THIRD FIVE-YEAR REVIEW REPORT FOR TUTU WELLFIELD SUPERFUND SITE ST. THOMAS, U.S. VIRGIN ISLANDS

Prepared by

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Region 2
New York, New York

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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
CVOC	Chlorinated Volatile Organic Compound
DNAPL	Dense Non-Aqueous Phase Liquid
DPNR	U.S. Virgin Islands Department of Planning and Natural Resources
DRO	Diesel Range Organics
EAB	Enhance Anaerobic Biodegradation
EPA	United States Environmental Protection Agency
FS	Feasibility Study
FYR	Five-Year Review
GAC	Granular Activated Carbon
gpm	gallons per minute
GRO	Gasoline Range Organics
GVI	Government of the Virgin Islands
GWTF	Groundwater Treatment Facility
ICs	Institutional Controls
ITP	Initial Testing Program
LNAPL	Light Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
MTBE	Methyl Tertiary Butyl Either
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PRG	Preliminary Remediation Goals
PRP	Potentially Responsible Party
PVC	Polyvinyl Chloride
RAO	Remedial Action Objectives
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
scfm	standard cubic feet per minute
SSL	Site Screening Level
SVE	Soil Vapor Extraction
TPDES	Territorial Pollution Discharge Elimination System
TBC	To be considered
UAO	Unilateral Administrative Orders
UE	Unrestricted Exposure
USVI	United States Virgin Islands
UU	Unlimited Use
WAPA	Water and Power Authority

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 FYR 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 FYR 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 third FYR for the Tutu Wellfield Superfund Site (Site). The triggering action for this policy review is the date of the second five-year review report. A five-year review is required at this site due to the fact that although the remedial action will ultimately result in the reduction of hazardous substances, pollutants or contaminants to levels that allow for unlimited use and unrestricted exposure, it will take longer than five years to achieve these levels.

The Site consists of two operable units (OUs). OU1 addresses Site-wide groundwater and will be addressed in this FYR. OU2 addresses source areas at the USVI Department of Education (VIDE) Curriculum Center property. OU2 was created after the second FYR concluded that while the OU1 remedy protects human health and the environment in the short term, in order for the remedy to be protective in the long-term additional evaluation of potential dense non-aqueous phase liquid (DNAPL) source areas in the Northern Plume area was needed. A Focused Source Remedial Investigation/ Feasibility Study for OU2 was completed in 2018. OU2 will not be addressed in this FYR because it does not yet have a Record of Decision (ROD).

The Tutu Wellfield Superfund Site FYR was led by Caroline Kwan (EPA-RPM). Participants included Sharissa Singh (EPA-Geologist), Julie McPherson (EPA-Human Health Risk Assessor), Mindy Pensak (EPA-Ecological Risk Assessor) and Geoff Garrison (EPA-Community Involvement Coordinator). This is a Fund-lead site. The review began in April 2014

Site Background

The Site is located on the eastern end of St. Thomas, U.S. USVI, in the Anna's Retreat section (Figures 1 and 2). Overall, the Site is approximately 4,000 feet in length and encompasses a total area of approximately 1.5 square miles (Figures 3 and 4). The site is situated within the upper Turpentine Run surface water drainage basin. The 2.3 square-mile basin trends roughly north-south and is bounded by the steep slopes of the surrounding hills. Land surface elevations along the axis of the basin decrease from about 200 feet above mean sea level (msl) at the northern end of the site to approximately 100 feet above msl at the southern end of the Site. Turpentine Run is a partially channelized, intermittent stream that traverses the length of the basin and ultimately discharges into Mangrove Lagoon and the Caribbean Sea. As a result of development in the area, storm water run-off is collected in a catchment system and combined with secondary sewage before discharging to Turpentine Run.

According to the 2010 U.S. Census, the population of the Town of Anna’s Retreat in the area around the Tutu Wells Superfund Site was 7,479. The Site contains a variety of residential and commercial establishments, schools and churches. The area sustained heavy damage to its buildings and

infrastructure during hurricanes Irma and Maria in 2017. However, rebuilding efforts are underway and it is expected that the area will return to its current land use in the future.

The Curriculum Center property is occupied by a single-story building that formerly housed offices, maintenance shops, warehouse space and walk-in freezers that supported the school district cafeterias. A paved parking lot is on the south side of the building, facing Smith Bay Road. An unpaved parking area and loading docks are located on the west side of the building. Additional loading and parking areas are located on the north side of the building. The northern OU1 groundwater treatment system is also located on the north side of the building. The Curriculum Center building was condemned after extensive damage sustained during Hurricane Irma/Maria in 2017. During the construction of Curriculum Center, the property was reportedly graded using imported fill.

A description of the Site operational history and a history of investigations conducted at the Site is provided in Appendix B.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Tutu Wellfield		
EPA ID: VID982272569		
Region: 2	**State:** USVI	**City/County:** St. Thomas
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** No	
REVIEW STATUS		
Lead agency: EPA ***[If "Other Federal Agency", enter Agency name]*:**		
Author name (Federal or State Project Manager): Caroline Kwan		
Author affiliation: Remedial Project Manager		
Review period: 4/30/2014 - 6/30/2019		
Date of site inspection: 6/4/2019		
Type of review: Policy		
Review number: 3		
Triggering action date: 4/30/2014		
Due date *(five years after triggering action date)*: 4/30/2019		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

Exposure to groundwater in the Northern and Southern Plumes was found to pose an unacceptable risk to current and future populations. Th primary contaminants of concern identified for groundwater were volatile organic compounds (VOCs), primarily the BTEX comounds (benzene, toluene, ethylbenzene and xylenes) and the chlorinated VOCs tetrachloroethene (PCE), trichloroethene (TCE), 1,2-dichloroethene (1,2-DCE) and vinyl chloride (VC). In addition, elevated concentrations of semi-volatile organic compounds, pesticides and metals were also detected.

Concentrations of these contaminants were detected in soil at the four source areas (Curriculum Center, Esso Service Station, Texaco Service Station and O'Henry Dry Cleaners, Inc.). In general, the concentrations in subsurface soil were not found to pose an unacceptable risk to human health, but were found to be sources of groundwater contamination. The only unacceptable risk from exposure to surface soil was limited to the Tillett Gardens property where the noncarcinogenic hazard index for surface soil was exceeded for the residential scenario by metals which were found to be at concentrations consistent with background and were not attributed to the site.

The ecological risk assessment identified unacceptable risk to certain ecological receptors, such as the anole and the red-tailed hawk, based on exposure to soil contaminated primarily with PCE.

Response Actions

The Record of Decision (ROD) for the site was signed on August 5, 1996. Exposure to groundwater was identified as the principle threat and the selected remedy addressed both groundwater and the source material (primarily unsaturated subsurface soil and bedrock) that may migrate to groundwater. The following Remedial Action Objectives (RAOs) were established for the Site:

- Remove and/or control the sources of groundwater contamination;
- Remove contamination in groundwater. Restore the aquifer to drinking water standards, except to the extent that such full groundwater restoration proves to be technically impracticable due to the presence of Dense Non-Aqueous Phase Liquids (DNAPLs);
- Control the migration of impacted groundwater;
- Prevent human ingestion of groundwater exhibiting excess lifetime cancer risks greater than 1 in 10,000 or a hazard index greater than 1;
- Prevent direct human contact and exposure to contaminated soil that poses excess cancer risks greater than 1 in 10,000 or a hazard index greater than 1; and
- Eliminate leaching of contaminants of concern from soil into groundwater at concentrations which adversely impact groundwater quality and which might ultimately have negative ecological effects.

The groundwater remedy called for area-wide plume/source containment and treatment of contaminated groundwater. The groundwater clean-up goals are the Federal maximum contaminant levels (MCLs) for drinking water. The groundwater remedy generally included the following:

- Decommission existing domestic and commercial wells within the confines of the groundwater plume if these wells are determined to interfere with the operation of the groundwater pump and treat system to be installed as part of this remedial action. During the remedial design (RD) it would be determined which wells would interfere with this remedial action and which wells would continue to operate to enhance aquifer restoration, which is a goal of this remedial action. For those wells that are decommissioned, EPA would analyze alternative sources of water for the users of those wells and determine appropriate alternate sources of water for the affected users. These wells could be reestablished at some point in the future, when and if groundwater quality improves to allow extraction and use of untreated groundwater.
- Obtain institutional controls in the form of governmental and/or proprietary controls to prohibit unauthorized use of groundwater or the installation of new wells, such that authorization must be obtained from DPNR and EPA before use of existing wells (i.e., wells that are not decommissioned) or installation of any new wells within the confines of the plume area.
- Implement Source Control Programs (consisting of installation and operation of extraction wells and air strippers) at the Texaco and Esso Service Stations to address impacted groundwater in the immediate vicinity of these facilities.
- Install groundwater recovery wells for hydraulic control of plume migration. The proposed containment program will include the installation of three recovery wells (RW-1, RW-2, and RW-3) strategically placed in an effort to hydraulically contain plume migration.
- Install two groundwater recovery wells (RW-4 and RW-5) for hydraulic control of CVOC contaminant sources. The source containment will provide hydraulic barriers around source areas, allowing the reduction of contaminants in other parts of the aquifer and potentially reducing the time needed to reach MCLs.
- Construct a central groundwater treatment facility with a total flow capacity of 100 gallons per minute (gpm). Water will be treated to surface water criteria for discharge to the storm sewer near the O'Henry Dry Cleaners facility leading to Turpentine Run, or be treated to MCLs for distribution for potable purposes. EPA, in consultation with the Virgin Islands Government, will choose one of these two options during the RD phase. If a decision is made to treat the water to surface water criteria (not to MCLs), then water will continue to be supplied to affected residents as it is currently being supplied (i.e., through collection of rain water to cisterns and trucking water by tanker truck).
- Conduct semi-annual groundwater sampling to monitor its quality and contaminant migration. The monitoring program would include the sampling of approximately 15 wells at or near the plume boundary for CVOCs, benzene, toluene, ethylbenzene and xylenes (BTEX); and semivolatile organic compounds, and would last for the duration of the remedial action and

operation and maintenance (O&M, estimated, for costing purposes, to be approximately 30 years).

- Natural attenuation of low concentration contaminants at the plume edges and downgradient of RW-2 and RW-3.

Various potable use options for the treated groundwater include:

- connect to the existing Water and Power Authority water main;
- truck the treated water to the impacted residences within the plume area; or
- install a water distribution system from the central treatment facility to the impacted residences within the plume area.

The soil remedy selected addressed multiple locations containing unsaturated zone BTEX/CVOC source materials. The ROD soil cleanup goals were derived using the EPA SSL methodology for protection of groundwater. The soil remedy generally included the following for each of the source areas:

- In-situ soil vapor extraction (SVE) treatment of impacted soil with catalytic oxidation for off-gas treatment at the Texaco Service Station;
- In-situ SVE treatment and bioventing of impacted soil with thermal oxidation for off-gas treatment at the Esso Service Station;
- Excavation and off-site disposal of additional soil, if needed (to be determined after confirmatory sampling during the RD) at Four Winds Plaza/Western Auto;
- At O'Henry dry cleaners, in-situ SVE treatment of impacted soil, or, if such in-situ SVE proves to be ineffective, excavation and ex-situ SVE of impacted soil; in-situ SVE treatment in the unsaturated bedrock; and thermal oxidation for off-gas treatment;
- At the Curriculum Center: excavation of impacted soil, followed by either off-site disposal or ex-situ SVE; in-situ SVE treatment in unsaturated bedrock areas and in soil areas not suitable for excavation; and thermal oxidation for off-gas treatment; and
- Institutional controls in the form of governmental and/or proprietary controls to place limitations on property usage and limit disturbance to impacted soil and bedrock.

Buried 4-inch diameter polyvinyl chloride (PVC) piping was identified as a potential source of contamination at the Four Winds Plaza, near the former Western Auto underground storage tank area. The ROD specified that additional investigation be conducted to determine the need for remedial work in the area of Four Winds Plaza. The ROD also specified confirmatory sampling in the area of the underground storage tank removed in 1994 be completed to confirm that no residual contaminated soil above the cleanup levels (SSLs) had been left in-place, with excavation and off-site disposal of impacted soil if contamination were found to be present.

Pursuant to a site inspection performed of all properties at the Site in 1995 following Hurricane Marilyn, it was determined that no soil remedial action was required at that time for the Ramsay Motors property, which is next to the curriculum center. The concrete floor in the area of subsurface soil contamination had been thought to be cracked appeared to be of sound integrity. However, the ROD specified that institutional controls be applied to this property.

Status of Implementation

EPA funded the RD for the Curriculum Center soil and the site-wide groundwater portions of the remedy in September 1997 and the remedial action of these portions in September 2003. EPA issued separate Unilateral Administrative Orders (UAOs) to Texaco, Esso, and Western Auto/Four Winds Plaza in May of 1998 and to O'Henry in May of 1999, requiring the responsible parties to implement their respective portion of the ROD remedy. EPA has been providing trucked water to the affected residents since the site was identified and contaminated supply wells were condemned. In September 2014, EPA completed the permeanent water supply lines to 5 affected homes to the local Water and Power Authority (WAPA).

Remedy Implementation for Curriculum Center Soil and Site-Wide Groundwater

A pre-design investigation of the Curriculum Center soil and site-wide groundwater was conducted from August 1998 to November 1999 to further define the extent of Curriculum Center soil and site-wide CVOC groundwater contamination and to collect hydrologic and geologic information to be used for the corresponding RDs. The RD for the Curriculum Center soil and site-wide groundwater was completed in September 2001. During the pre-design and RD activities, it was determined that soil excavation at the Curriculum Center was not required. Activated carbon was determined to be more feasible than thermal oxidation for off-gas treatment. In addition, it was determined that the SSLs defined in the ROD are not appropriate for evaluating the fractured bedrock. Therefore, shutdown of the SVE system was to be based upon a significant contaminant decrease and asymptotic conditions in the SVE system influent. A number of RD wells and piezometers were installed during pre-design and design phases to fine tune the extent of contamination of the site-wide plumes.

Site construction was completed in March 2004, and consisted of the following activities:

- Construction of a groundwater extraction and treatment system at the Curriculum Center, referred to as Groundwater Treatment Facility (GWTF) #1, to achieve hydraulic control and remove contaminant mass from the saturated-zone source of CVOC groundwater contamination.
- Construction of a groundwater extraction and treatment system downgradient of the Northern Plume (referred to as GWTF #2) to achieve hydraulic control and remove contaminant mass.
- Construction of an SVE system at the Curriculum Center to remediate the unsaturated zone source of the CVOC groundwater contamination.
- Construction of injection and monitoring wells at the Curriculum Center to support the performance of an enhanced anaerobic bioremediation (EAB) pilot study, which was performed following treatment system startup. Based on the unsuccessful results of the initial phase of the pilot study, no additional pilot testing or bioremediation was performed.

An initial testing program (ITP) for the facilities was completed between March 19 to April 16, 2004 to confirm achievement of the treatment system performance requirements, and to obtain data for supporting decisions regarding system treatment system operation and optimization. The results of the ITP indicated that the facilities were operating as intended. Both facilities discharge to surface water in accordance with the Territorial Pollutant Discharge Elimination System (TPDES) permit equivalent. Both facilities were operated on a continuous basis from startup through September 2017 when they were taken offline in preparation for Hurricanes Irma and Maria. The facilities have not operated since that time due to damage from the hurricanes. Repair of these facilities is pending.

Remedy Implementation for the Texaco Service Station

Texaco completed an RD for groundwater and the soil treatment system in 1995. Construction of an on-site SVE and groundwater treatment system and a downgradient groundwater treatment system was completed in early 1998. One shallow (TEW-1) and one deep (TEW-1D) extraction well was installed. In addition, 11 soil vapor probes were constructed for monitoring of the site soil gas. The downgradient groundwater treatment system consists of two groundwater extraction wells and an air stripper for removing hydrocarbons from extracted groundwater. One shallow (TEW-2) and one deep (TEW-2D) extraction well was installed. Treated water was discharged to catch basins located within the storm drainage system in the Turpentine Run in accordance with the facility's TPDES permit.

Groundwater start-up testing for the Texaco Service Station was performed in January 1998. The results of the start-up testing indicated that the system was operating as intended. Operation of the SVE system at the Texaco Service Station was initiated in April 1998. After conducting a pulsing period, the SVE and groundwater treatment system at the Texaco plant were shut down in July 2003. Monitored natural attenuation (MNA) activities have been conducted at the Texaco site since system shut down and remain on-going. Initially groundwater monitoring was performed on a quarterly basis and the frequency of the sampling events was reduced to semi-annually starting in 2004. Groundwater samples are typically collected from four to nine monitoring wells, and samples are analyzed for BTEX and methyl tertiary butyl ether (MTBE). Removal and replacement of three underground storage tanks and associated fuel lines was performed in December 2006. In January 2007, an enhanced bioremediation application was conducted at the site to further reduce the source area groundwater concentrations.

Remedy Implementation and System Operations, Maintenance, and Monitoring Programs for the Esso Service Station

Esso groundwater and soil treatment system construction was completed in February 1999. System start-up testing was performed in March 1999. Start-up of the SVE system was performed in June 1999. Although hydraulic capture was achieved by the groundwater remediation system, neither the soil nor the groundwater remediation system produced substantial rates of source mass removal. As a result, a modified source control program was implemented, which incorporated soil excavation and off-site treatment via bio-piles; installation of a groundwater "hot-spot" remediation system, and natural attenuation of distal plume areas.

Construction of the of the "hot-spot" remediation system was performed in 2002. Operation of the groundwater "hot-spot" remediation system was conducted until April 2005.

MNA activities have been conducted at the site since May 2005 and remain on-going. The existing groundwater treatment system remains on site and operable should it be concluded that natural attenuation along is not sufficient to maintain plume stability. Groundwater monitoring was initially performed quarterly and the frequency of monitoring was reduced to annually beginning in 2006. Typically five to seven groundwater monitoring wells are analyzed for BTEX and both gasoline range and diesel range total petroleum hydrocarbons (TPH-GRO and TPH-DRO) and five wells are analyzed for a suite of biological indicator parameters (nitrite, nitrate, sulfate, sulfide, chloride, total iron, total organic carbon (TOC), alkalinity, hardness, and methane).

Remedy Implementation and System Operations, Maintenance, and Monitoring Programs for the O'Henry Dry Cleaners

O'Henry completed a removal action in March 1995 to address CVOC contaminated soil. Pursuant to the UAO issued in May of 1999, O'Henry completed a pre-design investigation of the unsaturated zone soil and fractured bedrock in November 1999. The results of the pre-design soil delineation investigation and post soil excavation reports did not identify the presence of unsaturated source materials exceeding the ROD soil cleanup goals/objectives. In July 2000, EPA concurred with the recommendation of No further Action for unsaturated zone soil and fractured bedrock at the O'Henry property.

Remedy Implementation and System Operations, Maintenance, and Monitoring Programs for the Western Auto/Four Winds Plaza

The UAO issued to Western Auto/Four Winds Plaza required that characterization in the area of the buried 4-inch diameter PVC piping be performed and confirmatory sampling of the tank grave area be completed to confirm that no residual contaminated soil above the cleanup levels (SSLs) was present. Investigation work was performed in January and February of 1999. No investigation and confirmation sampling results exceeded the ROD specified cleanup criteria with the exception of ethylbenzene results in samples collected in the vicinity of the buried PVC piping. Western Auto/Four Winds Plaza consultants calculated a revised contaminant specific SSL for ethylbenzene, which was approved by EPA and DPNR. No sample results exceeded the revised criteria. The subsequent No Further Action recommendation was approved by EPA in January of 2000.

IC Summary

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	Parcels within or near the plume boundary	Governmental controls and/or proprietary controls to prohibit unauthorized use of groundwater or the installation of new wells. Authorization must be obtained from DPNR and EPA before use of existing wells (i.e., wells that are not decommissioned) or installation of any new wells within the confines of the plume area.	Virgin Islands Code: Title 12, Chapter 5

Systems Operations/Operation & Maintenance

The O&M, which consists of operation, maintenance and monitoring activities, is ongoing. The facilities are operated and maintained in accordance with the site documents, manufacturer's specifications with the U.S. Virgin Islands DPNR TPDES permit equivalency and Air Pollution Control permit equivalency.

Groundwater monitoring is routinely performed at site-wide groundwater monitoring wells to assess remedial action progress. Groundwater sampling was performed on a quarterly basis from system start-up until April 2007 and annual groundwater sampling has been performed thereafter. Samples are collected from approximately 28 groundwater monitoring wells and approximately 6 residential wells at each groundwater sampling event. The actual number varies slightly due to access during the sampling events. Based on existing information and recent conversations with area residents, the known remaining residential wells in the area are no longer used for drinking purposes since they have been connected with the WAPA line. Samples from all monitoring wells are analyzed for VOCs. In addition, samples from five groundwater monitoring wells located in the southern plume area are analyzed for nitrate, sulfate, chloride, TOC and ethane/ethene to assess monitored natural attenuation in this area. Groundwater monitoring levels are collected on a monthly basis from 36 monitoring wells. Additional information regarding the sampling of residential wells can be found in the Data Review section of this FYR.

The Curriculum Center SVE system was operated for approximately two years. Due to a significant decrease in SVE influent concentrations since system startup and achievement of asymptotic conditions, it was determined that the SVE system was no longer cost-effective and the system was shutdown in April 2006.

GWTF #1 and #2 operated continuously through mid to late September 2017, when damage to the USVI power grid resulted in a shutdown of both treatment facilities. Before both treatment plants became inoperable, the average extraction rate at GWTF #1 dropped from 20 gpm in 2014 to 11.1 gpm in 2017. The average extraction rate at GWTF #2 also dropped, from 17 gpm to 13 gpm, but then recovered to an average of 16.3 gpm in 2017. No other significant operational problems were encountered, other than continued frequent shutdowns attributed to power outages in the Water and Power Authority (WAPA) service. In addition, frequent replacement of equipment is typically necessary due to the humid conditions that exist on the island.

Before the power loss due to Hurricane Irma/Maria, no major operational changes were made during the review period. The SVE and off-gas systems continued to remain off-line. These systems were shut down after the first two years of operations because it was determined they were no longer needed.

Prior to transfer of the facilities to the USVI Government (GVI) in April 2013, a series of final inspections were performed to ensure the facility components were in good working order. Repairs were performed as necessary to transfer the facilities in an acceptable condition.

Potential site impacts from climate change have been assessed, and the perfomance of the remedy may be impacted by the following expected effects of climate change in the region and near the site: increasing frequency of heavy precipitation events and increasing intensity of storms. Once the treatment system is rebuilt and a remedy is in place for OU2, the O&M plan should be updated to include measures to address these concerns and protect the treatment facilities from future hurricane events.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the **last** FYR as well as the recommendations from the **last** FYR and the current status of those recommendations.

Table 3: Protectiveness Determinations/Statements from the 2014 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Short-term Protective	The remedy at Tutu Wellfield protects human health and the environment in the short term because residential wells with site-related constituents that exceed drinking water standards are no longer used for potable purposes and residents have been hooked up to public supply wells. In order for the remedy to be protective in the long-term, additional evaluation of potential DNAPL in the Northern Plume is needed and further evaluation of groundwater capture in the Southern Plume is needed.

Table 4: Status of Recommendations from the 2014 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
OU1	Potential DNAPL in the deep aquifer of the Northern Plume	Additional evaluation of the potential DNAPL will be conducted under a separate operable unit	Completed	Additional evaluation of the potential DNAPL was performed as part of the Focused Source Remedial Investigation for OU2	3/6/2018
OU1	Downgradient plume capture in the Southern Plume is not fully characterized	Additional evaluation of the southern plume to ensure complete capture of the downgradient plume will be conducted	Ongoing	Existing groundwater concentration trend figures are being reviewed and will continue to be updated on an ongoing basis based on annual sampling data. However, because treatment system is currently not operating, this issue cannot be closed out at this time.	10/15/2023

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On October 1, 2018, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at 42 Superfund sites in New York and New Jersey, including the the Tutu Wells Site. The announcement can be found at the following web address: https://www.epa.gov/aboutepa/fiscal-year-2019-five-year-reviews. In addition to this notification, a public notice was placed on the Tutu Wells Superfund website on July 15, 2019 and emailed to the Virgin Islands Daily News, The V.I. Consortium and the St. Thomas Source U.S. Virgin Islands

Newspaper and WVW1 10:00 am, WSTA 1340 AM USVI and WGOD 97.9 FM radio stations on August 6, 2019. These media outlets printed and announced the public notices to wide audience throughout the Virgin Islands. This public notice states that there was a FYR and inviting the public to submit any comments to the U.S. EPA. The results of the review and the report will be made available at the Site information repository located at EPA's Record Center located at 290 Broadway, NY and EPA's Virgin Islands office at the Tunick Building, Room 102, 1336 Beltjen Road, St. Thomas, USVI and at this link: https://epa.gov/superfund/tutu-wellfield

Data Review

The Site has a plume of groundwater contaminated with CVOCs, which is divided into the Northern and Southern portions, and two plumes of groundwater contaminated with gasoline components (the Texaco and Esso plumes). The CVOC plume originated at or near the Curriculum Center and extended beyond the former O'Henry Dry Cleaners building (potential secondary source), following an eastward path towards the discharge area of Turpentine Run. The two CVOC groundwater plumes were previously co-mingled, but recent data indicate that there may now be two separate plumes. Contaminants in the Northern CVOC Plume migrate southwest from north of the Curriculum Center. This plume extends vertically from 15-30 feet bgs to about 80 feet bgs. Contaminants in the Southern CVOC Plume migrate southeast from the former O'Henry Dry Cleaners and along Turpentine Run.

Please refer to Figure 3 for the CVOC isoconcentration map and Figure 4 for the Groundwater Contour Map.

Two Category 5 hurricanes, Irma and Maria, hit St. Thomas USVI and caused extensive damage to St Thomas and the treatment facilities (GWTF #1 & GWTF #2). Efforts were made to prepare for the storms and protect process equipment; however, the initial impact, flooding, and lack of electricity followed by inconsistent voltage has left the systems inoperable since their shutdown on September 2nd 2017. Below is a summary of groundwater sampling results that were collected prior to the hurricanes and after the hurricanes.

Pre-Hurricane Sampling Results

Prior to the hurricanes, groundwater samples were collected in April 2014, April 2015, April 2016 and February/March 2017. Twenty-six to twenty-nine site-wide groundwater monitoring wells were sampled for VOCs, and six wells in the southern plume area were sampled for MNA parameters during these routine annual sampling events. One supply well, Eglin-3, could not be sampled because the well pump was not operational. Historical CVOC concentrations have remained stable at this location over time. It is unknown if or when the well owner plans to repair the pump.

The analytical results described below were compared to results from groundwater samples collected during the baseline groundwater sampling event (March 2004), and previous annual monitoring events.

CVOC Northern Plume:

Former Source Areas:

GWTF #1 - The CVOC concentrations in most wells in the vicinity of GWTF #1 have decreased since the baseline groundwater monitoring event in 2004, but have remained relatively unchanged during the past

five to seven years of groundwater monitoring. Monitoring events conducted before the hurricanes during this five-year review period indicate that CVOC concentrations in the Northern Plume were generally comparable to results obtained during previous monitoring events. The data reviewed provide evidence that GWTF #1 has been successfully removing contaminant mass and retarding the migration of CVOC groundwater plume. However, the consistency of contaminant concentrations over the past few years in the shallow zone just downgradient of the facility suggests that some contamination from the highly contaminated deep zone may be migrating into the shallow zone. Due to the decrease in concentration at the downgradient portion of the Northern Plume, it is possible that the originally co-mingled Northern and Southern Plumes have split in half, with the Northern Plume terminating in the vicinity of Four Winds Plaza (near MW- 8) and the Southern Plume persisting in the vicinity of the O'Henry dry cleaners near the Steele well. When comparing the concentrations observed at the Northern Plume shallow wells to MCLs, exceedances for PCE were observed at RD-5 and TT-6 with concentrations of 36µg/L and 19µg/L, respectively, in 2015.

GWTF #2- CVOC concentrations at groundwater monitoring wells in the vicinity of and just downgradient of GWTF #2 have significantly decreased since the baseline groundwater monitoring event, but remained relatively unchanged during the past five to seven years of groundwater monitoring. Previous monitoring events conducted prior to the hurricanes during this 5 year review period indicate that CVOC concentrations were generally comparable. The data provide evidence that the Northern Plume has been being hydraulically controlled, and downgradient water quality has been improving via pore volume flushing with uncontaminated groundwater. When comparing the data to MCLs, there were no exceedances at the any of the monitoring wells.

CVOC Southern Plume:

Total CVOC concentrations observed during the April 2015 sampling event in the Southern Plume area wells have decreased since the baseline sampling event, but remained comparable to contaminant levels encountered in the most recent sampling events. Historically, total CVOC contaminant concentrations at the Steele supply well were relatively high, indicating that a low-level, residual CVOC source may be present in the area of this well. When comparing the concentrations observed at the Southern Plume wells to MCLs, all parameters were below MCLs with the exception of PCE and TCE results in the Steele well at concentrations of 9.4 µg/L and 17 µg/L, respectively, in 2015. The 2019 sampling results show 4.5 µg/L and 2.9 µg/L respectively for these compounds indicating that the source is diminishing. This area will continue to be monitored.

Groundwater samples are collected in the Southern Plume area for MNA parameter analyses. Existing data indicate that dilution is the driving mechanism for CVOC attenuation in groundwater within the Southern Plume area, rather than intrinsic anaerobic biodegradation (i.e., reductive dechlorination).

Please refer to Table 5 for a summary of groundwater laboratory analytical results.

Figures 7 and 8 provide Groundwater CVOC Concentration vs. Time plots for the Steele and LaPlace Supply Wells.

Bedrock Wells:

In February/March 2017, CVOCs in groundwater were collected from monitoring wells completed in the fractured bedrock, which is the primary focus of OU2. Groundwater samples were collected from conventional shallow bedrock wells and from open-hole wells. COCs were detected in all groundwater samples collected from the 26 monitoring wells and three treatment system extraction wells during the sampling event. Up to six COCs were detected, including (in order of frequency), PCE, TCE, VC, cis-12-DCE, trans-1,2-DCE, and 1,1-DCE. These compounds exceeded cleanup standards in 25 of the 29 well samples. The highest concentration of CVOCs in the shallow portion of the bedrock aquifer was detected in groundwater collected from IW-1 (depth of 85 feet bgs) . Groundwater collected from this well contained cis-1,2-DCE (33,000 µg/l), vinyl chloride (12,000 µg/l), TCE (5,800 µg/l), PCE (4,100 µg/l), trans-1,2-DCE (1,400 µg/l) and 1,1-DCE (170 µg/l).

Very high concentrations of CVOCs were detected in groundwater collected from RD-9 (depth 97.5 feet bgs) located north of Curriculum Center near IW1-85. Groundwater collected from RD-9 contained; cis-1,2-DCE (160,000 µg/l), PCE (92,000 µg/l), vinyl chloride (38,000 µg/l), TCE (29,000 µg/l), trans-1,2-DCE (2,300 µg/l) and 1,1-DCE (400 µg/l). The concentration of PCE (92,000 µg/l) detected in the sample from RD-9 was equivalent to 46 percent of its solubility limit, indicating the potential presence of PCE product. Bedrock at these depths contains very few fractures and has a correspondingly low permeability. Groundwater containing high concentrations of CVOCs in the deep portion of bedrock is not migrating very fast or very far. However, the high concentrations of CVOCs could be diffusing into the porewater in bedrock matrix creating a secondary source in this area.

The influence of the GWTF #1 extraction system appears to extend tens of feet cross gradient in an east-west direction and potentially a few hundreds of feet up and down gradient in the northeast-southwest direction in the shallow monitoring zone. RW-7 was the only well operated on a continuous basis of the three GWTF #1 extraction wells, RW6, WR-7 and RW-9. Drawdown has been limited to bedrock features and faults with a direct connection to pumping well RW-7. GWTF #1 does not capture the full width of aqueous CVOC's in the shallow zone. There has been no evidence to date that the influence of the extraction system extends measurably into the deep zone below 90 feet bgs. Therefore, contaminants that migrate to the deep zone are unlikely to be captured by the current extraction system. DNAPL is also outside the capture zone of GWTF #1.

Treatment System Operation and Maintenance:

Prior to the hurricanes, the cumulative CVOC mass removed from GWTF #1 extraction wells RW-6, RW-7 and RW-9 is approximately 200 pounds. Total CVOC influent concentrations have been steadily declining in PW-6 and RW-9. Total CVOC influent concentrations in extraction well RW-6 exhibited seasonal fluctuations with a maximum concentration of approximately 260,000 µg/L in the last quarter of 2015.

Prior to the hurricanes, the cumulative CVOC mass removed from GWTF #2 extraction well RW-1S is approximately 18 pounds through August 2017. The total CVOC influent concentration in extraction well RW-1S was approximately 16.3 ug/L during the most recent sampling event in August 2017.

CVOC influent concentrations and mass removal rates at both facilities have decreased significantly since system startup. Reductions of approximately 97 and 76 percent in influent concentrations were observed at GWTF #1 and #2, respectively.

Please refer to Figures 9, 10 and 11 for Influent CVOC Concentration and Mass Removed vs. Time graphs.

Total Petroleum (former Esso) Tutu Service Station:

Groundwater sampling activities associated with the MNA program at the Total Petroleum (former Esso) Tutu Service Station were conducted in May 2017. Monitoring wells sampled during this event included SW-IR, SW-2R, PW-1, CHT-3, MW-8, MW-9, and MW-10. All wells were sampled for BTEX and TPH-DRO and TPH- GRO.

BTEX compounds were not detected in upgradient monitoring well MW-8, crossgradient well MW-9, or downgradient wells CHT-3 or MW-10 in May 2017. However, one or more BTEX compounds were detected in three on-site monitoring wells during the May 2017 sampling event (SW-IR, SW-2R, and PW-1). Specifically, total BTEX concentrations in SW-IR, SW-2R, and PW-1 in May 2017 were 4.3 micrograms per liter (µg/L), 5.5 µg/L, and 47. 7 µg/L, respectively. Detected concentrations of toluene, ethylbenzene, and xylenes were below their respective MCLs; however, the benzene concentration of 24 ug/L in well PW-1 exceeded its MCL. The last occurrence of an MCL exceedance was also in source area monitoring well PW-1 in December 2009 when benzene was detected at a concentration of 150 µg/L. The December 2009 sampling event marked an increase in total BTEX concentrations in source area well PW-1 compared to 2007 and 2008 data; however, BTEX compounds were not detected in PW-1 during the 2010, 2011, 2013, or 2014 sampling events.

TPH GRO was not detected in MW-8, MW-9, CHT-3, or MW-10, but was present in monitoring wells SW-1R, SW-2R, and PW-1 in May 2017 at concentrations of 0.71 milligrams per liter (mg/L), 0.61 mg/L, and 1.6 mg/L, respectively. TPH DRO was detected in SW-lR, PW-1, and MW-10 at estimated concentrations of 0.078 J mg/L, 0.17 J mg/L, and 0.067 J mg/L, respectively. While concentrations of TPH GRO increased in May 2017 compared to the previous (May 2014) sampling event results, detected concentrations of TPH DRO decreased in May 2017.

Temporal trends for benzene and total BTEX concentrations in the source area (wells PW-1, CHT-3, and SW-2R), crossgradient of the site (MW-9), and approximately 40 feet downgradient of the site (well MW-10) indicate that benzene concentrations in monitoring well CHT-3 exceeded the MCL from October 2002 to May 2003 and May 2005 to November 2007, but were below applicable action levels from December 2008 to November 2011 and "non-detect" in January 2013, May 2014, and May 2017. Furthermore, despite the increases in BTEX concentrations observed in PW-1 and SW-2R in May 2017, hydrocarbon concentrations within the source area have demonstrated a temporal decline. All detected BTEX concentrations in monitoring well SW-2R were below their respective MCLs from October 2002 to May 2017 with the exception of the December 2002 event (7 µg/L). Benzene concentrations were generally below 1 µg/l or not detected, although concentrations of 4.4 µg/l were detected in 2008 and 2017.

Post-Hurricane Sampling Results

During the annual groundwater monitoring event performed in January 2018, 26 sitewide groundwater monitoring wells were sampled for CVOCs and two wells in the Southern Plume area were sampled for MNA parameters.

Groundwater level measurements were collected manually each month from May 2017 – August 2017 and January 2018 – April 2018. Groundwater level measurements were not collected September 2017 – December 2017 due to Hurricane related restrictions (i.e. inaccessibility, dangerous conditions, government enforced curfews, and lack of resources). The treatment systems were offline from September 2017 and still remain offline to date. There is no hydraulic control of the aquifer during the downtime therefore water levels in the aquifer were not drawn down by the extraction wells.

The analytical results described below were compared to results from groundwater samples collected during the baseline groundwater sampling event (March 2004), and previous routine annual monitoring events.

CVOC Northern Plume:

Former Source Areas:

GWTF #1 – The CVOC concentrations in most wells in the vicinity of Facility #1, the Puma Energy (formerly Texaco Caribbean, Inc.) and Total Petroleum (formerly Esso Standard Oil, USA, Inc.) service stations have decreased since the baseline groundwater monitoring event.

Since the previous monitoring event conducted in January 2017, CVOC concentrations in the Northern Plume were generally comparable to results obtained during the previous monitoring event except for wells MW-14, MW-15, MW-6D, RD-9 and MW-11D which showed slightly elevated concentrations. When comparing the concentrations observed at the Northern Plume wells to the MCLs, exceedances for PCE concentrations were detected above MCLs in monitoring wells: MW-1D (28 µg/L), MW-14 (20 µg/L), MW-15 (46 µg/L), MW-6D (6.7 µg/L), RD-5 (22 µg/L), TT-6 (15 µg/L), and Tillett (6.4µg/L). TCE concentrations were detected at or above MCLs in monitoring wells: MW-1D (7.1 µg/L) and MW-14 (6.1 µg/L). Cis-1,2-DCE concentrations were detected above MCLs in monitoring wells: RD-13 (160 µg/L), and RD-9 (630 µg/L). Vinyl chloride concentrations were detected above MCLs in monitoring wells: MW-15 (2.5 µg/L), RD-13 (58 µg/L), and RD-9 (1600 µg/L). The increases are likely due to the treatment system having been offline for five (5) months prior to the event. There is no longer hydraulic control over the aquifer therefore CVOC contaminates may be migrating downgradient. The data suggest that the treatment facility is necessary to restrict further migration of CVOC downgradient.

GWTF #2- CVOC concentrations at groundwater monitoring wells near and just downgradient of GWTF #2 have significantly decreased since the baseline groundwater monitoring event. Since the previous monitoring event conducted in January 2017, concentrations in January 2018 were slightly elevated. There was a PCE MCL exceedance that was not observed in 2017 in MW-11D, with a detection of 5.6 µg/L. The data suggest that since the Northern Plume is no longer being hydraulically controlled, contaminants may be migrating downgradient.

CVOC Southern Plume:

Total CVOC concentrations observed during the January 2018 sampling event in the Southern Plume area wells have decreased since the baseline sampling event, but are slightly elevated from the 2017 sampling event. When comparing the concentrations observed at the Southern Plume wells to the MCLs, a vinyl chloride exceedance was observed in MW-21D at a concentration of 2.6 µg/L.

Treatment System Operation and Maintenance:

The treatment facilities were taken offline in preparation for hurricanes Irma and Maria in September 2017 and continue to remain offline, pending repairs that need to be made in order to bring the systems back online.

Irrigation Well Sampling:
Out of 6 residential supply wells that have been known to be present within the plume area, five were once on the list to be sampled annually for VOC and MNA parameters (Elgin-3, Smith, Steele, Laplace and Delegard). Only the Smith well was sampled during the January 2018 site-wide groundwater sampling event. In June 2019, EPA conducted a site reconnaissance and found that none of the former supply wells are still being used as such. Three of the wells (Steele, Delegard and Smith) are still in service and used for irrigation and gray water purposes only. These wells were sampled in June 2019.

Irrigation wells Smith, Steele and Delegard were sampled after the hurricane on June 4, 2019. Laboratory analytical results indicate that CVOCs, including cis 1,2 DCE, PCE and TCE were detected near or below MCLs, which is consistent with previous results from this FYR period. Concentrations of PCE and TCE at the Steele well exceeded MCLs from system startup through 2014. The Steele well is located in the Southern Plume and is another indicator of conditions in this portion of the site.

Please refer to Table 6 for a Summary of Residential Water Analytical Results.

Site Inspection
The inspection of the Site was conducted on 6/4/2019. In attendance were Geoffrey Garrison, OSC from EPA, Jeffrey Johnson of the Department of Planning and Natural Resources. The purpose of the inspection was to assess the protectiveness of the remedy and to conduct residential wells sampling.

The team visited all six residential well locations during June 2019 site recon. Three residential wells are being used to provide homes with water for irrigation and/or gray water for flushing toilets, but the homeowners confirmed that none are being used for potable water. EPA collected water samples at all three of these wells.

Of the other three wells, one no longer has a pump and two well pumps have either been removed and/or the wells capped. Therefore no sampling was possible without substantial effort to bring them back online.

A more comprehensive site inspection, including an assessment of the treatment facilities, is scheduled for September 2019.

V. TECHNICAL ASSESSMENT

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

Question A Summary:

The data reviewed during this five-year review period indicate that GWTF #1, while operational, had been successful in removing contaminant mass and retarding the migration of the CVOC groundwater plume.

In 2011, a Remedial Systems Evaluation (RSE) was conducted with the objective of optimizing the effectiveness and protectiveness of the remedy. This report suggested that hydraulic capture associated with the GWTF #1 area is incomplete and recommended that the current extraction system be enhanced with more extraction wells. It was also suggested that GWTF #2 provides minimal benefit to controlling the plume and that this system be discontinued after modification to GWTF #1 are completed. However, these modifications have not been made to date. Due to the lack of monitoring points between the source area at GWTF #2 and downgradient monitoring wells (MW-14, MW-1D, RD-13), the limits of hydraulic capture are difficult to ascertain. Additionally, hydraulic capture in a fractured rock setting is complicated and complete capture may be difficult even with additional wells, especially considering the non-productive zone. The data presented above suggest that conditions in the shallow aquifer have improved, but there may be still be a concern for vertical migration from the deep highly contaminated fractured bedrock aquifer to the shallow aquifer, perhaps due to pumping activities and lateral migration of the deep CVOC plume. The majority of contaminant mass remains at high concentrations in the source area near GWTF #1, likely in the form of product, in the deep fractured bedrock where hydraulic capture would be difficult regardless of the capture system. Although this zone has a low productivity, it is likely acting as a slow and continuous source to downgradient areas and potentially to the shallow aquifer as suggested above. EPA has created a separate OU for the source area and has issued a proposed remedial action plan to address the source area. A Record of Decision for this operable unit has not be signed yet.

CVOC Southern Plume: Total CVOC concentrations in the vicinity of GWTF #2 have decreased since baseline monitoring. The southern extent of the plume continues south of O'Henry. The monitoring wells in this area include Steele, MW-21D, Laplace, Smith, RD-14, RD-6, Delegard, PZ-4, RD-2, and RD-3. Generally, CVOC concentrations in monitoring wells in this area have decreased since baseline sampling in March 2004, but Steele has shown an upward trend over this review period. This trend will be followed, as the most recent groundwater results were below MCLs.

In the BTEX plume, despite the increases in concentrations observed in PW-1 and SW-2R in May 2017, hydrocarbon concentrations within the source area have demonstrated a temporal decline.

The treatment facilities were taken offline in preparation for hurricanes Irma and Maria in September 2017 and continue to remain off pending repairs that need to be made in order to bring the systems back online. Irrigation wells Smith, Steele and Delegard were sampled after the hurricane on June 4, 2019. Laboratory analytical results indicate that CVOCs, including MTBE, cis 1,2 DCE, PCE and TCE were detected near or below MCLs.

Since the treatment facilities are offline and there is no hydraulic capture of the plumes, the remedy is not functioning as intended by the decision documents and protectiveness cannot be determined at this time.

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?

Question B Summary:

The risk assessment process has changed somewhat since the original risk assessment was performed in 1995. Chemical-specific toxicity values have changed since the original risk assessment was conducted. The risk assessment addressed exposure to the surface soil, subsurface soil and groundwater. This review will include an evaluation of the cleanup goals and objectives for each medium that was evaluated in the risk assessment.

Soil cleanup goals for organic compounds were based on impact to groundwater concerns. Even though the ROD included an RAO to prevent risks associated with direct contact to contaminated soil, the subsequent investigations did not identify areas where this applied. The soil remedy was reviewed to address the protectiveness of the remedy presented in the ROD. In order to determine if the remedy is currently protective of human health, the cleanup goals established for the chemicals of concern, BTEX and CVOCs, were compared to EPA's Industrial Soil Risk Screening Levels (RSLs) and were found to be within or below the Superfund risk range.

Soil vapor intrusion was not evaluated as a potential future exposure pathway during the RI. The evaluation of this pathway is based on the conservative, health-protective assumption that buildings are located above the maximum detected concentration of the contaminants of concern in the groundwater and accumulating vapors migrating up through the vadose zone may impact inhabitants. Considering the high concentrations of volatiles in the groundwater, it was recommended that the vapor intrusion pathway be evaluated, and this was initiated in 2008. Although concentrations of site-related contaminants are above the screening criteria in the subslab, the vapor intrusion pathway was determined to not be a concern at this site considering the relatively low concentrations of site-related contaminants found in the indoor air.
Within the past 5 years, the Virgin Islands has been impacted by Hurricane Maria. As a result of the damage caused by Hurricane Maria, the Curriculum Center has been condemned due to being structurally unsound. There has been no occupancy at this property since it has been impacted by Hurricane Maria, therefore, the exposure has been interrupted at this location The vapor intrusion pathway will be evaluated as additional data become available to determine whether vapor intrusion sampling is appropriate at additional downgradient properties.

While ARARs have not changed, certain screening levels used in the risk assessment have been updated. Certain chemical-specific toxicity values and components of the risk assessment process have changed since the original risk assessment was performed. However, these changes do not change the need to take a remedial action.

The groundwater remedy was reviewed to address the protectiveness of the remedy presented in the ROD. The RAO for groundwater is restoration as a potable water supply, and the remedial goals are MCLs. The MCLs are promulgated standards that apply to public water systems and are intended to protect human health by limiting the levels of contaminants in drinking water. The data indicates that groundwater concentrations continue to exceed drinking water standards. Although the RAO has not been met as of yet, the RAO continues to remain valid. Additionally, institutional controls prevent the installation of new wells in the contaminated area. All residential wells currently located in the plume are used for irrigation purposes only. All residents in the area were connected to public water as part of the 1996 ROD. More current groundwater data will be necessary to ensure that the plume has not expanded to impact additional residents.

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

The groundwater treatment system was severly damaged by Hurricane Maria. As a result, it has not been operating since September 2017. Although the available post-hurricane data shows slight increase in the concentrations throughout the plume, more current data is necessary to properly assess the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

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

Issues and Recommendations Identified in the Five-Year Review:

OU(s): 1	**Issue Category: Remedy Performance**			
	Issue: The treatment facilities are offline and there is no hydraulic capture of the plumes.			
	Recommendation: Repair and restart operation of treatment system using the rececommendations provided in the RSE			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
Yes	Yes	EPA	EPA	3/31/2020
OU(s): 1	**Issue Category: Monitoring**			
	Issue: The impact of the treatment system being offline since September 2017 cannot be fully evaluated with existing data.			
	Recommendation: Continue with regular groundwater monitoring to evaluate whether plume is expanding			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
Yes	Yes	EPA	EPA	6/30/2021
OU(s): 1	**Issue Category: Changed Site Conditions**			
	Issue: It is currently unknown if the plume has expanded beyond its previous boundaries and may have impacted additional private wells or potentially resulted in additional structures being impacted by vapor intrusion.			
	Recommendation: Continue with regular groundwater monitoring to evaluate whether plume is expanding. Consult with VIDPNR and WAPA on additional private wells that may exist in the area of the plume.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
Yes	Yes	EPA	EPA	6/30/2021

OTHER FINDINGS

In addition, the following are recommendations that were identified during the FYR and (may improve performance of the remedy, reduce costs, improve management of O&M, accelerate site close out, conserve energy, promote sustainability, etc.), but do not affect current and/or future protectiveness:

- *OU2 should evaluate source material beneath the Curriculum Center building now that it is not in use.*

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)		
Operable Unit: OU1	*Protectiveness Determination:* Protectiveness Deferred	*Planned Addendum Completion Date:* 8/31/2021
Protectiveness Statement: A protectiveness determination for the OU1 remedy at Tutu Wellfield cannot be made until further information is obtained. Further information will be obtained by taking the following actions: the treatment system will be repaired and restarted; data to delineate the current extent of the plume will be collected; and a survey will be conducted to determine if additional private wells or homes are impacted by the contaminated plume or vapor intrusion. It is expected that these actions will take approximately two years to complete, at which time a protectiveness determination will be made.		

VIII. NEXT REVIEW

The next FYR report for the Tutu Wellfield Superfund Site is required five years from the completion date of this review.

FIGURES

Figure 1: Site Location Map

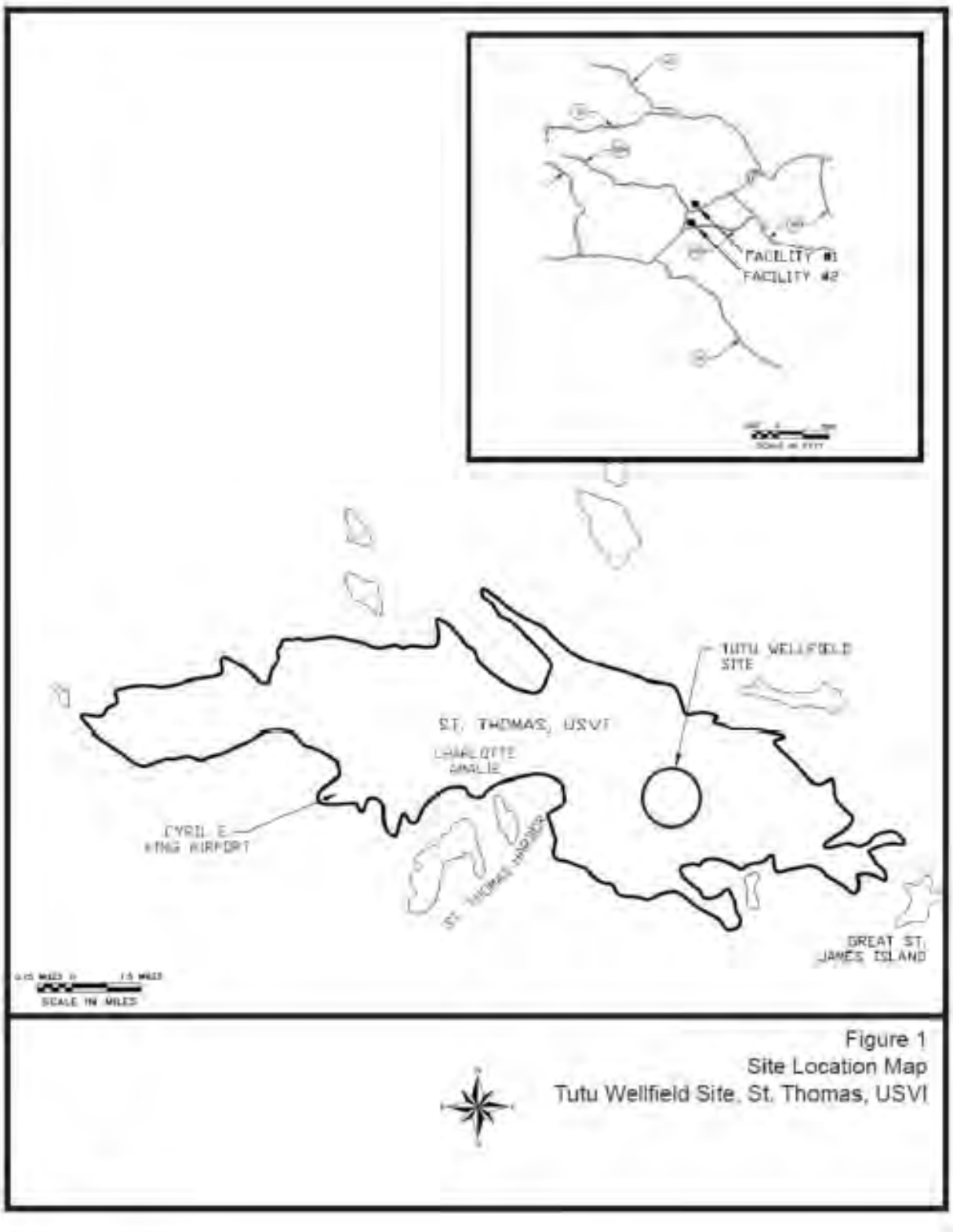


Figure 2: Topographic Site Map

Figure 2
Topographic Site Map
Tutu Wellfield Site, St. Thomas, USVI

Figure 3: Plume Extent (Figure 1-2 from OU2 RI Report)

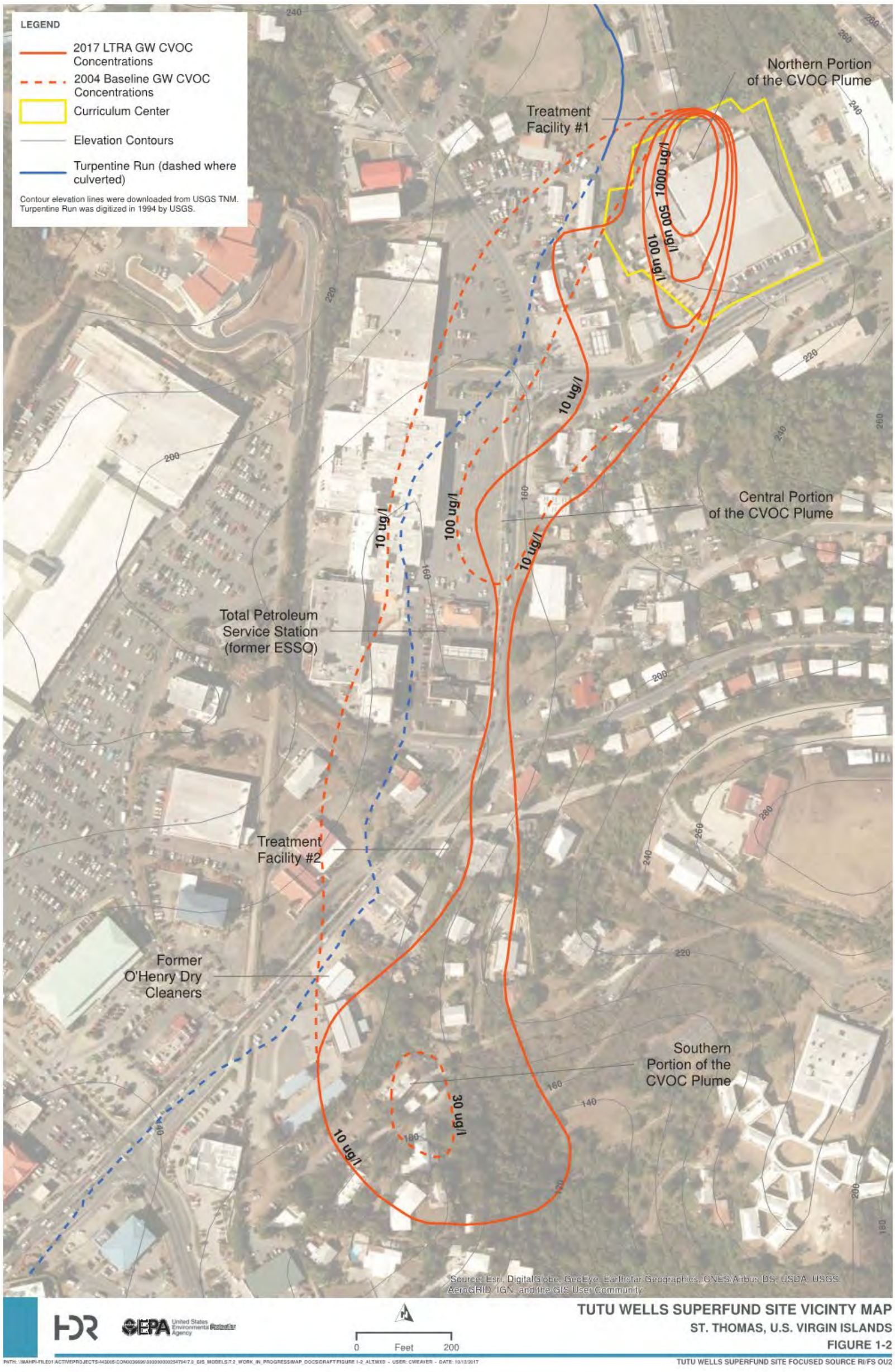


Figure 4: 2018 Groundwater Level Contour Map (Figure 2-1 from Tutu Wellfield Annual Remedial Action Report)

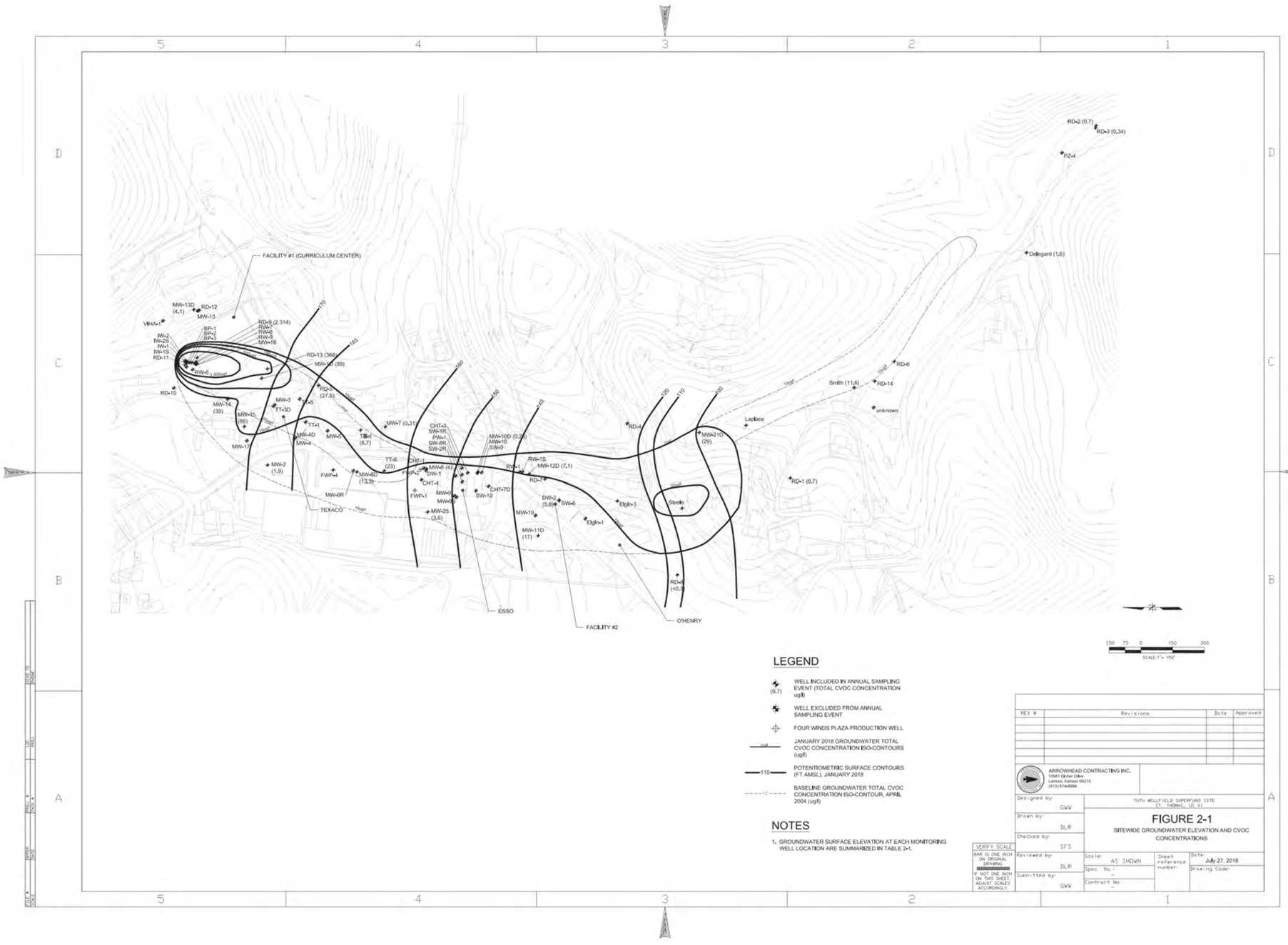


Figure 5: Graph of GWTF #1 flow rate compare to ambient groundwater levels shows 50 percent reduction in extraction rates independent of groundwater levels.

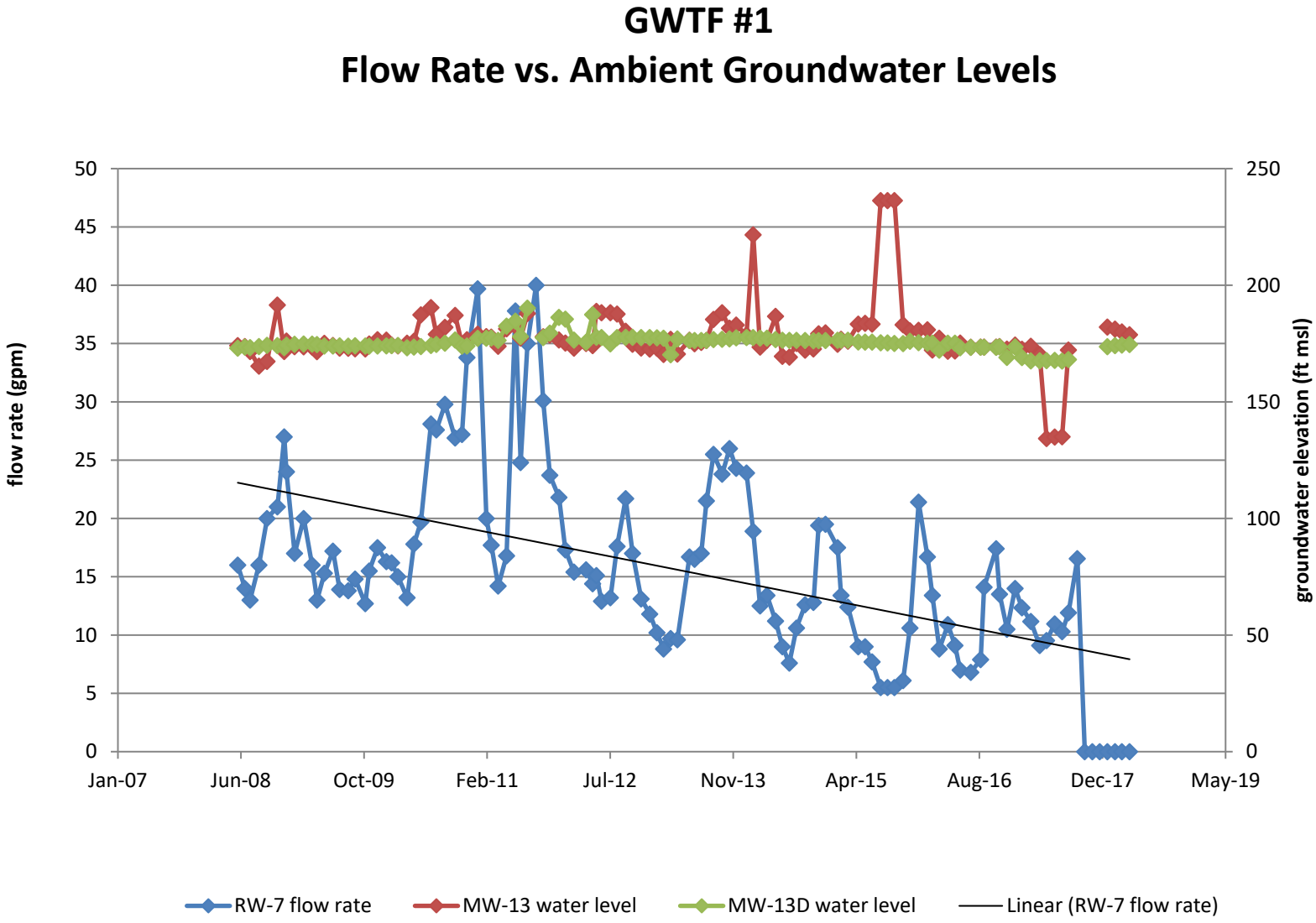


Figure 6: Graph of GWTF #2 flow rates compare to ambient groundwater levels shows slight reduction in extraction rates independent of groundwater levels

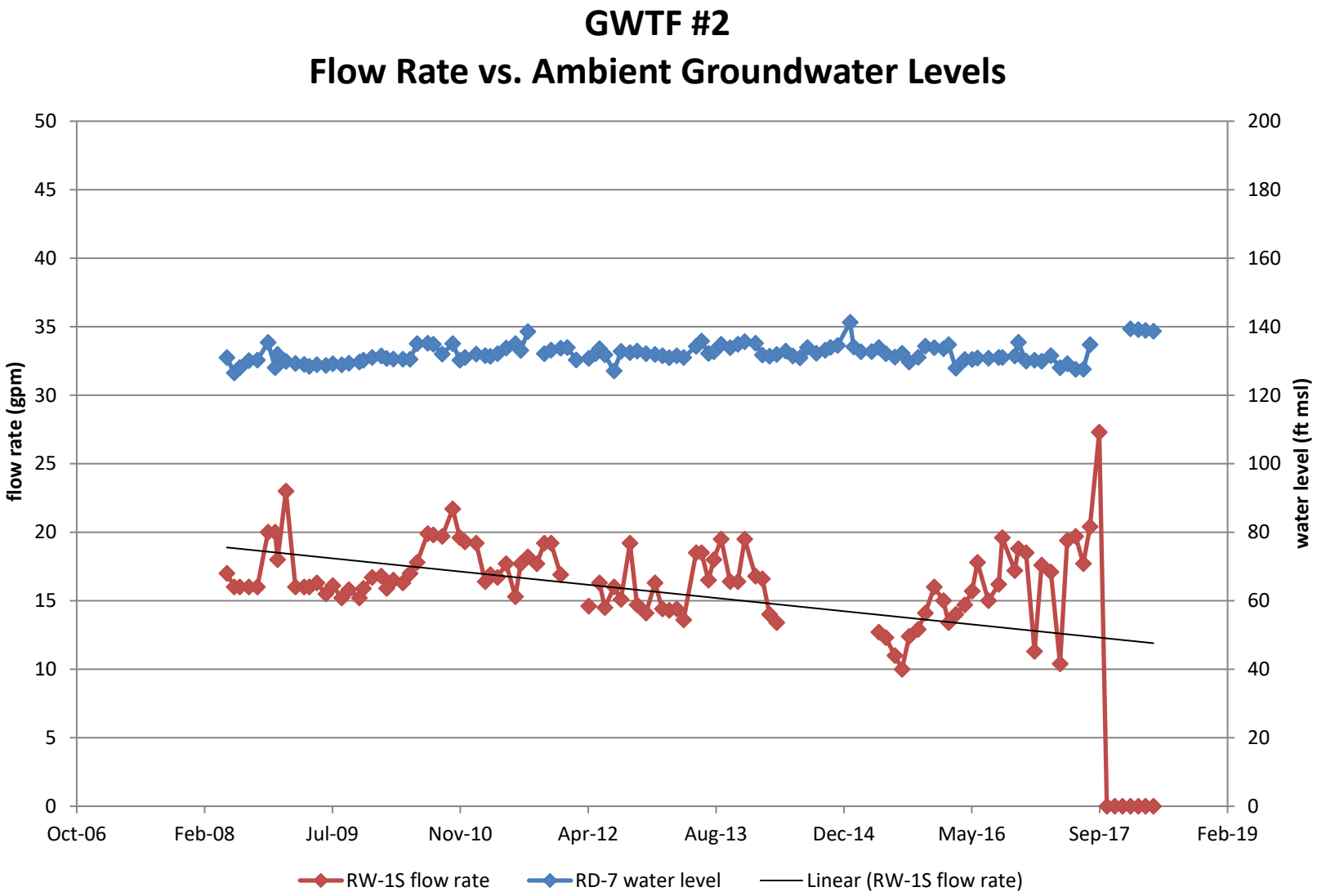


Figure 7: Concentration Trend Plot – Steele Supply Well (Figure 2-2 from Tutu Wellfield Annual Remedial Action Report)

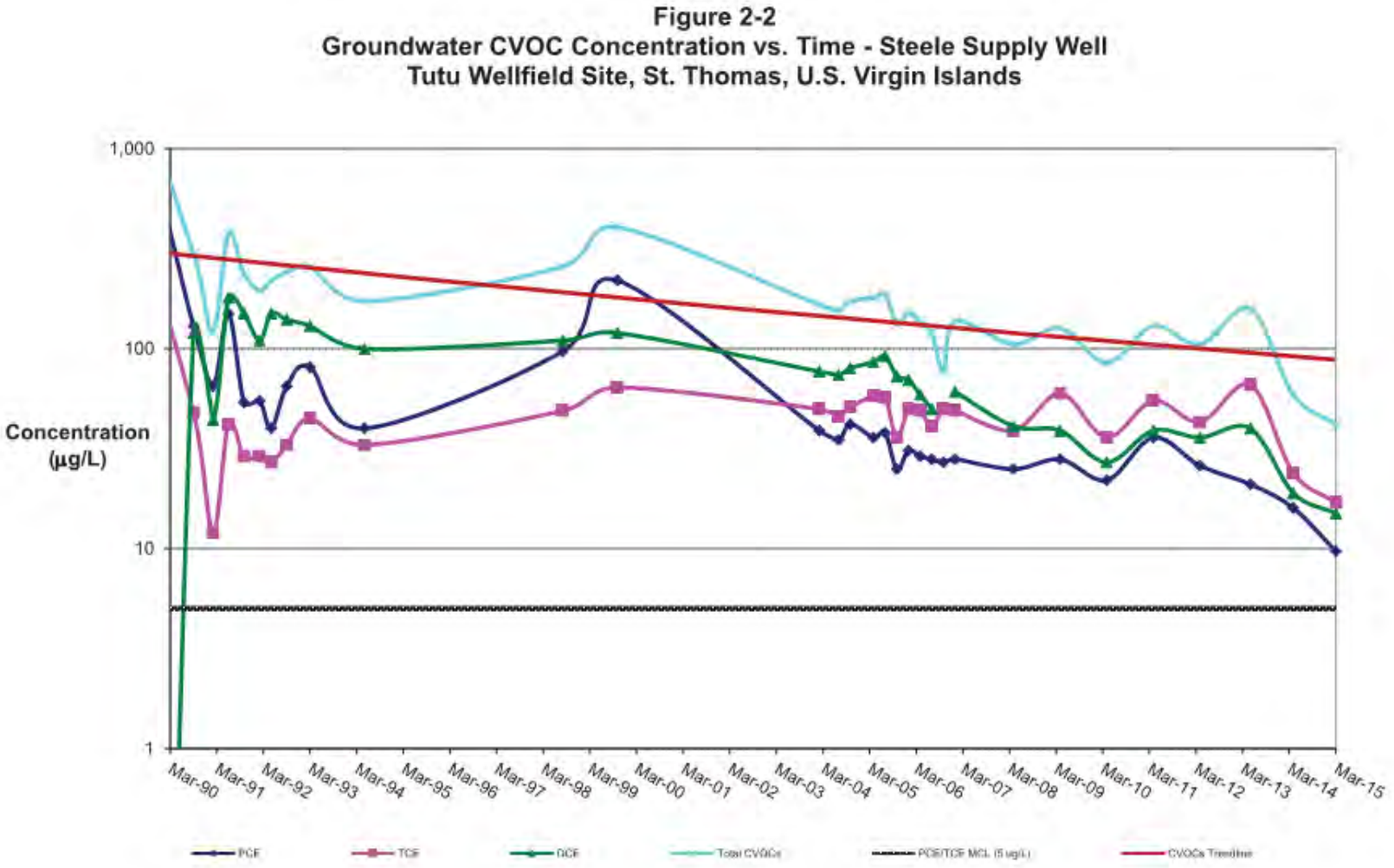


Figure 8: Concentration Trend Plot – LaPlace Supply Well (Figure 2-3 from Tutu Wellfield Annual Remedial Action Report)

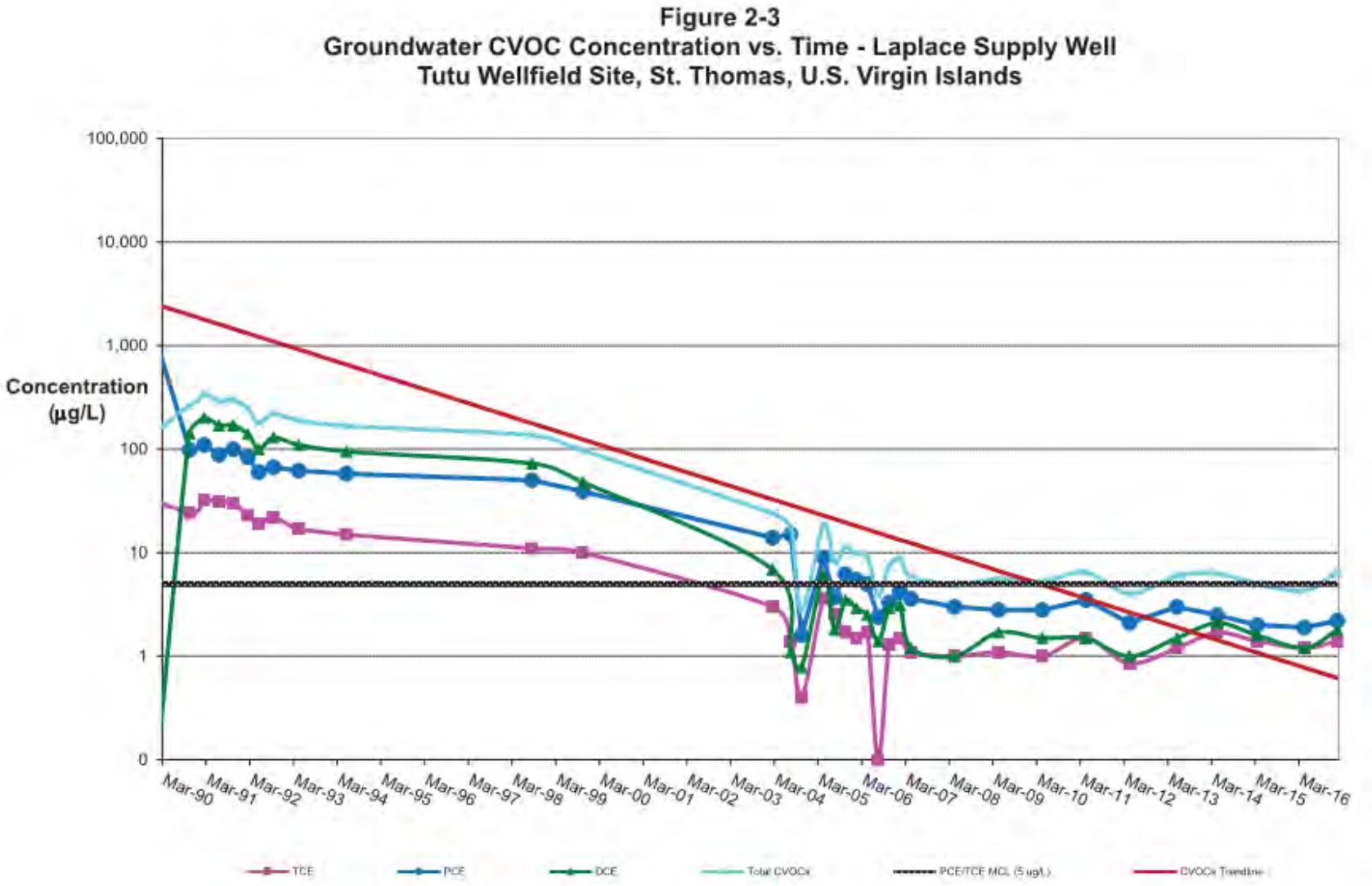


Figure 9: Operational Data – RW-7 and RW-9 (Figure 3-1 from Tutu Wellfield Annual Remedial Action Report)

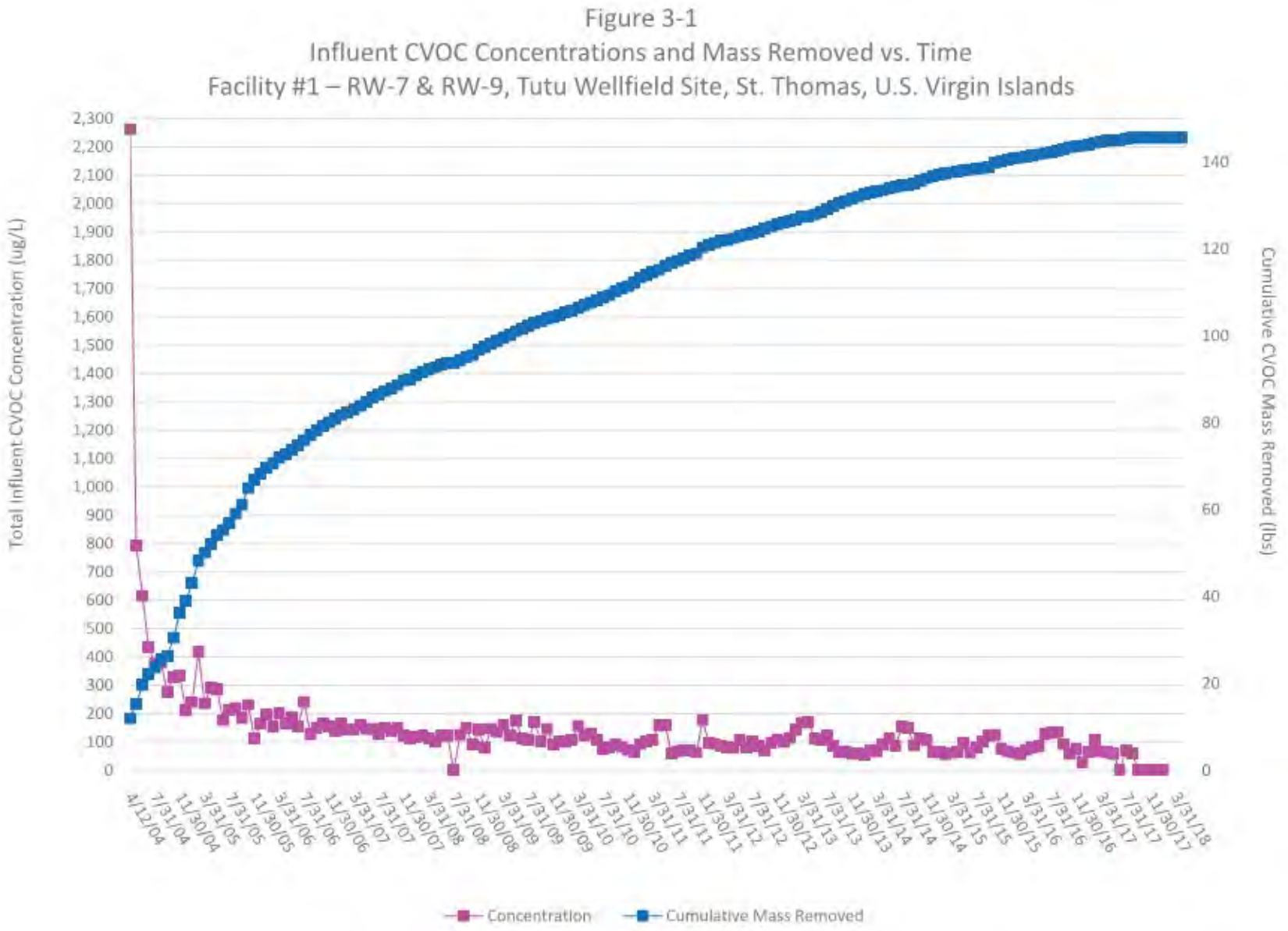


Figure 10: Operational Data Plot – RW-6 (Figure 3-2 from Tutu Wellfield Annual Remedial Action Report)

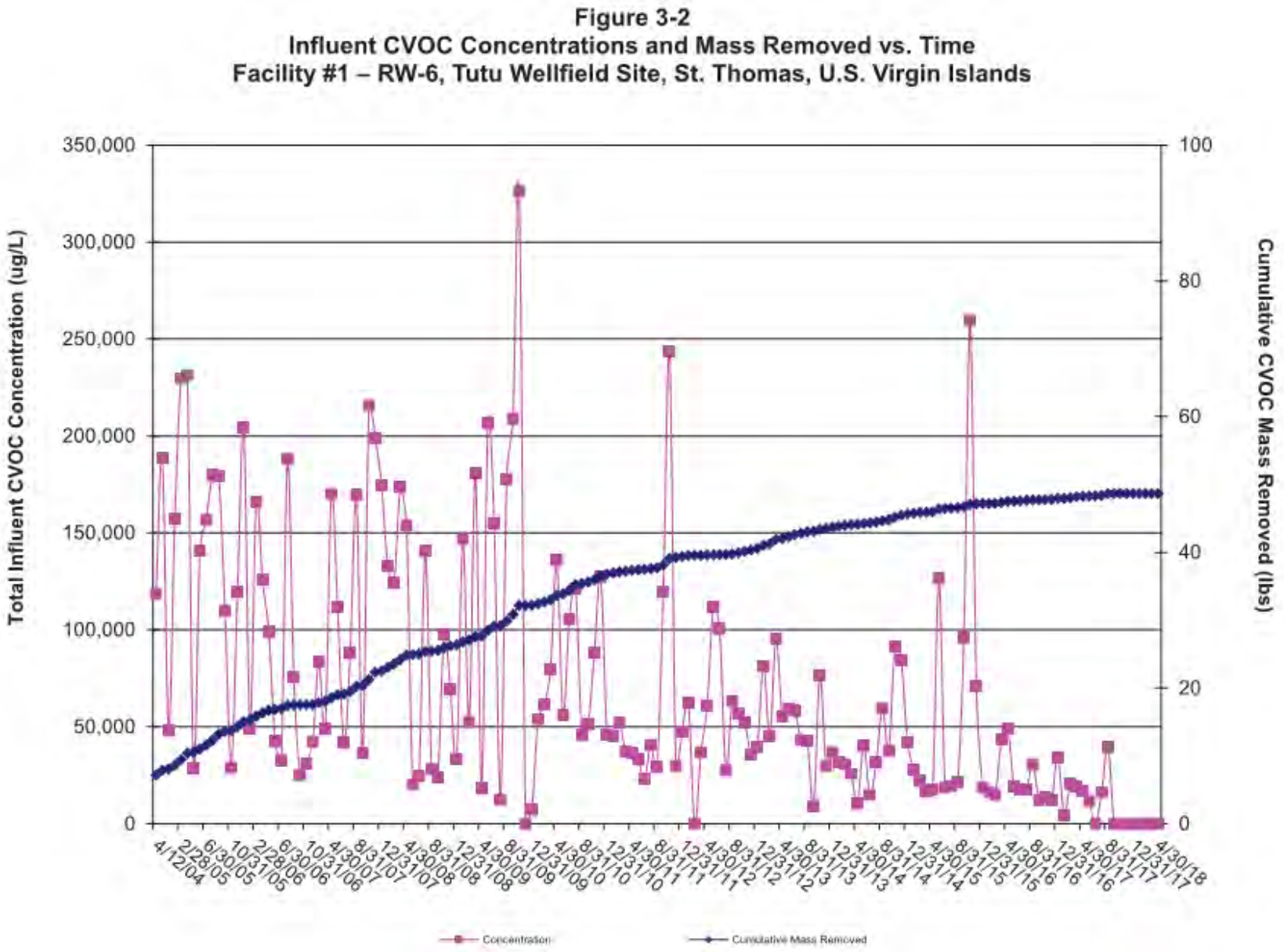
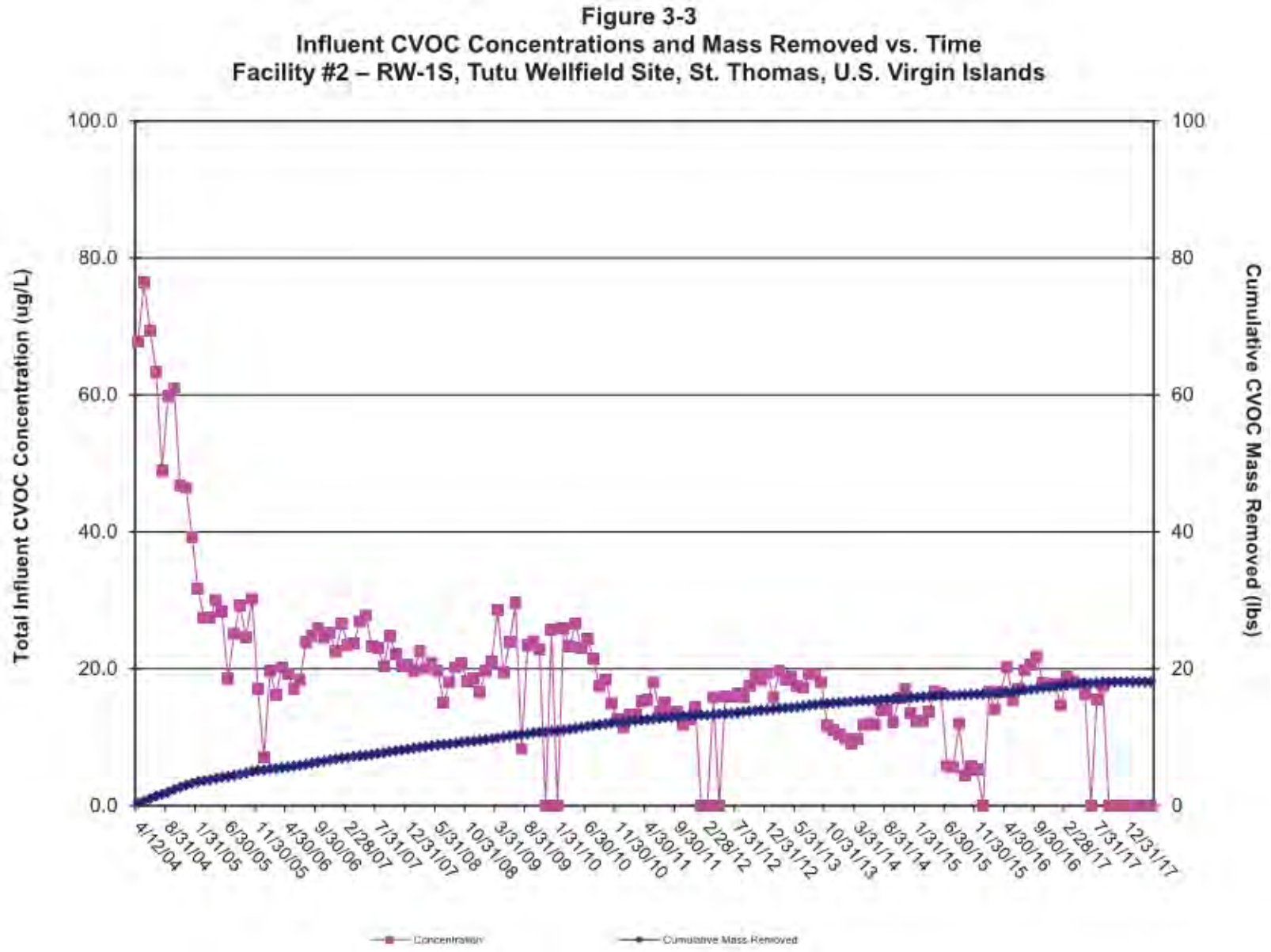


Figure 11: Operational Data Plot – RW-1S (Figure 3-3 from Tutu Wellfield Annual Remedial Action Report)



TABLES

Table 5 – Groundwater Laboratory Analytical Results (Table 2.2 from the Year 14 Tutu Wellfield Annual Remedial Action Progress Report)

Table 2-2
Summary of Groundwater CVOC Data
Tutu Wellfield Site, St. Thomas, U.S. Virgin Islands

Area	Well ID	Concentration (µg/L) Total CVOC																						Concentration (µg/L) January 2018 - CVOC Breakdown									
		Baseline March 2004	July 2004	October 2004	January 2005	April 2005	July 2005	October 2005	January 2006	April 2006	July 2006	October 2006	January 2007	April 2008	October 2009	April 2010	April 2011	April 2012	May 2013	April 2014	April 2015	April 2016	January 2017	January 2018	PCE		TCE		cis-1,2-DCE		trans-1,2-DCE		VC	
Curriculum Center/ Facility #1	MW-1D	701	917	589	1312	704	694	772	684	705	775	532	25	158	-	125	686	109	153	190	144	160	113.9	88.94	28	D	7.1		53	D	0.84		0.5	U
	MW-13D	0	-	-	-	2	-	-	-	2	-	-	-	0	-	2	3	6	5	4	3	4	4.91	4.1	4.1		0.40	J	0.5	U	0.5	U	0.5	U
	MW-14	11	252	16	22	11	0	25	12	28	32	1	0	58	-	23	58	31	13	5	1	6	9.6	39.1	20	D	6.1		13		0.48	J	0.5	U
	MW-15	55	90	39	20	47	30	43	31	36	41	37	46	37	50	39	41	30	52	31	36	40	50	85.6	46	D	4.6	D	35	D	2.5	U	2.5	U
	MW-2	11	-	-	-	2	-	-	-	0	-	-	-	1	1	1	0	1	3	0	0.4	1.1	0.43	1.88	1.1		0.5	U	0.78		0.5	U	0.5	U
	MW-6D	31	-	-	-	4	-	10	-	8	-	-	8	4	-	2	3	2	3	2	2	3	3.88	13.32	6.7		0.72		5.9		0.5	U	0.5	U
	MW-7	1	-	4	0	8	-	0	-	31	-	16	-	12	-	19	8	6	19	1	1	5	2.68	0.31	0.31	J	0.5	U	0.5	U	0.5	U	0.5	U
	RD-13	780	-	-	-	687	-	-	-	807	-	-	-	1060	1430	736	712	380	590	580	460	511	340	368	1.0	U	1.0	U	160	D	150	D	58	D
	RD-9	152020	-	-	-	71540	-	-	-	280000	-	-	-	-	-	15211	478500	165800	2909	3539	2588	601	237	2314	5.0	U	5.0	U	630	D	84	D	1600	D
	RD-5	204	221	139	115	137	-	-	-	-	-	2	92	-	-	70	50	57	98	44	44	37	21.9	27.5	22	D	2.1		3.4		0.5	U	0.5	U
	TT-6	165	-	-	-	-	-	-	-	-	-	-	27	34	40	28	29	20	40	24	22.6	30.0	16.7	23.1	15		1.3		6.8		0.5	U	0.5	U
	Tillett	100	105	18	10	37	23	5	24	39	56	36	44	39	-	36	35	3.1	68	17	7	22	20.9	8.69	6.4		0.49	J	1.8		0.5	U	0.5	U
	MW-10D	48	-	-	-	-	-	-	-	-	-	0	-	1	-	3	0	0.4	1.3	<2.5	6.7	1.8	1.2	0.25	0.5	U	0.5	U	0.25	J	0.5	U	0.5	U
	MW-25	26	-	-	-	7	-	-	-	-	-	6	-	4	-	2	3	2	2	2	2	3	2.42	3.6	2.0		0.41	J	1.2		0.5	U	0.5	U
	MW-8	44	-	-	-	-	-	-	-	-	-	2	31	0	2	2	3	1	1	1	2	4	2.87	2.14	1.6		0.25	J	0.29	J	0.5	U	0.5	U
Facility #2	DW-2	16	16	12	10	12	6	4	8	5	6	0	0	7	-	1	4	1	3	3	4	5	2.97	5.57	3.1		0.97		1.5		0.5	U	0.5	U
	Eglin-3	33	-	-	-	-	-	-	-	5	-	-	-	17	-	48	30	10	-	-	-	-	-	-	-		-		-		-		-	
	MW-11D	0	-	-	-	9	-	-	-	5	-	-	-	4	-	4	2	3	2	3	5	5	4.5	17.31	5.6		4.8		6.8		0.11	J	0.5	U
	MW-12D	71	46	36	26	17	18	12	15	29	12	16	0	0	-	12	12	9	12	10	10	14	6.4	7.12	4.6		0.72		1.8		0.5	U	0.5	U
	RD-7	74	31	23	18	16	-	8	-	9	-	-	8	10	-	7	7	9	8	7	7	3	3.88	5.98	3.7		0.88		1.4		0.5	U	0.5	U
Southern Plume	Delegard	12	9	9	8	6	7	5	4	4	4	4	4	1	-	1	0	1	2	7	2	2	1.33	-	-		-		-		-		-	
	Laplace	24	18	3	-	19	8	11	10	9	4	8	9	3	-	5	7	4	6	6	5	4	5.4	-	-		-		-		-		-	
	Mathias	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-		-		-		-		-	
	MW-21D	72	-	-	-	9	-	-	-	45	-	-	-	39	-	31	27	13	11	15	21	20	13.21	29.45	1.5		3.2		22	D	0.15	J	2.6	
	RD-1	6	-	-	-	4	-	-	-	4	-	-	-	0	-	1	1	1	1	1	0.3	0.3	0.68	0.71	0.5	U	0.5	U	0.71		0.5	U	0.5	U
	RD-2	1	1	0	0	0	-	0	-	0	-	-	0	0	-	0	0	0	1	0	0.0	0.7	0	0	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
	RD-3	4	9	4	6	2	2	5	1	5	3	1	2	4	-	0	0	0.5	0.6	1	0.4	0.0	0	1.6	0.5	U	0.5	U	1.6		0.5	U	0.5	U
	RD-6	8	14	10	13	10	9	10	8	7	8	6	7	4	-	0	2	2	4	7	7	7	7.9	5.8	1.3		2.1		2.4		0.5	U	0.5	U
	RD-8	14	-	-	-	8	-	-	-	8	-	-	-	5	-	3	50	NS	0	<0.50	<0.50	0.6	0	0.66	0.5	U	0.2	J	0.46	J	0.5	U	0.5	U
	Smith	11	-	-	-	15	-	6	-	11	-	-	-	4	-	4	2	6	3	9	10	13	8.2	11.6	2.7		4.4		4.5		0.5	U	0.5	U
	Steele	169	158	175	160	182	190	135	154	138	119	78	139	106	-	85	130	105	159	60	41	-	-	-	-		-		-		-		-	

Notes:
1. Non-detects were assumed to have a value of 0 µg/L.
2. The Smith and Steele VOC samples were most likely mislabeled in April 2007. These wells will continue to be monitored to verify contaminant trends.
3. Samples were not collected from the Eglin-3 well in April 2013 because the supply well pump was broken.
4. The Steele well has not been sampled since April 2015 due to an inoperable well pump.
5. The Steele and Eglin-3 wells have been removed from the list of wells to be sampled annually until well pumps are repaired.
6. Samples were not collected at Delegard or Laplace during the 2018 sampling event. There was no power available and both well pumps were damaged in hurricanes Irma and Maria.

Acronyms:
CVOCs - chlorinated volatile organic compounds
DCE - dichloroethene
ID - identification
NS - not sampled
TCE- trichloroethene
PCE- tetrachloroethene
VC- vinyl chloride
µg/L - microgram per liter

Table 6: Preliminary Residential Water Analytical Results Summary Table - TCL VOCs
Tutu Wellsfield Site
Anna's Retreat, St. Thomas, U.S. Virgin Island
June 4, 2019

RST 3 Sample Number	EPA MCL[1]	P0001-SMITH-190604-01	P0001-SMITH-190604-02	P0002-STEELE-190604-01	P0003-DELEGARD-190604-01	TB-190604
Sample Matrix		Water	Water	Water	Water	DI Water
Sample Source		Residential Well	Residential Well	Residential Well	Residential Well	Trip Blank
TCL VOC						
Dichlorodifluoromethane	NS	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
Chloromethane	NS	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
Vinyl chloride	2	0.090 U	0.090 U	0.090 U	0.090 U	0.090 U
Bromomethane	NS	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
Chloroethane	NS	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
Trichlorofluoromethane	NS	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
1,1-Dichloroethene	7	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NS	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
Acetone	NS	0.96 U	0.96 U	**2.3 J**	**2.4 J**	**9.1**
Carbon disulfide	NS	0.070 U	0.070 U	0.070 U	0.070 U	0.070 U
Methyl Acetate	NS	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Methylene chloride	NS	0.090 U	0.090 U	0.090 U	0.090 U	**0.44 J**
trans-1,2-Dichloroethene	NS	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Methyl tert-butyl Ether	NS	**0.17 J**	**0.16 J**	**0.28 J**	0.080 U	0.080 U
1,1-Dichloroethane	NS	0.090 U	0.090 U	0.090 U	0.090 U	0.090 U
cis-1,2-Dichloroethene	70	**4.1**	**3.9**	**3.5**	**0.78**	0.100 U
2-Butanone	NS	0.88 U	0.88 U	0.88 U	0.88 U	0.88 U
Bromochloromethane	NS	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
Chloroform	*	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
1,1,1-Trichloroethane	200	0.090 U	0.090 U	0.090 U	0.090 U	0.090 U
Cyclohexane	NS	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U
Carbon tetrachloride	5	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
Benzene	5	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
1,2-Dichloroethane	5	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Trichloroethene	5	**2.8**	**2.7**	**2.9**	**0.74**	0.090 U
Methylcyclohexane	NS	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
1,2-Dichloropropane	*	0.080 U	0.080 U	0.080 U	0.08 U	0.080 U
Bromodichloromethane	80	0.090 U	0.090 U	0.090 U	0.090 U	0.090 U
cis-1,3-Dichloropropene	NS	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
4-Methyl-2-pentanone	NS	0.54 U	0.54 U	0.54 U	0.54 U	0.54 U
Toluene	1,000	0.090 U	0.090 U	0.090 U	0.090 U	0.63
trans-1,3-Dichloropropene	NS	0.070 U	0.070 U	0.070 U	0.070 U	0.070 U
1,1,2-Trichloroethane	5	0.090 U	0.090 U	0.090 U	0.090 U	0.090 U
Tetrachloroethene	5	**1.5**	**1.5**	**4.5**	**0.28 J**	0.080 U
2-Hexanone	*	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U
Dibromochloromethane	80	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
1,2-Dibromoethane	0.05	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U
Chlorobenzene	100	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U
Ethylbenzene	700	0.080 U	0.080 U	0.080 U	0.080 U	**0.12 J**
o-xylene	NS	0.100 U	0.100 U	0.100 U	0.100 U	**0.13 J**
m,p-xylene	NS	0.100 U	0.100 U	0.100 U	0.100 U	**0.16 J**
Styrene	100	0.100 U	0.100 U	0.100 U	0.100 U	**0.55**
Bromoform	*	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U
Isopropylbenzene	NS	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
1,1,2,2-Tetrachloroethane	NS	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
1,3-Dichlorobenzene	NS	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
1,4-Dichlorobenzene	NS	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,2-Dichlorobenzene	600	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
1,2-Dibromo-3-chloropropane	0.2	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,2,4-trichlorobenzene	70	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U
1,2,3-Trichlorobenzene	NS	0.090 U	0.090 U	0.090 U	0.090 U	0.090 U

Notes:
RST 3 - Removal Support Team 3
TCL VOC - Target Compound List Volatile Organic Compound
U - Not Detected, J - Estimated Result, UJ - Estimated at the Detection Limit
DI - Deionized
[1]U.S. Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCLs), revised March 2018
All data reported in micrograms per liter (µg/L).
*For the total of the four trihalomethanes, the EPA MCL is 80 µg/L
Results in bold font are detections

APPENDICES

APPENDIX A – REFERENCE LIST

1. US Environmental Protection Agency Record of Decision, Tutu Wellfield, August 5, 1996
2. Forensic Environmental Services, Inc. -Remedial Action Progress Reports - Esso Tutu Service Station - Various Dates
3. MACTEC Engineering and Consulting, Inc.-Remedial Action Progress Report - Chevron/Texaco Tutu Service Station - Various Dates
4. Second EPA Five Year Review Report, September 2014
5. Arrowhead Contracting, Inc.- Annual Remedial Action Progress Reports, September 2014 to August 2018
6. No Further Action (NFA) Report for the Puma Tutu Service Station, October 2016
7. Response to Comments No Further Action (NFA) Request Puma Tutu Service Station, April 2017
8. 2017 Annual Remedial Action Progress Report and Request to Cancel TPDES Permit No. VI0040703 Total Petroleum (former Esso) tutu Service Station, August 2017
9. Final Remedial Investigation Report for the Tutu Wells Superfund Site Operable Unit 2, March 2018
10. Final Focused Source Feasibility Study for the Tutu Wells Superfund Site Operable Unit 2, March 2018
11. Residnetial Wells Sampling Reprot for the Tutu Werllsfield Site prepared by START V dated August 2019

APPENDIX B – SITE BACKGROUND

Investigation work began at the Tutu Wellfield Site in 1987 in response to complaints from local residents of an odor emanating from their groundwater supply wells. Subsequent groundwater sampling by the EPA's Technical Assistance Team revealed the presence of chlorinated volatile organic compounds (CVOCs) and benzene, toluene, ethylbenzene, and xylenes (BTEX) contaminants in the groundwater above Federal maximum contaminant levels (MCLs) for drinking water. Several of the wells in this area were large commercial wells used for public drinking water supply. The incident led the U.S. Virgin Islands Department of Planning and Natural Resources (DPNR) Commissioner to request EPA to assume the role of lead agency. EPA condemned the contaminated supply wells, made arrangements to provide an alternate drinking water supply to the affected residents and initiated investigations to identify the sources of the contamination. Several residences were identified as being impacted by the contaminated plume. They were the Mathias, Laplace, Harvey, Steele, Smith and Delegard residences.

The site was proposed for addition on the National Priorities List (NPL) in February 1992. Remedial investigation and feasibility study (RI/FS) activities were completed at the site from 1992 to 1995. The Tutu Wellfield site was added to the NPL on September 29, 1995.

The results of the remedial investigations identified four sources of groundwater CVOCs and/or BTEX contamination. The sources are briefly described below:

- Curriculum Center – The northern-most (upgradient) source of CVOC groundwater contamination is located on the Curriculum Center property, which is currently owned and operated by the USVI Department of Education. The Curriculum Center building and property were previously occupied by LAGA Industries, Ltd., who owned and operated a textile manufacturing plant at this location from 1971 to 1978. The plant included an industrial size dry cleaning process that utilized tetrachloroethene (PCE) as the dry cleaning solvent. The RI work revealed the presence of CVOC contaminants in the soilsoil and groundwater at the Curriculum Center property. The portion of the CVOC plume extending downgradient from the Curriculum Center to O'Henry Dry Cleaners, Inc., (O'Henry) is herein referred to as the Northern Plume.
- Texaco Service Station – RI work revealed the presence of BTEX and petroleum hydrocarbon contaminants in the soil and groundwater at the operating Texaco Caribbean, Inc., (Texaco) service station, which is located immediately downgradient (southwest) of the Curriculum Center building. Historically, the facility also included an automotive service station. This is located within the Northern Plume.
- Esso Service Station – RI work revealed the presence of CVOC, BTEX, and petroleum hydrocarbon contaminants in the soil and groundwater at the operating Esso Standard Oil, U.S.A., Inc., (Esso) service station, which is located downgradient (southwest) of Texaco. Historically, the facility also included an automotive service station. This is located within the Northern Plume.
- O'Henry Dry Cleaners – RI work revealed the presence of CVOC contaminants in soil and potentially in groundwater at O'Henry, an operating dry cleaning facility, which is located downgradient (south) of Esso. The portion of the CVOC plume extending south of O'Henry is herein referred to as the Southern Plume.

Additionally, BTEX-impacted soil was encountered at the Ramsey Motors property, located just to the north of the Texaco Service Station and at the Western Auto facility, which is located within the Four Winds Plaza shopping facility, west of the Esso Service Station.

Summary of Site Groundwater Contamination

The Northern Plume originates at the Curriculum Center property, which is located near the intersection of Routes 38 and 384 within the upper northeast reaches of the Turpentine Run Basin Aquifer. The Northern Plume extends site-wide to the lower reaches of the Tutu Valley and is historically believed to have co-mingled with the Southern Plume. Based upon the measured and observed convergent nature of groundwater flow within the Tutu valley, lateral dispersion of contaminants in this zone appears to be limited to a narrow strip along controlling faults and fractures. Vertically, the hydrogeology and contaminant distribution near the Curriculum Center can broadly be subdivided into:

- An upper, more productive zone, extending from the water table (15 to 30 feet below ground surface [bgs]) to a depth of approximately 80 feet.
- A lower, less productive zone, extending from approximately 80 to 140 feet bgs.

Contaminant transport is believed to be controlled by advection, with a discrete plume (with concentrations in excess of 1,000 micrograms per liter [ug/L] CVOCs) extending from north of the Curriculum Center to just north of the Texaco service station (approximately 500 feet downgradient of the center). The Northern Plume is also co-mingled with BTEX plumes that originate from the Texaco and Esso Service Stations. Anaerobic biodegradation of CVOC contaminants may be currently occurring in these sources, based upon the presence of dechlorination products such as trichloroethylene (TCE) and 1,2-dichloroethylene (1,2-DCE).

RI results indicated that a shallow BTEX plume located near the Texaco Tutu Service Station was approximately 400 feet long from north to south and approximately 200 feet wide from east to west. In the deep zone, it was approximately 300 feet by 130 feet in areal extent. The plume was elongated in the direction of shallow groundwater flow and appeared to have migrated past the Tillett Supply Well. The maximum concentrations of benzene, ethylbenzene, and xylenes were 21,000 µg/L, 3,700 µg/l and 18,000 µg/L, respectively. The shallow BTEX plume located near the Esso Service Station measured approximately 250 feet by 175 feet. The maximum concentrations of benzene, ethylbenzene, and xylenes detected at this location were 10,000 µg/L, 4,100 µg/L and 22,000 µg/L. Direct observations of floating product and sheens in some monitoring wells at the Esso and Texaco Service Stations confirmed the presence of light non-aqueous phase liquid (LNAPL).

The Southern Plume originates near the O'Henry facility and in this area there is a noticeable and measurable change in regional groundwater flow direction, from south to southeast. This change is believed to be controlled by regional fault and fracture zones along Turpentine Run, which "channel" groundwater flow toward the lower reaches of Turpentine Run and ultimately the Mangrove Lagoon. The Southern Plume CVOC contamination, therefore, travels within a relatively narrow zone along the southeast-northwest trending Turpentine Run.

Summary of Site Soil Contamination

During the RI, surface and subsurface soil samples were collected from borings and monitoring well boreholes. Soil quality data was collected from 15 properties in the project study area to identify impacted soil. Three properties were identified as having significant CVOC impact to soil, based on

exceedance of EPA's site-specific soil screening levels (SSLs) for impact to groundwater. At the Curriculum Center, contamination was detected at the north-central side of the main building in the vicinity of the former discharge pipe and presumed former waste pit, with PCE concentration up to 1,800 micrograms per kilogram (µg/kg) and TCE concentrations up to 130 µg/kg. The CVOC 1,1,1-trichloroethane (1,1,1-TCA), was also detected above the EPA's SSLs. The elevated concentrations of CVOCs in groundwater adjacent to and immediately downgradient of the Curriculum Center indicate a high probability that pure product is present in the unsaturated zone as dense non-aqueous phase liquid (DNAPL) at the Curriculum Center. At the Esso Tutu Service Station, PCE, TCE, 1,1,1-TCA, 1,2-DCE, and 1,1-dichloroethane (DCA) were detected above EPA's SSLs at the western portion of the property, near the north oil/water separator at concentrations up to 3,200 µg/kg. PCE was found in the vicinity of the O'Henry Dry Cleaners above EPA's SSLs in the southwestern portion of the property at concentrations up to 440,000 µg/kg. There is a potential for DNAPL to be present in the subsurface soil in the vicinity of the O'Henry dry cleaners due to significant concentrations of PCE detected in adjacent wells.

The site-specific SSLs for BTEX compounds were exceeded at five properties. At the northeast corner of the Curriculum Center, in an area where a sink from the paint shop drain discharged to the ground, BTEX compounds exceeded EPA's SSLs with benzene concentrations up to 2,700 µg/kg and toluene concentrations up to 500,000 µg/kg. Benzene and ethylbenzene were detected in the vicinity of the underground storage tank (UST) at the Ramsay Motors property at levels above the EPA SSLs with maximum benzene concentrations of 17 µg/kg and maximum ethylbenzene concentrations of 290 µg/kg. At the Texaco Service Station, BTEX compounds were found in the vicinity of the former USTs and at the oil/water separator at concentrations exceeding EPA's SSLs. Results ranged from 69 µg/kg for benzene to 630 µg/kg for ethylbenzene. At the Western Auto facility, all individual BTEX constituents exceeded EPA's SSLs, with maximum results for toluene and ethylbenzene at 16 µg/kg for each and xylene at 34,000 µg/kg. A shallow gravel layer underlying the pavement in this area also contained visible stained oil. The impacted soil was located adjacent to an underground storage tank, which was removed in August 1994. At the Esso Tutu Service Station, BTEX compounds exceeded EPA's SSLs near the gasoline pump island, the north oil/water separator, and the former UST excavation. Individual BTEX concentrations above EPA's SSLs ranged from 26 µg/kg of ethylbenzene to 540,000 µg/kg of xylenes.

At the Tillett Gardens property, no CVOCs or BTEX constituents were detected above screening levels in the site soil. However, elevated concentrations (120,000 µg/kg) of the polychlorinated biphenyl (PCB) Aroclor 1242 were detected in one surface sample in 1988. Because this sample concentration resulted in unacceptable risks to human health from direct exposure, EPA collected confirmatory samples from the affected area in August 1995 to delineate the extent of impacted soil. PCBs were not detected in any of the confirmatory samples, indicating that PCBs are no longer a concern at this property.

APPENDIX C – CHRONOLOGY OF SITE EVENTS

Event	Date
Investigation at the Site begins pursuant to complaints from local residents of an odor emanating from groundwater supply wells	1987
Unilateral Administrative Orders (UAO) issued to Texaco, Esso, and O'Henry Dry Cleaners to implement a well-water monitoring program, provide potable water to affected residents, and coordinate design plans to connect affected residents to public water supply	1988 - 1990
Hazard Ranking System package prepared, and Site is proposed for addition to the NPL	February 1992
PA issues Administrative Order of Consent (AOC) to Texaco and Esso to implement an RI/FS	February 1 992
Various RI/FS activities	1992 - 1995
Western Auto removes underground storage tank and paves the area with a concrete cap	August 1994
EPA issues Consent Order to O'Henry for soil cleanup. Pursuant to the Order O'Henry performs soil removal.	March 1995
Site is added to the NPL	September 1995
ROD signed	August 1996
Construction completed for the Texaco Service Station groundwater and soil treatment system and Vitelco groundwater treatment system. Texaco Service Station system is placed into operation.	1998
EPA issues UAOs to Texaco, Esso, and Western Auto /Four Winds Plaza for RDs/RAs to address site contamination	May 1998
Pre-design investigation performed for Curriculum Center soil and site-wide groundwater	August 1998 November 1999
Esso groundwater and soil treatment system construction completed and system is placed into operation	1999
Pre-design investigation performed at Western Auto/Four Winds Plaza	January- February 1999
EPA issues UAO to O'Henry for RDs/RAs to address site contamination	May 1999
O'Henry Dry Cleaners performs pre-design soil delineation investigation	November 1999
EPA approves No Further Action recommendation regarding ROD specified soil contamination for Western Auto Mart/Four Winds Plaza	January 2000
EPA approves No Further Action recommendation for O'Henry Dry Cleaners	July 2001
EPA completes the design for the Curriculum Center groundwater treatment and SVE, and side-wide groundwater treatment	September 2001
Soil excavation of contaminated soil at Esso Service Station and treatment of soil in bio-cells. Construction of Esso "Hot-Spot" remediation system.	2001 - 2002
Operation of Esso Service Station "Hot-Spot" remediation system	2002 - 2005
Texaco Service Station groundwater and SVE systems shutdown after a pulsing period is conducted	July 2003
MNA activities for Texaco Service Station	July 2003 – present

Site construction completed for Curriculum Center soil and site- wide groundwater. System is placed into operation.	March 2004
Operation, maintenance, and monitoring activities for Curriculum Center SVE and off-gas systems	March 2004 – March 2004
Operation, maintenance , and monitoring activities performed for site-wide groundwater	March 2004 -April 2013
MNA activities for Esso Service Station	2005 - present
Removal and replacement of three underground storage tanks and associated fuel lines performed at the Texaco Service Station	December 2006
Enhanced bioremediation application performed at the Texaco Service Station	January 2007
First Five Year Review report	April 2009
EPA transfer LTRA to Virgin Islands Government	April 2013
Second Five Year Review report	September 2014
OU2 Focused Source Area Remedial Investigation fieldwork	April 2016 – June 2017
OU2 Focused Source Area Remedial Investigation Report/Feasibility Study	March 2018
Residential Wells Sampling report prepared by START V	August 2019