FIFTH FIVE-YEAR REVIEW REPORT FOR BUTZ LANDFILL SUPERFUND SITE MONROE COUNTY, PENNSYLVANIA

Prepared by

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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FYR	Five-Year Review
GPRA	Government Performance and Results Act
IC	Institutional Control
MCL	Maximum Contaminant Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PADEP	Pennsylvania Department of Environmental Protection
PADER	Pennsylvania Department of Environmental Resources
PAL	Project Action Limit
PCB	Polychlorinated Biphenyl
PJJWA	Pocono Jackson Joint Water Authority
PRP	Potentially Responsible Party
ROD	Record of Decision
TBC	To-Be-Considered
TCE	Trichloroethene (or Trichloroethylene)
UU/UE	Unlimited Use/Unrestricted Exposure
VOC	Volatile Organic Compound
µg/L	Micrograms per Liter

I. INTRODUCTION

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in five-year review reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP)(40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fifth FYR for the Butz Landfill Superfund Site. The triggering action for this statutory review is completion of the previous FYR on September 9, 2011. This Fifth FYR has been prepared due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

The Site consists of two Operable Units (OUs) and both OUs will be addressed in this FYR. OU1 is the water supply system EPA constructed in 1992 to serve the area affected by the Site. OU2 is contaminated groundwater at the Site.

The Butz Landfill Superfund Site Fifth Five-Year Review was led by Stephen Tyahla of EPA Region 3 with support provided by EPA technical staff and Skeo Solutions, EPA's contractor.

The review began on October 7, 2015. Appendix A lists the documents reviewed.

Site Background

The Site is located on North Road (aka Township Road 601) in Monroe County, Pennsylvania (Figure 1). The Site contains an 8.5-acre closed landfill on two parcels (totaling 13 acres) in Jackson Township and an area of groundwater contamination that extends into Pocono Township. The Site is in a rural area; the closest town is Reeders, about 1 mile south of the landfill. The terrain is relatively flat with a mixture of woods, meadows and farmland.

Landfilling operations at the Site began as early as 1965. Although the specific quantities of waste received are unknown, it is known that the 8.5-acre landfill accepted municipal waste, sewage sludge/liquids and possibly industrial wastes. An operating permit application for the landfill was submitted to the Commonwealth of Pennsylvania in 1970; the permit was denied due to insufficient technical information about the landfill site. Waste disposal continued at the landfill without a permit until late 1973 when the Commonwealth ordered it closed. The events leading to its closure in 1973 and the response actions that followed are summarized in Section II.

The landfill portion of the Site is now used for the operation and monitoring of the groundwater pump-and-treat system (Figure 2). Land use around the Site is primarily residential, recreational (e.g., fishing, hunting, skiing) and agricultural. Big Pocono State Park is less than 1,000 feet north of the Site. Camelback Mountain Resort, a skiing area, is within Big Pocono State Park.

A population of about 7,000 people lives within 3 miles of the Site. Because of the presence of various resorts and summer homes in the area, the population approximately doubles during the tourist seasons of winter and summer.

Additional background information about the Site can be found on line at https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0301833. A table of the Site's chronology is included as Appendix C.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Butz Landfill		
EPA ID: PAD981034705		
Region: 3	**State:** PA	**City/County:** Jackson Township/Monroe County
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: EPA **If "Other Federal Agency" selected above, enter Agency name:**		
Author name: Stephen Tyahla, with additional support provided by Skeo Solutions		
Author affiliation: EPA Region 3		
Review period: October 2015 – August 2016		
Date of site inspection: November 12, 2015		
Type of review: Statutory		
Review number: 5		
Triggering action date: September 9, 2011		
Due date ***(five years after triggering action date)*****:** September 9, 2016		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

Past waste disposal at the Site resulted in contamination of approximately 1.5 square miles of groundwater with TCE, which had been disposed of in the landfill. Other volatile organic compounds (VOCs) are found in the groundwater at significantly lower concentrations; some of these are likely related to the natural degradation of TCE.

The Site's groundwater contaminants of concern (COCs) are:

- Trichloroethene (TCE)
- cis-1,2-Dichloroethene
- trans-1,2-Dichloroethene
- Vinyl Chloride
- Benzene
- Ethyl benzene
- Tetrachloroethene
- Toluene
- Carbon Tetrachloride
- Chloroform
- 1,1-Dichloroethene
- Methylene Chloride (aka Dichloromethane)
- Chlorobenzene

EPA found that exposure to the Site's groundwater posed potential human health risks. EPA's risk assessment found that the Site's soil, surface water and sediments do not pose a risk to human health or the environment.

Response Actions

Initial Response. Local citizens submitted complaints about the landfill; the first documented complaints were in 1971. The Pennsylvania Department of Environmental Resources (PADER) (now known as the Pennsylvania Department of Environmental Protection [PADEP]) subsequently ordered the landfill closed due to improper operation, and required development of a surface water management plan, groundwater monitoring and a landfill cover. Waste disposal ceased at the landfill in late 1973. The landfill owners installed a soil cover in September 1973. EPA's 1991 remedial investigation found that the soil cover was about 1 foot thick.

Groundwater monitoring of local wells was performed until 1979. Field examination of the landfill and surrounding areas was again initiated by PADER in 1984. Additional soil, water and groundwater samples were collected in March, April and June of 1986. The results indicated high levels of trichloroethene (TCE) in residential wells south of the landfill, which prompted a request from PADER to EPA that the Site be considered for an emergency response action.

During July 1986, PADER and EPA initiated area-wide response activities including site inspections, public information meetings, residential well sampling, and provided bottled water and/or water treatment systems to homes with contaminated well water. Over the next several months, EPA provided

bottled water to 28 locations, and installed carbon filtration systems at 22 residences. In addition, 17 groundwater monitoring wells were installed.

In April 1987, EPA completed a study for an alternate water supply system to serve residents in the area of contaminated groundwater wells. In March 1989, three new water supply wells were drilled and the water distribution system was completed in December 1992. EPA added the Site to the National Priorities List (NPL) on March 31, 1989.

OU1: Construction of a water supply system

EPA issued a Record of Decision (ROD) in September 1990, selecting construction of a water system (i.e., three new supply wells, storage tank, and distribution lines) to provide a new source of water to the 48 residences affected by groundwater contamination emanating from the landfill. EPA's remedial action objective was to mitigate and/or prevent human exposure to currently used contaminated groundwater.

OU2: Groundwater Cleanup

EPA issued a ROD in June 1992, selecting a remedial action for the cleanup of the contaminated groundwater. EPA has also issued two Explanations of Significant Differences (ESDs). The first ESD, issued in August 1999, revised the groundwater performance standards and the locations of groundwater extraction wells. The second ESD, issued in July 2011, revised the groundwater performance standards and called for institutional controls (ICs). EPA's remedial action objective is to mitigate and/or prevent human exposure to contaminated groundwater and to return groundwater to its beneficial use as a source of drinking water.

The selected groundwater cleanup remedy, as revised by the ESDs, includes:

- Installation of wells to extract contaminated groundwater;
- Construction of a system to treat the extracted groundwater to meet the specified discharge limits;
- Compliance with air discharge limits for the groundwater treatment system;
- Discharge of treated groundwater to a local stream via a wetland;
- Operation and maintenance (O&M) of the groundwater extraction and treatment system until the performance standards are met;
- ICs to protect the installed remedies; and
- ICs to prohibit use of contaminated groundwater for drinking, bathing or any other potable use.

Table 1 presents the Site's groundwater performance standards, as revised by the ESDs. The performance standards are based on applicable or relevant and appropriate requirements (ARARs) that include drinking water maximum contaminant levels (MCLs). In addition to these performance standards, there are two risk-based performance standards. The 2011 ESD requires that the remediation of groundwater at the Site continue until: (1) the ARAR-based performance standards for individual contaminants are achieved; (2) the cumulative risk presented by all remaining site-related compounds in the groundwater is at or below the $1x10^{-4}$ cancer risk level; and (3) the non-cancer hazard index for these compounds is equal to or less than 1.

Table 1: Groundwater COC ARAR-Based Performance Standards

Groundwater COC	ARAR-Based Performance Standard (micrograms per liter (µg/L))
Trichloroethene (TCE)	5
Vinyl chloride	2
cis-1,2-Dichloroethene (cis-1,2-DCE)	70
1,1-Dichloroethene (1,1-DCE)	7
trans-1,2-Dichloroethene (trans-1,2-DCE)	100
Benzene	5
Ethylbenzene	700
Tetrachloroethene	5
Toluene	1,000
Carbon tetrachloride	5
Chloroform	80
Methylene chloride	3
Chlorobenzene	55

Status of Implementation

OU1: Construction of the water supply system

EPA's contractor began construction activities for the water line on June 8, 1992, with users connected to the system by December 18, 1992. Construction was completed on June 30, 1993. Seven of the 55 properties that were part of the designed water supply system's service area declined to be connected to the system. However, since then, four of these properties have been connected and the remaining three, while still not connected, are outside the area of groundwater contamination.

The water line construction included:

- Installation of about 8 miles of ductile iron trunk line;
- Drilling and/or re-drilling of three groundwater supply wells in upgradient area not affected by groundwater contamination;
- Construction of a 75,000-gallon water storage tank and pump house;
- Realignment of a township road to provide access to the wellhead site;
- Connecting 48 service users to the water supply; and
- Grouting of formerly-used groundwater supply wells.

OU2: Groundwater Cleanup

In 1991, Jackson and Pocono Townships enacted ordinances requiring residents within the water supply system's service area to use the water system as their exclusive source of potable water, and requiring wells within the service area to be disabled. The status of the Site's institutional controls is summarized in Table 2, below.

Construction of the OU2 remedy was delayed for one year because of the discovery of a protected species, the bog turtle, near the Site. Following an on-site bog turtle investigation and several site visits with the United States Fish and Wildlife Service, EPA made design changes to the groundwater extraction and treatment system to include construction of a strip of wetlands between extraction wells EW1 and EW2, relocation of the discharge structure, and construction of about 3 acres of new wetlands at the discharge structure.

OU2 construction began on June 28, 2000. The United States Bureau of Reclamation provided oversight. The treatment system consists of the following features:

- A treatment building that houses a low-profile air stripper and a computerized control system;
- An access road to the treatment building and a road between the extraction wells, treatment building and discharge structure;
- Three extraction wells (EW1, EW2 and EW3);
- Three new monitoring wells and five retrofitted monitoring wells; and
- A treated water conveyance system and discharge structure with newly created wetlands.

On June 20, 2001, EPA issued a Preliminary Close-Out Report and declared the Site "construction complete." The pump-and-treat remedy became operational and functional on October 1, 2001.

The treatment system originally included an off-gas carbon treatment system to remove contaminants from the air effluent. In March 2007, the height of the off-gas stack was increased by 5 meters to a new height of 10 meters and the off-gas carbon treatment system was taken off-line because air modeling determined that it was no longer needed. Air samples were also collected on a semi-annual basis to evaluate off-gas concentrations and confirm that the increased discharge stack height is sufficient for reducing risk from treatment system air emissions. Semiannual ambient air samples were also collected to confirm the same.

In November 2015, the owner of the northern landfill parcel recorded an environmental covenant that (1) prohibits use of contaminated groundwater for drinking, bathing and any other potable use and (2) prohibits damaging the groundwater remedy's engineered structures (Table 2).

From 2008 to 2013, the EPA conducted a two-phase in-situ bioremediation pilot study. The objective of the pilot study was to determine whether in-situ bioremediation could shorten the time needed to clean up the Site's groundwater. The Phase I injection of vegetable oil was in April 2009; the Phase II injection was in August 2011 and used a proprietary groundwater amendment called EHC-L®. The Phase I injections were made into well EW-4 and Phase II injections were made into EW-5 (Figure 4). As part of the pilot study, the groundwater pump-and-treat system was not operated between October 2011 and October 2013, to allow more time for the injected chemicals to react with the contaminants. On October 21, 2013, the groundwater treatment system was restarted for continuous operation.

EPA's National Risk Management Laboratory reviewed the results of the pilot study and found that in-situ bioremediation could be an effective part of the Site's remedial approach, in combination with the (modified as necessary) pump-and-treat system. However, consistent distribution of reagents throughout the contaminated zones would be important to the success of in-situ bioremediation at the Site, and the fractured rock geology beneath the Site would make it difficult to control reagent distribution.

IC Summary Table

Table 2: Summary of Planned and/or Implemented ICs

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Groundwater	Yes	Yes (2011 ESD)	Various parcels with groundwater contamination	Prevent use of contaminated groundwater for drinking, bathing and any other potable use	Jackson and Pocono Township ordinances require use of water supply system as exclusive source of water (See Figure 1). However, three properties within the water supply system's service area (but outside the area of groundwater contamination) are not connected to the system and presumably continue to use well water. Environmental covenant recorded 11/3/2015 (applies only to parcel 08-6362-0035-7153)
Groundwater	Yes	Yes (2011 ESD)	08-6362-0035-7153; 08-6362-0034-4888; 08-6362-0032-9862; 08-6362-0045-8079 (See Figure 3)	Prohibit damaging the groundwater remedy's engineered structures	Environmental covenant recorded 11/3/2015 (applies only to parcel 08-6362-0035-7153); target for remaining parcels is 9/30/2017.

System Operation & Maintenance (O&M)

The water supply system (OU1) was initially maintained by EPA through the Bureau of Reclamation. On January 31, 1995, EPA relinquished the water supply system to the Pocono Jackson Joint Water Authority (PJJWA) who took over operation and maintenance of the system and continues to supply residents in the area with drinking water. EPA is not privy to the costs associated with the ongoing O&M of the water supply, which is now the property of PJJWA.

In October 2011, PADEP assumed O&M responsibilities for OU2 (groundwater cleanup) from EPA. PADEP's O&M contractor has conducted annual groundwater sampling since 2004; the sampling frequency for a given well, depending on prior sampling results, is either annual, every 2 years or every 5 years. Before 2004, groundwater sampling was conducted on a semiannual basis.

The current O&M manual (dated October 2011) for the OU2 groundwater treatment system includes daily remote monitoring, monthly O&M activities, effluent (air and treated water) sampling and long-

term groundwater performance monitoring. Daily monitoring and monthly O&M log sheets are completed by PADEP's O&M contractor. The treatment system is regulated by a series of alarms that cause the system to shut down in the event of a malfunction. The O&M contractor performs regular inspections, sampling and minor repair work at the Site in accordance with the O&M manual. This work is documented in monthly progress reports submitted to EPA and PADEP as well as annual groundwater performance monitoring reports.

PADEP's O&M contractor submitted a revised Sampling and Analysis Plan, on May 5, 2016. EPA approved the revised Sampling and Analysis Plan on May 18, 2016.

Table 3 presents annual O&M costs for OU2 for the previous five years. Annual O&M costs averaged approximately $55,000 (excluding utilities) over the previous five years. These costs are lower than the costs reported for the previous FYR ($125,000). OU1 O&M costs were not available for this FYR.

Table 3: Annual O&M Costs

Fiscal Year	Total Cost
2011	$58,000
2012	$44,000
2013	$87,000
2014	$53,000
2015	$35,000

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the **last** five-year review as well as the recommendations from the **last** five-year review and the current status of those recommendations.

Table 4: Protectiveness Determinations/Statements from the 2011 (4th) FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Protective	The OU1 remedy is considered protective of human health and the environment since a permanent municipal water-supply system was installed for affected residents and businesses. This system is being operated and maintained by the PJJWA.
2	Short-term Protective	The OU2 remedy is considered protective of human health and the environment in the short term as there is no known current exposure to contaminated groundwater. The groundwater extraction and treatment system is functioning as intended, and treated water meets NPDES requirements prior to being discharged to wetlands. In order for the OU2 remedy to be protective in the long-term, institutional controls need to be implemented and vapor intrusion monitoring should continue to ensure indoor air of nearby residences is not negatively impacted by the site.
Sitewide	Short-term Protective	*The last FYR did not make a "Sitewide" statement.*

Table 5: Status of Recommendations from the 2011 (4th) FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
2	The results of Vapor Intrusion ("VI") monitoring showed no current indoor air risk associated with Site-related contaminants. However, continued monitoring is warranted to ensure indoor air remains protective.	EPA will conduct another round of VI sampling in four residences during 2012.	Completed	EPA conducted four additional rounds of vapor intrusion sampling: one round in 2012, two rounds in 2013 and one round in 2014, the results of which were summarized in a report dated May 15, 2014. The four additional rounds of sampling found that indoor air in the seven sampled residences was not impacted by site-related contaminants.	5/15/2014
2	Institutional Controls, included in the 2011 OU2 ESD, are not yet implemented.	Complete the implementation of required institutional controls.	Ongoing	Local ordinances are in place to prohibit use of contaminated groundwater. One of the site parcels has an environmental covenant that prohibits potable use of groundwater and prohibits damaging the groundwater remedy infrastructure. EPA is seeking to obtain environmental covenants for the other three Site parcels to prohibit damaging the Site's groundwater remedy infrastructure.	Click here to enter a date

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On May 20, 2016, EPA published a public notice in the Pocono Record newspaper announcing the commencement of the Fifth FYR process for the Site, providing contact information, and inviting community participation. No one has contacted EPA as a result of the advertisement.

EPA will make the final Fifth FYR Report available to the public. EPA will place copies of the Report in the designated Site repository: Pocono Township Library, Township Municipal Building, Route 611, Tannersville, Pennsylvania 18372.

During the Fifth FYR process, EPA reached out to interview parties affected by the Site. The purpose of this was to document the perceived status of the Site and any perceived problems or successes with the phases of the remedy implemented to date. The results of the single interview that was conducted is summarized below.

On November 12, 2015, EPA interviewed the chairman of the PJJWA while inspecting their water treatment system's operations facility on Rinker Road. He stated that when EPA originally built the potable water system, several residents did not want to connect to the system. Therefore, neither PJJWA nor the Township compelled those residents to connect to the system. The current residents of these properties might not be aware that they should be connected to the water system. He also stated that EPA has been informed that the Brodhead Creek Regional Authority, a water and wastewater authority in Monroe County, is considering purchasing PJJWA. He mentioned that the PJJWA facility usually does not have problems with trespassing; however, about two years ago, someone broke in and stole metal spare parts.

Data Review

For this Fifth FYR, EPA reviewed groundwater, air effluent, and treated water effluent data from the past five years.

Groundwater

Groundwater contamination remains above the Site's performance standards (Table 1). TCE, cis-1,2-dichloroethene and vinyl chloride concentrations are one to two orders of magnitude greater than their respective ARAR-based performance standards at varying depths. Samples collected from monitoring wells at the site are denoted by the well number followed by the following decreasing depth intervals (i.e., A is deepest): A, B, C, D, E, I1 and I2 (see Figure 4).

Groundwater near the Site occurs within three layers (Layers 1, 2, and 3). Layer 1 is the shallowest unit and Layer 3 is the deepest unit. Historically, analyses of contaminant plumes indicated that the levels of contamination vary with depth and the distribution of contaminants vary by layer. The contaminant distribution and groundwater flow is strongly influenced by the geologic structure (the strike and dip of the bedrock units).

The highest TCE concentrations within the center of the plume occur within the lower portion of Layer 1 and the upper portion of Layer 2, reflecting the preferred migration of the contaminant plume along the bedding planes of the dipping bedrock. Layer 3 is historically the least contaminated layer.

Appendix D provides graphs of TCE concentrations since 2001. TCE concentrations in most monitoring wells have decreased since groundwater treatment began in 2001. The pilot test bioremediation injections in 2009 and 2011 caused TCE concentrations to decline temporarily, but concentrations have rebounded since the injections in well R2. For example, the TCE concentration in well R2-A decreased

from 4,000 µg/L in 2011 to 1,800 µg/L in 2012 and then increased to 4,100 µg/L in April 2014 and was 3,280 µg/L in April 2015. The more recent concentrations are close to pre-treatability test levels.

Figures 5 and 6 show the approximate lateral extent of TCE contamination in 2001 and 2015, respectively. TCE is the primary site contaminant. Layer 2 is the most highly contaminated layer and Figures 5 and 6 are predominantly based on Layer 2 data. These figures indicate that the groundwater treatment system has been effective in containing, and shrinking, the TCE plume. The Site's sampling data indicates that the extent of other VOCs is also contained. Although the treatment system is removing contaminant mass and shrinking the extent of the TCE plume, it is unlikely the current system will be able to achieve the groundwater cleanup goals within a reasonable length of time.

The lateral extent of groundwater contamination is not precisely defined. The location of highest VOC concentrations is east of the landfill property, indicating a roughly eastward direction of groundwater flow. As shown in Figure 7, there is a lack of monitoring wells to the east, between EW2 and RW10 and RW12, so the precise location of the eastern edge of the groundwater contamination is not well defined. However, monitoring wells RW12 and RW10 have been removed from the monitoring program due to lack of detection of constituents of concern over several years. The last sampling of monitoring well RW12 occurred in April 2010, while the last sampling of well RW10 was in April 2015 (Figure 4 shows the RW10 non detect ["ND"] results).

From 2001 to 2015, the groundwater treatment system has removed 2,469 pounds of TCE and 2,185 pounds of cis-1,2-dichloroethene. Of the total mass removed between 2001 and 2015, 43 percent of the TCE mass removed and 88 percent of the cis-1,2-dichloroethene mass removed were removed during the first three years of groundwater treatment system operation (October 2001 through September 2004). The removal rate was slower in the past 11 years, which removed 57 percent of the TCE and 12 percent of the cis-1,2-dichloroethene. The combined pumping rate for the three extraction wells is currently about half of the originally designed rate of about 75 gallons per minute. The extraction wells need to be cleaned to increase the well yields and, as discussed below under VI. Issues/Recommendations, other improvements should also be explored to increase the rate of cleanup.

Vapor Intrusion

From 2007 to 2014, EPA conducted seven rounds of indoor air sampling to evaluate vapor intrusion as a potential exposure pathway. Following a recommendation from the 2011 FYR, EPA conducted vapor intrusion sampling in March 2012 in three residences near the Site. The sampling included collection and analysis of indoor air and sub-slab vapor samples. Although indoor air samples did not identify site-related constituents at levels of concern, sub-slab concentrations prompted additional sampling events. Additional vapor intrusion monitoring performed after the March 2012 sampling event included:

- In January 2013, the three residences sampled in March 2012 were again sampled to test indoor air and sub-slab vapor. The results did not suggest that the indoor air was impacted by site-related contaminants.
- In November 2013, EPA collected indoor air, ambient air and sub-slab vapor samples and also performed real-time indoor air monitoring at six residences near the Site. Site-related contaminants were not detected in indoor air at levels above risk-based screening levels. One of the six units tested had trichloroethene in sub-slab vapors at levels above risk-based levels; the lack of indoor air exceedances suggests that attenuation is occurring to reduce concentrations between sub-slab air and indoor air.

- In March 2014, EPA collected indoor air, ambient air and sub-slab vapor samples and also performed real-time indoor air monitoring at seven residences near the Site. Site-related contaminants were not detected in indoor air at levels above risk-based screening levels. Two units tested had trichloroethene in sub-slab vapors at levels above risk-based levels; the lack of indoor air exceedances suggests that attenuation is occurring to reduce concentrations between sub-slab air and indoor air.

Air Effluent of Treatment System

Air samples have been periodically collected from the groundwater treatment system since February 2001, originally to confirm the performance of the granular activated carbon (GAC) used to treat off-gas vapors released from the air stripper, and later to confirm that emissions remain acceptable after the GAC was removed. For this Fifth FYR, EPA reviewed sampling results for air stripper off-gas and ambient air samples collected in August 2014, April 2015 and September 2015; and an ambient air sample collected in January 2011. Air sampling results show that the groundwater extraction and treatment system is functioning in a manner that does not pose an excessive risk to nearby receptors; it is working as intended. None of the ambient air samples had any Project Action Limit exceedances. However, one detection of TCE in the ambient air (2.85 $\mu g/m^3$) in August 2014 was at a concentration associated with a Hazard Index of 1. This sample was collected at a distance of only 50 feet from the stack and the nearest residence is over 800 feet away from the treatment plant building. The ambient air samples collected in April and September 2015 did not detect quantifiable concentrations of TCE. Monitoring of the effluent air should continue to ensure that concentrations remain within the protective range.

Treated Water Effluent

For this Fifth FYR, EPA compared treated water effluent sampling results against current MCLs and EPA Region 3's ecological freshwater screening benchmarks (Table 6). The O&M Plan identifies maximum discharge concentrations based on drinking water MCLs. The treated water effluent was analyzed for VOCs. Nearly all of the samples had no detectable levels of VOCs. There were several trace detections of VOCs, but these were far below MCLs and the freshwater screening benchmarks.

Table 6: Treated Groundwater Effluent Quality

	EPA Region III Freshwater Screening Benchmark (µg/L)[1]	Drinking Water MCL (µg/L)	Treated Water Effluent (µg/L)[2]							
			July 2011	Oct. 2011	Aug. 2014	Dec. 2014	March 2015	Sept. 2015	Dec. 2015	Apr. 2016
TCE	21	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.78	0.5U
1,1-DCE	25	7	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5U	0.5U
cis-1,2-DCE	590	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5U	0.5U
trans-1,2-DCE	970	100	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5U	0.5U
vinyl chloride	930	2	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5U	0.5U

Notes:

[1]Biological Technical Assistance Group (BTAG) Screening Values

[2]Letter qualifiers: "U" COC not detected above this level.

Site Inspection

The inspection of the Site was conducted on November 12, 2015. The purpose of the inspection was to assess the protectiveness of the remedy. In attendance were:

- Stephen Tyahla, EPA remedial project manager
- Trish Taylor, EPA community involvement coordinator
- Matt Taynor, EPA biologist
- Nathan Doyle, EPA hydrogeologist
- Neil Teamerson, Tetra Tech (PADEP's O&M contractor)
- Johnny Zimmerman-Ward and Hagai Nassau, Skeo Solutions (EPA's FYR contractor)

FYR site inspection participants toured the groundwater pump-and-treat system (including the treatment building, extraction wells, monitoring wells and treated water discharge) and the PJJWA water system's water tank and operations building on Rinker Road.

The three extraction wells were pumping at a total rate of 42-45 gallons per minute. Tetra Tech (PADEP's O&M contractor) stated that one of the extraction wells might be fouled, reducing its pumping rate; Tetra Tech plans to conduct maintenance work on that well to increase its flow rate. Tetra Tech stated that the pump-and-treat system does not operate during power outages, which often affect the area. For example, from May 2014 through June 2015, the system was operational during about 90 percent of its available runtime, with monthly operational percentages ranging from 14 percent to 100 percent. Tetra Tech visits the Site about twice per month. The treatment building and the pump-and-treat system are in good condition. Tetra Tech stated that there have been problems with mice chewing on electrical wire insulation; an exterminator visits the treatment building regularly for rodent control.

The treatment building is surrounded by a locked fence. The three operating extraction wells are within locked stainless steel vaults and are surrounded by locked fences. The landfill property is not fenced. Tetra Tech stated that dumping and all-terrain vehicle riding occur on the landfill property. Tractors have run into some monitoring wells at the Site. However, vandalism has not been a problem at the Site.

The monitoring wells and extraction wells EW-4, EW-5, and EW-6 were not labelled. Some of the wells were not locked. Site participants inspected the discharge area, where treated groundwater is discharged to a wetland. The discharge structure has three ports, two of which were clogged at the time of the FYR inspection; one of the ports was flowing well.

FYR site inspection participants visited the PJJWA water treatment system's operations building on Rinker Road. Dave Schultz of Prosser Laboratories (PJJWA's water system operator) explained the operation of the system. An electrical generator turns on automatically when power outages occur. Three extraction wells supply the system, but usually all do not run at once. Wells 1 and 3 are plumbed together and well 2 is on standby to supply the 75,000-gallon tank. System upgrades have been incorporated since the system went online. PJJWA has had problems with vandalism and theft of spare parts in the past. They also have problems with soda ash added to the water causing clogging of lines.

On November 12, 2015, Skeo Solutions staff visited the designated site repository, the Pocono Township Library in Tannersville. The most recent document available was the 2011 ESD. Accordingly, EPA will take action to update the repository with subsequently published and relevant documents.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:

Yes, with regards to OU1 (water supply system), the remedy is functioning as intended. Regarding OU2 (groundwater extraction and treatment), no, the system is not currently functioning as intended by the decision documents in that it is unlikely to achieve the groundwater performance standards (Table 1) within a reasonable amount of time.

The water supply system (OU1) serves the site area, including the area with groundwater contamination. Seven properties within the water supply system's service area declined to be connected to the system when constructed in 1992. However, since then, four of these properties have been connected and the remaining three, while still not connected, are outside the area of groundwater contamination.

The groundwater extraction and treatment system (OU2) is removing contaminant mass and shrinking the lateral extent of the plume, but the pace is slow. For the year May 2014 to May 2015 the system removed 104 pounds of TCE and 36 pounds of cis-1,2-dichloroethene from the groundwater. However, TCE concentrations in monitoring wells no longer seem to be declining significantly, and it appears that that the system, as currently configured and operating, will not likely be able to achieve the groundwater cleanup goals (Table 1) within a reasonable length of time.

The combined pumping rate for the three extraction wells is currently about half of the originally designed rate of about 75 gallons per minute. Steps to improve the efficacy of the extraction system (e.g., cleaning the extraction wells to increase well yields) are discussed below in Section VI (Issues/Recommendations). In addition, a Capture Zone Analysis (CZA) is needed to provide a current assessment of the extent of contaminated groundwater capture by the extraction system. In conjunction with the CZA, more work may be needed to assess the lateral extent of groundwater contamination which is not precisely defined to the east, and possibly the north, as discussed above under Data Review.

Jackson and Pocono Township ordinances require residents within the water supply system's service area to use the water system and stop using residential wells. EPA will assess the need to update the ordinances should there be a change in ownership of the water supply system. In November 2015, an environmental covenant, approved by EPA, was recorded for the site parcel where the groundwater treatment system is located to prevent use of contaminated groundwater and to prohibit interference with the efficacy and function of the treatment plant at the Site. Institutional controls need to be implemented for three other Site parcels to protect the integrity of the remedy and to prohibit interference with the function of the groundwater remedy's engineered structures.

One of three ambient air samples collected between 2014 and 2015 at the groundwater treatment plant, within 50 feet of the air discharge stack, contained TCE at 2.85 µg/m3, which would be associated with a Hazard Index of 1 using standard default residential assumptions. The other two concentrations were 0.59 µg/m3 and a non-detect. Therefore, the evidence does not suggest consistently high TCE concentrations. TCE is associated with a toxic effect (fetal cardiac malformations) that can occur within a three-week window. At present, there are no human receptors residing or routinely working near the

treatment plant. The closest residence is over 800 feet north of the treatment plant. Continued ambient air monitoring would ensure that ambient air remains within the acceptable range.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

The RAOs used at the time of remedy selection remain valid. Although some of the exposure assumptions, toxicity data, and cleanup levels have changed since that time, these changes do not affect the protectiveness of the Site's remedy because people are no longer exposed to contaminated groundwater and groundwater remediation will continue until performance standards are met and a risk assessment using up-to-date toxicity factors and risk assessment methodology shows that there is no unacceptable risk.

Question B Summary:

Have standards identified in the ROD been revised, and does this call into question the protectiveness of the remedy? Do newly promulgated standards call into question the protectiveness of the remedy? Have To-Be-Considered (TBC) criteria used in selecting cleanup levels at the Site changed, and could this affect the protectiveness of the remedy?

The Site's decision documents require groundwater remediation to continue until each COC achieves its performance standard (most of which are based on drinking water MCLs), and until the cumulative risk is at or below the $1x10^{-4}$ cancer risk level and the non-cancer hazard index is equal to or less than 1. The ARARs for 11 of the 13 groundwater COCs have not changed since the groundwater performance standards were revised in the 2011 ESD. The ARARs for the two other COCs have become less stringent since the 2011 ESD.

Has land use, or expected land use, on or near the Site changed? Have human health or ecological routes of exposure or receptors been newly identified or changed in a way that could affect the protectiveness of the remedy? Are there newly identified contaminants or contaminant sources? Are there unanticipated toxic byproducts of the remedy not previously addressed by the decision documents? Have physical site conditions or the understanding of these conditions changed in a way that could affect the protectiveness of the remedy?

In January 2016, the 6.3-acre northern landfill parcel (Figure 3) was purchased by a construction aggregate supply business. (The northern landfill parcel's previous owner recorded an environmental covenant just prior to its purchase.)

Several properties within the water supply system's service area declined to be connected to the potable water system constructed in 1992. However, since then, four of these properties have been connected and the remaining three are outside the area of groundwater contamination.

During the past five years, EPA conducted four rounds of indoor air sampling at residences near the Site to evaluate vapor intrusion as a potential exposure pathway. Indoor air samples did not identify site-related constituents at levels of concern. However, at two residences, TCE was detected in sub-slab vapor at levels above EPA's risk-based screening levels. Should Site conditions change, such as a substantial increase in TCE in groundwater or modifications to homes, additional vapor intrusion

sampling would be considered in the two residences where TCE concentrations were detected above EPA's risk-based screening levels in sub-slab samples.

The 2006 FYR recommended analyzing groundwater samples for 1,4-dioxane. Groundwater samples were analyzed for 1,4-dioxane as part of the annual sampling events in 2007, 2009 and 2010. 1,4-dioxane was not detected in any of the samples.

Have toxicity factors or other characteristics for COCs at the Site changed in a way that could affect the protectiveness of the remedy? Have standardized risk assessment methodologies changed in a way that could affect the protectiveness of the remedy?

No. Although there have been some changes in contaminant characteristics and EPA's risk assessment methods, these changes do not affect the protectiveness of the Site's remedy, because people are no longer exposed to contaminated groundwater and groundwater remediation will continue until a risk assessment using up-to-date toxicity factors and risk assessment methodology shows that there is no unacceptable risk.

As part of the 2011 ESD, EPA reviewed the groundwater COCs and conducted a risk assessment using current data, exposure factors and toxicity factors. As a result, one additional COC (cis-1,2-dichloroethene) was added to the list of performance standards.

EPA's risk assessment performed in 1991 as part of the remedial investigation found that the Site's soil does not pose unacceptable risk to human health or the environment. Therefore, EPA did not select a remedy for soil. EPA reassessed the soil in 2010 to ensure that conclusion was still protective. As part of the current FYR, EPA reassessed surface soil, subsurface soil and test pit soil sampling data from the 1991 remedial investigation using current default exposure factors, toxicity factors, and risk methodology. The conclusions are the same that EPA reached when evaluating this soil in 2010: a detection of Aroclor 1254 in deep soil would be the main driver of unacceptable cancer risk, but all the other soil samples were non-detect for this chemical. Therefore, it is expected that this Aroclor detection is localized and does not represent general soil risks. The main driver of cancer risk in soil was chromium, assuming the hexavalent form, with risks just at the upper end of the acceptable cancer risk range. The chromium risk is probably biased high, as most chromium in soil tends to be in the less toxic trivalent form.

The only other noteworthy item about the soil was the concentrations of VOCs, especially chlorinated benzenes, which could contribute to groundwater as an ongoing source if they have not yet degraded or migrated.

EPA also used current risk assessment methods during this FYR to assess the potential for vapor intrusion.

Is the remedy progressing as expected?

The water supply system (OU1) has achieved its objective of mitigating and/or preventing human exposure to contaminated groundwater. The groundwater treatment system (OU2) is removing contaminant mass and shrinking the lateral extent of the plume. However, it is unlikely that the system, as currently operating, will be able to achieve its objective (restoring groundwater to its beneficial use as

a source of drinking water) within a reasonable length of time. Although functioning, system maintenance and enhancements need to be pursued to attempt to achieve the cleanup goals.

QUESTION C: Has any **other** information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that calls into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
OU1

Issues and Recommendations Identified in the Five-Year Review:

OU(s): 2	Issue Category: Remedy Performance			
	Issue: It is unlikely that the groundwater extraction and treatment system, as currently configured and operating, will be able to achieve its objective (restoring groundwater to its beneficial use as a source of drinking water) within a reasonable length of time.			
	Recommendation: Take actions to improve performance of the groundwater extraction and treatment system including, but not limited to: a.) cleaning the extraction wells; b.) performing a capture zone analysis; and c.) evaluating what optimization or system enhancements can be made to achieve the groundwater performance standards sooner.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	State	EPA	9/30/2017

OU(s): 2	Issue Category: Institutional Controls			
	Issue: Institutional controls need to be implemented for several parcels to prohibit damaging the groundwater remedy's engineered structures.			
	Recommendation: Pursue environmental covenants on the remaining three parcels with groundwater remedy engineered structures.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA/State	9/30/2017

OTHER FINDINGS

In addition, the following are recommendations that were identified during the FYR and may improve performance of the remedy and accelerate cleanup, but do not affect current and/or future protectiveness:

- Wells susceptible to damage from off-road vehicles should be protected with bollards or bollards replaced where needed.
- All monitoring wells should be locked.
- Should the PJJWA system be sold, it may be necessary to have the existing Township Ordinances revised to refer to the new system owner.

VII. PROTECTIVNESS STATEMENT

Protectiveness Statement(s)	
Operable Unit: 1	*Protectiveness Determination:* Protective
Protectiveness Statement: The remedy at OU1 currently protects human health and the environment because a permanent municipal water supply system was installed for affected residents and businesses. The system is being operated and maintained by the PJJWA.	

Protectiveness Statement(s)	
Operable Unit: 2	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: The remedy at OU2 currently protects human health and the environment because there is no known current exposure to contaminated groundwater, site-related constituents are not present in indoor air at levels of concern, the groundwater extraction and treatment system is functioning as intended, an institutional control is in place prohibiting use of wells within the water supply service area, and treated water meets discharge requirements prior to being discharged to wetlands. In order for the OU2 remedy to be protective in the long term, an analysis of the groundwater remedy should be performed and additional institutional controls implemented.	

Sitewide Protectiveness Statement
Protectiveness Determination: Short-term Protective
Protectiveness Statement: The Site's remedy currently protects human health and the environment because a permanent municipal water supply system was installed for affected residents and businesses, there is no known current exposure to contaminated groundwater, site-related constituents are not present in indoor air at levels of concern, the groundwater extraction and treatment system is functioning as intended, an institutional control is in place prohibiting use of wells within the water supply service area, and treated water meets discharge requirements prior to being discharged to wetlands. In order for the Site's remedy to be protective in the long term, an analysis of the groundwater remedy should be performed and additional institutional controls implemented.

VIII. GOVERNMENT PERFORMANCE AND RESULTS ACT MEASURES

As part of this five-year review, the Government Performance and Results Act (GPRA) Measures have been reviewed. The GPRA Measures and their status are as follows:

Environmental Indicators
Human Health: Human Exposure Controlled and Protective Remedy in Place
Groundwater Migration: Contaminated Groundwater Migration Under Control

Sitewide Ready for Anticipated Use (SWRAU)
The Site has not yet achieved SWRAU. Completion of ICs will be needed to achieve SWRAU.

IX. NEXT REVIEW

The next five-year review report for the Butz Landfill Superfund Site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

EPA. September 28, 1990. Record of Decision, Butz Landfill Superfund Site, Operable Unit One.

EPA. June 30, 1992. Record of Decision, Butz Landfill Superfund Site, Operable Unit 2.

EPA. September 17, 1996. First Five-Year Review Report, Butz Landfill Superfund Site.

EPA. August 27, 1999. Explanation of Significant Differences, Butz Landfill Superfund Site.

EPA. September 28, 2001. Second Five-Year Review Report, Butz Landfill Superfund Site.

EPA. September 26, 2006. Third Five-Year Review Report, Butz Landfill Superfund Site.

EPA. September 9, 2011. Fourth Five-Year Review Report, Butz Landfill Superfund Site.

EPA. July 27, 2011. Second Explanation of Significant Differences, Butz Landfill Superfund Site.

EPA. February 27, 2014. Ground Water Technical Support Center Review of the Butz Landfill Site, Jackson Township, PA.

EPA. May 29, 2014. Review of the Butz Landfill Vapor Intrusion Data (Rounds 1 - 7).

Lockheed Martin. December 12, 2013. Butz Landfill Vapor Intrusion Study, Monroe County, Pennsylvania, November 2013 Trip Report.

Lockheed Martin. April 3, 2014. Final Analytical TAGA Report, Butz Landfill Vapor Intrusion Study, Revision 1, Monroe County, Pennsylvania, April 2014.

Lockheed Martin. May 15, 2014. Trip Report, Butz Landfill Vapor Intrusion Study, Monroe County, Pennsylvania, May 2014.

Tetra Tech. January 2008. Residential Vapor Intrusion Study Long-Term Remedial Action, Butz Landfill Site.

Tetra Tech. September 3, 2008. Round 2 Residential Vapor Intrusion Study Letter Report, Butz Landfill Site, Long-Term Remedial Action.

Tetra Tech. July 27, 2011. Round 3 Residential Vapor Intrusion Study Letter Report (Revision No. 1), Butz Landfill Site, Long-Term Remedial Action.

Tetra Tech. October 2011. Operation and Maintenance Manual, Remedial Response Activities, Revision No. 1, Butz Landfill Site.

Tetra Tech. June 1, 2012. Round 4 Residential Vapor Intrusion Study Letter Report, Butz Landfill Site, Long-Term Remedial Action.

Tetra Tech. May 16, 2013. Revised Round 5 Residential Vapor Intrusion Study Letter Report, Butz Landfill Site, Long-Term Remedial Action.

Tetra Tech. July 2013. Phase II Treatability Pilot Study Report for Butz Landfill Site.

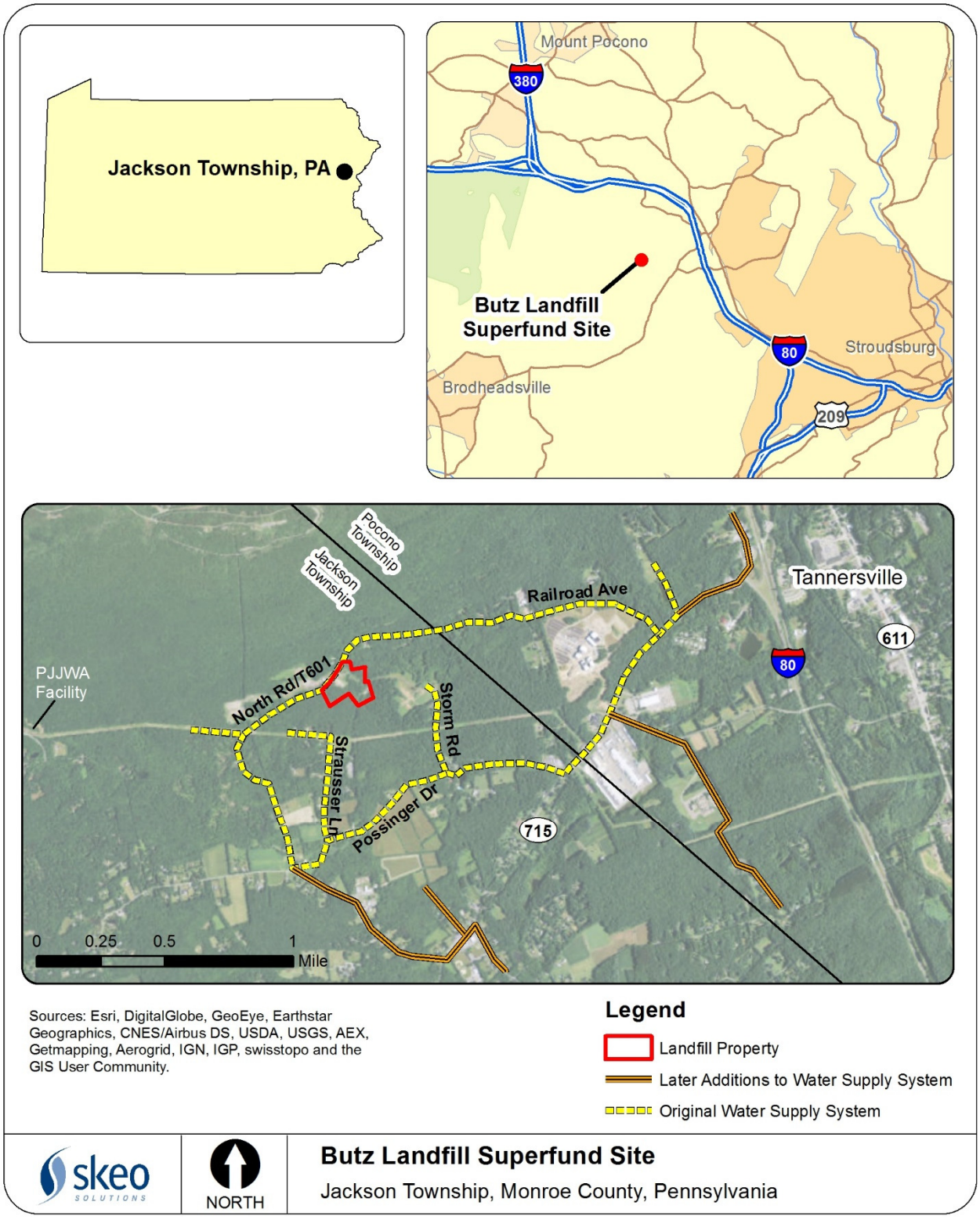
Tetra Tech. August 2014 – August 2015, October 2015 – February 2016. Monthly Groundwater Pump and Treat System Operating Reports, Butz Landfill Superfund Site, Remedial Response Activities.

Tetra Tech. May 5, 2016. Sampling and Analysis Plan for Long-Term Remedial Action, Butz Landfill Superfund Site, Operable Unit 2.

Tetra Tech. June 24, 2016. Fourteenth-Year Sampling Events (May 2014 – June 2015) Groundwater Monitoring Report Remedial Response Activities, Butz Landfill Superfund Site, Jackson Township, Monroe County, Tannersville, Pennsylvania.

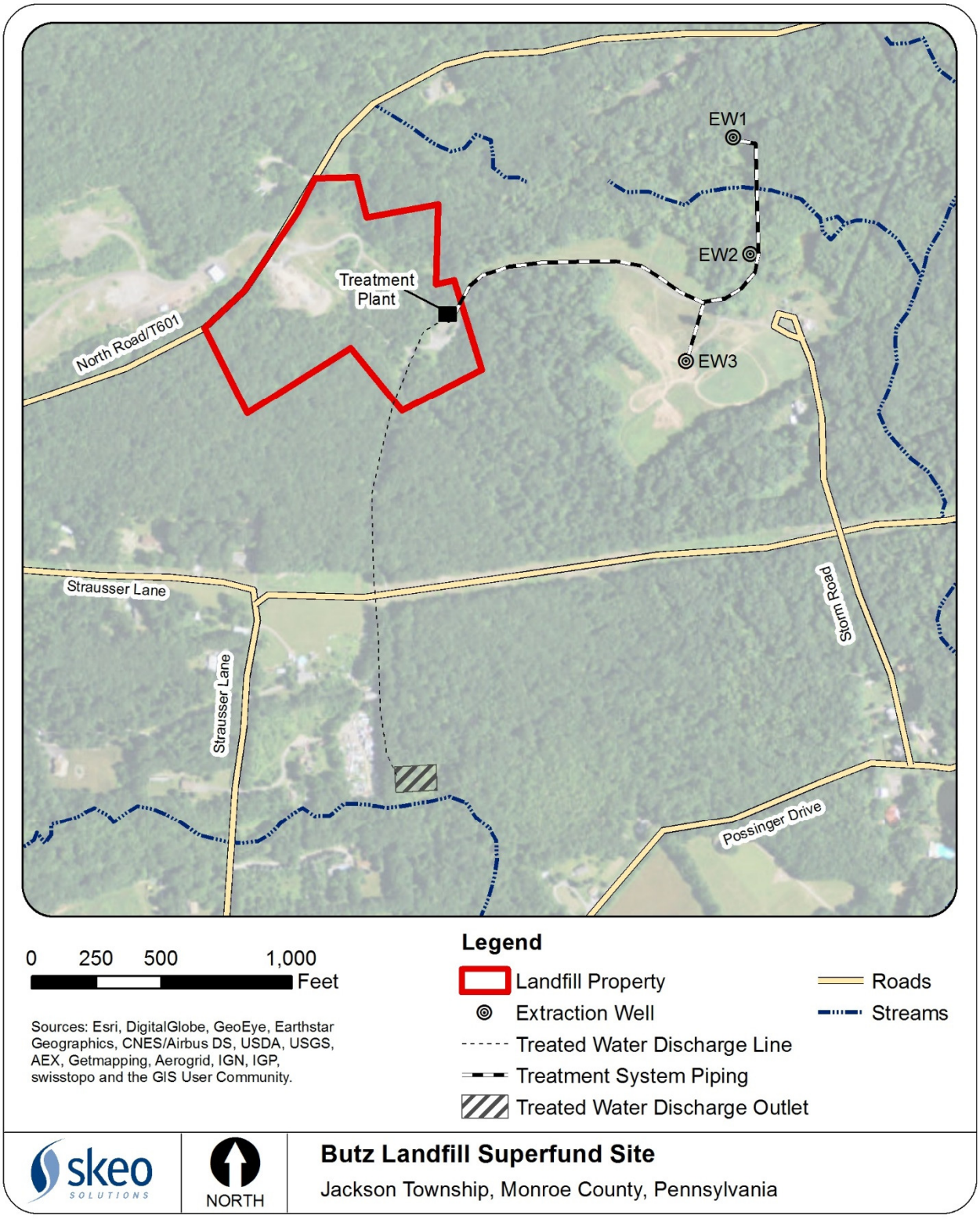
APPENDIX B – FIGURES

Figure 1: Site Location Map



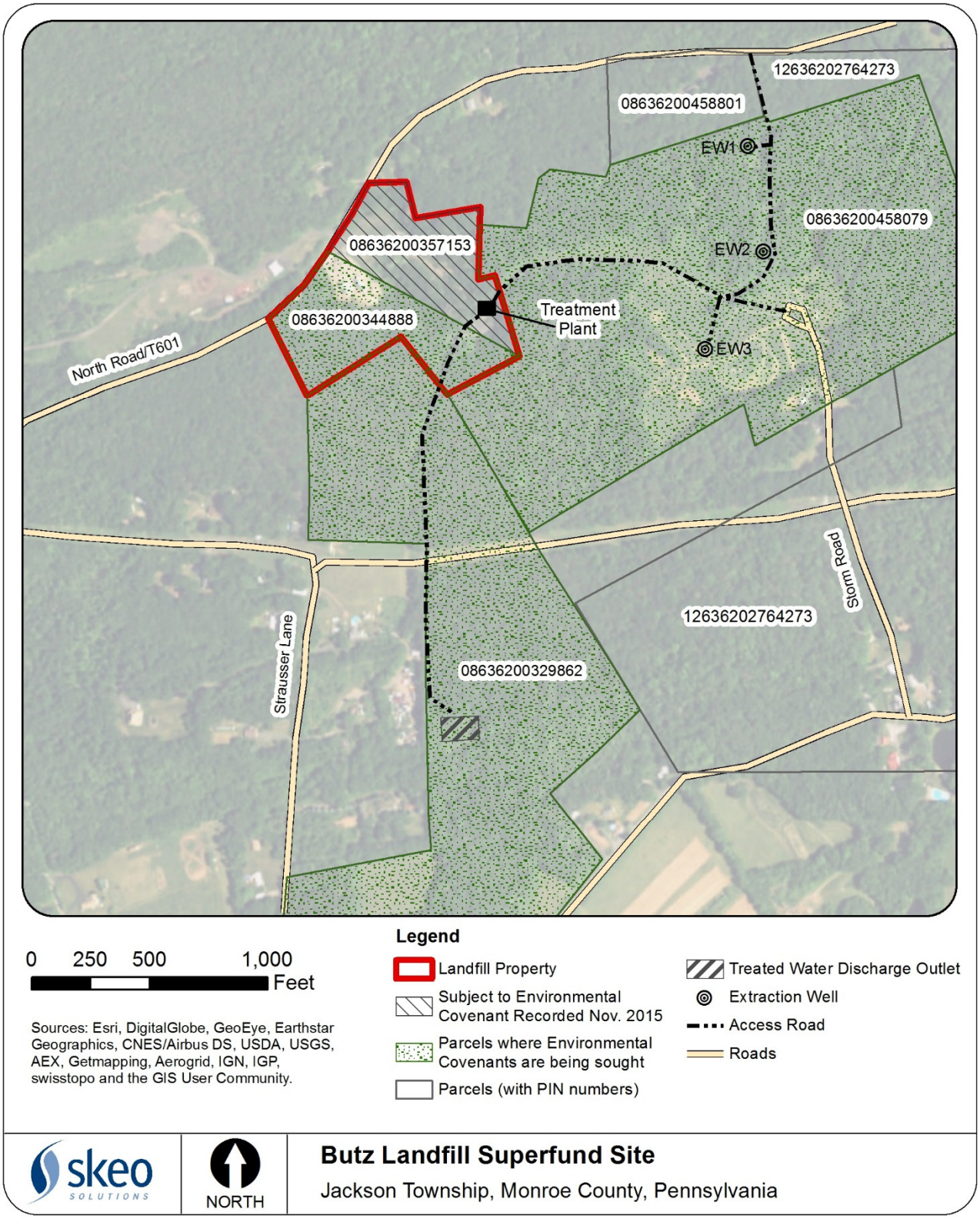
Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Figure 2: Detailed Site Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Figure 3: Environmental Covenant Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Figure 4: TCE, cis-1,2-Dichloroethylene and Vinyl Chloride Concentrations, Spring 2015

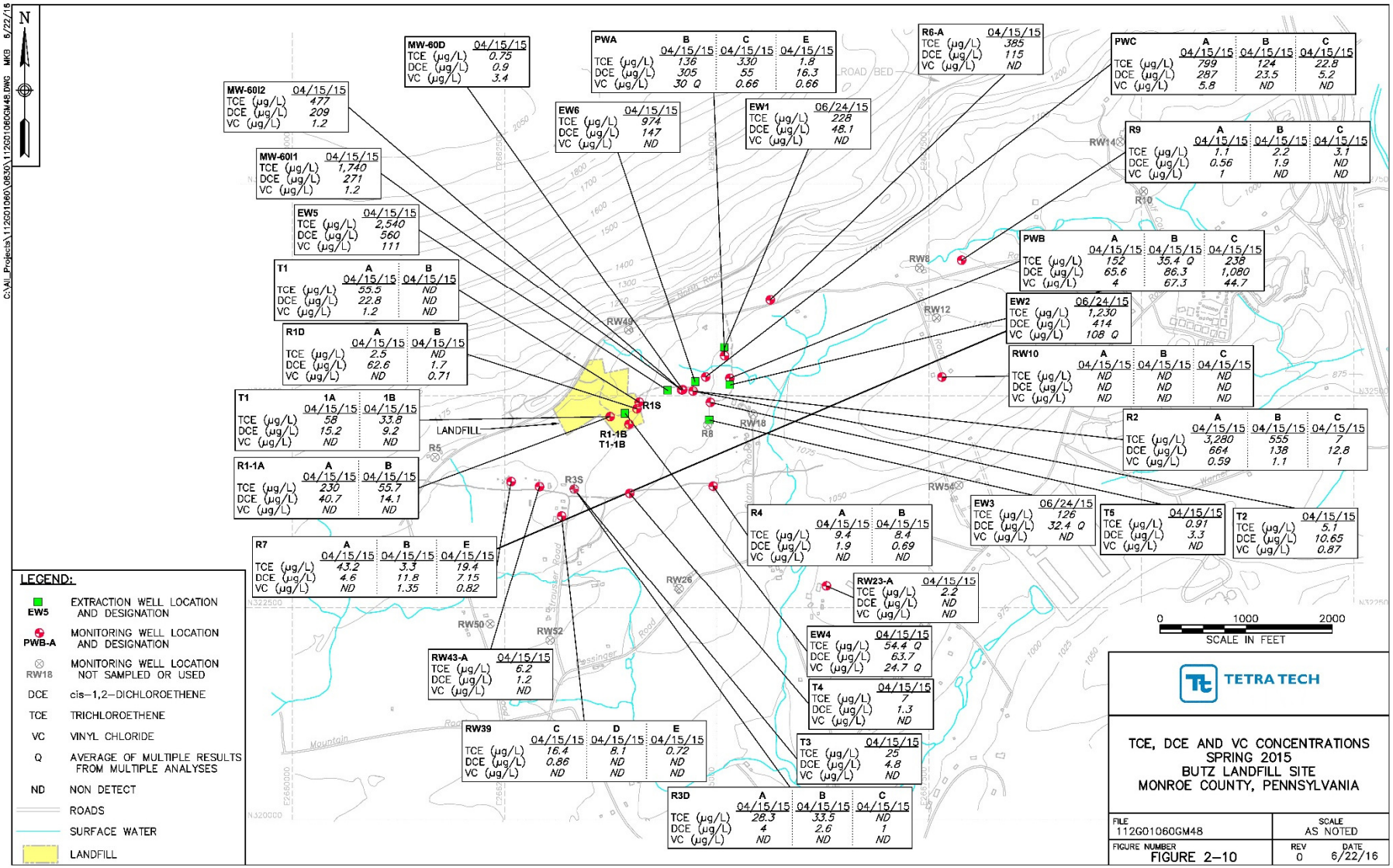


Figure 5: TCE Groundwater Plume Map prior to Groundwater Treatment System Start in April 2001

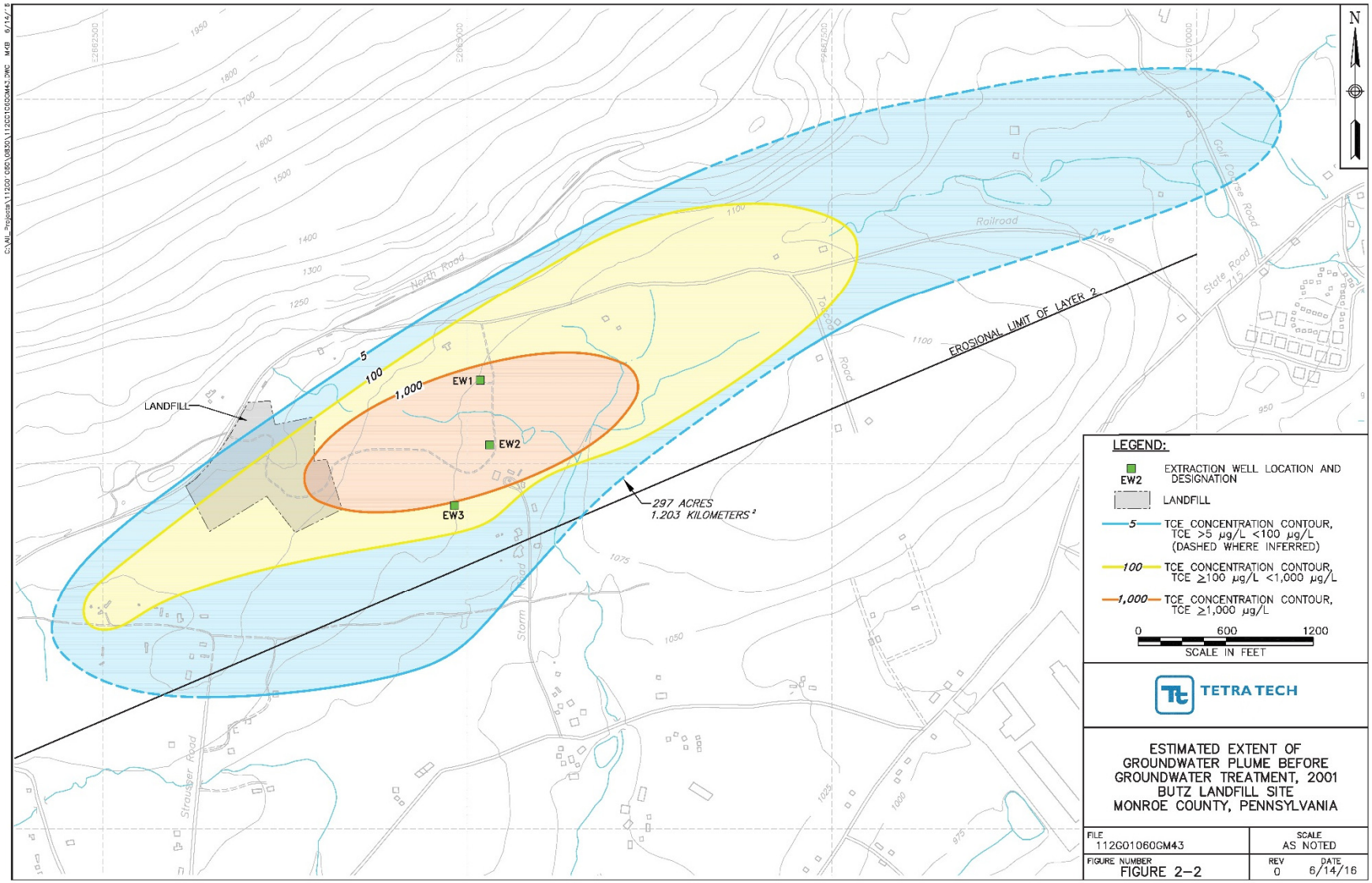


Figure 6: TCE Groundwater Plume Map in April 2015

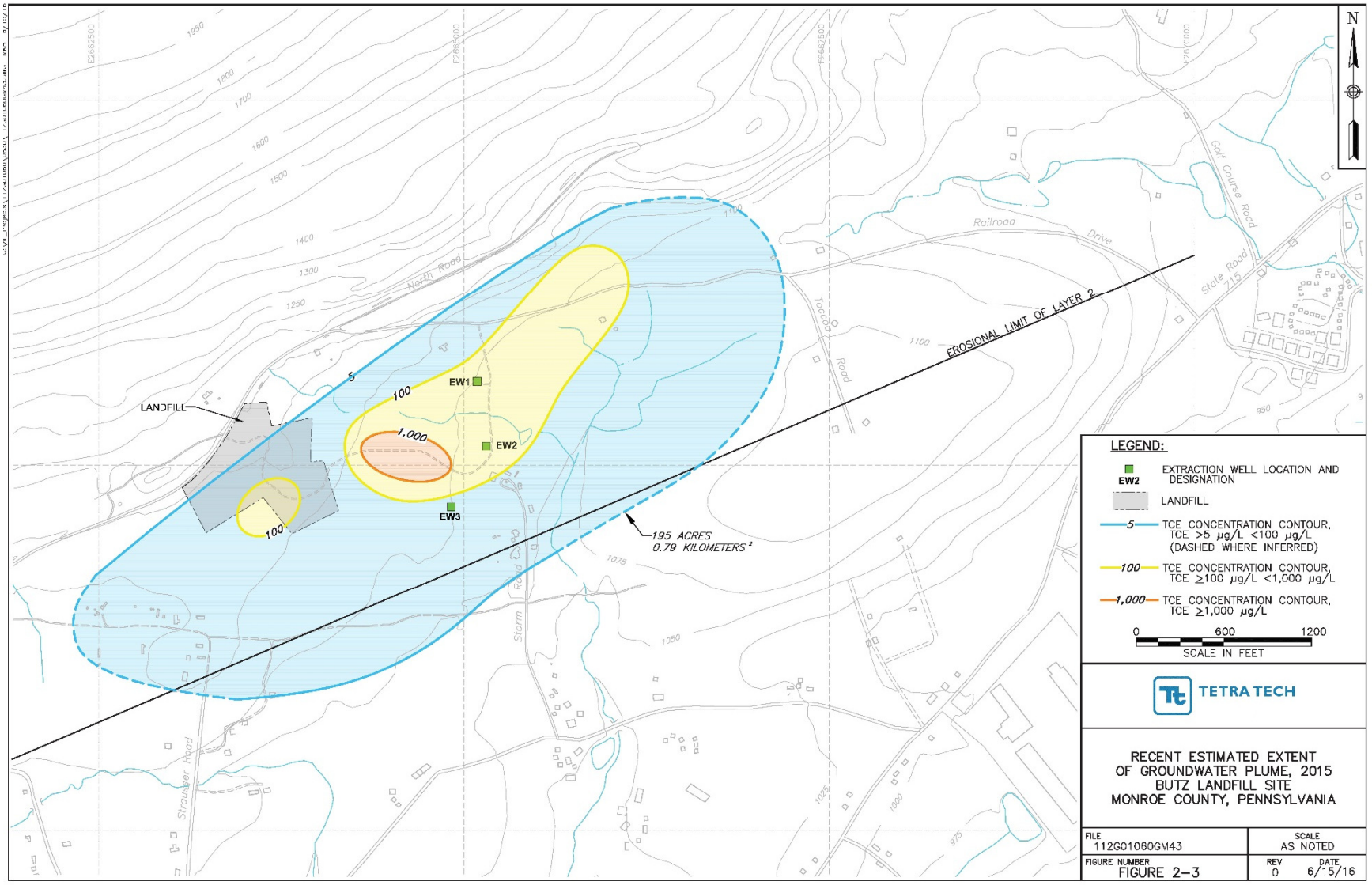
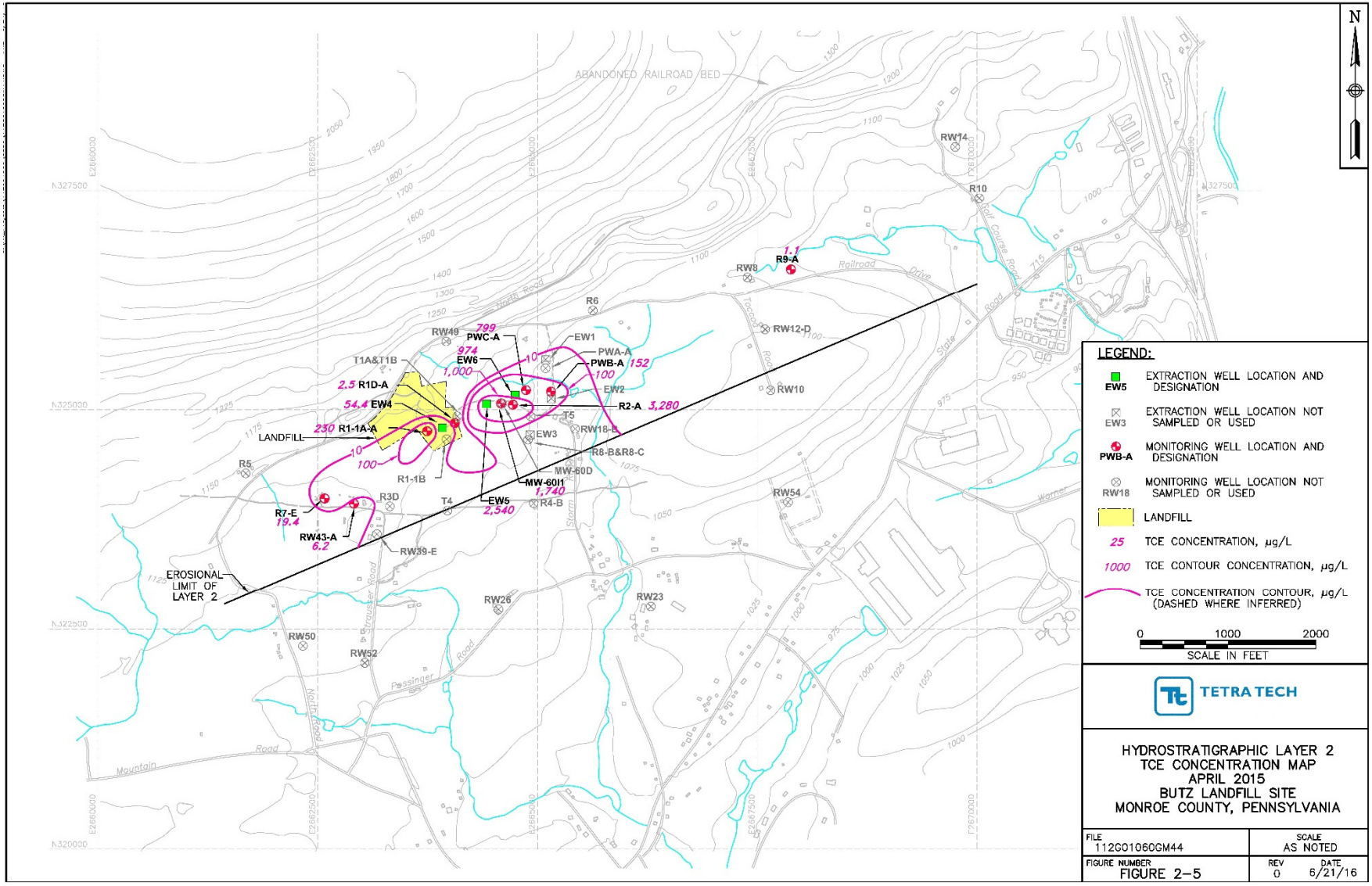


Figure 7: TCE Concentrations in Layer 2 in April 2015



APPENDIX C – CHRONOLOGY

Chronology of Butz Landfill Site Events

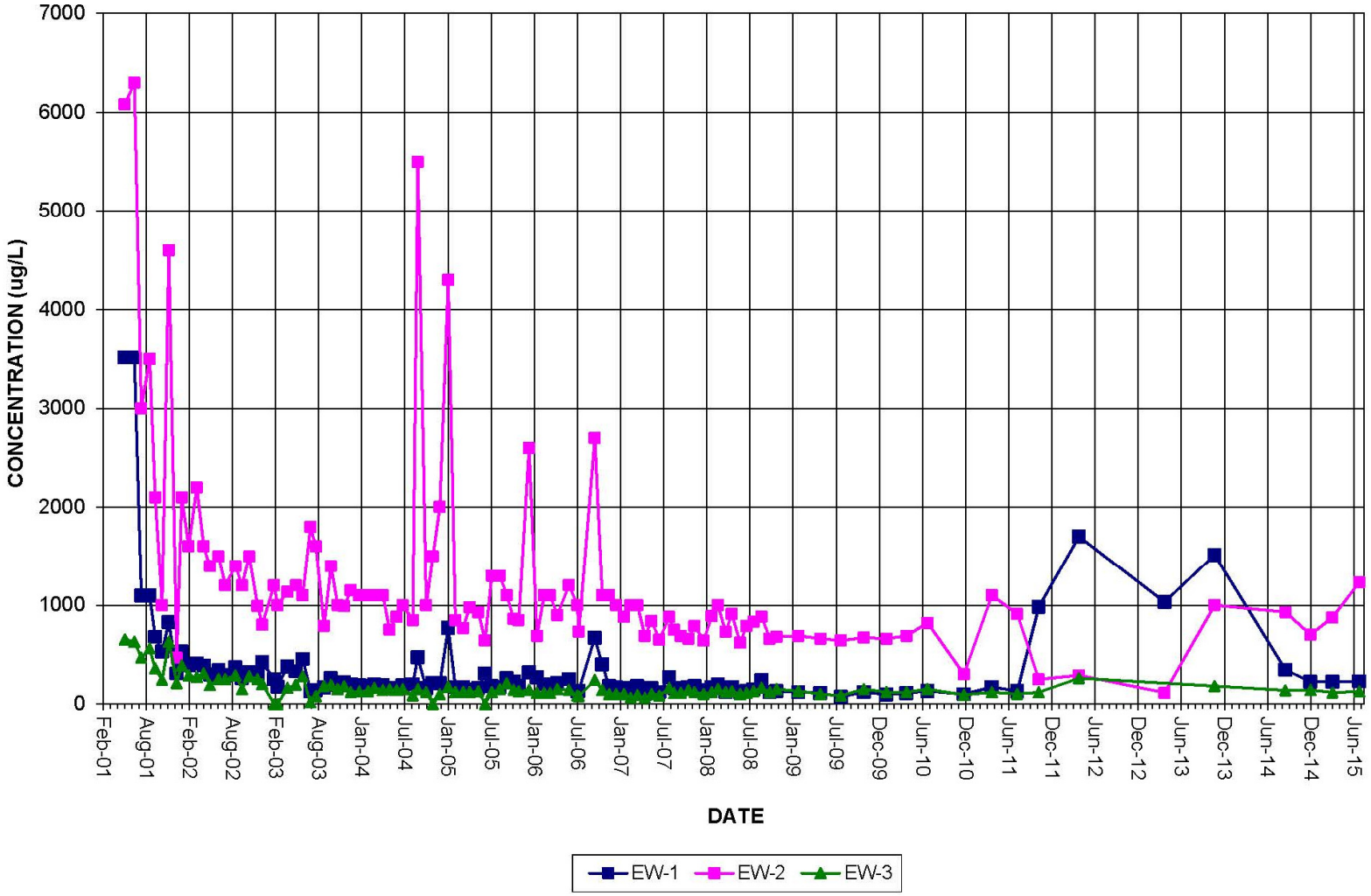
Event	Date
Site owners began landfilling activities at the Site	1965
Pennsylvania denied application from site owners for landfill operating permit	1970
Residents submitted complaints about the Site to Pennsylvania Department of Environmental Resources (PADER, now called PADEP)	1971
PADER ordered the site owners to close the landfill	1973
Site owners ceased waste disposal at the Site	1973
Site owners installed landfill cover	September 1973
PADER found elevated levels of trichloroethene (TCE) in domestic wells south of the landfill, and requested that EPA consider emergency response action	1984 and 1986
Pennsylvania requested EPA's assistance in defining and resolving the Site's contamination problem	1986
EPA began an emergency removal action (providing residents with bottled water)	July 1986
EPA proposed listing the Site on the Superfund program's National Priorities List (NPL)	June 24, 1988
EPA finalized the Site's listing on the NPL	March 31, 1989
EPA completed an engineering evaluation and cost analysis of a water distribution system	August 13, 1990
EPA issued the OU1 Record of Decision (ROD) selecting construction of a water supply system	September 28, 1990
EPA completed OU1 remedial design	June 13, 1991
Jackson Township adopted Ordinance No. 91-100, requiring residents within the water supply system's service area to use the water system as their exclusive source of potable water, and requiring wells within the service area to be disabled	July 18, 1991
Pocono Township adopted Ordinance No. 54, requiring residents within the water supply system's service area to use the water system as their exclusive source of potable water, and requiring wells within the service area to be disabled	August 23, 1991
EPA issued OU2 remedial investigation and feasibility study	April 22, 1992
EPA began OU1 construction	June 8, 1992
EPA issued OU2 ROD selecting construction of a groundwater pump-and-treat system	June 30, 1992
EPA finished connecting users to OU1 water supply system	December 18, 1992
EPA completed OU1 construction	June 30, 1993
EPA completed OU1 remedial action	September 14, 1993

Event	Date
EPA turned over the water system to the Pocono Jackson Joint Water Authority (PJJWA)	1995
EPA issued first FYR	September 17, 1996
EPA completed OU2 remedial design	June 17, 1997
EPA issued first Explanation of Significant Differences (ESD)	August 27, 1999
EPA and PADEP signed State Superfund Contract	October 28, 1999
EPA began OU2 construction	June 28, 2000
EPA completed OU2 remedial action EPA issued Preliminary Close-Out Report Site achieved "construction complete" milestone	June 20, 2001
EPA issued second FYR	September 28, 2001
Pump-and-treat remedy became operational and functional	October 1, 2001
EPA issued third FYR	September 26, 2006
EPA increased the height of the air emissions stack and shut down the off-gas carbon treatment system	March 2007
EPA conducted a vapor intrusion evaluation (round 1)	August 2007
EPA conducted a vapor intrusion evaluation (round 2)	May 2008
EPA conducted Phase I of the in-situ enhanced bioremediation pilot test	April 2009
EPA conducted an updated groundwater human health risk assessment	January 2011
EPA conducted a vapor intrusion evaluation (round 3)	March 2011
EPA issued second ESD	July 27, 2011
EPA conducted Phase II of the in-situ enhanced bioremediation pilot test	August 2011
EPA issued fourth FYR	September 9, 2011
PADEP took over responsibility for the Site's operation and maintenance (O&M)	October 2011
EPA conducted a vapor intrusion evaluation (round 4)	March 2012
EPA conducted a vapor intrusion evaluation (round 5)	January 2013
EPA conducted a vapor intrusion evaluation (round 6)	November 2013
EPA conducted a vapor intrusion evaluation (round 7)	March 2014

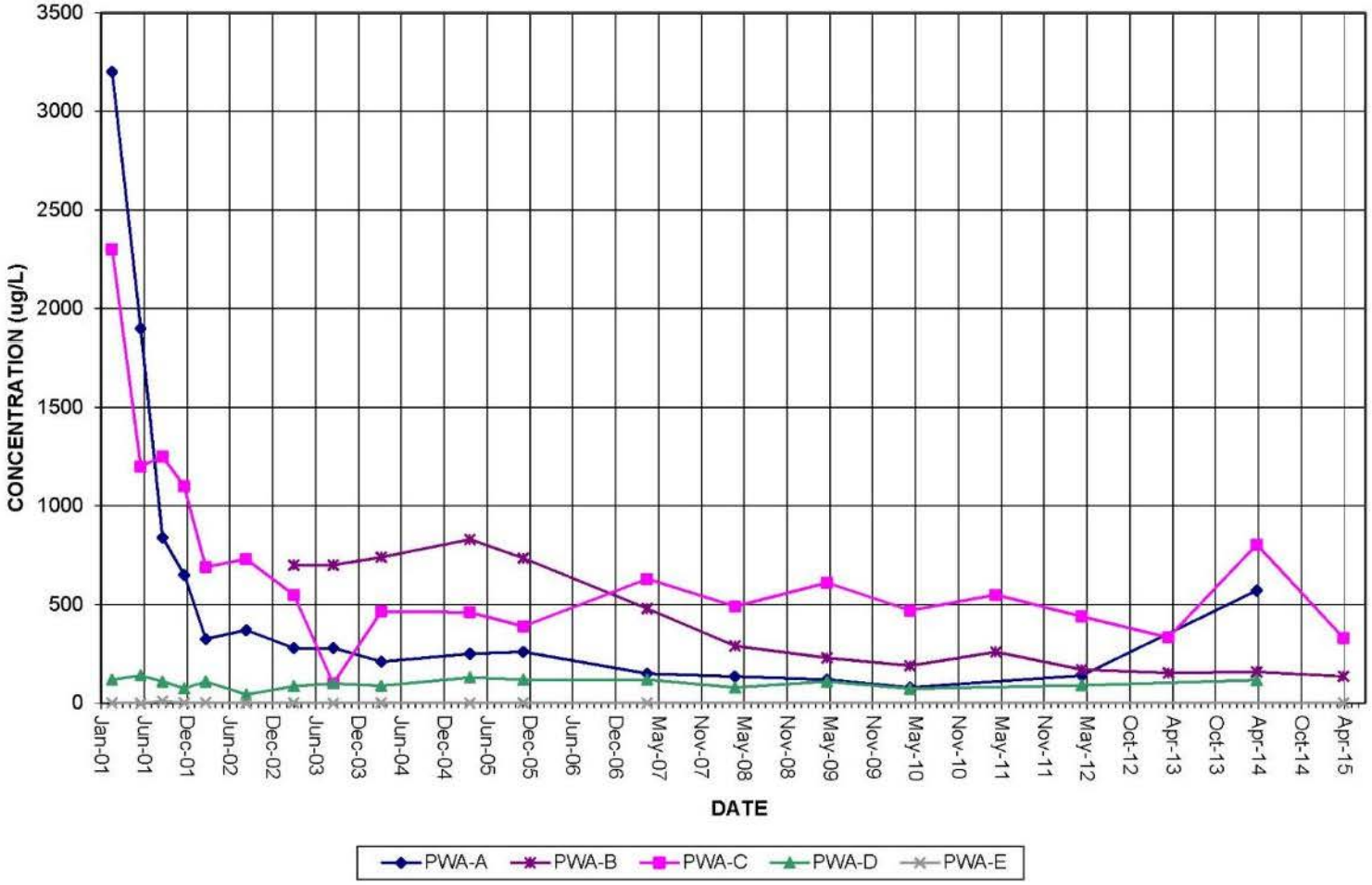
APPENDIX D – TCE CONCENTRATION GRAPHS

(Source: Tetra Tech. June 24, 2016.)

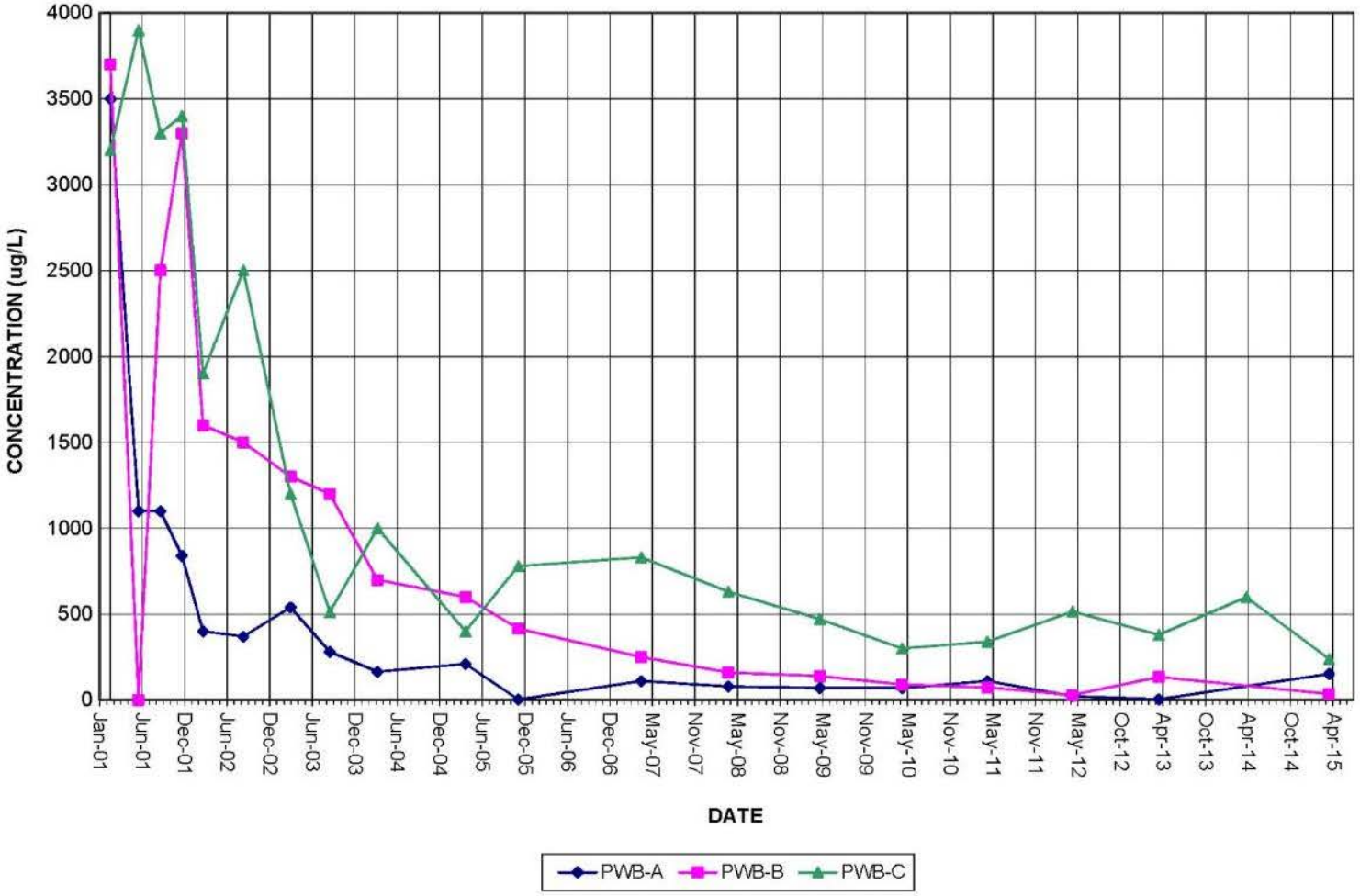
BUTZ LANDFILL
TCE CONCENTRATION RESULTS IN EXTRACTION WELLS
MAY 2001 TO JUNE 2015

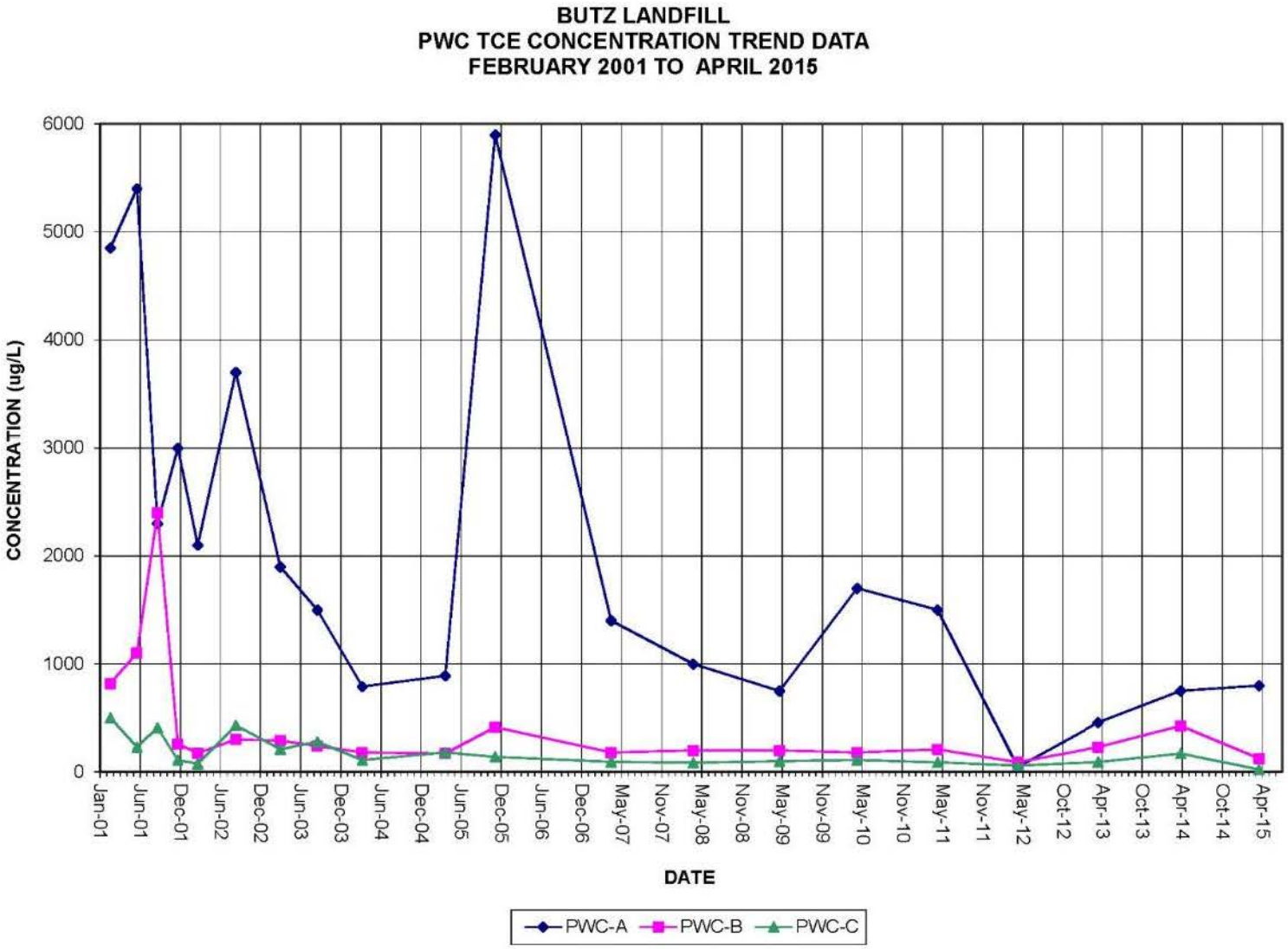


BUTZ LANDFILL
PWA TCE CONCENTRATION TREND DATA
FEBRUARY 2001 TO APRIL 2015

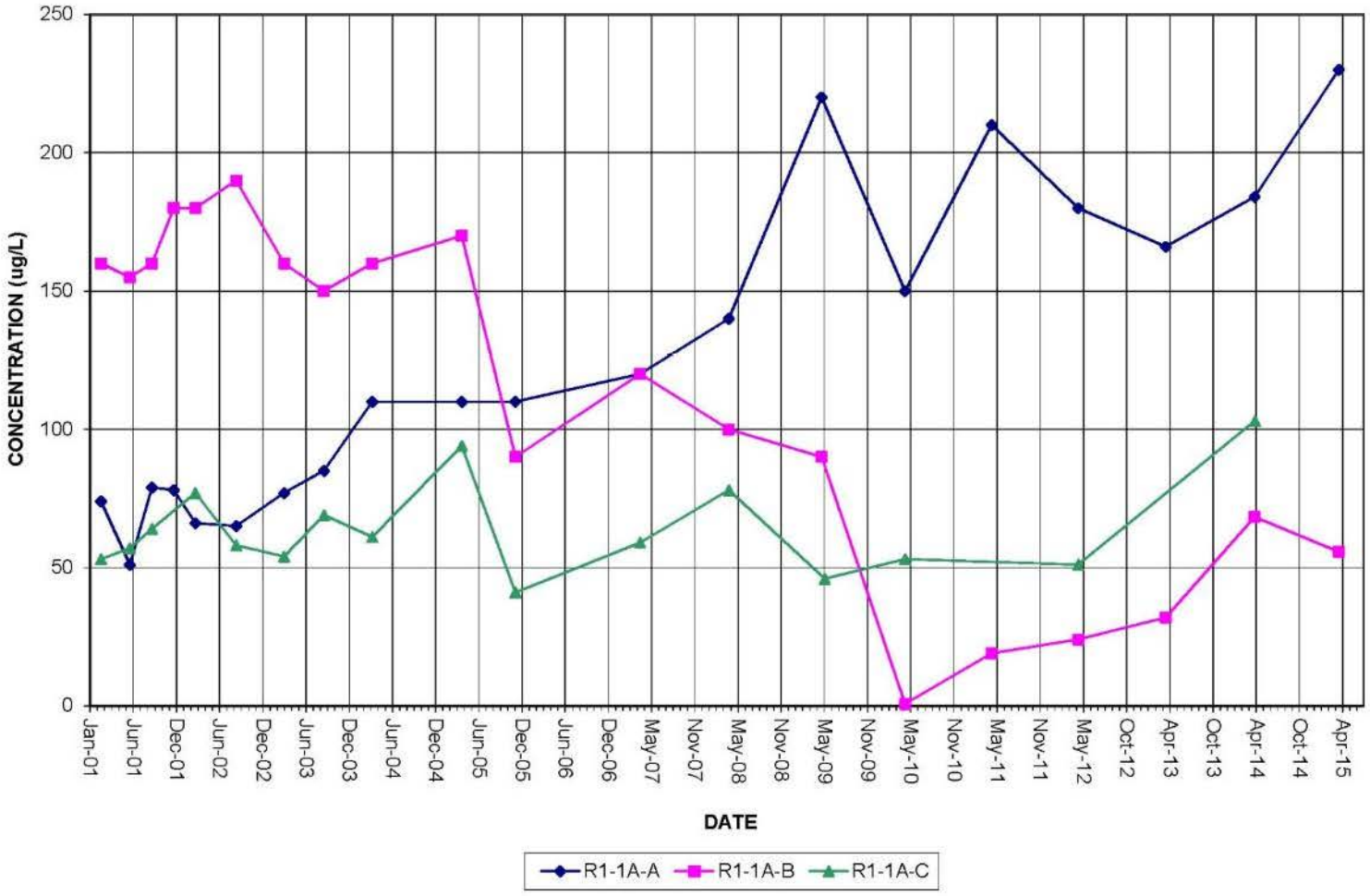


BUTZ LANDFILL
PWB TCE CONCENTRATION TREND DATA
FEBRUARY 2001 TO APRIL 2015

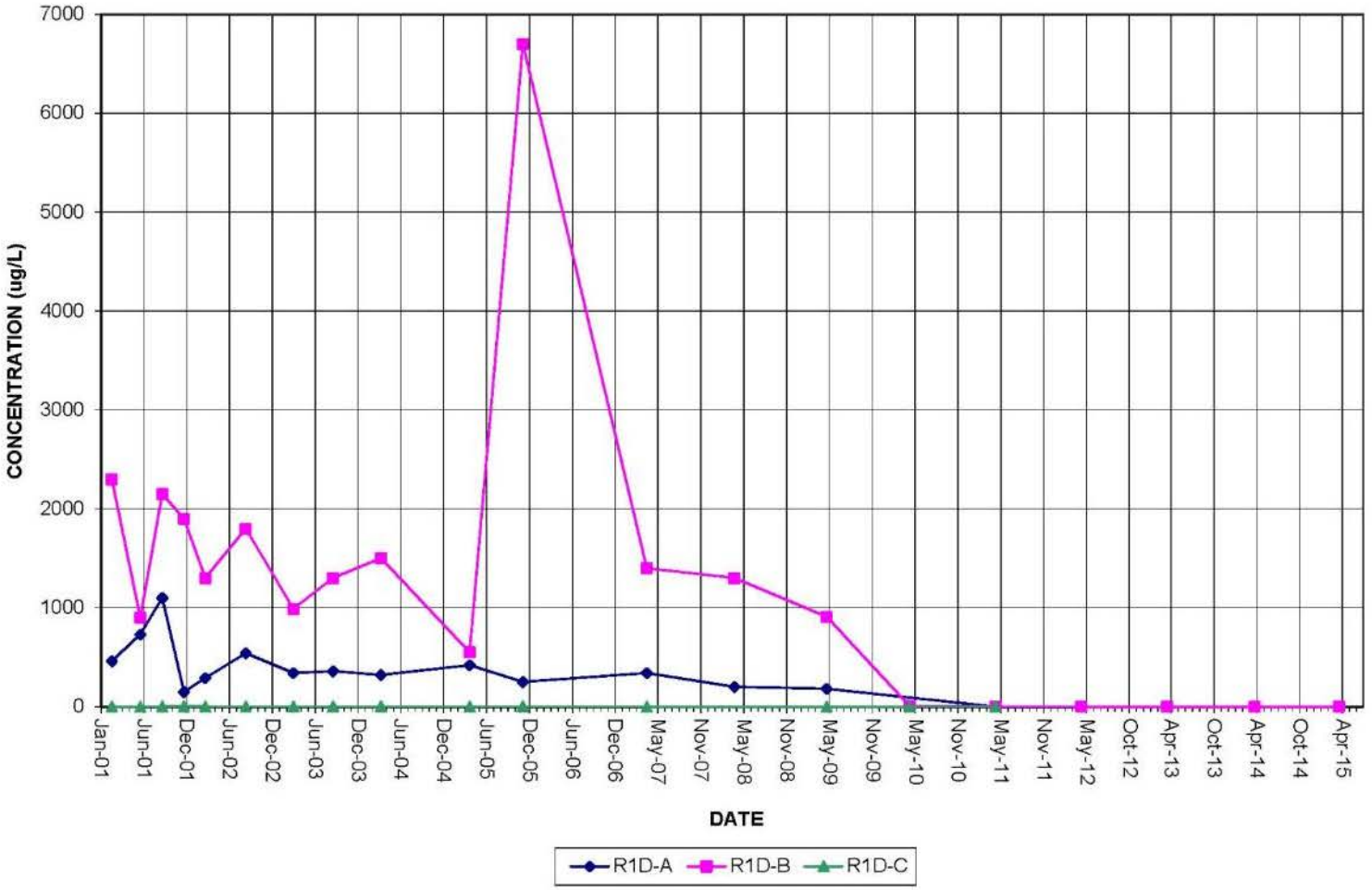



BUTZ LANDFILL
PWC TCE CONCENTRATION TREND DATA
FEBRUARY 2001 TO APRIL 2015
CONCENTRATION (ug/L)
6000
5000
4000
3000
2000
1000
0
Jan-01
Jun-01
Dec-01
Jun-02
Dec-02
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
May-07
Nov-07
May-08
Nov-08
May-09
Nov-09
May-10
Nov-10
May-11
Nov-11
May-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
DATE
PWC-A
PWC-B
PWC-C

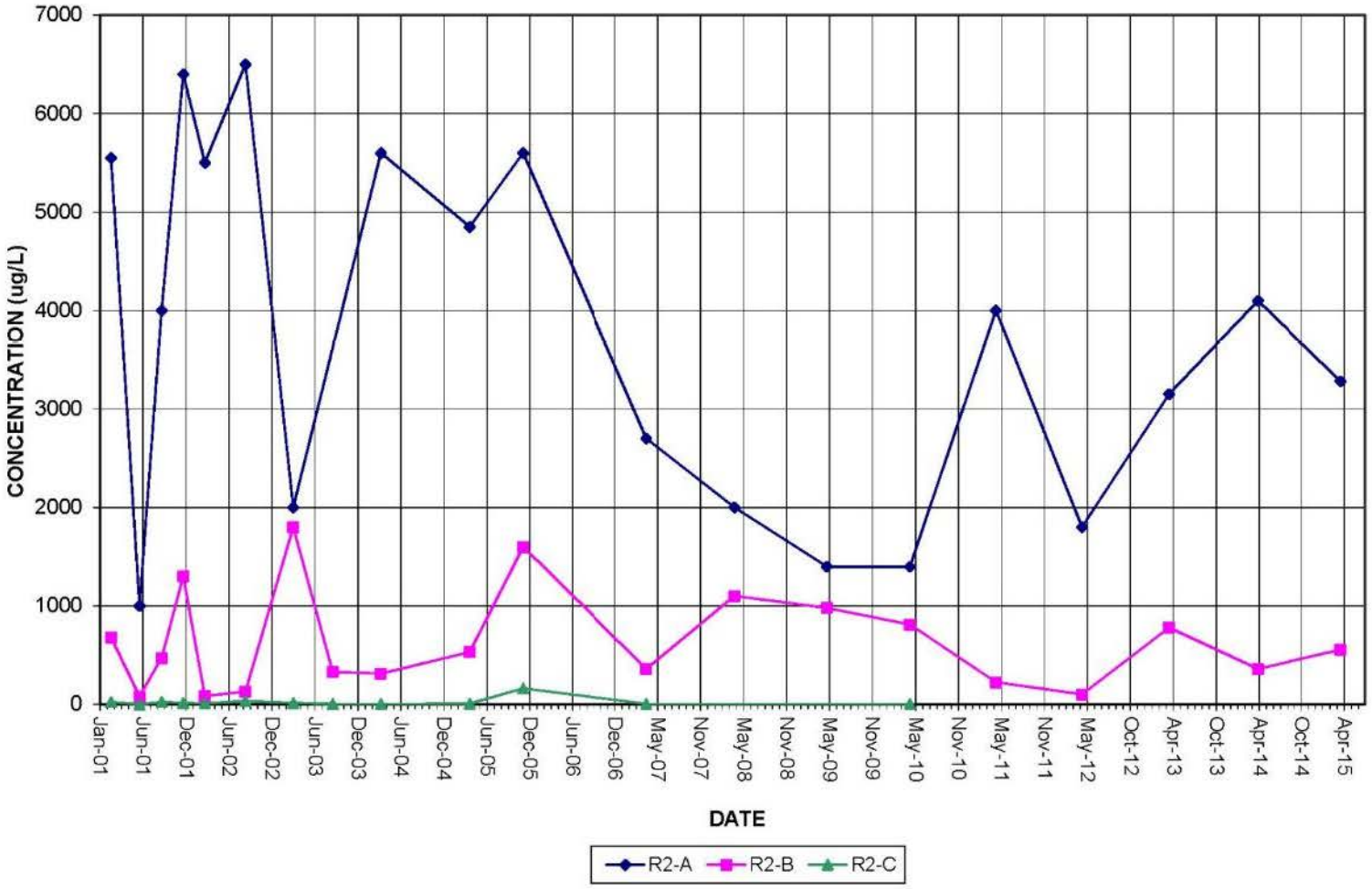
BUTZ LANDFILL
R1_1A TCE CONCENTRATION TREND DATA
FEBRUARY 2001 TO APRIL 2015

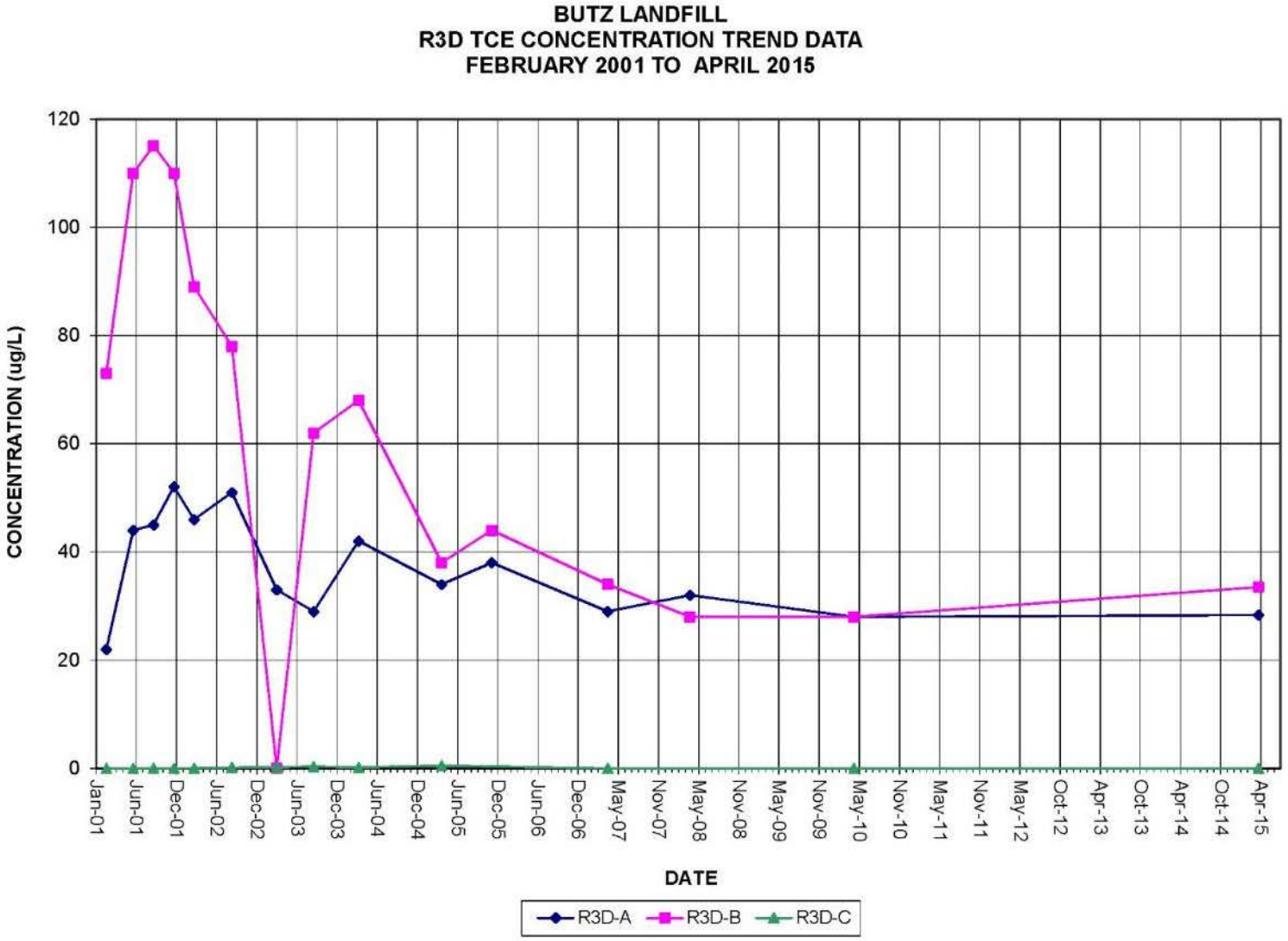


BUTZ LANDFILL
R1D TCE CONCENTRATION TREND DATA
FEBRUARY 2001 TO APRIL 2015

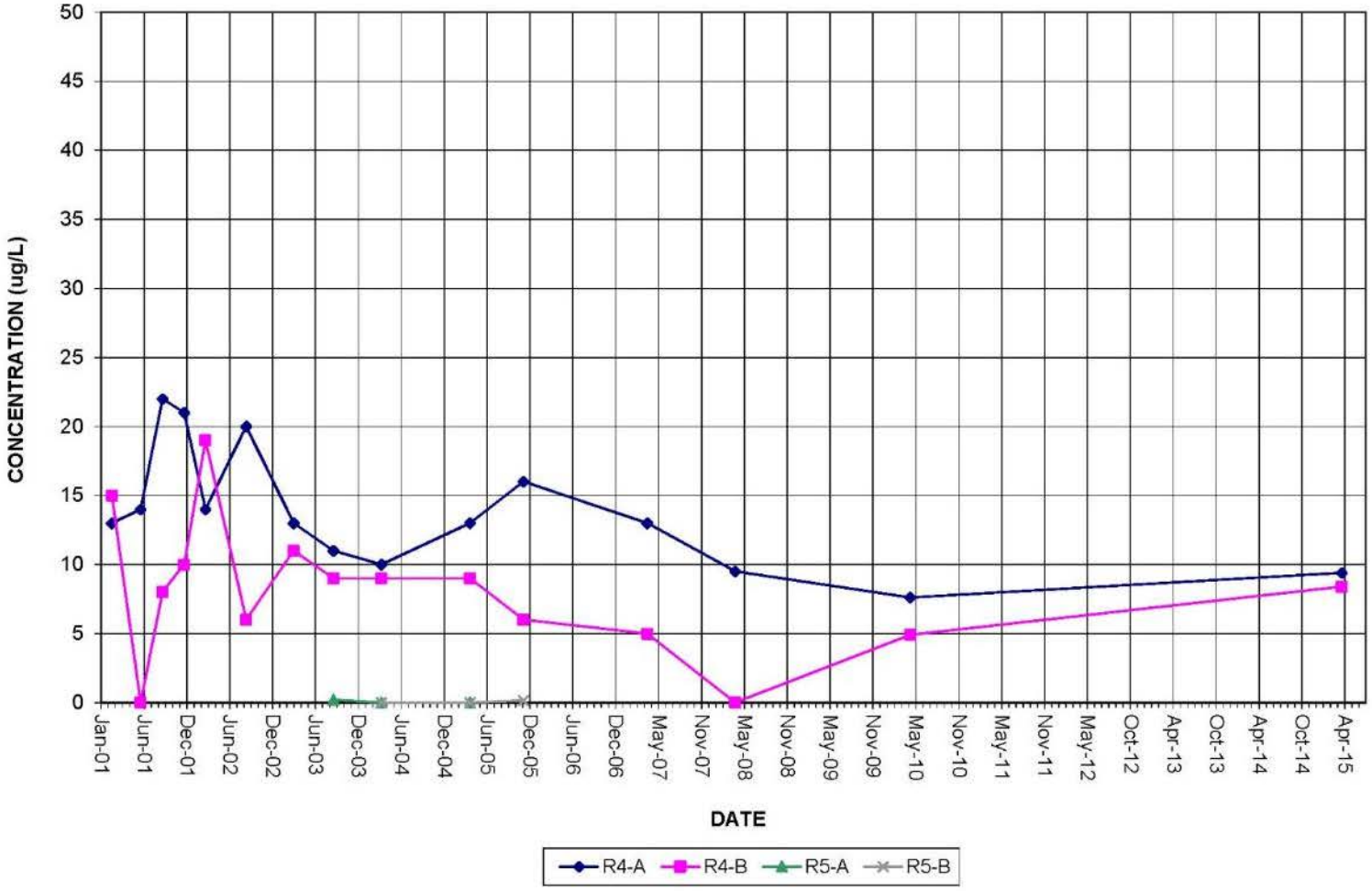


BUTZ LANDFILL
R2 TCE CONCENTRATION TREND DATA
FEBRUARY 2001 TO APRIL 2015

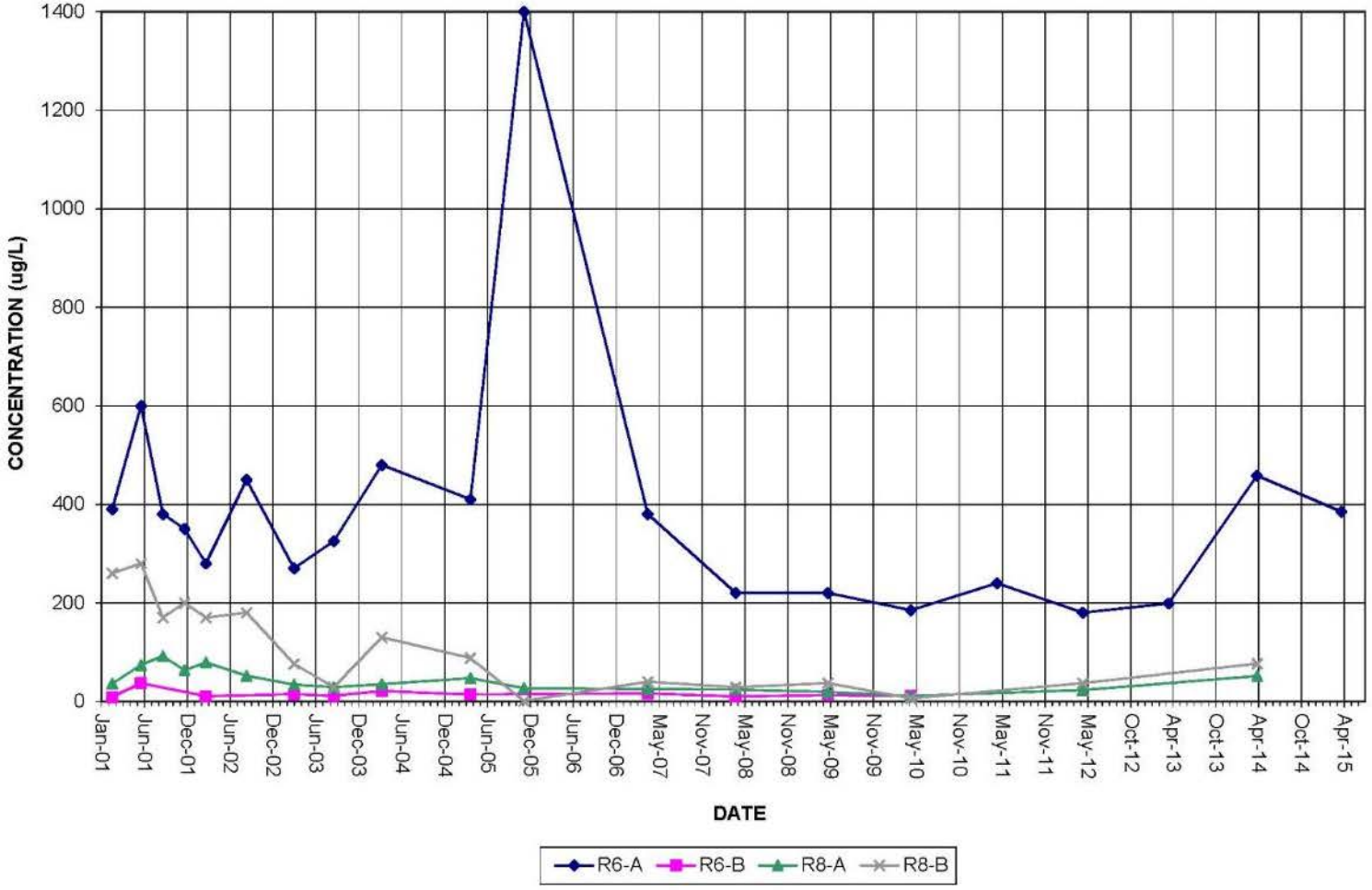



BUTZ LANDFILL
R3D TCE CONCENTRATION TREND DATA
FEBRUARY 2001 TO APRIL 2015
CONCENTRATION (ug/L)
120
100
80
60
40
20
0
Jan-01
Jun-01
Dec-01
Jun-02
Dec-02
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
May-07
Nov-07
May-08
Nov-08
May-09
Nov-09
May-10
Nov-10
May-11
Nov-11
May-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
DATE
R3D-A
R3D-B
R3D-C

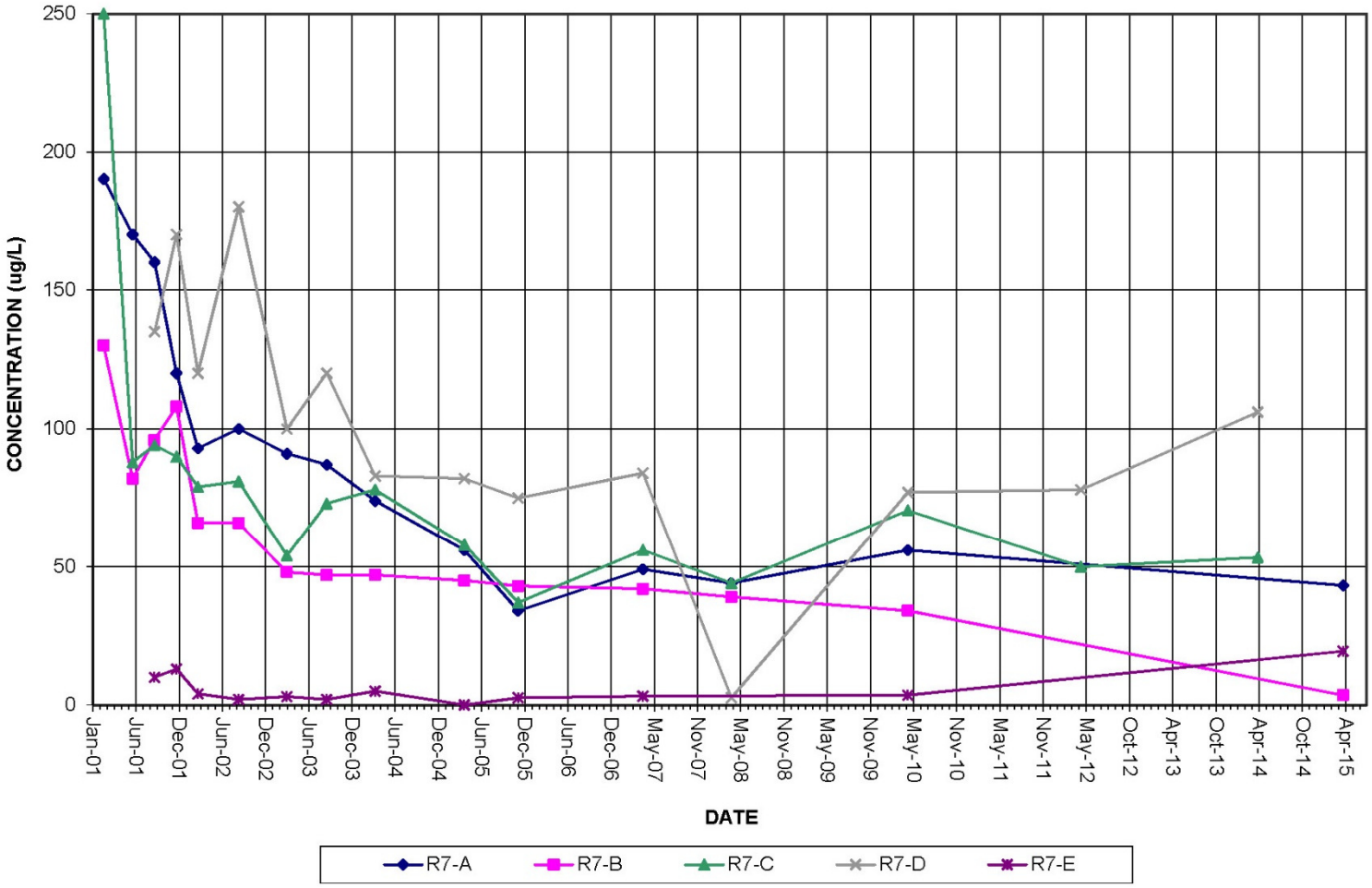
BUTZ LANDFILL
R4, R5 TCE CONCENTRATION TREND DATA
FEBRUARY 2001 TO APRIL 2015



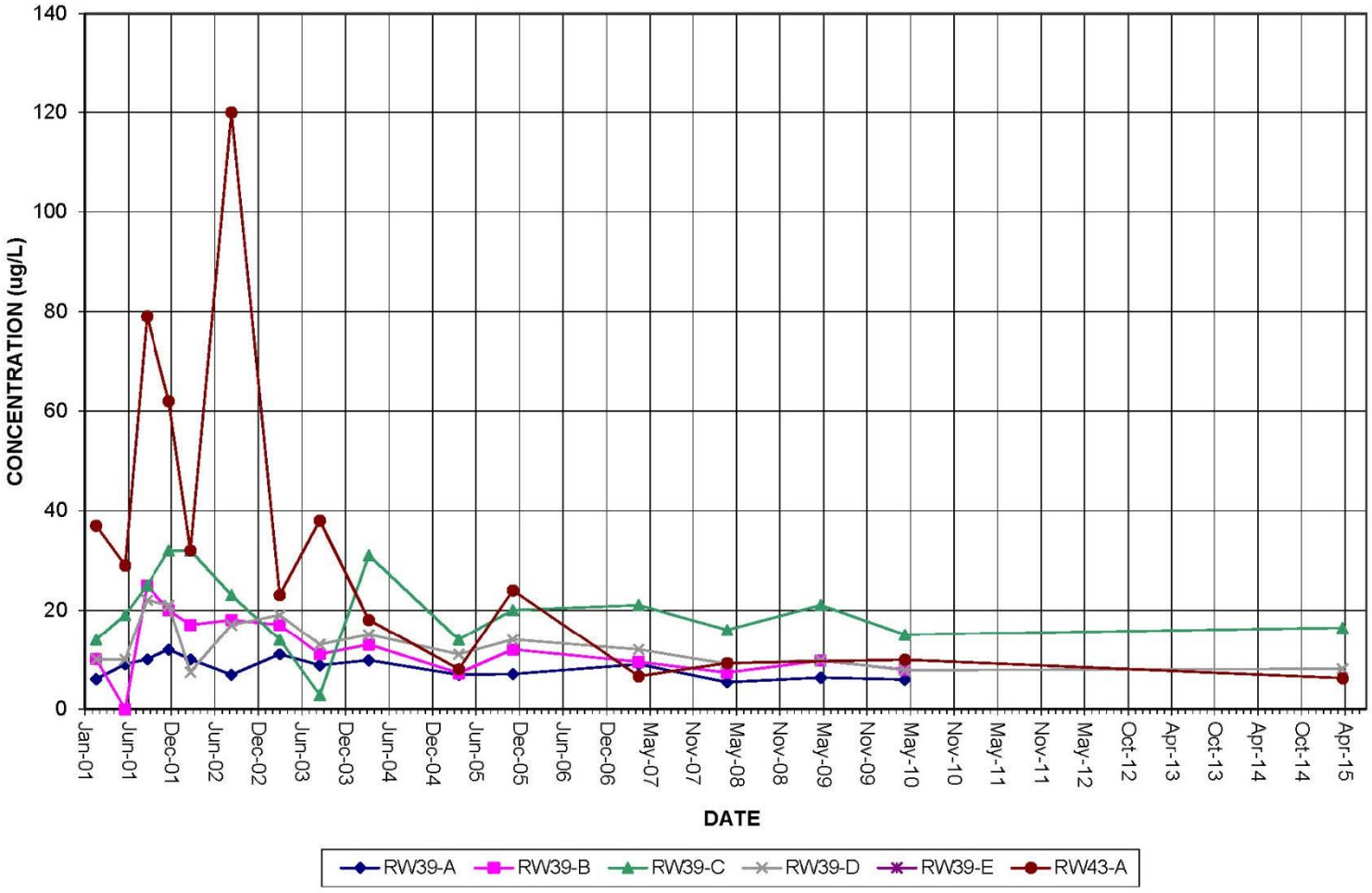
BUTZ LANDFILL
R6, R8 TCE CONCENTRATION TREND DATA
FEBRUARY 2001 TO APRIL 2015



BUTZ LANDFILL
R7 TCE CONCENTRATION TREND DATA
FEBRUARY 2001 TO APRIL 2015



BUTZ LANDFILL
RW39, RW43 TCE CONCENTRATION TREND DATA
FEBRUARY 2001 TO APRIL 2015



BUTZ LANDFILL
EW-4, EW-5, EW-6 TCE CONCENTRATION TREND DATA
APRIL 2010 TO APRIL 2015