DRAFT
FINAL PERIODIC REVIEW REPORT FOR
AREA 1395
FORT DRUM, NEW YORK

Prepared for:

UNITED STATES ARMY ENVIRONMENTAL COMMAND
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ACRONYMS

AEC	Army Environmental Command
AOC	area of concern
AAS	aquifer air sparge
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene and total xylenes
BV	bioventing
CA	Contamination Assessment
CDM	CDM Federal Programs Corporation
COCs	contaminants of concern
DER	Division of Environmental Remediation
DPT	direct-push technology
EA	EA Engineering, Science, and Technology, Inc.
EPA	Environmental Protection Agency
HI	Hazard Index
HHRA	human health risk assessment
HQ	Hazard Quotient
M-K	Mann-Kendall
µg/L	micrograms per liter
MNA	monitored natural attenuation
N:P:K	nitrogen: phosphorous: potassium
NYSDEC	New York State Department of Environmental Conservation
PAHs	polycyclic aromatic hydrocarbons
Plexus	Plexus Scientific Corporation
PRR	Periodic Review Report
Radian	Radian International LLC
RI	Remedial Investigation
SVE	soil vapor extraction
TPH	total petroleum hydrocarbons
USTs	underground storage tanks
VOCs	volatile organic compounds

EXECUTIVE SUMMARY

Under United States Army Environmental Command (AEC) Contract No. W91ZLK-05-D-0011 Delivery Order 0004, Plexus Scientific Corporation (Plexus) has provided this comprehensive review of the environmental data collected at the Fort Drum Area 1395 from 1989 to 2011. This report is comprised of five elements that evaluate the environmental program at Area 1395:

- Historical review of the remedial program to date;
- A comparison of the initial and current groundwater and soil chemical concentrations and extent of contamination at Area 1395;
- Time series and statistical evaluation of contaminant data trends;
- An evaluation of monitored natural attenuation (MNA); and,
- A human health risk assessment (HHRA) of the present condition of the site.

Review of these elements provides a comprehensive assessment of the program's progress and current conditions at the site. In addition, this review presents the required lines of evidence needed to achieve regulatory closure as outlined in the New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER)-10 "Technical Guidance for Site Investigation and Remediation" for Area 1395. Data have been specifically evaluated relative to subsection 6.4(c) of DER-10, which outlines the closure requirements. Based upon this evaluation, the Army has determined that MNA has remediated the site in a manner that is fully protective of all identified sensitive receptors and, therefore, that monitoring may be terminated.

Historical Review

Sections 2 and 3 provide a historical review of the remedial and monitoring activities to date. The source of the contamination at Area 1395 was determined to be two underground storage tanks (USTs) and associated infrastructure containing gasoline and diesel. The tanks and associated fuel dispensers were removed from Area 1395 in November 1994 and the remaining dispenser pipe sections were removed in 1995. From 1996 through 2006, active remediation of the site was conducted using a bioventing/soil vapor extraction (BV/SVE) remedial treatment system augmented by an aquifer air sparge system (AAS) installed in 2000. Following receipt of NYSDEC concurrence and approval, based on the results of the semi-annual groundwater sampling events, the treatment system at Area 1395 was shut down in August 2006. From August 2006 to August 2011, the site was monitored under the basewide sampling program that successfully evaluated MNA of the groundwater contamination. Due to persistent, low-level concentrations of ethylbenzene and total xylenes, Plexus operated an additional in-situ treatment at Area 1395 via a pilot test of a mobile ozone treatment system for one month in July 2009. Results of the pilot ozone application showed a significant rise in the concentrations of oxygen available that would enhance aerobic biodegradation.

Initial and Current Extent of Groundwater Contamination

Sections 4 and 5 outline the initial and current characterization of the groundwater contaminant plume at Area 1395. The primary contaminants of concern (COCs) at Area 1395 were determined to be benzene, toluene, ethylbenzene, and total xylenes (BTEX). The groundwater concentrations of all four of these compounds have exceeded NYSDEC screening criteria in monitoring wells 1395-MWS1 and 1395-MWS2 at least once in the monitored history of the site. The maximum recorded total BTEX concentration of 2,912 micrograms per liter (µg/L) was recorded at the site in July 1996. The maximum recorded benzene concentration of 53 µg/L was recorded in October 1999. Benzene has not exceeded screening criteria at the site since October 2001. The maximum recorded toluence concentration of 300 µg/L was recorded in July 1996. Toluene has not exceeded screening criteria since September 2004. The maximum recorded ethylbenzene concentration of 400 µg/L was recorded in July 1996. Ethylbenzene did not exceed screening criteria in the Fall 2011 sampling event. The maximum recorded total xylenes concentration of 2,200 µg/L occurred in July 1996. During the Fall 2011 sampling event, total xylenes (62.4 µg/L) remain above the screening criteria. No exceedances of COCs have been detected at any other well than area of concern (AOC) monitoring well 1395-MWS1 since October 2001.

Contaminant Data Trends

Section 5 outlines the contaminant data trends over the monitored history of Area 1395. Time series plots and Mann-Kendall (M-K) statistical evaluation were used to evaluate the contaminant data trends. Active remediation at the site ceased in May 2006, and since that time, MNA has been the only mechanism for contaminant degradation. Time series and M-K analyses show that site-related COCs have decreased or remained stable over time. Due to the Army's cumulative efforts, the total BTEX concentrations in the AOC monitoring point (1395-MWS1) have decreased from 2,912 µg/L to 65.6 µg/L over a time period of 14 years.

Evaluation of MNA

Section 5 outlines evidence showing that MNA continues to occur at the site and has proven to be an effective remedial approach for reducing site-related contaminants. A constant supply of oxygenated groundwater continues to facilitate aerobic biodegradation of the contaminant plume. MNA data show that the microbial population within the contaminant plume continues to use up the available oxygen, which demonstrates that the natural biodegradation mechanisms are still in place, despite the absence of active bioremediation. To enhance future MNA at the site, an application of a nitrogen: phosphorous: potassium (N:P:K) solution was administered from January to March 2011 (Plexus, 2010a).

Updated HHRA

Section 6 discusses the findings of the updated HHRA, which reconfirms the findings of the 2009 HHRA performed to evaluate conditions at Area 1395. The updated HHRA concludes that the only risk at the site is the nutrient metal manganese for children and adults under a residential scenario. Manganese is not related to the contaminant release associated with Area 1395, but is a naturally occurring metal in the aquifer. In addition, current and future land use scenarios do not include residential zoning.

Conclusion and Recommendations

This Final Periodic Review Report (PRR) for Area 1395 provides the lines of evidence, as outlined in Section 7, that clearly demonstrate that the remedial program at Area 1395 has satisfied the DER-10 requirements of no further monitoring under DER-10 subsection 6.4(c)3.

In accordance with DER-10 subsection 6.5(a), site close-out is recommended because the conditions of subsection 6.4 have been met as outlined in this Final PRR.

1.0 Introduction

Fort Drum is located in upstate New York, approximately 10 miles northeast of Watertown and 80 miles north of Syracuse (**Figure 1-1**). The military installation encompasses approximately 168 square miles. The Area 1395 fueling facility site is located on the northern side of Oneida Avenue, between Third Street West and Third Street East (**Figure 1-2**). The area surrounding Area 1395 is an active rail line, which is used for the storage and mobilization of military vehicles and equipment. A downgradient structure, Building 4525, functions as a warehouse and administration facility. The former USTs and related piping associated with the Area 1395 fueling facility were removed in 1994. The current remedy at this site is MNA. Groundwater sampling and well gauging were performed until August 2011, in accordance with AEC Contract No. W91ZLK-05-D-0011 Delivery Order 0004.

2.0 Site Background

Area 1395 previously contained two 25,000-gallon diesel USTs (**Figure 2-1**). In 1994, the two USTs were removed (EA Engineering, Science, and Technology, Inc. [EA], 1996). Volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs) were detected during UST removal. The most elevated concentrations were generally reported in the piping and UST excavation areas. High concentrations reported in several soil samples collected from the UST and pipe excavations suggested that residual product remained in the soil.

Subsurface soil samples were collected at Area 1395 by Radian International LLC (Radian) in 1996, prior to the installation of the combined BV/SVE remedial treatment system. Elevated petroleum hydrocarbon concentrations were reported in the soil samples collected from the eastern dispenser piping and downgradient of the former UST locations. Soil gas measurements of hydrocarbons, oxygen, and carbon dioxide were collected monthly after the BV/SVE system began operation in October 1997. In addition, respiration tests were conducted annually during the period of system operation to assess in-situ degradation rates.

Subsurface oxygen concentrations remained consistently greater than 17 percent, and average subsurface carbon dioxide concentrations increased during the system operation. The subsurface oxygen measurements suggested the subsurface was not oxygen limited due to the use of the BV system, and carbon dioxide measurements were indicative of microbial respiration.

In 1998, Radian conducted constant-rate and in-situ respiration tests and collected soil and groundwater samples as part of an investigation to assess the effectiveness of the existing BV/SVE systems. Data collected indicated that BTEX concentrations were being effectively reduced within the unsaturated zone; however, groundwater BTEX concentrations remained above applicable screening criteria in monitoring wells located within the former UST area.

An AAS system was installed in October 2000 to supplement the BV/SVE systems. The AAS system was designed to remediate soil and groundwater contamination in the saturated zone by injecting air through eight sparge wells with screened intervals placed below the water table.

Based on the results of the semi-annual groundwater sampling events, the treatment system at Area 1395 was shut down in August 2006. Continued, elevated concentrations of dissolve-phase petroleum hydrocarbons led to additional treatment via a pilot test of a mobile ozone treatment system for a one month duration at the site. The purpose of the ozone treatment system was to treat the remaining residual ethylbenzene and total xylenes within the plume.

Groundwater sampling at Area 1395 has been conducted since 1995. The groundwater sampling program was conducted quarterly from 1995 to 1999 and then semi-annually from 1999 until August 2011.

3.0 Investigations and Remedial Program to Date

Groundwater and soil in the vicinity of Area 1395 were investigated starting in 1989. Two former fuel USTs were the focus of these investigations.

1990. A Remedial Investigation (RI) was conducted by CDM Federal Programs Corporation (CDM). The objective of the RI was to assess the nature and extent of soil and groundwater petroleum hydrocarbons at four areas along Gasoline Alley, including Area 1395. Soil and groundwater samples were collected and analyzed by CDM.

1993. R. F. Weston Inc. conducted an investigation at the 1300 block, directly north (downgradient) of Area 1395, to identify the presence of contaminants in groundwater, sediment, and surface water, and to determine potential impacts to the construction of a warehouse.

March 1994. Woodward-Clyde Federal Services performed a Contamination Assessment (CA) of vadose zone soil at each of the fueling areas along Gasoline Alley. The purpose of the CA was to characterize the nature and extent of COCs in vadose zone soil for comparison of detected concentrations with NYSDEC screening criteria and to estimate the volume of soil requiring remediation.

1994. CDM conducted a groundwater contaminant plume reconnaissance using direct-push technology (DPT) to assess the nature and extent of COCs in groundwater and surface water along Gasoline Alley. Twenty-three DPT groundwater samples were collected from Area 1395. Groundwater samples from Area 1395 contained concentrations of BTEX and total petroleum hydrocarbons (TPH) exceeding NYSDEC screening criteria; the highest concentrations were reported near the center of the fuel dispenser lines and east of the pump house. A small groundwater plume was identified at this area, and CDM recommended installing one shallow downgradient well at this area, north of the railroad tracks.

1994. EA provided environmental oversight and analytical support during the removal of the 22 USTs at the nine former fuel storage facilities (including USTs situated at Area 1395). Soil samples were collected from the excavations and soil stockpiles, and analyzed for VOCs, semi-volatile organic compounds, PAHs, and lead.

July 1995 through December 1997. Groundwater samples were collected on a quarterly schedule from wells and piezometers at Area 1395. The first four sampling events (July and October 1995, and March and July 1996) were performed by Radian, and the subsequent three events (December 1996, and March and June 1997) were performed by Malcolm Pirnie. The objective of the groundwater sampling program has been to assess the lateral and vertical extent of the three dissolved-phase hydrocarbon plumes. The samples collected were analyzed for VOCs, PAHs, iron, manganese, and lead.

1996 to 1997. A BV/SVE system was installed and operated to remediate remaining contaminants at Area 1395. Soil gas measurements of hydrocarbon, oxygen, and carbon dioxide were collected on a monthly basis.

1998. Radian performed constant-rate and in-situ respiration tests at Area 1395. The results of the tests indicated the anticipated radius of influence of 40 feet would not be achieved under the then-current site conditions and equipment design specifications. However, further respiration tests concluded that biodegradation of site contaminants was occurring. It was estimated that the then-current biodegradation rates with the BV/SVE systems would result in clean-up objectives being met in nine years at Area 1395.

October 2000. An AAS system was installed to supplement the BV/SVE system. The AAS system was designed to remediate soil and groundwater contamination in the saturated zone by injecting air through sparge wells with screened intervals placed below the water table.

2006. Following receipt of NYSDEC concurrence and approval based on the results of the semi-annual groundwater sampling events, the treatment system at Areas 1395 was shut down in August 2006.

2006 to August 2011. Area 1395 was monitored under the basewide groundwater monitoring program on a semi-annual basis. The sampling program included analysis of groundwater for VOC and MNA parameters.

2009. Plexus completed a Risk Assessment for Building T-91. The findings showed that there is no human health risk associated with site related contaminants.

July 2009. Due to persistent low-level concentrations of ethylbenzene and total xylenes at Area 1395, Plexus operated an additional in-situ treatment via a pilot test of a mobile ozone treatment system for one month. Results of the pilot ozone application showed a significant rise in the concentrations of oxygen available to enhance aerobic biodegradation.

January to March 2011. Plexus administered an application of an N:P:K solution. The purpose of this treatment was to ensure that there are sufficient micro-nutrients for the indigenous microbial population.

2012. Plexus completed a Site Monitoring and Management Plan for Area 1395. Implementation of land use controls and changes in sampling frequency were recommended based on site conditions, data trend analysis, and human health and ecological risk scenarios. The land use controls included restricting groundwater use as a potable water source and preventing disturbance of soil below five ft below ground surface (bgs).

4.0 Initial Conditions and Contaminants of Concern

The results of the Plume Reconnaissance Report (CDM, 1995), based on an August 1994 investigation conducted after the removal of the associated USTs, showed that groundwater in the vicinity of the UST excavation exceeded NYSDEC screening criteria. Twenty-three groundwater samples were collected from 24 DPT sample locations. A conduit drainage system was installed north of the pump house to dewater the hillside and minimize problems associated with the high water table while the Area 1395 warehouse was being constructed. One grab sample was collected from the eastern end of this conduit system, which drains the area north of the pump house. Two monitoring wells (1395-MW27 and -MW28) located north of the pump house were also sampled.

The investigation identified a small groundwater contaminant plume originating from the Area 1395. BTEX compounds were detected in three DPT groundwater samples and in the conduit sample. The signature for the TPH concentrations was indicative of gasoline (CDM, 1995). The highest measured concentration of total BETX was 744 µg/L, at a location near the center of the fuel dispensers. COCs at Area 1395 were determined to be BTEX compounds. Over the history of the groundwater sampling program at Area 1395, the highest recorded total BTEX concentration was observed in July 1996 at 2,912 µg/L in AOC monitoring well 1395-MWS1.

Figure 4-1 illustrates the initial groundwater condition for BTEX at Area 1395, using results from the DPT sampling event. Historically, ethylbenzene and total xylenes have consistently exceeded NYSDEC screening criteria.

5.0 Current Conditions and Data Trends

In 2012, a Site Monitoring and Management Plan was written for Area 1395. The Site Monitoring and Management plan recommended the implementation of land use controls including restrictions on groundwater use and soil disturbance below five feet bgs. Additionally, the plan recommended a reduction in sampling frequency, from semi-annual to every five years.

5.1 Current Conditions

The groundwater gauging program at Area 1395 has characterized the local hydrology associated with the unconfined surficial aquifer. **Figure 5-1** illustrates the elevation and direction of groundwater flow, to the northwest.

Groundwater was analyzed for VOCs and MNA parameters during Fall 2011 basewide sampling event. During the Fall 2011 sampling event, total xylenes was the only COC to exceed NYSDEC screening criteria, at 62.4 µg/L in AOC monitoring well 1395-MWS1 (**Table 5-1, Figure 5-2**). In addition to total xylenes, the nutrient metal iron exceeded groundwater criteria in AOC monitoring well 1395-MWS1; however, this metal is ubiquitous to Fort Drum.

5.2 Time Series and Statistical Data Analysis

To assess groundwater contamination trends over time (**Figure 5-3**), analytical data time series have been evaluated for COCs. **Figures 5-4 through 5-6** illustrate time series data for BTEX compounds since May 1995. In addition, M-K trend analysis (**Table 5-2**) was performed for the six groundwater monitoring wells at Area 1395, with respect to BTEX compounds. The results show that all monitoring wells exhibit decreasing or stable concentration trends, and that no increasing trends were observed at the site.

5.3 MNA Evaluation

MNA parameter data collected during the Fall 2011 sampling event (**Figure 5-7**) show that groundwater exhibits an anoxic and reducing environment within the contaminant plume. The groundwater upgradient of the contaminant plume is aerobic in nature. The upgradient, oxygenated groundwater flowing into the contaminant plume is providing the required supply of oxygen to sustain aerobic biodegradation and promote MNA. The apparent lack of oxygen within the contaminant plume demonstrates that the microbial community is using the available oxygen and sustaining biodegradation of contaminant compounds.

5.4 Plume Stability Evaluation

To assess groundwater plume stability, the aerial extent of the August 1994 BTEX plume was compared to that of the Fall 2011 BTEX plume (**Figure 5-8)**. This comparison of the aerial extent of both plumes illustrates that the plume has shrunk significantly since August 1994, due to the cumulative efforts of the Army.

5.5 Nutrient Application

To enhance biodegradation at the site, Plexus administered an application of an N:P:K solution from January to March 2011 (Plexus, 2010a). This application provided additional micro-nutrients for the indigenous microbial population. **Figure 5-7** illustrates the measured MNA parameter concentrations at the site after the nutrient application. The MNA parameter concentration results show that in Fall 2011, after the application of nitrogen-based material, there remain no significant, elevated levels of these compounds in the groundwater. The absence of a significant, elevated level of total nitrogen in groundwater especially indicates that these added nutrients were consumed by the microbial population and that the application was successful in promoting biodegradation.

6.0 Risk Assessment

As part of this Final PRR, an HHRA was performed as an update to the 2009 HHRA for Area 1395 (Plexus, 2010b). All remaining contamination is confined to groundwater and to the smear zone, soil associated with the fluctuating water table. Impacted groundwater at the site has been characterized and does not extend beyond the site boundary. Because there is no discharge of site-related contaminants to surface water and a concrete apron covers the site surface, there are no exposure scenarios present for ecological receptors; therefore, an ecological risk assessment was not performed as part of this report.

Appendix A presents the findings of the 2011 HHRA for Area 1395. From an HHRA perspective, Area 1395 may be recommended for site closure. Industrial worker risks were below the Environmental Protection Agency (EPA) carcinogenic risk threshold. The industrial worker Hazard Index (HI) was slightly above the EPA non-carcinogenic Hazard Quotient (HQ) threshold based on exposure to manganese, which slightly exceeded 1.0 with an HQ of 1.3. Residential carcinogenic risks for ingestion and dermal exposure were at the low end of the target risk range based on exposure to ethylbenzene (carcinogenic risk of 2.1E-06), but were well below the 1E-04 threshold. The non-carcinogenic HQ threshold was exceeded based on ingestion and dermal exposure by the child (total HI of 9.7) and adult (total HI of 4.0) residents. The child and adult resident non-carcinogenic HQ threshold exceedances were based on exposure to manganese, which exceeded 1.0 with HQs of 8.7 and 3.6, respectively.

The HQ exceedances for child and adult ingestion and dermal exposure are associated with naturally occurring manganese that exceeds NYSDEC screening criteria. There are no human health risks associated with site-related contaminants. Current and future land use at Area 1395 is industrial and the contaminants are located under active rail infrastructure.

7.0 Recommendations

Based on existing site conditions, demonstrated trend data analysis, and current human health and ecological risk scenarios, the recommendations of this Final PRR for Area 1395 include:

1. No further monitoring; and
2. Site close-out.

These recommendations are made based on the following site conditions:

- There is no risk to any ecological or human receptors associated with the current conditions at Area 1395;
- The MNA remedial action has remediated the site in a manner that is fully protective of all receptors and is still active at the site;
- Contaminant concentrations in sentinel well 1395-MWS2 do not exceed site Standards, Criteria and Guidance (New York Codes, Rules and Regulations, Part 703); and
- The contaminant plume is stable or shrinking based on statistical and trend data analysis.

The evaluation outlined in this Final PRR satisfies the three criteria for no further monitoring as outlined in DER-10 subsection 6.4(c)3. The three criteria for no further monitoring include:

6.4(c)3. No further monitoring will be required for groundwater if:

i. Contaminant levels in the sentinel well do not exceed the applicable SCGs at any time during the monitoring program. The sentinel well is a well downgradient from the plume, which shows no impact from the site and which acts as an early detection for the leading edge of the plume from the site being monitored. This presumes that contaminants transported by groundwater have had sufficient time to reach the well, allowing for sorbtive retardation and other hydrogeological processes that may have slowed their migration. A proposal regarding the duration of the monitoring program at the sentinel well should be made by the person responsible for conducting the investigation and/or remediation, based upon site-specific data; and

ii. The contaminant plume length has been demonstrated to be stable or shrinking by sufficient and suitable groundwater monitoring. This requires concentration versus distance trend analysis, with suitable statistical validation, with the test applied to each individual contaminant detected in each monitoring well; and,

iii. The contaminant concentrations along the centerline of the plume have been demonstrated to be decreasing by sufficient and suitable groundwater monitoring. This requires concentration versus time trend analysis, with suitable statistical validation, with the test applied to each individual contaminant detected in each monitoring well and a demonstration that groundwater standards are met before reaching the compliance point identified in the decision document.

As presented within this report, the recommendations for no further monitoring and site close-out is in accordance with NYSDEC DER-10 "Technical Guidance for Site Investigation and Remediation," section 6.4(c)3 and 6.5.

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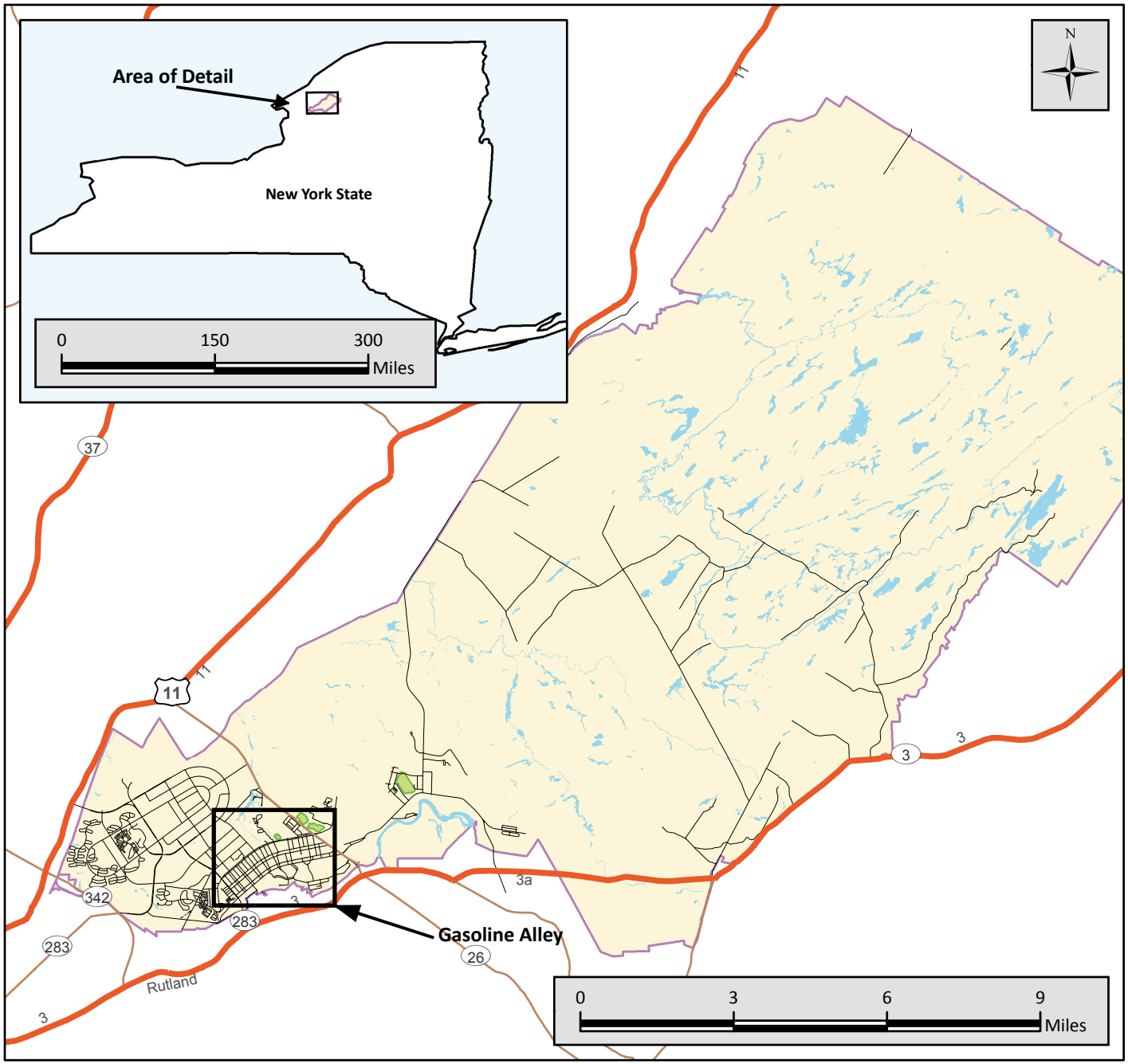
FIGURES



Legend

- Interstate
- Highway
- Major Road
- Local Road
- Fort Drum Roads
- Water
- Landfill
- Installation Area

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FIGURE 1-1

Site Location Map

Final Periodic Review Report for
Area 1395
Fort Drum, New York

Legend

- Fence Line
- Rail Road
- Paved Roadline
- Landfill Site
- Wetlands
- Building
- Paved Area

Fall 2011 BTEX Plume

- 1 µg/L
- 10 µg/L

Abbreviation Key:
µg/L = micrograms per liter

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FIGURE 1-2

Gasoline Alley Site Map

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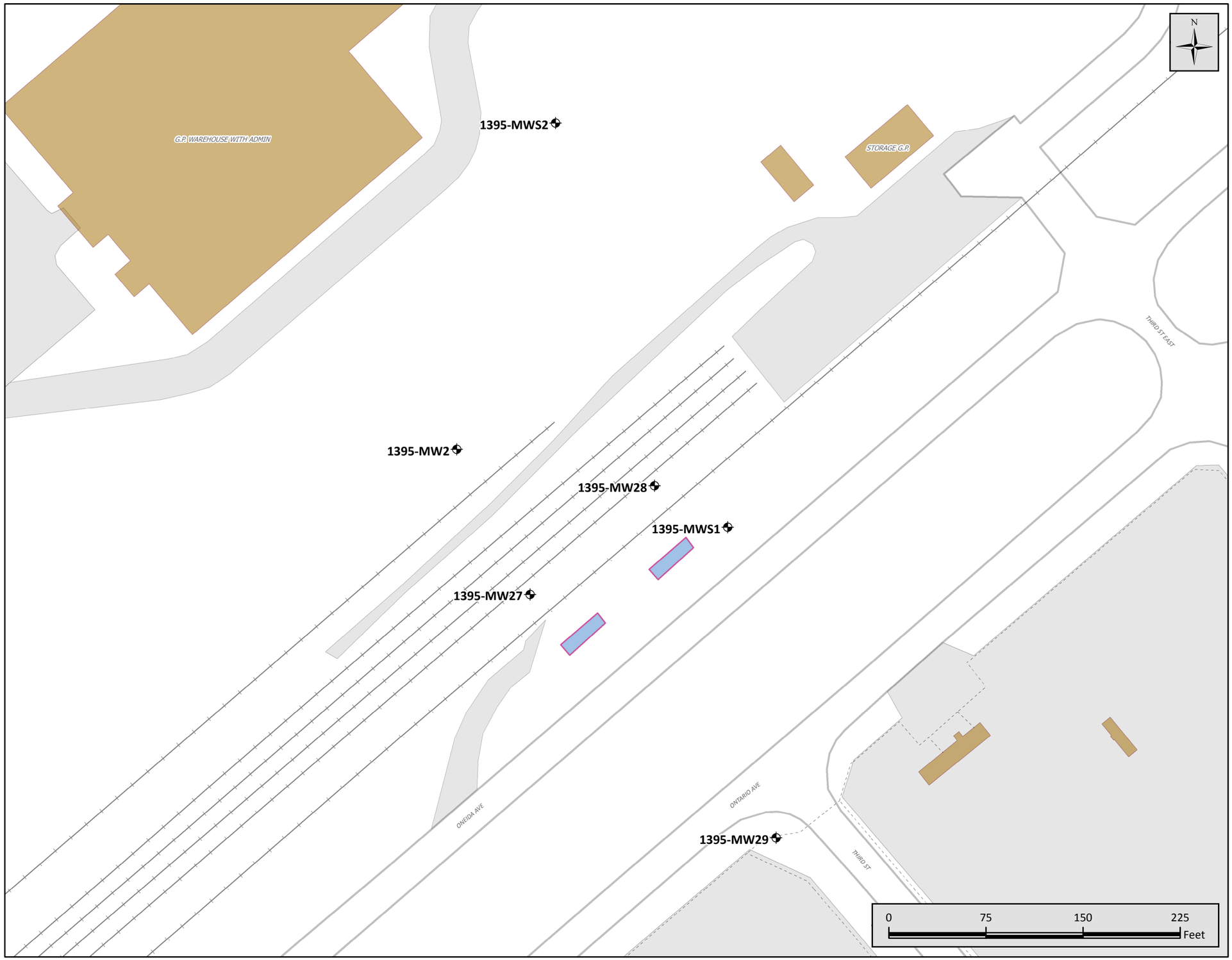

Legend

- Monitoring Wells
- Former UST
- Fence Line
- Rail Road
- Paved Roadline
- Building
- Paved Area

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FIGURE 2-1

Area 1395 Site Layout Map

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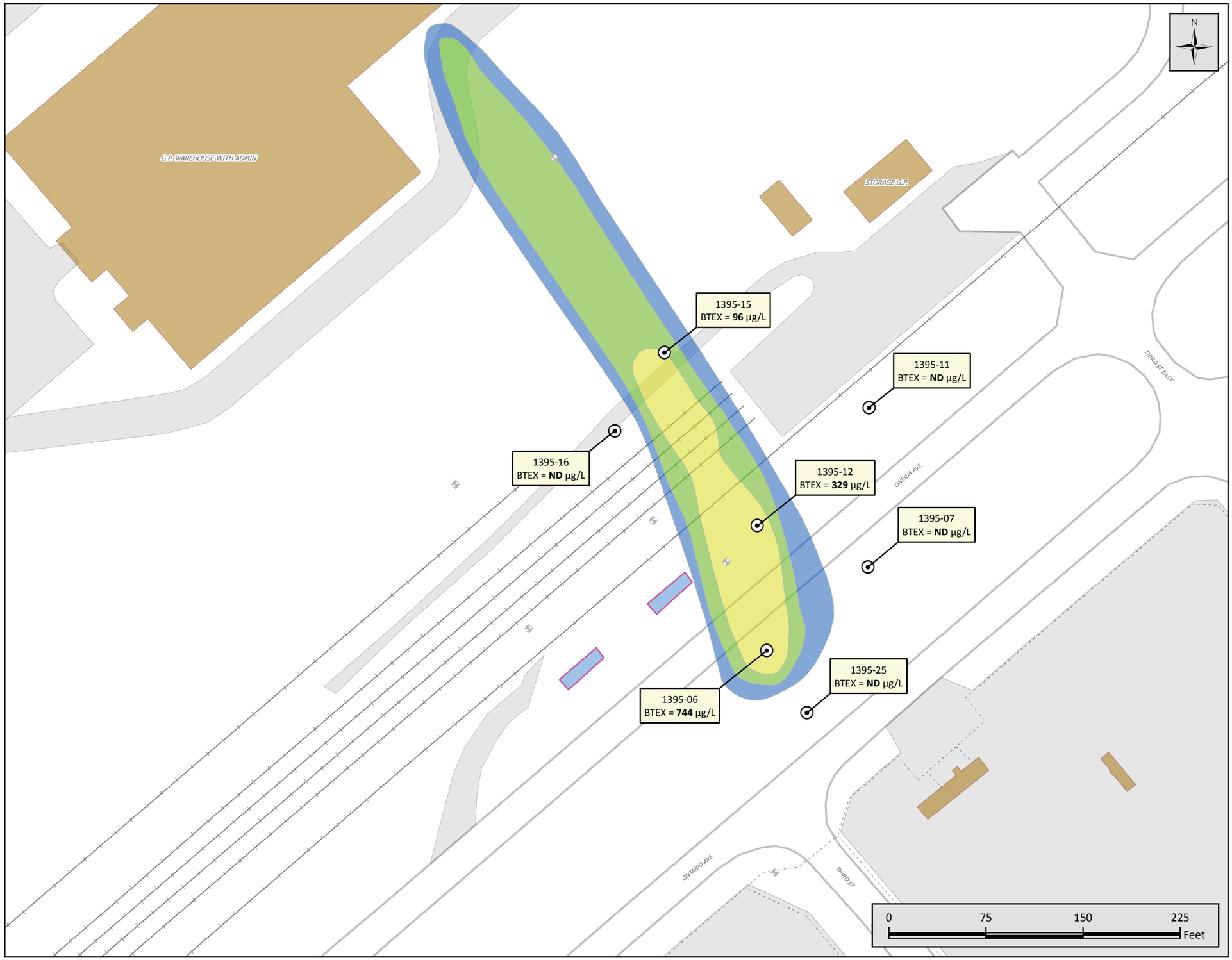

Legend

- Historical Direct Push Locations
- Monitoring Wells
- Former UST
- Fence Line
- Rail Road
- Paved Roadline
- Building
- Paved Area

August 1994 BTEX Plume

- 1 µg/L
- 10 µg/L
- 100 µg/L

BTEX Label Key:
Result values are expressed in units of µg/L followed by a qualifier if applicable.
µg/L = micrograms per liter

Location Well ID	Exceedence Criteria (µg/L):
B- **Benzene**	B - **1**
T- **Toluene**	T - **5**
E- **Ethyl Benzene**	E - **5**
X- **Total Xylenes**	X - **5**
BTEX- **Total BTEX**	

Qualifer Key:
U - Value is less than the method detection limit (MDL)
J - Value is greater than the MDL, but less than the reporting limit (RL)

Data taken from EA Engineering's, 1995 "Comprehensive Contaminant Assessment Report Volume II: Areas 1195, 1295, 1395 and 1495, Gasoline Alley, Fort Drum, NY"

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FIGURE 4-1

Area 1395
Initial BTEX Concentrations in Groundwater, August 1994

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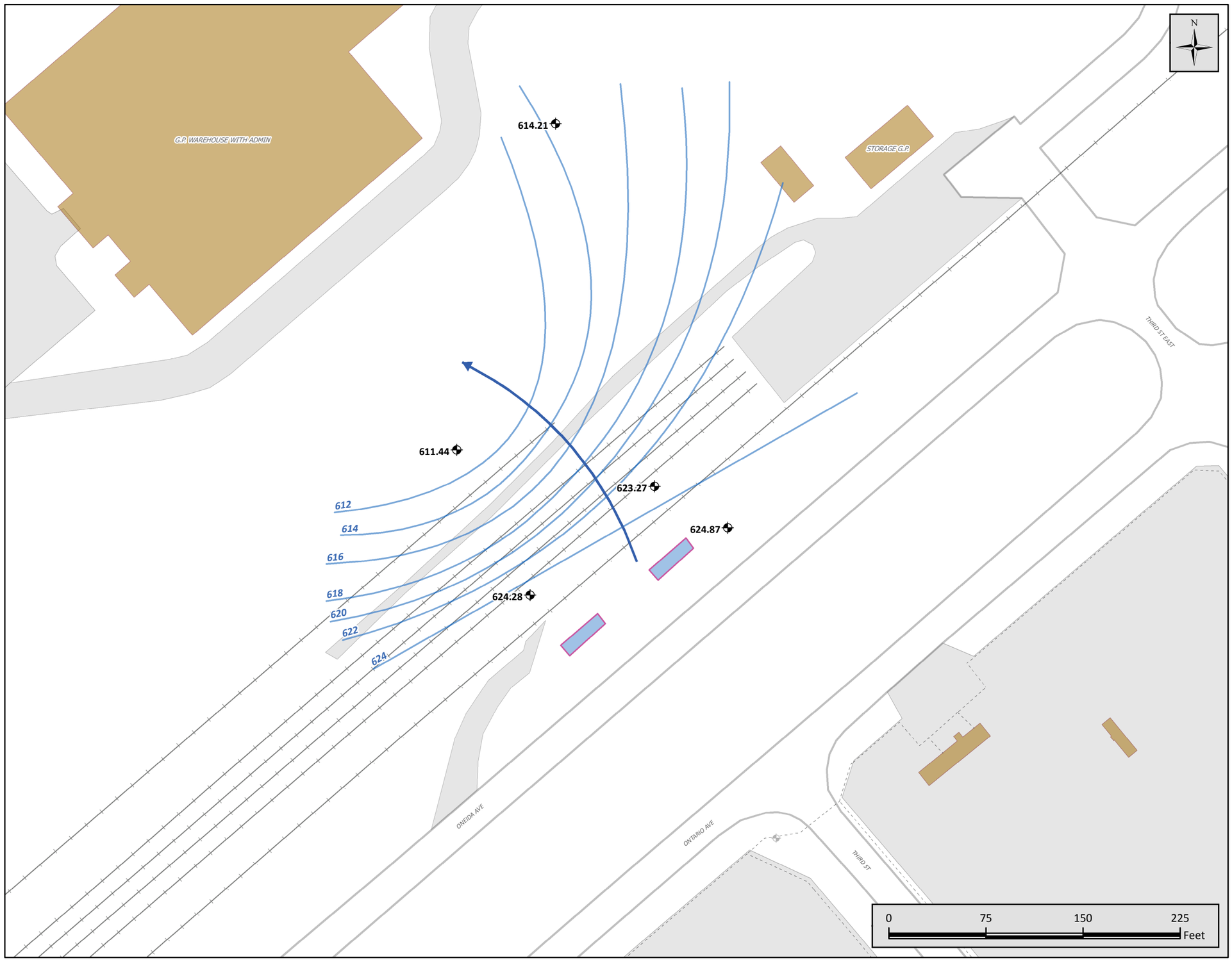

Legend

- Gauged Wells (ft MSL)
- Other Monitoring Wells
- Groundwater Flow Direction
- Groundwater Contour (ft MSL)
- Former UST
- Fence Line
- Rail Road
- Paved Roadline
- Building
- Paved Area

Abbreviation Key:
ft = Feet
MSL = Mean sea level

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FIGURE 5-1

Area 1395
Groundwater Contour Map
Fall 2011

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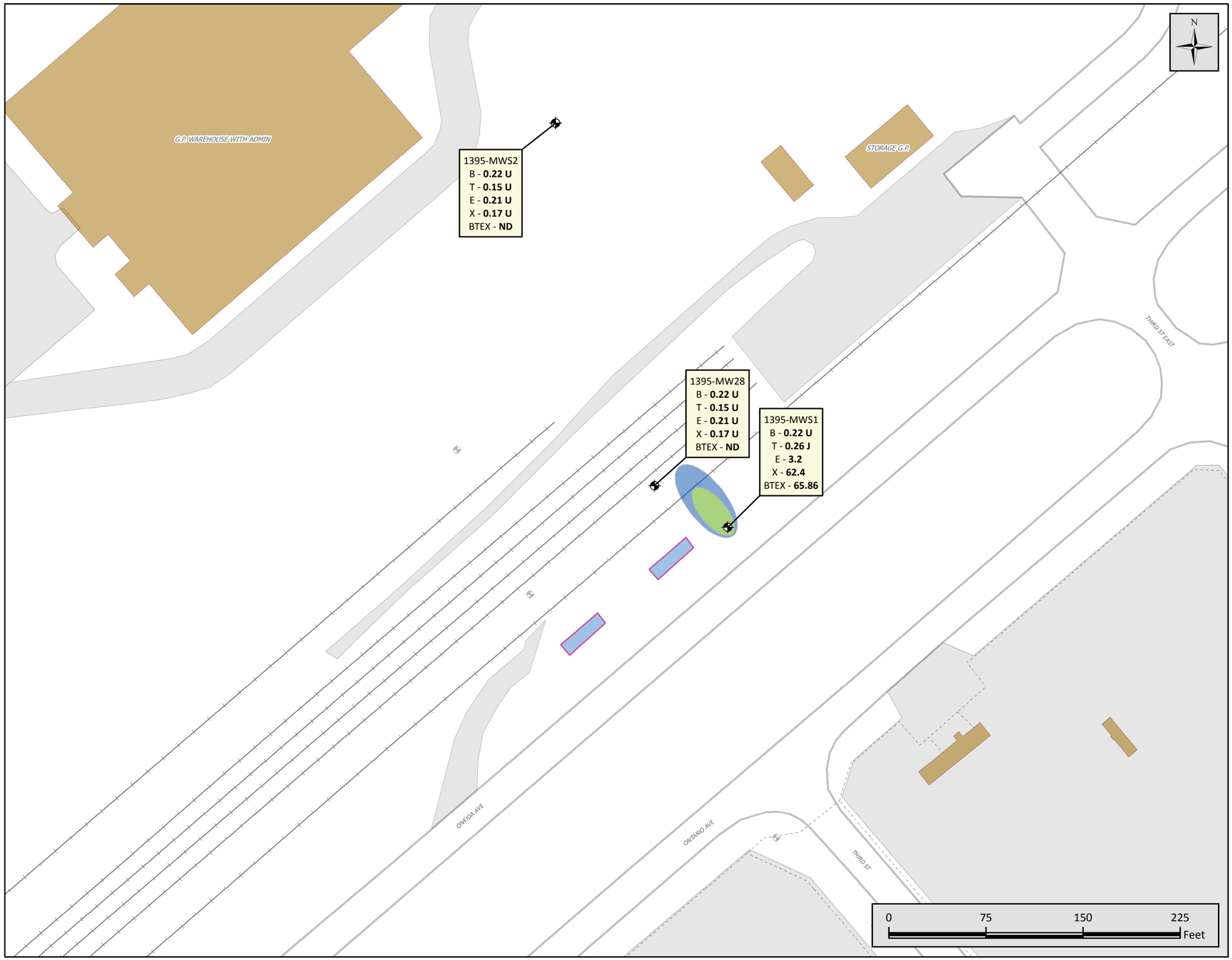
Area 1395
Fort Drum, New York



Legend

- Sampled Wells
- Other Monitoring Wells
- Former UST
- Fence Line
- Rail Road
- Paved Roadline
- Building
- Paved Area

Fall 2011 BTEX Plume

- 1 µg/L
- 10 µg/L

BTEX Label Key:
Result values are expressed in units of µg/L followed by a qualifier if applicable.
µg/L = micrograms per liter

Location Well ID
B- **Benzene**
T- **Toluene**
E- **Ethyl Benzene**
X- **Total Xylenes**
BTEX- **Total BTEX**

Exceedence Criteria (µg/L):
B - **1**
T - **5**
E - **5**
X - **5**

Qualifer Key:
U - Value is less than the method detection limit (MDL)
J - Value is greater than the MDL, but less than the reporting limit (RL)

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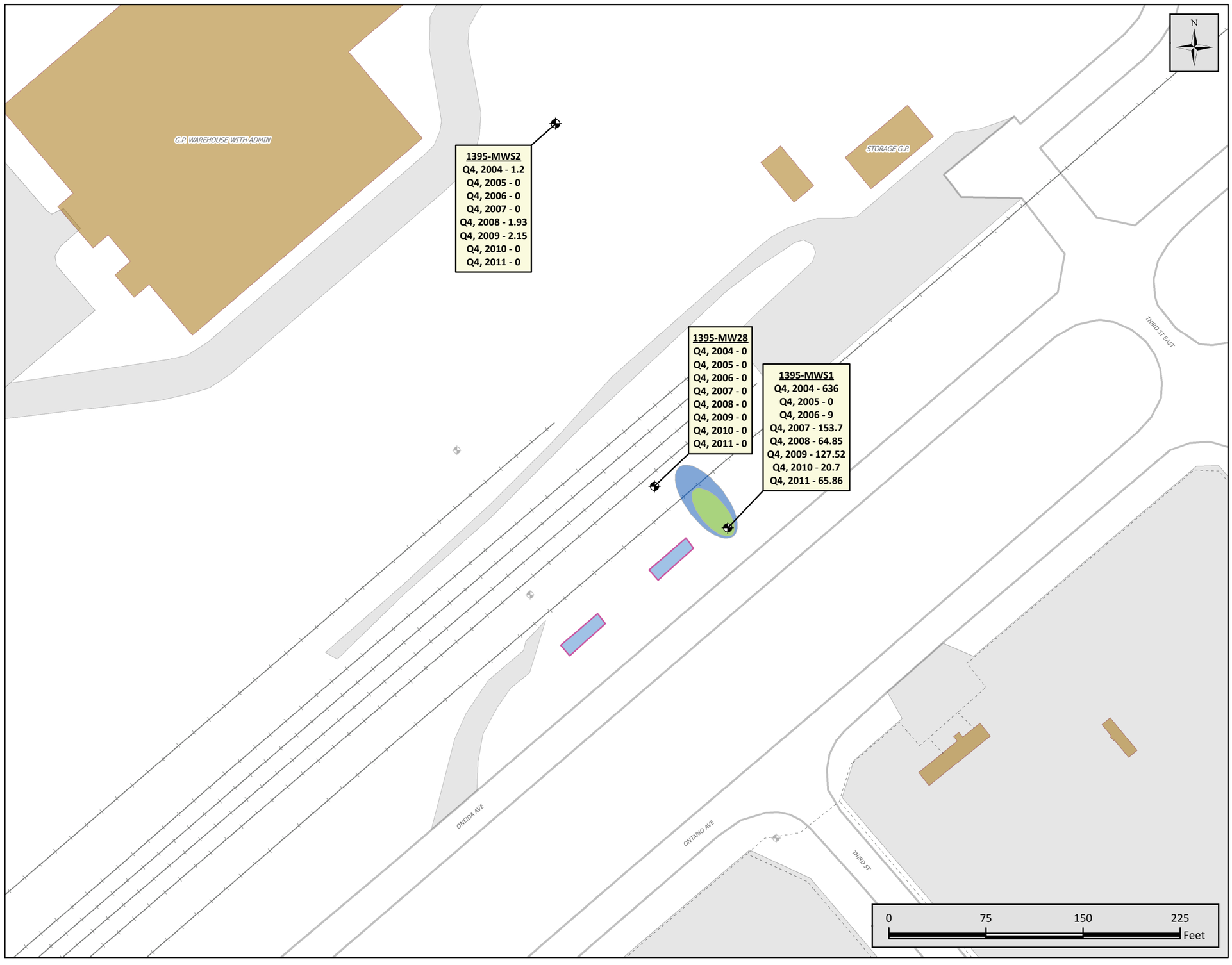
FIGURE 5-2

Area 1395
BTEX Concentrations in Groundwater
Fall 2011

Final Periodic Review Report for
Area 1395
Fort Drum, New York



Legend

- Sampled Wells
- Other Monitoring Wells
- Former UST
- Fence Line
- Rail Road
- Paved Roadline
- Building
- Paved Area

Fall 2011 BTEX Plume

- 1 µg/L
- 10 µg/L

Historical Total BTEX Label Key:
Result values are expressed in units of micrograms per liter (µg/L)

Location Well ID
Quarter, Year - Total BTEX (µg/L)
Q4, 2008 - 2,000

NS = Not Sampled

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FIGURE 5-3

Area 1395
Historical BTEX Concentrations in Groundwater, Fall 2004 to Fall 2011

Final Periodic Review Report for
Area 1395
Fort Drum, New York

Figure 5-4:
BTEX Time Series Trend Graph for Monitoring Well 1395-MW28

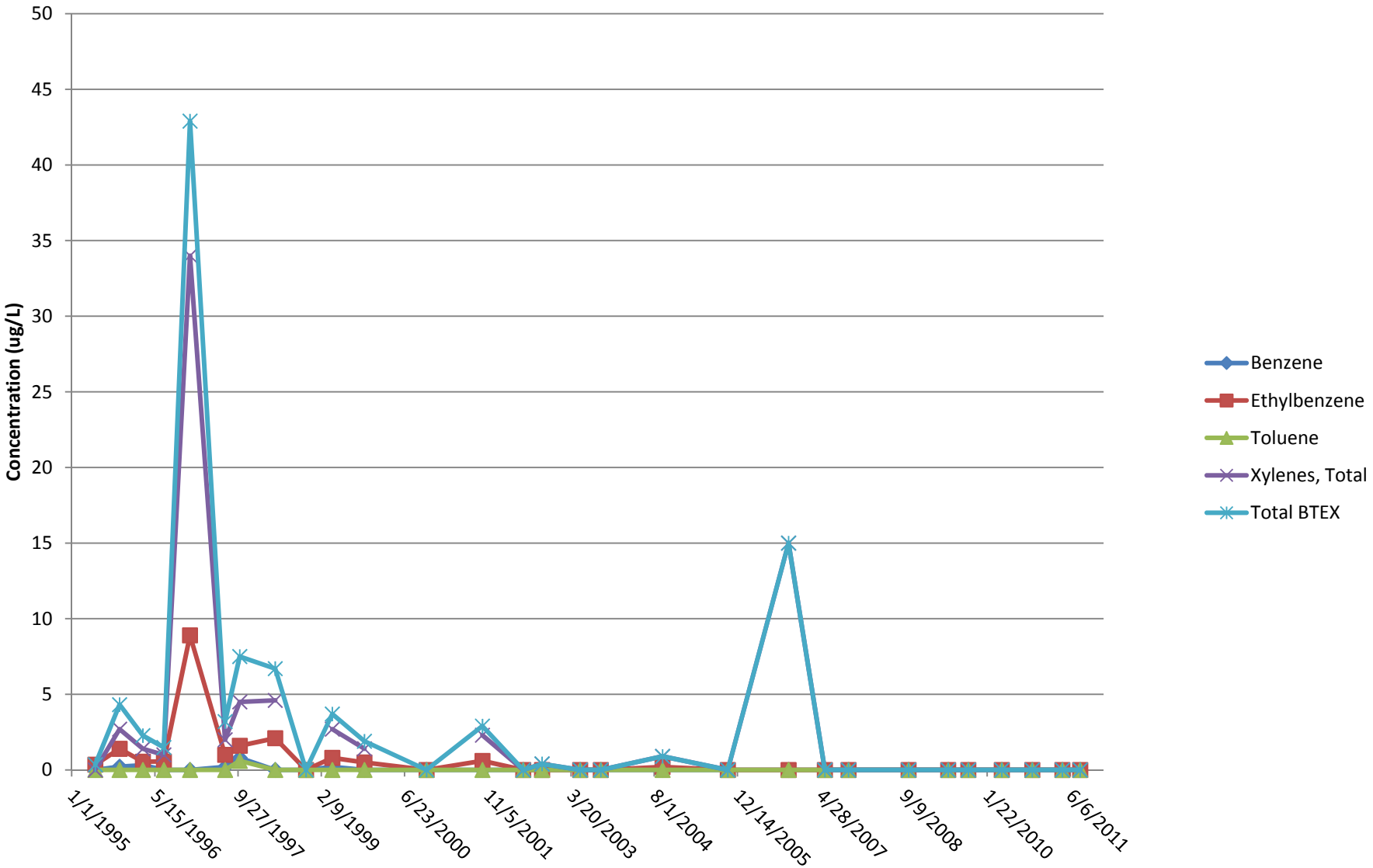


Figure 5-5:
BTEX Time Series Trend Graph for Monitoring Well 1395-MWS1

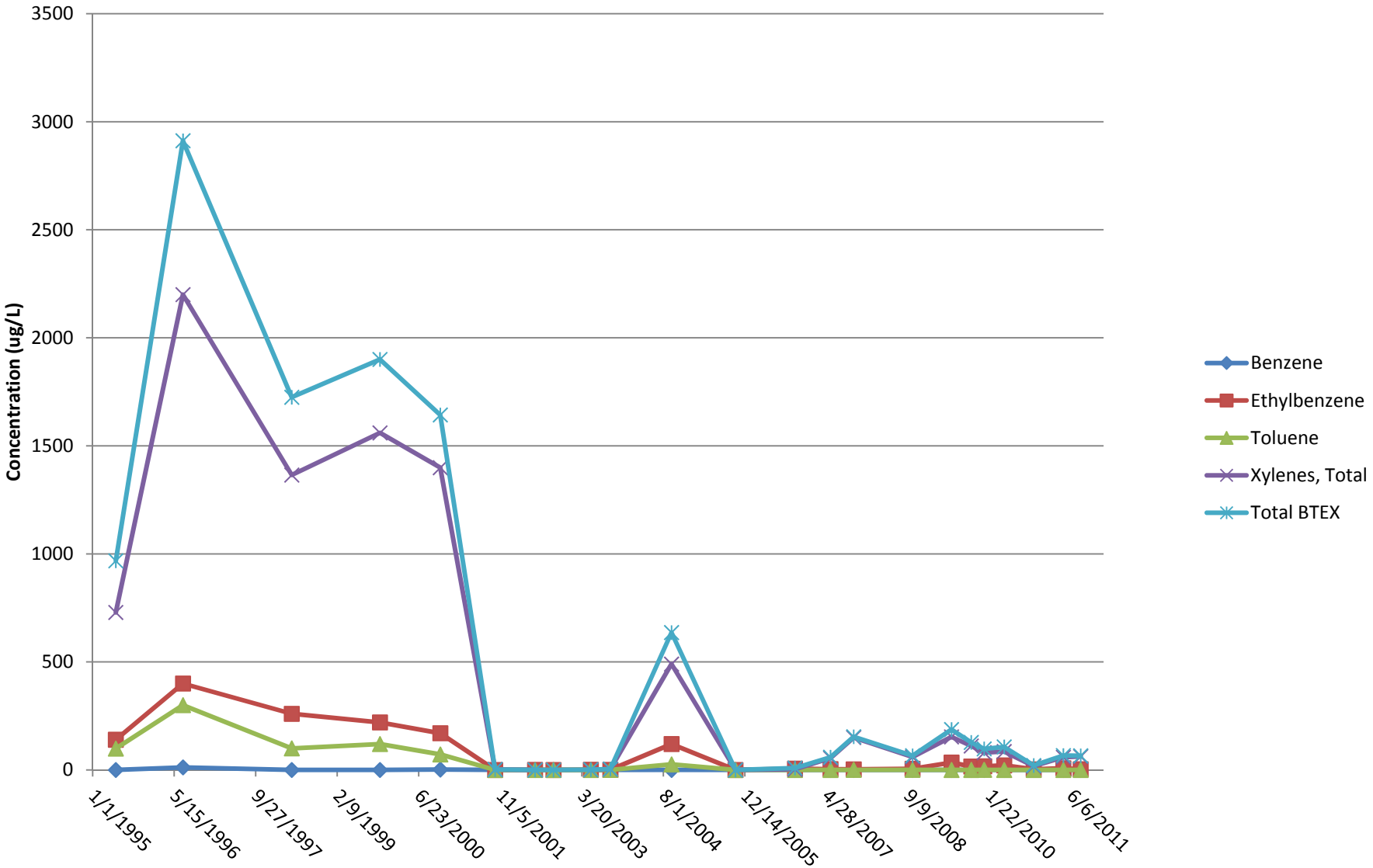
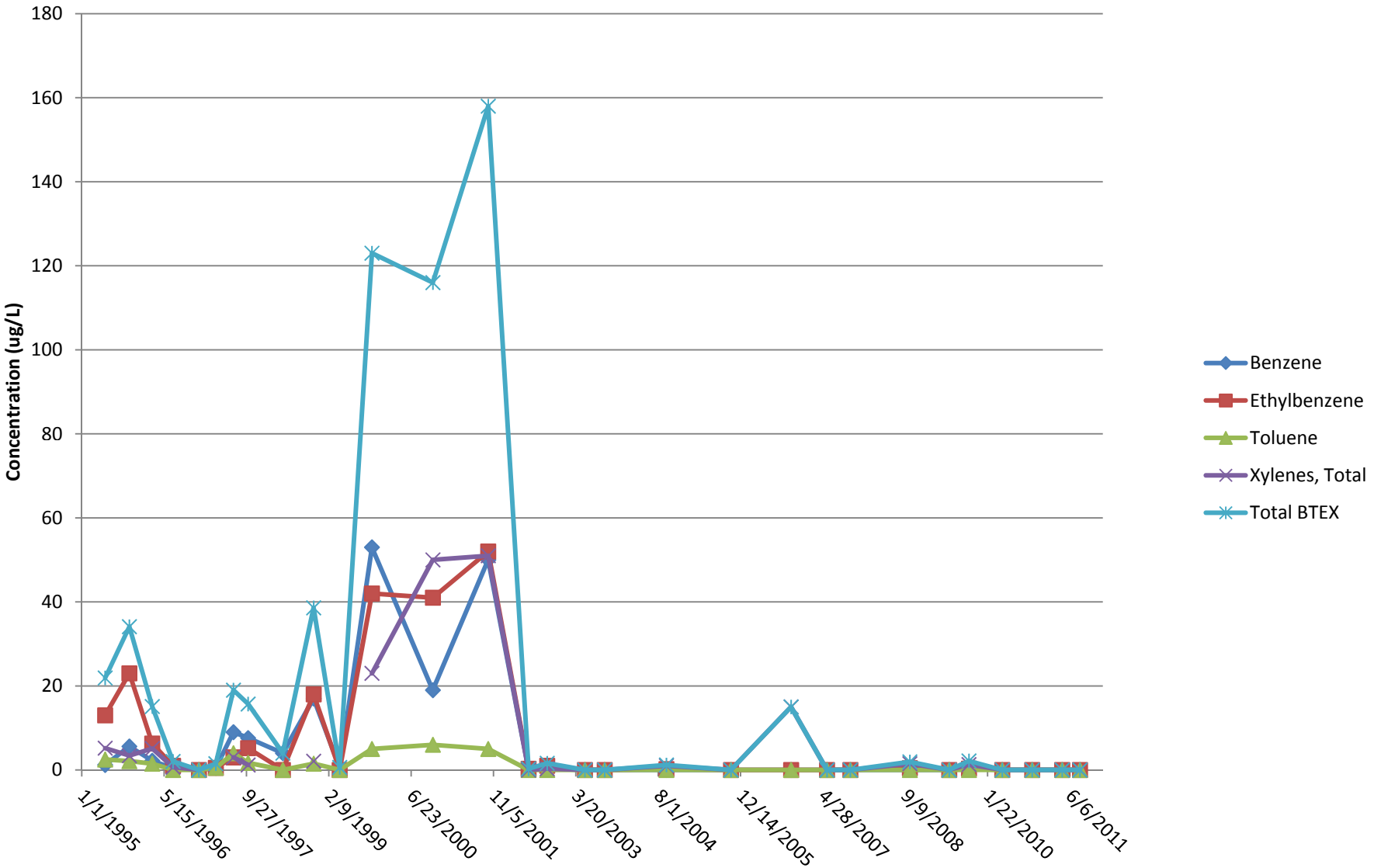
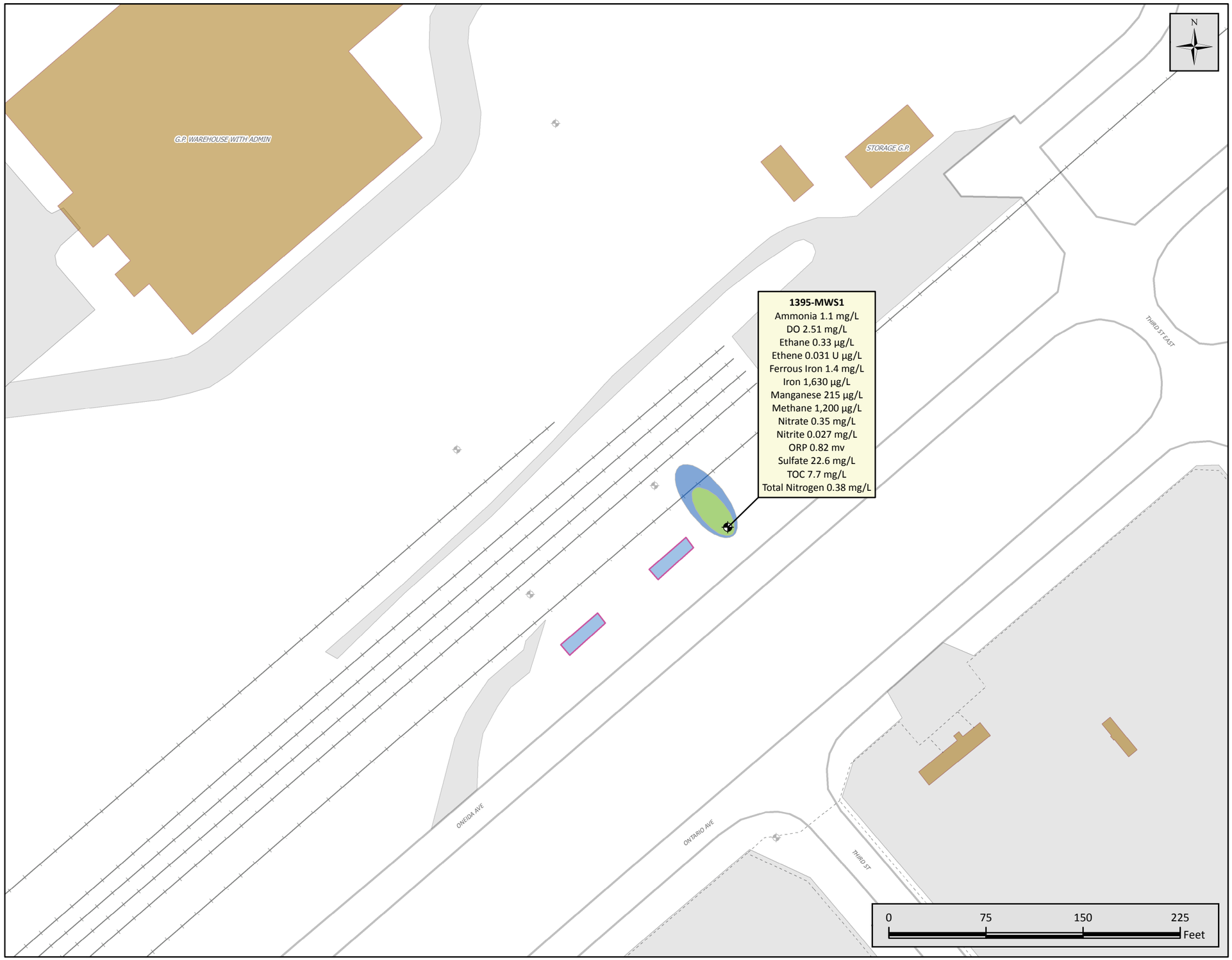


Figure 5-6:
BTEX Time Series Trend Graph for Monitoring Well 1395-MWS2





Legend

- Sampled Monitoring Well
- Other Monitoring Wells
- Former UST
- Fence Line
- Rail Road
- Paved Roadline
- Building
- Paved Area

Fall 2011 BTEX Plume

- 1 µg/L
- 10 µg/L

Monitored Natural Attenuation Label Key:
Result values are expressed in units of µg/L and mg/L followed by a qualifier if applicable

Abbreviation Key:
µg/L = micrograms per liter
DO - Dissolved Oxygen
mg/L = milligrams per liter
mV = millivolts
NS - Not Sampled
ORP - Oxidation Reduction Potential
TOC - Total Organic Carbon

Qualifer Key:
U - Value is less than the method detection limit (MDL)

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FIGURE 5-7

Area 1395
MNA Parameters
Fall 2011

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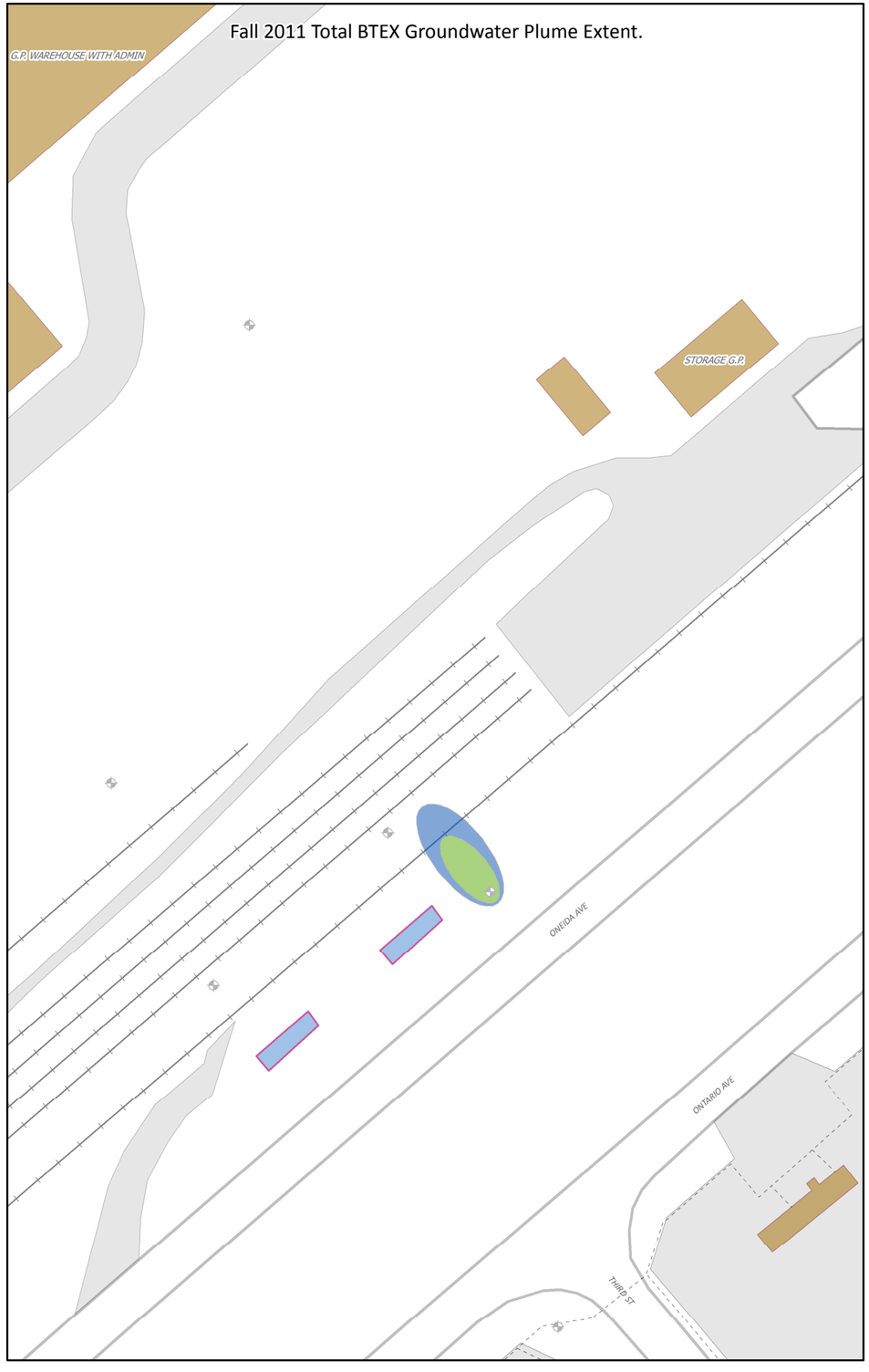
Area 1395
Fort Drum, New York

Fall 1994 Total BTEX Groundwater Plume Extent from EA Engineering 1995 "Comprehensive Contaminant Assessment Report Volume II: Areas 1195, 1295, 1395 and 1495, Gasoline Alley, Fort Drum, NY"

Fall 2011 Total BTEX Groundwater Plume Extent.



Legend

- Historical Direct Push Locations
- Monitoring Wells
- Former UST
- Fence Line
- Rail Road
- Paved Roadline
- Building
- Paved Area

BTEX Plume

- 1 µg/L
- 10 µg/L
- 100 µg/L

BTEX = Benzene, Toluene, Ethylbenzene & Total Xylenes
µg/L = micrograms per liter

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FIGURE 5-8

Area 1395
BTEX Concentrations in Groundwater, Fall 1994 and Fall 2011

Final Periodic Review Report for
Area 1395
Fort Drum, New York

TABLES

Table 5-1:

Historical BTEX and Napthalene Concentrations at Area 1395 Monitoring Wells

Well Name	SampleDate	Benzene	Ethylbenzene	Toluene	Xylene (Total)	Total BTEX	Iron	Manganese
1395-MW2	23-May-95	0.28	0.74	0.2 U	0.74 U	1.02	1.6	0.16
	17-Oct-95	0.2 U	0.2 U	0.2 U	0.2 U	0	1.3	0.39
	4-Mar-96	0.2 U	0.2 U	0.2 U	0.2 U	0	1.5	0.04
1395-MW27	11-Mar-96	0.2 U	0.2 U	0.2 U	0.2 U	0	0.73	0.06
1395-MW28	23-May-95	0.2 U	0.35	0.2 U	0.2 U	0.35	2.5	0.3
	16-Oct-95	0.22	1.4	0.2 U	2.7	4.32	2.4	0.26
	4-Mar-96	0.32	0.55	0.2 U	1.4	2.27	7.2	0.47
	8-Jul-96	0.2 U	0.56	0.2 U	1	1.56	NS	NS
	12-Dec-96	1 U	**8.9**	1 U	**34**	42.9	NS	NS
	11-Jul-97	0.2 J	1	0.5 U	2	3.2	NS	NS
	7-Oct-97	0.8	1.6	0.6	4.5	7.5	NS	NS
	8-May-98	0.5 U	2.1	0.5 U	4.6	6.7	NS	NS
	9-Nov-98	0.5 U	0.5 U	0.5 U	0.5 U	0	NS	NS
	16-Apr-99	0.2	0.8	5 U	2.7	3.7	NS	NS
	26-Oct-99	5 U	0.5 J	5 U	1.4 J	1.9	142	55.6
	2-Nov-00	5 U	5 U	5 U	5 U	0	NS	NS
	4-Oct-01	5 U	0.6 J	5 U	2.3 J	2.9	NS	NS
	6-Jun-02	5 U	5 U	5 U	5 U	0	NS	NS
	27-Sep-02	5 U	5 U	5 U	0.4 JB	0.4	NS	NS
	14-May-03	5 U	5 U	5 U	5 U	0	NS	NS
	15-Sep-03	5 U	5 U	5 U	10 U	0	NS	NS
	20-Sep-04	5 U	5 U	5 U	0.9 J	0.9	NS	NS
	17-Oct-05	5 U	5 U	5 U	15 U	0	NS	NS
	17-Oct-06	5 U	5 U	5 U	15 U	0	NS	NS
	23-May-07	5 U	5 U	5 U	15 U	0	NS	NS
	12-Oct-07	1 U	1 U	1 U	3 U	0	NS	NS
	7-Oct-08	0.26 U	0.27 U	0.15 U	0.39 U	0	**319**	91.6
	2-Jun-09	0.23 U	0.27 U	0.3 U	0.25 U	0	83 J	2.8 J
	1-Oct-09	0.23 U	0.27 U	0.3 U	0.25 U	0	291	74.8
	20-Apr-10	0.23 U	0.27 U	0.3 U	0.25 U	0	96.4 B	18.1
	20-Oct-10	0.23 U	0.27 U	0.3 U	0.25 U	0	NS	NS
	19-Apr-11	0.23 U	0.27 U	0.3 U	0.25 U	0	NS	NS
	4-Aug-11	0.22 U	0.21 U	0.15 U	0.17 U	0	NS	NS
1395-MW29	23-May-95	0.2 U	0.2 U	0.2 U	0.2 U	0	2	0.91
	16-Oct-95	0.2 U	0.2 U	0.2 U	0.2 U	0	2	0.68
	4-Mar-96	0.2 U	0.2 U	0.2 U	0.2 U	0	0.5	0.25
	27-Oct-99	NS	NS	NS	NS	NS	**1730**	**2,540**
1395-MWS1	23-May-95	8 U	**140**	**99**	**729**	968	9	0.52
	8-Jul-96	**12**	**400**	**300**	**2,200**	2912	NS	NS
	6-May-98	25 U	**260**	**100**	**1,365**	1725	NS	NS
	29-Oct-99	25 U	**220**	**120**	**1,560**	1900	NS	NS
	2-Nov-00	2 J	**170**	**72**	**1,399**	1643	NS	NS
	4-Oct-01	5 U	5 U	5 U	2 J	2	NS	NS
	6-Jun-02	5 U	5 U	5 U	5 U	0	NS	NS
	27-Sep-02	5 U	5 U	5 U	5 U	0	NS	NS
	14-May-03	5 U	1.18 J	5 U	0.481 J	1.661	NS	NS
	11-Sep-03	5 U	0.8 J	0.4 J	3 J	4.2	NS	NS
	20-Sep-04	5 U	**120**	**26**	**490**	636	NS	NS
	17-Oct-05	5 U	5 U	5 U	15 U	0	NS	NS
	17-Oct-06	5 U	**6**	5 U	3 J	9	NS	NS
	23-May-07	5 U	4 J	5 U	**55**	59	NS	NS
	12-Oct-07	1 U	3	0.7 J	**150**	153.7	NS	NS
	7-Oct-08	0.26 U	**5.4**	0.35 J	**59.1**	64.85	**7,350**	**974**
	3-Jun-09	0.23 U	**34.4**	0.3 U	**153**	187.4	**8,760**	**1,360**
	2-Oct-09	0.23 U	**16.2**	0.32 J	**111**	127.52	**5,120**	**528**
	20-Dec-09	0.23 U	**17**	0.5 J	**80.1**	97.6	NS	NS
	22-Apr-10	0.23 U	**21.3**	0.3 U	**85.5**	106.8	**7,220**	**452**
	20-Oct-10	0.23 U	3.1	0.3 U	**17.6**	20.7	**4,170**	225
	20-Apr-11	0.23 U	**8.1**	0.3 U	**58.7**	66.8	**7,670**	**2,800**
	4-Aug-11	0.22 U	3.2	0.26 J	**62.4**	65.86	**1,630**	216

Table 5-1:

Historical BTEX and Napthalene Concentrations at Area 1395 Monitoring Wells

Well Name	SampleDate	Benzene	Ethylbenzene	Toluene	Xylene (Total)	Total BTEX	Iron	Manganese
1395-MWS2	23-May-95	1.2	**13**	2.5	5.1 U	16.7	35	2.2
	17-Oct-95	**5.6**	**23**	2.1	3.4	34.1	18.6	1
	4-Mar-96	2.2	**6.3**	1.5	**5.1**	15.1	7.4	0.28
	8-Jul-96	0.38	0.99	0.2 U	0.67	2.04	NS	NS
	12-Dec-96	1 U	1 U	1 U	1 U	0	NS	NS
	25-Mar-97	0.5	0.5 J	0.5 J	1 U	1.5	NS	NS
	10-Jul-97	**9**	3	4	3	19	NS	NS
	7-Oct-97	**7.6**	**5.2**	1.7	1.2	15.7	NS	NS
	6-May-98	4	0.5 U	0.5 U	0.5 U	4	NS	NS
	9-Nov-98	**17**	**18**	1.5	2.1	38.6	**18,400**	**1,550**
	16-Apr-99	0.6	5 U	5 U	5 U	0.6	NS	NS
	29-Oct-99	**53**	**42**	5 J	**23**	123	**30,800**	**2,340**
	2-Nov-00	**19**	**41**	**6**	**50**	116	NS	NS
	4-Oct-01	**50**	**52**	5	**51**	158	NS	NS
	6-Jun-02	5 U	0.288 J	5 U	5 U	0.288	NS	NS
	27-Sep-02	0.3 J	1 JB	5 U	0.3 J	1.6	NS	NS
	14-May-03	5 U	5 U	5 U	5 U	0	NS	NS
	11-Sep-03	5 U	5 U	5 U	10 U	0	NS	NS
	20-Sep-04	5 U	0.2 J	5 U	1 J	1.2	NS	NS
	17-Oct-05	5 U	5 U	5 U	15 U	0	NS	NS
	17-Oct-06	5 U	5 U	5 U	15 U	0	NS	NS
	23-May-07	5 U	5 U	5 U	15 U	0	NS	NS
	12-Oct-07	1 U	1 U	1 U	3 U	0	NS	NS
	7-Oct-08	0.26 U	0.43 J	0.15 U	1.5	1.93	45.7 B	**455**
	3-Jun-09	0.23 U	0.27 U	0.3 U	0.25 U	0	**316**	49.7
	1-Oct-09	0.54 J	0.31 J	0.3 U	1.2	2.05	**713**	**809**
	21-Apr-10	0.23 U	0.27 U	0.3 U	0.25 U	0	100 U	**611**
	20-Oct-10	0.23 U	0.27 U	0.3 U	0.25 U	0	NS	NS
	20-Apr-11	0.23 U	0.27 U	0.3 U	0.25 U	0	NS	NS
	6-Aug-11	0.22 U	0.21 U	0.15 U	0.17 U	0	NS	NS

11 Concentration exceeds NYSDEC's groundwater screening criteria.

All analytical vlues shown are in units of µg/L (Micrograms per Liter) followed by a result qualifier if applicable

NS - Indicates that the well was not sampled for this analyte during the sampling event.

Qualifier Key

U - Analyte not detected in sample. Value reported is the quantitation/detection limit.

J - Analyte is detected but the reported value is a quantitative estimate

B - Analyte found in both the sample and method blank.

Table 5-2:
Mann-Kendall Trend Analysis for Monitoring Wells at Area 1395

COC	Well	N	N_D	S	P	Decreasing Trend?	Increasing Trend?
Benzene	1395-MW2	3	1	0	1.000		
	1395-MW27	1	0	0	1.000		
	1395-MW28	29	5	-95	0.039	Yes	
	1395-MW29	3	0	0	1.000		
	1395-MWS1	24	2	-37	0.188		
	1395-MWS2	31	15	-179	0.001	Yes	
Ethylbenzene	1395-MW2	3	1	0	1.000		
	1395-MW27	1	0	0	1.000		
	1395-MW28	29	12	-192	0.000	Yes	
	1395-MW29	3	0	0	1.000		
	1395-MWS1	24	21	-25	0.278		
	1395-MWS2	31	16	-182	0.001	Yes	
Toluene	1395-MW2	3	0	0	1.000		
	1395-MW27	1	0	0	1.000		
	1395-MW28	29	1	-16	0.390		
	1395-MW29	3	0	0	1.000		
	1395-MWS1	24	13	-87	0.016	Yes	
	1395-MWS2	31	10	-153	0.004	Yes	
Total BTEX	1395-MW2	3	1	0	1.000		
	1395-MW27	1	0	0	1.000		
	1395-MW28	29	14	-175	0.000	Yes	
	1395-MW29	3	0	0	1.000		
	1395-MWS1	24	22	-27	0.262		
	1395-MWS2	31	19	-191	0.000	Yes	
Xylenes, Total	1395-MW2	3	1	0	1.000		
	1395-MW27	1	0	0	1.000		
	1395-MW28	27	13	-148	0.001	Yes	
	1395-MW29	3	0	0	1.000		
	1395-MWS1	23	21	-35	0.187		
	1395-MWS2	28	15	-134	0.004	Yes	

Notes:
N: Number of Samples
N_D: Number of Detections
S: Man-Kendall Statistic
α: Significance Level

APPENDIX A
HUMAN HEALTH RISK ASSESSMENT

AVATAR ENVIRONMENTAL

TECHNICAL MEMORANDUM

TO: Greg Kendall, Plexus Scientific

FROM: Kristina Early, Avatar Environmental
cc: Charles Dobroski, Avatar Environmental

DATE: 10 June 2011

SUBJECT: Fort Drum, Gasoline Alley Area 1395 Groundwater Human Health Risk Assessment (HHRA)

Introduction

As a subcontractor to Plexus Scientific, Avatar Environmental was tasked with developing this Technical Memorandum to provide a summary of the potential human health risks resulting from exposure to refined petroleum and other chemical contamination in groundwater at the Gasoline Alley Area 1395 of Fort Drum. This risk assessment evaluates the most recent groundwater data with the intent of determining whether this area may undergo closure with regard to further environmental evaluations.

Data Evaluation/Reduction

Data evaluated in the HHRA include groundwater samples collected from Area 1395 in the spring of 2011. The following guidelines for data reduction were used to produce the data summary.

- If an analyte was not positively identified in any sample for a given medium because it was reported as a nondetect (indicated by a "U" qualifier), or because it was present as a result of blank contamination (indicated by a "B" qualifier for organics), it was not addressed for that medium;

- Analytical results with a "U" qualifier represent nondetect samples for the analyte evaluated. The full detection limit (DL) value was used for nondetect samples in subsequent calculations (i.e., the arithmetic mean and the 95 percent upper-confidence limit of the mean [95% UCL]); and

- If a sample duplicate was collected and analyzed, the average of the two reported concentrations was used for subsequent calculations unless there was a greater than 30% difference in water concentrations, in which case the higher of the two concentrations was used. In the case of a detected sample and a nondetect duplicate, the detected concentration was carried through subsequent calculations.

Table 1 presents the data summary for the groundwater at Area 1395.

A contaminant of potential concern (COPC) selection process was conducted to identify those analytes that were detected in the groundwater at levels that could pose a potential risk to potentially exposed human receptors. The criteria that were used to determine COPCs include:

- Non-detection – If an analyte was not detected in any samples, it was not evaluated as a COPC. Note that it was assumed that the analytical results met all of the project-specific data quality objectives (DQOs) and that a comparison of sample quantitation limits (SQLs) with benchmarks was unnecessary.

- A comparison of detected concentrations with screening criteria – If the maximum detected concentration for a given analyte was greater than the lower of its New York State Department of Environmental Conservation (NYSDEC) Ambient Water Quality Standards and Guidance Values for Class GA Groundwater (NYSDEC, 2008) or its NYSDEC Maximum Contaminant Levels (MCLs) for drinking water (NYSDEC, 2006), it was identified as a COPC.

Table 2 presents the COPC selection process for the analytes that were detected in groundwater at Area 1395.

Exposure Setting

The following description of the exposure setting for the subject area is taken from the *September 2002 Final Risk Assessment* (Malcom Pirnie, 2002), *September 2000 Final Risk Assessment* (Malcom Pirnie, 2000), and the *2008 Annual Basewide Groundwater and Surface Water Monitoring Report* (Plexus Scientific, 2009):

> Fort Drum is an active military base located in upstate New York, approximately 10 miles northeast of Watertown, 80 miles north of Syracuse, and 25 miles southeast of the U.S./Canadian border. Fort Drum occupies a large portion of northeastern Jefferson County and a portion of western Lewis County and encompasses approximately 107,265 acres.
>
> Area 1395, located in the southwestern portion of Gasoline Alley, contained two 25,000 gallon USTs of unknown material which stored diesel fuel prior to the early 1970s. In the early 1970s, these tanks were replaced with two 25,000 gallon steel USTs which were used to store diesel fuel. From 1990-1994, these tanks were used to store diesel fuel, and were removed during the fall of 1994.

Identification of Potentially Exposed Human Populations and Exposure Pathways

Based on the exposure setting and the current and potential future land uses, the potentially exposed populations include:

- Commercial/Industrial Worker. An employee could be exposed to contaminants in groundwater through potential consumption of drinking water (i.e., groundwater is assumed to be the source of drinking water). This worker is assumed to spend the majority of his/her time at work indoors.

- Resident Child and Adult. Area 1395 could be developed into a residential property in the future. Ingestion of, dermal contact with, and inhalation of COPCs in groundwater under future use conditions are evaluated. For dermal exposure to groundwater, adult exposure is associated with showering, and child exposure is associated with bathing. Inhalation of VOCs while showering is evaluated for the adult. Because the aerosolization of VOCs from bath water is not significant, this pathway is not evaluated for the bathing child.

Exposure Point Concentrations (EPCs)

EPCs are the representative COPC concentrations to which a receptor is assumed to be exposed. Guided by both the ProUCL Technical Manual (EPA, 2010a) and the ProUCL User's Guide (EPA, 2010b), it was determined that if fewer than 8 samples were collected, the EPC was based on the maximum detected concentration. Table 3 presents the EPCs that were used to estimate the risks associated with groundwater exposure. Because a maximum of 3 samples was collected, the maximum detected concentration was used for the EPC.

Exposure Equations and Parameters

The mathematical models and exposure assumptions that were used to calculate the exposure doses (chronic daily intakes; CDIs) of COPCs for each receptor population through the applicable exposure routes are presented in Tables 4 through 15. Exposure doses are dependent upon the magnitude, frequency, and duration of exposure. They are estimated by combining the COPC concentration (i.e., the EPC) and the exposure parameters. Two types of exposure doses are calculated. The cancer dose (lifetime average daily dose [LADD]) is averaged over a 70-year lifetime. The noncancer average daily dose (ADD) is averaged over the actual exposure duration for each receptor.

Summary of Toxicity Values Used in HHRA

Tables 16 through 19 present the available toxicity values (oral, dermal, and inhalation) for each COPC, as well as the source, the EPA weight-of evidence category, the route of administration, and the critical effect.

Risk Results

The Fort Drum Area 1395 cancer risks and noncancer hazard indices (HIs) are presented in Tables 20 through 26.

Commercial/Industrial Worker

Total cancer risk: 3.1E-07

Total noncancer hazard: HI: 1.3

- Potential exposure to manganese slightly exceeded a noncancer hazard quotient (HQ) of 1.0.

Age-Adjusted Resident

Total cancer risk: Ingestion/Dermal – 2.1E-06

- The risk from potential exposure to ethylbenzene was at the lower end of the USEPA target risk range of 1E-06 to 1E-04.

Child Resident

Total noncancer hazard: HI: 9.7

- Potential exposure to manganese exceeded a noncancer hazard quotient (HQ) of 1.0.

Adult Resident

Total cancer risk: Inhalation – 1.3E-09

Total noncancer hazard: HI: Ingestion/Dermal – 4.0, Inhalation – 0.00027

- Potential exposure to manganese exceeded a noncancer hazard quotient (HQ) of 1.0.

Summary

From a HHRA perspective, Area 1395 could be recommended for closure. Industrial worker risks were below EPA's cancer risk threshold. The industrial worker HI was slightly above EPA's noncancer HQ threshold based on exposure to manganese which slightly exceeded one with an HQ of 1.3. Residential cancer risks for ingestion and dermal exposure were at the low end of the target risk range based on exposure to ethylbenzene (cancer risk of 2.1E-06), but were well below the 1E-04 threshold. The noncancer HQ threshold was exceeded based on ingestion and dermal exposure by the child (total HI of 9.7) and adult (total HI of 4.0) residents. The child and adult resident noncancer HQ threshold exceedances were based on exposure to manganese which exceeded one with HQs of 8.7 and 3.6, respectively.

References

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Table 1
Summary of Analytes Detected in 2011 Groundwater
Fort Drum Gasoline Alley Facility - Area 1395
Fort Drum, NY

CAS Number	Analyte	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Detection Frequency[a]	Detection Limits[b]	Arithmetic Mean[c]	Standard Deviation[c]
95636	1,2,4-Trimethylbenzene	5.54E+01	5.54E+01	µg/L	1395-MWS1	1/3	2.80E-01 - 2.80E-01	1.87E+01	3.18E+01
108678	1,3,5-Trimethylbenzene	1.33E+01	1.33E+01	µg/L	1395-MWS1	1/3	3.00E-01 - 3.00E-01	4.63E+00	7.51E+00
74873	Chloromethane	5.00E-01	5.00E-01	µg/L	1395-MWS1	1/3	2.90E-01 - 2.90E-01	3.60E-01	1.21E-01
74840	Ethane	8.60E-01	8.60E-01	µg/L	1395-MWS1	1/1	NA	8.60E-01	NC
100414	Ethylbenzene	8.10E+00	8.10E+00	µg/L	1395-MWS1	1/3	2.70E-01 - 2.70E-01	2.88E+00	4.52E+00
98828	Isopropylbenzene	7.90E+00	7.90E+00	µg/L	1395-MWS1	1/3	5.70E-01 - 5.70E-01	3.01E+00	4.23E+00
179601231	m,p-Xylene	4.67E+01	4.67E+01	µg/L	1395-MWS1	1/3	2.50E-01 - 2.50E-01	1.57E+01	2.68E+01
74828	Methane	2.16E+03	2.16E+03	µg/L	1395-MWS1	1/1	NA	2.16E+03	NC
91203	Naphthalene	5.50E+00	5.50E+00	µg/L	1395-MWS1	1/3	9.70E-01 - 9.70E-01	2.48E+00	2.62E+00
104518	n-Butylbenzene	1.70E+00	1.70E+00	µg/L	1395-MWS1	1/3	4.70E-01 - 4.70E-01	8.80E-01	7.10E-01
103651	n-Propylbenzene	8.20E+00	8.20E+00	µg/L	1395-MWS1	1/3	2.40E-01 - 2.40E-01	2.89E+00	4.60E+00
95476	o-Xylene	1.19E+01	1.19E+01	µg/L	1395-MWS1	1/3	2.50E-01 - 2.50E-01	4.13E+00	6.73E+00
99876	p-Isopropyltoluene	4.10E+00	4.10E+00	µg/L	1395-MWS1	1/3	6.90E-01 - 6.90E-01	1.83E+00	1.97E+00
135988	sec-Butylbenzene	2.20E+00	2.20E+00	µg/L	1395-MWS1	1/3	2.20E-01 - 2.20E-01	8.80E-01	1.14E+00
98066	tert-Butylbenzene	1.90E+00	1.90E+00	µg/L	1395-MWS1	1/3	2.10E-01 - 2.10E-01	7.73E-01	9.76E-01
1330207	Xylene (total)	5.87E+01	5.87E+01	µg/L	1395-MWS1	1/3	2.50E-01 - 2.50E-01	1.97E+01	3.37E+01
7439896	Iron	7.67E+03	7.67E+03	µg/L	1395-MWS1	1/1	NA	7.67E+03	NC
7439965	Manganese	2.80E+03	2.80E+03	µg/L	1395-MWS1	1/1	NA	2.80E+03	NC

[a]Number of sampling locations at which analyte was detected compared with total number of sampling locations.

[b]Based on nondetected samples.

[c]Nondetects were included at the full detection limit.

µg/L = Micrograms per liter.

NA = Not applicable.

Table 2
COPC Selection Process for Analytes Detected in 2011 Groundwater
Fort Drum Gasoline Alley Facility - Area 1395
Fort Drum, NY

CAS Number	Analyte	Maximum Concentration	Units	Location of Maximum Concentration	NYSDEC Human Health Screening Criteria[a] (µg/L)	Ratio of Maximum Concentration to NYSDEC Screening Criteria	COPC
95636	1,2,4-Trimethylbenzene	5.54E+01	µg/L	1395-MWS1	5.00E+00	11.1	X
108678	1,3,5-Trimethylbenzene	1.33E+01	µg/L	1395-MWS1	5.00E+00	2.66	X
74873	Chloromethane	5.00E-01	µg/L	1395-MWS1	5.00E+00	0.10	
74840	Ethane	8.60E-01	µg/L	1395-MWS1	5.00E+00	0.17	
100414	Ethylbenzene	8.10E+00	µg/L	1395-MWS1	5.00E+00	1.62	X
98828	Isopropylbenzene	7.90E+00	µg/L	1395-MWS1	5.00E+00	1.58	X
179601231	m,p-Xylene	4.67E+01	µg/L	1395-MWS1	5.00E+00	9.34	X
74828	Methane	2.16E+03	µg/L	1395-MWS1	5.00E+00	432	X
91203	Naphthalene	5.50E+00	µg/L	1395-MWS1	5.00E+00	1.10	X
104518	n-Butylbenzene	1.70E+00	µg/L	1395-MWS1	5.00E+00	0.34	
103651	n-Propylbenzene	8.20E+00	µg/L	1395-MWS1	5.00E+00	1.64	X
95476	o-Xylene	1.19E+01	µg/L	1395-MWS1	5.00E+00	2.38	X
99876	p-Isopropyltoluene	4.10E+00	µg/L	1395-MWS1	5.00E+00	0.82	
135988	sec-Butylbenzene	2.20E+00	µg/L	1395-MWS1	5.00E+00	0.44	
98066	tert-Butylbenzene	1.90E+00	µg/L	1395-MWS1	5.00E+00	0.38	
1330207	Xylene (total)	5.87E+01	µg/L	1395-MWS1	5.00E+00	11.7	X
7439896	Iron	7.67E+03	µg/L	1395-MWS1	3.00E+02	25.6	X
7439965	Manganese	2.80E+03	µg/L	1395-MWS1	3.00E+02	9.33	X

[a] Screening criteria based on the minimum of the NYSDEC Ambient Water Quality Standards for Class GA Groundwater and the NYSDEC Maximum Contaminant Levels (MCLs).

µg/L = Micrograms per liter.

NYSDEC = New York State Department of Environmental Conservation.

Table 3
Summary of Exposure Point Concentrations for COPCs in 2011 Groundwate
Fort Drum Gasoline Alley Facility - Area 139
Fort Drum, NY

COPC	Maximum Detected Concentration (µg/L)	Data Distribution	Calculation Method	95% UCL (µg/L)	Exposure Point Concentration (µg/L)
1,2,4-Trimethylbenzene	5.54E+01	ND	ND	NC	5.54E+01
1,3,5-Trimethylbenzene	1.33E+01	ND	ND	NC	1.33E+01
Ethylbenzene	8.10E+00	ND	ND	NC	8.10E+00
Isopropylbenzene	7.90E+00	ND	ND	NC	7.90E+00
m,p-Xylene	4.67E+01	ND	ND	NC	4.67E+01
Methane	2.16E+03	ND	ND	NC	2.16E+03
Naphthalene	5.50E+00	ND	ND	NC	5.50E+00
n-Propylbenzene	8.20E+00	ND	ND	NC	8.20E+00
o-Xylene	1.19E+01	ND	ND	NC	1.19E+01
Xylene (total)	5.87E+01	ND	ND	NC	5.87E+01
Iron	7.67E+03	ND	ND	NC	7.67E+03
Manganese	2.80E+03	ND	ND	NC	2.80E+03

NC=Not calculated. The maximum concentration used for EPC due to less than 4 detected values.

ND=Not determined. The maximum concentration used for EPC due to less than 4 detected values.

Table 4
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure - Groundwater - Commercial/Industrial Worker
Fort Drum Gasoline Alley Facility
Fort Drum, NY

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Receptor Population: Commercial/Industrial Worker
Receptor Age: Adult

Exposure Route	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation
Ingestion	Tapwater	EPC	Exposure Point Concentration	COPC-specific	µg/L	Calculated	Chronic daily intake (mg/kg-day) =
		IRW	Ingestion Rate of Water	2	L/day	EPA, 2002	EPC x IRW x CF x FI x EF x ED x 1/BW x 1/AT
		FI	Fraction Ingested	0.5	unitless	Professional Judgement	
		EF	Exposure Frequency	250	days/year	EPA, 2002	
		ED	Exposure Duration	25	years	EPA, 2002	
		CF	Conversion Factor	1.00E-03	mg/µg	-----	
		BW	Body Weight	70	kg	EPA, 1997	
		AT_C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		AT_{NC}	Averaging Time (Non-Cancer)	9,125	days	Calculated	

Table 5
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure - Groundwater - Resident
Fort Drum Gasoline Alley Facility
Fort Drum, NY

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Receptor Population: Residents
Receptor Age: Child/Adult

Exposure Route	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Tapwater	EPC	Exposure Point Concentration	COPC-specific	µg/L	Calculated	Chronic daily intake (CDI)(mg/kg-day) =
Child/Adult (Cancer)		IFW_{adj}	Age-adjusted water ingestion factor	1.1	L-year/kg-day	Calculated	$EPC \times IFW_{adj} \times CF \times FI \times EF \times 1/AT_C$
		FI	Fraction Ingested	1	unitless	EPA, 1989	Where
		EF	Exposure Frequency	350	days/year	EPA, 2002	$IFW_{adj} = (IRW_c \times ED_c \times 1/BW_c) + (IRW_a \times ED_a \times 1/BW_a)$
		ED_c	Exposure Duration - child	6	years	EPA, 2002	
		ED_a	Exposure Duration - adult	24	years	EPA, 2002	
		IRW_c	Ingestion Rate of Water - child	1	L/day	EPA, 2002	
		IRW_a	Ingestion Rate of Water - adult	2	L/day	EPA, 2002	
		BW_c	Body Weight - child	15	kg	EPA, 1997	
		BW_a	Body Weight - adult	70	kg	EPA, 1997	
		CF	Conversion Factor	0.001	mg/µg	-----	
		AT_C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		AT_{NC}	Averaging Time (Non-Cancer)	8,760	days	Calculated	
Ingestion	Tapwater	EPC	Exposure Point Concentration	COPC-specific	µg/L	Calculated	Chronic daily intake (CDI)(mg/kg-day) =
Child (Noncancer)		FI	Fraction Ingested	1	unitless	EPA, 1989	$EPC \times IRW_c \times CF \times FI \times EF \times ED_c \times 1/BW_c \times 1/AT$
		EF	Exposure Frequency	350	days/year	EPA, 2002	
		ED_c	Exposure Duration - child	6	years	EPA, 2002	
		IRW_c	Ingestion Rate of Water - child	1	L/day	EPA, 2002	
		BW_c	Body Weight - child	15	kg	EPA, 1997	
		CF	Conversion Factor	0.001	mg/µg	-----	
		AT_C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		AT_{NC}	Averaging Time (Non-Cancer)	2,190	days	Calculated	
Ingestion	Tapwater	EPC	Exposure Point Concentration	COPC-specific	µg/L	Calculated	Chronic daily intake (CDI)(mg/kg-day) =
Adult (Noncancer)		FI	Fraction Ingested	1	unitless	EPA, 1989	$EPC \times IRW_a \times CF \times FI \times EF \times ED_a \times 1/BW_a \times 1/AT$
		EF	Exposure Frequency	350	days/year	EPA, 2002	
		ED_a	Exposure Duration - adult	24	years	EPA, 2002	
		IRW_a	Ingestion Rate of Water - adult	2	L/day	EPA, 2002	
		BW_a	Body Weight - adult	70	kg	EPA, 1997	
		CF	Conversion Factor	0.001	mg/µg	-----	
		AT_C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		AT_{NC}	Averaging Time (Non-Cancer)	8,760	days	Calculated	

Table 5
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure - Groundwater - Resident
Fort Drum Gasoline Alley Facility
Fort Drum, NY

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Receptor Population: Residents
Receptor Age: Child/Adult

Exposure Route	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Tapwater	SFS_{adj}	Age-adjusted skin contact factor	8,811	event-year-cm^2/kg-day	Calculated	Dermally Absorbed Dose (DAD) (mg/kg-day) =
Child/Adult (Cancer)	While Bathing/	SA_c	Skin Surface Area Available for Contact - child	6,600	cm^2	EPA, 2004	$DA_{EVENT-adj} \times SFS_{adj} \times EF \times 1/AT_C$
	Showering	SA_a	Skin Surface Area Available for Contact - adult	18,000	cm^2	EPA, 2004	
		DA_{EVENT}	Absorbed Dose Per Event	See Table 6	mg/cm^2-event	EPA, 2004	$SFS_{adj} = (SA_c \times EV_c \times ED_c \times 1/BW_c) + (SA_a \times EV_a \times ED_a \times 1/BW_a)$
		EV_c	Event Frequency - child	1	event/day	EPA, 2004	$DA_{EVENT-adj}$ Calculations
		EV_a	Event Frequency - adult	1	event/day	EPA, 2004	$t_{event-adj} = (ED_c \times t_{event-c}) + (ED_a \times t_{event-a})/(ED_c + ED_a)$
		EF	Exposure Frequency	350	days/year	EPA, 2002	
		ED_c	Exposure Duration - child	6	years	EPA, 2002	if $t_{event-adj} \leq t^*$, then $DA_{EVENT-adj}$ (Organic) =
		ED_a	Exposure Duration - adult	24	years	EPA, 2002	$2\ FA \times K_p \times C_w \times CF_1 \times CF_2 \times \sqrt{(6\tau_{event} \times t_{event-adj}/\pi)}$
		BW_c	Body Weight - child	15	kg	EPA, 1997	
		BW_a	Body Weight - adult	70	kg	EPA, 1997	otherwise if $t_{event-adj} > t^*$, then $DA_{EVENT-adj}$ (Organic) =
		AT_C	Averaging Time (Cancer)	25,550	days	EPA, 1989	$FA \times K_p \times C_w \times CF_1 \times CF_2 \times$
		$t_{event-adj}$	Age-adjusted event duration	0.66	hr/event	Calculated	$[((t_{event-adj})/(1+B)) + 2\tau_{event}((1 + 3B + 3B^2)/(1+B)^2)$
		$t_{event-c}$	Event Duration - child	1	hr/event	EPA, 2004	
		$t_{event-a}$	Event Duration - adult	0.58	hr/event	EPA, 2004	$DA_{EVENT-adj}$ (Inorganic) =
		FA	Fraction Absorbed Water	See Table 6	unitless	EPA, 2004	$K_p \times C_w \times CF_1 \times CF_2 \times t_{event-adj}$
		K_p	Dermal Permeability Coefficient	See Table 6	cm/hour	EPA, 2004	
		C_w	Chemical Concentration in Water	COPC-specific	µg/L	Calculated	
		CF_1	Conversion Factor	0.001	mg/µg	-----	
		CF_2	Conversion Factor	0.001	L/cm^3	-----	
		B	Ratio of Permeability Coefficient	See Table 6	unitless	EPA, 2004	
		t*	Time to Reach Steady State	See Table 6	hour	EPA, 2004	
		t_{event}	Lag Time Per Event	See Table 6	hr/event	EPA, 2004	

Table 5
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure - Groundwater - Resident
Fort Drum Gasoline Alley Facility
Fort Drum, NY

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Receptor Population: Residents
Receptor Age: Child/Adult

Exposure Route	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Tapwater	SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2004	Dermally Absorbed Dose (DAD) (mg/kg-day) =
Child (Noncancer)	While Bathing	DA_{EVENT}	Absorbed Dose Per Event	See Table 7	mg/cm^2-event	EPA, 2004	$DA_{EVENT} \times EV \times SA \times EF \times ED \times 1/BW \times 1/AT_{NC}$
		EV	Event Frequency	1	event/day	EPA, 2004	
		EF	Exposure Frequency	350	days/year	EPA, 2002	DA_{EVENT} Calculations
		ED	Exposure Duration	6	years	EPA, 2002	if $t_{event} \le t^*$, then DA_{EVENT} (Organic) =
		BW	Body Weight	15	kg	EPA, 1997	$2\ FA \times K_p \times C_w \times CF_1 \times CF_2 \times \sqrt{(6\tau_{event} \times t_{event}/\pi)}$
		AT_{NC}	Averaging Time (Non-Cancer)	2,190	days	Calculated	
		FA	Fraction Absorbed Water	See Table 7	unitless	EPA, 2004	otherwise if $t_{event} > t^*$, then DA_{EVENT} (Organic) =
		K_p	Dermal Permeability Coefficient	See Table 7	cm/hour	EPA, 2004	$FA \times K_p \times C_w \times CF_1 \times CF_2 \times$
		C_w	Chemical Concentration in Water	COPC-specific	µg/L	Calculated	$[((t_{event})/(1+B)) + 2\tau_{event}((1 + 3B + 3B^2)/(1+B)^2)$
		CF_1	Conversion Factor	0.001	mg/µg	-----	
		CF_2	Conversion Factor	0.001	L/cm^3	-----	DA_{EVENT} (Inorganic) =
		B	Ratio of Permeability Coefficient	See Table 7	unitless	EPA, 2004	$K_p \times C_w \times CF_1 \times CF_2 \times t_{event}$
		t*	Time to Reach Steady State	See Table 7	hour	EPA, 2004	
		t_{event}	Lag Time Per Event	See Table 7	hr/event	EPA, 2004	
		t_{event}	Event Duration	1	hr/event	EPA, 2004	
Dermal	Tapwater	SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2004	Dermally Absorbed Dose (DAD) (mg/kg-day) =
Adult (Noncancer)	While Showering	DA_{EVENT}	Absorbed Dose Per Event	See Table 7	mg/cm^2-event	EPA, 2004	$DA_{EVENT} \times EV \times SA \times EF \times ED \times 1/BW \times 1/AT_{NC}$
		EV	Event Frequency	1	event/day	EPA, 2004	
		EF	Exposure Frequency	350	days/year	EPA, 2002	DA_{EVENT} Calculations
		ED	Exposure Duration	24	years	EPA, 2002	if $t_{event} \le t^*$, then DA_{EVENT} (Organic) =
		BW	Body Weight	70	kg	EPA, 1997	$2\ FA \times K_p \times C_w \times CF_1 \times CF_2 \times \sqrt{(6\tau_{event} \times t_{event}/\pi)}$
		AT_{NC}	Averaging Time (Non-Cancer)	8,760	days	Calculated	
		FA	Fraction Absorbed Water	See Table 7	unitless	EPA, 2004	otherwise if $t_{event} > t^*$, then DA_{EVENT} (Organic) =
		K_p	Dermal Permeability Coefficient	See Table 7	cm/hour	EPA, 2004	$FA \times K_p \times C_w \times CF_1 \times CF_2 \times$
		C_w	Chemical Concentration in Water	COPC-specific	µg/L	Calculated	$[((t_{event})/(1+B)) + 2\tau_{event}((1 + 3B + 3B^2)/(1+B)^2)$
		CF_1	Conversion Factor	0.001	mg/µg	-----	
		CF_2	Conversion Factor	0.001	L/cm^3	-----	DA_{EVENT} (Inorganic) =
		B	Ratio of Permeability Coefficient	See Table 7	unitless	EPA, 2004	$K_p \times C_w \times CF_1 \times CF_2 \times t_{event}$
		t*	Time to Reach Steady State	See Table 7	hour	EPA, 2004	
		t_{event}	Lag Time Per Event	See Table 7	hr/event	EPA, 2004	
		t_{event}	Event Duration	0.58	hr/event	EPA, 2004	

Table 5
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure - Groundwater - Resident
Fort Drum Gasoline Alley Facility
Fort Drum, NY

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Receptor Population: Residents
Receptor Age: Child/Adult

Exposure Route	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Tapwater	E	Inhalation Exposure per Shower	See Tables 8 through 15	mg/kg/day	Calculated	Exposure Concentration (EC)(mg/m^3) =
Adult	While Showering	BW	Body Weight	70	kg	EPA, 1989	E x BW x CF1 x 1/VR x CF2 x EF x ED x 1/AT
		CF1	Conversion Factor	1.00E+03	L/m^3	-----	
		VR	Ventilation Rate	1.50E+01	L/minute	Foster and Chrostowski, 1987	
		CF2	Conversion Factor	6.94E-04	d/min	-----	
		EF	Exposure Frequency	350	days/year	EPA, 2002	
		ED	Exposure Duration	24	years	EPA, 2002	
		AT-C	Averaging Time (Cancer)	25,550	hours	EPA, 2009b	
		AT-NC	Averaging Time (Non-Cancer)	8,760	hours	EPA, 2009b	

Table 6

Age-Adjusted Absorbed Dose per Event (DA_{event}) Calculations[a]
Fort Drum Gasoline Alley Facility - Area 1395
Fort Drum, NY

COPC	EPC[b] (µg/L)	EPC[b] (mg/cm^3)	FA (unitless)	K_p (cm/hr)	τ_{event} (hr/event)	B (unitless)	t^* (hr)	DA_{event} (mg/cm^2-event)[c] Age-Adjusted
1,2,4-Trimethylbenzene	5.54E+01	5.54E-05	1.0 [d]	1.05E-01 [e]	4.95E-01 [f]	4.43E-01 [g]	1.19E+00	9.20E-06
1,3,5-Trimethylbenzene	1.33E+01	1.33E-05	1.0 [d]	6.08E-02 [e]	4.95E-01 [f]	2.57E-01 [g]	1.19E+00	1.28E-06
Ethylbenzene	8.10E+00	8.10E-06	1.0	4.90E-02	4.20E-01	2.00E-01	1.01E+00	5.78E-07
Isopropylbenzene	7.90E+00	7.90E-06	1.0 [d]	8.76E-02 [e]	4.95E-01 [f]	3.69E-01 [g]	1.19E+00	1.09E-06
m,p-Xylene	4.67E+01	4.67E-05	1.0	5.30E-02	4.20E-01	2.00E-01	1.01E+00	3.60E-06
Methane	2.16E+03	2.16E-03	1.0 [d]	6.75E-03 [e]	1.29E-01 [f]	1.04E-02 [g]	3.10E-01	1.36E-05
Naphthalene	5.50E+00	5.50E-06	1.0	4.70E-02	5.60E-01	2.00E-01	1.34E+00	4.34E-07
n-Propylbenzene	8.20E+00	8.20E-06	1.0 [d]	9.17E-02 [e]	4.95E-01 [f]	3.87E-01 [g]	1.19E+00	1.19E-06
o-Xylene	1.19E+01	1.19E-05	1.0	5.30E-02	4.20E-01	2.00E-01	1.01E+00	9.18E-07
Xylene (total)	5.87E+01	5.87E-05	1.0	5.30E-02	4.20E-01	2.00E-01	1.01E+00	4.53E-06
Iron	7.67E+03	7.67E-03	NA	1.00E-03	NA	NA	NA	5.06E-06
Manganese	2.80E+03	2.80E-03	NA	1.00E-03	NA	NA	NA	1.85E-06

[a] EPA, 2004
[b] See Table 3
[c] t_{event} was age-adjusted assuming t_{event} of 1 for 6 years and t_{event} 0.58 for 24 years. Adjusted value equals 0.66.
[d] In the absence of chemical-specific data, the FA was conservatively assumed to be 1.
[e] Calculated based on Equation 3.8 in EPA, 2004.
[f] Calculated based on Equation A.4 in EPA, 2004.
[g] Calculated based on Equation A.1 in EPA, 2004.

B = Ratio of the permeability coefficient of a COPC through the stratum corneum relative to its permeability coefficient across the viable epidermis.
FA = Fraction absorbed.
K_p = Dermal permeability coefficient.
NA = Not applicable.
τ_{event} = Lag time per event.
t^* = Time to reach steady-state.

Table 7

Child and Adult Absorbed Dose per Event (DA_{event}) Calculations[a]
Fort Drum Gasoline Alley Facility - Area 1395
Fort Drum, NY

COPC	EPC[b] (µg/L)	EPC[b] (mg/cm^3)	FA (unitless)	K_p (cm/hr)	τ_{event} (hr/event)	B (unitless)	t^* (hr)	DA_{event} (mg/cm^2-event)[c] Child	DA_{event} (mg/cm^2-event)[c] Adult
1,2,4-Trimethylbenzene	5.54E+01	5.54E-05	1.0 [d]	1.05E-01 [e]	4.95E-01 [f]	4.43E-01 [g]	1.19E+00	1.13E-05	8.62E-06
1,3,5-Trimethylbenzene	1.33E+01	1.33E-05	1.0 [d]	6.08E-02 [e]	4.95E-01 [f]	2.57E-01 [g]	1.19E+00	1.57E-06	1.20E-06
Ethylbenzene	8.10E+00	8.10E-06	1.0	4.90E-02	4.20E-01	2.00E-01	1.01E+00	7.11E-07	5.42E-07
Isopropylbenzene	7.90E+00	7.90E-06	1.0 [d]	8.76E-02 [e]	4.95E-01 [f]	3.69E-01 [g]	1.19E+00	1.35E-06	1.02E-06
m,p-Xylene	4.67E+01	4.67E-05	1.0	5.30E-02	4.20E-01	2.00E-01	1.01E+00	4.43E-06	3.38E-06
Methane	2.16E+03	2.16E-03	1.0 [d]	6.75E-03 [e]	1.29E-01 [f]	1.04E-02 [g]	3.10E-01	1.85E-05	1.24E-05
Naphthalene	5.50E+00	5.50E-06	1.0	4.70E-02	5.60E-01	2.00E-01	1.34E+00	5.35E-07	4.07E-07
n-Propylbenzene	8.20E+00	8.20E-06	1.0 [d]	9.17E-02 [e]	4.95E-01 [f]	3.87E-01 [g]	1.19E+00	1.46E-06	1.11E-06
o-Xylene	1.19E+01	1.19E-05	1.0	5.30E-02	4.20E-01	2.00E-01	1.01E+00	1.13E-06	8.61E-07
Xylene (total)	5.87E+01	5.87E-05	1.0	5.30E-02	4.20E-01	2.00E-01	1.01E+00	5.57E-06	4.25E-06
Iron	7.67E+03	7.67E-03	NA	1.00E-03	NA	NA	NA	7.67E-06	4.45E-06
Manganese	2.80E+03	2.80E-03	NA	1.00E-03	NA	NA	NA	2.80E-06	1.62E-06

[a] EPA, 2004
[b] See Table 3
[c] Calculated based on Equation 3.2 or 3.3 for organics and Equation 3.4 for inorganics in EPA, 2004a where t_{event} equals 1.0 for children and 0.58 for adults.
[d] In the absence of chemical-specific data, the FA was conservatively assumed to be 1.
[e] Calculated based on Equation 3.8 in EPA, 2004.
[f] Calculated based on Equation A.4 in EPA, 2004.
[g] Calculated based on Equation A.1 in EPA, 2004.

B = Ratio of the permeability coefficient of a COPC through the stratum corneum relative to its permeability coefficient across the viable epidermis.
FA = Fraction absorbed.
K_p = Dermal permeability coefficient.
NA = Not applicable.
τ_{event} = Lag time per event.
t^* = Time to reach steady-state.

Table 8

Inhalation Exposure Per Shower (E)
Fort Drum Gasoline Alley Facility – Area 1395
Fort Drum, NY

$$E = \frac{VR \times S}{BW \times R \times 10^{6}} \times \frac{D_S + \exp(-R \times D_T)}{R - \frac{\exp[R \times (D_S - D_T)]}{R}}$$

Parameter	Definition	Value	Reference
E	Inhalation exposure per shower ($\mu g/m^3$).		
VR	Ventilation rate (L/minute).	15	Foster and Chrostowski, 1987
S	Indoor VOC generation rate ($\mu g/m^3$-minute).	Calculated	See Table 9
BW	Body weight (kg).	70	EPA, 1989
R	Air exchange rate ($minute^{-1}$).	90	Foster and Chrostowski, 1987; upper-bound value
CF	Conversion factor.	10^6	Foster and Chrostowski, 1987
Ds	Shower duration (minute).	34.8	EPA, 1997; RME value

Table 9

Indoor VOC Generation Rate (S)
Fort Drum Gasoline Alley Facility – Area 1395
Fort Drum, NY

$$S = \frac{C_{WD} \times FR}{SV}$$

Parameter	Definition	Value	Reference
S	Indoor VOC generation rate (µg/m^3-minute).		
C_{WD}	Concentration leaving shower droplet after time t_s (µg/L).	Calculated	See Table 10
FR	Indoor shower water flow rate (L/minute).	10	Foster and Chrostowski, 1987
SV	Shower room air volume (m^3).	12	Professional Judgement

Table 10

Concentration Leaving Shower Droplet After Time T_S (C_{WD})
Fort Drum Gasoline Alley Facility – Area 1395
Fort Drum, NY

$$C_{WD} = C_{WO} \times \left(1 - \exp\left(-\frac{K_{aL} \times t_s}{60 \times d}\right)\right)$$

Parameter	Definition	Value	Reference
C_{WD}	Concentration leaving shower droplet after time t_s (µg/L).		
C_{WO}	Shower water concentration (µg/L).	COPC-Specific	See Table 3
K_{aL}	Adjusted overall mass transfer coefficient (cm/hr).	Calculated	See Table 11
t_s	Shower droplet drop time (seconds).	0.5	Foster and Chrostowski, 2003
d	Shower droplet diameter (mm).	1	Foster and Chrostowski, 1987

Table 11

Adjusted Overall Mass Transfer Coefficient (Ka_L)
Fort Drum Gasoline Alley Facility – Area 1395
Fort Drum, NY

$$K_{aL} = K_L \times \left(\frac{T_1 \times \mu_s}{T_s \times \mu_1} \right)^{-0.5}$$

Parameter	Definition	Value	Reference
Ka_L	Adjusted overall mass transfer coefficient (cm/hr).		
K_L	Overall mass transfer coeeficient (cm/hr).	Calculated	See Table 12
T_1	Calibration water temperature of K_L (K).	293	Foster and Chrostowski, 1987
μ_s	Water viscosity at T_s (cp).	0.59	Foster and Chrostowski, 1987
T_s	Shower water temperature (K).	318	Foster and Chrostowski, 1987; upper-bound value
μ_1	Water viscosity at T_1 (cp).	1.002	Foster and Chrostowski, 2003

Table 12

Overall Mass Transfer Coefficient (K_L)
Fort Drum Gasoline Alley Facility – Area 1395
Fort Drum, NY

$$K_L = \left(\frac{1}{k_{l(VOC)}} + \frac{R \times T}{H \times k_{g(VOC)}} \right)^{-1}$$

Parameter	Definition	Value	Reference
K_L	Overall mass transfer coefficient (cm/hr).		
$k_{l\,(VOC)}$	Liquid-film mass transfer coefficient for VOC (cm/hr).	Calculated; COPC-Specific	See Table 13
R	Gas constant (atm-m^3/mol-K).	0.000082	Foster and Chrostowski, 1987
T	Absolute temperature (K).	293	Foster and Chrostowski, 1987
H	Henry's law constant (atm-m^3/mol).	COPC-Specific	See Table 15
$k_{g\,(VOC)}$	Gas-film mass transfer coefficient for VOC (cm/hr).	Calculated; COPC-Specific	See Table 14

Table 13

Liquid-Film Mass Transfer Coefficient ($k_{l\,(VOC)}$)
Fort Drum Gasoline Alley Facility – Area 1395
Fort Drum, NY

$$k_{l\,(VOC)} = k_{l(CO_2)} \times \left(\frac{44}{MW_{VOC}} \right)^{0.5}$$

Parameter	Definition	Value	Reference
$k_{l\,(VOC)}$	Liquid-film mass transfer coefficient for VOC (cm/hr).		
$k_{l\,(CO2)}$	Liquid-film mass transfer coefficient for CO_2(cm/hr).	20	Foster and Chrostowski, 1987
MW_{VOC}	Molecular weight of VOC (g/mol).	COPC-Specific	See Table 15

Table 14

Gas-Film Mass Transfer Coefficient ($kg_{(VOC)}$)
Fort Drum Gasoline Alley Facility – Area 1395
Fort Drum, NY

$$k_{g\,(VOC)} = k_{g(H_2O)} \times \left(\frac{18}{MW_{VOC}} \right)^{0.5}$$

Parameter	Definition	Value	Reference
$K_{g\,(VOC)}$	Gas-film mass transfer coefficient for VOC (cm/hr).		
$kg_{(H2O)}$	Gas-film mass transfer coefficient for H_2O (cm/hr).	3,000	Foster and Chrostowski, 1987
MW_{VOC}	Molecular weight of VOC (g/mol).	COPC-Specific	See Table 15

Table 15

COPC-Specific Henry's Law Constant (H) and Molecular Weight (MW)
Fort Drum Gasoline Alley Facility – Area 1395
Fort Drum, NY

COPC	H ($atm\text{-}m^3/mol$)	MW (g/mol)
1,2,4-Trimethylbenzene	6.2E-03 (HSDB, 2010)	120.191 (HSDB, 2010)
1,3,5-Trimethylbenzene	8.8E-03 (HSDB, 2010)	120.191 (HSDB, 2010)
Ethylbenzene	7.9E-03 (HSDB, 2010)	106.16 (HSDB, 2010)
Isopropylbenzene	1.2E-02 (HSDB, 2010)	120.19 (HSDB, 2010)
m,p-Xylene	6.6E-03 (HSDB, 2010)	106.17 (HSDB, 2010)
Methane	6.6E-01 (HSDB, 2010)	16.04 (HSDB, 2010)
Naphthalene	4.4E-04 (HSDB, 2010)	128.17 (HSDB, 2010)
n-Propylbenzene	1.1E-02 (HSDB, 2010)	120.19 (HSDB, 2010)
o-Xylene	5.2E-03 (HSDB, 2010)	106.16 (HSDB, 2010)
Xylenes	6.6E-03 (HSDB, 2010)	106.17 (HSDB, 2010)

Table 16
Noncancer Toxicity Data - Oral and Dermal
Fort Drum Gasoline Alley Facility - Area 1395
Fort Drum, NY

COPC	Oral RfD Value	Oral RfD Units	GI_{abs} Oral Absorption Efficiency for Dermal[a]	Dermal RfD[a] Value	Dermal RfD[a] Units	Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	Source(s)	Date(s)[b]
1,2,4-Trimethylbenzene	NA	---	---	NA	---	---	---	---	---
1,3,5-Trimethylbenzene	1.00E-02	(mg/kg-day)	1.0	1.00E-02	(mg/kg-day)	Liver	10,000	PPRTV	9/9/2010
Ethylbenzene	1.00E-01	mg/kg/day	1.0	1.00E-01	(mg/kg-day)	Liver, Kidney	1,000	IRIS	6/8/2011
Isopropylbenzene	1.00E-01	mg/kg/day	1.0	1.00E-01	(mg/kg-day)	Kidney	1,000	IRIS	6/8/2011
m,p-Xylene	2.00E-01	(mg/kg-day)	1.0	2.00E-01	(mg/kg-day)	Body Weight, Mortality	1,000	IRIS	6/8/2011
Methane	NA	---	---	NA	---	---	---	---	---
Naphthalene	2.00E-02	(mg/kg-day)	1.0	2.00E-02	(mg/kg-day)	Body Weight	3,000	IRIS	6/8/2011
n-Propylbenzene	1.00E-01	(mg/kg-day)	1.0	1.00E-01	(mg/kg-day)	Liver, Kidney	1,000	PPRTV	2/9/2004
o-Xylene	2.00E-01	(mg/kg-day)	1.0	2.00E-01	(mg/kg-day)	Body Weight, Mortality	1,000	IRIS	6/8/2011
Xylene (total)	2.00E-01	(mg/kg-day)	1.0	2.00E-01	(mg/kg-day)	Body Weight, Mortality	1,000	IRIS	6/8/2011
Iron	7.00E-01	(mg/kg-day)	1.0	7.00E-01	(mg/kg-day)	Gastrointestinal	1.5	PPRTV	9/6/2011
Manganese	2.40E-02	(mg/kg-day)	0.04	9.60E-04	(mg/kg-day)	Nervous System	1	IRIS	6/8/2011

[a]Source: EPA, 2004.

[b]Represents date source was searched.

Definitions: IRIS=Integrated Risk Information System
NA=Not available
PPRTV=Provisional Peer-Reviewed Toxicity Value
RfD=Reference dose

Table 17
Noncancer Toxicity Data - Inhalation
Fort Drum Gasoline Alley Facility - Area 1395
Fort Drum, NY

COPC	Inhalation RfC Value	Inhalation RfC Units	Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	Source(s)	Date(s)[a]
1,2,4-Trimethylbenzene	7.00E-03	mg/m^3	Blood	3,000	PPRTV	6/7/2011
1,3,5-Trimethylbenzene	NA	---	---	---	---	---
Ethylbenzene	1.00E+00	mg/m^3	Developmental	300	IRIS	6/8/2011
Isopropylbenzene	4.00E-01	mg/m^3	Kidney, Endocrine	1,000	IRIS	6/8/2011
m,p-Xylene	1.00E-01	mg/m^3	Nervous System	300	IRIS	6/8/2011
Methane	NA	---	---	---	---	---
Naphthalene	3.00E-03	mg/m^3	Respiratory System	3,000	IRIS	6/8/2011
n-Propylbenzene	1.00E+00	mg/m^3	Developmental	300	PPRTV	2/9/2004
o-Xylene	1.00E-01	mg/m^3	Nervous System	300	IRIS	6/8/2011
Xylene (total)	1.00E-01	mg/m^3	Nervous System	300	IRIS	6/8/2011

[a]Represents date source was searched.

Definitions: IRIS=Integrated Risk Information System
NA=Not available
PPRTV=Provisional Peer-Reviewed Toxicity Value
RfC=Reference concentration

Table 18
Cancer Toxicity Data - Oral and Dermal
Fort Drum Gasoline Alley Facility - Area 1395
Fort Drum, NY

COPC	Oral CSF		GI_{abs} Oral Absorption Efficiency for Dermal[a]	Dermal CSF[a]		Weight of Evidence/ Cancer Guideline Description	Source(s)	Date(s)[b]
	Value	Units		Value	Units			
1,2,4-Trimethylbenzene	NA	---	---	NA	---	---	---	---
1,3,5-Trimethylbenzene	NA	---	---	NA	---	---	---	---
Ethylbenzene	1.10E-02	$(mg/kg\text{-}day)^{-1}$	1.0	1.10E-02	$(mg/kg\text{-}day)^{-1}$	D	CalEPA	6/8/2011
Isopropylbenzene	NA	---	---	NA	---	D	IRIS	6/8/2011
m,p-Xylene	NA	---	---	NA	---	Inadequate information to assess	IRIS	6/8/2011
Methane	NA	---	---	NA	---	---	---	---
Naphthalene	NA	---	---	NA	---	C	IRIS	6/8/2011
n-Propylbenzene	NA	---	---	NA	---	---	---	---
o-Xylene	NA	---	---	NA	---	Inadequate information to assess	IRIS	6/8/2011
Xylene (total)	NA	---	---	NA	---	Inadequate information to assess	IRIS	6/8/2011
Iron	NA	---	---	NA	---	---	---	---
Manganese	NA	---	---	NA	---	D	IRIS	6/8/2011

[a]Source: EPA, 2004.
[b]Represents date source was searched

Definitions: C - Possible human carcinogen.
D - Not classified as to human carcinogenicity.
CalEPA=California Environmental Protection Agency
CSF = Cancer slope factor
IRIS=Integrated Risk Information System
NA=Not available

Table 19
Cancer Toxicity Data - Inhalation
Fort Drum Gasoline Alley Facility - Area 1395
Fort Drum, NY

COPC	Unit Risk Value	Unit Risk Units	Weight of Evidence/ Cancer Guideline Description	Source(s)	Date(s)[a]
1,2,4-Trimethylbenzene	NA	---	---	---	---
1,3,5-Trimethylbenzene	NA	---	---	---	---
Ethylbenzene	2.50E-06	$(\mu g/m^3)^{-1}$	D	CalEPA	6/8/2011
Isopropylbenzene	NA	---	D	IRIS	6/8/2011
m,p-Xylene	NA	---	Inadequate information to assess	IRIS	6/8/2011
Methane	NA	---	---	---	---
Naphthalene	3.40E-05	$(\mu g/m^3)^{-1}$	C	CalEPA	6/8/2011
n-Propylbenzene	NA	---	---	---	---
o-Xylene	NA	---	Inadequate information to assess	IRIS	6/8/2011
Xylene (total)	NA	---	Inadequate information to assess	IRIS	6/8/2011

[a]Represents date source was searched.

Definitions: C - Possible human carcinogen.
D - Not classifiable as a human carcinogen.
CalEPA=California Environmental Protection Agency
IRIS = Integrated Risk Information System.
NA = Not available.

Table 20

ısonable Maximum Exposure Doses and Cancer Risks for Indoor Worker Exposure to 2011 Groundw
Fort Drum Gasoline Alley Facility - Area 139
Fort Drum, NY

COPC	EPC (µg/L)	Cancer		
		Exposure Dose		Cancer Risk
		Tapwater Ingestion (mg/kg-day)	Oral CSF $(mg/kg\text{-}day)^{-1}$	Tapwater Ingestion
1,2,4-Trimethylbenzene	5.54E+01	1.94E-04	NA	NA
1,3,5-Trimethylbenzene	1.33E+01	4.65E-05	NA	NA
Ethylbenzene	8.10E+00	2.83E-05	1.10E-02	3.1E-07
Isopropylbenzene	7.90E+00	2.76E-05	NA	NA
m,p-Xylene	4.67E+01	1.63E-04	NA	NA
Methane	2.16E+03	7.55E-03	NA	NA
Naphthalene	5.50E+00	1.92E-05	NA	NA
n-Propylbenzene	8.20E+00	2.87E-05	NA	NA
o-Xylene	1.19E+01	4.16E-05	NA	NA
Xylene (total)	5.87E+01	2.05E-04	NA	NA
Iron	7.67E+03	2.68E-02	NA	NA
Manganese	2.80E+03	9.78E-03	NA	NA
			Total	**3.1E-07**

Table 21

Reasonable Maximum Exposure Doses and Hazard Quotients for Indoor Worker Exposure to 2011 Groundwater
Fort Drum Gasoline Alley Facility - Area 1395
Fort Drum, NY

		Noncancer			
		Exposure Dose			Hazard Quotient
COPC	EPC (µg/L)	Tapwater Ingestion (mg/kg-day)	Oral RfD (mg/kg-day)	Primary Target Organ	Tapwater Ingestion
1,2,4-Trimethylbenzene	5.54E+01	5.42E-04	NA	---	NA
1,3,5-Trimethylbenzene	1.33E+01	1.30E-04	1.00E-02	Liver	0.013
Ethylbenzene	8.10E+00	7.93E-05	1.00E-01	Liver, Kidney	0.00079
Isopropylbenzene	7.90E+00	7.73E-05	1.00E-01	Kidney	0.00077
m,p-Xylene	4.67E+01	4.57E-04	2.00E-01	Body Weight, Mortality	0.0023
Methane	2.16E+03	2.11E-02	NA	---	NA
Naphthalene	5.50E+00	5.38E-05	2.00E-02	Body Weight	0.0027
n-Propylbenzene	8.20E+00	8.02E-05	1.00E-01	Liver, Kidney	0.00080
o-Xylene	1.19E+01	1.16E-04	2.00E-01	Body Weight, Mortality	0.00058
Xylene (total)	5.87E+01	5.74E-04	2.00E-01	Body Weight, Mortality	0.0029
Iron	7.67E+03	7.50E-02	7.00E-01	Gastrointestinal	0.11
Manganese	2.80E+03	2.74E-02	2.40E-02	Nervous System	1.1
				Total	**1.3**
				Total Liver HI	**0.015**
				Total Kidney HI	**0.0024**
				Total Body Weight HI	**0.0084**
				Total Mortality HI	**0.0057**
				Total Gastrointestinal HI	**0.11**
				Total Nervous System HI	**1.1**

Table 22

Reasonable Maximum Exposure Doses and Cancer Risks for Residential Exposure to 2011 Groundwater - Ingestion and Dermal Contact
Fort Drum Gasoline Alley Facility - Area 1395
Fort Drum, NY

		Cancer						
		Age-Adjusted Exposure Doses				Age-Adjusted Cancer Risks		
COPC	EPC (µg/L)	Tapwater Ingestion (mg/kg-day)	Dermal Contact (mg/kg-day)	Oral CSF $(mg/kg\text{-}day)^{-1}$	Dermal CSF $(mg/kg\text{-}day)^{-1}$	Tapwater Ingestion	Dermal Contact	Total
1,2,4-Trimethylbenzene	5.54E+01	8.24E-04	1.11E-03	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	1.33E+01	1.98E-04	1.54E-04	NA	NA	NA	NA	NA
Ethylbenzene	8.10E+00	1.20E-04	6.97E-05	1.10E-02	1.10E-02	1.3E-06	7.7E-07	2.1E-06
Isopropylbenzene	7.90E+00	1.17E-04	1.32E-04	NA	NA	NA	NA	NA
m,p-Xylene	4.67E+01	6.95E-04	4.35E-04	NA	NA	NA	NA	NA
Methane	2.16E+03	3.21E-02	1.64E-03	NA	NA	NA	NA	NA
Naphthalene	5.50E+00	8.18E-05	5.24E-05	NA	NA	NA	NA	NA
n-Propylbenzene	8.20E+00	1.22E-04	1.43E-04	NA	NA	NA	NA	NA
o-Xylene	1.19E+01	1.77E-04	1.11E-04	NA	NA	NA	NA	NA
Xylene (total)	5.87E+01	8.73E-04	5.47E-04	NA	NA	NA	NA	NA
Iron	7.67E+03	1.14E-01	6.11E-04	NA	NA	NA	NA	NA
Manganese	2.80E+03	4.16E-02	2.23E-04	NA	NA	NA	NA	NA
					Total	**1.3E-06**	**7.7E-07**	**2.1E-06**

Table 23

Reasonable Maximum Exposure Doses and Cancer Risks for Residential Exposure to 2011 Groundwater
Inhalation
Fort Drum Gasoline Alley Facility - Area 139
Fort Drum, NY

		Cancer		
		Adult Exposure Concentrations		Cancer Risks
COPC	EPC (µg/L)	Inhalation (mg/m^3)	URF $(\mu g/m^3)^{-1}$	Inhalation
1,2,4-Trimethylbenzene	5.54E+01	5.01E-07	NA	NA
1,3,5-Trimethylbenzene	1.33E+01	1.22E-07	NA	NA
Ethylbenzene	8.10E+00	7.82E-08	2.50E-06	2.0E-10
Isopropylbenzene	7.90E+00	7.26E-08	NA	NA
m,p-Xylene	4.67E+01	4.48E-07	NA	NA
Methane	2.16E+03	4.95E-05	NA	NA
Naphthalene	5.50E+00	3.27E-08	3.40E-05	1.1E-09
n-Propylbenzene	8.20E+00	7.53E-08	NA	NA
o-Xylene	1.19E+01	1.13E-07	NA	NA
Xylene (total	5.87E+01	5.64E-07	NA	NA
			Total	**1.3E-09**

Table 24

Reasonable Maximum Exposure Doses and Hazard Quotients for Residential Exposure to 2011 Groundwater - Ingestion and Dermal Contact
Fort Drum Gasoline Alley Facility - Area 1395
Fort Drum, NY

		Noncancer							
		Child Exposure Doses					Child Hazard Quotients		
COPC	EPC (µg/L)	Tapwater Ingestion (mg/kg-day)	Dermal Contact (mg/kg-day)	Oral RfD (mg/kg-day)	Dermal RfD (mg/kg-day)	Primary Target Organ	Tapwater Ingestion	Dermal Contact	Hazard Index
1,2,4-Trimethylbenzene	5.54E+01	3.54E-03	4.78E-03	NA	NA	---	NA	NA	NA
1,3,5-Trimethylbenzene	1.33E+01	8.50E-04	6.64E-04	1.00E-02	1.00E-02	Liver	0.085	0.066	0.15
Ethylbenzene	8.10E+00	5.18E-04	3.00E-04	1.00E-01	1.00E-01	Liver, Kidney	0.0052	0.0030	0.0082
Isopropylbenzene	7.90E+00	5.05E-04	5.68E-04	1.00E-01	1.00E-01	Kidney	0.0051	0.0057	0.011
m,p-Xylene	4.67E+01	2.99E-03	1.87E-03	2.00E-01	2.00E-01	Body Weight, Mortality	0.015	0.0094	0.024
Methane	2.16E+03	1.38E-01	7.83E-03	NA	NA	---	NA	NA	NA
Naphthalene	5.50E+00	3.52E-04	2.26E-04	2.00E-02	2.00E-02	Body Weight	0.018	0.011	0.029
n-Propylbenzene	8.20E+00	5.24E-04	6.17E-04	1.00E-01	1.00E-01	Liver, Kidney	0.0052	0.0062	0.011
o-Xylene	1.19E+01	7.61E-04	4.77E-04	2.00E-01	2.00E-01	Body Weight, Mortality	0.0038	0.0024	0.0062
Xylene (total)	5.87E+01	3.75E-03	2.35E-03	2.00E-01	2.00E-01	Body Weight, Mortality	0.019	0.012	0.031
Iron	7.67E+03	4.90E-01	3.24E-03	7.00E-01	7.00E-01	Gastrointestinal	0.70	0.0046	0.71
Manganese	2.80E+03	1.79E-01	1.18E-03	2.40E-02	9.60E-04	Nervous System	7.5	1.2	8.7
								Total	**9.7**
								Total Liver HI	**0.17**
								Total Kidney HI	**0.030**
								Total Body Weight HI	**0.090**
								Total Mortality HI	**0.061**
								Total Gastrointestinal HI	**0.71**
								Total Nervous System HI	**8.7**

Table 25

Reasonable Maximum Exposure Doses and Hazard Quotients for Residential Exposure to 2011 Groundwater - Ingestion and Dermal Contact
Fort Drum Gasoline Alley Facility - Area 1395
Fort Drum, NY

		Noncancer							
		Adult Exposure Doses					Adult Hazard Quotients		
COPC	EPC (µg/L)	Tapwater Ingestion (mg/kg-day)	Dermal Contact (mg/kg-day)	Oral RfD (mg/kg-day)	Dermal RfD (mg/kg-day)	Primary Target Organ	Tapwater Ingestion	Dermal Contact	Hazard Index
1,2,4-Trimethylbenzene	5.54E+01	1.52E-03	2.13E-03	NA	NA	---	NA	NA	NA
1,3,5-Trimethylbenzene	1.33E+01	3.64E-04	2.95E-04	1.00E-02	1.00E-02	Liver	0.036	0.030	0.066
Ethylbenzene	8.10E+00	2.22E-04	1.34E-04	1.00E-01	1.00E-01	Liver, Kidney	0.0022	0.0013	0.0036
Isopropylbenzene	7.90E+00	2.16E-04	2.53E-04	1.00E-01	1.00E-01	Kidney	0.0022	0.0025	0.0047
m,p-Xylene	4.67E+01	1.28E-03	8.33E-04	2.00E-01	2.00E-01	Body Weight, Mortality	0.0064	0.0042	0.011
Methane	2.16E+03	5.92E-02	3.06E-03	NA	NA	---	NA	NA	NA
Naphthalene	5.50E+00	1.51E-04	1.00E-04	2.00E-02	2.00E-02	Body Weight	0.0075	0.0050	0.013
n-Propylbenzene	8.20E+00	2.25E-04	2.75E-04	1.00E-01	1.00E-01	Liver, Kidney	0.0022	0.0027	0.0050
o-Xylene	1.19E+01	3.26E-04	2.12E-04	2.00E-01	2.00E-01	Body Weight, Mortality	0.0016	0.0011	0.0027
Xylene (total)	5.87E+01	1.61E-03	1.05E-03	2.00E-01	2.00E-01	Body Weight, Mortality	0.0080	0.0052	0.013
Iron	7.67E+03	2.10E-01	1.10E-03	7.00E-01	7.00E-01	Gastrointestinal	0.30	0.0016	0.30
Manganese	2.80E+03	7.67E-02	4.00E-04	2.40E-02	9.60E-04	Nervous System	3.2	0.42	3.6
								Total	**4.0**
								Total Liver HI	**0.075**
								Total Kidney HI	**0.013**
								Total Body Weight HI	**0.039**
								Total Mortality HI	**0.027**
								Total Gastrointestinal HI	**0.30**
								Total Nervous System HI	**3.6**

Table 26

Reasonable Maximum Exposure Doses and Hazrd Quotients for Residential Exposure to 2011 Groundwater - Inhalation
Fort Drum Gasoline Alley Facility - Area 139
Fort Drum, NY

		Noncancer			
		Adult Exposure Concentrations			Hazard Quotients
COPC	EPC (µg/L)	Inhalation (mg/m^3)	RfC (mg/m^3)	Target Organ	Inhalation
1,2,4-Trimethylbenzene	5.54E+01	1.46E-06	7.00E-03	Blood	0.00021
1,3,5-Trimethylbenzene	1.33E+01	3.54E-07	NA	---	NA
Ethylbenzene	8.10E+00	2.28E-07	1.00E+00	Developmenta	0.00000023
Isopropylbenzene	7.90E+00	2.12E-07	4.00E-01	Kidney, Endocrine	0.00000053
m,p-Xylene	4.67E+01	1.31E-06	1.00E-01	Nervous System	0.000013
Methane	2.16E+03	1.44E-04	NA	---	NA
Naphthalene	5.50E+00	9.53E-08	3.00E-03	Respiratory System	0.000032
n-Propylbenzene	8.20E+00	2.19E-07	1.00E+00	Developmenta	0.00000022
o-Xylene	1.19E+01	3.30E-07	1.00E-01	Nervous System	0.0000033
Xylene (total	5.87E+01	1.64E-06	1.00E-01	Nervous System	0.000016
				Total	**0.00027**
				Total Blood HI	**0.00021**
				Total Developmental HI	**0.00000045**
				Total Kidney HI	**0.00000053**
				Total Endocrine HI	**0.00000053**
				Total Nervous System HI	**0.000033**
				Total Respiratory System HI	**0.000032**