Tutu Wellfield Superfund Site

St. Thomas, U.S. Virgin Islands

August 2018

EPA ANNOUNCES PROPOSED PLAN

This Proposed Plan describes remedial alternatives that the United States Environmental Protection Agency (EPA) considered to address groundwater contamination associated with the contaminant source areas at the Tutu Wellfield Superfund Site located in St. Thomas, U.S. Virgin Islands. This Plan also identifies EPA's Preferred Alternative and provides the rationale for this preference.

This Proposed Plan includes summaries of cleanup alternatives evaluated to more effectively address contaminant source areas and accelerate the cleanup of groundwater contamination at the site. As described herein, EPA, in consultation with the United States Virgin Islands (USVI) Department of Planning and Natural Resources (DPNR), will select the remedy for source area groundwater after reviewing and considering all information submitted during the 30-day public comment period. EPA, in consultation with DPNR, may modify the Preferred Alternative or select another response action presented in this Proposed Plan based on new information or public comments. Therefore, the public is encouraged to review and comment on all the alternatives presented in this Proposed Plan.

EPA is issuing this Proposed Plan as part of its public participation responsibilities in accordance with Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. §117(a) (CERCLA) (also known as Superfund), and Sections 300.430(f) and 300.435(c) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This Proposed Plan summarizes information that can be found in greater detail in the Remedial Investigation (RI) and Feasibility Study (FS) reports as well as other related documents contained in the publicly available Administrative Record for this decision. EPA encourages the public to review these documents to gain a more comprehensive understanding of the site and Superfund activities that have been conducted.

MARK YOUR CALENDAR

PUBLIC COMMENT PERIOD: August 8 - September 7, 2018
EPA will accept written comments on the Proposed Plan during the public comment period. Written comments should be addressed to:

Caroline Kwan
Remedial Project Manager
U.S. Environmental Protection Agency
290 Broadway, 20th Floor
New York, NY 10007
Email: kwan.caroline@epa.gov

Written comments must be postmarked or emailed no later than September 7, 2018.

PUBLIC MEETING: August 23, 2018 at 7:00 pm
EPA will hold a public meeting to explain the Proposed Plan and all of the alternatives presented in the Feasibility Study. Oral and written comments will also be accepted at the meeting. The meeting will be held at:

GRACE GOSPEL CHAPEL
148-320-321&322 Estate Anna's Retreat
St. Thomas, VI 00802

In addition, select documents from the administrative record are available on-line at:

https://www.epa.gov/superfund/tutu-wellfield

The current remedy for the site, selected in 1996 in a document called a Record of Decision (ROD), consists of extraction of contaminated groundwater, ex-situ treatment, discharge of the treated groundwater to a nearby stream, and institutional controls (ICs). Construction of the remedy selected in the 1996 ROD was completed in 2004 and began operation at that time. Operation and maintenance (O&M) of the treatment system was transferred from EPA to the USVI government in April 2013, and the USVI O&M obligation continues. The Preferred Alternative identified in this Proposed Plan would include expansion of the existing pump and treat system, reinjection of groundwater to create a hydraulic barrier downgradient of the source area, long-term monitoring, and the implementation of the already-required ICs.

COMMUNITY ROLE IN SELECTION PROCESS

This Proposed Plan is being issued to inform the public of EPA's proposed alternative and to solicit public comments pertaining to all of the remedial alternatives evaluated, including the Preferred Alternative. Changes to the Preferred Alternative, or a change to a preference for another alternative, may be made if public comments or additional data indicate that such a change would result in a more appropriate remedial action. The final decision regarding the selected remedy will be made after EPA has taken into consideration all public comments. As stated above, EPA is soliciting public comments on all of the alternatives considered in the Proposed Plan because EPA may ultimately select a remedy other than the Preferred Alternative. This Proposed Plan has been made available to the public for a public comment period that concludes on September 7, 2018.

A public meeting will be held during the public comment period to present the information regarding the investigations of groundwater at the site, including the conclusions of studies performed to assess treatment options, as well as the FS, so as to elaborate further on the reasons for proposing the Preferred Alternative. The public meeting will include a presentation by EPA of the Preferred Alternative and other cleanup options and an opportunity to receive comments from the public. Information on the public meeting and how to submit written comments can be found in the "Mark Your Calendar" text box on Page 1.

Comments received at the public meeting, as well as written comments received during the comment period, will be addressed and documented in the Responsiveness Summary section of the ROD. The ROD is the document that presents which alternative has been selected and the basis for the selection of the remedy.

SCOPE AND ROLE OF ACTION

The site has been divided into two operable units. The 1996 ROD selected a remedy to address the entire site as one operable unit (OU1). The remedy was designed to address three distinct plumes of groundwater contamination, one consisting of chlorinated volatile organic compounds (CVOCs) and two others consisting of petroleum products from two service stations (the Texaco and Esso plumes). A secondary source of CVOC contamination originates from the O'Henry Dry Cleaners building and mixes with the primary CVOC plume downgradient of the source. The 1996 remedy called for extraction of contaminated groundwater, ex-situ treatment, discharge of the treated groundwater to a nearby stream and the implementation of ICs (Figure 1).

The 1996 remedy has been constructed and operating since 2004 and is effectively managing the Texaco and Esso plumes. However, monitoring conducted since 2004 has shown that concentrations in the CVOC plume are not decreasing as quickly as anticipated, suggesting that an unidentified source may still be present in the northern part of the plume. Therefore, in April 2015 EPA created OU2 to further investigate potential contaminant source areas and to evaluate options to accelerate the cleanup of groundwater contamination at the site.

The primary objectives of the OU2 remedy are to accelerate the remediation of the source area groundwater contamination, restore groundwater quality to its most beneficial use (i.e., federal drinking water standards), and minimize any potential future health and environmental impacts.

SITE BACKGROUND

Site Description

The site is located in east-central St. Thomas in the USVI, and it consists of contaminated groundwater plumes covering an area approximately 108 acres in size. This Proposed Plan focuses on the source area of the CVOC plume, which is centered on the USVI Department of Education (VIDE) Curriculum Center property in the Anna's Retreat section of St. Thomas, east of the city of Charlotte-Amalie. A site location map is provided as Figure 1.

The Curriculum Center property is located at 386 Smith Bay Road (Highway 38). The 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 existing northern groundwater treatment system is located on the north side of the building. The Curriculum Center building was condemned after sustaining extensive damage during Hurricane Irma/Maria in 2017.

Site History

The Curriculum Center property is currently owned by VIDE. The property was originally owned by LAGA Industries, Ltd. (LAGA), which began operation of a textile manufacturing facility at the property in 1969. In 1970, LAGA was sold to the Duplan Corporation at which time Duplan reportedly began dry cleaning operations at the property using tetrachloroethene (PCE) as the dry cleaning fluid. PCE is part of the CVOC group of chemicals. Duplan filed for bankruptcy in 1976 and ceased all operations at the property in late 1978. Panex Co. (a corporation formed by the former owners of LAGA) purchased the facility from Duplan's bankruptcy trustee in 1979 and sold it to VIDE in 1981. Information on property operations during Panex's ownership was not available. From 1982 to 2017, the building was used by VIDE as a book repository/library, warehouse with cold storage, maintenance shop and school district administrative offices.

Remedial Investigation/Action Summary

Multiple investigations have been performed at the Curriculum Center property since 1982. The original RI that focused on the entire site identified a plume of groundwater contaminated with CVOCs and two plumes of groundwater contaminated with gasoline components (the Texaco and Esso plumes) that co-mingled with the CVOC plume. EPA concluded that the CVOC plume originated at or near the Curriculum Center property, extended beyond the former O'Henry Dry Cleaners building (a potential secondary source), and followed an eastward path towards Turpentine Run.

In 1995, the CVOC plume extended approximately 1,600 feet to the southwest from the Curriculum Center to Four Winds Plaza and was approximately 500 feet wide. The highest concentrations of total CVOCs were observed in the shallow zone (less than 90 feet below grade surface (bgs)) monitoring wells near the northern source area at Curriculum Center property. The CVOCs detected at Curriculum Center were DCE, PCE, TCE, and vinyl chloride (VC). The highest concentrations detected were 2,100 µg/l of cis-1,2-DCE, 1,300 µg/l of VC, 360 µg/l of PCE, and 78 µg/l of TCE; all exceeded their respective Maximum Contaminant Levels (MCLs). In the RI, EPA concluded that the elevated concentrations of CVOCs in groundwater adjacent to and immediately downgradient of the Curriculum Center indicated a high probability that PCE, a primary component of the CVOC plume, was present as dense non-aqueous phase liquid (DNAPL) in the saturated and/or unsaturated bedrock.

The 1996 remedy for the site was to address the site-wide groundwater contamination, calling for extraction of contaminated groundwater, ex-situ treatment, surface discharge of the treated groundwater, and ICs.

Following completion of the remedial design (RD) in September 2001, EPA constructed Groundwater Treatment Facility Number 1 (GWTF #1) at the Curriculum Center property to achieve hydraulic control of the northern portion of the plume and remove CVOC mass from the saturated zone. GWTF #2 is located downgradient of GWTF #1 and addresses downgradient central portions of the plume, north of the O'Henry drycleaner (Figure 2).

EPA completed construction of GWTF #1 in 2004 which initially consisted of three groundwater extraction wells, an equalization tank and transfer pumping system, bag filters, a low-profile air stripper and an off-gas treatment system. Use of the off-gas treatment system was discontinued in April 2006 after CVOC concentrations dropped below the air pollution control permit equivalency limits. One granular activated carbon filter unit and one potassium permanganate unit remain at the Curriculum Center on standby for emergency use. Chemical feed systems were also included for sequesterant/biocide injection and pH adjustment.

The three groundwater extraction wells associated with GWTF #1 are RW-6, RW-7, and RW-9. Extraction wells RW-7 and RW-9 are completed in the shallow, more productive portion of the aquifer, with access to the groundwater at 30 to 80 bgs and 40 to 60 feet bgs, respectively. Extraction well RW-6 is completed in the deeper, less productive portion of the aquifer with access from 80 to 130 ft bgs. Extraction well RW-7 is operated on a continuous basis. Extraction well RW-9 operates as required to maintain the target groundwater elevation and is typically operated during and following heavy rain events. Extraction well RW-6 is operated approximately one hour per week, at a flow rate of approximately two gallons per minute (gpm), until the extraction well pump shuts down as a result of a low water level in the well. Treated water is discharged to Turpentine Run on the adjoining property to the northwest.

Overall, the site-wide remedy was operated by EPA from 2004 to 2013. Operation and maintenance of the treatment system was transferred from EPA to the USVI government in April 2013. As part of the long-term response action for the site, groundwater monitoring is routinely completed to assess progress. Groundwater monitoring was completed on a quarterly basis from system startup in 2004 until April 2007, and it has been conducted annually since 2007. Groundwater from a total of 30 monitoring and residential wells is analyzed for the presence of site-related contamination as part of site monitoring, and groundwater levels are measured on a monthly basis from 36 monitoring wells. Influent monitoring is performed monthly at two of the extraction wells (RW-6 and RW-7) using the GWTF #1 influent sampling port.

An SVE system was constructed in 2004 to remediate the unsaturated zone source of the CVOC groundwater contamination. The system included two SVE wells with discharge to the GWTF off-gas treatment system. The system was shut down in April 2006 due to a significant decrease in influent concentrations and achievement of asymptotic conditions.

EPA's Environmental Response Team (ERT) performed two investigations to characterize the potential for vapor intrusion into the Curriculum Center building. The investigations were performed in December 2007 and December 2011. The extent of soil vapor with elevated concentrations of PCE and TCE did not change noticeably between the two sampling rounds. All but one sample exceeded the soil vapor action level for PCE. The area of the highest sub-slab concentrations was found in the warehouse area located in the central portion of the Curriculum Center building and extends into the adjoining maintenance and office areas. The extent of TCE concentrations that exceeded action levels in soil vapor falls within the area of highest PCE concentrations.

A 2011 evaluation of the remediation system resulted in a conclusion that extraction well RW-7 was too far upgradient to effectively contain the Curriculum Center source area, and it was recommended that a new containment system with additional wells screened across the shallow and deep zones be considered.

Consistent with the law, EPA formally reviews the remedy every five years to assure it is meeting its remedial action objectives. Results of the second five-year review, completed in 2014, revealed that the existing remedy would not achieve its objective of restoring the aquifer to drinking water standards. Of particular concern to EPA was the potential presence of DNAPL as an ongoing source of groundwater contamination to the deep aquifer in the northern portion of the groundwater plume. The review resulted in a recommendation for the installation of additional wells to further evaluate the presence of DNAPL, the evaluation of groundwater monitoring results and the development of a conceptual site model (CSM) to determine a strategy for addressing the ongoing sources of CVOCs at the Curriculum Center property. The review further reported that vapor intrusion concerns had been addressed by sampling in 2007, because, although the sub-slab results exceeded screening values, the indoor air concentrations were negligible and well below risk-based concentrations.

RESULTS OF THE FOCUSED SOURCE REMEDIAL INVESTIGATION (FSRI)

The FSRI Report, dated March 2018, provides the analytical results of sampling conducted between April 2016 and June 2017, the purpose of which was to further investigate the source or sources of groundwater contamination in the northern portion of the site, specifically in the area of the Curriculum Center. The FSRI activities included a surface geophysical survey, rock matrix diffusion sampling and analysis, a borehole geophysical investigation, packer testing and sampling, monitoring well installation, groundwater sampling and groundwater level monitoring, and DNAPL monitoring.

The investigation focused on six contaminants, based on the site history, frequency of detection, and concentrations that exceeded cleanup standards: PCE, trichloroethene (TCE), 1,1-dichloroethene (1,1-DCE), *cis*-1,2 dichloroethene *(cis*-1,2-DCE), *trans*-1,2 dichloroethene *(trans*-1,2-DCE), and vinyl chloride (VC).

The following conclusions were made based on the FSRI results:

- The bedrock aquifer can be divided into two general zones; a shallow, more hydraulically conductive zone at depths less than 90 feet bgs and a deep, less conductive zone between the approximate depths of 90 and 140 feet bgs. Water bearing fractures in the vicinity of the Curriculum Center property are consistent with regional trends. The degree and orientation of fracturing observed below 140 feet bgs suggests limited potential for vertical contaminant migration below this depth;

- DNAPL is present within the shallow and deep bedrock zones based on direct observation and the presence of high levels of dissolved phase contamination. Evidence also indicates that DNAPL may be present in multiple source areas; on the surface of bedrock either beneath the Curriculum Center building, at the suspected waste pit, and/or in the former drum storage area. DNAPL is present in a partially mobile state and it has been concluded that it will act as an ongoing source of dissolved phase contamination at the Curriculum Center property;

- Dissolved phase CVOC contamination consisting of PCE, TCE, *cis*-1,2-DCE and VC is present at the Curriculum Center property ranging in concentration from low microgram per liter (µg/l) to milligram per liter (mg/l) concentrations. The plume of contaminated groundwater is primarily located in the shallow bedrock zone on the northwest side of the Curriculum Center and migrates to the southwest. Contaminants have also migrated to the east of the Curriculum Center and into the deep zone at the southwest corner of the building;

  Matrix diffusion data indicate that contamination of the rock matrix can be expected in areas where high levels of contaminants of concern (COCs) are present in groundwater. Contaminants present in the rock matrix will continue to back-diffuse from the rock matrix and impact groundwater in the Curriculum Center area for an estimated 17-25 years after source removal.

- The degree of reductive dechlorination varies throughout the Curriculum Center area. PCE degradation on the northwest side of Curriculum Center has resulted in high levels of TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and VC, while areas to north, east and south show more limited to no degradation.; and

- The influence of the existing extraction system is dependent on the fractures, fracture systems, and faults that intersect the extraction wells. Although the impact of pumping can be observed at distances of 50 feet or more, the capture zone of the existing extraction system does not extend the full width of the plume or far enough in a downgradient direction to contain potential source material in the drum disposal area or in the immediate area of monitoring well OU2-MW3 at the southwestern corner of the Curriculum Center.

Based on visual evidence and concentrations indicative of DNAPL, the presence of DNAPL has been confirmed in the fractured bedrock aquifer underlying the Curriculum Center property.

Principal Threat Waste

Principal threat wastes are considered source materials, i.e., materials that include or contain hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or as a source for direct exposure. Contaminated groundwater is generally not considered to be source material; however, the presence of DNAPL in the subsurface may be viewed as source material. Please refer to the text box entitled, "What is a Principal Threat" for more information on the principal threat concept.

WHAT IS A "PRINCIPAL THREAT"?

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water or air, or acts as a source for direct exposure. Contaminated ground water generally is not considered to be a source material; however, Non-Aqueous Phase Liquids (NAPLs) in ground water may be viewed as source material. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur. The decision to treat these wastes is made on a site-specific basis through a detailed analysis of the alternatives using the nine remedy selection criteria. This analysis provides a basis for making a statutory finding that the remedy employs treatment as a principal element.

SUMMARY OF SITE RISKS

A baseline human health risk assessments was conducted as part of the FSRI to estimate the risks associated with exposure to contaminants based on current and likely future uses of the site as commercial/industrial. Relevant information associated with this risk assessment is summarized below.

An ecological risk assessment was not performed for OU2, as the focus of this investigation was ground water, which does not discharge to surface water anywhere within the OU2 area. Ecological receptors are not expected to have contact with ground water; therefore, exclusion of an ecological risk assessment is consistent with EPA guidance that states ecological risk related to ground water is to be considered only if there is potential for impacts on ecological receptors. It is also consistent with the scope of the 1996 RI, which limited the evaluation of ecological risk to surface soil contamination at the site.

Human Health Risk Assessment

EPA conducted a four-step baseline human health risk assessment (HHRA) as part of the FSRI to assess site-related cancer risks and non-cancer health hazards in the absence of any remedial action. The four-step process is comprised of: Hazard Identification, Exposure Assessment, Toxicity Assessment, and Risk Characterization (refer to the text box, "What is Risk and How is it Calculated").

The HHRA began with selecting chemicals of potential concern (COPCs) in groundwater that could potentially cause adverse health effects in exposed populations. The COPC screening of the HHRA identified 13 COPCs. The potential exposure scenarios considered in the HHRA include drinking water ingestion, dermal contact and inhalation of groundwater by residents, drinking water ingestion and dermal contact by indoor and outdoor workers as well as incidental ingestion, contact and inhalation with groundwater by a construction worker in a trench.

The evaluation of potential cancer risks and noncancer hazards to future, on-site receptors from exposure to COPCs in environmental media indicates that there are several primary COPCs, now identified as COCs, whose concentrations in environmental media contribute to the hazard and risk estimates, and exposure to these COCs may result in potential adverse health effects.

WHAT IS RISK AND HOW IS IT CALCULATED?

A Superfund baseline human health risk assessment is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these releases under current- and anticipated future-land uses. A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios.

Hazard Identification: In this step, the chemicals of potential concern (COPCs) at the site in various media (*i.e.*, soil, groundwater, surface water, and air) are identified based on such factors as toxicity, frequency of occurrence, and fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation.

Exposure Assessment: In this step, the different exposure pathways through which people might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated soil and ingestion of and dermal contact with contaminated groundwater. Factors relating to the exposure assessment include, but are not limited to, the concentrations in specific media that people might be exposed to and the frequency and duration of that exposure. Using these factors, a "reasonable maximum exposure" scenario that portrays the highest level of human exposure that could reasonably be expected to occur is calculated.

Toxicity Assessment: In this step, the types of adverse health effects associated with chemical exposures and the relationship between magnitude of exposure and severity of adverse effects are determined. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other non-cancer health hazards, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some chemicals are capable of causing both cancer and non-cancer health hazards.

Risk Characterization: This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks for all COPCs. Exposures are evaluated based on the potential risk of developing cancer and the potential for non-cancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means a "one-in-ten-thousand excess cancer risk"; or one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions identified in the Exposure Assessment. Current Superfund regulations for exposures identify the range for determining whether remedial action is necessary as an individual excess lifetime cancer risk of 10^{-4} to 10^{-6}, corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk. For non-cancer health effects, a "hazard index" (HI) is calculated. The key concept for a non-cancer HI is that a "threshold" (measured as an HI of less than or equal to 1) exists below which non-cancer health hazards are not expected to occur. The goal of protection is 10^{-6} for cancer risk and an HI of 1 for a noncancer health hazard. Chemicals that exceed a 10^{-4} cancer risk or an HI of 1 are typically those that will require remedial action at a site and are referred to as chemicals of concern, or COCs, in the final remedial decision document or Record of Decision.

The evaluation for future, on-site workers indicates that VC, TCE, PCE and cis-1,2-DCE have been identified as COCs for groundwater exposure, based on an excess lifetime cancer risk (ELCR) exceeding $1x10^{-4}$ or resulting in an HI greater than or equal to one.

PCE and TCE volatilizing into buildings are also of potential concern to workers based on groundwater, indoor air and sub-slab soil gas data. Volatilizing of VC into buildings may be of potential concern based on groundwater concentrations; however, VC was non-detect in the sub-slab soil gas and indoor air during two sampling events in 2007 and 2011. Note that the Curriculum Center building has been condemned due to damage during hurricanes Irma and Maria. Future use of the building is currently unknown.

1,1-DCE does not exceed the noncancer threshold, however, it exceeds its MCL, so it is included as a COC.

The ELCRs for a potential future resident's exposure to COPCs in groundwater are significantly above the threshold of $1x10^{-4}$ at $7x10^{-1}$, and largely result from ingestion of VC, TCE and PCE. This assumes the groundwater is used for potable purposes with no treatment, as is required to be done in a baseline HHRA. The vapor intrusion risk evaluation indicates that these same COCs could also result in excess risks to future residents from exposure to contaminated soil vapor should an occupied building be located on the site.

These cancer risks and noncancer health hazards indicate that there is significant, potential risk from direct exposure to groundwater for future residents and site workers. The results of the HHRA indicate the proposed alternative will be necessary to mitigate potential risks associated with existing contamination. A more detailed discussion of the exposure pathways and estimates of risk can be found in the February 2018 HHRA in the Administrative Record of this action. Refer Table 1, Risk Summary.

Table 1: Risk Summary – Future Scenario

COC	Construction Worker		Worker		Resident		
	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Adult Noncancer Hazard	Child Noncancer Hazard
PCE	1.07E-04	7.10E+02	4.03E-04	8.96E+01	3.80E-03	8.08E+02	9.25E+02
TCE	5.71E-04	4.78E+03	2.38E-03	2.90E+02	4.06E-02	3.97E+03	4.06E+03
1,1-DCE***	N/A	2.50E-01	N/A	1.28E-02	N/A	1.77E-01	1.80E-01
cis-1,2-DCE***	N/A	6.05E+01	N/A	4.01E+02	N/A	1.20E+03	1.97E+03
trans-1,2-DCE***	N/A	1.28E-01	N/A	8.47E-01	N/A	2.52E+00	4.16E+00
VC	1.53E-03	2.11E+02	5.33E-02	6.91E+01	9.88E-01	2.93E+02	4.09E+02
1,1,2-Trichloroethane	1.13E-07	2.45E+00	1.56E-07	1.92E-03	2.59E-06	1.70E+00	1.44E+00
Total Risk and HQ	2.20E-03	5.77E+03	5.48E-02	8.50E+02	7.18E-01	6.27E+03	7.37E+03

Notes:
*** N/A = Not available. No cancer toxicity values are available for these COCs; no risks have been calculated.
Total cancer risks and HQs include all constituents evaluated in the HHRA.

Conclusion

The results of the HHRA indicate that the contaminated groundwater presents an unacceptable exposure risk. It is the EPA's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan or on the superfund records website https://semspub.epa.gov/src/collections/02/AR/VID982272569 , is necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from this site which may present an imminent and substantial endangerment to public health or welfare.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and standards such as applicable or relevant and appropriate requirements (ARARs), to-be-considered guidance, and site-specific, risk-based levels.

Based on technical impracticability matrix diffusion modeling conducted as part of the FS and described more in the next section, the restoration of the groundwater within a reasonable time frame may be possible notwithstanding the presence of DNAPL.

As such, the following RAOs have been established for the source areas and groundwater:

- Decrease DNAPL mass in the bedrock aquifer;
- Restore the groundwater so that concentrations of site-related contaminants are below the Federal MCLs;
- Prevent migration of groundwater contamination from the source areas, and
- Protect human health by preventing exposure to contaminated groundwater.

The preliminary remedial goal (PRGs) for groundwater are identified in Table 2.

Table 2: PRGs for Groundwater

COC	MCLs (µg/L)	PRG (ug/l)
PCE	5	5
TCE	5	5
1,1-DCE	7	7
cis-1,2-DCE	70	70
trans-1,2-DCE	100	100
VC	2	2
1,1,2-Trichloroethane	5	5

http://www.epa.gov/safewater/consumer/pdf/mcl.pdf.

SUMMARY OF REMEDIAL ALTERNATIVES

Section 121(b)(1) of CERCLA, 42 U.S.C. § 9621(b)(1), mandates that remedial actions must be protective of human health and the environment, cost-effective, comply with ARARs, and utilize permanent solutions, alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. Section 121(b)(1) of CERCLA also establishes a preference for remedial actions that employ, as a principal element, treatment to reduce permanently and significantly the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants at a site. Section 121(d) of CERCLA, 42 U.S.C. § 9621(d), further specifies that a remedial action must attain a level or standard of control of the hazardous substances, pollutants, and contaminants that at least attains

ARARs under federal and territory laws, unless a waiver can be justified pursuant to Section 121(d)(4) of CERCLA, 42 U.S.C. § 9621(d)(4).

The objective of the focused FS was to identify and evaluate remedial action alternatives for addressing the contamination associated with the source areas and to meet the RAOs. A total of four alternatives were developed in the FS. Alternative 2 also includes four enhancement options. Detailed descriptions of the remedial alternatives are provided in the FS Report, dated March 2018. Expansions to the existing remedy as well as new remedial alternatives were assessed in the FS.

Common Elements

All of the alternatives, with the exception of the no action alternative, include common components.

Matrix diffusion modeling was performed to simulate the fate and transport of PCE in fractured bedrock where matrix diffusion plays a role in attenuating the contaminant's life in the system after the source has been removed. Results of the matrix diffusion modeling indicate concentrations at the property boundary are predicted to drop below the MCL within an estimated range of 17 - 25 years after complete source removal.

Alternatives 2 through 4 include long-term monitoring to ensure that groundwater quality improves following implementation of these alternatives until such time as clean up levels are achieved.

Assumptions were made in the FS for areas that were not fully investigated during the FSRI, specifically, beneath the northern portion of the Curriculum Center building. Alternatives 2 through 4 will include a pre-design investigations (PDI) to verify FS assumptions, to address data gaps and to obtain design parameters for the completion of an RD at the Curriculum Center source areas. The timeframes for remediation presented below include the time for PDIs, remedial design, contract procurements and the actual time required to construct and implement the action.

Alternatives 2 through 4 also include ICs that will rely on groundwater use restrictions in the form of local well use laws until RAOs are achieved to ensure the remedy remains protective. Specifically, Title 12, Chapter 5, Virgin Islands Code, regulates installation of any well other than a public water supply well in the Virgin Islands. ICs will include vapor intrusion restrictions for any new construction at the Site.

A site management plan (SMP) would be developed to provide for the proper O&M of the site remedy post-construction, and it would include long-term groundwater monitoring, institutional controls, and periodic reviews until clean up levels are achieved.

Additionally, because it will take longer than five years to achieve cleanup levels under all of the alternatives, CERCLA requires that a review of conditions at the site be conducted no less often than once every five years until such time as cleanup levels are achieved. Alternatives 2 through 4 will be subject to these five year reviews, as required by CERCLA 121(c) and the NCP [40 C.F.F.§300.430(f)(4)(ii)].

Alternative 1: No Action

The NCP requires that a "No Action" alternative be developed and considered as a baseline for comparing other remedial alternatives. Under this alternative, no additional action would be implemented beyond the remedy selected in the 1996 ROD. Existing ICs that were required under the 1996 ROD would remain in place.

Capital Cost:	$0
O&M Costs:	$0
Present-Worth Cost:	$0
Time frame:	Not Applicable

Alternative 2: Expand and Optimize Existing Groundwater Extraction and Ex-Situ Treatment (Pump and Treat)

Capital Cost:	$4,616,924
Annual O&M Costs:	$7,600,039
Present-Worth Cost:	$12,273,313
Time frame:	*30* years

This remedial alternative consists of expanding the current groundwater treatment system with the addition of new extraction wells downgradient from the Curriculum Center. The addition of downgradient wells will allow for more flexibility in containing the plume as it moves away from the source area. Alternative 2 also includes upgrading the current system capacity, and adding alternate pumping and dual-phase extraction (DPE)/enhanced fluid recovery (EFR) from existing monitoring wells with high contaminant concentrations.

For the conceptual design, it is estimated that two additional extraction wells would be installed downgradient from the existing recovery wells to a target depth of 140 feet bgs It is estimated that the existing treatment system capacity will be upgraded from 60 to 100 gpm and will operate in "flow control" mode rather than at the current "constant head" configuration and all existing treatment equipment will be replaced with newer, more efficient equipment to accommodate the additional flow. The above ground conveyance system within the facility from each of the existing extraction wells will be upgraded on an as needed basis to accommodate the higher capacity. The current 1,000 gallon equalization tank will be replaced with a similar capacity tank that is designed for flow equalization in addition to DNAPL recovery. The DNAPL that is collected at the bottom of the recovery tank will be removed and disposed at a licensed waste disposal facility. Extracted groundwater will be treated with air stripping and discharged via the existing outfall to Turpentine Run.

Alternative 2 will include alternate pumping from existing monitoring wells with high contaminant concentrations. It is assumed that the source area wells will include wells identified as OU2-MW3, RD-9, OU2-MW6, OU2-MW2, IW-1, IW-2, and OU2-MD1. The well selection will be made during the RD phase. It is assumed that a small pump connected to a flexible HDPE line will be placed inside each of these monitoring wells, and groundwater will be pumped into the DNAPL recovery tank, treated through the existing treatment system as described above, and then discharged at the existing outfall. It was assumed that this will be done in sequence at each well for a total estimated duration of one week per event.

Alternative 2 will also include DPE/EFR from existing monitoring wells where high contaminant concentrations are present. The DPE/EFR is a portable system that will extract groundwater from designated monitoring wells that are present in source areas at the Curriculum Center property. A pilot study will be conducted to obtain design parameters for the DPE/EFR. The well head of each extraction point/monitoring well will be sealed, and a DPE/EFR mobile system will be used to apply a high vacuum to each well in order to remove contaminated groundwater/DNAPL from source areas. The recovered contaminated groundwater will be treated through the existing pump and treat system and then discharged at the outfall. The DNAPL that is collected at the bottom of the recovery tank will be removed and disposed at a licensed waste disposal facility. At a minimum, the DPE/EFR system will include a vacuum blower, knockout tank, air filters and silencers, flow meters, transfer pump and a control panel. It is assumed that DPE/EFR events will be twice a year at each well, for a period of five years. The frequency of the events will be refined during the RD.

Based on calculations, it is estimated that clean up time for the Curriculum Center source areas using groundwater pump and treat will be in excess of 30 years. For cost-estimating and planning purposes, an estimated remediation time frame of 30 years is used for developing costs associated with O&M activities. It is assumed that active remediation would be employed in the targeted treatment areas until the MCL for each of the COCs is attained within the targeted treatment area. Natural processes would be relied upon to achieve the MCLs for areas outside the capture zone and not targeted for active remediation. The success of the remedy in meeting the RAOs will be evaluated through the above-mentioned statutorily required 5-Year reviews.

The conceptual design would be refined during the remedial design phase if this alternative is selected.

Alternative Enhancement 2A: Reinjection

Capital Cost:	$425,260
Annual O&M Costs:	$51,364 plus Alt 2
Present-Worth Cost:	$476,624
Time frame:	*30* years

This enhancement for Alternative 2, the cost of which would be in addition to Alternative 2, includes enhancing the existing pump and treat system as described in Alternative 2 with reinjection of the treated groundwater downgradient from the Curriculum Center in an effort to act as a hydraulic barrier to further, off property migration of the contamination.

For the conceptual design, it is estimated that two injection wells would be installed downgradient from the existing and proposed extraction wells and along major fracture/weathered zone trends identified during the FSRI.

For cost-estimating and planning purposes, an estimated remediation time frame of 30 years is used for developing costs associated with O&M activities. Alternative Enhancement 2A, using reinjection, will not reduce the remedial timeframe; however, reinjection of groundwater downgradient will help maintain water balance.

Alternative Enhancement 2B: Air Sparging/Soil Vapor Extraction

Capital Cost:	$1,710,790
Annual O&M Costs:	$169,501 plus Alt 2
Present-Worth Cost:	$1,880,291
Time frame:	*30* years

This enhancement for Alternative 2 consists of enhancing the existing pump and treat system as described earlier in Alternative 2 with air sparging/soil vapor extraction (AS/SVE) in source areas, including the area beneath the northern portion of the building, in order to help mobilize residual DNAPL within the zone influenced by air sparging and thereby reducing the remedial timeframe of the groundwater extraction and treatment system.

For the conceptual design, it is estimated that 25 SVE wells and 30 AS wells would be installed at the Curriculum Center property. It is estimated that each SVE well will be installed to a depth of approximately 15 feet bgs, and each AS well will be installed to a depth of approximately 140 feet bgs. For cost estimating purposes, granular activated carbon and potassium permanganate is assumed as the vapor phase treatment option for the enhancement to the treatment system.

For both cost-estimating and planning purposes, an initial five years of AS/SVE is proposed. Based on calculations, it is estimated that the clean up time for the Curriculum Center source, areas after complete removal of source concentrations, will be within about 25 years. It is therefore assumed that the remedial system will be active for a period of 30 years.

Alternative Enhancement 2C: In-Situ Chemical Oxidation

Capital Cost:	$93,920
Annual O&M Costs:	$98,620 plus Alt 2
Present-Worth Cost:	$192,540
Time frame:	*30* years

This enhancement for Alternative 2 consists of enhancing the existing pump and treat system as described earlier in Alternative 2 with in-situ chemical oxidation (ISCO) treatment at the potential source areas as an enhancement. This process involves introducing strong oxidizing agents through existing monitoring wells within the potential source areas via slow-release cylinders or a comparable delivery method. Operating the pump and treat system could potentially enhance the distribution of oxidants across the source zone and maintain hydraulic control of the dissolved-phase plume emanating from the source areas.

For the conceptual design, it is estimated that 64 cylinders will be deployed in a total of 12 monitoring wells in the potential source areas. It is estimated that the cylinders will be removed and replaced on a yearly basis.

For cost estimating purposes, an initial five years of ISCO treatment is proposed before evaluating if further source area treatment is necessary. Based on calculations, it is estimated that the clean up time for the Curriculum Center source areas, after complete removal of source concentrations, will be within about 25 years. For cost estimating purposes, it is assumed that the remedial system will be active for a period of 30 years in order to capture contaminated groundwater beyond the active treatment source areas.

Alternative Enhancement 2D: Surfactant Flushing

Capital Cost:	$1,222,799
Annual O&M Costs:	Same as Alt 2
Present-Worth Cost:	$1,222,799
Time frame:	*26* years

This enhancement for Alternative 2 consists of enhancing the existing pump and treat system as described earlier in Alternative 2 with in-situ flushing of fractures with surfactants at the potential source areas as an enhancement.

For the conceptual design, it is estimated that two deep injection wells and five shallow injection wells will be installed in the potential source areas. Extraction wells are required to maintain hydraulic control, bring emulsified/dissolved DNAPL to the surface for treatment and to clear the aquifer of surfactant solution.

As a result of challenges associated with surfactant flushing in a bedrock aquifer, it is assumed that surfactant flushing will be performed in source areas for one year. For cost estimating purposes, two rounds of injections are assumed. Based on calculations, it is estimated that clean up time for the Curriculum Center source areas, after complete removal of source concentrations, will be within about 25 years. For cost estimating purposes, it is assumed that the remedial system will be active for a period of 26 years in order to capture contaminated groundwater beyond the active treatment source areas.

Alternative 3: In-Situ Thermal Treatment and Pump and Treat

Capital Cost:	$79,015,003
Annual O&M Costs:	$4,094,323
Present-Worth Cost:	$83,221,216
Time frame:	*12* years

This remedial alternative includes in-situ thermal treatment (ISTT) to target DNAPL in potential source areas with downgradient pump and treat for hydraulic control.

The ISTT proposed for the Curriculum Center property consists of in-situ bedrock heating as a means to provide significant mass reduction (>99%) of CVOCs and DNAPL in groundwater within the fractured bedrock of the potential source areas with a time frame of approximately two years. Heat causes the underground contaminants, DNAPL and water to boil, creating in-situ steam and vapor. Contaminated vapor and steam are extracted using vacuum recovery wells and treated above ground. The heater wells will be co-located with the recovery wells. Each recovery well is connected to the conveyance pipe that routes the steam and vapors to the condenser. All conveyance piping and cable will be above grade.

For the conceptual design, it is estimated that 260 to 270 heater wells, co-located with 260 to 270 vacuum extraction points, would be used to treat groundwater within the area beneath the northern portion of the Curriculum Center building and the potential source areas. It is assumed that each heater well boring will be installed from 1 to 140 feet bgs within the bedrock. The average distance between heater wells will be approximately 17 feet. It is estimated that 15 temperature monitoring points will be installed to monitor the subsurface temperature data continuously.

Alternative 3 includes the addition of two new extraction wells downgradient of the Curriculum Center to provide hydraulic control during in-situ thermal treatment at the source areas. Alternative 3 also includes upgrading the current treatment system to a capacity of 100 gpm. It is estimated that operating the treatment system at a total flow rate of 100 gpm will establish hydraulic control and capture the deep bedrock groundwater in the vicinity of the Curriculum Center source areas. This hydraulic containment will limit or prevent the downgradient migration of contaminants from the Curriculum Center property.

All existing treatment equipment will be replaced with newer, more efficient equipment to accommodate the additional flow as described in detail in Alternative 2, above.

It is anticipated that the duration of operating the active thermal treatment system will be on the order of two years. During this time, the pump and treat system will remain operational in order to maintain hydraulic control of the downgradient dissolved plume. It is estimated that contamination outside of the thermal treatment area will take 10 years to reach the perimeter pump and treat system. For cost estimating purposes, it is assumed that the enhanced groundwater treatment system will be active for a period of 12 years in order to capture contaminated groundwater beyond the active treatment source areas.

The conceptual design would require further evaluation during the remedial design phase if this alternative is selected.

Alternative 4: In-Situ Steam Injection and Pump and Treat

Capital Cost:	$23,541,419
Annual O&M Costs:	$7,169,229
Present-Worth Cost:	$30,773,828
Time frame:	*27* years

This remedial alternative consists of steam injection at the potential source areas to mobilize the DNAPL in bedrock fractures and to cause destruction of contaminants in potential source areas. Mobilized DNAPL will be captured by the pump and treat system at the Curriculum Center property.

Under the conceptual design, 60 steam injection wells and 30 multi-phase extraction wells would be installed across the source area. This configuration is intended to facilitate outward, horizontal advancement of the steam front from the steam injection wells toward the dual-phased extraction wells. The injection wells would be screened across the low-productive zone of the aquifer (approximately 80 to 140 feet bgs). The pressure of steam injection would also mobilize and transport contaminants vertically based upon the higher permeability of the overlying shallow zone and the enhanced upward gradient imposed on the aquifer by shallow-zone remedial pumping associated with the pump and treat system. It is estimated that 10 temperature monitoring points would be installed to monitor the subsurface temperature data continuously.

Alternative 4 includes the addition of two new extraction wells downgradient from the Curriculum Center to provide hydraulic control to maintain hydraulic control during steam injections at the source areas. Alternative 4 also includes upgrading the current system to a capacity of 100 gpm. It is estimated that operating the system at a total flow rate of 100 gpm will establish hydraulic control and capture the deep bedrock groundwater at the Curriculum Center source areas. This hydraulic containment will limit or prevent the downgradient migration of contaminants from the Curriculum Center property.

All existing treatment equipment will be replaced with newer, more efficient equipment to accommodate the additional flow as described in detail in Alternative 2, above.

It is anticipated that the duration of operating the steam injection system will be on the order of two years. During this time, the pump and treat system will remain operational in order to maintain hydraulic control of the downgradient dissolved plume. Based on calculations, it is estimated that clean up time in the Curriculum Center area after complete removal of source area concentrations will be within about 25 years. For cost estimating purposes, it is assumed that the enhanced groundwater treatment system will be active for a period of 27 years in order to capture contaminated groundwater beyond the active treatment source areas.

EVALUATION OF ALTERNATIVES

In evaluating the remedial alternatives, each alternative is assessed against the nine evaluation criteria set forth in the NCP, namely overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; cost; and State and community acceptance. Refer to the text box for a more detailed description of these evaluation criteria.

This section of the Proposed Plan evaluates the relative performance of each alternative against the nine criteria, noting how each compares to the other options under consideration. A detailed analysis of alternatives can be found in EPA's FS Report supporting this decision, dated March 2018.

Overall Protection of Human Health and the Environment

Alternative 1 (No Action) would not meet the RAOs and would not be protective of human health and the environment since no action would be taken. Alternatives 2 through 4 are the active remedies that address groundwater contamination, minimize the migration of contaminated groundwater, and would restore groundwater quality over the long-term.

Under Alternative 2, the pump and treat system will capture and treat the contaminants at and downgradient from the potential source areas. Expanding the pump and treat system by installing additional extraction wells downgradient from the Curriculum Center will prevent groundwater from migrating further downgradient and reduce the contaminant concentrations in the area.

Alternatives 3 and 4 will prevent impact to groundwater because these alternatives will remove the DNAPL and dissolved CVOC contamination from the bedrock aquifer and will prevent further downward migration of CVOC contamination to groundwater by operating newly installed downgradient extraction wells.

Until RAOs are met, protectiveness under Alternatives 2 through 4 requires a combination of actively reducing contaminant concentrations in groundwater and limiting exposure to residual contaminants through existing ICs for groundwater use. ICs are anticipated to include existing governmental controls in the form of DPNR well use regulations.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

EPA has promulgated MCLs (40 CFR Part 141), which are enforceable standards for various drinking water contaminants (and are chemical-specific ARARs). The USVI does not have drinking water source-based quality standards for organics in groundwater, as drinking water is taken from rainwater cisterns or from pumped water supply using desalinated seawater. In the absence of any USVI regulations for CVOCs in groundwater, compliance with the federal standard is required.

Alternative 1 would not comply with ARARs. Action-specific ARARs do not apply to this alternative since no remedial action would be conducted under the no action alternative.

Alternative 2 would achieve chemical-specific ARARs through extraction and *ex-situ* treatment of contaminated groundwater. Alternative 3 could achieve chemical-specific ARARs through *in-situ* thermal treatment. Alternative 4 would achieve chemical-specific ARARs through *in-situ* steam injections; however, Alternative 4's long-term effectiveness would need to be verified in the field because it relies on its ability to contact, heat, and physically displace contaminants.

For Alternatives 2 to 4, action-specific ARARs would be met through compliance with local construction codes, health and safety requirements, off-gas treatment requirements, if applicable, and water discharge criteria when applicable. There are no location-specific ARARs associated with the site.

It is estimated that the RAOs would be achieved in 30 years with Alternative 2, 12 years with Alternative 3, and 27 years with Alternative 4. Active remediation under Alternatives 2 through 4 would be employed in the targeted treatment areas until the MCL for each of the COCs is attained within the targeted treatment area.

Long-Term Effectiveness and Permanence

Alternative 1 would not provide long-term effectiveness and permanence since groundwater contamination would not be addressed. Alternatives 2 through 4 are considered effective technologies for treatment and/or containment of contaminated groundwater, if designed and constructed properly.

EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES

Overall Protectiveness of Human Health and the Environment evaluates whether and how an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the Site, or whether a waiver is justified.

Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.

Reduction of Toxicity, Mobility, or Volume (TMV) of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, the community, and the environment during implementation.

Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.

Cost includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

State/Support Agency Acceptance considers whether the State agrees with EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.

Community Acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

Alternatives 2 through 4 would provide long-term effectiveness and permanence by using in-situ treatment processes to reduce the contaminant mass in the treatment area. Alternatives 2 through 4 would also provide hydraulic control to prevent off-property migration of the contaminated plume at the Curriculum Center property.

Alternative 2's approach has been proven to be an effective technology in reducing the concentrations of VOC contaminated groundwater. Extraction and treatment of contaminated groundwater will limit downgradient migration of the contaminants and reduce groundwater contamination. Alternative 2 on its own might be ineffective at removing DNAPL from the low-yielding fractured bedrock. Enhancements associated with Alternative 2 will likely be effective in reducing source area concentrations and mobilizing the DNAPL if implemented in conjunction with the pump and treat system.

Among Alternatives 2 through 4, Alternative 3 using *in-situ* thermal treatment would provide the highest mass reduction of groundwater contamination at the potential source areas in the shortest period of time, followed by Alternative 4 using steam injections.

Alternative 4, *in-situ* steam injections, has the potential to significantly reduce contaminant concentrations in the treatment zones but has only limited application in the field for bedrock. Properly designing the injection and the recovery system will be critical to the success of this alternative and to ensure that the system does not drive the contamination deeper into the subsurface.

Alternatives 2 through 4 would control risk to human health through the implementation of ICs until clean up levels are achieved.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 1, no action, does not address the contamination through treatment, so there would be no reduction in toxicity, mobility, or volume of the contaminants, and the alternative does not include long-term monitoring of groundwater conditions.

Alternatives 2, 3, and 4 would provide reduction of toxicity, mobility, and volume through treatment and removal of contaminants. Alternative 3, using *in-situ* thermal remediation, would be the most effective in reducing toxicity and volume of contamination in groundwater through treatment, followed by Alternative 4 using in-situ steam injections, and finally Alternative 2 using pump and treat system.

Short-Term Impact and Effectiveness

Alternative 1 would not have short-term impacts since no action would be implemented.

There would be significant short-term impacts to the local community and workers for Alternatives 2 through 4 as a result of the active remedial actions undertaken and associated with construction, operation and/or treatment activities. Efforts could be made to minimize noise and impact from construction activities related to the operations of the Curriculum Center, if applicable. Currently, the building is closed because of damage from the 2017 hurricanes. The future of the building and previous operations is unknown.

Coordination and access would be required from DPNR and VIDE for staging or remedial action purposes. Noise and community air monitoring plans would be developed during the design and discussed with owners and local authorities. Engineering controls and appropriate personnel protective equipment would be used to protect the community and workers for Alternatives 2 through 4.

It is estimated that construction for each of the Alternatives 2 to 4 will be over a period of 1 year.

Implementability

Alternative 1, no action, would be the easiest of all the alternatives to implement. Alternatives 2 through 4 are all implementable, although each present different challenges.

Services, materials and experienced vendors are readily available in the continental USA. Shipping equipment to the USVI from the United States would be required for a majority of the equipment needed for Alternatives 2 – 4 because local supplies of these materials are scarce. Pilot studies could be implemented to obtain site-specific design parameters for Alternatives 2 through 4. A permit equivalent would be developed for in-situ treatment technologies into the subsurface and/or to discharge treated vapor to the atmosphere under Alternatives 2 through 4.

The success rate of Alternatives 2 through 4 depends on site-specific conditions. Based on the conditions at this site, with high levels of contamination and DNAPL in bedrock fractures, Alternative 3, using in-situ thermal remediation, will have the highest success rate followed by Alternative 4, using in-situ steam injections, and then Alternative 2, using an expanded pump and treat system (Alternatives 3 and 4 also employ the expanded pump and treat system).

Of the three active remediation alternatives, Alternative 2 would be the easiest alternative to construct since this technology has been implemented under the 1996 ROD as part of the site-wide remedy, and it would result in less disruption to the existing, operating system.

Alternative 4 would be the most difficult to implement because delivery of steam to the source material through small aperture fractures can be problematic. Properly designing the injection and the recovery system in Alternative 4 will be critical to ensure that the system does not drive the contamination deeper into the subsurface. Alternative 3 may require an alternative power source because existing sources are insufficient in part because of the demand of the community, particularly when considering damage caused by the 2017 hurricanes. The construction activities for Alternative 3 would also result in the greatest disruption since this alternative requires installation of a significant number of wells when compared with the two new extraction wells and two injection wells in Alternative 2.

Alternatives 2 through 4 would require routine groundwater quality, performance and administrative monitoring including five-year CERCLA reviews.

Cost

The estimated capital cost, O&M, and present worth cost are discussed in detail in the March 2018 FS Report. For cost estimating and planning purposes, a 30-year time frame was used for O&M and long term monitoring under Alternative 2, 12-years for Alternative 3, and 27-years for Alternative 4. Based on calculations, for the enhancement Alternatives 2A through 2C, a 30-year timeframe was assumed and a 26-year timeframe was used for Alternative 2D. The cost estimates are based on the available information. Alternative 1 (No Action) has no cost because no activities would be implemented. The highest present value cost is Alternative 3 at $83.22 million. Of the three alternatives with active remedial components, Alternative 2 is the least expensive at $12.27 million.

The estimated capital, O&M, and present-value costs for each of the alternatives are as follows:

Alternative	**Capital Cost ($)**	**Annual O&M Cost ($)**	**Present Value Cost ($)**
1 No Action	0	0	0
2 Pump & Treat	4,616,924	7,600,039	12,273,313
2A Reinjection	425,260	51,364	476,624
2B AS/SVE	1,710,790	169,501	1,880,291
2C ISCO	93,920	98,620	192,540
2D Surfactant Flushing	1,222,799	Same as Alt 2	1,222,799
3 *In-situ* Thermal and Pump & Treat	79,015,003	4,094,323	83,221,216
4 *In-situ* Steam and Pump & Treat	23,541,419	7,169,229	30,773,828

State/Support Agency Acceptance

DPNR is reviewing the preferred alternative.

Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and all comments are reviewed. Comments received during the public comment period will be addressed in a responsiveness summary section of the OU2 ROD. The ROD is the document that will formalize the selection of the remedy for the site.

PREFERRED ALTERNATIVE

Based upon an evaluation of the remedial alternatives, EPA proposes Alternative 2, Expand Existing Groundwater Extraction and Ex-Situ Treatment (Pump and Treat) with Alternative 2A, Reinjection, as the preferred remedial alternative for the Curriculum Center source areas. Combined Alternatives 2 and 2A have the following key components:

- Expansion of the existing pump and treat system to include two downgradient extraction wells;
- Upgrade pump and treat system to higher flow rate;
- Upgrade all treatment equipment to accommodate additional flow and improve efficiency;
- Reinjection of treated water;
- Alternate pumping from existing monitoring wells with high contaminant concentrations;
- Dual phase extraction from source area wells; and
- Long-term groundwater monitoring.

A contingency remedy to Alternative 2A, Reinjection will be Alternative 2B, Expand Existing Groundwater Extraction and Treatment System with AS/SVE.

The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. DNAPL in groundwater maybe viewed as source material. Principal threat waste will be addressed by designing active remediation elements to achieve the clean up levels by establishing containment, decreasing DNAPL mass in the bedrock aquifer, and restoring groundwater. The enhanced extraction and treatment system would operate until remediation goals are attained. Natural processes would be relied upon to achieve the MCLs for areas not targeted for active remediation. Figure 3 provides the conceptual locations of the new extraction and injection wells and the existing treatment plant. The exact number and placement of extraction wells and injection wells would be determined during the remedial design.

The effectiveness of the preferred alternative would be evaluated based upon the attainment of specific performance standards and cleanup goals during the 5 year reviews (e.g., reduction in CVOC concentrations, hydraulic control, etc.). Should the preferred alternative fail to attain these standards and goals (e.g., there is persistence of high CVOC concentrations) or should its implementation prove ineffective (e.g., ineffective hydraulic control due to the inability of the bedrock aquifer to accept the re-injected water and thereby create a hydraulic mound to support the hydraulic capture of the contaminant plume), Alternative 2B, "Expand Existing Groundwater Extraction and Treatment System with AS/SVE", would be evaluated as a contingency remedy. Should Alternative 2 with alternative 2B enhancement prove to be ineffective, the need for a technical impracticability waiver could be evaluated. The ineffectiveness of Alternative 2 with Alternative 2B enhancement would imply the presence of DNAPL in the bedrock fractures beneath the Curriculum Center building that was not accessible during the remedial investigation. DNAPL presence in the aquifer beneath the Curriculum Center could have major impacts on the remediation approach and extend remediation timeframes warranting technical impracticability evaluations**.**

A long-term groundwater monitoring program would be implemented to track and monitor changes in the groundwater contamination to ensure the RAOs are attained. The results from the long-term monitoring program would be used to evaluate the migration and changes in VOC contaminants over time.

Existing ICs will ensure that the remedy remains protective until RAOs are achieved for protection of human health over the long term. Institutional controls for groundwater use would consist of DPNR well use laws and for new construction vapor intrusion prevention.

A SMP would also be developed and would provide for the proper management of the site remedy post-construction, and it would include long-term groundwater monitoring, institutional controls, and periodic reviews until such time as clean up levels are attained.

The total, estimated, present-worth cost for the selected remedy is $12,749,937. Further detail of the cost is presented in Appendix A of the FS Report. This is an engineering cost estimate that is expected to be within the range of plus 50 percent to minus 30 percent of the actual project cost.

While this alternative would ultimately result in reduction of contaminant levels in groundwater such that levels would allow for unlimited use and unrestricted exposure, it is anticipated that it would take longer than 30 years to achieve these levels. As a result, in accordance with Section 121(c) of CERCLA, the performance of the remedy in meeting the RAOs will be reviewed at least once every five years until remediation goals are achieved.

Alternative 2, extraction and treatment, is a proven technology which has demonstrated effectiveness at reducing contaminant mass and providing containment to achieve cleanup standards for VOC-contaminated groundwater. While Alternative 3, *in-situ* thermal treatment, and Alternative 4, *in-situ* steam injections are both proven technologies to actively remediate VOC-contaminated groundwater, the uncertainty associated with the location and quantity of DNAPL in the source area and beneath the Curriculum Center, coupled with the complexity of the fractured bedrock aquifer, increase the design challenges with these treatment technologies.

Based upon the information currently available, EPA believes that the preferred alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing criteria. EPA expects the preferred alternative to satisfy the following statutory requirements of Section 121(b) of CERCLA: 1) the proposed remedy is protective of human health and the environment; 2) it complies with ARARs; 3) it is cost effective; 4) it utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) it satisfies the preference for treatment. Long-term monitoring would be performed to assure the protectiveness of the remedy. With respect to the two modifying criteria of the nine criteria, territory acceptance and community acceptance, DPNR and community acceptance will be evaluated upon the close of the public comment period.

FOR FURTHER INFORMATION

The Administrative Record file, which contains copies of the Proposed Plan and supporting documentation are available at the following information repositories:

U.S. Environmental Protection Agency
Virgin Islands Field Office
Tunick Building, Suite 102
1336 Beltjen Road
St. Thomas, VI 00801
(340) 714-2333
Hours of operation:
Mon-Fri 9:00 am – 4:30 pm

USEPA – Region II
Superfund Records Center
290 Broadway, 18th Floor
New York, New York 10007-1866
(212) 637-4325
Hours: Monday – Friday: 9:00 am to 4:30 pm

In addition, the Administrative Record file is available on-line at:

https://www.epa.gov/superfund/tutu-wellfield

United States Environmental Protection Agency

0 1 2
Miles

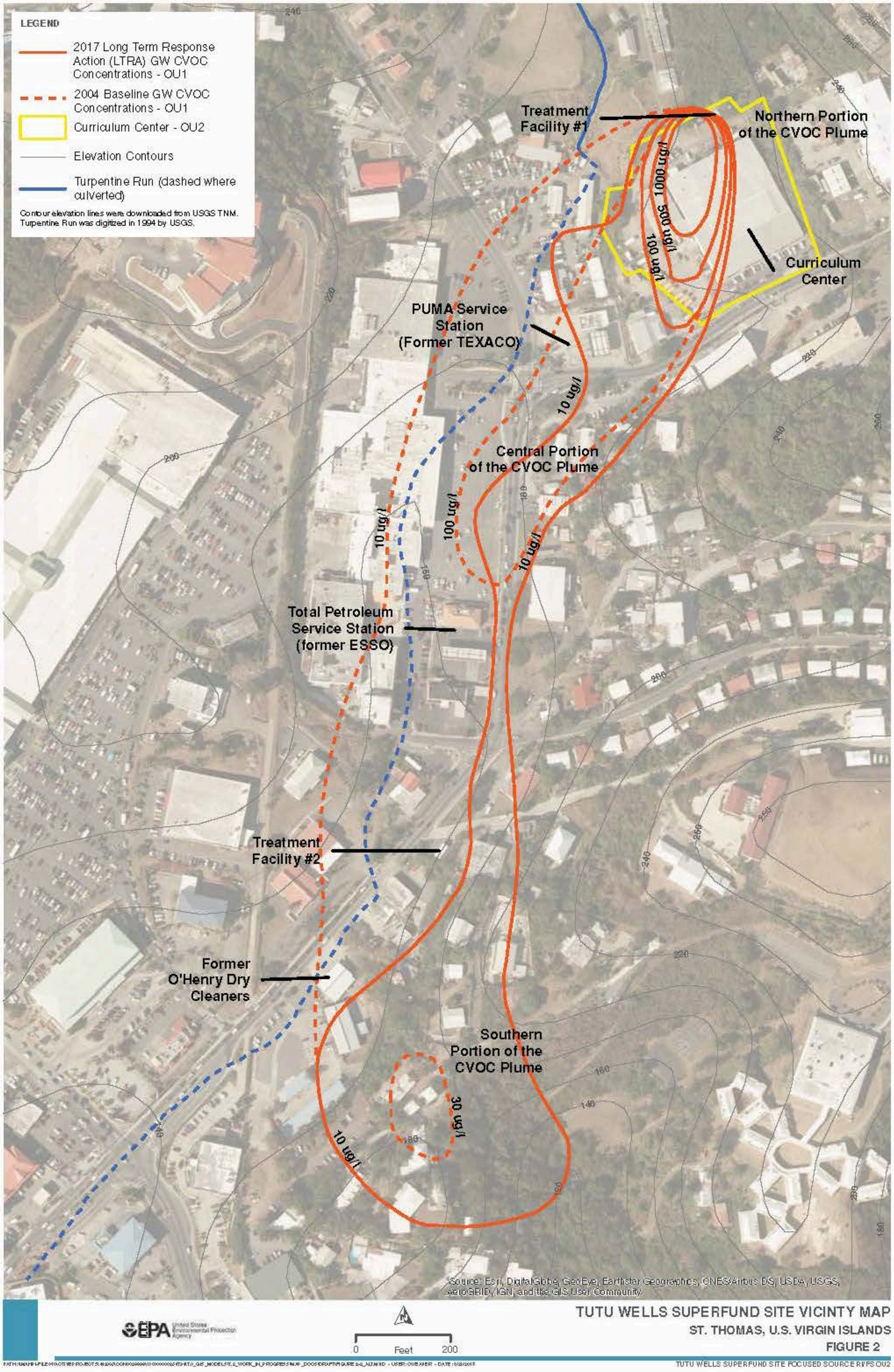
SITE LOCATION MAP

ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE 1

TUTU WELLS SUPERFUND SITE FOCUSED SOURCE RI/FS OU2

PATH: \\MAHPI-FILE01\ACTIVEPROJECTS\443005\COR0036696\0000000025479\7.0_GIS_MODELS\7.2_WORK_IN_PROGRESS\MAP_DOCS\DRAFT\FIGURE 2-1.MXD - USER: CWEAVER - DATE: 10/12/2017



TUTU WELLS SUPERFUND SITE VICINTY MAP
ST. THOMAS, U.S. VIRGIN ISLANDS
FIGURE 2

TUTU WELLS SUPERFUND SITE FOCUSED SOURCE RI/FS OU2

ALTERNATIVE 2A - EXPANSION OF PUMP AND TREAT SYSTEM AND REINJECTION

TUTU OU2, ST. THOMAS, U.S. VIRGIN ISLANDS

FIGURE 3

EPA United States Environmental Protection Agency

TUTU WELLS SUPERFUND SITE FOCUSED SOURCE RI/FS OU2