Public Health. His office is near the Waycross Canal, and he crosses it every day on his commute to work.

children between the ages 6 to 11 years as the most vulnerable population that could be exposed to contaminants in surface water and sediment in the Waycross Canal. Note here that no sports facilities or parks are near the Waycross Canal section that runs along the CSX Rail Yard site's southern boundary, thus limiting the possible presence of children in the area.

Other evaluation uncertainties include the bioavailability of metals. Bioavailability is dependent on several factors, including the chemical characteristics and physical forms of a contaminant [ATSDR 2005]. For exposure to sediment in the Waycross Canal, DPH assumed 3% bioavailability (dermally absorbed fraction) and 60% bioavailability (ingestion) for arsenic, and a 13% (dermally absorbed fraction) and 100% (ingestion) bioavailability for benzo(b)fluoranthene [USEPA 2004].

DPH estimated exposure doses for children between the ages of 6 to < (less than) 11 who could occasionally contact surface water and sediment in the Waycross Canal and who could be exposed to either the 95UCL[11] concentrations of VOCs or the maximum concentrations of benzo(b)fluoranthene and arsenic in the Waycross Canal (see Toxicological Evaluation below). DPH chose a health-protective exposure assumption of 1 day per week for 4 months per year to estimate past exposures to site-related contaminants in the Waycross Canal during a period in which historical concentrations were at their highest levels—that is, before the horizontal recovery wells were fully operational. For this evaluation, in the approximate 400-foot section of the Waycross Canal (W-15 to W-35) where the highest historical surface water VOC concentrations were found, DPH used 95 UCL concentrations of TCE, *cis*-1,2-DCE, *and* 1,2-DCE, to estimate exposure doses and to determine a possible need to analyze upstream and downstream any past and current VOC concentrations found in the Waycross Canal.

4.6 Toxicological Evaluation

When persons are exposed to a hazardous substance, several factors determine whether health effects occur; several factors also determine the type and severity of health effects associated with chemical exposure. Such factors include:

- Chemical concentration,
- Frequency and duration of exposure,
- Route of exposure (e.g., ingestion, inhalation) and
- Cumulative exposures (i.e., the combination of chemicals and routes of exposures).

Once exposure occurs, individual characteristics such as age, sex, nutritional status, genetics, lifestyle, and health status influence how that exposed person absorbs, distributes, metabolizes, and excretes the chemical. These characteristics, together with the exposure factors discussed above and the toxicological effects of the substance, determine the nature and extent of any health effects.

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[11] The 95 percent upper confidence level (UCL) is a statistical number that represents the mean concentration, with 95 percent confidence that the true arithmetic mean concentration for the medium evaluated will be less than the UCL.

In its toxicological evaluation, DPH estimated the exposure doses for each chemical of concern using conservative exposure assumptions. DPH then compared these doses with health guidelines.

DPH evaluated the possibility of noncancer and cancer health effects for those contaminants that exceeded CVs. Contaminants that have both cancer and noncancer health outcomes were evaluated for both endpoints. The American Cancer Society estimates 1 in 3 Americans will get will get some form of cancer during their lifetime. That means for every 10,000 people, 3,333 will get some kind of cancer. General information on cancer in provided in Appendix F.

DPH used the following health guidelines and cancer potency information, some of which have been previously referenced:

- Minimal Risk Levels, or MRLs: Estimates of daily human exposure to a substance likely without an appreciable risk of adverse, noncancer health effects over a specified exposure duration. MRLs are based on a no-observed-adverse-effect level (NOAEL) or a lowest-observed-adverse-effect level (LOAEL) [ATSDR 2015b]. ATSDR derives and disseminates MRLs.
- References Doses, or RfDs: Estimates—with uncertainty spanning perhaps an order of magnitude—of a daily oral exposure to the human population (including sensitive subgroups) likely without an appreciable risk of deleterious noncancer effects during a lifetime of exposure. U.S. EPA derives and disseminates RfDs.
- Cancer Slope Factors, or CSFs: Estimates of a specific substance's carcinogenicity. To obtain lifetime cancer risk estimates, a chronic daily exposure dose is calculated based on the concentration, frequency, and length of exposure. This chronic daily exposure, averaged over a lifetime, is then multiplied by the CSF to calculate the excess cancer risk above the normal cancer baseline for a community. U.S. EPA derives and disseminates CSFs.

4.6.1 Uncertainties

Like exposure assumptions, toxicological evaluations also include uncertainties. Toxicity studies usually involve adult animals, whereas human studies often use worker populations exposed to high contaminant concentrations. Little information is available to evaluate exposures to multiple chemicals (mixtures), or evaluate adverse health effects from exposure to very low contaminant levels over long periods. To account for some of these differences (e.g., adjusting from high dose to low dose, animal to human, short-term to long-term exposures, adult to child exposure), health guidelines build in uncertainty factors.

While the evaluation of potential noncancer effects and cancer conducted at this site do not predict if any one person will develop such health effects, it does enable us to assess the level of health concern related to exposure to a substance and to that substance's concentration and toxicity, and the exposure dose estimates can be used as the basis to make recommendations about reducing exposures to protect public health, as needed. The selection of health –protective exposure assumptions as part of this assessment may result in an overestimation of the actual exposures that are occurring.

4.6.2 Surface Water

DPH evaluated the 95 UCL concentrations of TCE, *cis*-1,2-DCE, and 1,1-DCE in surface water for past exposures in a Waycross Canal section that spans approximately 400 feet and is downgradient from the locomotive paint and air brake shop/old cleaning vat sludge pit groundwater plume. This Waycross Canal section lies between sampling locations W-15 and 35, where the highest past concentrations of contaminants of concern, or COCs, were found.[12] A statistical approach identifies the most appropriate representative concentrations of COCs in surface water. Consistent with U.S. EPA methodology, the lower of the maximum concentration and the 95 percent upper confidence limit, or 95 UCL, of the mean is used as the exposure point concentration [USEPA 2002]. The 95 UCLs are calculated using ProUCL 5.0 software available from U.S. EPA [USEPA 2010]. Nondetected values are assumed equal to the detection limit [USEPA 2002]. The UCL is a statistical number that represents the mean concentration, with 95 percent confidence that the true arithmetic mean concentration for the medium evaluated will be less than the UCL. This high level of confidence compensates for the uncertainty involved in representing site conditions with a finite number of samples.

The individual contaminants are evaluated by calculating the exposure dose and building the Hazard Quotient, or HQ—the ratio of the exposure dose over the MRL or RfD. If the HQ is greater than 1, these exposures must be evaluated further to determine if there is a noncancer health risk. If multiple COCs were found, their HQs are usually added, resulting in a Hazard Index, or HI. If the resulting HI is greater than 1, further evaluation is needed to determine whether exposures could be harmful. If the resulting HI is less than 1, further evaluation is not necessary; exposures to multiple COCs will not result in noncancer harmful effects, even to the most sensitive populations.

4.6.3 Noncancer Health Effects

4.6.3.1 Surface Water

Table 5 below shows the estimated exposure doses for dermal absorption and ingestion of Waycross Canal surface water using the assumptions described above and in Appendix E:

Table 5: Noncancer Dermal and Ingestion Dose Estimates for Children between 6 to <11 Years Old from Exposure to Surface Water between Sample Locations W-15 to W-35 in the Waycross Canal

Chemical of Concern	Exposure Point (95UCL) Concentration mg/L	Estimated Dermal Exposure Dose mg/kg/day	Estimated Ingestion Exposure Dose mg/kg/day	Combined Exposure Dose mg/kg/day	Health Guideline Value mg/kg/day	Hazard Quotient (unitless)
1,1-DCE	0.1	7.7×10^{-6}	2.8×10^{-7}	8.0×10^{-6}	0.009 MRL	0.0009

[12] Between September 1989 through September 2001 at surface water sampling location W-15 and between October 1997 through September 2001 for surface water sampling location W-33. Surface water sampling locations W-31, W-32, W-34, and W-35 were sampled one time in 1997.

cis-1,2-DCE	0.9	5.1×10^{-5}	2.5×10^{-6}	5.3×10^{-5}	0.002 RfD	0.027
TCE	1.4	2.3×10^{-4}	3.9×10^{-6}	2.35×10^{-4}	0.0005 MRL	0.47
Hazard Index from exposure to all the chemicals of concern in surface water						0.50

TCE: trichloroethene
cis-1,2-DCE: *cis*-1,2-dichloroethene
1,1-DCE: 1,1-dichloroethene
95UCL: 95 percent upper confidence limit. A statistical number calculated to represent the mean concentration with 95 percent confidence that the true arithmetic mean concentration for the medium evaluated will be less than the UCL. This high level of confidence is used to compensate for the uncertainty involved in representing site conditions with a finite number of samples.
mg/L: milligrams of contaminant per liter of surface water
mg/kg/day: milligrams of contaminant per kilogram of body weight per day
MRL: ATSDR minimal risk level (February 2017)
RfD: USEPA reference dose (June 2017)

For past exposures, the hazard quotient for exposure to surface water from dermal contact and incidental ingestion for all VOCs was below 1. For the combined estimated exposure doses, the hazard index (combined HQs) is also below 1. From the individual hazard quotients, exposure to TCE is more relevant than does exposure to 1,1-DCE or *cis*-1,2-DCE; in fact, this exposure dose is approximately 2 times less than the minimal risk level, or MRL. Again, the MRL is an estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful, noncancerous health effects. Thus, DPH does not expect any noncancer health effects from past or present exposure to VOCs in Waycross Canal surface water.

As stated, children between the ages of 6 to 11 years and up are the most sensitive and the most likely exposed population at this site. It should be noted that since horizontal recovery well operations began, VOC concentrations, as reported either semiannually or annually, have not been detected in most Waycross Canal surface water sample locations. Of the VOCs that have been detected sporadically since horizontal recovery system installation, the predominant VOC detected in the Waycross Canal has been *cis*-1,2-DCE, but at concentrations far lower that the drinking water CV.

4.6.3.2 Sediment

Because of limited sediment sampling data in the Waycross Canal, DPH used the maximum contaminant concentrations found in the sediment to provide a health-protective exposure assessment. The Waycross Canal—the area of likely exposure—is easily accessible to trespassers off Hamilton Avenue and Ted Snyder Road, both of which run near the southern CSX Rail Yard site boundary.

In 1993, U.S. EPA provided guidance for quantitatively assessing exposure to PAHs [USEPA 1993]. This guidance provides a systematic approach to the way PAHs can be evaluated as benzo[a]pyrene (the most toxic PAH) toxic equivalents. The benzo[a]pyrene-toxic equivalent (BaP-TE) is a derived concentration of the seven most common PAHs, with their specific concentrations adjusted for their toxicity relative to benzo[a]pyrene (BaP). These specific PAHs and relative toxicities expressed as toxic equivalent factors, or TEFs, are:

PAH compound	***TEF***
• Benzo[a]pyrene	1
• Benz[a]anthracene	0.1
• Benzo[b]fluoranthene	0.1
• Benzo(k)fluoranthene	0.01
• Chrysene	0.001
• Dibenz(a,h)anthracene	1
• Indeno[1,2,3-cd]pyrene	0.1

BaP-TE equals the sum of the individual concentrations multiplied by their respective TEF. The estimated benzo(b)fluoranthene exposure dose was evaluated and estimated as a BaP-toxic equivalent where the respective concentrations found in sediment are adjusted for toxicity relative to benzo[a]pyrene.

Although cumulative dermal absorption values for PAHs were reported at 10% [Turkall 2010], DPH used the recommended dermal absorption factor for soil and sediment of 0.13 (or 13%) for benzo(b)fluoranthene [USEPA 2004]. For arsenic, DPH used the recommended dermal absorption factor for soil and sediment of 0.03 (or 3%) for arsenic [USEPA 2004].

Table 6 below shows the estimated exposure doses for dermal absorption of sediment in the Waycross Canal:

Table 6: Noncancer Dermal Dose Estimates for Children between 6 to <11 Years from Exposure to Sediment in the Waycross Canal (Data from 2004)

Chemical of Concern	Exposure Point (Maximum) Concentration mg/kg	Estimated Ingestion Exposure Dose mg/kg/day	Estimated Dermal Exposure Dose mg/kg/day	Combined Exposure Dose mg/kg/day	Health Guideline Value mg/kg/day	Hazard Quotient (unitless)
Arsenic	208	8.6×10^{-6}	2.1×10^{-6}	1.1×10^{-5}	0.0003 MRL	0.036
Benzo(b)fluoranthene BaP-TE	0.036	2.5×10^{-9}	1.6×10^{-9}	4.1×10^{-9}	0.0003 RfD	0.00001
Hazard Index from exposure to all the chemicals of concern in sediment						0.04

mg/kg: milligrams of contaminant per kilogram of sediment

mg/kg/day: milligrams of contaminant per kilogram of body weight per day

MRL: ATSDR minimal risk level (February 2017)

RfD: USEPA reference dose (June 2017)

BaP-TE: The toxic equivalent of benzo(b)fluoranthene to benzo(a)pyrene, which equals the highest concentration of benzo(b)fluoranthene multiplied by the toxic equivalent factor (TE) of 0.1 for benzo(b)fluoranthene.

Again, using the conservative assumptions described above and in Appendix E, for past exposures the hazard quotient for exposure to sediment from dermal contact to arsenic and benzo(b)fluoranthene was below 1, while the hazard index (combined HQs) was also below 1. From the individual hazard quotients, exposure to arsenic is more relevant than exposure to benzo(b)fluoranthene; this exposure dose is significantly below the MRL. Thus, DPH does not expect any adverse health effects from past or present exposure to any arsenic and benzo(b)fluoranthene in Waycross Canal sediment.

4.6.3.3 Potential for Offsite Vapor Intrusion into Residential Area South of the CSX Rail Yard

DPH cannot evaluate whether people were exposed to site-related chemicals in the indoor air of homes in the past as a result of soil vapor intrusion because these data are not available. DPH's primary concern for vapor intrusion south of the CSX Rail Yard is related to the Locomotive Shop Area/Old Cleaning Vats Sludge Pond groundwater plume, where over a five-year period (between March 2009 and September 2013), low levels of VOCs were detected in monitoring well-88. Sampling results showed that TCE increased from 2 µg/L in March 2013 to 38 µg/L in September 2013, and then decreased to nondetect levels (< 1µg/L) one month later in November 2013. Since November 2013, TCE or any other VOC has not been detected in monitoring well-88 [ARCADIS 2017].

Although the groundwater velocity (hydraulic conductivity) in the Locomotive Shop Area groundwater plume has not been measured directly, a groundwater flow velocity of 17.7 feet/day was measured in the Old Refuse Area Number 2/Old Runoff Pond groundwater plume located approximately 1000-1200 feet east of monitoring well-88 [ARCADIS 2013a]. If groundwater velocity in the Locomotive Shop Area is similar, groundwater sampled at a point in time in monitoring well-88 would have travelled over 6000 feet south/southeast of the Rail Yard in one year, being diluted by shallow groundwater underlying the residential neighborhood south of the CSX Rail Yard and beyond.

For these reasons, DPH does not expect vapor intrusion to be, or to have been, a source of VOC exposure at concentrations that would lead to adverse health effects in the neighborhood south of the CSX Rail Yard.

Collecting soil gas or shallow groundwater data downgradient of MW-88 nearer the potentially affected residential properties at this time would not allow DPH to determine if resident were exposed to site-related contaminants in the past, or currently. However, if site-related contaminants are once again detected in any sentinel groundwater monitoring wells, DPH recommends that CSX pursue immediate downgradient soil gas and shallow groundwater sampling to determine the extent of downgradient contaminant migration and take measures to prevent further migration of contaminants into nearby residential areas.

The potential for future Waycross Canal contaminant exposure depends largely on whether 1) the CSX Rail Yard horizontal and vertical recovery wells malfunction, and 2) any abatement is unduly prolonged. That said, however, delay in prompt malfunction abatement is unlikely. As stated, the CSX Rail Yard site is a permitted, hazardous waste treatment facility under close

Georgia Environmental Protection Division scrutiny. CSX would likely discover any malfunction during its 7-day per week recovery system inspections and report this malfunction to EPD as required. CSX Rail Yard maintenance logs note that employees or others usually complete any required maintenance or repairs within 3 days. EPD receives semiannual reports of such maintenance or repairs. Nonetheless, if any prolonged recovery system malfunction should occur, DPH, if requested, would revisit its exposure evaluation for such an event.

4.4.3.4. Ambient Air

DPH cannot currently evaluate whether the air emissions from the CSX Rail Yard site may impact the health of the community because no ambient air data exists. However, the CSX Rail Yard is operating under an Air Quality Synthetic Minor Permit issued by the EPD for locomotive painting and sandblasting, and for emergency generators and firewater pumps. The permit requires CSX Rail Yard to calculate the amount of VOCs and hazardous air pollutants (HAPs) associated with paint usage on a monthly basis as well as the mass of emissions associated with the use of emergency generators and the firewater pump. In 2016, CSX reported 5.52 tons of VOCs and 1.54 tons of HAP emissions from facility operations; well below 100 tons of VOCs and 10 tons of HAPs emissions allowed by permit over a consecutive 12-month period.

Records indicate that chlorinated solvents have not been used at the CSX Rail Yard in the past 20 years. An air quality monitoring program for these compounds would not be effective because there are no current emissions, and present measurements would not provide any information about past exposure.

Exposures to diesel exhaust are difficult to precisely quantify because of its complex composition, and because many of its components are also emitted from other sources, such as tobacco smoke, manufacturing emissions, and woodsmoke or formed through atmospheric photochemical processes. No single constituent of diesel exhaust serves as a unique marker of exposure, although fine particles and elemental carbon have been used as surrogates of exposure to diesel exhaust particulate matter (PM). Consequently, many researchers have used the particles in diesel exhaust to quantify exposure to whole diesel exhaust [OEHHA 1998].

As described previously, diesel exhaust particles are primarily composed of aggregates of spherical carbon particles coated with organic and inorganic substances. Because of their size, these particles can be inhaled and eventually trapped into the bronchial and alveolar regions of the lung. Many of these substances are mutagenic, cytotoxic, or carcinogenic [OEHHA 1998]. In experimental studies of acute exposure, healthy human subjects have shown increased symptoms of irritation and compromised pulmonary function after short-term exposure. Additional studies have shown that diesel exhaust particles influence localized immunological components involved with allergic reactions. There have also been cases of newly developed asthma reported in workers exposed to diesel exhaust [OEHHA 1998].

Most human epidemiologic studies did not find an excess of chronic respiratory disease associated with diesel exhaust. However, animal data indicate that chronic respiratory disease can result from long-term exposure to decrease resistance to infection and increase chronic inflammation [OEHHA 1998]. Based on the animal studies, the U.S. EPA determined a chronic inhalation Reference Concentration (RfC) value of 5 micrograms per cubic meter for noncancer effects of diesel exhaust associated with pulmonary inflammation and changes in lung tissue. An RfC of a chemical is an estimate, with uncertainty spanning perhaps an order of magnitude, of the air concentration below which no noncancer adverse health effects are likely to occur from lifetime exposure.

Current emissions, including diesel exhaust, from the facility have not been characterized through air monitoring or modeling. Modeling of emissions using an accurate emissions inventory, or targeted air quality monitoring for compounds associated with diesel emissions would provide a better understanding of air quality in the area surrounding the CSX Rail Yard.

4.6.4 Contaminants of Concern with Cancer-Causing Health Effects

From records of past exposure to contaminants in the Waycross Canal, Georgia DPH identified five chemicals of concern identified as carcinogens. These COCs also have cancer slope factors, or CSFs, that we can use to estimate cancer risk:

1. Arsenic,
2. Benzo(b)fluoranthene
3. 1,1-dichloroethane,
4. Trichloroethene, and
5. Vinyl chloride.

To estimate cancer risk from exposure to the above contaminants in Waycross Canal sediment, DPH used the estimated exposure dose, the duration of exposure for the assessed target population, and contaminant's cancer slope factor to estimate a lifetime risk of developing cancer from this exposure.

4.6.4.1 Arsenic

Several studies have shown that ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs. Inhalation of inorganic arsenic can increase lung cancer risk [ATSDR 2007a]. The U.S. Department of Health and Human Services (DHHS) and the U.S. EPA have determined that inorganic arsenic is a known human carcinogen. The International Agency for Research on Cancer (IARC) has also determined that inorganic arsenic is carcinogenic to humans.

4.6.4.2 Benzo(b)fluoranthene

The Department of Health and Human Services has determined that some polycyclic aromatic hydrocarbons (PAHs), which includes benzo(b)fluoranthene, may reasonably be expected to be carcinogens. Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer) [ATSDR 2005b].

4.6.4.3 1,1-Dichloroethane, or 1,1-DCA

One rat-and-mouse study found persuasive evidence that 1,1-dichloroethane could cause cancer. But the study had several flaws, thus the results are not conclusive. Another long-term study involved mice that drank water containing 1,1-dichloroethane. The study authors did not find evidence of cancer associated with this exposure [ATSDR 2015]. The DHHS and the IARC have not evaluated 1,1-dichloroethane's carcinogenic potential. U.S. EPA, however, has determined that 1,1-dichloroethane is a possible human carcinogen.

4.6.4.4 Trichloroethene, or TCE

Strong evidence suggests that TCE can cause kidney cancer in people. Other evidence points to the conclusion that TCE can cause cancer and malignant lymphoma. Lifetime TCE exposure resulted in increased liver cancer in mice and increased kidney cancer and testicular cancer in rats [ATSDR 2014].

U.S. EPA recently released an extensive toxicological review of TCE, which reclassified TCE as "carcinogenic to humans by all routes of exposure" [USEPA 2011]. The National Toxicology Program (NTP) has also determined that TCE is "known to be carcinogenic" [DHHS 2016]. But kidney cancer studies provide the most consistent and convincing evidence of an association between TCE exposure in humans and cancer. Moreover, scientists have found compelling links between TCE exposure and cancers of the lymphoid tissues (lymphoma) and liver [USEPA 2011]. And the IARC also classifies TCE as "carcinogenic to humans."

4.6.4.5 Vinyl Chloride, or VC

The DHHS has determined that vinyl chloride is a known carcinogen. Studies in workers who breathed in vinyl chloride over many years showed an increased risk of liver, brain, lung cancer; some cancers of the blood have also been observed in such workers [ATSDR 2006]. The IARC, U.S.EPA, and the NTP have all determined that VC is a known human carcinogen.

4.6.4.6 Diesel Particulate Matter (PM)

Many carcinogenic compounds are found in diesel exhaust. Compounds found in the vapor phase include benzene, formaldehyde, 1,3-butadiene, and ethylene dibromide. At least 16 hydrocarbons that are classified as possibly carcinogenic (IARC Classification 2B) to humans are adsorbed on the exhaust particles. Additionally, benzo(a)pyrene, benzo(a)anthracene, and dibenzo(a,h)anthracene, which are classified as probably carcinogenic to humans (IARC Classification 2A), are adsorbed on the particles [OEHHA 1998].

Over 30 epidemiological studies have investigated the potential carcinogenicity of diesel exhaust. The epidemiological evidence primarily concerns cancer of the lung. There were no published industrial hygiene measurements of diesel exhaust exposures for any of the study populations. Therefore, exposures have generally been defined indirectly by occupation and duration of employment [OEHHA 1998]. The World Health Organization (WHO) also evaluated the carcinogenicity of diesel exhaust in 1996 and found that the epidemiological data are consistent in showing weak associations between exposure to diesel exhaust and lung cancer. However, the California Office of Environmental Health Hazard Assessment (OEHHA) found increased risk of lung cancer from exposure to diesel PM. Unlike the WHO, who selected a range of risks based only upon animal studies and then estimated risks based on human studies, OEHHA selected a range of risks based only on human studies of rail yard workers occupationally exposed to diesel PM [OEHHA 1998].

4.6.5 Cancer Risk Conclusions

Appendix E shows estimated excess lifetime cancer risk estimates for children ages 6 to 11 years from exposure to arsenic, benzo(b)fluoranthene, 1,1-dichloroethane, trichloroethene, and vinyl chloride based on 5 years' exposure. DPH reached the following conclusions in our cancer risk estimate:

> The overall arsenic, benzo(b)fluoranthene, 1,1-DCA, TCE, and VC exposure from incidental ingestion and dermal contact with surface water and sediment in the Waycross Canal results in estimated cancer risks (i.e., number of additional cancers in a population of 1 million persons exposed to the same concentrations of VOCs) of approximately
>
> - 1 in a million for arsenic,
> - 2.6 in 10 billion for benzo(b)fluoranthene
> - 1.5 in 10 billion for 1,1-dichloroethane,
> - 9.8 in 10 million for trichloroethene, and
> - 1.7 in 100 million for vinyl chloride.

These estimates are considered to be very low cancer risks and DPH concludes that children who might have been exposed to site-related contaminants in the Waycross Canal are not expected to be at risk for cancer.

On December 17, 2015, EPA released the most recent update to the National Air Toxics Assessment[13] (NATA). NATA contains emissions data from 2011 and uses models to make broad estimates of health risks over geographic areas of the country. The 2011 NATA assessment includes emissions, ambient concentrations, and exposure estimates for 180 of the 187 Clean Air Act air toxics plus diesel particulate matter. For 138 of these air toxics (those with health data based on chronic exposure), the assessment includes cancer or non-cancer health effects, or both, including non-cancer health effects for diesel PM. The NATA estimates the excess cancer risk from exposure to ambient air in Waycross, Georgia to range between 44 and 62 excess cancer cases in a million persons exposed to ambient air in Waycross over a lifetime of 70 years. This risk estimate is similar to cancer risk estimates from Tifton, Valdosta, and Albany, Georgia.

5 Community Health Concerns

DPH identified the community health concerns for Waycross and Ware County using reviews of historical information and individual email requests and reports sent to staff at

[13] https://www.eoa.gov/national-air-toxics-assessment/nata-overview

- DPH,
- ATSDR,
- U.S. EPA, and
- EPD.

DPH also used information collected from

- Local public health, and the DPH Epi-On-Call System,
- Public meetings,
- Local media coverage, and
- Input from community leaders and advocacy groups.

DPH staff spoke on the phone with several residents living in Waycross who are experiencing health issues themselves or who know of other residents with health issues. Self-reported health conditions included cancer, benign masses, and respiratory and neurological symptoms. Appendix G lists symptoms and diseases DPH obtained from the beginning of our investigation into Waycross sites (July 2013) through publication of the second health consultation for the Seven Out site (April 2014) along with the age, sex, year of onset of the health condition, and disease symptoms. Note, however, that DPH has not validated these self-reported conditions. And analyses of reported symptoms and diseases do not indicate any trends in illnesses, nor are the numbers any higher of any specific illness among a specific group than would be expected (e.g., children with typically adult onset cancer). Note that the data do not contain enough information (e.g., age of employees, length of residency, lifestyle factors, type of cancer) to conclude definitively that residents are not experiencing elevated rates or incidences of illness. Still, many illnesses reported are common, most descriptions are vague, and the terms “mass” and “tumor” include numerous diagnoses.

5.1 Silent Disaster

Since July 2013, numerous DPH, ATSDR, U.S. EPA, and EPD staff have received hundreds of emails[14] from a few persons representing “Silent Disaster,” a Waycross, Georgia based grassroots organization. Silent Disaster claimed residents’ health problems resulted from exposure to environmental contamination from local industries, including a former industrial site known as “Seven Out." Silent Disaster further claimed increases in the number of cancer cases and in the prevalence of noncancer health conditions.

In mid-September 2013, DPH met with EPD and U.S EPA staff, then notified community leaders and residents that we would investigate and evaluate the Seven Out site and issue a health consultation regarding our assessment of any health risk(s) the site posed. In November 2013, U.S. EPA held a public meeting to discuss Seven Out. In attendance was DPH’s Chemical Hazards Program staff, Waycross District Health Department, EPD, and U.S. EPA staff. DPH staff also attended two other public meetings during this time.

[14] DPH staff members usually respond to e-mails within 24–48 hours of receipt.

In January 2014, the first health consultation for the Seven Out site provided community members, local elected officials, and the media with a health consultation summary fact sheet and web site link to the health consultation. In April 2014, DPH published and distributed a second health consultation for the Seven Out site. In July 2014, U.S. EPA, EPD, and DPH hosted a public meeting to present the health consultation findings to the community and to hear additional comments and health concerns. At this meeting, DPH's Chemical Hazards Program staff committed to conducting a health consultation for the CSX Rail Yard. With that commitment both U.S. EPA and EPD said that pending DPH's findings, they would not conduct additional sampling or investigation activities for any Waycross sites.

Between July 2014 and September 2014, CHP worked with residents, Silent Disaster and their consultants, the Satilla Riverkeeper, and other community members to construct and distribute a community health education needs assessment survey. Plans were developed to send multiple copies of the survey to physicians and other health care providers, pharmacists, and the business sector to make the public aware of the survey and to rally participation. Following numerous rounds of edits and widespread support from community members, the Silent Disaster representative notified DPH that they declined to participate or recommend participation in the survey, stating, "This survey is not designed to help the community and is actually designed to disprove any correlation to the contamination in the area and the health problems." DPH received no further communication regarding the survey.

In July 2015, some Waycross residents reported health concerns and asked DPH and other agency staff to conduct a cancer cluster investigation in the Waycross area. In September 2015, DPH hosted a conference call with Waycross residents and with staff from EPD, ATSDR, and the Waycross Water Department to report on the requested cancer cluster investigation, explain the CSX Rail Yard health assessment process, discuss noncancer health concerns, and answer questions from Waycross residents and community leaders. In March 2016, ATSDR held a public meeting and launched a web site (www.atsdr.cdc.gov/sites/waycross) dedicated to the Waycross community. The web site highlights current media and community events and informs the public regarding the health assessment process.

During December 2015, DPH reviewed self-reported symptoms and diseases from an online survey conducted by Silent Disaster. The online survey's objective was to collect self-reported health information on persons with health conditions, including their children, neighbors, and relatives. Reported symptoms and diseases included

allergies	digestive disorders
anxiety disorders	memory problems
autoimmune diseases	miscarriages
benign tumors	neurological impairments
different types of cancer	respiratory infections

Report analyses do not indicate any illness trends. But much of the data do not contain essential information such as sex, age of disease onset, length of residency in the community, and formal diagnoses. All this information is necessary to determine possible elevated rates or numbers of cases of specific illness among residents in a specific geographic location.

5.2 Cancer Cluster Investigation

Cancer clusters are an occurrence of a greater than expected number of cases of cancer within a group of people, a defined geographic location, or a specific period. Cancer clusters can result from a variety of causes.

Investigating cancer clusters in Georgia is a responsibility of the Georgia Comprehensive Cancer Registry, or GCCR. This population-based registry collects, maintains, and analyzes cancer incidence data in Georgia. A team of epidemiologists, statisticians, and other cancer experts continually identify and evaluate cancer morbidity and mortality trends and problems, and develop strategies and policies for prevention, control, and treatment. Find more information at www.dph.georgia.gov/georgia-comprehensive-cancer-registry or by contacting DPH using the Epi-On-Call System at (404) 657-2588 between 8AM and 5PM Monday through Friday. Concerned persons can also report a suspected cancer cluster to their local health department. GCCR is responsible for determining how any proposed cancer inquiry should proceed.

In 2013 and 2015, GCCR conducted cancer cluster investigations for Ware and Pierce Counties. Cancer incidence data were analyzed for the general population for 2006–2010 for Ware and Pierce Counties, and District 9-2. Additionally, childhood cancer incidence data were analyzed for 2001–2010, 2010–2013, and again in 2015. Reports documenting the results of these investigations were provided to the media and community leaders, and to residents on request. For copies of these reports, contact Epi-On-Call and reference "Southeast Georgia Childhood Cancer Inquiry–Spring 2013" and "Southeast Georgia Childhood Cancer Inquiry–Summer 2015 Update."

In July 2015, a person brought to DPH's attention four "sarcoma" cases. After DPH completed and reported on that investigation, someone else reported to DPH another childhood cancer case. This report was about another "sarcoma" diagnosed in 2015 in neighboring Brantley County. Investigation revealed a true cancer case, but the case-patient's residence was more than 14 miles outside of the areas identified as of environmental concern. DPH recommends continued surveillance in Ware and Pierce Counties. Findings from the most recent (2015) report include:

- Georgia Comprehensive Cancer Registry data show that over the past decade, childhood cancer incidence has been below the expected rates for District 9-2. The overall age-adjusted invasive childhood cancer incidence rate in Health District 9-2 is 146.3 per million persons. This is significantly lower than the rate for Georgia (160.7 per million).

- Pierce County has experienced a recent increase in the number of childhood cancer cases (an average of one new case per year between 2003 to 2012 among children ages 0-19). This slight uptick in the number of cases appears to be isolated to 1 year and one common cancer type (leukemia). No excess cases have been reported in the most recent years. And the overall numbers are trending back down toward expected levels, tending toward the conclusion that this one-time increase was due to chance. Ongoing surveillance, however, will track overall cancer rates.

- The cancer cases listed in the investigation were spread throughout Ware and Pierce Counties. No geographic clustering was found.

- The types of cancer found among the four cases in the investigation do not have known environmental risk factors. The cancer types of these cases included bone cancer and varying types of soft tissue sarcomas. See, in this regard, (www.cancer.org/cancer/ewingfamilyoftumors/detailedguide/index and www.cancer.org/cancer/rhabdomyosarcoma/detailedguide/index).

- Except for laryngeal and lung cancers, cancer incidence in general is significantly lower in District 9-2 than in the rest of the state. Higher incidence of laryngeal and lung cancers in District 9-2 might be due to elevated smoking rates among residents.

6 Child Health Considerations

In communities faced with contamination of the water, soil, air, or food, DPH recognizes that the unique vulnerabilities of infants and children demand special emphasis. Due to their immature and developing organs, infants and children are usually more susceptible to toxic substances than are adults. Children are more likely to be exposed to contamination because they play outdoors, and they often bring food into contaminated areas. They are also more likely to encounter dust, soil, and contaminated vapors close to the ground. Children are generally smaller than are adults, which results in higher doses of chemical exposure because of lower body weights relative to adults. In addition, the developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages.

This health assessment uses child-specific exposure factors such as body weights, intake rates, and skin exposure areas as the basis for calculating exposures to contaminants found in surface water and sediment. Because the resulting exposure doses for children are higher than comparable adult exposure doses, they represent the basis for the following public health conclusions and recommendations.

7 Conclusions

DPH evaluated past, current, and potential future exposure to contaminants of concern from surface water and sediment at the CSX site in Waycross, Georgia. All conclusions were based on site visits, interviews, and review of available data and reports.

DPH concludes that:

1. Past and current exposures to chemicals in the surface water and sediment in the Waycross Canal are not likely to harm the health of children and adults who made wade or play in the area.

2. DPH cannot conclude whether breathing contaminants in air near the CSX Rail Yard site in the past, currently, or in the future could harm people's health.

3. DPH cannot conclude whether people were exposed to chemicals in the indoor air of homes in the past as a result of soil vapor intrusion because these data are not available. However, based on extensive groundwater sampling results and continuous remediation activities at the rail yard, DPH does not expect vapor intrusion to be a source of volatile organic compound (VOC) exposure at concentrations that would lead to adverse health effects in the neighborhood south of the CSX Rail Yard.

4. People in the Waycross community are not being exposed to CSX Rail Yard site-related contaminants in their drinking water, which is derived from municipal water obtained from the Floridan aquifer. Waycross requires a municipal well connection for all residential properties within the city limits.

8 Recommendations

DPH recommends:

1. CSX, under EPD oversight, maintain the groundwater treatment system operating at the site and monitor the groundwater contamination plume to ensure that chemicals do not migrate off the site into the neighboring community. Maintenance of vertical and horizontal groundwater recovery wells should include preventive measures to preclude calcification and iron-fouling (such as well flushing and periodic redevelopment) of recovery well screens.
2. CSX, under EPD oversight, sample downgradient soil gas and shallow groundwater if site-related contaminants are once again detected in sentinel groundwater monitoring wells to determine the extent of downgradient contaminant migration and take measures to prevent contaminant migration into nearby residential area. Sentinel monitoring well-88 is of particular concern because of the close proximity to residences located downgradient in the direction of groundwater flow.
3. CSX establish a deed restriction to limit site use to commercial/industrial purposes and to restrict site groundwater use for purposes other than monitoring because groundwater and soil contamination underlying the CSX Rail Yard is extensive and because remediation efforts are likely to continue many years from now.
4. CSX conduct periodic monitoring of indoor air and soil gas and take any necessary measures to protect the health of their workers, particularly as they relate to indoor air in buildings overlying the groundwater contamination plume and areas with extensive soil contamination. Although the results of indoor air sampling from CSX's vapor intrusion investigation reported that concentrations of trichloroethene, tetrachloroethene and associated hydrocarbons indicated no significant carcinogenic risk or non-cancer hazard to personnel that work within and around onsite building structures, significantly high concentrations of trichloroethene remain in sub-slab soil gas underneath the locomotive shop, which is a vapor intrusion and worker health concern.
5. EPD consider air modeling in the area surrounding the CSX Rail Yard to better characterize current diesel emissions and air quality.

9 Public Health Action Plan

DPH will:

1. Distribute this a copy of this health assessment or a fact sheet summarizing our findings to the Petitioner, to EPD, and to any Waycross residents who request copies.
2. Address public comments to this health assessment.
3. Provide technical assistance to assess the health risks to workers in site occupied buildings resulting from vapor intrusion at the request of the EPD.
4. Share this health assessment with the National Institute for Occupational Safety and Health and Occupational Safety and Health Administration to inform them of the potential exposure pathways for workers.
5. If a prolonged groundwater recovery system failure occurs, and abatement is not prompt, DPH, if requested, will revisit its exposure evaluation for the CSX Rail Yard site.
6. Collaborate with EPD on air modeling in the area surrounding the CSX Rail Yard at EPD's request.

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Report Authors and Reviewers

This public health assessment for the CSX Transportation – Rail Yard site was prepared by the Georgia Department of Public Health 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.

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Figures

Figure I: Site Location, Topographical Features, and Solid Waste Management Units

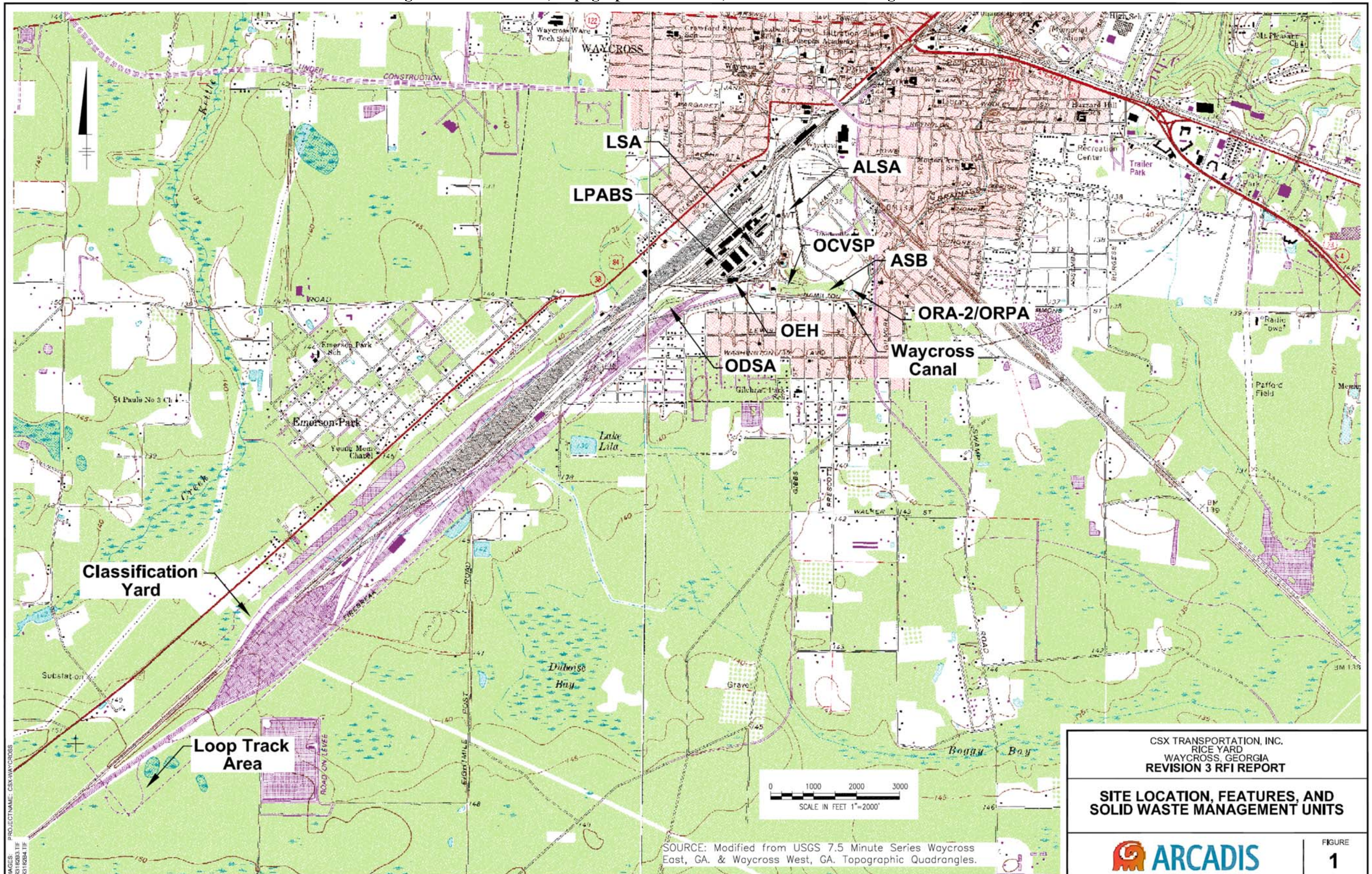


Figure II: CSX Rail Yard Map Showing Groundwater Flow Directions

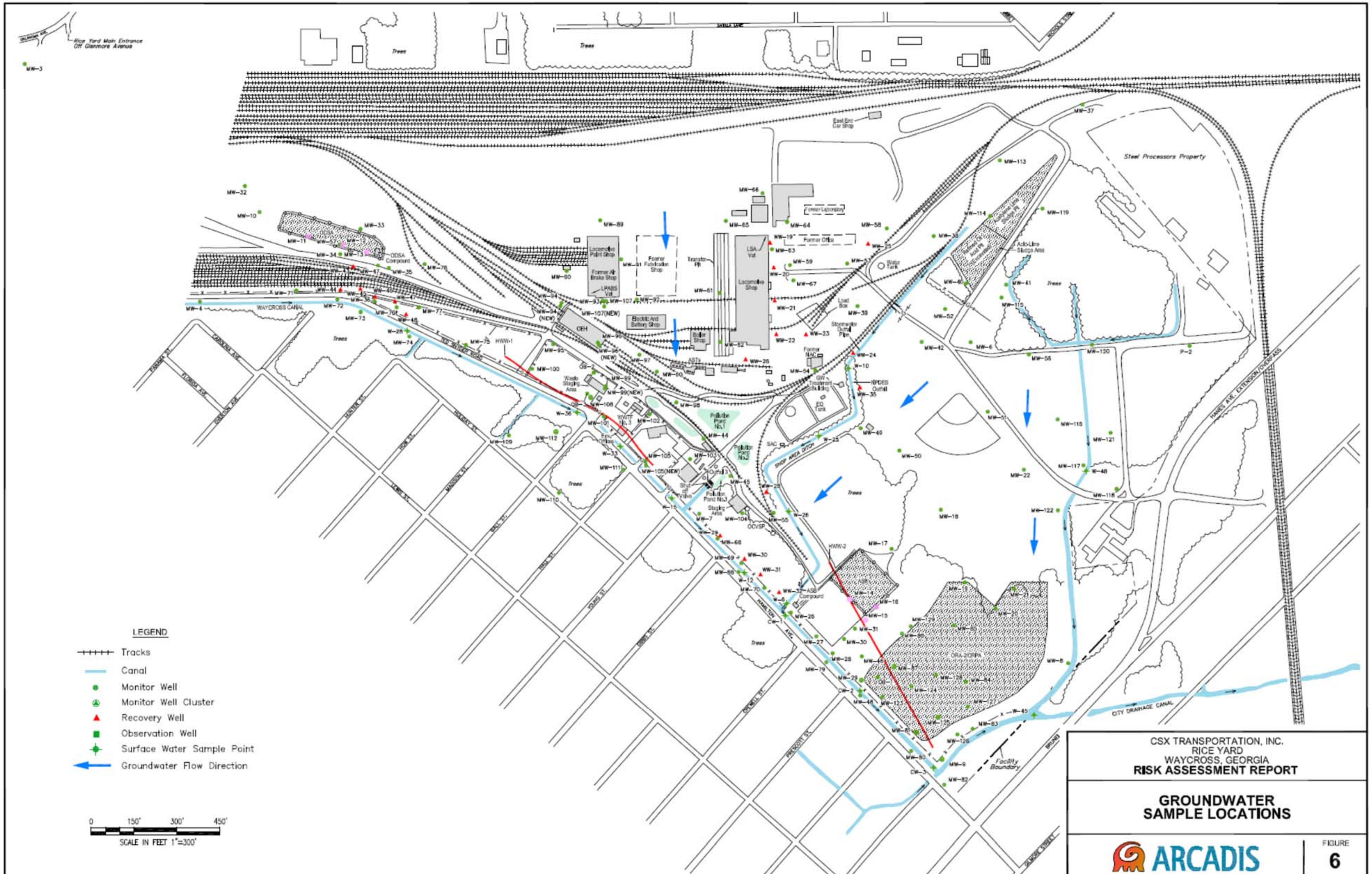


Figure III: Site and Demographic Snapshot

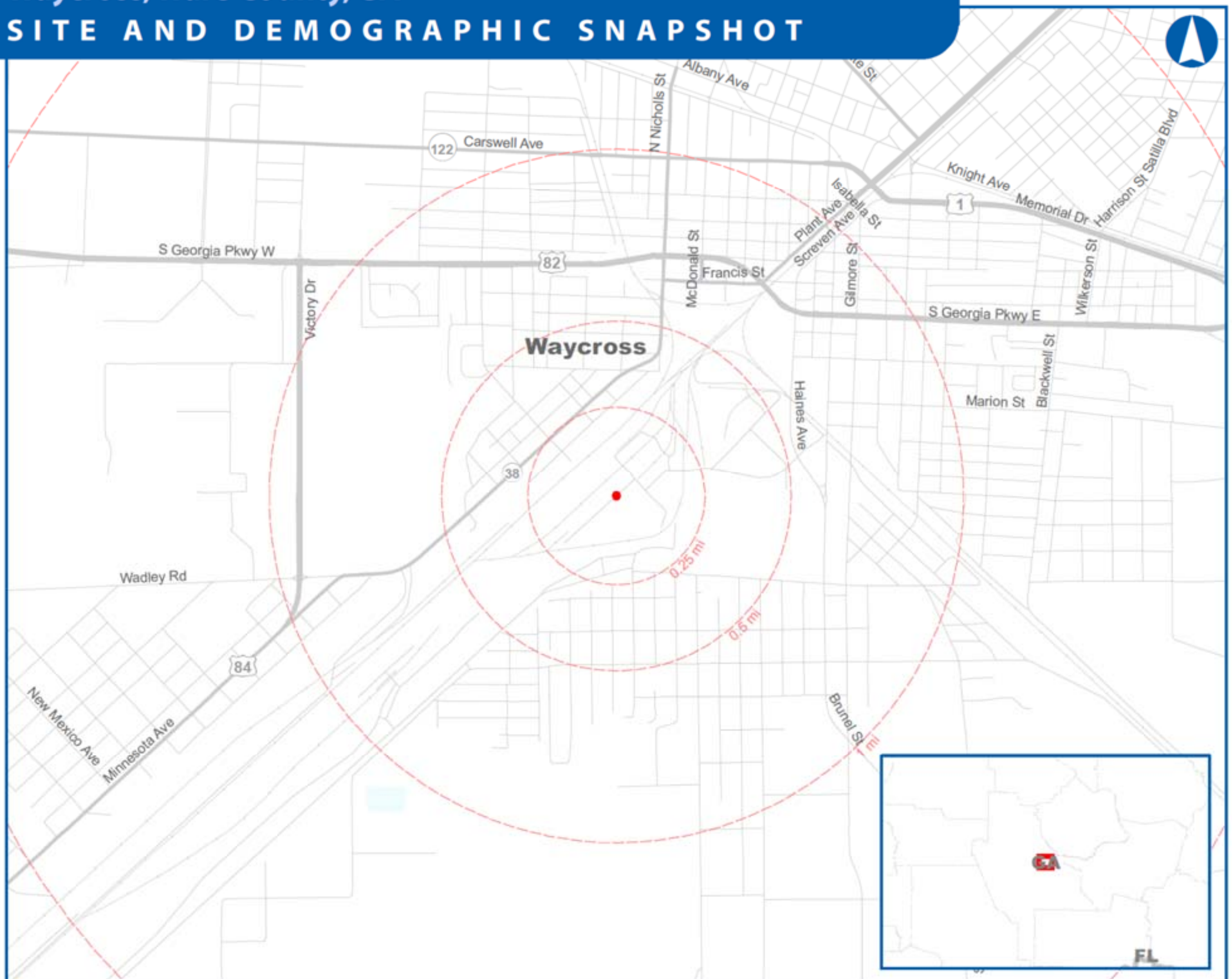
Csx Transporation - Waycross Facility

Waycross, Ware County, GA

SITE AND DEMOGRAPHIC SNAPSHOT

EPA FACILITY ID GASAIDS4487

INTRODUCTORY MAP SERIES



Site of Interest[1] | Park[3] | Airport[3] | Neighboring County[3]

Site of Interest Buffers[2] | Industrial[3] | Military Base[3]

0 — 0.5 — 1 Miles

Demographic Statistics[4,5]

Within 1 mile buffer of site boundary

Measure	2000	2010	Change	Measure	2000	2010	Change
Total Population	4,121	3,862	-6%	Two or More Races	37	88	+137%
White Alone	1,915	1,553	-18%	Hispanic or Latino[6]	75	166	+121%
Black Alone	2,118	2,105	+0%	Children Aged 6 and Younger	428	533	+24%
Am. Indian & AK Native Alone	4	16	+300%	Adults Aged 65 and Older	460	386	-16%
Asian Alone	18	7	-61%	Females Aged 15 to 44	881	837	-4%
Native Hawaiian & Other Pacific Islander Alone	0	0	+0%	Housing Units	1,966	1,867	-5%
Some Other Race Alone	33	89	+169%	Housing Units Pre 1950	161	217	+34%

Data Sources: [1]ATSDR GRASP Hazardous Waste Site Boundary Database. [2]ATSDR GRASP. [3]TomTom International BV (2012). [4]US Census 2010.
Notes: [5]Calculated using area-proportion spatial analysis method. [6]Individuals identifying origin as Hispanic or Latino may be of any race.
Projection: NAD 1983 StatePlane Georgia East FIPS 1001 Feet.

PRJ 04691 IWE7 8/5/15

GRASP

Agency for Toxic Substances and Disease Registry

Division of Toxicology and Human Health Sciences

ATSDR

FINAL - FOR PUBLIC RELEASE

Figure IV: Public and Private Water Supply Wells

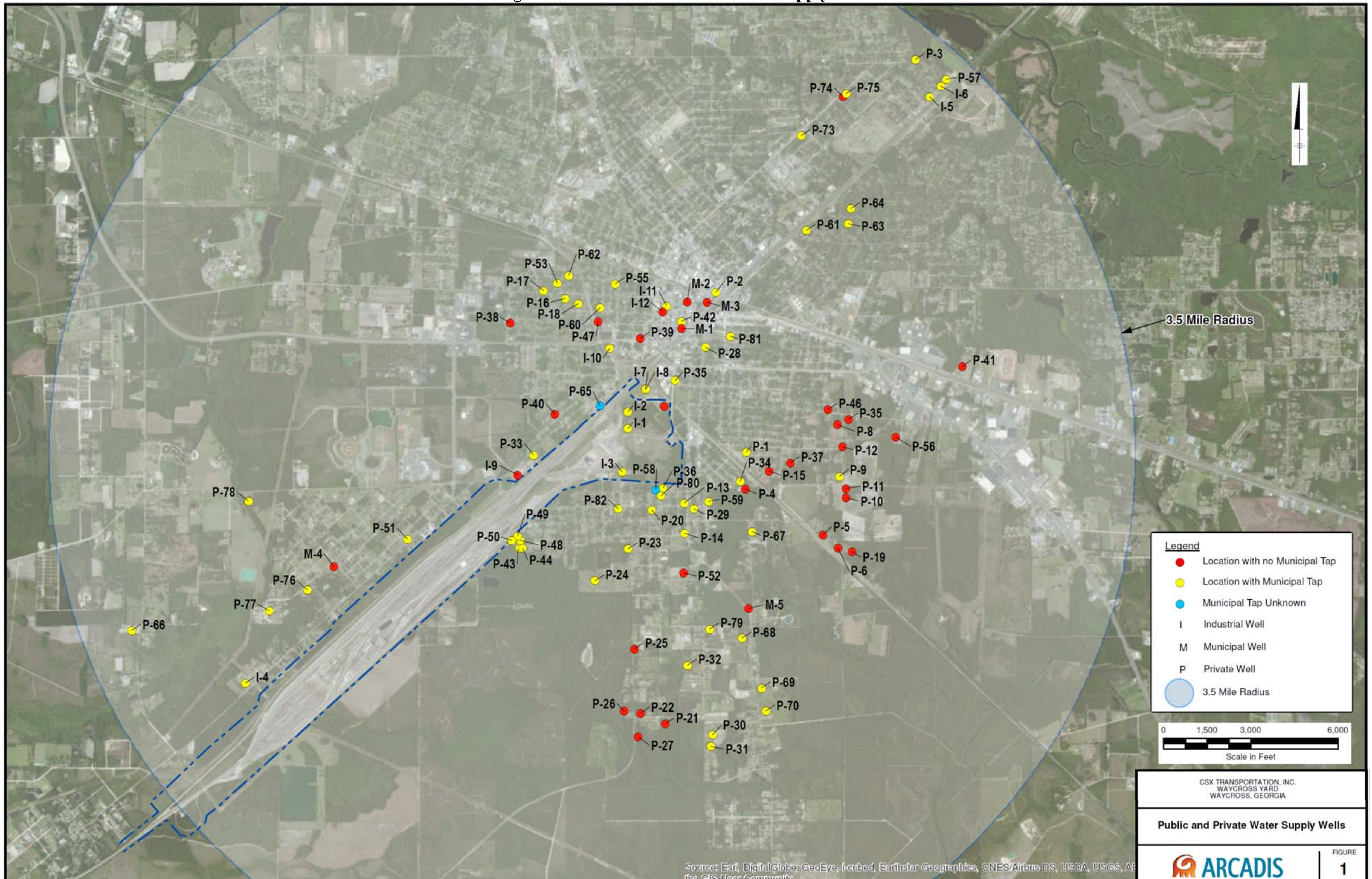


Figure V: Site Features and Regulated Waste Management Units and Groundwater Monitoring Wells

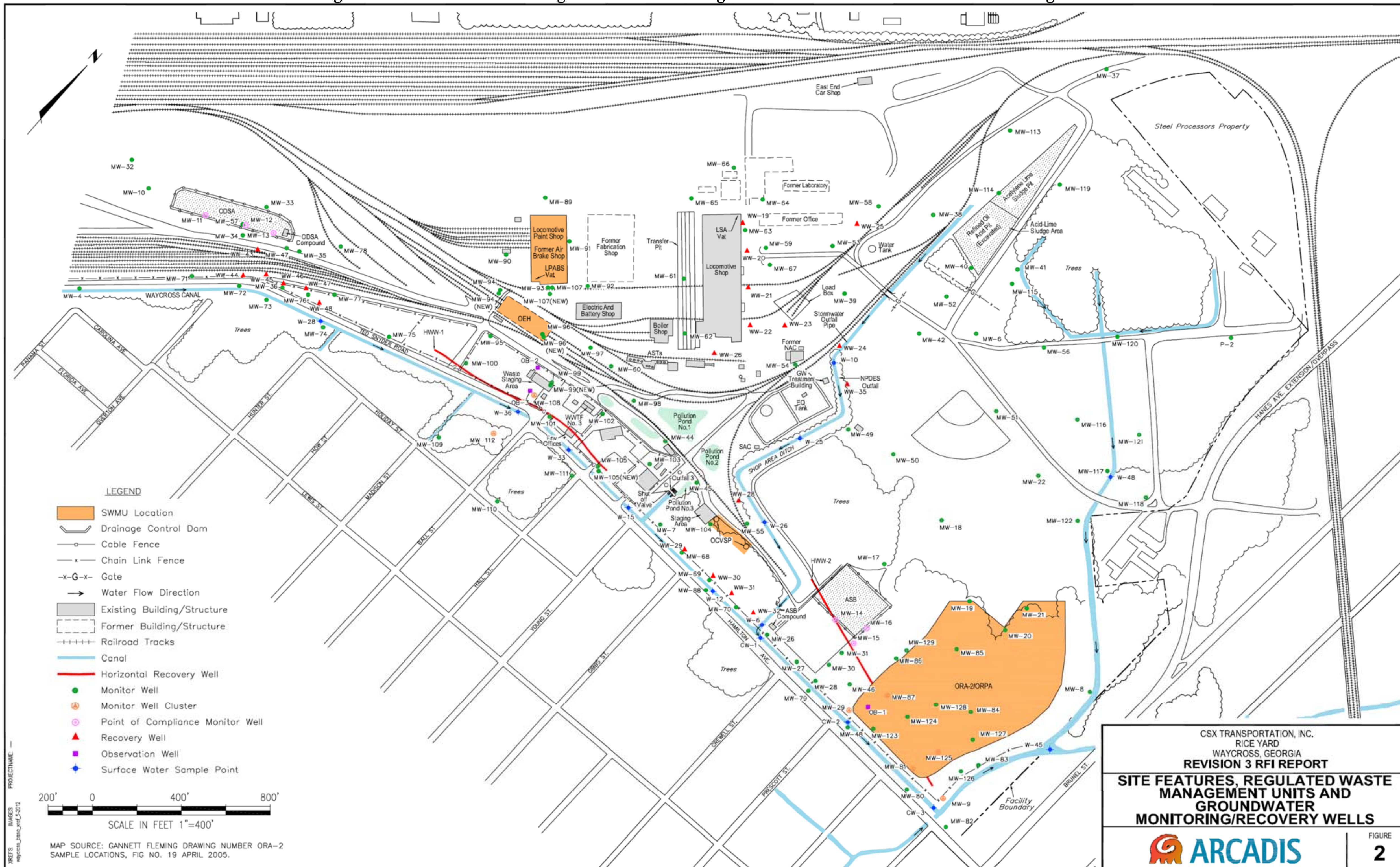


Figure VI: CSX Rail Yard Site Layout

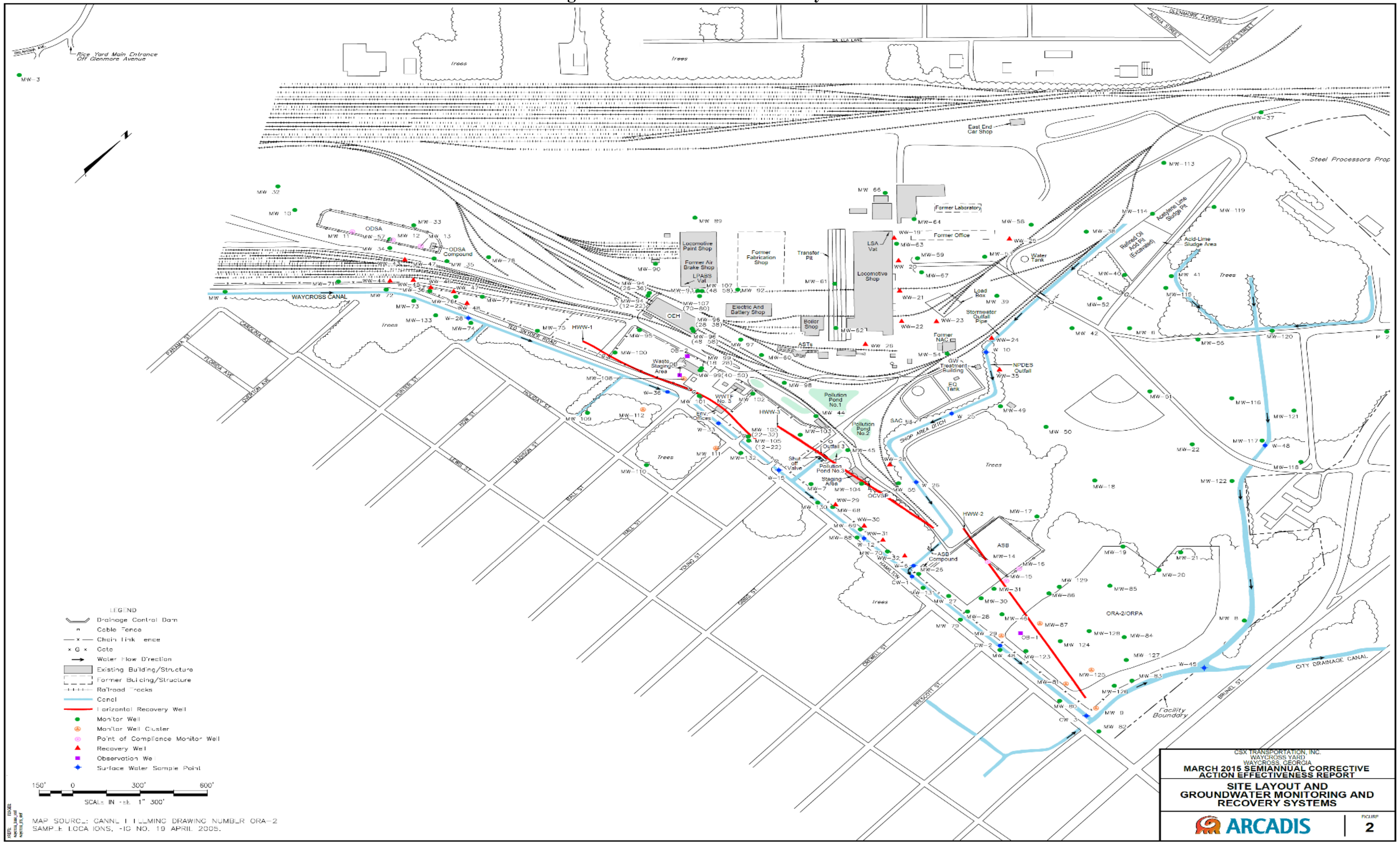


Figure VII: Potentiometric Surface of Shallow Groundwater (Recovery System On)

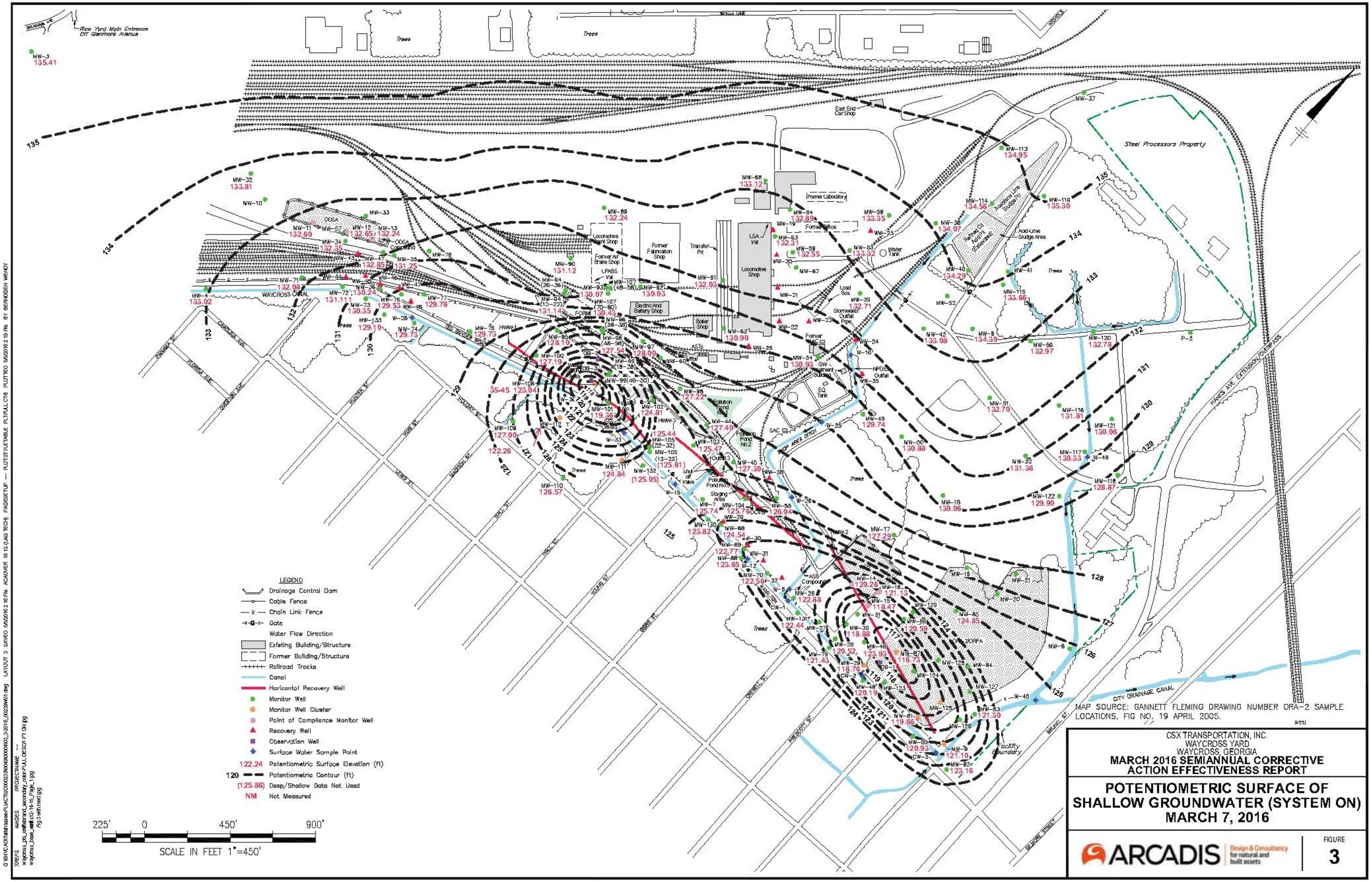


Figure VIII: Potentiometric Surface of Shallow Groundwater (Recovery System Off)

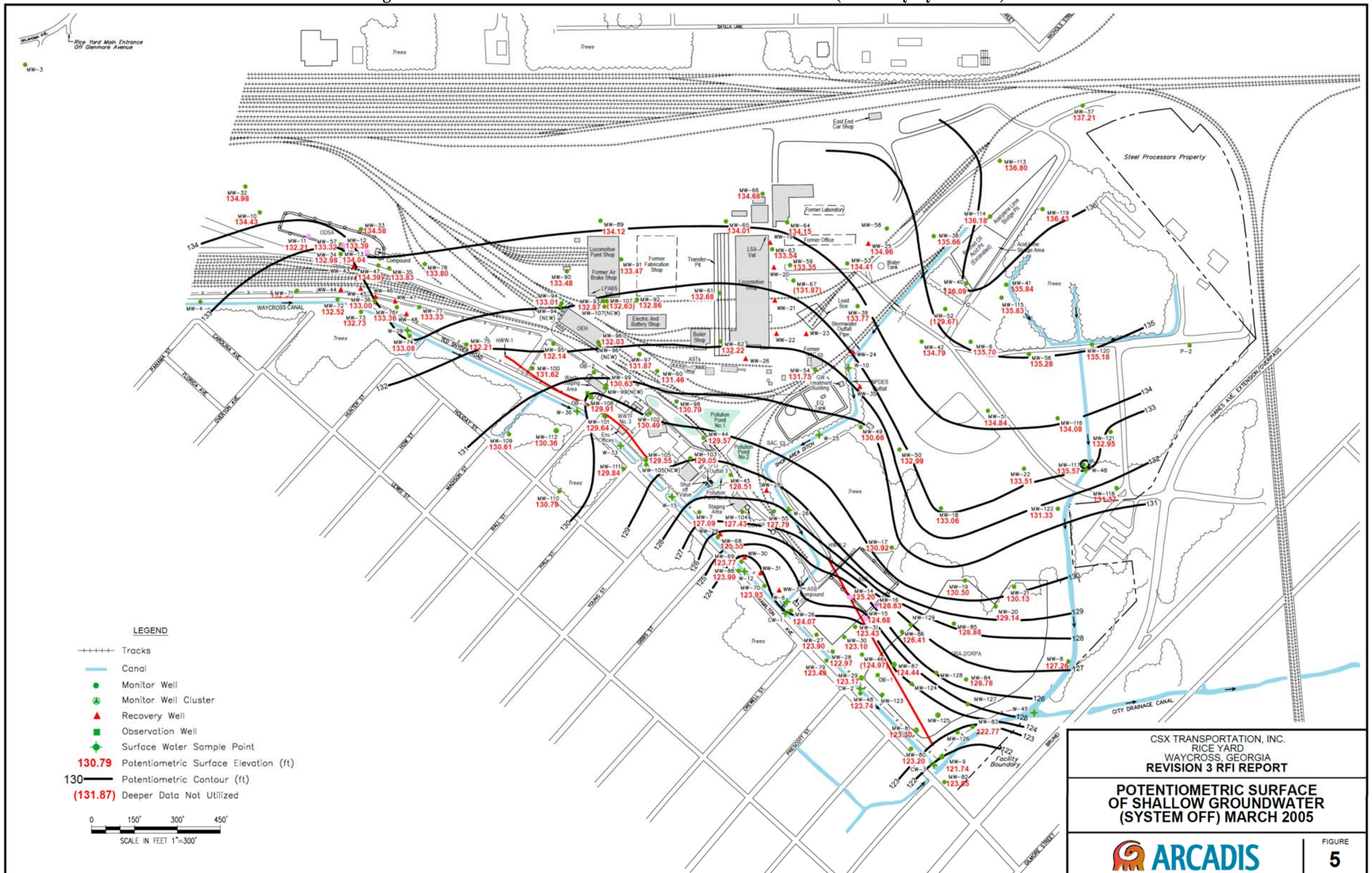


Figure IX: Sediment and Surface Water Sample Locations

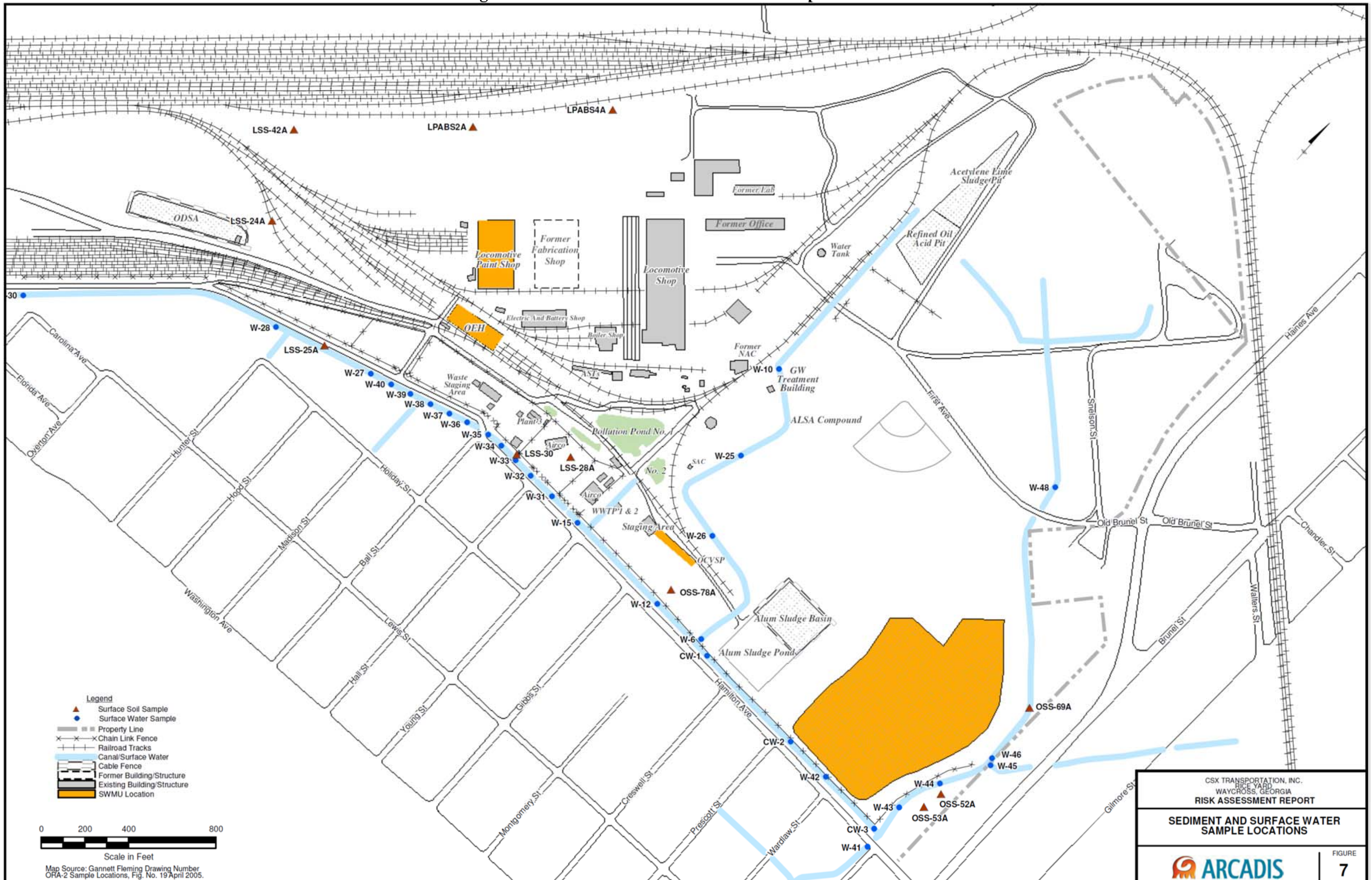


Figure X: Cross Section D-D' LPABS and OEH

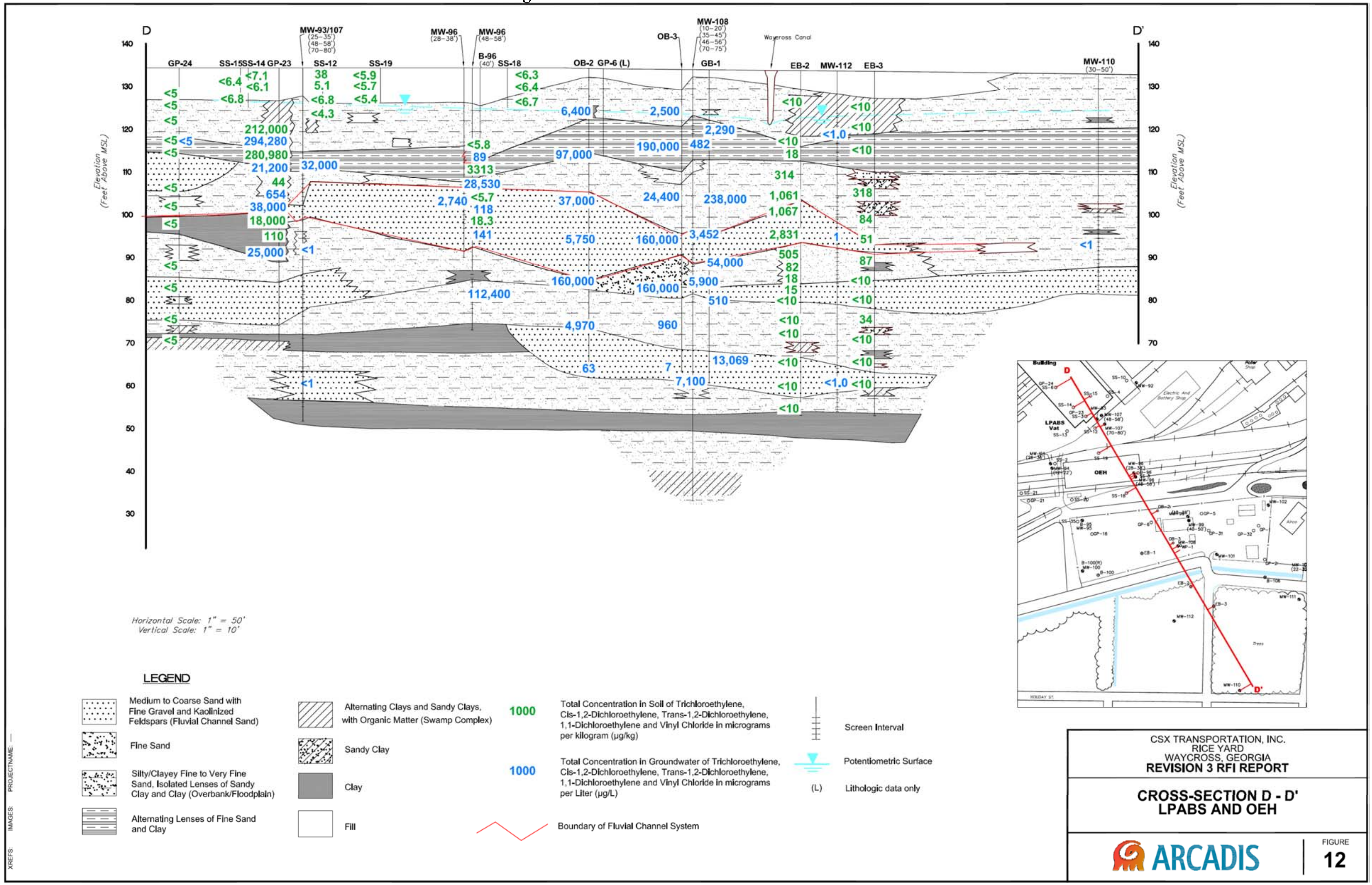


Figure XI: TCE Concentration Isopleth Map in 2001

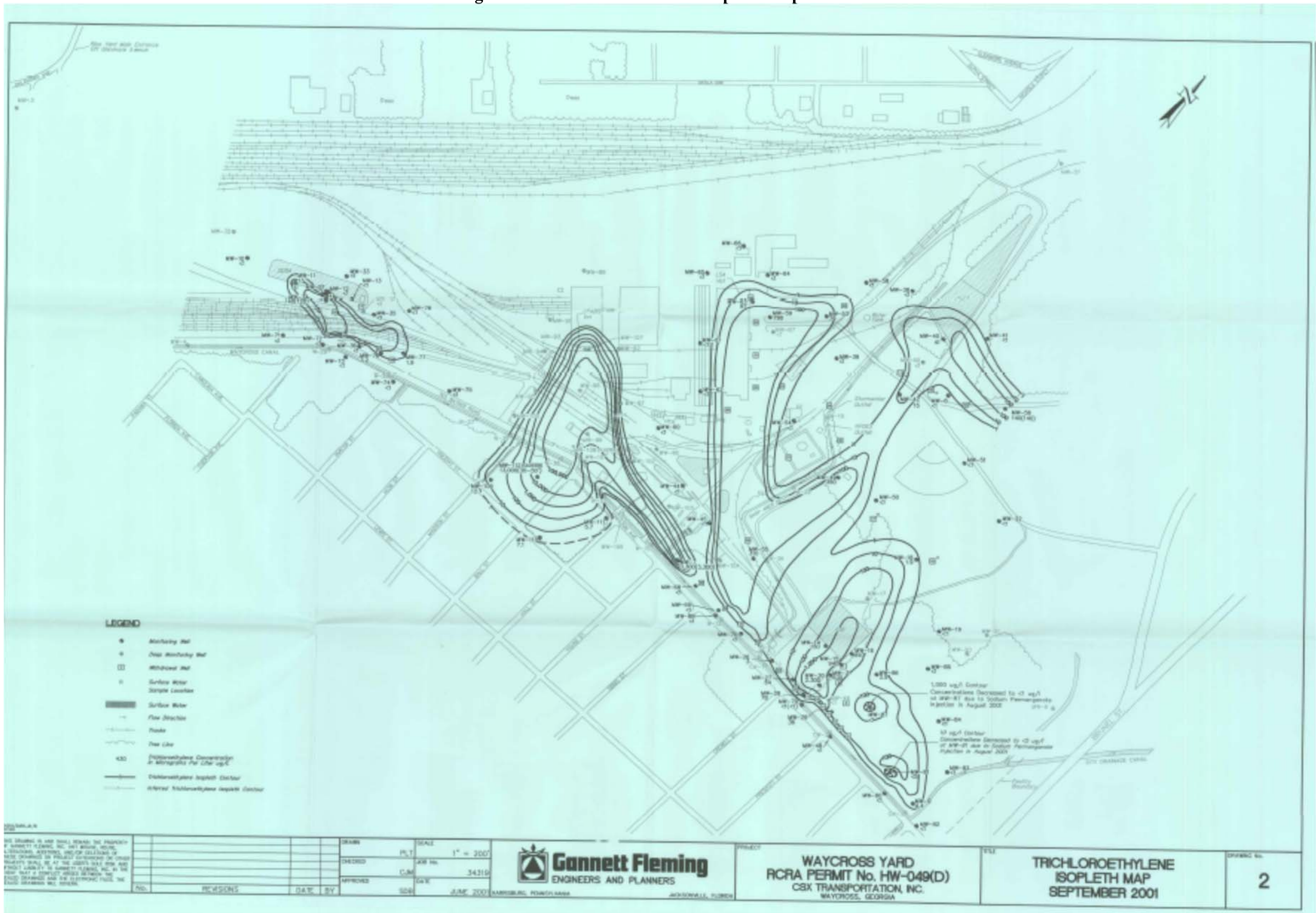
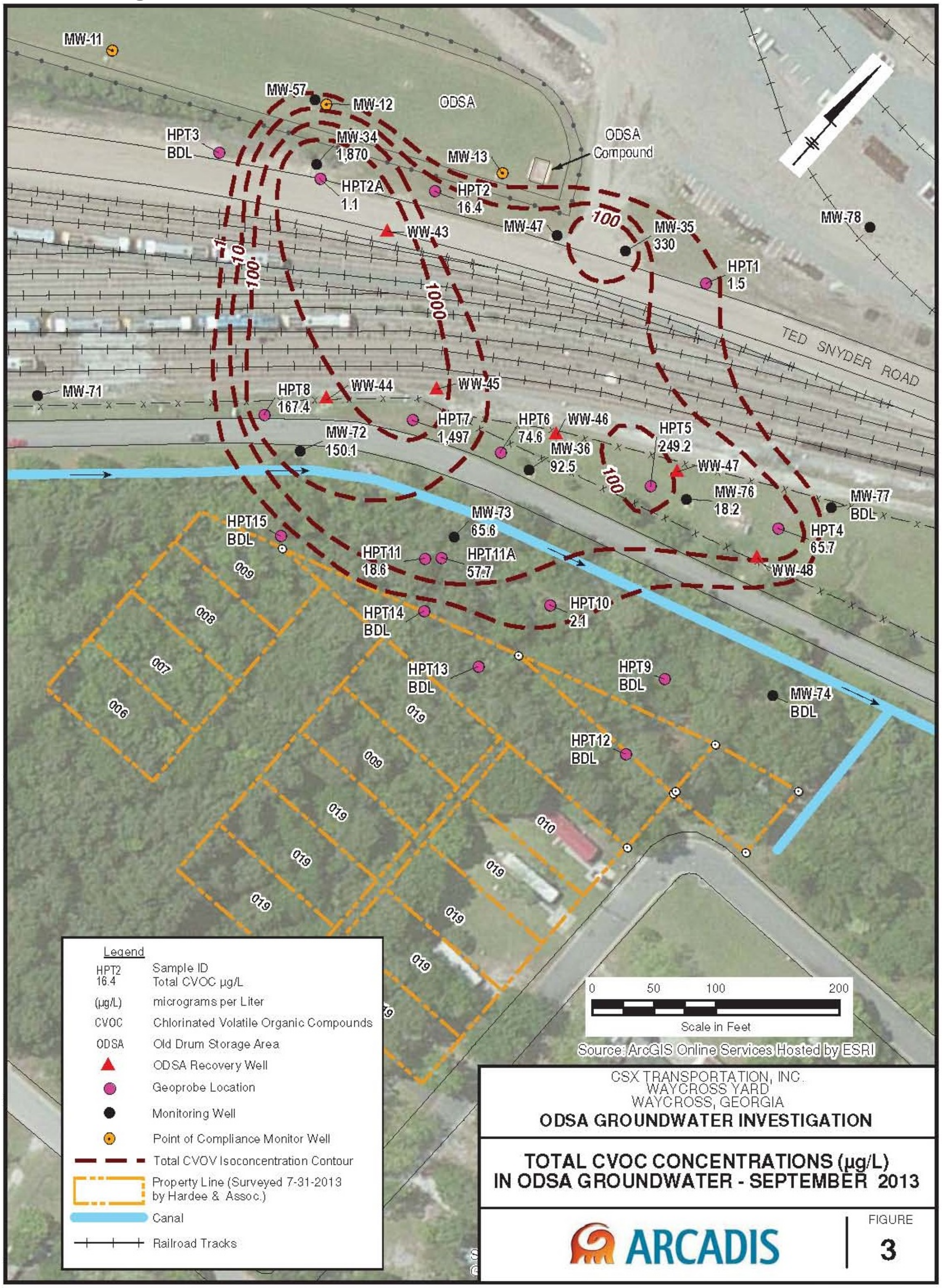


Figure XII: Total VOC Concentrations in ODSA Groundwater



Appendices

Appendix A: Facility Operations Responsible for Onsite Environmental Contamination of the CSX Rail Yard and Regulatory History

Operations Responsible for Site Contamination

A.1 Hazardous Waste Management Units

A hazardous waste management unit can be any container or surface area or pond that held or holds hazardous waste. Some of the most common examples are 55-gallon drums and ponds or sludge collection areas.[15]

A.1.1 Old Drum Storage Area

CSX long used the old drum storage area for the staging of scrap material destined for recycling. The area is presently a vacant field west of the locomotive paint and air brake shop (Figures I, V). Before 1985, the area was also used for the temporary storage of some 4,000 empty and partially empty 55-gallon drums awaiting removal for offsite reconditioning. Drum handling activities resulted in spills that affected surface soils, subsurface soils, and groundwater. This hazardous waste management unit is approximately 500 feet long, 75 feet wide at the southwest end, and 14 feet wide at the other end [DNR 2015, 2014b].

A.1.2 Alum Sludge Basin

The alum sludge basin is a former surface impoundment designed and constructed in 1980 to dewater and dispose of sludges generated from CSX Rail Yard's wastewater treatment plant. The sludge basin is east-southeast of the maintenance shop area (Figures I, V) and operated until January 1985. This hazardous waste management unit was approximately 250 feet long by 200 feet wide and 6 feet deep. Although analytical characterization of the alum sludge indicated that it was a nonhazardous solid waste, during a January 1985 site inspection an EPD inspector found that spent paint stripper had been disposed of ion the sludge basin. Analysis of a sample of this waste indicated the presence of methylene chloride [DNR 2015, 2014b]. Later sludge basin investigations concluded that chlorinated VOCs had entered the shallow groundwater, and that the sludge basin area had released chromium and vanadium [DNR 2014b].

Closure of the drum storage area and the alum sludge basin included soil caps and restricted access. The final cover consists of a compacted, sloped-soil cap with erosion-retarding vegetation. Site control measures include a barricade to restrict area access and a surface water run-off control system around both the drum storage area and the alum sludge basin [Gannett Fleming 2001].

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[15] 40 CFR 264(B) §264.13.

A.2 Solid Waste Management Units

The U.S. EPA defines a "solid waste management unit as "...any unit at a facility from which hazardous constituents might migrate, irrespective of whether the units were intended for the management of solid and/or hazardous wastes."[16]

A.2.1 Acid-Lime Sludge Area

The acid lime sludge area consists of two pits: the refined oil acid sludge pit and the much larger acetylene lime sludge pit. The acid lime sludge area is northeast of the locomotive shop area (Figures V and VI). Until 1969 and for an unknown period previously, rail yard employees used the refined oil acid sludge pit to dispose of sludges from a lubrication oil purification facility. The soil/sludge contained large concentrations of trichloroethene (TCE), which proved to be the TCE source found in the shallow groundwater downgradient of the acid lime sludge area [Gannett Fleming 2001]. In 1993, contractors excavated and removed offsite to RCRA[17]-permitted disposal facilities over 1900 tons of soil/sludge from the oil acid sludge pit. Additional source removal occurred in March and April 2004. Contractors also removed 1,464.72 tons of nonhazardous waste soil and debris and 4,393.30 tons of hazardous waste. CSX Rail Yard then began a 3-year trial program of monitored natural attenuation. [18] But increasing VOC levels in many of the monitoring wells around the acid lime sludge area necessitated additional corrective actions. In March 2009, CSX began an additional investigation to identify residual source material and conduct limited treatment, source removal, or both to reduce overall mass to levels that monitored natural attenuation could effectively control [DNR 2015].

A.2.2 Locomotive Shop Area

The locomotive shop area is northwest of the alum sludge basin and southwest of the acid lime sludge area (Figures I, V). CSX and its predecessors used the shop area for locomotive maintenance and repair. The shop area contained a parts-cleaning vat, approximately 8 x 8 x 6 to 8 feet deep, in which trichloroethylene and *trans*-1,2-dichloroethylene were used as cleaning and degreasing agents. The vat is suspected to have leaked in the past, acting as a primary source for the TCE and related constituents found in downgradient shallow groundwater and surface water [Gannett Fleming 2001].

To comply with permit requirements and to demonstrate the effectiveness of the corrective action program, in December 1995 shallow groundwater monitoring was initiated and will continue for the duration of the corrective action program. The results of the corrective action monitoring program are reported semiannually EPD.

[16] USEPA July 15, 1985 HSWA Codification Rule

[17] **RCRA**: Resource Conservation and Recovery Act.

[18] **Natural attenuation** means dilution, dispersion, bio- degradation, irreversible sorption, or radioactive decay of contaminants in soils and groundwater. It results in a net reduction of contaminant toxicity and in reduction of human and ecological risk.

A.2.3 Old Refuse Area Number 2/Old Runoff Pond Area

Before 1960, oily wastewater from maintenance operations reportedly flowed to a separation basin and wastewater runoff pond in the old runoff pond area. Before February 1985, employees used old refuse area number 2 to dispose of concrete debris and other solid waste material from the CSX Rail Yard site (Figure V). Eight abandoned 55-gallon drums were discovered during site clearing activities in 1998 and were disposed of in accordance with RCRA regulations. An abandoned concrete structure and buried 36-inch diameter corrugated steel pipe were found in the old pond runoff area. The pipe was excavated and a black, sludge-like soil with a strong petroleum odor was observed in the excavated area and in the pipe. The pipe and its contents were disposed in accordance with RCRA regulations [ARCADIS 2013a].

A.2.4 Locomotive Paint and Air Brake Shop

The locomotive paint and air brake shop is southwest and north of the locomotive shop area and the old engine house, respectively (Figures V, VI). Locomotive preparation and painting continues today in the locomotive paint shop in the northern 60% of the locomotive paint and air brake shop building. During a 1986 waste identification survey, investigators found no evidence of hazardous waste release associated with the locomotive paint shop operation [ARCADIS 2013a]. The old air brake shop was in the southern portion of the locomotive paint and air brake shop building, but this operation was terminated in the 1960s. The General Electric Corporation currently uses the former air brake shop for customer inventory.

The 1986 waste identification survey also documented a potential release from reported frequent, small quantity solvent spills in the southern portion of the locomotive transfer pit, outside the old air brake shop. Part of the old air brake shop operation included a parts-cleaning vat where TCE was used as a cleaning agent [ARCADIS 2013a].

A.2.5 Old Engine House

The old engine house encompasses 1) an area where the former engine house building stood, 2) a former fueling area on the tracks west of the engine house area, and 3) a ditch to the south of the that area. The outline of the old engine house foundation is still visible, despite its demolition several years ago (Figure V). The 1986 waste identification survey indicated that employees used the old engine house building for painting freight cars; at one time, however, employees also did minor locomotive repairs in this building, and they might have used small amounts of TCE for parts degreasing or drying [ARCADIS 2013a].

A.2.6 Old Cleaning Vat Sludge Pits

The old cleaning vat sludge pits included two former waste pits, which were used a single time in 1985 to dispose of approximately 28 cubic yards of sludge from parts-cleaning vats (Figure V) [ARCADIS 2013a].

A.2.7 Recent Spill Incidence

On December 20, 2013, a fuel plug on a CSX locomotive failed, resulting in the release of some 1500 gallons of diesel fuel within the CSX Rail Yard site. CSX immediately reported the release to EPD and to the National Response Center. The release occurred along the northwest side of the locomotive service center parking lot. Fuel flowed through the track ballast and ran overland east and west of the track, toward and into the adjacent industrial stormwater drains located east and west of the flow. When emergency response contractors arrived, they immediately closed the stormwater drain valve, shutting down two outfalls that discharge into the Waycross Canal. This quick response prevented any fuel from reaching the canal; indeed, no fuel was noted during canal inspection. In addition, test pits were excavated within the immediate area to determine the lateral extent of fuel in subsurface soil and in the inferred direction of migration. Investigators determined that the fuel spill was confined to the top 2 inches of soil, just above tight, dry sandy silt [ARCADIS 2014c]. Over a 4-month period, response contractors recovered approximately 1135 gallons of diesel fuel, conducted soil removal, installed two collection drains parallel to the tracks to recover any remaining fuel in the adjacent ballast, and did confirmatory soil sampling. A total of 91 tons of soil containing residual diesel fuel were excavated and stockpiled onsite. All excavated soils were transported to— and disposed of at—the Chesser Island waste management landfill in Folkston, Georgia.

A.3 Regulatory History

In accordance with a June 30, 1986 Consent Order issued by the Georgia Environmental Protection Division (EPD), CSX made an initial environmental assessment of the site. The assessment's purpose was 1) to characterize solid and hazardous waste streams generated by current operations and 2) to identify where land disposal or spills of solid or hazardous materials had occurred. The "Waste Identification Survey-Waycross, Georgia Facility" provided to EPD in August 1986 documented this assessment [Gannett Fleming 1999; ARCADIS 2013a].

CSX contractors identified three locations as hazardous waste management units where land disposal of hazardous wastes occurred between 1980 and 1985:

- Old Drum Storage Area, or ODSA,
- Alum Sludge Basin, or ASB, and
- Wastewater Treatment Plant/Grit Collection Area, or WWTPA.

CSX's use of these three hazardous waste management units ended in 1985. To properly close these hazardous waste management units, CSX submitted a Resource Conservation and Recovery Act (RCRA) Part A Closure permit application to EPD in August 1986. EPD issued the permit in December 1986. After completion of closure activities, in August 1987 CSX submitted a RCRA Part B – Post Closure permit application to EPD, which, on September 28, 1987, issued Hazardous Waste Facility Permit No. HW-049(D) for post-closure care of the ODSA and the ASB. The WWTPA was clean-closed and reclassified as a solid waste management unit in 1989 [Gannett Fleming 1999]. Subsequent 1993–1997 permit activities included

October 1993: CSX submitted a "Revised Part B" – Post-Closure Permit Modification adding the ALSA to Permit HW-049(D).

- June 1995: CSX submitted another permit modification to HW-049(D) incorporating the corrective action plan for remediating the Locomotive Shop Area (LSA).

- April 1997: CSX submitted a 10-year permit renewal application; in September 1997, EPD reissued HW-049(D).
- April 1997: CSX submitted a permit renewal application that included corrective action plans addressing the expanded groundwater effects at the ODSA and ASB.

In June 1998, CSX contractors completed a preliminary subsurface investigation to determine the source of the chlorinated solvent constituents found upstream of the surface water sample location W-15 (Figure IX), where the highest concentrations of chlorinated solvents in the Waycross Canal had been found. In November 1999, EPD requested further source investigation at the LPABS, OEH, and OCVSP [ARCADIS 2013a].

In October 1999, CSX submitted a permit modification to EPD addressing affected groundwater east of the ASB. The modification included a corrective action plan to address the Old Refuse Area No. 2 (ORA-2) and the Old Runoff Pond Area (ORPA) [Gannett Fleming 2001]. In May 2000, EPD approved this permit modification.

In October 2000, the permit was again amended to suspend the ALSA groundwater withdrawal system. Other withdrawal wells located at other units were found capable of remediating the ALSA groundwater contamination, minor monitoring program changes were deemed appropriate, and a comprehensive corrective action approach to groundwater contamination was approved [DNR 2004].

CSX submitted another permit modification application to EPD in March 2002, which proposed a new groundwater corrective action system at the ASB to better control the migration of groundwater contaminants of concern in this area and modifications to the groundwater corrective action effectiveness monitoring program [ARCADIS 2015].

The permit was amended again in May 2003 for the following reasons: reduction in the groundwater monitoring frequency and incorporation of a performance-based corrective action approach for the ODSA, ASB, ALSA, and LSA [DNR 2004].

On March 2007, CSX submitted a 10-year permit renewal application that provided updated groundwater recovery system specifics and proposed revisions to the corrective measures monitoring system and protocol. EPD issued the permit renewal in July 2010 [ARCADIS 2015].

Beginning in January 1999, CSX began a RCRA Facility Investigation (RFI) that was completed in various phases that, as directed by EPD, culminated in January 2013. The purpose of an RFI is to determine the nature and extent of releases of hazardous wastes or hazardous constituents from regulated units, solid waste management units, and other source areas at the facility, and to gather all necessary data to support the environmental indicator determinations and a Corrective Measures Study. The RFI includes the collection of site specific data to evaluate any human health and/or ecological impacts of contamination from the site.

CSX prepared and submitted a RFI Report for the Locomotive Paint and Air Brake Shop (LPABS) in June 1999. In May 2004, CSX submitted an RFI Report for the Old Refuse Area

Number 2 and the Old Runoff Pond Area (ORA-2/ORPA), LPABS, the Old Engine House (OEH), and the Old Cleaning Vat Sludge Pits (OCVSP) SWMUs [ARCADIS 2013a].

To complete the RFI for the subject SWMUs, EPD requested additional investigations to fully delineate the distribution of constituents of potential concern (COPCs) in the various media (soil, sub-surface soil, groundwater, and surface water) to site-specific background concentrations and/or alternate delineation criteria. By April 2012, EPD had concurred that CSX had delineated the nature and extent of COPCs sufficiently so that CSX could begin conducting a site-specific human health and ecological risk assessment for the facility. On March 28, 2013, EPD issued the final approval of the RFI Report (Revision 3) for the ORA-2/ORPA, LPABS, OEH, and the OCVSP concurring with the vertical and horizontal extent of contaminated soil, subsurface soil, groundwater, and surface water at the CSX facility.

Appendix B: Corrective Action Program and Corrective Action Effectiveness

B.1 Groundwater

The groundwater corrective action program comprises a groundwater monitoring well network of 131 wells dispersed across the facility, including monitoring well-3, the background well. Approximately half of these wells were drilled in areas intended to determine the limits of contamination related to the acid-lime sludge area, the locomotive shop area, the old drum storage area, and the alum sludge basin units named in the current permit's corrective action plan. Contractors drilled additional wells to investigate contamination related to the locomotive paint and air brake shop. Later, contractors drilled wells to investigate contamination related to additional solid waste management units, which included

- Old refuse area 2,
- Old runoff pond area,
- Old engine house, and
- Old cleaning vat sludge pits

Some wells were not a part of the acid-lime sludge area, locomotive shop area, locomotive paint and air brake area, old drum storage area, or alum sludge basin investigations. Investigators included these additional wells with those that most closely afforded examination of the plume related to the unit in which they were placed. For example, for investigation purposes, wells close to but not actually in the locomotive shop area were included with the shop area wells. The current network is adequate to monitor groundwater conditions across the facility and is sufficient to assess the effectiveness of the corrective action program [DNR 2015].

Before the spring of 2010, CSX Rail Yard sampled half the monitoring wells across the site and in the fall, sample the remaining half. Currently, all the wells for the old drum storage area, the locomotive paint and brake shop, and the acid-lime sludge area are sampled in the spring event, and the locomotive shop area and alum sludge basin monitoring wells are sampled in the fall [DNR 2015].

In addition to the monitoring well network, the corrective action program includes

- A surface water monitoring network of 14 sample locations,
- Eight vertical recovery wells for the old drum storage area,
- Ten vertical recovery wells for the locomotive shop area,
- One horizontal recovery well for the locomotive paint and air brake shop (HWW-1),
- One horizontal recovery well (HWW-2) and one recently added horizontal recovery well (HWW-3) for alum sludge basin, and
- Underground piping to the groundwater treatment system.

Monitoring well 3, the background well for the entire site, is to the northwest of the old drum storage area (Figure VI).

B.2 Surface Water

The CSX Rail Yard site has four surface water drainage features points: the Waycross Canal, the shop area ditch, the City Drainage Canal, and an unnamed feature. Each drainage feature receives runoff and groundwater from the rail yard's operations areas. The Waycross Canal is a drainage feature that runs along the southern and eastern boundaries of the site. Eight surface water sample locations in the Waycross Canal are sampled semiannually. The shop area ditch, which runs south from the western side of the acid-lime sludge area, feeds into the Waycross Canal just west of the alum sludge basin. Four surface water sample locations in the shop area ditch are sampled semiannually. This joined drainage feature connects to the City Drainage Canal just east of the old refuse area-2/old runoff pond area unit. The City Drainage Canal runs north and connects to the fourth unnamed drainage feature. The unnamed feature runs south along the site's north and eastern boundaries, from the eastern side of the acid-lime sludge area. Two surface water sample locations associated with the unnamed drainage feature are sampled semiannually [DNR 2015].

B.3 Groundwater Treatment System

The groundwater remediation system's goal is to prevent further migration of the contaminant plumes and to remediate the shallow groundwater to the background concentrations established during the RCRA Facility Investigation [ARCADIS 2013a]. Until September 15, 1996, a packed column air stripper treated the recovered groundwater from the old drum storage area, alum sludge basin, and acid-lime sludge area recovery wells. On that date, contractors brought a low profile, shallow-tray air stripper online to treat the contaminated groundwater from the old drum storage area, the alum sludge basin, the acid-lime sludge area, and the locomotive shop area. With the installation and operation of the horizontal recovery well #1 in December 2001, contractors added groundwater recovered from the locomotive paint and air brake shop to the treatment system. In June 2002, horizontal recovery well #2 for the alum sludge basin was brought online [DNR 2015]. Between December 2014 and January 2015, horizontal recovery well #3 was brought online to improve chlorinated VOC recovery in the locomotive shop area plume between established monitoring wells 103 and 26 (Figure VI). Contaminated groundwater from the old drum storage area, alum sludge basin, locomotive shop area, and locomotive paint and air brake shop is now piped underground to the groundwater treatment system.

During the period that horizontal recovery well #3 was being installed, five capture-zone, sentinel monitoring wells (monitoring wells #111, #130, #131, #132, and #133) were drilled along Hamilton Avenue. Contractors drilled these wells to improve the corrective action monitoring network associated with the locomotive service area, locomotive paint and air brake shop, and old drum storage area solid waste management units [ARCADIS 2015].

All the vertical and horizontal groundwater recovery wells are screened in the Zone III stratigraphic unit (i.e., between 20-30 feet bgs). Recovered groundwater is pumped to an equalization tank and then transferred to a low-profile, shallow-tray air stripper for treatment. The treated water is discharged to Outfall-002 (shown in Figures V, VI) of NPDES[19] Permit No.

[19] **National Pollutant Discharge Elimination System** is a provision of the Clean Water Act that prohibits discharge of pollutants into U.S. waters unless a special permit is issued by the USEPA, a state, or a tribal government.

GA0046680. During periods of discharge, an effluent sample is collected every 6 months and analyzed for select parameters specified in the NPDES permit [ARCADIS 2015]. Monthly NPDES reports are submitted to EPD for review. As of the date of this health assessment, no violations of the permit have occurred, and concentrations that have been reported at surface water sampling locations are orders of magnitude below permitted levels [DNR 2015]. The air stripper discharge is sent through activated carbon canisters to remove VOCs before release to the atmosphere [DNR 2015].

B.4 Corrective Action Effectiveness

Figure VII shows the groundwater recovery system's capture zone, which maps the potentiometric surface[20] of shallow groundwater when the recovery system is activated [ARCADIS 2016]. Defined cones of depression[21] are maintained by the operation of horizontal recovery well #1 (locomotive paint and air brake shop) and horizontal recovery well #2 (alum sludge basin) recovery well systems.

Comparison under pumping conditions of the potentiometric surface configuration of shallow groundwater (Figure VII) to past nonpumping conditions (Figure VIII) indicates statistically significant drawdown of the water table from groundwater recovery at horizontal well #1 and horizontal well #2, and moderate drawdown at horizontal well #3. Measured water levels indicate that the operation of well #1 was responsible for approximately 10 feet of drawdown near the well #1 screen (near monitoring well #101). Drawdown resulting from groundwater recovery at horizontal well #1 is observed over an area approximately 1,100 feet by 900 feet [ARCADIS 2016]. Well #1's influence of extends over 400 feet south of the Waycross Canal in the south of the locomotive paint and air brake shop groundwater plume.

The influence of groundwater recovery from well horizontal well #2 near the pump intake is like that observed in horizontal well #1, with observed drawdowns of more than 10 feet. The drawdown resulting from groundwater recovery at horizontal well #2 is observed over an area of approximately 1,300 feet by 600 feet [ARCADIS 2016]. Well #2's influence extends over 200 feet south of the Waycross Canal, in the southeast corner of the CSX Rail Yard.

The influence of groundwater recovery from the new horizontal recovery well #3, coupled with exiting vertical recovery wells (WW-29 through WW-32) adjacent to the Waycross Canal, has enhanced groundwater capture. This enhanced capture zone is between the areas of hydraulic influence of horizontal recovery well #1 and horizontal recovery well #2, with observed drawdowns of 2-4 feet. The drawdown resulting from groundwater recovery at horizontal recovery well #3 and existing vertical recovery wells adjacent to the Waycross Canal is observed over an area of approximately 900 feet by 450 feet [ARCADIS 2016], extending its influence south of the Waycross Canal between horizontal recovery well #1 and horizontal recovery well #2.

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[20] A **potentiometric surface** is a concept based on hydraulic principles. It is the imaginary plane in which a given reservoir of fluid will "equalize out" if allowed to flow.

[21] A **cone of depression** occurs in an aquifer when groundwater is pumped from a well. In an unconfined aquifer (i.e., the water table), this is an actual **depression** of the water levels.

During groundwater recovery operations in the old drum storage area, groundwater plume investigators observed approximately 1-2 foot drawdowns. Note that the old drum storage area and locomotive shop area groundwater recovery systems have a smaller area of hydraulic influence on the water table as compared with horizontal recovery wells #1, #2, and #3. [ARCADIS 2016].

In the Waycross Canal surface water, trichloroethene (TCE) remains the most significant contaminant. Reported concentrations of contaminant constituents (Appendix D, Table D.1) and the considerable reductions in contaminant concentrations in the locomotive paint and air brake shop monitoring wells south of the Waycross Canal [ARCADIS 2016] demonstrated the effectiveness of the horizontal wells in hydraulically controlling the site's groundwater. Since 2007, semiannual groundwater monitoring results have shown that TCE, *cis*-1,2-dichloroethene (*cis*-1,2-DCE), *trans*-1,2-dichloroethene (*trans-1,2- DCE)*, and vinyl chloride (VC) are at nondetect levels [ARCADIS 2013a, ARCADIS 2015; DNR 2015].

In addition, the presence of *cis*-1,2-DCE, *trans*-1,2- DCE, and VC in onsite groundwater north of horizontal recovery well #1 indicates that attenuation of VOCs by natural reductive dechlorination[22] continues to occur even under increased aerobic (i.e., activity occurring in the presence of oxygen) conditions induced by groundwater pumping.

[22] **Natural reductive dechlorination** is the biodegradation of chlorinated organic compounds by naturally occurring anaerobic bacteria. One particularly important example for public health is the organochloride respiration of TCE by naturally occurring anaerobic bacteria, often members of the candidate genera *Dehalococcoides*. Bioremediation of these chloroethenes can occur when other microorganisms at the contaminated site provide hydrogen (H_2) as a natural byproduct of various fermentation reactions. The dechlorinating bacteria use this H_2 as their electron donor, ultimately replacing chlorine atoms in the chloroethenes with hydrogen atoms via reductive dechlorination. If the soil and groundwater contain enough organic electron donor and the appropriate strains of bacteria, this process can proceed until all of the chlorine atoms are removed, and TCE is dechlorinated completely via (DCE) and (VC) to ethene, a harmless end-product [McCarty 1997].

Appendix C: Past and Present Groundwater Sampling Data Summary

These data summaries are for all the hazardous and solid waste management units at the CSX Rail Yard and the Georgia groundwater protection standards established for the site.

C.1. Old Drum Storage Area

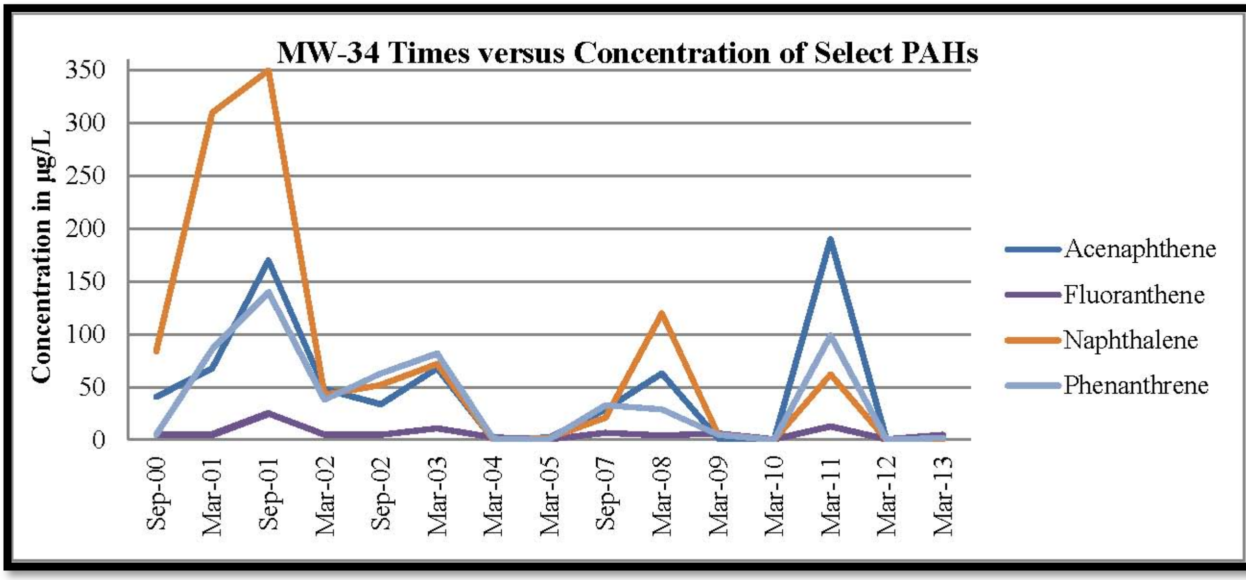
Historically, most of the old drum storage area monitoring wells show low to no-detect contaminant levels. Nevertheless, a few wells (MW-12, 34, 35, and 36) routinely detect contaminant levels significantly above the Georgia groundwater protection standards, or GPS. The contaminants most often detected in the old drum storage area monitoring wells are PAHs and VOCs:

- acenaphthene
- acenaphthylene,
- fluoranthene,
- fluorene,
- 2methylnapthalene,
- naphthalene,
- phenanthrene,
- pyrene,
- TCE,
- VC, and
- *cis*-1,2-DCE.

Detections of lead, zinc, 1,1-dichloroethylene (1,1-DCE), PCE, and *trans*-1,2-DCE also occur [DNR 2014a, 2015].

Before 2000, no detectable PAH levels of were observed in MW-34. Since 2000, however, every sampling event has detected PAHs. These PAH levels vary from a high of 905 micrograms per liter (µg/L) for total PAHs in September 2001 to a low of 3.92 µg/L in March 2010. As of March 2015, the total PAH concentration was 27.02 µg/L. [DNR 2015; ARCADIS 2015]. Figure C.1 shows PAH concentrations from September 2000 to March 2013. PAH constituents not shown are lower than 5 µg/L.

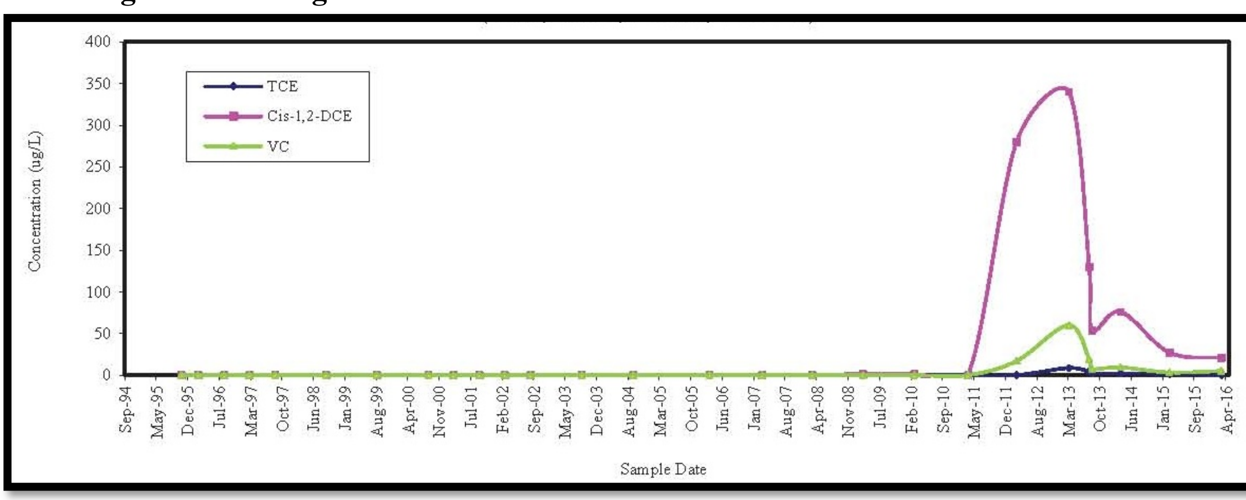
Figure C.1: Long-Term Concentrations of PAHs



MW-34: monitoring well-34
PAHs: polycyclic aromatic hydrocarbons
µg/L: micrograms of contaminant per liter of water

Figure C.2 below shows TCE, *cis*-1,2-DCE, and VC concentrations over a 21-year period. MW-73 was selected because this monitoring well is south of the Waycross Canal, in the direction of groundwater flow.

Figure C.2: Long-Term Trend of Select VOCs in MW-73

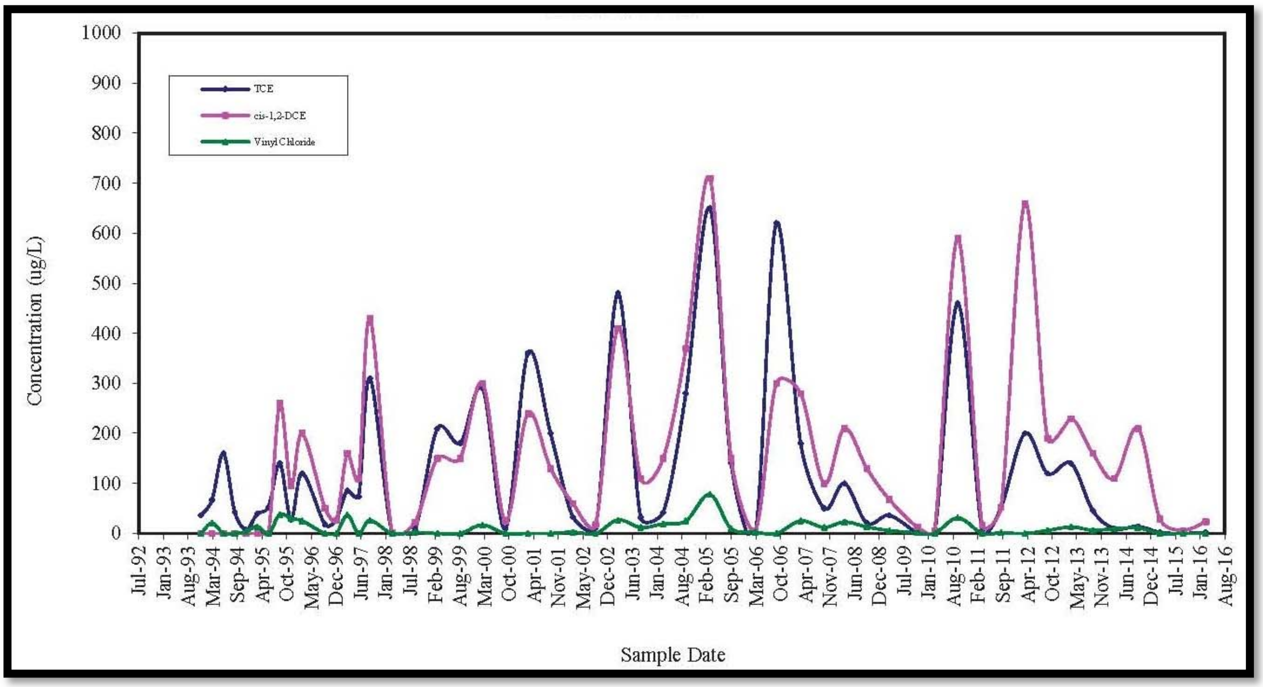


VOCs: volatile organic compounds
MW-73: monitoring well-73
µg/L: micrograms of contaminant per liter of water

Groundwater recovered from the six old drum storage area recovery wells routinely contained TCE, *cis*-1,2-DCE, and low levels of VC. Occasionally *trans*-1,2-DCE and tetrachloroethene (PCE) were detected in very low concentrations. During the March 2015 sampling event, groundwater recovered from the ODSA recovery wells contained three constituents above the GPS (Table B.8): TCE, *cis*-1,2-DCE, and VC [DNR 2015].

Figure C.3 below shows the concentrations of TCE, *cis*-1,2-DCE, and VC recovered over a 21-year period.

Figure C.3: ODSA Recovery System Influent (Select VOCs)



ODSA: Old Drum Storage Area
VOCs: volatile organic compounds
µg/L: micrograms of contaminant per liter of water

From October 1993 through March 2016, over 45 million gallons of groundwater have been recovered and treated from the old drum storage area plume [ARCADIS 2016].

C.1.1 Contaminant Detection South of the Waycross Canal

In recent years, some monitoring wells downgradient of the old drum storage area landfill (monitoring wells #34, #35, #36, #72, #73, and #76) have recorded increasing VOC levels. In June 2013, contractors redeveloped current operating vertical recovery wells #44 through #48 using chemical and physical methods [ARCADIS 2014b] in an effort to stop further migration of dissolved VOCs south of the Waycross Canal. Following recovery well redevelopment, contractors also conducted a downgradient soil and groundwater investigation at 15 downgradient locations on CSX Rail Yard and City of Waycross property to target permeable zones for depth-discrete groundwater sampling. A high profile tool was advanced to a depth of 30 feet bgs at each location. Lithologic logs were recorded from each core. Groundwater samples were collected from up to four depth intervals, coinciding with the more transmissive zones where VOC mass preferentially concentrates in areas downgradient from the old drum storage area source. Groundwater samples, collected from each interval, were analyzed in the field using

U.S. EPA Method 8265 via direct sampling ion trap mass spectrometer technology. A split of each sample was submitted to TestAmerica, Savannah, Georgia, for VOC analysis using U.S. EPA Method 8260C. In addition, a sample split from one depth interval in each probe hole was submitted for analysis of select biogeochemical parameters (e.g., total iron, dissolved iron, chloride, total organic carbon, alkalinity). Contractors used an iterative process, incorporating real-time spectrometer technology results from previous locations to determine/adjust subsequent sampling locations and fully delineate areas of elevated VOCs [ARCADIS 2014b].

The reported VOC concentrations in depth-discrete samples, collected at locations downgradient of monitoring wells #72 and #73, and high profile tool sample locations #9 through #15 indicated that VOCs exceeding regulatory limits are on CSX Rail Yard property south of the Waycross Canal. Table C.1 summarizes these findings.

Table C.1: ODSA Downgradient Groundwater Investigation Summary South of the Waycross Canal (September 2013)

Sample Location	Sample Depth (feet)	Total VOCs* (µg/L)	VOC Component* Concentration (µg/L)
HPT-9	14-16	ND	none
	20-22	ND	none
HPT-10	13-15	2.1	*cis*-1,2-DCE (2.1)
	18-22	ND	N/A
	26-28	ND	N/A
HPT-11	13-15	8.1	*cis*-1,2-DCE (5.9), TCE (1.0), VC (1.2)
	17-20	18.6	*cis*-1,2-DCE (13) TCE (3.1), VC (2.5)
	25-27	ND	N/A
HPT-11A	10-14	57.7	*cis*-1,2-DCE (49) TCE (2.1), VC (6.6)
	15-19	25.6	*cis*-1,2-DCE (19) TCE (3.4), VC (3.2)
	25-27	57.8	*cis*-1,2-DCE (53) TCE (1), VC (3.8)
HPT-12	12-14	ND	none
	18-22	ND	none
	26-28	ND	none
HPT-13	14-16	ND	none
	18-20	ND	none
	21-23	ND	none
HPT-14	14-16	ND	none
	17-19	ND	none
	21-24	ND	none
HPT-15	10-12	ND	none
	14-16	ND	none
	14-16 DUP	ND	none
MW-73	13-23	63.6	*cis*-1,2-DCE (54) TCE (2), VC (7.6)
MW-74	13-23	ND	none

cis-1,2-DCE: *cis*-1,2-dichloroethene
TCE: trichloroethene
VC: vinyl chloride
µg/L; micrograms of contaminant per liter of water, or parts per billion
HTP: High Profile Tool sample location shown in Figure XII
ND: not detected
DUP: duplicate sample
*Analytical Laboratory sample results

Figure XII shows the lateral distribution of total VOCs in old drum storage area groundwater. VOCs appear concentrated between approximately 10 to 20 feet bgs, in a silty-sand transmissive zone. In this zone, contractors measured groundwater seepage velocities in the sediments containing VOCs downgradient from the ODSA to range from 31–161 feet/year (ft/yr), with a geometric mean of 86 ft/yr. Under pumping conditions, estimated groundwater travel time from the old drum storage area to downgradient recovery wells #44 through #46 is approximately 2 years [ARCADIS 2014b].

One additional monitoring well—monitoring well #133—screened between 14–24 feet bgs. This monitoring well, installed in January 2015, is approximately 100 feet southeast of monitoring well #73 and approximately 200 feet west of monitoring well #74. Two consecutive sampling events in March 2015 and March 2016 showed that VOCs were not detected. In addition, sample result trends from monitoring well #73 showed TCE levels declining from 8.6 µg/L in March 2013 to below detection limits in March 2016, and levels of *cis*-1,2-DCE also declining from 340 µg/L in March 2013 to 21 µg/L in March 2016. Before detection of *cis*-1,2-DCE at a concentration of 1.4 µg/L in March 2012, no VOCs had been detected in monitoring well #74 since monitoring began in November 1995.

C.2 Alum Sludge Basin, or ASB

The ASB contaminants of primary concern are TCE, *cis*-1,2-DCE, chromium, and vanadium. 1,2-dichlorobenzene (1,2-DCB), VC, and chlorobenzene are detected in several wells occasionally but at concentrations at or below the GPS (Table C.1).

C.2.1. Trichloroethene (TCE)

In the past, monitoring wells MW-14, 15, 16, 29, 30, 31, and 81 (drilled at 13–23' bgs intervals) have historically contained high TCE levels, but those levels have declined significantly. To date, most of the monitoring wells show TCE concentrations below the current GPS level of 78.4 µg/L [DNR 2015].

MW-86 and 87 (drilled at 13-23' bgs intervals) continually contain the highest contaminant concentrations. The levels present in MW-87 indicate the presence of free product. These monitoring wells are downgradient and farther south of the ASB landfill on the old refuse area 2/old runoff pond area solid waste management unit.

Table C.2 contains TCE sample results between 2013 and 2015. The only wells shown are those in which TCE was detected over this period in concentrations above the 78.4 µg/L GPS.

Table C.2: TCE Concentrations (in µg/L) in Select Monitoring Wells from September 2012 to September 2014

Monitoring Well	September 2013	September 2014	September 2015
MW-16	470/490	5404	810
MW-17	200	220	220
MW-86	240	110	60
MW-87 (13-23')	17,000	2,400	17,000

µg/L: micrograms of contaminant per liter of water
All groundwater samples were analyzed for select VOCs using USEPA Method 8260.

Note: The slash in the September 2013 MW-16 sampling result indicated a duplicate sampling result.

Since 1988, low TCE concentrations ranging from 1.61 to 7.3 µg/L were detected in 4 of 25 sampling events conducted in alum sludge basin (ASB) MW-48. TCE concentrations ranging from 3.4 to 7.1 µg/L were detected in 3 of 23 sampling events conducted since 1995 in ASB MW-79. Since 1995 low TCE concentrations ranging from 5.2 to 8.9 µg/L were detected in 3 of 23 sampling events conducted in ASB MW-80. Monitoring wells 48, 79, 80, and 83 have not shown TCE or any other VOCs since March 2013. These three monitoring wells are near the Waycross Canal and Hamilton Avenue. They are considered sentinel wells that monitor the groundwater plume that breaches the Waycross Canal [ARCADIS 2014a].

C.2.2. *cis*-1,2-Dichloroethene, or *cis*-1,2-DCE

Between 2013 and 2015, *cis*-1,2-DCE was observed in only three wells: MW-17, 81 (drilled at 13-23’ bgs intervals), and MW-86. Current concentrations in these wells are 2.2 µg/L, <1 µg/L, and 3.5 µg/L, respectively [DNR 2015].

C.2.3. Chromium

In September 1999, the highest chromium levels in the alum sludge basin were detected in MW-16 (2,700 µg/L), in September 2005 in MW-79 (1,800 µg/L), in March 2002 in MW-81 (19,000 µg/L), and in September 2001 in MW-87 (4,700 µg/L). The chromium level in each of these wells has since declined. During the September 2014 sampling event, MW-9 and MW-17 were the only wells in which chromium was detected above the GPS (50 µg/L) [DNR 2015]. Table C.3 contains 2013 to 2015 sampling data for chromium. The only well data shown are those in which chromium was detected between 2012 and 2014 at concentrations above the GPS.

Table C.3: Chromium (in µg/L) in Select Monitoring Wells from September 2012 to September 2014

Monitoring Well	September 2013	September 2014	September 2015
MW-9 (17-27’)	20	75	130
MW-16	116	14	50
MW-17	25	220	239
MW-48	10	11	11
MW-81 (13-23’)	65	36	<10
MW-82	11	14	11

µg/L: micrograms of contaminant per liter of water
All groundwater samples were analyzed for chromium using U.S. EPA Method 6010.

C.2.4. Vanadium

In March 2008, vanadium was detected in MW-81 at a concentration of 110 µg/L. Since then, however, vanadium has not been detected above the laboratory detection limit (<10 µg/L) in any alum sludge basin monitoring well [DNR 2015].

C.2.5. Horizontal Water Recovery System 2, or HWW-2

In June 2002, ASB horizontal recovery well HWW-2 went online. Groundwater recovered from HWW-2 has been analyzed for VOCs. In the past, TCE and *cis*-1,2-DCE were the only constituents detected at higher than the GPS of 78.4 and 8 µg/L, respectively. Since initiation of monitoring 1993, the concentrations for these constituents have steadily declined from a high of 12,000 and 310 µg/L, respectively, to the levels shown below in Table C.4 [DNR 2015].

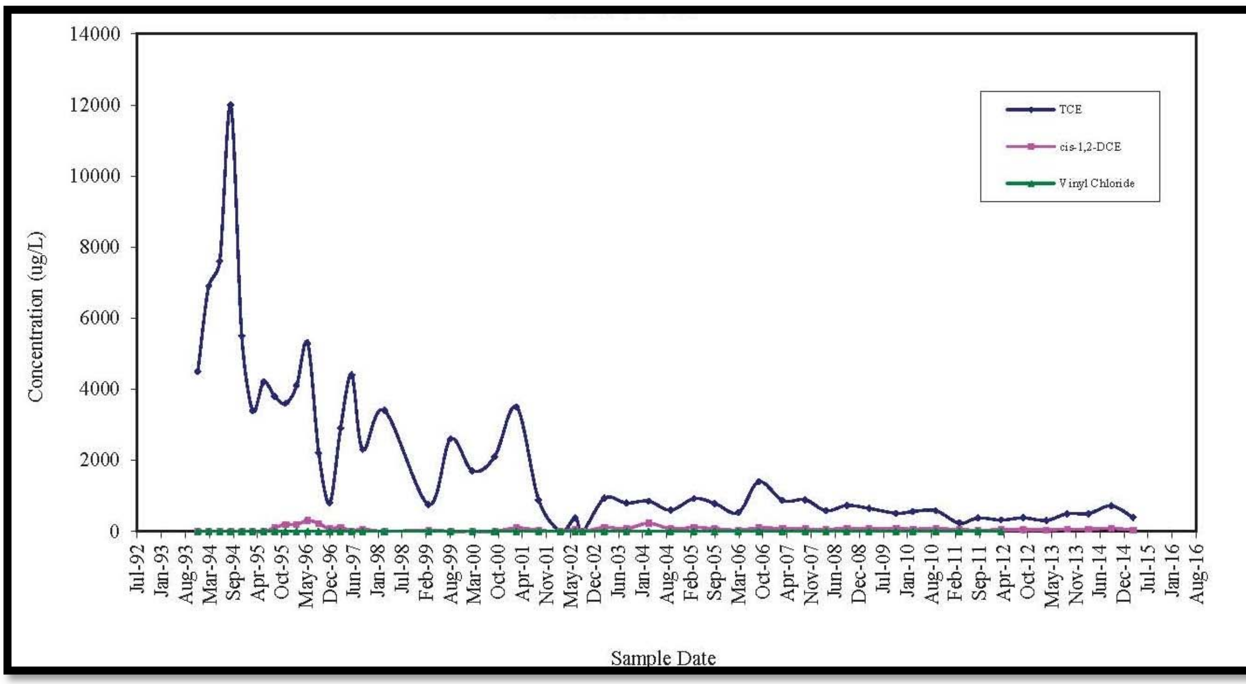
Table C.4: Contaminants (in µg/L) in HWW-2 from April 2012 to September 2014

Analyte	March 2013	Sept. 2013	March 2014	Sept. 2014	March 2015	Sept. 2015
TCE	310	500	500	720	390	410
cis-1,2-DCE	45	60	66	84	45	55

TCE: trichloroethene
cis-1,2-DCE: *cis*-1,2-dichloroethene
µg/L: micrograms of contaminant per liter of water
All groundwater samples were analyzed for select VOCs using U.S. EPA Method 8260.

As Figure C.4 below shows, VOCs have decreased significantly over time at the ASB, and continue to decline slowly. Generally, the corrective actions now in place appear to be achieving this unit's corrective action program goals.

Figure C.4: ASB Recovery System Influent (Select VOCs)



ASB: Alum Sludge Basin
VOCs: volatile organic compounds
µg/L: micrograms of contaminant per liter of water

From October 1993 through March 2016, over 213 million gallons of ASB groundwater have been recovered and treated [ARCADIS 2016].

C.3. Acid-Lime Sludge Area, or ALSA

When monitoring at this unit began, five recovery wells (WW-14 through WW-18) were installed to meet corrective action program goals. In 2000, due to the very low levels of contaminants detected in groundwater, CSX contractors stopped pumping from the recovery wells and initiated a program of monitored natural attenuation. From April 1994 through September 2000, over 11.6 million gallons of groundwater at the ALSA had been recovered and treated. In 2007, however, some wells began to show dramatic increases in TCE and vanadium. EPD then requested that CSX submit a workplan for remedial investigation and reduction of residual concentrations of vanadium and VOCs in groundwater.

The CSX contractors' workplan called for an initial soil and groundwater investigation, pilot in-situ chemical oxidation testing, post treatment monitoring, and contingency for limited source removal of dissolved metals. The pilot scale investigation began in October of 2009. The result of the pilot injection test showed that ALSA groundwater was amenable to in-situ treatment, and that additional treatment was warranted. On August 31, 2010, EPD approved the workplan for full-scale injection. An Underground Injection Control, or UIC permit for oxygen (peroxide) injection treatment was approved on April 7, 2011, and the workplan was subsequently put in place [DNR 2014a].

In the September 2014 sampling event, the concentration of TCE in MW-115—the well in which the highest concentration was detected—had dropped from 26,000 to 2,900 µg/L. *Cis*-1,2-DCE and VC concentrations had also dropped in the same relative proportions. But in MW-56, the adjacent downgradient well, TCE increased from 10 to 710 µg/L, with concomitant increases in *cis*-1,2-DCE and VC [DNR 2014a; ARCADIS 2015b]. VOC increases that exceeded regulatory limits were also seen in MW-121. In October 2014, CSX contractors submitted a workplan to EPD that proposed installation of soil borings in this area to determine the lateral and horizontal extent of contamination, and identification of any site-specific features that might influence contamination migration. In June 2015, EPD approved this workplan [DNR 2015].

The full-scale injection results showed positive effects; that is, a reduction in groundwater VOCs. Nevertheless, additional active remedial measures remain necessary [ARCADIS 2015].

C.4 Locomotive Shop Area, or LSA

The monitoring wells associated with the LSA identify two separate TCE contamination plumes—Northern and Southern. The northern plume is centered on the locomotive shop (MW-63) and has a TCE level of 850 µg/L reported during the September 2014 sampling event. The southern plume, centered on the old cleaning vat sludge pits, contained high TCE levels, with 13,000 and 6,200 µg/L in MW-55 and MW-104, respectively [DNR 2015; ARCADIS 2015b].

C.4.1. Northern Plume

In the past, the well with the highest contaminant concentrations was MW-63, with TCE at 71,000 µg/L (December 1996), *cis*-1,2-DCE at 6,800 µg/L (June 1997), *trans*-1,2-DCE at 7,600 µg/L (September 1990), VC at 380 µg/L (June 1990), and 1,1,2-trichloroethane (1,1,2-TCA) at 1,700 µg/L (September 1990). Concentrations of these constituents have fallen significantly, but remain high for TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and VC. Table C.5 contains the last 3 years of data for MW-63:

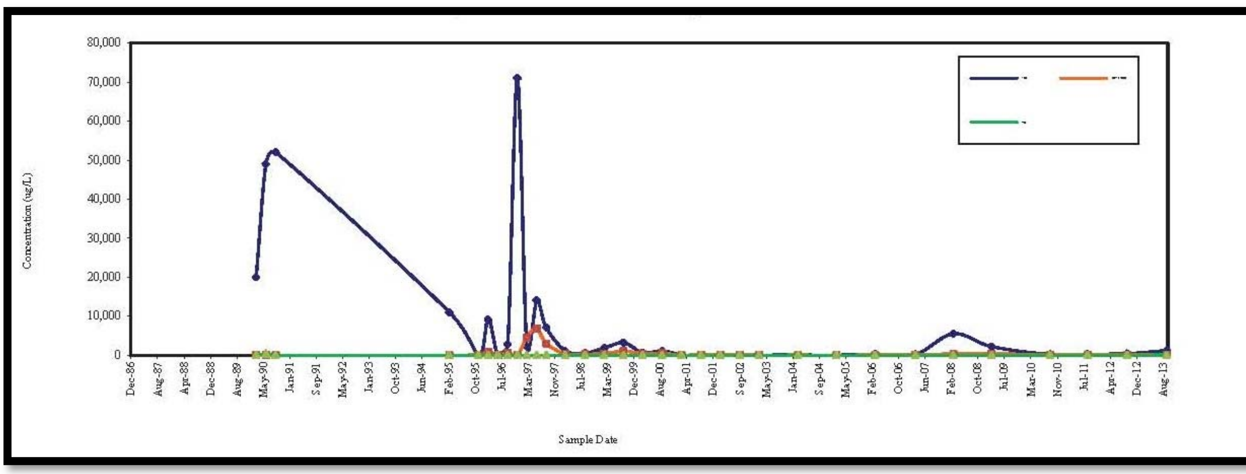
Table C.5: Contaminant Concentrations (in µg/L) in MW-63 from September 2012 to March 2014

Analyte	September 2013	September 2014	April 2015	September 2015
TCE	1200	850	720	520
cis-1,2-DCE	150	60	130	180
trans-1,2-DCE	<10	<10	<10	<10
Vinyl Chloride	13	<10	11	11

TCE: trichloroethene
cis-1,2-DCE: *cis*-1,2-dichloroethene
trans-1,2-DCE: *trans*-1,2-dichloroethene
µg/L: micrograms of contaminant per liter of water
All groundwater samples were analyzed for select VOCs using U.S. EPA Method 8260.

Figure C.5 below shows the MW-63 concentrations of TCE, *cis*-1,2-DCE, and VC over a 24-year period:

Figure C.5: Long-Term Trend of Select VOCs in MW-63

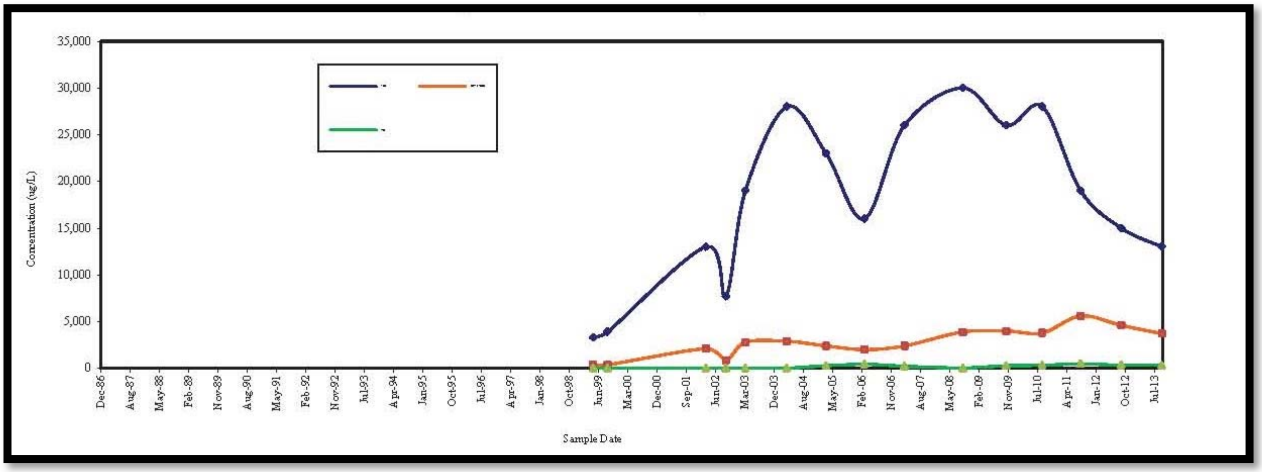


VOCs: volatile organic compounds
MW-63: monitoring well-63
Blue line: TCE
Orange line: *cis*-1,2-DCE
Green line: VC
µg/L: micrograms of contaminant per liter of water

C.4.2. Southern Plume

In the past, the southern plume area monitoring well with the highest contaminant concentrations was MW-55, located between the two old cleaning vat sludge pits. The lowest levels were in 1995–1996, but those levels have increased consistently each year since 2006. Since initial sampling began in 1999, concentrations of TCE and *cis*-1,2-DCE have increased significantly in the southern plume area monitoring wells, particularly in MW-104, reaching a high of 30,000 µg/L for TCE in 2008. Since 2008, levels have shown a downward trend as shown in Figure C.6:

Figure C.6: Long-Term Trend of Select VOCs in MW-104



VOCs: volatile organic compounds
MW-104: monitoring well-104
Blue line: TCE
Orange line: *cis*-1,2-DCE
Green line: VC
µg/L: micrograms of contaminant per liter of water

Groundwater recovery wells are near both the northern and southern plumes, and the extracted groundwater is commingled. An averaging of the northern plume contaminant levels (which are decreasing) with the southern plume contaminant levels (which are increasing) results in groundwater contaminant levels from the combined recovery well system over the locomotive shop area that are relatively consistent over time. Table C.6 shows reported contaminant concentrations:

Table C.6: Contaminant Concentrations (in µg/L) in LSA Recovery Wells from 2012 to 2014

Analyte	March 2012	September 2012	March 2013	September 2013	March 2014	September 2014
TCE	440	500	290	1,800	1,480	1,300
cis-1,2-DCE	1,200	140	74	250	270	160
trans-1,2-DCE	22	<10	<2	<20	<20	<20
Vinyl Chloride	14	<10	5.2	35	<20	24

TCE: trichloroethene
cis-1,2-DCE: *cis*-1,2-dichloroethene
trans-1,2-DCE: *trans*-1,2-dichloroethene
µg/L: micrograms of contaminant per liter of water
All groundwater samples were analyzed for select VOCs using U.S. EPA Method 8260.

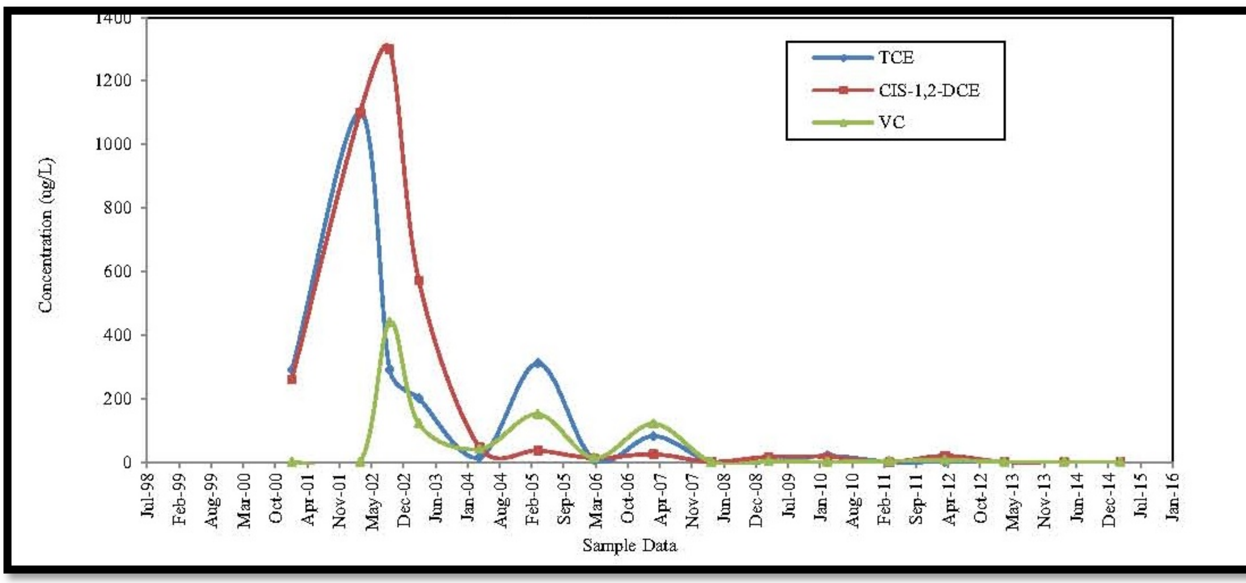
From October 2009 through March 2016, approximately 91 million gallons of groundwater have been recovered and treated from the locomotive shop area plume [ARCADIS 2016].

C.5 Locomotive Paint and Air Brake Shop, or LPABS

The LPABS plume contains TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and trace concentrations of VC. The plume was originally centered on MW-96 and MW-108 in the old engine house solid waste management unit. MW-96, completed over the 48' to 58' horizon, was installed in 1999. Initial sample results showed 280,000 µg/L of TCE. MW108 is a four-well cluster, each well completed in a separate horizon: 10–20', 35–45, 46–56', and 70–75'. Initial sample results reported TCE concentrations of 290,000, 240,000, 160,000, and 2,200 µg/L, respectively. With the December 2001 installation and operation of the horizontal well HWW-1 near the MW-108 well cluster, contamination in the MW-108 well cluster has been significantly reduced. The TCE level in the MW-96 well has also significantly reduced [DNR 2015].

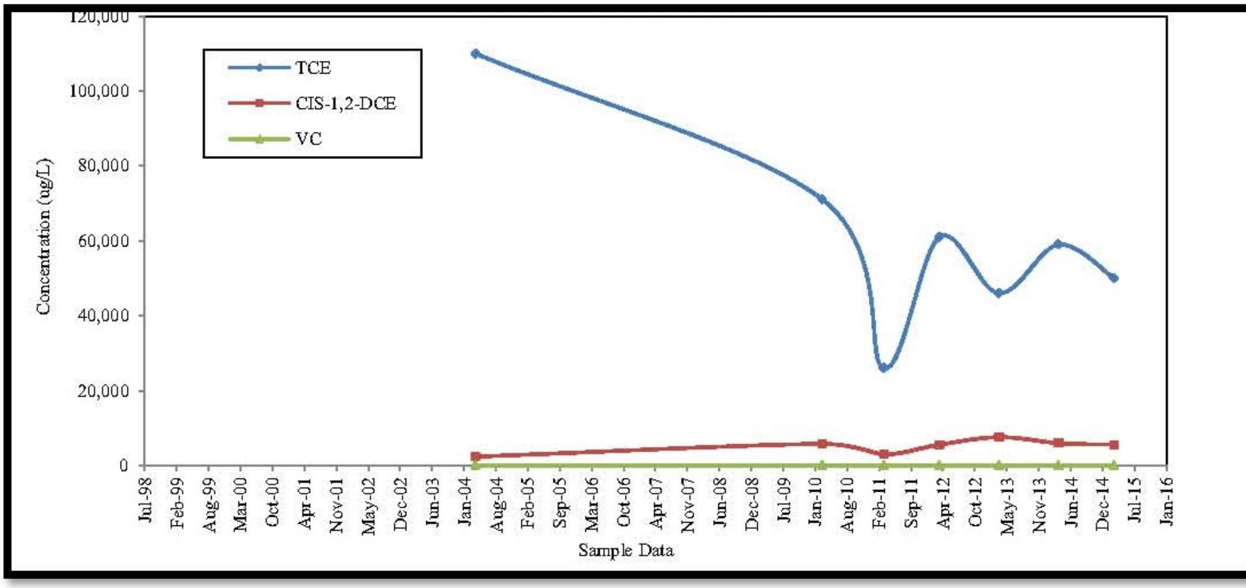
Figures C.7 and C.8 show the long-term trend of chlorinated VOC concentrations (in µg/L) in monitoring wells MW-108 and MW-96:

Figure C.7: Long-Term Trend of Select VOCs in MW-108 Cluster (10 ft. to 20 ft. Horizon)



VOCs: volatile organic compounds
MW-108: monitoring well-108
µg/L: micrograms of contaminant per liter of water
Note: Influenced by HWW-1 online December 2001

Figure C.8: Long-Term Trend of Select VOCs in MW-96 Cluster (48 ft. to 58 ft. Horizon)



VOCs: volatile organic compounds
MW-96: monitoring well-96
µg/L: micrograms of contaminant per liter of water
HWW-1 online December 2001

For the most current sampling events, the highest TCE level was centered over MW-96 (48–58') well cluster. The TCE concentration reported in March 2015 was 50,000 µg/L. In recent years, MW-108 (46–56') has shown a significant TCE increase (from a low of 2.2 µg/L in 2008 to 640 µg/L in March 2012). But the levels are relatively low compared with the levels before the horizontal recovery well installation [DNR 2015; ARCADIS 2015]. Wells in which TCE was detected also displayed levels of *cis*-1,2-DCE and VC in line with expected degradation levels as daughter products. Table C.7 shows TCE contaminant concentrations over the last 4 years for all wells in which TCE was detected during that period:

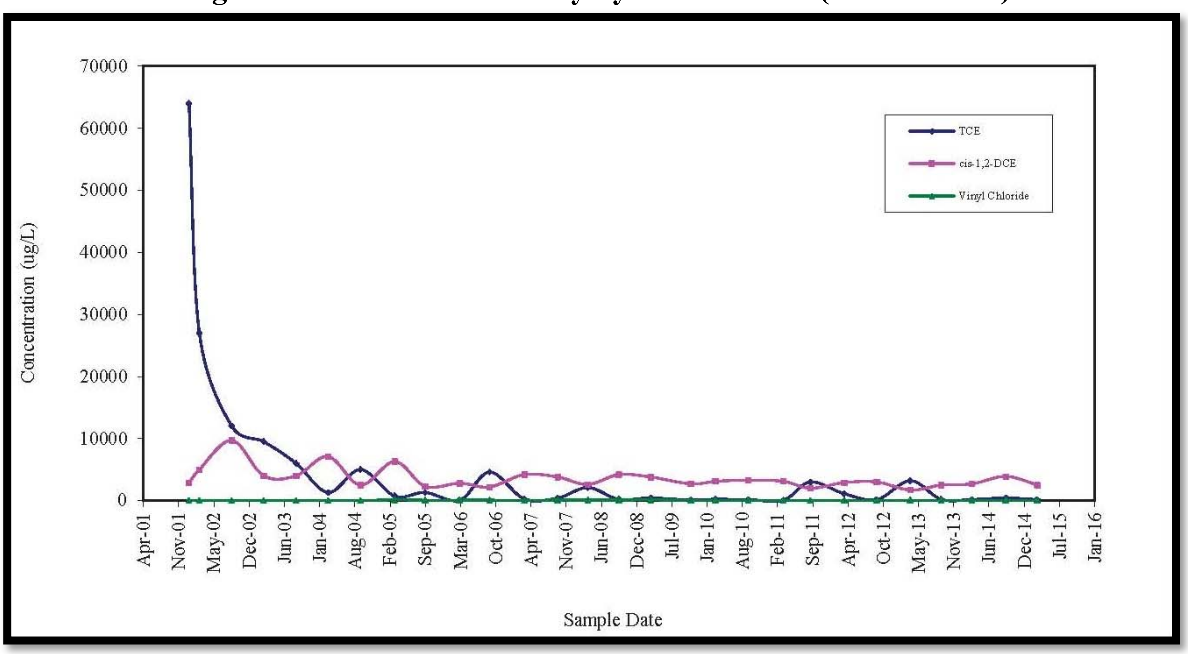
Table C.7: TCE Concentrations (in µg/L) in Select Monitoring Wells from March 2012 to March 2015

Monitoring Well	2012	2013	2014	2015
MW-89	320*	<1	<1	<1
MW-90	660*	<1	<1	<1
MW-92	250*	<1	<1	<1
MW-93 (25-35')	9,700	7,400	24,000	18,000
MW-94 (12-22')	2,000	<1	<1	<1
MW-95	2.9	5.7	3.5	11
MW-96 (48-58')	61,000	46,000	59,000	50,000
MW-97	<1	<1	11	<1
MW-105 (12-22')	67	<20	<20	<20
MW-107 (70-80')	460	2.3	1.5	<1
MW-108 (35-45')	<20	<5	1.6	<100
MW-108 (46-56')	640	63	<50	<50
MW-108 (70-75')	<1	1	3	<1

*These wells were re-sampled in October 2012, with no TCE detected.
µg/L: micrograms of contaminant per liter of water
All groundwater samples were analyzed for select VOCs using U.S. EPA Method 8260.

Analytical data indicate a significant groundwater contamination plume at the locomotive paint and air brake shop. The vertical and horizontal extent of contamination has been fully delineated, though comprehensive remedial goals have yet to be determined. As shown in Figure C.9, the current recovery system manages groundwater effects [DNR 2015]:

Figure C.9: LPABS Recovery System Influent (Select VOCs)



LPABS: Locomotive Paint and Air Brake Shop
VOCs: volatile organic compounds
µg/L: micrograms of contaminant per liter of water
HWW-1 online December 2001

From November 2001 through March 2016, over 154 million gallons of groundwater have been recovered and treated from the LPABS plume [ARCADIS 2015].

Since recovery and treatment operations began at CSX Rail Yard to March 2016, over 516 million gallons of contaminated groundwater have been recovered, and approximately 10,795 pounds of VOCs have been removed from the old dump storage area, alum sludge basin, acid-lime sludge area, locomotive shop area, and locomotive paint and air brake shop plumes [ARCADIS 2016].

Table C.8: Site-Specific Groundwater Protection Standards for the CSX Rail Yard Established by the Georgia Environmental Protection Division in Micrograms per Liter (µg/L)

Constituent	Facility BCL	ODSA GPS	ASB GPS	ALSA BCL	LSA NLE	LPABS BCL	Surface Water NPDES
Trichloroethene (TCE)	8~~8~~	2	78.4	1	2	NLE	80.7*
Tetrachloroethene (PCE)	1	1	8	1	1.2	--	8.85*
cis-1,2-Dichloroethene (*cis*-1,2-DCE)	1	1	8	1	1.4	NLE	--
1,1,2-Trichloroethane (1,1,2-TCA)	1	--	--	--	1	NLE	--
trans-1,2-Dichloroethene (*trans*-1,2-DCE)	1	1.9	1.2	1	1	NLE	*
1,1-Dichloroethene (1,1-DCE)	8	2.2	1.5	--	--	NLE	3.2*
Methylene Chloride	5	5.3	1.5	--	--	--	*
Vinyl Chloride	1	4	3.3	1	1	--	*
Chlorobenzene	1	--	2.3	--	--	NLE	*
1,1-Dichloroethane (1,1-DCA)	1	--	1.9	--	--	NLE	*
1,2-Dichlorobenzene (1,2-DCB)	1	--	1.4	--	--		*
Acenaphthene	0.19	10	--	--	--		--
Acenaphthylene	0.33	10	--	--	--		--
Fluoranthene	0.33	15	--	--	--		--
Fluorene	0.33	10	--	--	--		--
2-methylnaphthalene	0.33	10	--	--	--		--
Naphthalene	0.19	10	--	--	--		--
Phenanthrene	0.34	10	--	--	--		--
Pyrene	0.33	10	--	--	--		--
Dibenzofuran	8.4	10	--	--	--		--
Carbon Tetrachloride	--	--	--	--	--	NLE	--
Chloroform	--	--	--	--	--	NLE	--
Chloroethane	--	--	--	--	--	NLE	--
Chloromethane	--	--	--	--	--	NLE	--
1,2-Dichloroethane (1,2-DCA)	--	--	--	--	--	NLE	--
Chromium	8.4	--	50	--	--	--	--
Lead	11.6	50	--	--	--	--	--
Zinc	17	54	--	--	--	--	--
Vanadium	10	--	10	24.25	--	--	--

BCL: Background concentration level
ODSA: Old Drum Storage Area
ASB: Alum Sludge Basin
ALSA: Acid-Lime Sludge Area
LSA: Locomotive Shop Area
LPABS: Locomotive Paint and Air Brake Shop
GPS: Georgia Groundwater Protection Standards.
NPDES: National Pollutant Discharge Elimination System
* The total of these constituents cannot exceed 250 parts per billion (ppb).
NLE: No limit established

Appendix D. Historic and Current Surface Water and Sediment Sample Results

Table D.1: Summary of Historical and Current Surface Water Sampling Results from the Waycross Canal Adjacent to the CSX Rail Yard

Chemical Contaminant	Sample Location	Earliest Sample Date	Number of Samples Taken	Date Last Detected	Maximum Concentration µg/L / Number of Samples above CV	Date of Maximum Concentration	Comparison Value µg/L	Type of CV
1,1-Dichloroethane	CW-1	Sep-90	65	Sep-2001	2.3 / 0	Sep-01	3,800; 2.8	RSL_{nc}; RSL_c
1,1-Dichloroethene		Sep-90	65	Sep-2001	7.1 / 0	Jun-93	63	$_cEMEG_{child}$
cis-1,2-Dichloroethene		Sep-95	46	Mar-2016	**210** / 10	**Mar-00**	36	RSL_{nc}
trans-1,2-Dichloroethene		Sep-90	65	Jun-1993	72 / 0	Jun-93	360	RSL_{nc}
Trichloroethene		Sep-90	65	Mar-2015	**190** / 36	**Dec-93**	3.5; 0.43	$_cEMEG_{child}$, CREG
Vinyl Chloride		Sep-90	65	Sep-1996	**2** / 2	**Sep-01**	21; 0.017	$_cEMEG_{child}$, CREG
1,1-Dichloroethane	CW-2	Jun-88	67	Sep-2001	2.2 / 0	Sep-01	3,800; 2.8	RSL_{nc}; RSL_c
1,1-Dichloroethene		Jun-88	67	Sep-2001	8.9 / 0	Jun-96	63	$_cEMEG_{child}$
cis-1,2-Dichloroethene		Sep-95	45	Mar-2015	**130** / 7	**Sep-97**	36	RSL_{nc}
trans-1,2-Dichloroethene		Jun-88	67	Mar-1995	**130** / 0	**Jun-93**	360	RSL_{nc}
Trichloroethene		Jun-88	67	Mar-2015	**200** / 39	**Dec-93**	3.5; 0.43	$_cEMEG_{child}$, CREG
Vinyl Chloride		Jun-88	67	Sep-2001	**5.4** / 5	**Jun-93**	21; 0.017	$_cEMEG_{child}$, CREG
1,1-Dichloroethane	CW-3	Jun-88	69	Sep-2001	2.5 / 0	Sep-01	3,800; 2.8	RSL_{nc}; RSL_c
1,1-Dichloroethene		Jun-88	69	Sep-2001	15 / 0	Jun-93	63	$_cEMEG_{child}$
cis-1,2-Dichloroethene		Sep-95	46	Mar-2016	**96** / 10	**Mar-00**	36	RSL_{nc}
trans-1,2-Dichloroethene		Jun-88	69	Mar-1995	110 / 0	**Jun-88**	360	RSL_{nc}
Trichloroethene		Jun-88	69	Mar-2015	**730** / 43	**Jun-88**	3.5; 0.43	$_cEMEG_{child}$, CREG
Vinyl Chloride		Jun-88	69	Sep-2001	**3.7** / 7	**Jun-88**	21; 0.017	$_cEMEG_{child}$, CREG

Chemical Contaminant	Sample Location	Earliest Sample Date	Number of Samples Taken	Date Last Detected	Maximum Concentration µg/L / Number of Samples above CV	Date of Maximum Concentration	Comparison Value µg/L	Type of CV
1,1-Dichloroethane	W-6	Mar-95	44	ND	ND	ND	3,800; 2.8	RSL_{nc}; RSL_c
1,1-Dichloroethene		Sep-89	44	ND	ND	ND	63	$_cEMEG_{child}$
cis-1,2-Dichloroethene		Mar-96	43	Mar-2016	**110** / 4	**Mar-97**	36	RSL_{nc}
trans-1,2-Dichloroethene		Sep-89	45	Mar-1995	150 / 0	**Mar 95**	360	RSL_{NC}
Trichloroethene		Sep-89	45	Mar-2016	**230** / 24	**Sep-89**	3.5; 0.43	$_cEMEG_{child}$, CREG
Vinyl Chloride		Mar-95	44	Mar-2015	**1.4** / 2	**Mar-15**	21; 0.017	$_cEMEG_{child}$, CREG
1,1-Dichloroethane	W-12	Mar-95	45	Sep-1996	**7.6** / 2	**Jun-96**	3,800; 2.8	RSL_{nc}; RSL_c
1,1-Dichloroethene		Mar-95	45	Mar-2001	**69** / 1	Sep-97	63	$_cEMEG_{child}$
cis-1,2-Dichloroethene		Dec-95	43	Mar-2016	**1,100** / 9	**Sep-97**	36	RSL_{nc}
trans-1,2-Dichloroethene		Jun-91	46	Mar-1995	22 / 0	Mar-95	360	RSL_{NC}
Trichloroethene		Jun-91	46	Mar-2015	**1,800** / 19	**Sep-97**	3.5; 0.43	$_cEMEG_{child}$, CREG
Vinyl Chloride		Jun-91	46	Sep-2001	**5.1** / 3	**Jun-96**	21; 0.017	$_cEMEG_{child}$, CREG
1,1-Dichloroethane	W-15	Mar-95	45	Jun-1996	**2.8** / 1	**Sep-96**	3,800; 2.8	RSL_{nc}; RSL_c
1,1-Dichloroethene		Sep-89	45	Mar-2001	53 / 0	Sep-97	63	$_cEMEG_{child}$
cis-1,2-Dichloroethene		Dec-95	44	Mar-2016	**990** / 10	**Sep-97**	36	RSL_{nc}
trans-1,2-Dichloroethene		Sep-89	46	Mar-1995	19 / 0	Mar-95	360	RSL_{nc}
Trichloroethene		Sep-89	46	Sep-2010	**1,500** / 20	**Sep-97**	3.5; 0.43	$_cEMEG_{child}$, CREG
Vinyl Chloride		Mar-95	45	Sep-1996	**2.7** / 1	**Sep-96**	21; 0.017	$_cEMEG_{child}$, CREG

Chemical Contaminant	Sample Location	Earliest Sample Date	Number of Samples Taken	Date Last Detected	Maximum Concentration µg/L / Number of Samples above CV	Date of Maximum Concentration	Comparison Value µg/L	Type of CV
1,1-Dichloroethane	W-28	Mar-95	41	ND	ND	ND	3,800; 2.8	RSL_{nc}; RSL_c
1,1-Dichloroethene		Mar-95	41	ND	ND	ND	63	$_c EMEG_{child}$
cis-1,2-Dichloroethene		Sep-96	40	Mar-2016	6.1 / 0	Mar-07	36	RSL_{nc}
trans-1,2-Dichloroethene		Mar-95	41	ND	ND	ND	360	RSL_{nc}
Trichloroethene		Mar-95	41	ND	ND	ND	3.5; 0.43	$_c EMEG_{child}$, CREG
Vinyl Chloride		Mar-95	41	ND	ND	ND	21; 0.017	$_c EMEG_{child}$, CREG
1,1-Dichloroethane	W-33	Oct-97	36	ND	ND	ND	3,800; 2.8	RSL_{nc}; RSL_c
1,1-Dichloroethene		Oct-97	36	Mar-2001	**140** / 3	**Oct-97**	63	$_c EMEG_{child}$
cis-1,2-Dichloroethene		Oct-97	36	Mar-1016	**1,800** / 7	**Sep-99**	36	RSL_{nc}
trans-1,2-Dichloroethene		Oct-97	36	ND	ND	ND	360	RSL_{nc}
Trichloroethene		Oct-97	36	Sep-2001	**3,100** / 8	**Oct-97**	3.5; 0.43	$_c EMEG_{child}$, CREG
Vinyl Chloride		Oct-97	36	Sep-2000	**2.4** / 1	**Mar-00**	21; 0.017	$_c EMEG_{child}$, CREG
1,1-Dichloroethane	W-36	Oct-97	36	ND	ND	ND	3,800; 2.8	RSL_{NC}; RSL_C
1,1-Dichloroethene		Oct-97	36	ND	ND	ND	63	$_c EMEG_{child}$
cis-1,2-Dichloroethene		Oct-97	36	Mar-2016	9.2 / 0	Mar-00	36	RSL_{nc}
trans-1,2-Dichloroethene		Oct-97	36	ND	ND	ND	360	RSL_{nc}
Trichloroethene		Oct-97	36	Mar-2000	**2** / 2	**Mar-00**	3.5; 0.43	$_c EMEG_{child}$, CREG
Vinyl Chloride		Oct-97	36	Mar-2000	**2.4** / 2	**Mar-00**	21; 0.017	$_c EMEG_{child}$, CREG

Chemical Contaminant	Sample Location	Earliest Sample Date	Number of Samples Taken	Date Last Detected	Maximum Concentration µg/L / Number of Samples above CV	Date of Maximum Concentration	Comparison Value µg/L	Type of CV
1,1-Dichloroethane	W-45	Mar-00	32	Sep-2001	1.2 / 0	1Sep-01	3,800; 2.8	RSL_{nc}; RSL_c
1,1-Dichloroethene		Mar-00	32	Sep-2001	2.1 / 0	Sep-01	90	$_{c}EMEG_{child}$
cis-1,2-Dichloroethene		Mar-00	32	Mar-2015	**38** / 1	Sep-01	36	RSL_{nc}
trans-1,2-Dichloroethene		Mar-00	32	ND	ND	ND	360	RSL_{nc}
Trichloroethene		Mar-00	32	Mar-2015	**26** / 7	**Sep-01**	3.5; 0.43	$_{c}EMEG_{child}$, CREG
Vinyl Chloride		Mar-00	32	Sep-2001	**1.8** / 1	**Sep-01**	21; 0.017	$_{c}EMEG_{child}$, CREG

µg/L: micrograms of contaminant per liter of water
RSL_{nc}: USEPA non-carcinogenic Regional Screening Level for Resident Tapwater June 2017)
RSL_c: USEPA carcinogenic Regional Screening Level for Resident Tapwater (June 2017)
$_{c}EMEG_{child}$: ATSDR Environmental Media Evaluation Guide for a child's chronic exposure to drinking water (February 2017)
CREG: Cancer Risk Evaluation Guide (November 2016)
ND: not detected at the limit indicated
Bolded values exceed a comparison value.

Table D.2: Summary of Historical Sediment Sampling Results for Polycyclic Aromatic Hydrocarbons from the Waycross Canal Near the CSX Rail Yard Site.

Chemical Contaminant	Sample Location	Number of Samples Taken	Date Sampled	Concentration mg/kg	Comparison Value mg/kg	Type of CV
Benzo(b)fluoranthene	CW-1	1	Mar-04	ND	1.1	RSLc
Chrysene				ND	110	RSLc
Indeno(1,2,3-cd)pyrene				ND	1.1	RSLc
Benzo(b)fluoranthene	CW-2	1	Mar-04	ND	1.1	RSLc
Chrysene				ND	110	RSLc
Indeno(1,2,3-cd)pyrene				ND	1.1	RSLc
Benzo(b)fluoranthene	CW-3	1	Mar-04	ND	1.1	RSLc
Chrysene				ND	110	RSLc
Indeno(1,2,3-cd)pyrene				ND	1.1	RSLc
Benzo(b)fluoranthene	W-15	1	Mar-04	ND	1.1	RSLc
Chrysene				ND	110	RSLc
Indeno(1,2,3-cd)pyrene				ND	1.1	RSLc
Benzo(b)fluoranthene	W-27	1	Mar-04	ND	1.1	RSLc
Chrysene				ND	110	RSLc
Indeno(1,2,3-cd)pyrene				ND	1.1	RSLc
Benzo(b)fluoranthene	W-31	1	Nov-04	ND	1.1	RSLc
Chrysene				ND	110	RSLc
Indeno(1,2,3-cd)pyrene				ND	1.1	RSLc
Benzo(b)fluoranthene	W-32	1	Nov-04	ND	1.1	RSLc
Chrysene				ND	110	RSLc
Indeno(1,2,3-cd)pyrene				ND	1.1	RSLc
Benzo(b)fluoranthene	W-33	1	Nov-04	ND	1.1	RSLc
Chrysene				ND	110	RSLc
Indeno(1,2,3-cd)pyrene				ND	1.1	RSLc

Chemical Contaminant	Sample Location	Number of Samples Taken	Date Sampled	Concentration mg/kg	Comparison Value mg/kg	Type of CV
Benzo(b)fluoranthene	W-34	1	Nov-04	ND	1.1	RSL_c
Chrysene				ND	110	RSL_c
Indeno(1,2,3-cd)pyrene				ND	1.1	RSL_c
Benzo(b)fluoranthene	W-36	1	Mar-04	0.360	1.1	RSL_c
Chrysene				0.140	110	RSL_c
Indeno(1,2,3-cd)pyrene				0.120	1.1	RSL_c
Benzo(b)fluoranthene	W-41	1	Mar-04	ND	1.1	RSL_c
Chrysene				ND	110	RSL_c
Indeno(1,2,3-cd)pyrene				ND	1.1	RSL_c
Benzo(b)fluoranthene	W-42	1	Mar-04	ND	1.1	RSL_c
Chrysene				ND	110	RSL_c
Indeno(1,2,3-cd)pyrene				ND	1.1	RSL_c
Benzo(b)fluoranthene	W-43	1	Mar-04	ND	1.1	RSL_c
Chrysene				ND	110	RSL_c
Indeno(1,2,3-cd)pyrene				ND	1.1	RSL_c
Benzo(b)fluoranthene	W-44	1	Mar-04	ND	1.1	RSL_c
Chrysene				ND	110	RSL_c
Indeno(1,2,3-cd)pyrene				ND	1.1	RSL_c
Benzo(b)fluoranthene	W-45	1	Mar-04	ND	1.1	RSL_c
Chrysene				ND	110	RSL_c
Indeno(1,2,3-cd)pyrene				ND	1.1	RSL_c
Benzo(b)fluoranthene	W-46	1	Mar-04	ND	1.1	RSL_c
Chrysene				ND	110	RSL_c
Indeno(1,2,3-cd)pyrene				ND	1.1	RSL_c

mg/kg: milligrams of analyte per kilogram of sediment;
RSL_c: USEPA carcinogenic Regional Screening Level for Resident Soil (June 2017);
ND: not detected above the detection limit

Table D.3: Summary of Historical Sediment Sampling Results for Metals in the Waycross Canal Adjacent to the CSX Rail Yard Site

Chemical Contaminant	Sample Location	Number of Samples Taken	Date Sampled	Concentration mg/kg	Comparison Value mg/kg	Type of CV
Arsenic	CW-1	1	Mar-04	1.7	17	$_{c}$EMEG$_{child}$;
Barium				21	11,000	$_{c}$EMEG$_{child}$
Chromium				4.5	51*	$_{c}$EMEG$_{child}$
Lead**				15	NA	NA
Arsenic	CW-2	1	Mar-04	ND	17	$_{c}$EMEG$_{child}$;
Barium				20	11,000	$_{c}$EMEG$_{child}$
Chromium				8.8	51*	$_{c}$EMEG$_{child}$
Lead**				25	NA	NA
Arsenic	CW-3	1	Mar-04	1.8	17;	$_{c}$EMEG$_{child}$;
Barium				33	11,000	$_{c}$EMEG$_{child}$
Chromium				10	51*	$_{c}$EMEG$_{child}$
Lead**				32	NA	NA
Arsenic	W-15	1	Mar-04	3.5	17	$_{c}$EMEG$_{child}$;
Barium				42	11,000	$_{c}$EMEG$_{child}$
Chromium				23	51*	$_{c}$EMEG$_{child}$
Lead**				170	NA	NA
Arsenic	W-27	1	Mar-04	**208**	17	$_{c}$EMEG$_{child}$;
Barium				27	11,000	$_{c}$EMEG$_{child}$
Chromium				13	51*	$_{c}$EMEG$_{child}$
Lead**				85	NA	NA
Arsenic	W-31	1	Nov-04	2.9	17	$_{c}$EMEG$_{child}$;
Barium				18	11,000	$_{c}$EMEG$_{child}$
Chromium				19	51*	$_{c}$EMEG$_{child}$
Lead**				7.3	NA	NA
Arsenic	W-32	1	Nov-04	6.1	17	$_{c}$EMEG$_{child}$;
Barium				45	11,000	$_{c}$EMEG$_{child}$
Chromium				19	51*	$_{c}$EMEG$_{child}$
Lead**				76	NA	NA$_{c}$
Arsenic	W-33	1	Nov-04	3.7	17	$_{c}$EMEG$_{child}$;
Barium				32	11,000	$_{c}$EMEG$_{child}$
Chromium				13	51*	$_{c}$EMEG$_{child}$
Lead**				62	NA	NA
Arsenic	W-34	1	Nov-04	1.2	17	$_{c}$EMEG$_{child}$;
Barium				52	11,000	$_{c}$EMEG$_{child}$
Chromium				16	51*	$_{c}$EMEG$_{child}$
Lead**				89	NA	NA

Chemical Contaminant	Sample Location	Number of Samples Taken	Date Sampled	Concentration mg/kg	Comparison Value mg/kg	Type of CV
Arsenic	W-36	1	Mar-04	2.7	17	$_{c}$EMEG$_{child}$;
Barium				22	11,000	$_{c}$EMEG$_{child}$
Chromium				31	51*	$_{c}$EMEG$_{child}$
Lead**				46	NA	NA
Arsenic	W-41	1	Mar-04	ND	17	$_{c}$EMEG$_{child}$;
Barium				2.7	11,000	$_{c}$EMEG$_{child}$
Chromium				ND	51*	$_{c}$EMEG$_{child}$
Lead**				1.2	NA	NA
Arsenic	W-42	1	Mar-04	ND	17	$_{c}$EMEG$_{child}$;
Barium				3.6	11,000	$_{c}$EMEG$_{child}$
Chromium				1.6	51*	$_{c}$EMEG$_{child}$
Lead**				5.3	NA	NA
Arsenic	W-43	1	Mar-04	ND	17	$_{c}$EMEG$_{child}$;
Barium				11	11,000	$_{c}$EMEG$_{child}$
Chromium				2.4	51*	$_{c}$EMEG$_{child}$
Lead**				8.8	NA	NA
Arsenic	W-44	1	Mar-04	ND	17	$_{c}$EMEG$_{child}$;
Barium				18	11,000	$_{c}$EMEG$_{child}$
Chromium				4.8	51*	$_{c}$EMEG$_{child}$
Lead**				15	NA	NA
Arsenic	W-45	1	Mar-04	ND	17	$_{c}$EMEG$_{child}$;
Barium				20	11,000	$_{c}$EMEG$_{child}$
Chromium				6.9	51*	$_{c}$EMEG$_{child}$
Lead**				11	NA	NA
Arsenic	W-46	1	Mar-04	2.5	17	$_{c}$EMEG$_{child}$;
Barium				14	11,000	$_{c}$EMEG$_{child}$
Chromium				5.8	51*	$_{c}$EMEG$_{child}$
Lead**				19	NA	NA

mg/kg: milligrams of analyte per kilogram of sediment
$_{c}$EMEG$_{child}$: ATSDR Environmental Media Evaluation Guide for a child's chronic exposure to soil (November 2016)
ND: not detected above the detection limit
NA: not applicable
*Comparison value for hexavalent chromium.
** CDC recommends that all exposures to lead should be minimized, as possible, therefore no screening level has been developed for soil.
Bolded value exceeds a comparison value.

Appendix E. Explanation of Evaluation Process

Step 1--The Screening Process

To evaluate the available data, DPH used comparison values, or CVs, to determine which chemicals to examine more closely. CVs are contaminant concentrations found in a specific environmental media (air, soil, water, sediment, and food chain) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of environmental media that someone may inhale or ingest each day. CVs are generated to be conservative and non-site specific. The CV is used as a screening level during the public health assessment (PHA) or health consultation process. CVs are not intended to be environmental clean-up levels or to indicate that health effects occur at concentrations that exceed these values.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based CVs are calculated from the U.S. Environmental Protection Agency's (USEPA) oral cancer slope factors for ingestion exposure, or inhalation risk units for inhalation exposure. Noncancer CVs are calculated from ATSDR's minimal risk levels, USEPA's reference doses for ingestion, or USEPA's reference concentrations for inhalation exposure. When a cancer and noncancer CV exist for the same chemical, the lower of these values is used as a conservative measure.

Step 2--Evaluation of Public Health Implications

The next step in the evaluation process is to take those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Separate child and adult exposure doses (or the amount of a contaminant that gets into a person's body) are calculated for site-specific scenarios, using assumptions regarding an individual's likelihood of exposure to contaminants associated with CSX Rail Yard in the Waycross Canal. A brief explanation of the calculation of estimated exposure doses used in this health assessment is presented below.

Incidental Ingestion of contaminants found in the surface water and sediment of the Waycross Canal at the CSX Rail Yard site- Exposure doses for the consumption of contaminants present in sediment were calculated using the 95UCLs of 1,1-DCE, *cis*-1,2-DCE, and TCE found in an approximate 400 feet section (between W-15 and W-35) of the Waycross Canal where the highest concentrations of these VOCs were in micrograms per liter of surface water. The following equation is used to estimate the exposure doses resulting from ingestion of surface water:

$$ED = \frac{C \times IR \times EF}{BW}$$

where;

ED = exposure dose from incidental ingestion (mg/kg/day)
C = contaminant concentration in surface water (mg/L)
IR = incidental ingestion rate based on the central tendency exposure (0.049 liters/hour for children ages 6 to <11 years old, which translates to 0.002 L/day for this calculation. For sediment, the incidental ingestion rate is based on a central tendency exposure of 50 mg/day where sediment is not located at or near a residence and not likely to be tracked into the home and become dust.

Table E.1: ATSDR Recommended Values for Surface Water Ingestion Rates.

Group	*CTE* (L/hour)	*RME* (L/hour)	*Body Weight* (L/hour)
Children (6< 11 years old)	0.049	0.12*	31.8

CTE: central tendency exposure (typical intake rate)
RME: reasonable maximum exposure
L/hour: ingestion rate in liter per hour
*97th percentile
**Maximum
Source: [USEPA 2011]

EF= exposure factor (based on frequency of exposure, exposure duration, and time of exposure). The exposure factor used for exposure to surface water found in the Waycross Canal is 0.0438 (0.044) based on a 1 day per week exposure for 16 weeks per year (1 day/wk * 16wk/yr * yr/365 day)
CF = soil/sediment conversion factor (10^{-6} kg/mg)
BW = body weight (based on the average body weight of a child aged 6<11 years old (31.8 kg))

For example, the following is an estimated exposure dose for 6 to <11-year-old children incidentally ingesting the 95UCL concentration of TCE found in the Waycross Canal (1.4 mg/L):

$$ED = \frac{1.4 \text{ mg/L x 0,049 L/day x 0.044}}{31.8 \text{ kg}}$$

$$= 9.5 \times 10^{-5} \text{ mg/kg/day (or 0.0009 mg/kg/day) TCE}$$

Dermal absorption of contaminants present in the sediment of the Waycross Canal- Exposure doses from dermal absorption of contaminants present in sediment were calculated using the highest concentration of arsenic and benzo(b)fluoranthene in milligrams per kilogram (mg/kg) found in sediment. The following equation is used to estimate the exposure doses resulting from dermal absorption of arsenic and benzo(b)fluoranthene in sediment:

$$DA\ event = C_{(soil/sed)} \times CF \times AF \times ABS_d$$

$$DAD = (DA_{event} \times EF \times SA)/BW$$

$$DAD = (C_{(soil/sed)} \times CF \times AF \times ABS_d \times EF \times SA)/BW$$

where;

- DAD = Dermally Absorbed Dose (mg/kg-day)
- DA_{event} = Absorbed dose per event (mg/kg-day
- $C_{(soil/sed)}$ = Contaminant Concentration (mg/kg)
- CF = Soil Conversion Factor (10^{-6} kg/mg)
- AF = Default Adherence Factor (21mg/cm^2 for children)
- ABS_d = Dermal Adsorption Factor (0.03 for arsenic and 0.13 for benzo(b)fluoranthene)
- EF = Exposure Factor. Exposure factor (based on frequency of exposure, exposure duration, and time of exposure). The exposure factor used for exposure to sediment found in the Waycross Canal in this analysis was 0.002. This exposure factor assumes that exposure is occurring for one day per week, 16 weeks per (1 day/week * 16 wk/yr * yr/8760 hr)
- SA = Exposed Skin Surface Area. For children, we used the mean of the 50th percentile for surface area of the feet and hands of a child between the ages of 6 to <11 years old. Therefore, 1,240 cm^2 was used for the surface area potentially exposed to contaminants found in the sediment of the Waycross Canal.

BW = body weight (based on the average body weight of a child aged 6<11 years old (31.8 kg).

Dermal absorption of VOCs present in the surface water of the Waycross Canal- Exposure doses from dermal absorption of VOCs present in surface water were calculated using the 95UCL concentrations of 1,1-DCE, *cis*-1,2-DCE, and TCE found in an approximate 400 feet section (between W-15 and W-35) of the Waycross Canal where the highest concentrations of these VOCs were observed in the past. The following equations are used to estimate the exposure doses resulting from dermal absorption of VOCs in surface water:

Equation E.1: Dermal Absorbed Dose from Contact with Surface Water

Dermal Absorbed Dose – Water Contact

$$DAD = \frac{DA_{event} \times EV \times ED \times EF \times SA}{BW \times AT} \qquad (3.1)$$

where:

Parameter		Definition (units)	Default Value
DAD	=	Dermally Absorbed Dose (mg/kg-day)	–
DA_{event}	=	Absorbed dose per event (mg/cm^2-event)	Chemical-specific, see Eq. 3.2 and 3.3
SA	=	Skin surface area available for contact (cm^2)	See Exhibit 3-2
EV	=	Event frequency (events/day)	See Exhibit 3-2
EF	=	Exposure frequency (days/year)	See Exhibit 3-2
ED	=	Exposure duration (years)	See Exhibit 3-2
BW	=	Body weight (kg)	70 kg
AT	=	Averaging time (days)	noncarcinogenic effects AT = ED x 365 d/yr carcinogenic effects AT = 70 yr x 365 d/yr

where;

DAD = Dermally Absorbed Dose (mg/kg-day)
DA_{event} = Absorbed dose per event (mg/kg-day
EV = Event Frequency (events/day) = 1.0 events/day
ED = Exposure Duration (years) = 5 years
EF = Exposure Frequency (days/year) = 16
SA = Exposed Skin Surface Area. For children, we used the central tendency exposure (CTE) or the 50th percentile for surface area of the hands (510 cm^2), forearms (680 cm^2), lower legs (1244 cm^2), and feet (730 cm^2) of a child between the ages of 6 to <11 years old. Therefore, 3,164 cm^2 was used for the surface area potentially exposed to contaminants found in the sediment of the Waycross Canal.
BW = body weight (based on the average body weight of a child aged 6<11 years of age (31.8 kg).
AT = Averaging time (days) = 1825 days

and,

Equation E.2: Dermal Absorbed Dose for Organic Compounds per Event

Dermal Absorbed Dose per event for Organic Compounds - Water Contact

DA_{event} (mg/cm^2-event) is calculated for oganic compounds as follows :

$$If\ t_{event} \leq t^*,\ then:\ DA_{event} = 2\ FA \times K_p \times C_w \sqrt{\frac{6\ \tau_{event} \times t_{event}}{\pi}} \qquad (3.2)$$

$$If\ t_{event} > t^*,\ then:\ DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1 + B} + 2\ \tau_{event}\left(\frac{1 + 3\ B + 3\ B^2}{(1 + B)^2}\right)\right] \qquad (3.3)$$

where:

Parameter		Definition (units)	Default Value
DA_{event}	=	Absorbed dose per event (mg/cm^2-event)	–
FA	=	Fraction absorbed (dimensionless)	Chemical-specific, See Appendix B
K_p	=	Dermal permeability coefficient of compound in water (cm/hr)	Chemical-specific, See Appendix B
C_w	=	Chemical concentration in water (mg/cm^3)	Site-specific
τ_{event}	=	Lag time per event (hr/event)	Chemical-specific, See Appendix B
t_{event}	=	Event duration (hr/event)	See Exhibit 3-2
t^*	=	Time to reach steady-state (hr) = 2.4 τ_{event}	Chemical-specific, See Eq. A.5 to A.8
B	=	Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (ve) (dimensionless).	Chemical-specific, See Eq. A.1

where,

DA_{event} = Absorbed dose per event (mg-cm^2-event)
FA = Fraction absorbed (dimensionless).
K_p = Dermal permeability coefficient of compound in water (cm/hour)
C_w = Chemical concentration in water (mg/cm^3)
τ_{event} = Lag time per event (hr/event)
t_{event} = Event duration (hr/event)
t^* = Time to reach steady-state (hr) = 2.4 τ_{event}
B = Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis.

Noncancer Health Risks

The doses calculated for exposure to individual chemicals are then compared to an established health guideline, such as an ATSDR minimal risk level (MRL) or an U.S. EPA reference dose RfD), to assess whether adverse health impacts from exposure are expected. Health guidelines are chemical-specific values that are based on available scientific literature and are considered protective of human health. Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. Thus, the current practice to derive health guidelines is to identify, usually from animal toxicology experiments, a no observed adverse effect level, or NOAEL. This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The values are summarized in ATSDR's *Toxicological Profiles (https://www.atsdr.cdc.gov/toxprofiles/index.asp).* The NOAEL is modified with an uncertainty (or safety) factor. The magnitude of the uncertainty factor considers various factors such as sensitive subpopulations (e.g., children, pregnant women, and the elderly), extrapolation from animals to humans, and the completeness of the available data. Thus, exposure doses at or below the established health guideline are not expected to cause adverse health effects because these guidelines are lower (and more human health protective) than doses that do not cause adverse health effects in laboratory animal studies.

For noncancer health effects, MRLs and RfDs were used in this health assessment. A direct comparison of site-specific exposures and doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur. If the estimated exposure dose to an individual is less than the MRL or RfD, the exposure is unlikely to result in non-cancer health effects. If the calculated exposure dose is greater than the MRL or RfD, the exposure dose is compared to known toxicological values for that chemical. Exposure dose is discussed in more detail in the text of the health assessment.

It is important to consider that the methodology used to develop health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a U.S. EPA cancer risk evaluation is necessary for potentially cancer-causing contaminants detected at this site.

Cancer Risks

Exposure to a cancer-causing chemical, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated risk for developing cancer from exposure to contaminants associated with the site was calculated by multiplying the site-specific doses by U.S. EPA's chemical-specific cancer slope factors, or CSFs available at https://www.epa.gov/iris. This calculation estimates an excess cancer risk expressed as a proportion of the population that may be affected by a carcinogen during a lifetime of exposure. For example, an estimated risk of 1 x 10^{-6} predicts the probability of one additional cancer over background in a population of 1 million. An increased lifetime cancer risk is not a specified estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime in his or her lifetime following exposure to a contaminant under specific exposure scenarios. For children, the estimated excess cancer risk is not calculated for a lifetime of exposure, but from a fraction of lifetime; based on known or suspected length of exposure, or years of childhood.

When there is sufficient weight of evidence to conclude that a carcinogen operates through a mutagenic mode of action, and in the absence of chemical-specific data on age-specific susceptibility, U.S. EPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens [USEPA 2005] advises that increased early-life susceptibility be assumed and recommends that default age-dependent adjustment factors or ADAFs be applied to adjust for this potential increased susceptibility from early-life exposure. The current ADAFs and their age groupings are 10 for <2 years, 3 for 2–<16 years, and 1 for ≥16 years [USEPA 2005]. For risk assessments based on specific exposure assessments, the 10- and 3-fold adjustments to the slope factor or unit risk estimates are to be combined with age-specific exposure estimates when estimating cancer risks from early-life (<16-years-of-age) exposure. Currently, due to lack of appropriate data, no ADAFs are used for other life stages, such as the elderly. Estimated cancer risks from exposure to surface water and sediment are shown in Table E.2

Table E.2: Cancer Risk Estimates from Exposure to Surface Water and Sediment in the Waycross Canal

Chemical Contaminant	Estimated Cancer Risk From Ingestion	Estimated Cancer Risk From Dermal Absorption*	Estimated Cancer Risk From Ingestion and Dermal Absorption
Arsenic[a]	8.3×10^{-7}	2.0×10^{-7}	1.0×10^{-6}
Benzo(b)fluoranthene[b]	1.6×10^{-10}	1.0×10^{-10}	2.6×10^{-10}
1,1-Dichloroethane[c]	7.7×10^{-12}	1.4×10^{-10}	1.5×10^{-10}
Trichloroethene	1.6×10^{-8}	9.6×10^{-7}	9,8 x 10^{-7}
Vinyl chloride[a]	1.3×10^{-9}	1.6×10^{-8}	1.7×10^{-8}

*DPH used the mean skin surface area for body parts of children ages 6-<11 years old that included the hands (510 cm^2), and feet (730 cm^2) for estimating dermal absorption exposure doses from sediment. DPH used the mean skin surface area for body parts that included the hands (510 cm^2), forearms (680 cm^2), lower legs (1244 cm^2), and feet (730 cm^2) of a child between the ages of 6 to <11 years old.

[a]Arsenic and vinyl chloride cancer risks are based on the highest concentrations found in the Waycross Canal. A dermal absorption factor of 3% was used for arsenic. Cancer risk is based on 5 years of exposure.

[c]Based on BaP-TE

[b]The only concentration found in the Waycross Canal used to estimate exposure dose and cancer risk based on 5 years of exposure.

Note: U.S. EPA cancer slope factors used in the cancer risk estimation were as follows: 1.5 $(mg/kg/day)^{-1}$ for arsenic, 0.0057 $(mg/kg/day)^{-1}$ for 1,1-dichloroethane, 0.046 $(mg/kg/day)^{-1}$ for trichloroethene, and 1.4 $(mg/kg/day)^{-1}$ for vinyl chloride.

Appendix F. General Cancer Information

Cancer will affect one in 2 men and one in 3 women in the United States, according to statistics collected by the Surveillance Epidemiology and End Results program at the National Cancer Institute [*www.seer.cancer.gov*]. Cancer is a group of more than 100 diseases characterized by uncontrolled growth and spread of abnormal cells. Different types of cancers have differing rates of occurrence, different causes and chances for survival. Therefore, we cannot assume that all the different types of cancers in a community or workplace share a common cause or can be prevented by a single intervention.

Cancers may be caused by a variety of factors acting alone or together, usually over a period of many years. Scientists estimate that most cancers are due to factors related to how we live, or lifestyle factors which increase the risk for cancer including: smoking cigarettes, drinking heavily, and diet (for example, excess calories, high fat, and low fiber). Other important cancer risk factors include reproductive patterns, sexual behavior, and sunlight exposure. A family history of cancer may also increase a person's chances of developing cancer.

Smoking is by far the leading risk factor for lung cancer. Smokers are about 20 times more likely to develop lung cancer than nonsmokers. People who don't smoke but who breathe the smoke of others also have a higher risk of lung cancer. A non-smoker who lives with a smoker has about a 20% to 30% greater risk of developing lung cancer. Workers exposed to tobacco smoke in the workplace are also more likely to get lung cancer. Exposure to radon, asbestos, arsenic, chromium, nickel, soot, tar, and other substances can also cause lung cancer. An increased risk for lung cancer has also been associated with personal or family history of lung cancer. Most people are older than 65 years when diagnosed with lung cancer.

Smoking tobacco is also an important risk factor for kidney cancer. Obesity and high blood pressure have also been linked to the disease. People with a family member who had kidney cancer have a slightly increased risk of kidney cancer. Also, certain hereditary conditions can increase the risk. Kidney cancer is about twice as common in men as in women, and is slightly more common among blacks than other races. Workplace exposure to asbestos, cadmium, some herbicides, benzene, and organic solvents, particularly trichloroethylene, has also been associated with an increased risk for kidney cancer.

While cancer occurs in people of all ages, new cases of most types of cancer rise sharply among people over 45 years of age. When a community, neighborhood, or workplace consists primarily of people over the age of 45 (and even more so over the age of 60), we would expect more cancers than in a neighborhood or workplace with people of younger ages. However, cancer is also the second leading cause of death in children.

Many people believe that cancer is usually caused by toxic substances in the home, community, or workplace. Although we do not know the exact impact now of environmental pollutants on cancer development, less than 10% of cancers are estimated to be related to toxic exposures – only 2 percent are attributed to environmental causes.

Since the 1970s when state cancer registries were first being organized, many public health scientists and residents hoped that anecdotal observations of clusters of cancer in the community might lead to prevention of new cases via discovery of specific causes of these cancers. Since then, thousands of investigations have taken place throughout the country, mainly conducted by state, local, or federal agencies. With one or two possible exceptions involving childhood cancers, none of these investigations have led to the identification of the causes of any of these possible clusters, even when a statistically elevated number of cancers in a geographic area could be documented. The Georgia Department of Public Health has developed strategies for active cancer surveillance. This systematic approach to monitoring cancer trends in our state will lead to more opportunities for prevention and control of cancer in Georgia.

Appendix G. Self-Reported Symptoms and Diseases

Location	Resident Gender	Age	Year of Onset	Self-Reported Condition	Disease Group
City of Waycross Government Building	Female			Cancer; deceased	Cancer
	Female		2009	Cancer; deceased	
	Unknown	70	2011	Cancer; deceased	
	Female		2013	Cancer; deceased	
	Male		2006	Cancer; deceased	
	Male	56	2008	Cancer; deceased	
	Male			Cancer	
	Female			Cancer	
	Female			Cancer	
	Male		2005	Lung cancer (nonsmoker); deceased	
	Male			Prostate cancer	
	Female			Breast cancer	
	Male			Cancer, lung disease	Cancer Respiratory
Home #6			2005	Cancerous masses	Cancer
Home #1	Female	44	2004-2005 2011-2012	Age 44: masses, cyst on ovaries heavy menstrual cycle Age 50: mass in left leg, thyroid, and neck, headaches, brain fog, fatigue, ringing in ears, cold hands and feet, cough, cold sores in mouth, vision problems (woke up blind in right eye), blood pressure dropping 30 points in a few minutes, rapid heart rate, stomach problems, lost 30 pounds	Masses Neurological Respiratory Other

Location	Resident Gender	Age	Year of Onset	Self-Reported Condition	Disease Group
Home #3	Man	50		Masses all over his body; deceased	Masses
Home #5	Female	70+		Mass in stomach	
Home #5	Male	70+		Mass in lungs	
Home #7	Female	40		Hysterectomy to remove masses on her ovaries	
Home #8	Male	40	3 months	Mass under chin	
	Female			Tumors on ovaries and in legs, chemical intolerance	Masses Other
	Male			Tumors, heart problems, kidney failure; deceased	
Home #4	Female	elderly		Parkinson's disease; deceased	Neurological
Church #1	Males/ Females			neurological problems, symptoms similar to Lyme disease or TIA	
Home #10	Male	50	2004	Neurological problems with twitching and shaking in hands	
Bank #1	Female			Neurological problems, now disabled	
Home #7	Female	80		Breathing problems, chronic cough, memory problem	Neurological Respiratory
Home #2	Female	65	Two months	Neurologic problems, cough, breathing problems, esophagus problems	Neurological Respiratory Other
Home #1	Male	25	Two week visit	Cold sores in mouth, respiratory/cough	Respiratory

Location	Resident Gender	Age	Year of Onset	Self-Reported Condition	Disease Group
Home #1	Female		2006-2011	Rapid heartbeat, endocrine system problems	Other
Home #3	Female	60		Pre-cancer on face and other areas	
Home #4	Male	elderly		Died of suspected drug treatment	
City of Waycross Building	Male		2006	Deceased	
	Female			Sick	
	Male and Female Parents of Female			Both died after one year of moving in neighborhood	
	Male			Heart problems	
	Male			Heart attack; deceased	