FIFTH FIVE-YEAR REVIEW REPORT FOR
Bog Creek Farm Superfund Site
Monmouth County, New Jersey

Prepared by

U.S. Environmental Protection Agency
Region 2
New York, New York

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Date 3/27/17

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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
EPA	United States Environmental Protection Agency
FYR	Five-Year Review
ICs	Institutional Controls
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
PRP	Potentially Responsible Party
RAO	Remedial Action Objectives
ROD	Record of Decision
RPM	Remedial Project Manager
TBC	To be considereds

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 Bog Creek Farm Superfund Site (Site). The triggering action for this policy review is the completion date of the previous FYR. The remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unrestricted use and unrestricted exposure (UU/UE); however, it is EPA policy to conduct five-year reviews when remedial activities will take longer than five years to meet UU/UE.

The Site is being addressed in two remedial phases or operable units (OUs). Operable Unit One (OU1), based on a Record of Decision (ROD) issued on September 30, 1985 and modified by an Explanation of Significant Differences (ESD) on January 3, 2005, addressed stabilization and security, excavation of contaminated soils followed by excavation of contaminated sediments, incineration and/or off-site disposal of contaminated soil. The OU has been completed and does not require long term operation and maintenance. Operable Unit Two (OU2), based on the June 28, 1989 ROD, and a September 29, 2005 ROD Amendment, addresses contaminated groundwater and included construction of a groundwater pump and treat/air sparging system and reinjection trenches for the reinjection of treated groundwater. This FYR will address OU2.

The Site Five-Year Review was led by Ed Finnerty, EPA Region 2 Remedial Project Manager (RPM) and Tamara Rossi, EPA Region 2 RPM. Participants included:

- Robert Alvey (EPA Hydrogeologist)
- Julie McPherson (EPA Risk Assessor)
- Mindy Pensak, (EPA Ecological Risk Assessor)
- Pat Seppi (EPA Community Involvement Coordinator)

Site Background

The Site is located at 579 Lakewood/Farmingdale Road in Howell Township, New Jersey. The Site consists of a 4-acre disposal area situated on the eastern end of a former 12-acre farm (Block 46: Lot 29), which originally contained a contaminated pond, bog, and trench, plus two-acres of adjoining farmland (Block 46: Lot 28), which is a small piece of a 181-acre tract. The waste was deposited on Lot 29, but the contamination migrated to a portion of the adjoining property via the groundwater. The northern portion of Lot 28, which was not found to be contaminated, has been redeveloped by Howell Township into a series of athletic fields. The Site is bounded on the west by County Road 547, on the north by the North Branch of Squankum Brook, a tributary of the Manasquan River, and to the east and

south by public athletic fields. Because of this public use of Lot 28, EPA has installed a fence to prevent trespassers from accidentally entering the Site. (Figure 1 Site Location Map).

The Site lies in a rural agricultural and recreational area and is approximately three miles south of Farmingdale, five miles north of Lakewood and 12 miles west of the Atlantic coast. Farms which raise horses, nursery stock, vegetables, grain, sod, and flowers are situated here. Allaire State Park is 1/2- mile east of the Site and is used by golfers, fishermen, hunters, and equestrians. The Site is bounded by a chain-link fence on three sides that ties into the North Branch of Squankum Brook which is the physical boundary to the north.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Bog Creek Farm		
EPA ID: NJDO63157150		
Region: 2	**State:** NJ	**City/County:** Howell Township/Monmouth 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", enter Agency name]*:**		
Author name (Federal or State Project Manager): Tamara Rossi		
Author affiliation: EPA		
Review period: 6/1/2016 – 12/30/2016		
Date of site inspection: 10/26/2016		
Type of review: Policy		
Review number: 5		
Triggering action date: 7/2/2012		
Due date *(five years after triggering action date)*: 7/2/2017		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

Bog Creek Farm was proposed for addition to the National Priorities List (NPL) of Superfund sites in December 1982. After a public comment period, the status of the Site on the NPL was changed to final in September 1983. EPA began a Remedial Investigation and Feasibility Study (RI/FS) in 1984 to determine the nature and extent of contamination at Bog Creek Farm. This study determined that the greatest hazard at the Site was the soil near the waste trench, which was highly contaminated with volatile organic compounds (VOCs). In addition, unacceptable levels of contamination and potential exposure were identified in the bog and an on-site pond.

Based on 2003 groundwater sampling results, Site groundwater was found to be significantly contaminated with a variety of VOCs, including chlorinated VOCs and petroleum hydrocarbon contaminants. In particular, the following compounds and maximum concentrations were detected: 1,2-dichloroethane 30,000 micrograms per liter (µg/l), vinyl chloride 590 µg/l, benzene 8,800 µg/l, trichlorethene (TCE) 520 µg/l, cis-1,2-dichloroethane (DCE) 8,300 µg/l, l,2,4 trimethylbenzene 1,600 µg/l, toluene 5,800 µg/l, tetrachloroethene (PCE) 590 µg/l, l, l,2-trichloroethane 640 µg/l, l, l, l-trichloroethane 260 µg/l, 2,4-methylphenol 3,900 µg/l, phenol 1900 µg/l, and lead 25 µg/l. The 2005 screening level ecological risk assessment determined that contaminated sediments and surface water may have an impact on aquatic biota in the North Branch of Squankum Brook due to the presence of 1,2-dichlorobenzene in the sediment and barium in the surface water.

Response Actions

Initial Response

Prior to 1974, no removal or enforcement actions were undertaken at the Site. Late in 1974, the property owner removed some waste from the disposal trenches, transported the waste to KinBuc landfill in Edison, New Jersey and backfilled the pits with soil under the direction of the Howell Township Health Department. Over the next several years, the Howell Township Health Department and New Jersey Department of Environmental Protection (NJDEP) monitored the Site.

Selected Remedy

OU1 Remedy Selection

Based on the results of the RI/FS, EPA signed the OU1 ROD on September 30, 1985. The OU1 remedial action objectives are to:

- Control the release of contaminants from the waste disposal area; and,
- Reduce the adverse public health and environmental impacts associated with the high levels of contamination at the Site.

The OU1 ROD selected a cleanup level of 10,000 milligrams/kilogram (mg/kg) for total VOCs in the soils. However, the final action level for the excavation was deferred to the remedial design and was established to be 200 mg/kg for total VOCs.

The major components of the remedy selected in the OU1 ROD include the following:

- Remove the waste water and sediments from the pond and the bog;
- Regrade and cover the pond and the bog to prevent re-ponding;
- Treat the waste water on-site and discharge to the stream;
- Excavate the waste deposits and contaminated soil greater than 10,000 mg/kg of total volatile organics;
- Dispose of the excavated materials by incineration at a temporary facility on-site or at an off-site facility in accordance with the Resource Conservation and Recovery Act (RCRA);
- Perform a further analysis of the impact of the residual contaminated soil to determine the appropriate extent of additional soil cleanup;
- Cover the excavated area with a compact soil cap;
- Construct a security fence surrounding the Site and work areas;
- Implement a monitoring program to assess the effectiveness and reliability of the remedial action; and,
- Evaluate soil washing, soil segregation and other innovative technologies for the residual contaminated soil.

The OU1 ROD was modified on January 3, 2005 with an ESD. The OU1 ESD called for the excavation and disposal of contaminated soils that exceeded the New Jersey Impact to Groundwater Soil Cleanup Criteria (NJIGSCC). This ESD resulted in the removal of all contaminated soils and as a result, removed the requirement for FYRs at this OU.

OU2 Remedy Selection

The OU2 ROD for Bog Creek Farm, signed on June 28, 1989 called for two actions:

- Groundwater extraction, treatment, and reinjection to restore the Upper Kirkwood aquifer to cleanup goals identified in the Decision Summary.
- Excavation and incineration of contaminated sediments from the North Branch of Squankum Brook.

In September 2005, EPA issued the OU2 ROD Amendment which called for the optimization of the groundwater treatment plant, additional groundwater recovery wells, and if needed, in-situ treatment of contaminated soils/groundwater. The OU2 ROD Amendment remedial action objectives (RAOs) are:

- Prevent exposure to contaminated groundwater;
- Prevent/minimize contaminated groundwater discharge to the North Branch of Squankum Brook;
- Reduce Site cleanup time and life cycle costs; and,
- Restore contaminated groundwater to drinking water standards within a reasonable time-frame.

Status of Implementation

Remedy Implementation OU1

The OU1 remedy was implemented between 1989-1990 with the on-site incineration of 15,000 cubic yards of contaminated material and restoration of the Site with clean fill. The remediated areas were regraded, capped with clean topsoil and reseeded. These actions were intended to remediate the primary source of the groundwater contamination.

While the on-site incinerator was still in operation for OU1, it also treated the contaminated sediments removed from the stream bed of the North Branch of Squankum Brook as required under OU2. The OU1 ROD remedy included limited excavation of contaminated soils and established that if post-remediation monitoring and modeling demonstrate that the remedy is not meeting established goals, then additional excavation would be required. In May 2003, EPA conducted soil sampling that determined that an estimated additional 21,000 cubic yards of soil may be present with elevated VOC concentrations exceeding the NJIGSCC that could potentially impact the groundwater. The soil contamination remaining at the Site included VOCs at concentrations up to 16,800 mg/kg. Without removal of the remaining soils, the groundwater pump and treatment remedy would be unable to reach cleanup objectives for the groundwater for many decades. A second remedial action resulting in the removal of 14,500 tons of soils was completed in two phases during 2005 and 2006.

Remedy Implementation OU2

The OU2 remedial design (OU2 RD) began on December 5, 1989 and was completed on August 10, 1990. A slurry wall was constructed adjacent to the North Branch of Squankum Brook. The slurry wall was constructed primarily to reduce clean water from the North Branch of Squankum Brook from entering the pump and treatment system and at the same time it would also contain the plume, thus preventing any contaminated groundwater from reaching the North Branch of Squankum Brook until it attains the groundwater cleanup levels established in the OU2 ROD. A groundwater extraction system consisting of 33 well points and a vacuum system was installed inside the slurry wall alignment. The existing aqueous waste treatment system used in OU1 was upgraded and used for the treatment component of the remedy. Finally, two infiltration trenches were constructed up-gradient of the contaminant plume to receive the treated groundwater and thus provide a continuous, closed-loop flushing cycle. The upgraded treatment plant began trial runs in May 1994, and was determined to be fully operational and functional by August 1, 1995. In accordance with the OU2 ROD, the plant was designed to remove certain contaminants known to have migrated into the groundwater, namely four VOCs (benzene, toluene, 1,l,l-trichloroethane, trans-1,2-dichloroethene) and three heavy metals (copper, lead, zinc). While the on-site incinerator was still in operation for OU1, it also treated the contaminated sediments removed from the stream bed of the North Branch of Squankum Brook as required under the OU2 ROD. The plant operated during the long-term response action (LTRA) period and was utilized to treat contaminated groundwater during the contaminated soils remediation.

The 2005 OU2 ROD amendment selected a modified groundwater extraction and ex-situ treatment strategy with wells located across the contaminated portions of the Site, as opposed to only along the slurry wall, in order to both maintain hydraulic control and facilitate contaminant removal via focused pumping within the directly contaminated areas. In addition, the selected remedy included provisions for the groundwater extraction and treatment to be coupled with additional in-situ treatment enhancements for the groundwater, as necessary based on the monitoring of Site groundwater conditions

following the OU1 ESD contaminated soil and source area removal.

Based on pilot testing work completed in February 2008, and the amended OU2 RD completed in July 2008, a new treatment facility was constructed during a 12-month period from July 2009 to July 2010. The extracted groundwater is currently treated on a continuous cycle after which the clean effluent is discharged to the two reinjection trenches which remain intact from the original facility. Contaminants in vapor stream are captured in vapor phase granular activated carbon vessels and treated. It is important to note that three of the air sparge wells, namely AS-32, 33 and 34, have been positioned outside the slurry wall in order further diminish any contaminants that still might be impacting the North Branch of Squankum Brook.

Institutional Controls (ICs) Summary Table

Table 1: 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	New Jersey Department of Environmental Protection (NJDEP) ID #G000003346	Use restriction provided by Classification Exception Area (CEA). Restricts installation of ground water drinking wells and ground water use.	NJDEP CEA implemented August 6, 2014

Systems Operations/Operation & Maintenance

The operation and maintenance requirements and activities are specified in the Bog Creek Farm August 8, 2011, Contractor's Operation and Maintenance Manual. The manual provides that throughout the groundwater treatment plant's operational duration, the operator is responsible for the inspection, preventive maintenance, and unscheduled maintenance of all components of the groundwater, extraction, treatment, and discharge systems. The operator performs a minimum of one Site facility inspection per week. Additional inspections are performed as necessary. The operator performs a monthly inventory of all supplies. The operator is responsible for monitoring treatment system performance, permit equivalency compliance, and remedial progress. The operator maintains and submits a monthly operating log which includes but is not limited to: inventory, Site visitors, waste disposal quantities, operating conditions, maintenance, recommendations, and an inspection report. During the system operations, the largest problem has been fouling caused by iron that naturally occurs in groundwater in the area. The contractor has taken actions such as variation in treatment processes to optimize performance and pump restoration to enhance efficiency. There have been no reported compliance issues with the NJDEP permit equivalencies at the Site.

Potential Site impacts from climate change have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the Site.

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 2: Protectiveness Determinations/Statements from the 2012 FYR

OU #	Protectiveness Determination	Protectiveness Statement
2	Protective	The OU2 remedy is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.
Sitewide	Protective	All immediate threats at the Site have been addressed, and the remedy is expected to be fully protective of human health and the environment after the groundwater cleanup goals are achieved. Currently, there are no exposure pathways that could result in unacceptable risks and none are expected as long as the Site is properly maintained or until the aquifer itself is restored.

IV. FIVE-YEAR REVIEW PROCESS

Community Involvement

On November 14, 2016, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at 38 Superfund sites in New York and New Jersey, including the Bog Creek Farm Superfund Site. The announcement can be found at the following web address: https://www.epa.gov/sites/production/files/2016-11/documents/five_year_reviews_fy2017_final.pdf. In addition to this notification, the EPA Community Involvement Coordinator (CIC) for the Site, Pat Seppi, arranged for a notice to be posted on the township website, as well as the EPA website, https://www.epa.gov/superfund/bog-creek-farm. This notice indicated that a FYR would be conducted at the Bog Creek Farm Superfund Site to ensure that the Site is protective of human health and the environment. Once the FYR is completed, the final report will be posted on the EPA website and will be made available at the following repository: Howell Library at 318 Old Tavern Road, Howell Township, New Jersey 07731.

Document Review

The documents, data, and information which were reviewed in completing this fifth five-year review are summarized in the reference list (Appendix A).

Data Review

Groundwater samples and water levels are monitored in addition to limited surface water and sediment samples. Soil vapor samples are no longer collected. The frequency of the sampling is varied to address the data objectives of the sampling.

Groundwater Sampling

While most groundwater sampling is conducted on an annual basis, in the event that new monitoring wells are installed, they are initially sampled quarterly. In summary, groundwater data collected during the FYR period indicated that the remedy is progressing towards restoration of groundwater. Historical contaminants of concern (benzene, PCE, TCE and vinyl chloride) have decreased substantially since 2011. Table 3 presents a historical data comparison of monitoring well groundwater analytical results for benzene, TCE, PCE, and vinyl chloride.

During the most recent monitoring well sampling event in November 2015, benzene, PCE, TCE and/or vinyl chloride concentrations were found in groundwater exceeding the associated cleanup goals. Some monitoring well locations include, MP-01, MP-03, MW-39 and MW-40.

- MP-01 detected PCE and TCE concentrations of 1.7 µg/L and 2.3 µg/L, respectively.
- MP-03 had benzene, PCE and TCE concentrations of 2.5 µg/L, 1.6 µg/L and 3.2 µg/L, respectively.
- MW-39 detected benzene and TCE concentrations of 2.9 µg/L and 1.6 µg/L, respectively.
- MW-40 detected vinyl chloride concentrations in groundwater of 9.0 µg/L.

Four new monitoring wells (MW-38, MW-39, MW-40 and MW-41) were installed in February 2015 and have been added to the sampling database and will continue to be sampled.

Roughly half of the two-phase extraction (TPE) wells, where benzene, PCE, and TCE in groundwater exceeded cleanup goals during the reporting period, also exhibited downward concentration trends during the FYR period. The concentrations of benzene, PCE, and TCE in groundwater sampled from monitoring wells have decreased when compared to historic analytical results. Therefore, the remedy goal of reducing groundwater contaminant concentrations to below the cleanup goals using the GWTP would be achieved over the course of time. Trend graphs for benzene in the TPE wells are provided in Figure 2. Trend graphs for TCE, PCE, and vinyl chloride in the TPE wells are provided in Figure 3.

No Semi-volatile Organic Compounds (SVOCs) were detected above regulatory standards in the new monitoring wells added to the sampling network during the November 2015 sampling round. Additional monitoring wells are scheduled to be sampled to confirm that SVOCs are not constituents of concern in the groundwater at the Site.

Three metals detected in groundwater samples collected at the four new monitoring wells exceeded cleanup goals with iron and manganese most frequently detected. High concentrations of iron and manganese in groundwater are thought to be naturally occurring, and the naturally-occurring elevated iron concentrations contribute to well and pump fouling at the Site. Cobalt in groundwater was detected above the cleanup goals in three of the four monitoring wells. Metals were only sampled in the four new monitoring wells. Metals have been added to the sampling parameters for future sampling of select wells to further assess these constituents.

Water Level Elevations

Water level elevations were measured on annual, monthly and weekly basis. The annual groundwater sampling event in November 2015 provided the data used to create the potentiometric surface contour map. Monthly measurement of TPE wells monitor groundwater flow direction and gradient. The water

level elevations in MW-18 and MW-26 are compared to the elevation of the top of the slurry wall on a weekly basis and an inward gradient has been consistently maintained.

Surface Water and Soil Sampling Outside Slurry Wall

Surface water samples were collected at two locations in the North Branch of Squankum Brook outside of the slurry wall in 2015. No VOCs were detected in surface water in 2015. However, a small area of VOC impacted soils was detected immediately outside the slurry wall. Further sampling of this area is planned, and both surface water and sediment samples will be collected on a semi-annual basis in the future to reduce the uncertainty associated with the impacted groundwater and its impacts on the North Branch of Squankum Book.

Soil Vapor Samples

The soil vapor extraction (SVE) system was taken off line on June 17, 2015. It was determined that the TPE well screens were submerged by groundwater. The submergence of the well screens prevents the SVE system from being effective.

Site Inspection

The five-year review Site inspection was held with the five-year review team on October 26, 2016. In attendance were Mindy Pensak, Julie McPherson and Rob Alvey from EPA Region 2; and Neil Kolb and Brian Packowski from the United States Army Corps of Engineers (USACE). The purpose of the inspection was to assess the protectiveness of the remedy. No issues were found. The plant operators are present on-site five days a week to make sure everything is functioning smoothly and all required testing and sampling is being done on schedule. Similarly, the USACE is on the Site on a daily or weekly basis, as needed, to arrange the changeout of carbon, dispose of waste sludge, handle all visitors, as well as conduct field activities such as sampling and investigations.

Interviews / Meetings

There have been Site visits, discussions and limited interviews with the town engineers since the Township of Howell has taken over the adjacent properties, since some of their activities require joint planning with EPA. No issues were identified resulting from the Site visits, discussions and limited interviews with the township.

V. TECHNICAL ASSESSMENT

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

The OU2 ROD and OU2 ROD Amendment called for extracting, treating, and reinjecting groundwater to restore the Upper Kirkwood Aquifer to cleanup goals and excavating and treating contaminated sediment from the North Branch of Squankum Brook. Groundwater data and surface water data collected over the last five years indicate that the groundwater plume continues to reduce in size and contaminant concentrations. The remaining plume is contained at the Site, i.e., the groundwater plume is confined to the shallow aquifer and the slurry wall aligned along the North Branch of Squankum Brook is preventing the plume from reaching any possible down-gradient wells. Contamination close to the North Branch of Squankum Brook pre-dated the construction of the slurry wall as part of the OU2

remedy. In the current 5-year period, the remediation outside the slurry wall has incorporated three air sparging wells close to piezometer 4 (PZ-4) to induce VOC aeration from that area and address this residual contamination. Data will be collected to evaluate the process of this additional remedy component and confirm that groundwater in this area is not impacting the North Branch of Squankum Brook.

Access to the property and the groundwater is currently restricted and is preventing any unacceptable exposure until final cleanup standards are achieved. The CEA was established by NJDEP on August 6, 2014 to restrict installation of ground water drinking wells and ground water use. EPA will evaluate the need for an additional IC, such as a deed notice, in the future. If it is determined to be required, the deed notice would include a list of the contaminants that remain, restrictions on use, alterations, improvements and disturbances, and monitoring and maintenance upon property redevelopment or transfer.

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?

There have been no physical changes to the Site that would adversely affect the protectiveness of the remedy. Land use assumptions, exposure assumptions and pathways, cleanup levels and remedial action objectives considered in the decision documents remain valid. The Site is a farmland property located in a rural, agricultural and recreational area with no future use planned for the Site. The following RAOs for OU2 include: prevent exposure to contaminated groundwater; prevent/minimize contaminated groundwater discharge to the North Branch of Squankum Brook; reduce Site cleanup time and life cycle costs; and, restore contaminated groundwater to drinking water standards within a reasonable time-frame. The established RAOs for OU2 remain valid.

The risk assessment process has changed somewhat since the original risk assessment was performed in 1983 and 1986. In addition, chemical-specific toxicity values have changed since the Site was originally assessed. A streamlined Human Health Risk Assessment (HHRA) conducted in 2005 took into account the changes in toxicity values and exposure assumptions since the original risk assessment was conducted. This HHRA has identified additional chemicals of concern (COCs). A summary of the COCs that have the potential to impact human health is provided in Table 4-1 of the 2005 streamline HHRA. In order to account for changes in the risk assessment process, the maximum detected concentrations of the COCs identified during the 2006 sampling event (post-excavation of residual contamination in the soil) were compared to groundwater cleanup levels. This analysis indicates that multiple COCs exceeded cleanup levels in 2006; however, it has also been noted that the concentrations of COCs have also decreased considerably since 2003, i.e., prior to the recent excavation of residual contamination detected in the soil and that groundwater contamination is limited to the shallow aquifer inside the slurry wall.

Soil vapor intrusion was previously evaluated as a potential future exposure pathway even though there are currently no buildngs onsite. The maximum detected concentrations of several contaminants in groundwater exceeded their respective screening criteria. This does not indicate that a vapor intrusion problem would occur if a building were to be erected over the plume. It merely indicates that further investigation would be necessary, which includes site-specific considerations such as the type of building, its foundation, the location of the building in relation to the maximum detected concentrations, and the subsurface characteristics of the Site should buildings be constructed.

The 2005 screening level ecological risk assessment determined that contaminated sediments and surface water may have an impact on aquatic biota in the North Branch of Squankum Brook due to the presence of 1,2-dichlorobenzene in the sediment and barium in the surface water. The detected contaminants of potential concern however do not pose an ecological risk to piscivorous avian and mammal receptors that utilize the brook. It was noted that the calculated hazard quotient most likely overestimates the direct exposure to 1,2-dichlorobenze since it is highly volatile and only moderately able to adsorb to soil (sediment) making exposure unlikely. For barium, exceedances were noted in only one sample, and there was uncertainty associated with the reference value used for barium as it was based on only one study. However, contaminated sediment was removed to restore the environmental quality of the brook. Recent surface water and sediment data collected from the North Branch of Squankum Brook do not exhibit concentrations of constituents above screening criteria. Remedial actions taken at the Site (excavation and backfill with clean fill of the site soils as well as brook sediment and construction of a slurry wall with the groundwater remedy) have resulted in interrupting the exposure pathways for ecological receptors.

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 could call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
None

Other: Groundwater samples were analyzed for 1,4-dioxane but it was not detected. However, the achieved detection limit of 1.9 µg/L was above the NJDEP groundwater quality standard of 0.4 µg/L. EPA will analyze future groundwater samples to determine if 1,4-dioxane is present at levels above the NJDEP groundwater quality standard of 0.4 µg/L.

VII. PROTECTIVNESS STATEMENT

Protectiveness Statement(s)		
Operable Unit: OU2	*Protectiveness Determination:* Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: The OU2 remedy is protective of human health and the environment.		
Sitewide Protectiveness Statement		
Protectiveness Determination: Protective		*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: The Site remedy is protective of human health and the environment.		

VIII. NEXT REVIEW

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

APPENDIX A – REFERENCE LIST

Five-Year Review Report, Bog Creek Superfund Site, EPA, September 1997

2nd - Five-Year Review Report, Bog Creek Superfund Site, EPA, September 2002

Streamlined Human Health Risk Assessment, Focused Feasibility Study, Bog Creek Farm Superfund Site, Howell Township, NJ, CDM, June 2005

Final Data Summary Report, Focused Feasibility Study, Bog Creek Farm Superfund Site, Howell Township, NJ, CDM, August 2005

Amended OU2 Record of Decision, Bog Creek Farm Superfund Site, Howell, NJ, EPA, September 2005

Final Screening Level Ecological Risk Assessment, Focused Feasibility Study, Bog Creek Farm Superfund Site, Howell Township, NJ, CDM, October 2005

Technical Memorandum, Subsurface Investigation in Support of On-site Soil Excavation and Removal, Bog Creek, Howell, NJ, REAC, November 2005

Technical Memorandum, Additional Subsurface Investigation in Support of On-site Remedial Activities, Bog Creek, Howell, NJ, REAC, April 2006

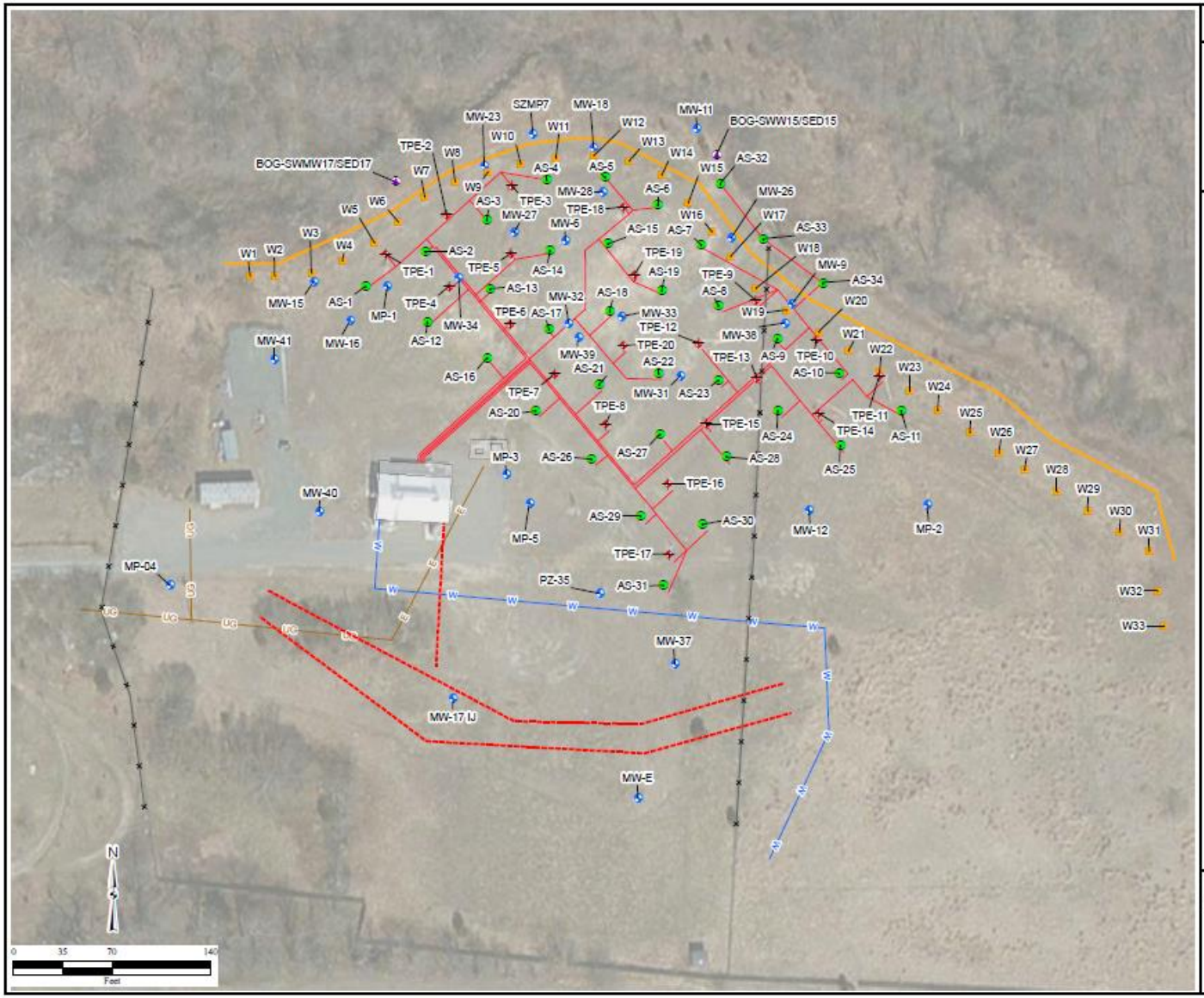
3rd Five Year Review Report, Bog Creek Farm Superfund Site, EPA, June 7, 2007

4th Five Year Review Report, Bog Creek Farm Superfund Site, EPA, July 2, 2012

Annual O&M Report for Reporting Period June 2014- April 2015, ECC- USACE, June 2015

Annual Operations and Maintenance Report May -2015-November 2015, HydroGeologic, Inc.- USACE, June 2016

Figure 1.2
Site Layout



Legend

- Air Sparge Well
- Extraction Well
- Two Phase Extraction Well
- Monitoring Well/Monitoring Point
- Surface Water/Sediment Sample
- Fence
- Injection Trench
- Potable Water
- Slurry Wall
- Treatment System Piping
- Underground Electric Line
- Underground Utility
- Treatment Plant

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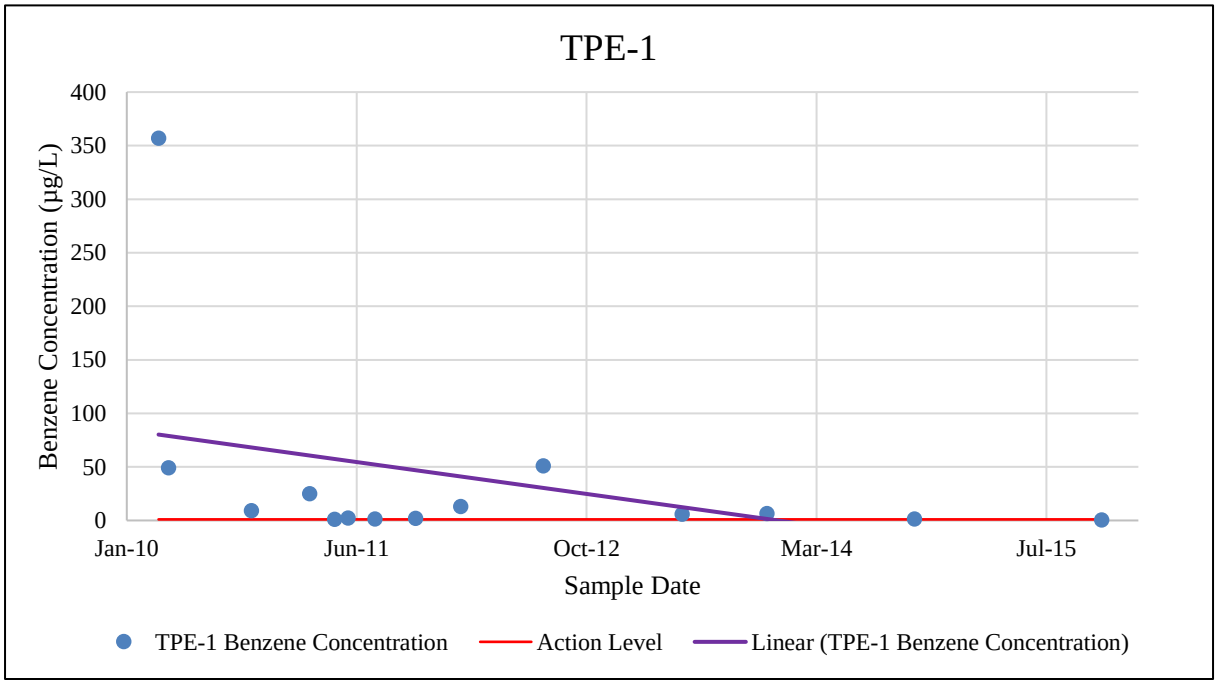
5/18/2016 TB
Source: HGL, NJGIN, NJDEP, ArcGIS Online Imagery

Figure 2 - Historical Benzene Concentrations in TPE Wells



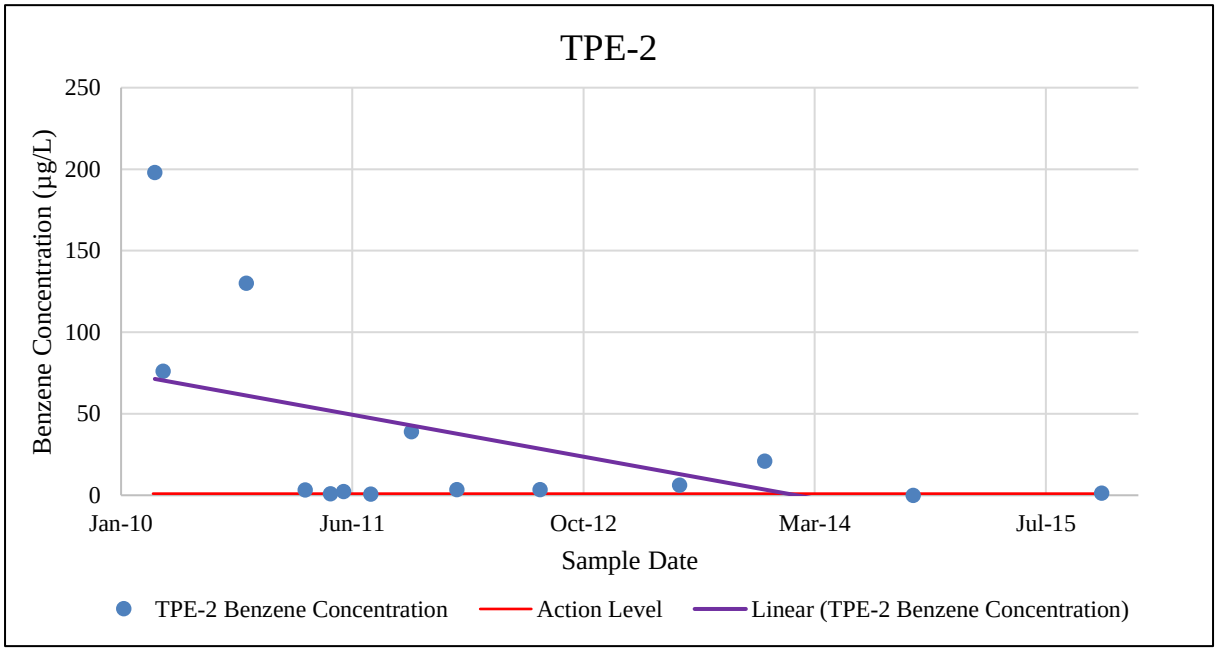
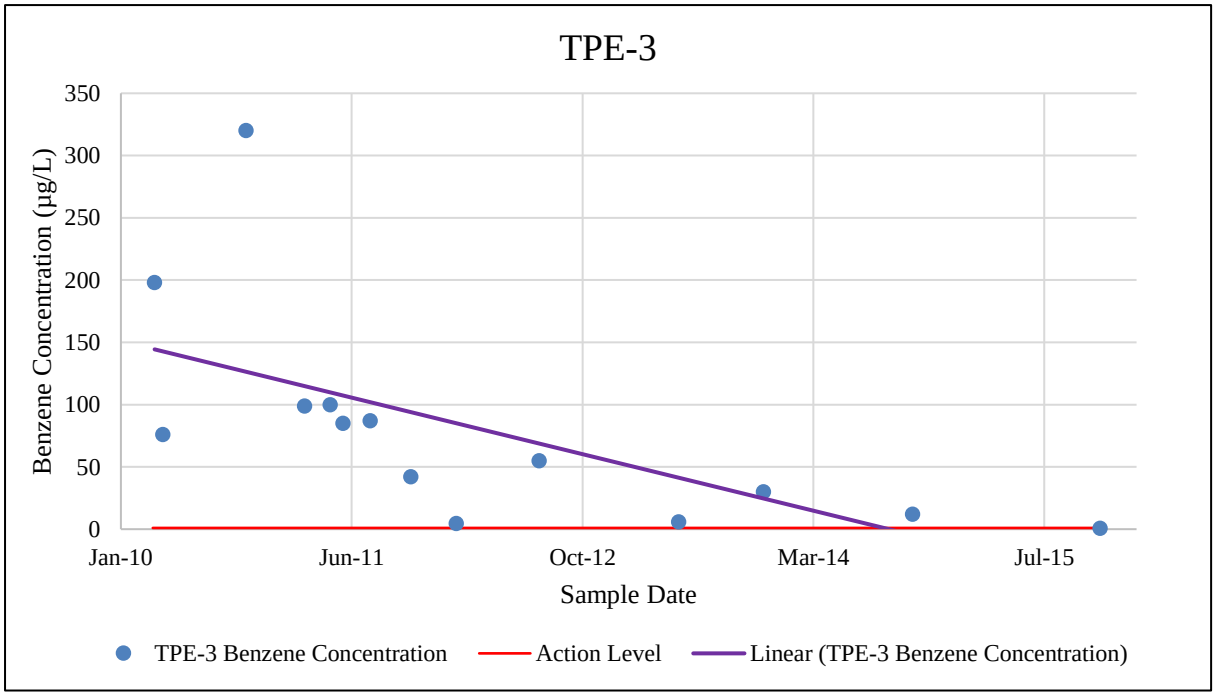


Figure 2 - Historical Benzene Concentrations in TPE Wells



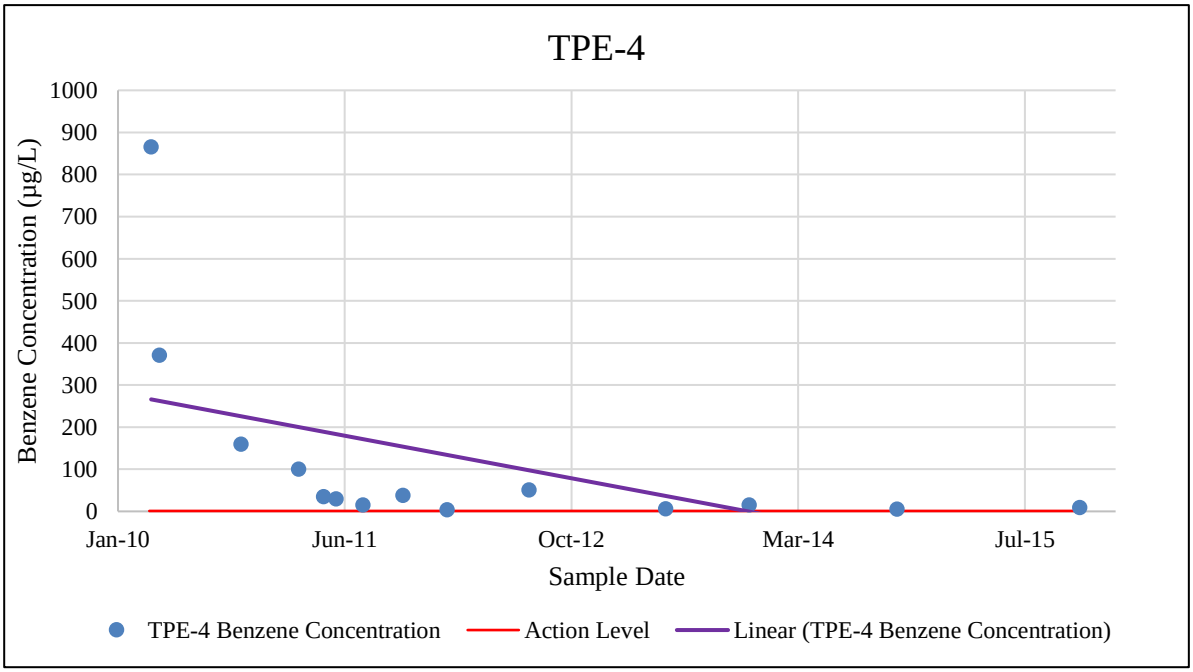
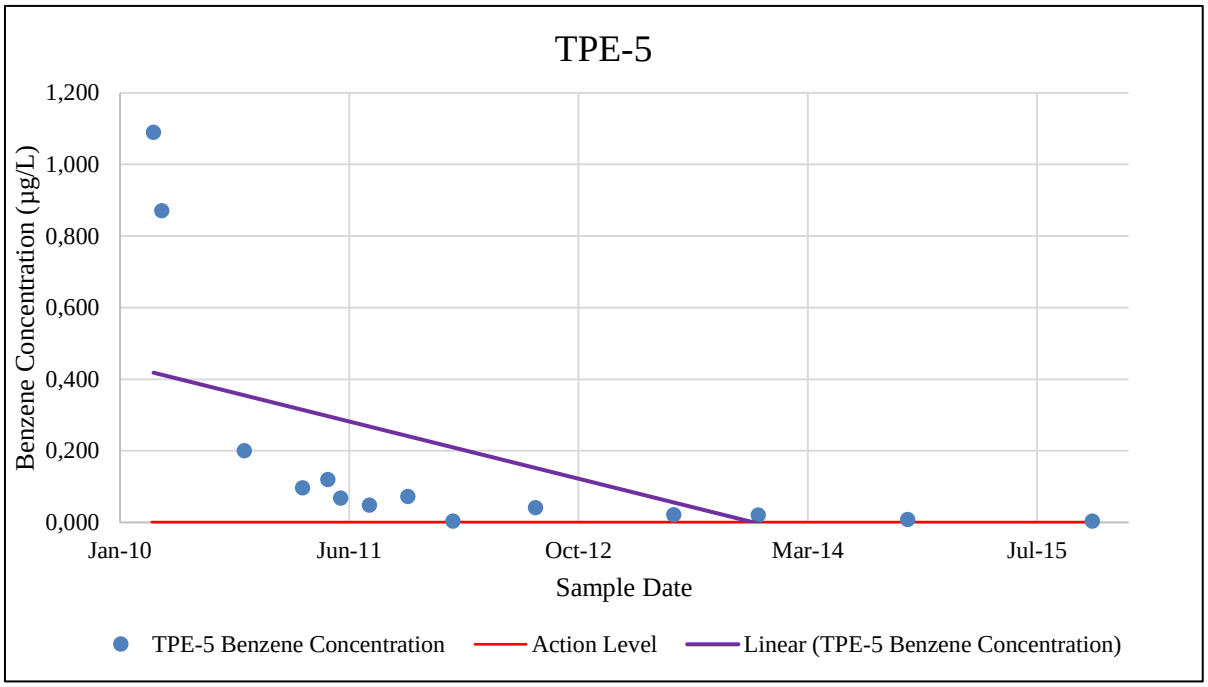


Figure 2 - Historical Benzene Concentrations in TPE Wells



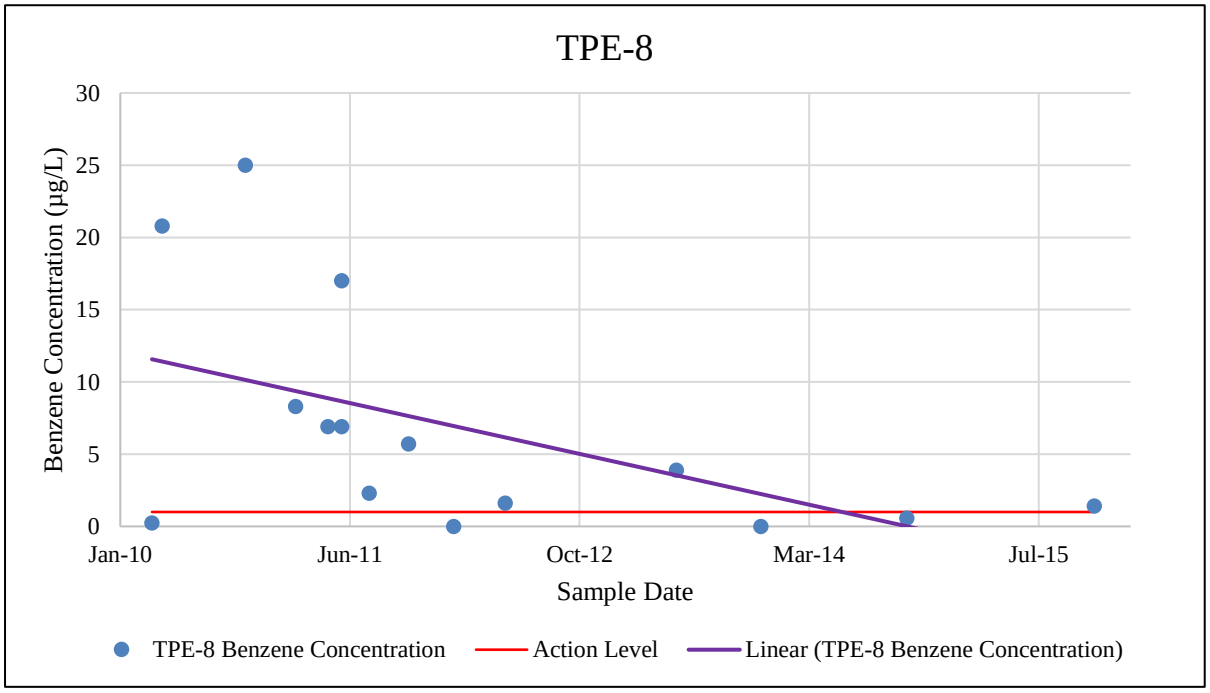
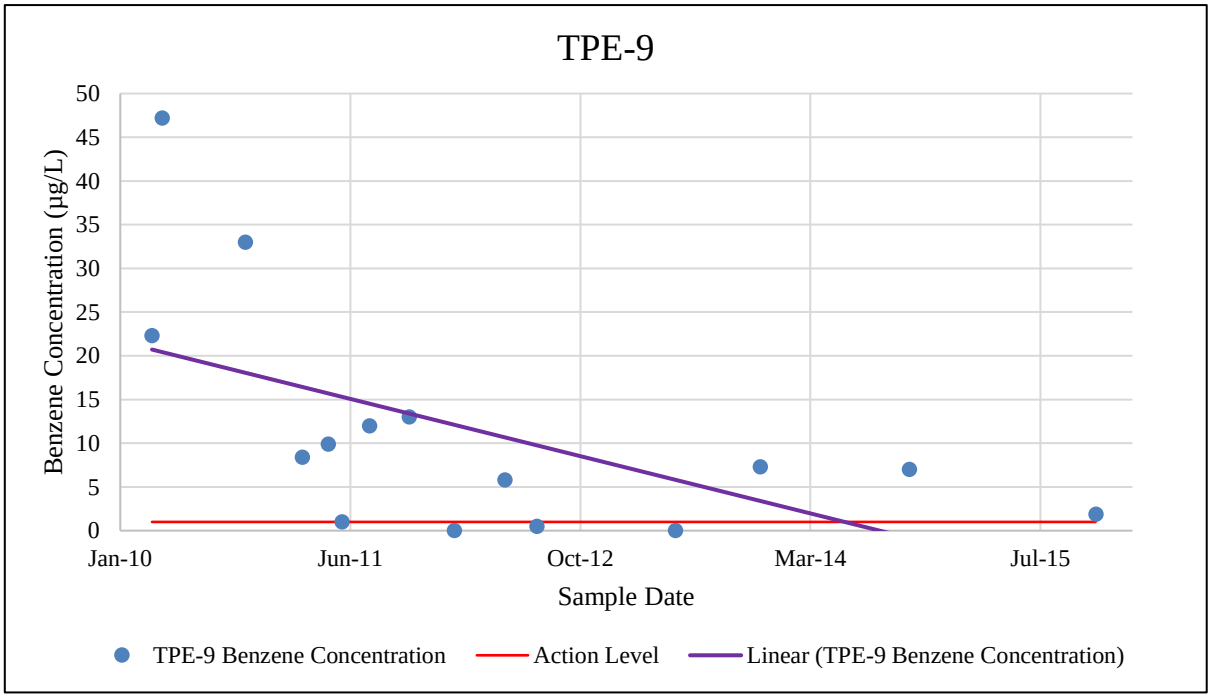


Figure 2 - Historical Benzene Concentrations in TPE Wells



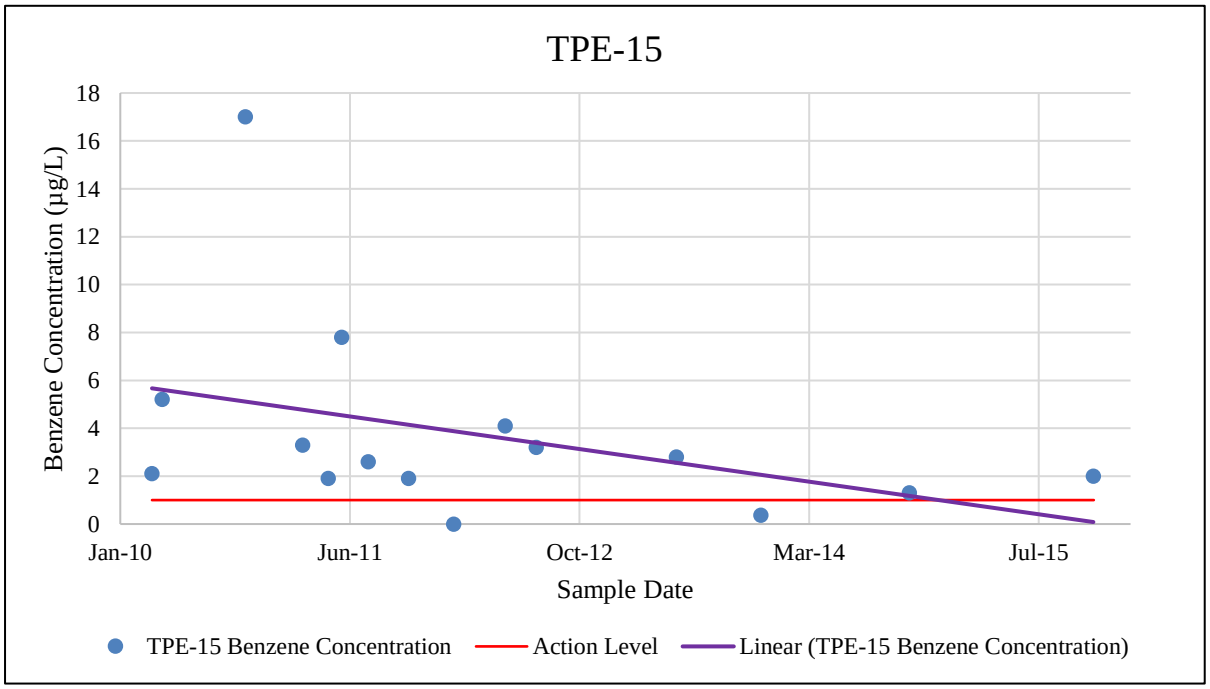
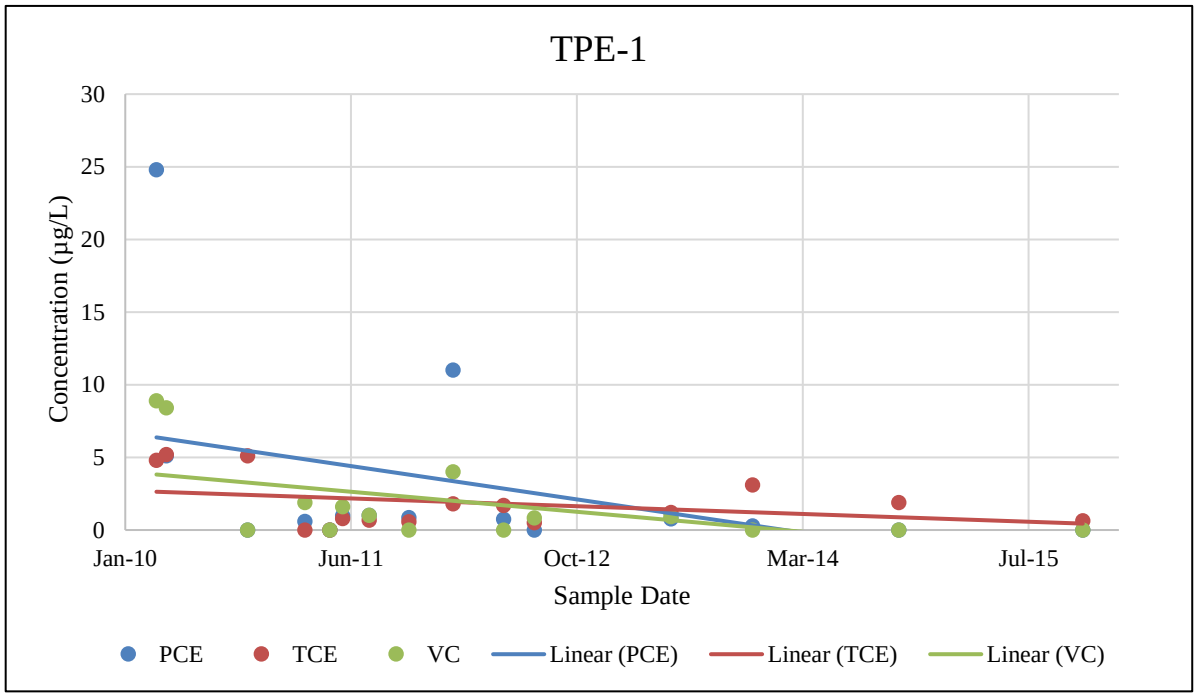


Figure 3 - Historical PCE, TCE and Vinyl Chloride Concentrations in TPE Wells



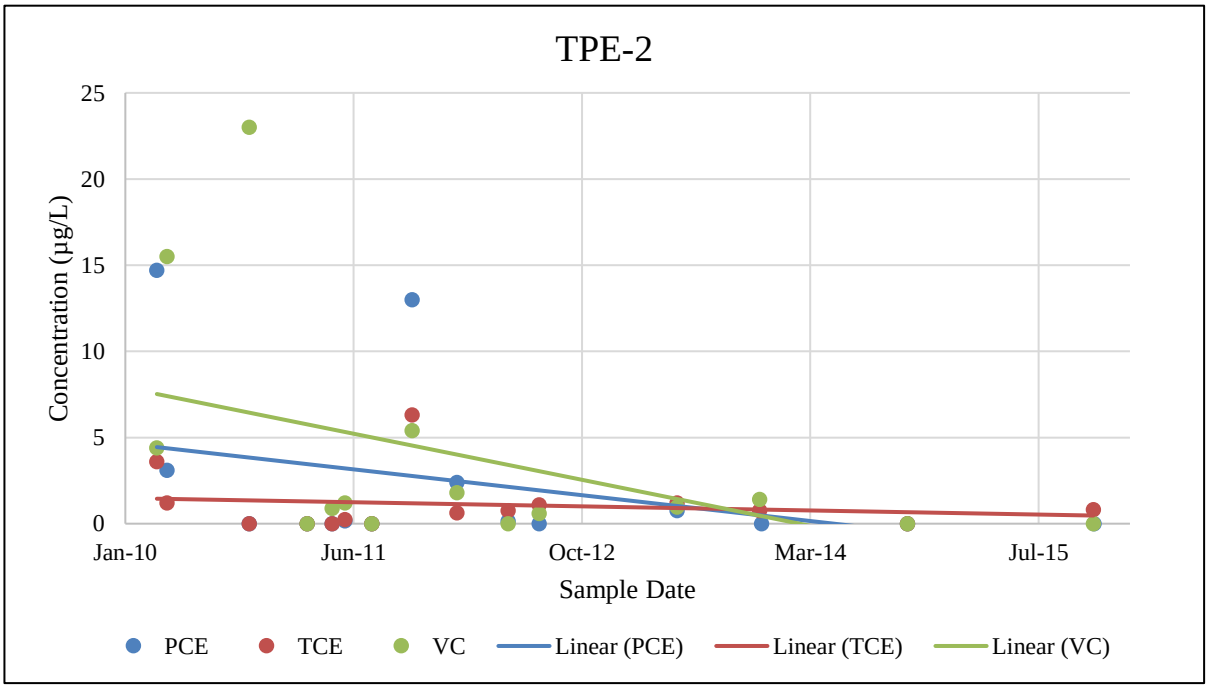
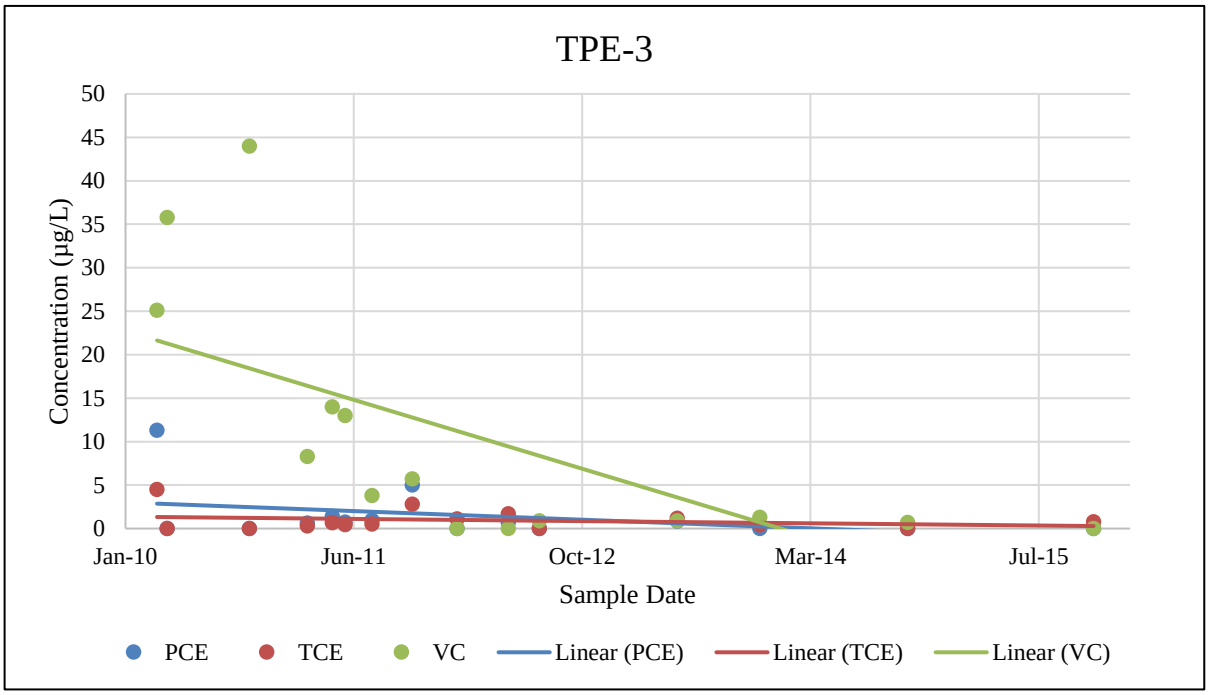


Figure 3 - Historical PCE, TCE and Vinyl Chloride Concentrations in TPE Wells



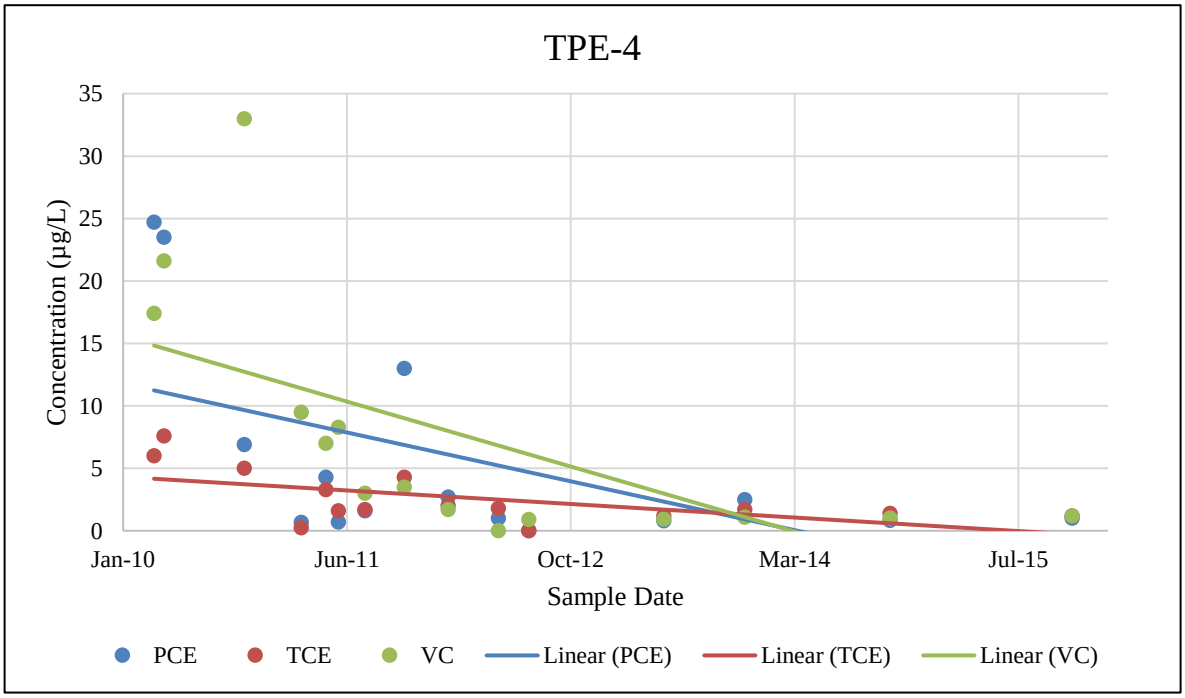
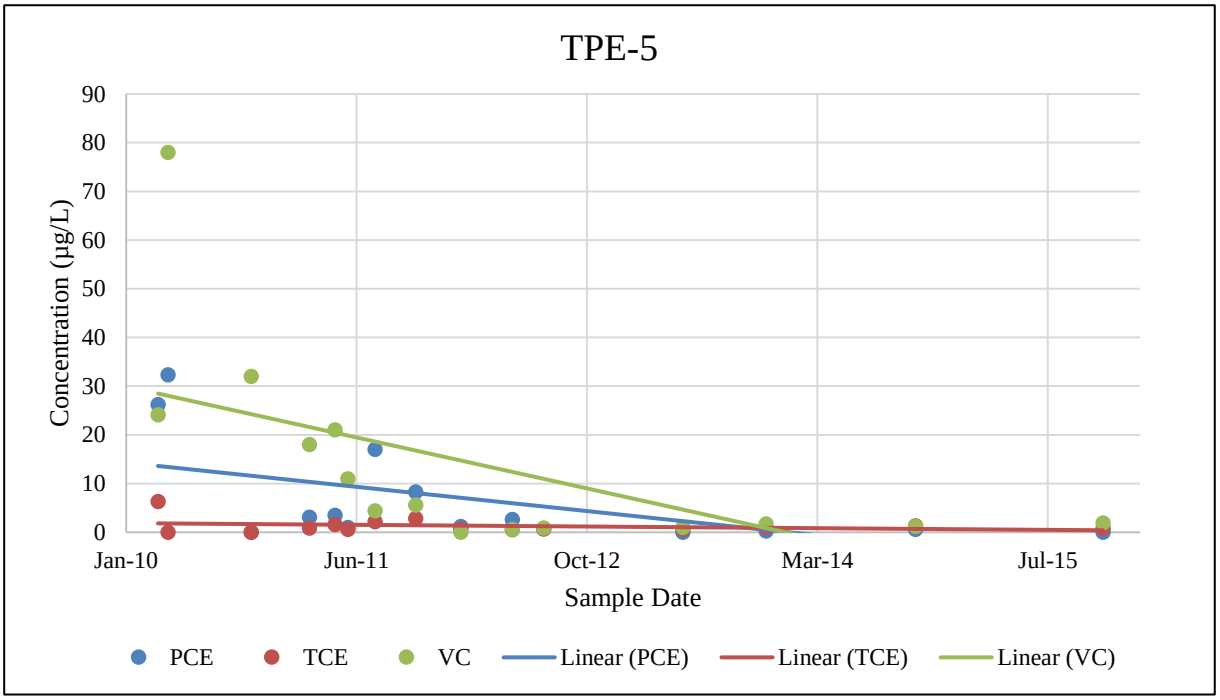


Figure 3 - Historical PCE, TCE and Vinyl Chloride Concentrations in TPE Wells



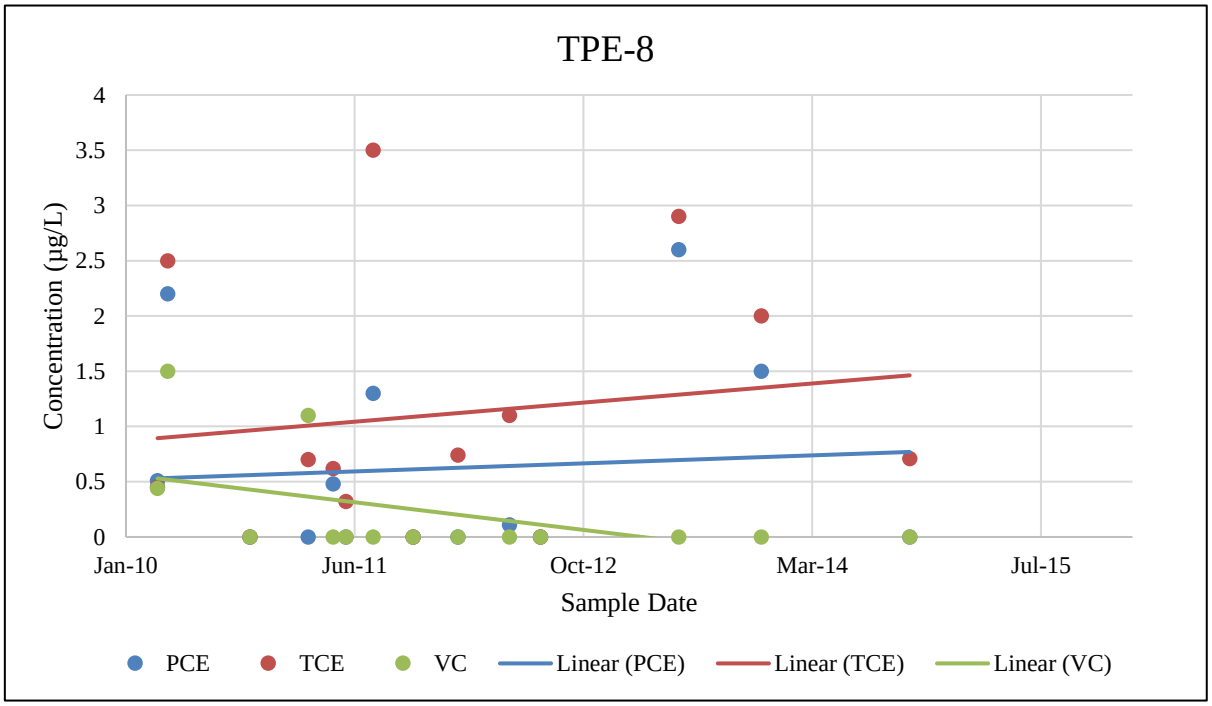
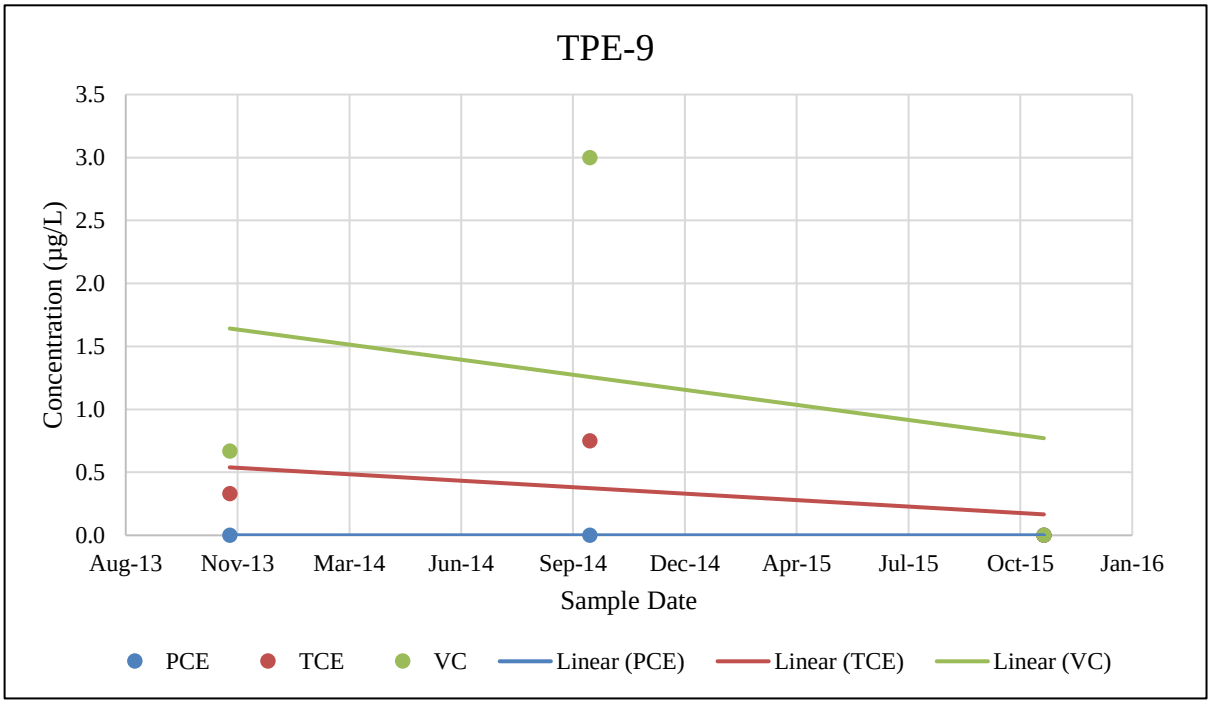


Figure 3 - Historical PCE, TCE and Vinyl Chloride Concentrations in TPE Wells



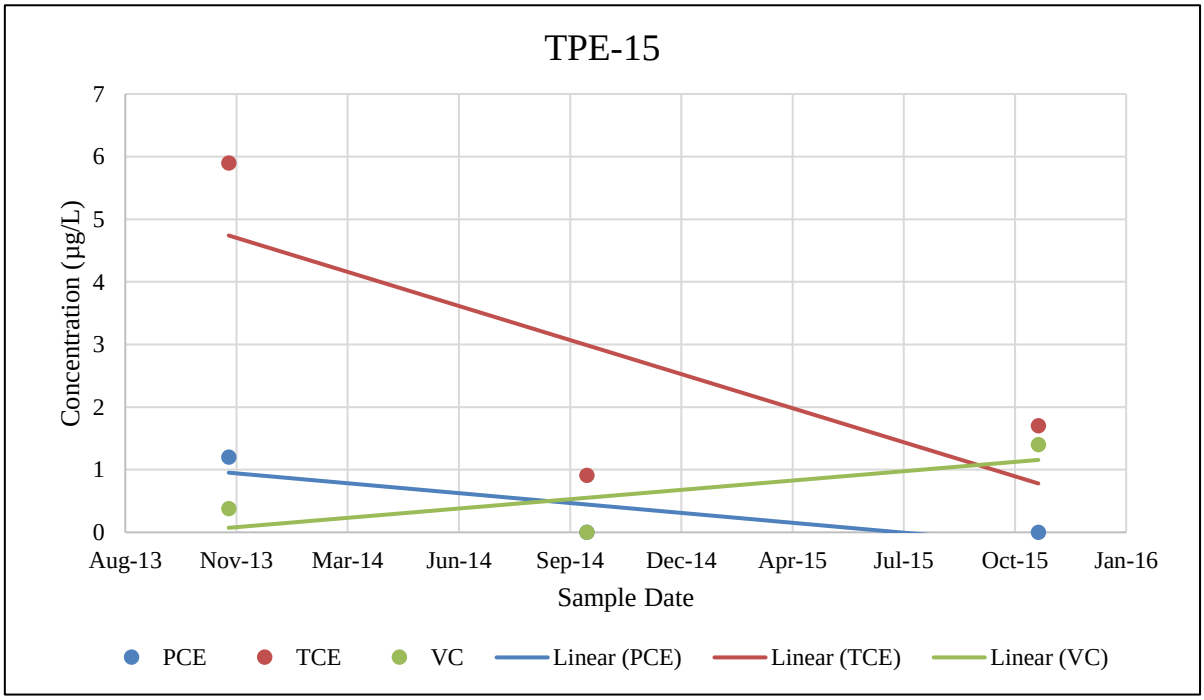


Table 3

TCE, PCE, Vinyl Chloride, and Benzene Historical Groundwater Results Comparison

Location (Well)	Sample Date	TCE	PCE	Vinyl Chloride	Benzene	Sample Date	TCE	PCE	Vinyl Chloride	Benzene
		µg/L	µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L
PAL		**1**	**1**	**5**	**1**		**1**	**1**	**5**	**1**
SZMP7	Sep-06	---	---	---	---	Nov-11	ND	ND	ND	
SZMP8	Sep-06	---	---	---	---	Nov-11	ND	ND	ND	ND
MW-G	Sep-06	ND	ND	ND	ND	Nov-11	ND	ND	ND	0.59
W2	Sep-06	---	---	---	---	Nov-11	---	---	---	---
W15 (EW-15)	Sep-06	**1**	**2.7**	**8.9**	**100 J**	Nov-11	---	---	---	---
MP1 (MW01)	Sep-06	ND	ND	ND	**53**	Nov-11	**2.2**	**1.9**	**2.1**	**3.2**
MP-2	Sep-06	ND	ND	ND	ND	Nov-11	---	---	---	---
MW-3	Sep-06	**5.2**	**1.3**	ND	ND	Nov-11	---	---	---	---
MW-5	Sep-06	---	---	---	---	Nov-11	ND	ND	ND	ND
MW-9	Sep-06	ND	ND	ND	**37**	Nov-11	---	---	---	---
MW-12	Sep-06	---	---	---	---	Nov-11	ND	ND	ND	ND
MW-16	Sep-06	---	---	---	---	Nov-11	**8**	**10**	**1.2**	**59**
MW-18	Sep-06	---	---	---	---	Nov-11	ND	ND	ND	ND
MW-26	Sep-06	---	---	---	---	Nov-11	ND	ND	ND	**1.2**
W29	Sep-06	---	---	---	---	Nov-11	---	---	---	---
MW-31	Sep-06	---	---	---	---	Nov-11	ND	ND	ND	ND
MW-37	Sep-06	---	---	---	---	Nov-11	ND	ND	ND	ND
MW-38	Sep-06	---	---	---	---	Nov-11	---	---	---	---
MW-39	Sep-06	---	---	---	---	Nov-11	---	---	---	---
MW-40	Sep-06	---	---	---	---	Nov-11	---	---	---	---
MW-41	Sep-06	---	---	---	---	Nov-11	---	---	---	---

Notes:

Reportable detections are in Bold

Highlighted results equal to or above Project Action Levels (PALs)

--- = No Data Reported

µg/L = Micrograms per Liter

J = Estimated Value

U = Not detected at the indicated value.

PAL= PROJECT ACTION LIMIT

PCE = tetrachloroethene

MW= monitoring well

ND = Not Detected

TCE = Trichloroethene

Table 3

TCE, PCE, Vinyl Chloride, and Benzene Historical Groundwater Results Comparison

Location (Well)	Sample Date	TCE	PCE	Vinyl Chloride	Benzene	Sample Date	TCE	PCE	Vinyl Chloride	Benzene
		µg/L	µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L
PAL		**1**	**1**	**5**	**1**		**1**	**1**	**5**	**1**
SZMP7	Nov-12	ND	ND	ND	ND	Nov-13	ND	ND	ND	**0.70**
SZMP8	Nov-12	---	---	---	---	Nov-13	---	---	---	---
MW-G	Nov-12	ND	ND	**8.7 J**	**45**	Nov-13	**0.14 J**	ND	ND	**11**
W2	Nov-12	---	---	---	---	Nov-13	ND	ND	ND	ND
W15 (EW-15)	Nov-12	ND	ND	ND	ND	Nov-13	ND	ND	ND	**2.3**
MP1 (MW01)	Nov-12	**5.5**	**4**	**1.5 K**	**17**	Nov-13	**1.8**	**1.3**	**1.8**	**1.7**
MP-2	Nov-12	---	---	---	---	Nov-13	---	---	---	---
MW-3	Nov-12	---	---	---	---	Nov-13	---	---	---	---
MW-5	Nov-12	---	---	---	---	Nov-13	---	---	---	---
MW-9	Nov-12	---	---	---	---	Nov-13	---	---	---	---
MW-12	Nov-12	ND	ND	ND	ND	Nov-13	---	---	---	---
MW-16	Nov-12	---	---	---	---	Nov-13	---	---	---	---
MW-18	Nov-12	ND	ND	ND	ND	Nov-13	ND	ND	ND	ND
MW-26	Nov-12	ND	ND	ND	**3.9**	Nov-13	ND	ND	ND	ND
W29	Nov-12	---	---	---	---	Nov-13	ND	ND	ND	ND
MW-31	Nov-12	**0.56**	ND	ND	ND	Nov-13	ND	**0.18 J**	**0.53**	**1.1**
MW-37	Nov-12	ND	ND	ND	ND	Nov-13	**0.34 J**	**0.3 J**	ND	ND
MW-38	Nov-12	---	---	---	---	Nov-13	---	---	---	---
MW-39	Nov-12	---	---	---	---	Nov-13	---	---	---	---
MW-40	Nov-12	---	---	---	---	Nov-13	---	---	---	---
MW-41	Nov-12	---	---	---	---	Nov-13	---	---	---	

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PCE = tetrachloroethene

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TCE = Trichloroethene

Table 3

TCE, PCE, Vinyl Chloride, and Benzene Historical Groundwater Results Comparison

Location (Well)	Sample Date	TCE	PCE	Vinyl Chloride	Benzene	Sample Date	TCE	PCE	Vinyl Chloride	Benzene
		µg/L	µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L
PAL		**1**	**1**	**5**	**1**		**1**	**1**	**5**	**1**
SZMP7	Oct-14	ND	ND	ND	ND	Nov-15	ND	ND	ND	ND
SZMP8	Oct-14	---	---	---	---	Nov-15	---	---	---	---
MW-G	Oct-14	**0.59**	ND	**1.2**	**24**	Nov-15	**0.77**	ND	ND	ND
W2	Oct-14	---	---	---	---	Nov-15	ND	ND	ND	**4.0**
W15 (EW-15)	Oct-14	ND	ND	ND	**42**	Nov-15	ND	ND	ND	**63**
MP1 (MW01)	Oct-14	**1.6**	**1.1**	**0.68**	**0.95**	Nov-15	**2.3**	**1.7**	**0.64**	ND
MP-2	Oct-14	---	---	---	---	Nov-15	ND	ND	ND	ND
MW-3	Oct-14	---	---	---	---	Nov-15	---	---	---	---
MW-5	Oct-14	---	---	---	---	Nov-15	---	---	---	---
MW-9	Oct-14	---	---	---	---	Nov-15	---	---	---	---
MW-12	Oct-14	ND	ND	ND	ND	Nov-15	---	---	---	---
MW-16	Oct-14	**2.3**	**4.1**	**0.6**	**28**	Nov-15	---	---	---	---
MW-18	Oct-14	ND	ND	ND	ND	Nov-15	ND	ND	ND	ND
MW-26	Oct-14	ND	ND	ND	ND	Nov-15	ND	ND	ND	ND
W29	Oct-14	---	---	---	---	Nov-15	ND	ND	ND	ND
MW-31	Oct-14	ND	ND	ND	ND	Nov-15	---	---	---	---
MW-37	Oct-14	ND	ND	ND	ND	Nov-15	---	---	---	---
MW-38	Oct-14	---	---	---	---	Nov-15	ND	ND	ND	ND
MW-39	Oct-14	---	---	---	---	Nov-15	**1.6**	ND	ND	**2.9**
MW-40	Oct-14	---	---	---	---	Nov-15	**0.89**	ND	**9.0**	ND
MW-41	Oct-14	---	---	---	---	Nov-15	ND	ND	ND	ND

Notes:

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PAL= PROJECT ACTION LIMIT

PCE = tetrachloroethene

MW= monitoring well

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TCE = Trichloroethene