FINAL Engineering Evaluation/Cost Analysis Report Areas 1, 2, and 3 of the Caneel Bay Resort

Prepared by VHB

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Revision Log

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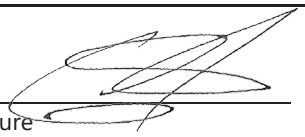
Pedro M. Ramos		9/20/21
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List of Abbreviations and Acronyms

amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirements
AST	aboveground storage tank
BCY	bank cubic yards
BERA	baseline ecological risk assessment
bgs	below ground surface
CBIA	CBI Acquisitions
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHF	Central Hazardous Materials Fund
COC	contaminant of concern
COPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
CSM	conceptual site model
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DDT-total	DDT plus its metabolites DDD and DDE
DO	Director's Order
DU	decision unit
EE/CA	Engineering Evaluation/Cost Analysis
EHI	EHI Acquisitions, LLC
EMI	electromagnetic induction
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
ESA	Environmental Site Assessment
ESV	NPS ecological screening value
ft	foot or feet
FWS	Fish and Wildlife Service
GPR	ground penetrating radar
HHRA	human health risk assessment
HQ	hazard quotient
ISM	incremental sampling methodology
LOEL	lowest observable effects level
mg/kg	milligrams per kilogram
MCL	Maximum Contaminant Level
MP	Management Policy
NAAQS	National Primary and Secondary Ambient Air Quality Standards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOEL	no observable effects level

NPS	National Park Service
PAH	polycyclic aromatic hydrocarbon
PAL	Project Action Level
PCB	polychlorinated biphenyl
PM	Policy Memorandum
PRG	preliminary removal goals
PRP	potentially responsible party
PRSC	post-removal site controls
RAO	removal action objective
RBCG	risk-based cleanup goal
RCRA	Resource Conservation and Recovery Act
RG	removal goal
RM	Reference Manual
RME	reasonable maximum exposure
RSE	Removal Site Evaluation
RSL	Regional Screening Level
RSSL-HQ	Refined soil screening level hazard quotient
SAP	Sampling and Analysis Plan
SLERA	screening-level ecological risk assessment
SSL	soil screening level
TBC	to be considered
TCLP	Toxicity Characteristic Leaching Procedure
TSCA	Toxic Substances Control Act
UST	underground storage tank
USC	United States Code
USDA	United States Department of Agriculture
USDOI	United States Department of the Interior
USGS	United States Geological Survey
USVI	United States Virgin Islands
VIIS	Virgin Islands National Park
VOC	volatile organic compound

Executive Summary

ES 1. Introduction and Purpose

The Caneel Bay Resort (Resort) is located within the Virgin Islands National Park (VIIS) on St. John, U.S. Virgin Islands (USVI). VIIS is owned by the United States and under the jurisdiction of the National Park Service (NPS). The National Park Service (NPS) manages the Virgin Islands National Park (VIIS) on St. John. The Resort has been continuously operated by private businesses since at least 1956. The Resort closed to overnight visitors in 2017 after Hurricanes Irma and Maria severely damaged many of its buildings. EHI and CBIA currently operate the Resort pursuant to the Retained Use Estate Indenture Agreement (RUE), which will expire on September 30, 2023 (NPS, 2013).

NPS has evaluated potential existing and threatened releases of hazardous substances or contaminants related to previous resort operations. In a 2017 Removal Site Evaluation, NPS recommended assessing potential soil and groundwater contamination in several areas of the property. Based on previous assessments, a letter to NPS alleging environmental concerns, and field observations, NPS identified the presence or potential presence of metals, volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), and pesticides in soil and groundwater.

NPS performed an Engineering Evaluation/Cost Analysis (EE/CA) investigation for Areas 1, 2, and 3 in 2021 to assess the nature and extent of contamination, assess risks to human health and the environment, and determine a preferred cleanup alternative. NPS identified additional conditions that will be addressed in an EE/CA addendum or a separate EE/CA. These conditions are listed in Section ES. 8, below.

NPS is investigating Caneel Bay Resort using its authority under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and its implementing regulations, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), which govern response actions at sites where hazardous substances present a potential risk to human health or ecological receptors.

This EE/CA report documents the environmental review and the process used to evaluate alternatives and select the recommended solution. It also identifies removal alternatives and analyzes the effectiveness, implementability, and cost of those alternatives.

ES 2. Site Description, Investigation Results, Conceptual Site Model, and Risk Assessment Results

NPS's investigation focused on three separate areas, Areas 1, 2, and 3, of the Resort property where releases of hazardous substances were known or suspected to have occurred; these areas are collectively called the Site in this report.

Area 1

Area 1 is a gravel area near the wastewater treatment plant, where equipment and machinery have been stored. Field investigators collected surface soil samples at Area 1. Sampling results show low levels of contaminants in Area 1 soil—possibly from materials stored in the gravel

staging area that may have released metals. Arsenic concentrations found in Area 1 soil were above human health-based risk levels based on a potential future residential land use scenario (Area 1 is not currently developed for residential use). However, naturally occurring arsenic is often found in soil at concentrations that are higher than the calculated human risk level; therefore, cleanup levels require consideration of natural background concentrations. After careful review of the background data collected during the EE/CA investigation, NPS decided to defer cleanup decisions in Area 1 until additional background data can be collected.

Area 2

Area 2 is the maintenance, landscaping, and vehicle-fueling part of the Resort. Field investigators collected surface soil and one water sample from an existing monitoring well. Investigators also drilled in soil near the fuel dispenser pump. The risk assessment for Area 2 indicates that elevated levels of certain pesticides present in part of Area 2, may pose an unacceptable ecological risk and human health risk, specifically to a future resident or worker. Like at Area 1, arsenic is also present at concentrations that may cause a risk to a future resident. One part of Area 2 may also present an unacceptable ecological risk due to barium concentrations in soil. A paved drainage channel along the northern side of Area 2 increases the potential for impacted soil from Area 2 to be carried towards the ocean during rainstorms. NPS concluded that a removal action is required in Area 2 to address pesticides and metals in soil.

Area 3

Area 3 is the former landfill east of Honeymoon Beach. Field investigators collected surface and subsurface soil samples, and installed a monitoring well for possible future groundwater sampling in the wet season. The investigation results for Area 3 reflect the mixed contents of the landfill, where wastes were deposited over decades without proper containment measures (for example, a permitted landfill would now require a liner, leachate collection, and monitoring for contaminant movement). The landfill includes a mixture of benign organic materials, plastics, metals, and CERCLA hazardous substances, including the pesticide DDT and polychlorinated biphenyls (PCBs). NPS concluded that the ecological risk from pesticides and metals in Area 3 are above acceptable levels. In addition, a steep slope of the landfill, which faces Honeymoon Beach and the ocean, is unstable. There is visible evidence of slope failure and erosion, and exposed landfill waste. Contaminated sediment migration from the landfill toward Honeymoon Beach and the potential failure of the landfill slope, which would potentially expose additional hazardous substances, poses an unacceptable risk. This risk will increase with the increased frequency and intensity of storms due to climate change. Therefore, NPS concluded that a removal action is required to address conditions in Area 3.

Other Resort Conditions

The Sampling and Analysis Plan prepared to support the EE/CA investigation was developed based in part on observations made during a site visit in 2016. As a result of severe hurricane damage to the resort and with recent citizen input, NPS identified additional concerns related to the distribution of hazardous building materials in other areas of the resort. Because of pandemic travel restrictions and other access constraints, NPS was not able to conduct a post hurricane site visit before starting the EE/CA investigation. Therefore, NPS added a visual

inspection of the other resort areas and limited sampling to screen for additional areas of site contamination. This screening-level data will be used to plan additional investigation activities outside of Areas 1, 2, and 3.

ES 3. Identification and Analysis of Applicable or Relevant and Appropriate Requirements

NPS identified chemical-, location-, and action-specific Applicable or Relevant and Appropriate Requirements (ARARs) and items to be considered that influence the need for and choice of removal action alternatives.

ES 5. Removal Action Objectives (RAOs) and Preliminary Removal Goals

NPS identified three RAOs: eliminate unacceptable risks to human health and the environment; eliminate or minimize contaminant-related constraints on park resources and allow park resources to be used consistent with NPS mandates; and satisfy federal and state ARARs and associated cleanup standards.

To determine recommended removal goals (RGs), NPS compared the human health and ecological risk-based cleanup goals (RBCGs), ARAR-based goals, and representative background concentrations.

Text Table ES 5 summarizes the selected RGs and the basis for each.

Text Table ES 5 Recommended RG Selection

Contaminant of Concern	Background	Human Health RBCG	Ecological RBCG	ARAR-Based PRG	Basis for RG	Recommended RG
Soil (mg/kg)						
Arsenic	**2***	0.68	None	None	Background	To be determined
Barium	83	None	**185**	None	Ecological	185
Copper	85	None	**99**	None	Ecological	99
Zinc	57	None	**147**	None	Ecological	147
DDT-Total	0.049	None	**0.17**	None	Ecological	0.17
Aldrin	0.014	0.039	**0.018**	None	Ecological	0.018
Chlordane	0.142	None	**1.20**	None	Ecological	1.20
Dieldrin	0.013	**0.034**	0.051	None	Human health	0.034

Note:

* To reduce uncertainty regarding this background concentration, NPS plans to perform additional background and clean fill source sampling.

ES 6. Identification of Removal Action Alternatives

After considering several alternatives, NPS evaluated two: (1) No action and (2) remove surface soil in portions of Area 2 and soil and landfill contents from Area 3. The selected alternative is Alternative 2. Other alternatives considered in the screening process were eliminated due to impracticality or lack of effectiveness.

No action (Alternative 1) is considered as a baseline for comparison. No additional monitoring or maintenance would be performed, soil and the landfill remain in place, and human health and ecological risks would not be addressed. This alternative would not include a mechanism to prevent future exposure to contaminants identified and does not meet goals for the Site.

The selected Alternative 2 includes removal of some surface soil in Area 2 and all landfill material in Area 3. To remove contaminated materials and reduce long-term maintenance requirements, this alternative includes excavating soil and waste from the landfill down to rock, followed by grading and revegetation.

ES 7. Comparative Analysis of Removal Action Alternatives

The no action alternative does not protect human or ecological health, nor does it comply with ARARs or reduce the toxicity, mobility, or volume of contamination. Taking no action is not acceptable to NPS, nor is it expected to be accepted by the Territory or community.

Alternative 2 will protect human health and the environment, comply with ARARs, and reduce the toxicity, mobility, and volume of contaminants. The soil removal will increase potential for releases in the short term, however, and the work would need to be conducted carefully. This alternative is expected to be accepted by both the Territory and community. Costs are projected to be $6 million, which assumes a mid-priced scenario in which non-hazardous waste is disposed of at the St. Thomas landfill at a tipping cost for mixed waste, and 1% of the waste is characterized as hazardous and must be transported to a facility in the continental U.S. for disposal. Costs will be higher if the waste has to be disposed of in the continental U.S., and less if the waste is accepted for disposal at the closed landfill on St. John.

ES. 8 Recommended Removal Action Alternative

The recommended alternative is to remove contaminated soil from Area 2 and Area 3. For removal actions that are not time-critical, the public has a minimum 30-day comment period on the EE/CA and supporting documentation. In June 2021, NPS held two public meetings to present the EE/CA preferred alternative and discuss the investigation findings. NPS requested all comments be made within 30 days, and one 15-day extension to the public comment period was granted upon request. NPS considered all public comments received before the deadline and made changes where appropriate.

Finally, NPS will prepare the Action Memorandum, which substantiates the need for the removal action, identifies the selected action, provides the rationale, and provides responses to significant public comments

During the investigation, NPS observed additional conditions that are outside this EE/CA scope but warrant more consideration. NPS will conduct additional investigations to address these

data gaps before the RUE expires, if possible. These conditions are listed below and discussed in detail in the report.

1. **Asbestos-containing material**. NPS identified potential asbestos-containing materials in buildings, pipe insulation, buried pipes, and hurricane debris scattered throughout various parts of the Resort property. Asbestos releases to soil may have occurred or could occur in the future as the material degrades. Appropriate debris removal and asbestos abatement, performed according to applicable solid waste regulations, should be conducted as soon as possible to avoid future releases. Additional soil sampling may be required to evaluate risks to human health and the environment that may result from existing concentrations of asbestos in soil. Asbestos released to the environment is a CERCLA hazardous substance release and will be further investigated.

2. **Lead-based paint**. NPS found lead in soils at building and debris driplines at concentrations, in some areas, that indicate lead paint was used on the buildings. Lead-paint abatement should be performed to avoid future releases of lead to soil. Additional soil sampling may be required to evaluate risks to human health and the environment that may result from existing lead concentrations in soil. Lead released to the environment is a CERCLA hazardous substance release and will be further investigated.

3. **UST at Cottage 7**. Based on a gauge and pipes in the Cottage 7 basement, an underground storage tank (UST) was, and may still be, present outside the building. Soil excavation will be necessary to definitively establish if the UST has been removed. If the location (or former location) of the UST and/or fill pipe can be determined, surface and subsurface soil sampling will be performed to identify potential releases to the environment.

4. **Petroleum in soil in Area 2**. A 2010 accidental diesel release from a buried fiberglass pipe at the aboveground storage tank (AST) was addressed by a 2010 emergency response and possibly in a later response. A list of reports related to this release from DPNR indicates that no further action is required. However, in 2021, NPS encountered petroleum odors in soil near the release area. Additional soil sampling may be required to evaluate risks to human health and the environment that may result from existing concentrations. NPS has reviewed the DPNR's release files and will conduct additional investigation to evaluate the nature and extent of residual contamination in soil and, if possible, groundwater.

5. **MW-1 closure.** The monitoring well installed to monitor the former UST closure is functioning as a conduit to the subsurface, rather than as a groundwater monitoring well. The 2021 groundwater analysis from MW-1 did not indicate a reason to collect additional samples from this location. If petroleum or other chemicals enter the well at

the surface, they could contaminate underlying soils. The monitoring well should be closed in accordance with USVI well abandonment requirements.

6. **Catchment Basin buried items.** In 2021, a ground-penetrating radar survey detected evidence of a large, unidentified buried, rectangular item. This, in combination with anecdotal reports that wastes may have been buried near the catchment basin, raises a question about possible contaminant burial and related releases. The top of the buried item, which is 2 feet below the surface, will be uncovered to evaluate if additional investigation is required. NPS will collect and analyze additional soil samples in the area.

7. **Arsenic background and clean fill values.** In 2021, NPS collected background samples at the Resort and calculated a background value of 2 mg/kg for arsenic. Because this concentration is lower than worldwide averages, NPS is uncertain about whether this value represents the possible range of local concentrations, and whether clean fill is available to restore areas subject to soil removal. NPS plans to collect additional background and possible clean fill samples to address this uncertainty. This work is expected to result in an arsenic removal goal.

8. **Possible migration of contaminants in groundwater at the landfill.** In 2021, no evidence of intermittent groundwater was observed in any soil borings, but whitish stains were present on the eroded edge of the landfill. These stains indicate rainwater moves through part of the landfill, and could carry contamination with it. NPS installed a monitoring well in the landfill near the seeps and plans to collect a groundwater sample in the rainy season.

1. Introduction

The Caneel Bay Resort is located within the Virgin Islands National Park (VIIS) on St. John, U.S. Virgin Islands (USVI) (see Figure 1). VIIS is owned by the United States and under the jurisdiction of the National Park Service (NPS). Continuously operated by various private businesses since at least 1956, the Caneel Bay Resort did not reopen after Hurricanes Irma and Maria severely damaged many of its buildings in 2017. EHI Acquisitions, LLC (EHI) and CBI Acquisitions, LLC (CBIA) currently operate the Resort property pursuant to the Retained Use Estate Indenture Agreement (RUE), which will expire on September 30, 2023 (NPS, 2013).

This Engineering Evaluation/Cost Analysis (EE/CA) report was prepared to evaluate the nature and extent of contamination at the Caneel Bay Resort, to assess potentially unacceptable human health and ecological risk, to evaluate removal alternatives that address unacceptable human health or ecological risk, and to identify a recommended removal alternative. This report documents the EE/CA investigation and analysis and selection of a recommended removal action.

After assessing possible contamination related to the Resort as part of a real estate process related to the RUE expiration, in 2017, NPS conducted a Removal Site Evaluation (RSE) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (3E Consultants, 2017). The purpose of the RSE was to evaluate conditions and assess the threat posed by the release or threatened release of hazardous substances to the environment. The RSE included a review of available information about the Resort operations, review of earlier assessments, and a visit to the Resort to observe conditions (no sampling or laboratory analysis was included). The RSE report concluded that a non-time-critical removal action should be initiated to assess potential soil and groundwater contamination related to three general areas that included engineering, maintenance, and landscaping operations surrounding the former generator, the wastewater treatment plant, and landfill.

Based on information provided in the RSE report, and on information obtained during a visit to the Resort in 2016, NPS developed a Sampling and Analysis Plan (SAP) to support the EE/CA investigation. The SAP was drafted in 2016 based on site visit observations and information that was available at the time; it was not finalized until 2021 (VHB, 2021). Due to access constraints, NPS was delayed in implementing the EE/CA investigation until February 2021. Travel restrictions surrounding the Covid-19 pandemic prevented NPS from making an updated, post-hurricane site visit before mobilizing for the field program. In 2020, NPS received a letter from a member of the public (DiGiacomo, 2020) identifying a number of potential environmental concerns related to the Resort and the property. Most of the concerns raised in the 2020 letter were addressed in the original SAP; however, the field sampling program was adjusted to help address some of the additional concerns that were raised.

Based on the information reviewed in preparation of the SAP, NPS developed a list of "study constituents" that included: metals, volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), and pesticides. The EE/CA

investigation was designed to assess the nature and extent of study constituents in soil and groundwater. The goal of the investigation was to evaluate the need for a removal action based on potential risks to human health and the environment. Based on the post-hurricane conditions, which includes the scattering of building debris across the Resort, the subsequent deterioration of those building materials as they weather, and the potential presence of hazardous building materials (e.g., asbestos and lead-based paint), NPS identified additional questions regarding the possible presence of contaminants in visitor areas that are not part of the EE/CA investigation areas. To avoid delaying the investigation of the areas identified in the RSE, NPS chose to collect preliminary information about these additional questions, understanding that there may be gaps to be filled by a follow-up investigation. This may result in an addendum to this EE/CA or in a separate removal action.

1.1. CERCLA and NPS Authority

The NPS is authorized under CERCLA, 42 United States Code (USC) Section 9601 et seq., and Executive Order 12580, as amended, to respond as the lead agency to a release or threatened release of hazardous substances and/or a release or threatened release of any pollutant or contaminant that may present an imminent and substantial danger to public health or welfare or the environment on or from land under the jurisdiction, custody, or control of NPS.

CERCLA's implementing regulations, codified in the National Oil and Hazardous Substances Pollution Contingency Plan, commonly called the National Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, establish the framework for responding to such releases and threatened releases. The NCP prescribes two processes for responding to releases: (1) removal actions and (2) remedial actions (see NCP Sections 300.400 through 300.440). Previous investigations have determined that the Site presents a current or potential threat to public health and/or to the environment and that a removal action is appropriate at the Site as specified in 40 CFR Section 300.415(b). This determination was formalized in an EE/CA Approval Memorandum, signed on September 27, 2018, by NPS Southeast Region Director Robert Vogel and included in the Administrative Record for the Site.

This EE/CA Report was generated in accordance with the NCP, 40 CFR Section 300.415(b)(4)(i), the U.S. Environmental Protection Agency (EPA) *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (EPA, 1993a), and the U.S. Department of the Interior (USDOI) *Central Hazardous Materials Fund (CHF) CERCLA Process for CHF Projects* Environmental Compliance Memorandum 16-3 (USDOI, 2016).

1.2. EE/CA Purpose and Development

This Report is organized by the following headings, which also represent the EE/CA's overall objectives:

- Characterize the nature and extent of contamination at the Site and conduct risk assessments (Sections 2 and 3)
- Identify applicable or relevant and appropriate requirements (ARARs) (Section 4)
- Develop removal action objectives (RAOs) and preliminary removal goals (PRGs) (Section 5)
- Identify and analyze potential removal action alternatives (Section 6)
- Conduct a comparative evaluation of the removal action alternatives (Section 7)
- Recommend a removal action alternative (Section 8)

1.2.1. Impact of NPS-Specific Regulations and Policies on EE/CA Development

The NPS has several regulations that apply to the release of hazardous substances, pollutants, or contaminants on NPS-managed land (see NPS 2015), including the NPS Organic Act of 1916 (Organic Act) (16 USC Section 1 et seq.; 36 CFR Chapter 1, Part 1), which requires that the NPS manages parks to conserve the scenery, natural and historic objects, and wildlife and provide for their enjoyment by means that will leave them unimpaired for the enjoyment of future generations. The NPS strives to clean up contaminated sites with long-term, comprehensive solutions in which post-removal site controls (PRSCs) are minimized or non-existent.

While additional investigation or response actions may be necessary to address other risks at the Resort where this report identifies data gaps, this EE/CA Report will be the basis of a permanent response action to address human health risk, ecological risk, and ARARs in Areas 1, 2, and 3, which comprise the Site, except where data gaps exist. Consequently, this EE/CA Report includes a baseline human health risk assessment (HHRA), a screening-level ecological risk assessment (SLERA) (USDOI, 2016), and a SLERA Refinement.

1.2.2. Park-Specific Considerations during EE/CA Development

The VIIS enabling legislation states that VIIS "shall be administered and preserved . . . in its natural condition for the public benefit and inspiration . . . ." This requirement was considered during EE/CA development, with the understanding that the Resort RUE has resulted in a change from "natural conditions" for several decades. The establishing legislation also seeks to "preserve for the benefit of the public significant coral gardens, marine life, and seascapes in the vicinity" of VIIS. The VIIS management plan identifies water clarity as "a primary VIIS value", which required additional consideration in this EE/CA. The VIIS enabling legislation provides a framework for determining what is required to attain the Organic Act non-impairment requirement. The Organic Act requires NPS to maintain national park resources unimpaired for the enjoyment of future generations.

Also, the location of the Park in the USVI required a modification to the ecological risk assessment so that native plant and wildlife were assessed.

2. Site Description, Investigation Results, and Conceptual Site Model

This section includes a summary of site features, operational history, historical sources and releases of contaminants, and factors that influence contaminant migration such as hydrogeology, hydrology, climate, extent of contaminants in site media, and contaminant transport pathways and behavior. All these elements contribute to the development of the conceptual site model (CSM), which is presented in Section 2.14 and is presented graphically in Figure 6a for Area 2 and Figure 6b for Area 3.

2.1. Site Description

The Resort is on northwestern shore of the island of St. John, between North Shore Road and the Atlantic Ocean. This approximately 150-acre vacation resort is located approximately 1 mile northeast of the major port town of Cruz Bay. The Resort includes the entire 150 acres covered by the RUE and other lands owned and operated by EHI/CBIA. The approximate longitude and latitude of the Resort entrance are 18.341497 degrees north, -64.784298 degrees west.

The Resort occupies a peninsula on the Atlantic Ocean and is surrounded by water to the west and north and by VIIS forest to the south and east, which is crossed by hiking trails and public roads. The popular, publicly accessible Honeymoon Beach is in the southwest part of the Resort. Hawksnest Bay, east of the Resort, also includes multiple public beaches. The Resort is located at the northern edges of Margaret Hill (elevation approximately 800 feet above mean sea level [amsl]) to the southeast and Caneel Hill (elevation approximately 700 feet amsl). The resort's topography is gently rolling and varies between approximately 140 feet amsl and sea level (Figure 1).

Based on historical investigations and the 2016 reconnaissance, NPS established an investigation "Site" consisting of three areas that encompass the facilities of concern identified in the Level 2 Environmental Site Assessment Report (Barksdale & Associates, 2014 and included as Appendix E) and the Removal Site Evaluation (RSE) report (3E Consultants, 2017). These are described below, in the following section, and shown on Figure 2.

- Area 1: approximately 0.8 acres near the wastewater treatment plant (WWTP) structures, on the southeastern side of the Resort
- Area 2: approximately 5.4 acres that encompass the engineering, maintenance, landscaping, and fuel buildings and facilities, to the southwest of the WWTP
- Area 3: approximately 1.5 acres of land (undeveloped except for a donkey shelter) that will be referred to in this document as the landfill to reflect historical usage, located immediately east of Honeymoon Beach

Areas 1 through 3 comprise the approximately 8-acre Site, which is wholly within the 150-acre Resort.

The Site was defined before the 2017 hurricanes, when resort buildings were occupied. In 2021, access to the Resort by NPS and its contractors was restricted to the 2021 EE/CA field work.

During planning for the investigation, NPS recognized that hurricane damage may have caused contamination to other parts of the Resort. NPS also received information from local sources about possible chemical use and disposal outside of Site Areas 1, 2, and 3. New concerns, including possible asbestos-containing materials, lead-based paint, and concealed waste burials were raised. Because little information was available regarding the precise locations and nature of these possible releases, NPS chose to gather screening-level information during this phase of the EE/CA investigation about these possible issues. NPS recognizes that additional focused investigation is needed to evaluate the nature and extent of these releases, if any, and associated potential risk to human health and the environment.

2.2. Operational History and Sources/Releases

The Resort property occupies a prominent place in the history of St. John, with evidence of pre-Columbian settlement and development in the early 1700s as a plantation (NPS, 2013). The Resort operated from at least 1956 through 2017 when it closed due to hurricane damage. The Resort is not currently listed on the National Register of Historic Places, but plantation ruins have been preserved in the central portion of the Resort (NPS, 2013) and 109 buildings at the Resort are potentially eligible for listing. There are no apparent aboveground plantation ruins on the Site (Areas 1 through 3), although park records show portions of Area 2 may cut through the location a historic village. The operational history of the Resort, based on available records, is as follows.

1938: The West Indies Company built seven small rental cottages on the former sugar plantation; the Resort had been developed with a small hotel and eight rental cottages by 1952, when the owner at that time, Rhode Island Charities Trust, sold the property to Laurance Rockefeller (The Daily News of the Virgin Islands, 1976).

1956: Caneel Bay Resort was opened by Laurance Rockefeller's RockResorts (RockResorts, n.d.) and later became part of the Jackson Hole Preserve, Inc. a non-profit organization headed by Rockefeller.

1983: Jackson Hole Preserve, Inc. donated the 150 acres of resort "land to the U.S. government subject to a 40 year Retained Use Estate Indenture Agreement (RUE)" (NPS, 2013). RockResorts/The Jackson Hole Preserve, Inc. continued to operate the Resort.

1986: RockResorts was sold to CSX Corporation (RockResorts, n.d.), which continued to operate the Resort.

1989: RockResorts was sold to VMS Realty, via a loan from Bankers Trust, which foreclosed on the Resort shortly thereafter (Kerch, 1991). The RUE was transferred to Bankers Trust in 1989 (NPS, 2013).

1993: Rosewood Hotels and Resorts began managing the Resort (Lohr, 2013).

1998: Bankers Trust was acquired by Deutsche Bank (Andrews, 1998).

2004: EHI, a CBIA affiliate, purchased the RUE from Deutsche Bank (Business Wire, 2004). Rosewood Hotels and Resorts continued to manage the Resort (Lohr, 2013).

2014: EHI/CBIA did not renew the management contract with Rosewood Hotels and Resorts and began managing the Resort (Lohr, 2013). The RUE status did not change.

2017: Hurricanes Irma and Maria caused significant damage to the resort, leading to its closure for overnight accommodations through at least 2021.

The RUE will expire on September 30, 2023 (NPS, 2013). Following expiration of the RUE, it is possible that Caneel Bay Resort will resume resort operations after hurricane damage is addressed, although Park management is considering other potential future uses.

Until September 2017, the Resort was open to overnight guests from November through August. Some Resort employees lived at the Resort throughout the year. The Resort did not reopen after the 2017 hurricane season and is closed for overnight accommodations at least through 2021. Many of the buildings have been partially destroyed, and building debris, former building contents, and equipment are scattered around the Resort.

Housing on the adjacent property has reopened since the hurricane, according to Park staff.

The WWTP in Area 1 includes a pumphouse—which had been partially destroyed before the 2021 field investigation—and a small laboratory and office building.

Office and maintenance buildings are located within Area 2.

As of the 2021 field investigation, there were two operational restaurants within the Resort boundary. Zozo's, a fine-dining restaurant, is west of Area 2 on the southern end of Caneel Beach. Bikinis on the Beach, a small bar and grill, is immediately west of Area 3 on Honeymoon Beach. A gift and equipment rental shop is adjacent to the bar and grill. Guests are shuttled through the Resort to both restaurants and Honeymoon Beach, which is open to the public year-round. Access to other parts of the Resort is restricted by signage along the road. Public access to Honeymoon Beach on foot is also possible via the Lind Point Trail.

The EE/CA does not include the marina and fuel facility on Tracts 04-104 and 04-115, which are part of the Resort but are not NPS property.

2.2.1. General Historical Operations/Buildings and Sources/Releases

Many of the buildings and facilities at the Resort provided guest accommodations, food services, or recreation services, which are not associated with recognized environmental conditions that could result in the release of CERCLA hazardous substances. However, due to the age of the buildings, the presence of hazardous building materials, including asbestos-containing materials (ACM) and lead-based paint, is possible. During the field investigation, VHB visually identified possible asbestos fibers in various building materials, including plaster, drywall, and tar paper. The 2017 hurricanes dispersed building debris across the Resort, and it was beyond the scope of the field investigation to evaluate asbestos concentrations in soil. A previous investigation confirmed that some buried piping (now out of service) was ACM. NPS contracted a ground-penetrating radar (GPR) survey to trace the pipes in Area 2, but the amount of debris on the ground surface limited the extent of the survey. The GPR survey found evidence that the piping has not been removed, only disconnected from buildings. Soil sampling for lead near buildings was part of the EE/CA field investigation, as summarized in Section 2.10.2, and indicates the presence of lead paint associated with some of the buildings.

The Level 2 Environmental Site Assessment Report in Appendix E (Barksdale & Associates, 2014) discussed reports of a possible UST and bomb shelter at Cottage 7, but no evidence of either was observed during the 2016 reconnaissance. On behalf of NPS, VHB personnel inspected the exterior of Cottage 7 in 2016, and observed no evidence of vent or fill pipes, stained soil, stressed vegetation, or groundwater seeps with staining. Based on the statement in the Level 2 Environmental Site Assessment Report that the bomb shelter predated World War II, and the construction date of the Resort was after World War II, it is possible that if the UST existed, it was removed during the construction of Cottage 7 before 1956. On behalf of NPS, VHB inspected the interior of the cottage as part of the 2021 field investigation and found evidence of a previous UST, including a level gauge connected to pipes that exited the building below ground. The pipes were traced to beneath an air conditioning unit on a concrete pad, where the signal disappeared. Beyond the air conditioning unit, there is a mixture of dense vegetation and debris that prevents additional above-ground investigation. If present, a UST could be found by digging in the area, after clearing the vegetation and debris.

2.2.2. Area 1 Historical Operations and Sources/Releases

The existing WWTP was constructed in 1968 (NPS, 2012), and the gravel staging area above the WWTP building and ponds may have been constructed around the same time. The WWTP was not operating during the 2021 EE/CA investigation, and appeared to have been out of service since the 2017 hurricanes. At the time of the 2021 investigation, the assumed primary clarifier contained liquid while the downstream reactors or basins were dry. For an unknown period before 2014, sludge from the WWTP was reportedly disposed "every 10 years" at the landfill in Area 3 (Barksdale & Associates, 2012; 2014). In 2016, an EHI/CBIA representative stated that since 2014, the practice was to dispose of sewage sludge at the St. Thomas landfill (Dow, 2016). The DiGiacomo correspondence expressed a concern regarding disposal of human wastes, especially since the 2017 hurricanes, and inquired whether permits were acquired to operate the

facility. The 2013 environmental assessment (NPS, 2013) states that the WWTP was permitted, but does not include copies of permits.

A material re-use staging area is in a gravel clearing north of the WWTP building. Various resort-related fixtures, machinery, and mechanical parts were present in 2016; in 2021 the area was mostly empty apart from building debris and scrap metal. During the field investigation, NPS observed rusted drums containing pebbles and an area (approximately 20 feet by 20 feet) where paint had been discarded and dried on the ground surface. During the EE/CA investigation, NPS collected surface soil samples at the gravel staging pad, drum disposal location, and paint-stained soil limits for analysis of metals, PAHs, and pesticides.

2.2.3. Area 2 Historical Operations and Sources/Releases

Most of the buildings in Area 2 were constructed circa 1956 to 1960 (NPS, 2012), although buildings and roads are visible in this Area on the 1954 aerial photograph in the RSE report (3E Consultants, 2017). The existing gasoline and diesel aboveground storage tanks (ASTs) were installed after 1960, but the installation date was not provided in documents reviewed for this Site. The installation date of the gasoline and diesel dispenser pump is not provided in available documents, however an emergency response to a diesel release was reported in 2010. According to the response report, a contractor pierced a buried fiberglass pipe and released diesel, which followed utility bedding sand/gravel towards the northeast (along AST piping and, separately, along a buried electrical wire trench) and the north (along piping that terminated at the fuel pump). In 2010, the emergency response included removing diesel-contaminated soil and pipe bedding material, and stockpiling it on a concrete pad beside the AST. Based on a list of available files provided by DPNR in April 2021, additional soil investigation was performed in 2013, a risk assessment was completed in 2014, and the DPNR required no further action (Syedali, 2021).

NPS attempted to install a monitoring well close to the fuel dispenser, but the dense clay and silt did not yield water at the time of the EE/CA investigation. The lack of saturated conditions and dense nature of the natural clay should limit the potential for subsurface diesel and diesel chemical migration.

Based on field observations, subsurface soil near the fuel pump contains evidence (petroleum odors) of residual petroleum contamination. Based on the utility clearance survey and reports from EHI/CBIA, there is a buried utility corridor along the road beside the fuel dispenser; additional soil borings could not be completed without the risk of contacting a live electrical wire or breaking an in-use pipe. During the EE/CA investigation, NPS collected surface soil samples on the gravelly slope that extended from the gasoline and diesel ASTs to the fuel pump for analysis of metals, VOCs, PAHs, and pesticides.

Area 2 also hosts the landscaping and maintenance buildings and chemical (including pesticide) storage sheds. These buildings are surrounded by asphalt roads/parking lots, concrete pads, and lawns, and much of the area is bordered by forest. There is one previously installed monitoring well in the concrete pad at the maintenance buildings. The monitoring well, which is screened to the ground surface and in a low spot in the concrete, likely collects surface water that then dissipates into the surrounding soil, which is dense clay and silt. Based on this observation and

the finding during the EE/CA field investigation that no wet soils were encountered in nearby borings, the water in the monitoring well is not considered to be groundwater and cannot be monitored to evaluate contaminant migration. NPS recommends that MW-1, which acts a conduit to the subsurface, be closed in accordance with USVI regulations. NPS collected a water sample from the monitoring well for analysis of VOCs, metals, and PAHs (insufficient water was present to obtain a sample for pesticides). NPS also collected surface soil samples in unpaved areas around the buildings for analysis of metals, PAHs, and pesticides.

A paved drainage channel at the eastern end of Area 2, near the Resort entrance, is aligned along the northern edge of Area 2 and discharges to the ocean near the dock at Little Caneel Beach. The course of a second paved drainage channel begins at the southern end of Area 2, near the desalination plant, and joins the first channel in the grounds and landscaping area. The drainage channel locations are shown on Figure 2. In 2014, the channel was mostly dry but contained some sediment, which was sampled; results indicated that concentrations of contaminants were highest near Area 2 and diminished to nondetectable levels at the discharge point. In 2021, a continuous discharge—suspected to be from the desalination plant—to the southern drainage channel was observed. The northern drainage channel was dry above the confluence of the two channels. As discussed in the SAP, disinfection byproducts may be used in the desalination plant, but according to the EPA, products commonly used as bleach and for water disinfection, sodium hypochlorite and calcium hypochlorite, "react easily with organic matter and convert readily into sodium chloride (table salt) and calcium chloride (road salt)" (USEPA, 1991). Sea salt is also expected to be in the desalinization effluent water. These salts are not CERCLA hazardous substances and were not investigated in this EE/CA.

2.2.4. Area 3 Historical Operations and Sources/Releases

The landfill is on the northern end of a small coastal valley to the east of Honeymoon Beach. While the landfill does not exhibit features of an engineered landfill (e.g., cover and liner systems, gas vents), the term has been maintained for historical consistency. The landfill protrudes south into the valley from the presumed natural valley slope. Relatively flat on top, the landfill is approximately level with surrounding grades at the northern end and is 10 to 20 feet above surrounding grades along the southern and western edges. The western toe of the landfill is immediately behind the restaurant and gift/rental shop on Honeymoon Beach and only several feet above sea level.

During the 2021 field investigation, NPS identified an apparent ephemeral stream that had incised a drainage channel along the southern face of the landfill; the stream was dry at the time of the fieldwork. Two possible tributary ephemeral streams were observed along the upslope side of the drainage channel. NPS observed evidence of erosion of the landfill, including exposed waste, along the drainage channel. Based on visual observation and topographic survey data, the landfill slopes along the drainage channel to the south and Honeymoon Beach to the west are steep, with grades approaching 90% in some areas. NPS observed possible previous seeps, as evidenced by salt deposits, along the southern face of the landfill. Although dry during the 2021 field investigation, the seeps appeared to discharge toward the drainage channel.

The northeastern slope of the valley appears to have been historically quarried, and exposed rock faces remain along the access road. An apparent quarry pit with approximately 20-foot rock faces remains to the east of the landfill and separates Area 3 from the slope above.

The landfill was reportedly used for more than 50 years to dispose of all types of wastes from the Resort, including sewage sludge from the Resort WWTP. Prior to the advent of environmental regulation in the 1980s, it was typical for unregulated landfills to include both nonhazardous and hazardous wastes, including paints, pesticide containers, used oil, batteries, cleaning supplies, and other items. It is possible such materials were disposed of at this landfill. In 2016, the Resort staff reported that the landfill was used for disposal of compostable materials, such as trees and brush, although plastic plant pots were also visible among vegetative waste during the 2016 reconnaissance. During the 2021 field investigation, a large amount vegetative debris was observed along the landfill slopes and partially forming a berm around its southern and eastern edges. Resort staff reported occasionally burying animal carcasses in the landfill.

Based on soil core observations from the 2021 field investigation, the landfill materials include silts, sands, and gravels with intermixed solid waste, including wood and other organic materials, concrete, brick, tar paper, plastic, textiles, glass, and metal. Based on the heterogeneous nature of these wastes, typical disposal practices during the first decades this landfill was in use, and sample results revealing both PCBs and DDT, it is likely some hazardous materials are comingled with these solid wastes. Solid waste was observed at all boring locations with recovered cores, at maximum depths ranging from 1 ft below ground surface (bgs) to 26 ft bgs, and presumed rock was encountered between 0 ft bgs and 27 ft bgs. Based on soil core observations and a Site survey, the rock below the landfill slopes down from the northeast to the southwest, towards Honeymoon Beach. The observed solid-waste layer generally slopes down in the same direction, with the deepest and thickest layer in the southwestern corner. The landfill topography is shown on Figure 3 and cross-sections are shown on Figure 4.

The volume of landfill materials was estimated using topographic survey data and soil core observations. The estimated volume of material between the ground surface and the maximum observed solid waste depth is 14,700 bank cubic yards (BCY). The estimated volume of underlying material from the maximum observed solid waste depth to boring refusal or presumed rock is 4,600 BCY. Because there are indications that the landfill was previously a quarry, and overlying soil surrounding the landfill is thin, NPS infers that all soils and wastes in the landfill above the bedrock bottom were disposed of from elsewhere on the Resort. These wastes may include contaminated soils from other parts of the Resort, or the containers from pesticides, petroleum, and lead-based paint that were used at the Resort.

NPS collected surface soil samples from the surface of the landfill, side slope of the drainage channel, and the drainage channel bottom, as well as deeper soil/waste samples from soil cores for analysis of metals, PAHs, PCBs, and pesticides. NPS installed a groundwater monitoring well at the southern end of the landfill understanding that the well would be dry for at least half of the year (including at the time of the field work), but may yield a groundwater sample in the rainy season (i.e., June through November).

2.2.5. Catchment Basin Storage Area Operations and Sources/Releases

The Catchment Basin Storage Area is located to the east of the main Resort property, immediately below and to the north of the Catchment Basin. The area is situated at the end of dirt access road and bounded to the west by a steep hillside that appears to have been previously quarried and to the east by a steep valley leading towards Hawksnest Bay. During the 2021 field investigation, EHI/CBIA representatives indicated that the area was being used for material storage by a local contractor and semitrailer storage by a local nonprofit organization. Correspondence from local resident, Mr. David DiGiacomo, stated "at least one former employee reports that the area above Caneel *[Bay Resort]* often referred to as the catchment basin and also referred to as the Caneel Quarry was used not only to store DDT but also other chemicals that may still be leaching into the soil. It is rumored that employees were told to go up to that area with a backhoe at night to bury things" (DiGiacomo, 2020).

During the 2021 field investigation, NPS observed piles of quarry material and debris—including metal, concrete, discarded paint and oil containers, vehicle parts, and batteries—scattered around the area and down the adjacent slope. A patch of stained soil was observed on the access road at the northern end of the storage area. A GPR and EMI survey detected a buried pipe and a buried anomaly (22 feet long by 5 feet wide, at 2 feet bgs). These conditions were not observed during an earlier reconnaissance of the area in 2016.

2.3. Historically and Culturally Significant Features

Although Caneel Bay has a long history of settlement, possibly beginning with the Taino people around 840 BC (NPS, 2016), to a sugarcane processing operation and plantation in the early 1800s, and as a resort in the late 1930s. NPS is not aware of historically or culturally significant features in Areas 1, and 3. Area 2 may be culturally significant based on NPS accessioned artifacts and archival documentation. During the field investigation, no historical artifacts were observed in soil cores.

2.4. Waste Characteristics

With restaurants, lodging, water and wastewater treatment plants, fuel and maintenance facilities, and a small landfill, the Resort was similar in many ways to a village. Some building materials, cleaning supplies, and pesticides, popular in the 1950s-70s, contained potentially hazardous ingredients and may have been used at the Resort. Recent erosion or disturbance at the southwestern end of the landfill exposed debris and solid waste, including plastic, steel, aluminum, pipes, tile, painted and unpainted wood, and car parts. Some of these items may be used containers from pesticides, lead-based paint, and petroleum, all of which have been used at the Resort, based on soil sampling results. Additionally, soil contaminated with hazardous substances may have been disposed of at the landfill.

Gasoline and diesel are stored and used on site to fuel the emergency generator and vehicles. One reported diesel fuel leak occurred at the AST in 2010, and stained soil was observed near the fuel dispenser in later investigations.

The NPS investigation as part of this EE/CA (summarized in Appendix B) provided evidence that pesticides and metals are present in surface soil at concentrations above human health and

ecological screening levels. Observations during coring indicate that residual petroleum is present in subsurface soil near the fuel dispenser.

Asbestos is suspected to be present in building materials and pipes (with one pipe sample confirmed as asbestos), and some of these materials exist as uncontrolled debris on the ground surface, with the potential to release asbestos to soil and air as the debris degrades.

The use of lead-based paint at some buildings is suspected based on surface soil samples collected at building and debris pile driplines.

The sampled landfill contents were not characterized as hazardous based on the Toxicity Characteristic Leaching Procedure (TCLP) analytical results, although additional characterization would be needed to assess excavated waste. The estimated volume of landfill material between the ground surface and the maximum observed solid waste depth is 14,700 BCY. The estimated volume of underlying material from the maximum observed solid waste depth to boring refusal or presumed rock is 4,600 BCY.

2.5. Geology and Hydrogeology

2.5.1. Regional and Local Geology

The bedrock below the Site, and most of the western portion of St. John, is the Louisenhoj Formation, which consists primarily of strongly calcite cemented volcanic conglomerate, breccia, and volcanic sandstone (United States Geological Survey [USGS], 2002).

According to the Natural Resources Conservation Service (United States Department of Agriculture [USDA), 2020], soils in Areas 1, 2, and 3 consist of the Fredriksdal-Susannaberg complex, which is very gravelly clay, sometimes with an overlying layer of several inches of clay loam or clay. These soils are considered well drained, and the typical depth to the water table is more than 80 inches (6.7 feet) (USDA, 2020). Soils in the cores retrieved during the EE/CA investigation were consistent with the USDA classifications and appeared as dense, dry, silt with layers of clay, sand, and gravel. In Area 2, soil cores could be advanced as much as 22 feet deep. The observed dense, dry, clayey soil in Area 2 is likely to have a low permeability, which would limit potential migration of dissolved-phase contaminants from the Site.

In Area 3, soil cores drilled on the slope above the landfill were refused on bedrock at between 0.7 and 4 ft bgs. As shown on the cross-sections in Figures 4, soil mixed with solid waste was observed to depths ranging from 1 ft bgs to 26 ft bgs, and presumed rock was encountered between 0 ft bgs and 27 ft bgs. Based on soil core refusal, the believed top of rock slopes down from the northeast to the southwest, towards Honeymoon Beach.

2.5.2. Hydrogeology

Local depth to groundwater and groundwater flow directions are uncertain; moist soils were not encountered at any of the soil borings to refusal. One previously installed monitoring well is present but, based on the observations that the well screen extends to the ground surface, this well appears to act as a drain sump that collects rainwater from the surrounding concrete. Measurements of the water level over several days during the EE/CA field work saw the water

level decline with a lack of rain, indicating that water inside the well infiltrates into surrounding soil.

The seeps along the southwestern edge of the landfill indicate that rainwater percolates downward into waste, and then runs along a less permeable layer to discharge from the sidewall. The absence of groundwater during the dry season may not be indicative of conditions during the rainy season, and NPS installed a monitoring well in the landfill near the seeps for possible monitoring in the rainy season.

A comprehensive Site-wide groundwater assessment has not been performed. Based on the topography at the Site and surrounding area, the direction of shallow groundwater flow is estimated to be generally westwards towards Caneel Bay in Areas 1 and 2 and towards Salomon Bay in Area 3.

Groundwater Use

There is no evidence that Caneel Bay Resort currently extracts groundwater. EHI/CBIA currently operate a water treatment plant near Area 2 and sells water for distribution on St. John. Fresh water collected in the catchment basin (described in section 2.2.5) is mixed with desalinated ocean water and stored in a cistern near the grounds and landscaping area prior to delivery. Caneel Bay Resort is reported to have two drilled wells northeast of the Site areas; one of these wells is reported to have been drilled in 1982 and have total depth of 200 feet, and there is no information on the other except that the depth to water was at 33 ft bgs in 1990 (USGS, 1995). NPS has been informed that these wells were drilled as emergency backup water supply wells to be used if a release or spill affected the surface water supply. As of 2016, the Resort identified one of the former water supply wells, approximately 50 ft east of the engineering (mechanics) shop in Area 2, but it had been capped and grouted closed (Simon, 2016).

During the 2021 EE/CA investigation, no evidence of groundwater, such as mottled or wet soil, was observed in any boring drilled to bedrock. Although some groundwater may be present during the wet season, it is unlikely to be a reliable source of water for drinking, irrigation, or other uses. Because the desalination plant and catchment basin have supplied sufficient water for the Resort and other locations around St. John, these utilities can be expected to continue to serve the Resort if it reopens. Use of groundwater in overburden (i.e., above bedrock) soils is, therefore, considered unlikely.

Other properties on St. John are known to withdraw groundwater, possibly from bedrock wells. Based on the Site's location beside the ocean within small coastal valleys, contamination from the Site would not be expected to be transported in groundwater towards other properties. Site conditions in February did not present any evidence of groundwater transport of contaminants as a migration pathway. The possibility of groundwater transport as a migration pathway remains a data gap as conditions during the wet season are unknown, although no evidence of intermittent groundwater was observed in any soil borings. Also, there is no evidence of the combination of contamination type and hydraulic conditions at the Site that would carry contaminants downward through bedrock to deep wells, such as liquids that are heavier than water, including chlorinated solvents and coal tar.

2.6. Site Surface Water

The nearest major surface water feature downstream of the Site is the Atlantic Ocean. A concrete-lined drainage channel within Area 2 has an outlet to the ocean, but this drain only functions when it is raining or water is discharged to it and would not be a functional habitat for fish. Runoff from this drain could contain sediment, but the vegetation around the drain limits the erosion and sedimentation. Water is released to another concrete-lined spillway from the desalinization plant east of the southern side of Area 2; NPS understands this water has high concentrations of salt, both from the desalinization process and as a byproduct of disinfection, but salts are not CERCLA hazardous substances. A large rainwater catchment structure is east of Area 1, but the captured water is used by the Resort and the basin is dry in the dry season.

Water clarity is a primary value of VIIS. Caneel Bay and Honeymoon Bay have extremely popular white sand beaches, considered to be among the best in the world. These beaches are very popular for swimming and recreational use, year-round.

The national wetlands inventory shows one estuarine wetland area near Area 3, immediately west of the cleared landfill area (E2FO3P); however, that mapped wetland would be approximately 15 feet above the ocean and is not likely to be an estuarine system fed by tidewater, as classified.

The erosion channel along the southwestern edge of the landfill appears to be an ephemeral stream, which is dry except during rainfall. NPS did not observe evidence that the erosion channel discharges sediment directly to the ocean, although it is near a paved low water crossing that leads to the ocean. Now that the channel exists and erosion has started, there is increased risk that sediment from the landfill will enter the ocean at Honeymoon Beach during a hurricane or extreme rainstorm.

2.7. Local Climate

According to the National Oceanic and Atmospheric Administration (NOAA, 2016), normal monthly precipitation ranges between 1.5 and 6.8 inches. The driest months are February through March, and the wettest (with greater than 5 inches/month) are September through December. The average temperature highs and lows are between 73 and 90 degrees Fahrenheit.

2.8. Sensitive Environments

For National Priorities List (NPL) scoring purposes, all National Parks, including VIIS, are considered "sensitive environments." Numerous federally listed threatened or endangered species are present on St. John or in waters off St. John. According to a National Marine Fisheries Service letter dated October 10, 2012, to NPS, "listed sea turtle and coral species may occur" near Caneel Bay Resort (NPS, 2013). The Resort is not within mapped critical habitat for threatened and endangered species on the Fish & Wildlife Service's map viewer (U.S. Fish and Wildlife Service [US FWS], 2021). There is no evidence that the release of contaminants is impacting sensitive environments other than VIIS. As discussed in Section 2.6, however, there is an increasing chance of a release to the ocean at Honeymoon Beach during extreme weather events through the eroded channel at the landfill or if soil erodes into the drain channel in Area 2.

2.9. Previous Investigations and Response Actions

During the 2021 EE/CA field investigation, EHI/CBIA's representative on site reported that there are three leaking transformers (numbered 11, 22, and 23) at Caneel Bay Resort, and they are being addressed. One of the leaking transformers is within the IA-2-02 decision unit in Area 2. EHI/CBIA's representative reported that they were not PCB-containing transformers. NPS did not include the oily soil in the IA-2-02 soil samples, with the understanding that the transformers were not within the EE/CA field work scope and leaking oil will be remediated separately. NPS will require documentation from EHI/CBIA that all oily and/or PCB-contaminated soil associated with the transformers was removed and that no additional leaks have occurred.

NPS obtained one report documenting an emergency response action related to the 2010 diesel fuel release from an AST in Area 2 (ERTEC, 2010). ERTEC estimated that 1,000 gallons of diesel were released to shallow subsurface soil when a contractor accidentally pierced a buried fiberglass fuel line while installing an electrical grounding rod. ERTEC performed the emergency response and prepared the report on behalf of Chevron. During the response, ERTEC excavated 10 test pits and found diesel had migrated along the granular pipe and electrical utility line bedding, approximately 3 ft deep. The highest concentrations of diesel range petroleum hydrocarbons were in soil along the diesel fuel line toward the northwest and northeast, and along the electrical line trench to the northwest. NPS has reviewed documentation provided by DPNR to gather additional information regarding why evidence of petroleum remains in subsurface soils near this release. NPS currently considers the nature and extent of residual contamination in soil to be a data gap, and is planning additional investigation in this area.

2.9.1. Nature and Extent of Contaminants Controlled or Treated through Previous Cleanup Actions

ERTEC's response included removing an unspecified volume of soil from 10 test pits excavated to investigate the extent of contamination. Photographs from the ERTEC report show the soil encapsulated in plastic sheeting on a concrete pad beside the diesel AST. In 2012, ERTEC submitted to the USVI Department of Planning and Natural Resources (DPNR) a Quality Assurance Project Plan describing an additional test pit investigation to evaluate the extent of soil contamination (ERTEC, 2012). NPS reviewed additional information on this release from DPNR. According to the documentation provided, DPNR concluded in 2014 that no further action was needed to address the diesel release. No soil was present on the concrete pad at the time of the 2016 site visits by JCO and 3E Consultants. According to EHI/CBIA's representatives who were on site during the 2021 EE/CA field work, the soil was removed by Puma Energy, which acquired Chevron's USVI fuel marketing business in 2012. Based on observations made by NPS's contractors during the February 2021 field work in an area outside the limits of the fuel release investigation, NPS intends to conduct additional sampling to evaluate the presence of residual contamination in Area 2.

2.9.2. Treatability of Compounds

Polyencapsulation of petroleum-impacted soil is or has been allowed by some regulators as a remediation method that relies on biodegradation to reduce petroleum concentrations. With

monitoring, diesel compounds may degrade to concentrations below regulatory levels. The reports available for review from DPNR did not record whether soil concentrations were monitored, whether it was disposed of or reused, and what the diesel concentrations were when it was removed from the concrete pad.

2.9.3. Equipment/Utilities/Installations at the Site

No equipment or facilities were installed to treat the diesel release.

2.10. Data Summary

The 2021 EE/CA investigation was preceded by Level 1 Pre-Acquisition Environmental Site Assessment (ESA) Survey (Barksdale & Associates, 2012) and a Level 2 ESA (Barksdale & Associates, 2014). As described in the EE/CA Sampling and Analysis Plan (SAP), information from previous ESA reports was used to design the EE/CA investigation (VHB, 2021a). An RSE report in 2017 found that additional CERCLA action was necessary and recommended that NPS conduct a non-time-critical removal action (3E Consultants, 2017). The resulting action began with the EE/CA investigation as documented in the 2021 EE/CA Investigation Summary Report (VHB, 2021b; provided in Appendix B).

2.10.1. Data Summary – Level 1 and Level 2 ESA Reports

The Level 1 ESA identified recognized environmental conditions related to hazardous substances or petroleum at the Resort. Recognized environmental conditions were identified in the maintenance and engineering area, the landscaping and grounds maintenance area, the WWTP, the emergency generator building, the emergency generator fuel tanks, the marina, the former fuel storage tanks for the marina, and the landfill. No samples were collected during the Level I ESA. The marina and its fuel storage tanks, although part of the Resort, are not located on park property and therefore were not investigated further by NPS.

In the Level 2 ESA, NPS collected samples at locations where recognized environmental conditions had previously been identified to characterize their impacts to soil and groundwater, as appropriate. The following samples were collected in January 2014.

- Area 1: surface soil samples from near the WWTP; analyzed for metals, petroleum organics, PCBs, and PAHs.

- Area 2: surface soil samples from the stormwater runoff areas near the concrete, accumulated sediment in the paved drainage channel, chemical storage areas, near maintenance buildings; analyzed for metals, petroleum organics, PCBs, PAHs, organochlorine and organophosphorus pesticides, and herbicides. Subsurface soil samples were collected from the former UST footprint and a groundwater sample

from downgradient of the former UST, analyzed for metals, PAHs, and a short list of petroleum VOCs.

- Area 3: surface soil samples from the landfill; analyzed for metals, PCBs, PAHs, organochlorine and organophosphorus pesticides, and herbicides

The Level 2 ESA provided sufficient data to identify preliminary study constituents requiring additional evaluation in the EE/CA investigation. Findings from the 2014 investigation are summarized in Text Table 2.11.1.

2.10.2. Data Summary – EE/CA Investigation

VHB conducted an EE/CA investigation in February 2021 to assess the nature and extent of study constituents in surface soil, landfill contents/subsurface soil, and groundwater; support risk assessments; and evaluate the potential for other releases related to building materials and a reported UST. The EE/CA investigation focused on the media and study constituents listed in Text Table 2.10.1. The purpose of the field investigation was to provide sufficient data to complete an EE/CA for Areas 1, 2, and 3 of the Site. Additional information was collected regarding possible contamination outside the Site but within the Caneel Bay Resort property.

VHB compared analytical results to screening levels identified in the sampling and analysis plan (SAP) (VHB, 2021a). Because risk assessments were performed as part of the EE/CA, discussions of screening values are not required. The risk assessments use more site-specific information to draw conclusions about potential risks. Based on the investigation data and risk assessments, VHB concluded that the field investigation met the following data quality objectives:

- Decision Question 1: Has the distribution of study constituents across the Site been adequately delineated such that human health and ecological risks can be quantified?
    - The EE/CA investigation adequately delineated study constituent concentrations in surface soil in Areas 1, 2, and 3, and subsurface soil in Area 3. The risk assessment can be completed with these data.
- Decision Question 2: Are concentrations of study constituents present in Site surface soil posing an unacceptable potential for risk to human and/or ecological receptors? and Decision Question 3: Are concentrations of study constituents present in soil in the landfill posing an unacceptable potential for risk to human and/or ecological receptors?
    - The data collected in this EE/CA investigation will be used to assess risks from exposure to surface soil and subsurface soil in the landfill.

- Decision Question 4: Are concentrations of study constituents present in Site groundwater posing an unacceptable potential for risk to human and/or ecological receptors?

    - Information gathered during this investigation related to the lack of shallow groundwater at the Site will be considered in the risk assessment. Additional groundwater investigation will be conducted during the wet season.

    - Evidence for the presence of groundwater in unconsolidated soil during the fieldwork was not observed at boring locations or temporary piezometers. The possible presence of groundwater during other seasonal or environmental conditions is unknown. The potential for contamination of possible seasonal groundwater is also unknown.

- Decision Question 5: Do study constituent concentrations in Site soil exceed study constituent concentrations in reference/background soil samples?

    - Sufficient background soil samples were collected during the investigation to compare Site soil concentrations to background in the EE/CA report, with the exception of arsenic, which will be further investigated.

- Decision Question 6: Do study constituents in groundwater downgradient of potential source areas exceed screening levels?

    - Information gained during this investigation related to the usability of groundwater samples from MW-01 and the lack of shallow groundwater at the Site will be considered in the risk assessment.

    - Evidence for the presence of groundwater in unconsolidated soil during the fieldwork was not observed at boring locations or temporary piezometers. The possible presence of groundwater during other seasonal or environmental conditions is unknown. The potential for contamination of possible seasonal groundwater is also unknown. Additional groundwater investigation will be conducted.

- Decision Question 7: Are the study constituents detected in groundwater above screening levels related to a release on Site, or are they consistent with local background/reference concentrations?

    - Information gained during this investigation related to the lack of shallow groundwater at the Site indicated that local background groundwater

concentrations are not required to evaluate the Site. Additional groundwater investigation will be conducted.

- Decision Question 8: Is the soil in the landfill characterized as hazardous by chemical concentration?
    - Based on TCLP results of waste samples, the landfill material would not be considered a characteristic hazardous waste by toxicity for disposal purposes, although additional characterization would be necessary prior to disposal. It is possible some waste would be nonhazardous for disposal purposes and other waste would be hazardous.
- Decision Question 9: Is there evidence of a UST at Cottage 7?
    - Evidence of an historical UST at Cottage 7 was identified. Evidence of a currently existing UST was not identified; however, investigation was restricted by access limitations. Additional investigation will be conducted to evaluate the potential presence of a UST and related contamination,
- Decision Question 10: Is there visual evidence of ACM within and around Site structures at the Resort that may be impacting the environment?
    - Extensive evidence of possible ACM that is damaged, fragmented, or otherwise exposed to the environment was identified within and around Resort structures and scattered through many areas of the Resort.
- Decision Question 11: Is there evidence that known asbestos pipes are connected to an existing buried network?
    - The previously identified asbestos-cement pipe in the grounds and landscaping area appears to be connected to an existing piping network.
    - Seven similar pipes, possibly asbestos-cement, were identified at various locations around the Resort, suggesting widespread use of the pipes.
- Decision Question 12: Is there visual and/or analytical evidence of lead-based paint on and around Site structures that may be impacting the environment?
    - Painted surfaces that may contain lead-based paint and are peeling, chipping, or are otherwise exposed to the environment were observed on and around Resort structures. Painted debris was observed scattered through many areas of the Resort.

- Preliminary surface soil results show lead concentrations along building driplines over background concentrations at more than half of sample locations.

- Estimation Question 1: In the event potential response actions are necessary, what is the areal and vertical extent of the landfill at the Site?

  - This investigation collected sufficient evidence of the areal and vertical extents of the landfill to reasonably estimate its volume. The estimated volume of material between the ground surface and the maximum observed solid waste depth is 14,700 BCY. The estimated volume of underlying material from the maximum observed solid waste depth to boring refusal or presumed rock is 4,600 BCY.

Additional analysis of these data was performed in the risk assessments provided in Appendix C and summarized in Section 3.

2.11. Site Contaminants

In the 2021 field investigation, NPS created decision units (DUs) within sampling Areas. Each DU was designed to be approximately 0.25 acres or less, cover a surface area with similar soil types, and have no evident point sources of contamination. A DU is the smallest user-defined area for which a decision will be made (e.g., to cleanup or not cleanup) based on sampling. Environmental contamination by study constituents has been identified to varying degrees in Areas 1, 2, and 3. Certain study constituents were also identified during the 2021 field investigation in background or reference samples. Comparisons of study constituent concentrations within investigation areas to Site-specific background suggest whether their presence is attributable to Site-specific activities, background conditions, or a combination of both. Through preliminary assessment, the 2021 field investigation also identified the potential for environmental contamination from asbestos and lead-based paint in building materials, in other areas of the Resort. A summary of identified and potential Site contaminants follows. The attached EE/CA Tables 1 and 2 include the metals and pesticide results for each DU sampled in 2021.

Area 1

Surface Soil

The 2021 field investigation identified metals, pesticides, and PAH in surface soil in Area 1. Concentrations were relatively consistent throughout the Area 1 and were not indicative of significant localized sources or releases. Concentrations of certain metals (arsenic, barium, chromium, lead, mercury, nickel, thallium, and zinc), pesticides (DDT and DDE), and PAH (benzo(a)pyrene) were reported at concentrations exceeding the lowest screening levels (the Project Action Levels, or PALs) in at least one surface soil sample. Based on the background comparison discussed in Section 2.11.2, concentrations of metals (arsenic, cadmium, chromium, copper nickel, selenium, and zinc) and PAH (benzo(a)pyrene) exceeded Site-specific background

conditions in one or more DU. These elevated concentrations of metals and PAH may be related to historical use of Area 1 as a material and equipment storage area. A summary of Area 1 background comparisons and 95% UCL calculations is provided in EE/CA Table 3.

Area 2

Surface Soil

The 2021 field investigation identified metals, pesticides, and PAH in surface soil in Area 2. Concentrations of certain metals (antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, and zinc), pesticides (DDD, DDE, DDT, aldrin, chlordane, dieldrin), and PAH (benzo(a)pyrene) were reported at concentrations exceeding PALs in at least one surface soil sample. Based on the background comparison discussed in Section 2.11.2, concentrations of metals (antimony, arsenic, barium, cadmium, copper, lead, mercury, nickel, selenium, and zinc), pesticides (DDD, DDE, DDT, DDT-total, aldrin, dieldrin, and chlordane), and PAH (benzo(a)pyrene) exceeded Site-specific background conditions in one or more DUs. A summary of Area 2 background comparisons and 95% UCL calculations is provided in EE/CA Table 3.

Concentrations of study constituents, particularly pesticides, were higher in the vicinity of the engineering and maintenance area (IA-2-01 and IA-2-02) as compared to the rest of Area 2 (IA-2-03, IA-2-04, and IA-2-05). Surface soil concentrations of pesticides in this area were 10 to 1,000 times higher, which indicates a possible connection to historical storage or a larger release in this area.

Subsurface Soil

Subsurface soil sampling was not conducted during the 2021 field investigation in Area 2. However, during drilling at proposed monitoring well locations, evidence of petroleum contamination in subsurface soil was discovered. VHB observed visual, olfactory, and VOC-field screening evidence of petroleum contamination at borings SC-2-03 and SC-3-05, approximately 10 feet to the northwest and 5 feet to the northeast, respectively, of the fuel dispenser in the emergency generator and AST area. At SC-2-03, evidence of petroleum contamination was observed from approximately 5 ft bgs to near boring refusal on rock at 13.2 ft bgs. At SC-2-05, evidence of petroleum contamination was observed from approximately 3.5 ft bgs to near boring refusal at 23 ft bgs. Further investigation would be required to characterize this contamination.

Groundwater

As discussed in Section 2.5.2, groundwater sampling during the 2021 field investigation was limited to existing well MW-01, where evidence suggests sampled water represents infiltrating surface runoff and not a larger groundwater aquifer. Concentrations of metals (arsenic, barium, cadmium, copper, lead, nickel, silver, and zinc) at MW-01 exceeded PALs. Comparisons to Site-specific background or downgradient conditions were not possible.

Area 3

Surface Soil

The 2021 field investigation identified metals, pesticides, and PAH in surface soil in Area 3. Concentrations were relatively consistent throughout Area 3 and may be related to disposal of these substances along with other non-hazardous wastes, soils, and compost. Certain metals (antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, thallium, and zinc), pesticides (DDD, DDE, DDT, aldrin, and dieldrin), and PAH (benzo(a)pyrene) were reported at concentrations exceeding PALs in at least one surface soil sample within Area 3. Based on the background comparison discussed in Section 2.11.2, concentrations of metals (antimony, arsenic, barium, cadmium, copper, lead, selenium, and zinc), pesticides (DDE and DDT), and PAH (benzo(a)pyrene) exceeded Site-specific background conditions in one or more DUs. These elevated concentrations of metals, pesticides, and PAH may be related to contamination from materials disposed at the landfill. A summary of Area 3 background comparisons and 95% UCL calculations is provided in EE/CA Table 3.

Subsurface Soil

The 2021 field investigation identified metals, PAH, VOCs, PCBs, and pesticides in subsurface soil (the landfill contents) in Area 3. Reported concentrations of PAH, VOCs, and PCBs were low and did not exceed any PALs. Concentrations of certain metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, thallium, zinc) and pesticides (DDD, DDE, and DDT) exceeded PALs in at least one subsurface sample. Based on the background comparison discussed in Section 2.11.2, the concentration distributions of metals (chromium, nickel, and thallium) and pesticides (DDE, DDD, and DDT) exceeded background conditions for the landfill soils. These elevated concentrations of metals and pesticides are relatively consistent among sample locations and are not indicative of localized sources or release areas within the landfill. A summary of subsurface soil background comparisons and 95% UCL calculations is provided in EE/CA Table 4.

Groundwater

Groundwater was not present in Area 3 during the 2021 field investigation. Possible dry seeps were observed along the southern landfill slope. During wet weather, infiltrating precipitation may leach contaminants from soil in the landfill and transport them to groundwater and/or the possible seeps. A monitoring well, MW-3-01, was installed within the landfill near the seeps to monitor for the presence of groundwater and sample if found.

Other Resort Areas

Potential Lead-Based Paint

The potential for environmental contamination due to lead-based paint on building materials in other areas of the Resort was evaluated during the 2021 field investigation. The investigation identified a variety of painted surfaces on buildings and scattered building debris with severely peeling or chipping paint exposed to the environment. Surface layers of paint generally appeared to be latex-based, but underlying layers of paint were observed in some areas.

Reported concentrations of lead in surface soil samples collected along building driplines ranged from 6.8 mg/kg to 280 mg/kg. At 11 of the 19 locations, concentrations exceeded the proposed Site-specific surface soil background concentration of 18.12 mg/kg. Further investigation is required to characterize this contamination.

Potential ACM

The 2021 field investigation also evaluated potential for environmental contamination due to asbestos in building materials in other areas of the Resort. The investigation identified a variety of possible ACM, including plaster, drywall, tile, grout, acoustic tile, tar paper, and pipes within and surrounding many structures. In many areas, these materials were observed damaged and exposed to the environment. Roofing debris, including tar paper with exposed possible ACM fibers, was observed scattered around many areas of the Resort. Evidence of possible ACM exposure to the environment was identified in the areas around the rooms at Turtle Bay Beach, the Turtle Bay Estate, and the Turtle Town Children's Center; the rooms at Hawksnest Beach, Scott Beach, Cottage Point, and Caneel Beach; the Beach Terrace Dining Room; the Tennis Pro Shop and Massage Center; the Equator Restaurant; the Courtside rooms; the Fitness Center; the Garden View rooms; and the gravel staging area. Sampling to confirm the presence of asbestos in building materials or evaluate potential contamination of environmental media was not performed. Further investigation is required to characterize this potential contamination.

2.11.1. Summary of 2014 and 2021 Site Contaminants

The 2014 Level 2 ESA results and 2021 EE/CA field investigation results for the study constituents are summarized in Text Table 2.11.1.

Text Table 2.11.1: Summary of Investigation Results: Study Constituents			
Contaminant	Media	Area	General Results
Metals			
RCRA 8 and 13 Priority Pollutant metals	Soil (surface, landfill contents)	All areas	Most of the sampled metals were present in multiple soil samples collected in 2014 and 2021. Lead was present in the MW-1 water sample in 2014, and several metals were present in the 2021 sample from the same well. Lead in soil collected from building and debris driplines in 2021 indicates the presence of lead-based paint at some buildings.
Toxicity Characteristic Leaching Procedure RCRA 8 metals	Soil (landfill contents)	Area 3	Landfill content samples collected in 2021 were not hazardous by toxicity.
Volatile Organic Compounds (VOCs)			
VOCs	Soil near ASTs	In Area 2 near the petroleum ASTs and fuel pump. In Area 3 in the landfill contents.	Soil removal actions were conducted in 2010 (and possibly later) at the AST and fuel pump area. Surface soil here did not exhibit signs of petroleum contamination in 2021, although surface soil downgradient of the pumps contained petroleum odors. The MW-1 water sample contained lower concentrations of benzene, ethylbenzene, toluene, and xylenes in 2021 than in 2014. No overburden groundwater was present in Area 2 or 3 in 2021. A monitoring well was installed in the landfill at Area 3 for possible sampling in the wet season.
PCBs			
PCBs	Soil (landfill contents)	Area 3	The Level 2 results and 2021 investigation indicated the presence of PCBs in the landfill, below PALs. Because PCBs generally sorb to soil and organic material, these samples cannot rule out the presence of higher concentrations elsewhere in the landfill. No groundwater samples could be collected in Area 3.
Semi-Volatile Organic Compounds (SVOCs)			
SVOCs – PAHs	Soil (surface, subsurface)	Area 2	The water sample from MW-1 contained lower PAH concentrations in 2021 than in 2014. PAHs may be present in petroleum-contaminated soils near the AST and fuel dispenser pump.

Text Table 2.11.1: Summary of Investigation Results: Study Constituents			
Contaminant	Media	Area	General Results
Pesticides			
Pesticides	Soil (surface, landfill contents)	Areas 2 and 3	Organochlorine pesticides were present in various soil samples collected during the Level 2 investigation. Concentrations of pesticides in Area 2 in 2021 were 10 times higher than those reported in 2014, but the sampling methods were more representative in 2021. In Area 3, the same pesticides (DDT-total, aldrin, and dieldrin) were detected in 2014 and 2021.
Asbestos			
Asbestos in soil	Soil	Area 3	Surface soil samples collected at the landfill in 2021 did not contain asbestos fibers at concentrations above 1%.
Asbestos in building materials	Building materials	Area 2 and throughout the Resort	Sampling in 2014 verified the presence of asbestos-containing pipe in Area 2, and a GPR survey in 2021 confirmed that a pipe network remains buried. A visual survey in 2021 identified potential asbestos-containing materials in building debris and inside and/or on intact buildings.

2.11.2. Background Concentrations

Some chemicals or minerals may be present in the background environment for reasons other than Site activities; these are typically described as "naturally occurring" (i.e., background) or "anthropogenic" (i.e., reference). Naturally occurring background substances are present due to natural processes and materials (e.g., metals that are part of the natural soil or rock composition, or, as measured in the Virgin Islands, constituents of windblown dust that reportedly originates on the African continent and is deposited on the islands), as discussed in Section 5.2.4. Anthropogenic substances are present due to larger, non-Site related, human activities (e.g., atmospheric fallout of PAHs from combustion). Some substances—such as metals included in the natural soil and in atmospheric fallout—may have both naturally occurring and anthropogenic contributions (USEPA, 2002).

During the 2021 field investigation, VHB collected surface soil samples from two background or reference DUs and subsurface soil samples from three background soil borings to characterize Site-specific soil conditions. The reference soil borings were shallower than planned, and two of the three were the same depth as surface soil samples. Therefore, the subsurface background samples are not used in this investigation. While characterization of background groundwater conditions was planned in the SAP, sampling was not performed as shallow groundwater was not found.

Surface Soil

Surface soil samples were collected by incremental sampling methodology (ISM) from two reference DUs (IA-REF-01 and IA-REF-02) using the same methodology used for other surface

soil DUs. IA-REF-01 is situated in a grassy area near the Resort entrance, between Areas 1 and 2. The DU is landscaped but separated from Site buildings and known Site activities. IA-REF-02 is situated to the east of and topographically above Area 3. The DU appeared to have been historically cleared and benched for possible access to power lines. Metals (arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc), PAHs (1-methylnaphthalene, 2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene), and pesticides (DDE, DDT, and dieldrin) were detected in at least one reference DU sample above method detection limits. Reported concentrations of metals (arsenic, barium, chromium, copper, lead, mercury, nickel, thallium, and zinc) and pesticides (DDE, DDT, and dieldrin) exceed PALs in at least one reference DU sample. Pesticides were detected in a single replicate at IA-REF-02, suggesting heterogeneous conditions and not a widespread presence.

To evaluate whether study constituent concentrations in a particular Area's DU significantly exceed background concentrations—and are therefore likely to be attributable to Site activities—DU results were compared to the combined results of IA-REF-01 and IA-REF-02. VHB performed statistical analyses (Welch's two-sample t-tests) to compare the DU concentration distributions to background distributions with confidence levels of 90% (α=0.1), in accordance with the SAP, USEPA guidance (USEPA, 2002), and Interstate Technology and Regulatory Council (ITRC) guidance (ITRC, 2020). Proposed background concentrations were defined as the combined reference DU mean plus a "significant difference" (S), which was defined in the SAP as a multiple of the background sample standard deviation. This multiple was determined by increasing its value from one until both reference DUs "passed" the statistical test—indicating they were within Site-specific background conditions. Where study constituents were not detected in reference DU samples, 50% of the laboratory reporting limit was substituted for the constituent concentration. Proposed background concentrations for study constituents that exceeded PALs in at least one sample are summarized in Text Table 2.11.2. An example background comparison calculation for DDT in surface soil is provided in EE/CA Table 5.

Text Table 2.11.2. Proposed Site-Specific Background/Reference Concentrations in Surface Soil			
Analyte Class	**Study Constituent**	**Proposed Background or Reference Surface Soil Concentration (mg/kg)**	**Detected in Surface Soil Reference Samples?**
Metals	Antimony	0.290	No
	Arsenic	2 (Additional sampling is needed)	Yes
	Barium	83.3	Yes
	Cadmium	0.182	Yes
	Chromium	44.5	Yes
	Copper	85	Yes
	Lead	18.1	Yes
	Mercury	0.08	Yes
	Nickel	19.8	Yes
	Selenium	0.34	Yes
	Thallium	0.192	Yes
	Zinc	56.6	Yes
Pesticides	DDD	0.014	No
	DDE	0.02	Yes
	DDT	0.014	Yes
	DDT-total (DDD+DDE+DDT)	0.049	Yes
	Aldrin	0.014	No
	Chlordane (technical)	0.142	No
PAH	Benzo(a)pyrene	0.008	No

2.12. Contaminant Fate and Transport

The study constituents can be divided into four general groups: metals, pesticides/PCBs, petroleum, and asbestos. The EE/CA investigation found that these contaminants primarily affect soil. As such, contaminant transport is relatively limited, but groundwater and surface water are also discussed in this section for a more thorough evaluation of the Site.

Soil

The most significant transport pathway for metals and pesticides/PCBs in soil is physical movement. Metals, pesticides, and PCBs tend to stick to soil. There are several ways they can be moved, some more likely than others:

- **Physical reworking and erosion.** Soil can be transported physically by people doing earthwork, or by water during extreme rainfall. There is little evidence of digging at Area 2, where the ground surface is at the same level as the surrounding buildings. In Area 3, more significant earthwork has occurred as materials and animals were buried or the surface was regraded. Severe rainstorms have created an eroded channel along the southeastern edge of the landfill, exposing soil. Metals, pesticides, and other study constituents may have been transported out of the landfill and down the channel. Some pesticides are volatile and will degrade once exposed to air. Other pesticides and metals will remain in soil and may become more mobile if the chemistry of the soil or water changes (i.e., if conditions become more or less acidic). Pesticides and some metals can be taken up by plants, so if those plants are cut and moved to other areas, the contaminants can travel with them. Because the landfill has been used for composting vegetation in the past, these plants were likely not disposed of at other parts of the Resort.
- **Dust.** Metals and pesticides sorbed to soil can be mobilized as wind-blown dust. For the most part in Areas 2 and 3, dense coverage of vegetation protects against wind dispersion. The gravel surface in Area 1 is more likely to be dusty.

Asbestos is a fiber that does not typically stick to soil. At the Resort, it appears to be present in building materials, including roofing paper, wallboard, plaster, and underground pipes. Asbestos can be released to the air when the materials it is in break down and become friable. If asbestos-containing material is in good condition and not friable, it does not present an immediate health risk. Many of the suspected asbestos-containing materials visible on the ground surface at the Resort have been there since the 2017 hurricanes. As these items decay, they are more likely to release asbestos to soil, where it can become dispersed by wind and water. Asbestos-containing pipes buried in the ground do not appear to have significantly decayed and become friable. They are more likely to be broken during earthwork.

The 2010 diesel release in Area 2 resulted in transport in granular soil used for pipe and electrical conduit bedding beneath the ground surface. The gasoline dispenser may also have contributed to petroleum contamination in soil. If the fuel dispenser continues to be used, there remains a possibility that additional contamination to soil will occur. Some diesel and gasoline components will sorb to soil, while others are more likely to move with water. It is harder for liquid petroleum to flow through fine-grained soil, like the silt and clay dominant at Area 2, than coarse grained soil like the sand and gravel used in pipe bedding and present naturally in some soil layers at Area 2. The lighter constituents of petroleum can evaporate and move upwards in soil, possibly posing a risk to indoor air if present immediately below a building with cracks or holes in the floor to allow vapors to enter. In fine-grained soil, however, petroleum contaminants are likely to remain in soil below the ground surface at Area 2, slowly biodegrading with natural bacteria and oxygen. With little groundwater present to move contaminants below ground, and if there are no future releases of gasoline or diesel that can act as a carrier for the contaminants, the primary way for this contamination to be transported is if it is excavated. Because the petroleum odors were observed close to buried electrical lines, it is unlikely that the soil will be excavated unintentionally or without advance planning.

Groundwater

There was no evidence of groundwater during the field investigation, nor was there evidence in soil cores that groundwater is usually present above bedrock except for seeps at the landfill. During drilling, geologists look for signs of wet soil or mottled color that indicates where groundwater has been. In Area 2, no signs of groundwater were present above the bedrock, which varied from just a few feet to more than 22 feet bgs. When released to water, diesel and gasoline liquids follow the "path of least resistance." Therefore, since it has been reported that the diesel release followed the granular pipe bedding, it is unlikely that diesel or gasoline migrated down through bedrock into underlying aquifers used to supply water on St. John. Based on the properties of diesel and gasoline and the expectation that groundwater would flow to the west toward the ocean, no deep groundwater sources are likely to be affected by the diesel release.

At the landfill, there was evidence of groundwater flow in the form of dried, light-colored staining on the eroded side slope of the landfill. These stains indicate that rainwater percolates through the surface soil of the landfill until it encounters a less-permeable soil layer, which acts like a horizontal surface directing water to the side instead of down. The location where the water exits the landfill's side slope is a seep. Groundwater would then flow down the side of the eroded channel and follow the channel down the hill. In dry seasons, this water likely infiltrates back into the ground, evaporates, or is used by plants. In the wet season, it is more likely to eventually discharge to the ocean.

Surface water

The Area 3 landfill presents a threat to surface water, although existing impacts appear to be slight. As noted above, the channel near the southeast edge of the landfill can carry soil towards the ocean. Because metals and pesticides sorb to soil, they are relatively heavy particles that tend to settle out of slow-moving water, remaining in the channel instead of discharging to the ocean. Now that erosion has started, however, it is increasingly possible for more soil to be washed out of the landfill with each rainfall. If storms become more severe, as predicted, the amount of water moving in the channel will increase and erosion will worsen. Adding to this, the toe of the landfill slope is only approximately 2 feet above current water levels. As the sea level rises, erosion along the western side of the landfill will occur, and landfill contents will fall directly into the ocean. This could have severely detrimental effects on water clarity, which is a primary VIIS value. The contaminants in the landfill could also be harmful to marine life and habitat in the immediate area.

Although Area 2 is more than 1,000 feet from the ocean, it is beside a paved drainage channel that carries stormwater and releases from the laundry and desalinization plant. During storms, there is the potential for rainwater to wash away surface soil from Area 2 into the drainage channel. In the 2014 investigation, sediment in the drainage channel was sampled for several analytes, including pesticides. The results showed a reduction in pesticide concentrations along the length of the channel until the sample collected at the ocean discharge point did not have detectable pesticide concentrations. Because the paved surface of the channel is rough, there

are places where sediment accumulates. This accumulated sediment could be washed into Caneel Bay under extreme rainfall conditions.

2.12.1. Chemical and Physical Properties of Site Contaminants

Many study constituents were present in soil samples. As presented in Section 3, only some of these constituents pose an unacceptable risk to human health and the environment, and this section has been limited to discussing that group.

Arsenic and copper can be naturally occurring, but also have been sold as pesticides and fungicides, among other products. Based on the distribution of the results throughout the decision units, there is no evidence to indicate a concentrated release of arsenic or copper. Based on the concentrations of arsenic in soil, there is no evidence to indicate that it was used as a pesticide or herbicide. Because elevated concentrations of certain forms of arsenic can be very toxic, many studies have sought to evaluate what concentrations of arsenic are naturally occurring, and there is general agreement in the United States that arsenic is present naturally at concentrations greater than risk levels. This is reflected in state-specific cleanup levels that range from 6 mg/kg in California to 17 mg/kg in New Jersey, even though the RSL for arsenic is 0.39 mg/kg (Vosnakis *et al*, 2010). For this reason, it is important to have a technically sound site-specific background concentration for arsenic.

Other than sources related to smelting and mining, which did not occur at the Site, common products containing zinc include galvanized metal, fertilizers, and wood preservatives. The historical contents of the drums at DU-1-04 is unknown, but they may have included zinc-containing products. Zinc tends to adsorb to soil, particularly where the soil is not acidic (EPA, 1992a). Zinc is not volatile, so it does not evaporate. Therefore, the current concentrations likely represent the release, and migration in groundwater is not a significant concern.

Barium is also a naturally occurring metal often found in sedimentary rocks. Barium sulfate is often used as a white pigment in paint and barium carbonate is used as a rodenticide (ATSDR, 2007), and has more industrial uses—for example, in drilling mud—that would not be a source at the Resort. Barium sulfate and barium carbonate are "poorly soluble" in water, according to ATSDR (2007). Barium sulfate is used medically for taking x-rays of the digestive tract and is not toxic to humans, whereas barium carbonate dissolves in the stomach and is toxic, potentially causing kidney, nerve, and heart damage (ATSDR, 2007).

Organochlorine pesticides, including aldrin, technical chlordane, DDT-total, and dieldrin, are not naturally occurring. DDT was banned for use in the United States in 1972, although it continues to be used in some countries for mosquito control. DDD and DDE may be present as contaminants in commercial DDT preparations, although DDE was also previously used as for pest control (ATSDR, 2002a). If DDT is eaten, the body metabolizes it into parts that include DDD and DDE, so these are also known as DDT metabolites. DDT, DDD, and DDE adsorb strongly to soil, and have a half-life of 2 to 15 years, depending on the soil type (ATSDR, 2002a). In general, DDT and its metabolites have the greatest impacts on animals in the wild because of the food chain (e.g., a bird may eat several insects that are contaminated by the DDT the insects consumed in plants). DDT may cause cancer in humans if eaten, but it is still used around the world inside houses to control malaria (World Health Organization, 2011).

Aldrin and dieldrin, which are chemically similar, were used on food and cotton crops. They were banned in 1974 except to control termites, and the manufacturers voluntarily cancelled production in 1987. Aldrin and dieldrin are so chemically similar that sunlight and bacteria can convert aldrin into dieldrin, which is more commonly found in the environment (ATSDR, 2015). Aldrin and dieldrin readily adsorb to soil and sediment, but dieldrin will evaporate slowly in air, with a half-life in soils of about 5 years (ATSDR, 2002b). Aldrin and dieldrin can affect the nervous system and liver, and may cause cancer (ATSDR, 2002b).

Technical chlordane is a mixture of more than 140 related chemicals, and was used as pesticide in the United States from 1948 to 1978 generally on crops, lawns, and gardens, and then from 1983 to 1988 on homes to control termites (ATSDR, 2018). Technical chlordane does not dissolve in water and attaches strongly to soil; although it breaks down slowly, in surface soil it will evaporate to air (ATSDR, 2018). Breathing high concentrations or eating technical chlordane can result in damage to the liver and blood, neurotoxic effects (such as migraines, convulsions, and seizures), developmental delays, and possible cancer (ATSDR, 2018).

2.12.2. Physical Site Characteristics Affecting Contaminant Migration

As discussed in Section 2.12, the following physical Site characteristics affect contaminant migration:

- Vegetation in Area 2 reduces dust and erosion, but extreme rainfall and wind could result in contaminant transport to the paved drainage channel or in the air as dust. Removal or disturbance to vegetation would reduce this cover and increase exposures.

- The side walls of the landfill are made of organic material and soil and are prone to erosion from extreme weather events; this could result in movement of large volumes of soil from the landfill into the ocean, and some of this soil may be contaminated.

- Contaminants present in the landfill may be carried to the ground surface through groundwater and discharged at seeps.

- The dense, fine-grained soils at Area 2 slow the flow of petroleum contaminants in soil, but petroleum can travel along layers of coarser-grained materials.

- Groundwater is not present in the dry season and does not appear to be a significant transport mechanism for contaminants in the subsurface at Area 2.

- Potential asbestos-containing building materials on site are not protected from degradation or breakdown, which could result in future releases to air and soil.

2.12.3. Site-Specific Contaminant Transport

The following types of intermedia transfer of contamination are occurring or could occur at the Site:

- Surface soil contamination transport during extremely rainy or windy weather to other parts of the Resort or into the ocean. Soil erosion potential is highest along the landfill's southeastern edge where soil erosion and slope failure are ongoing (Area 3), but the drainage channel also provides a pathway to surface water for soil at Area 2.

- Buried contaminants may leave the landfill through seeps, where they are exposed to the environment.

- If fuel spills occur at the petroleum dispenser in the future, liquid petroleum can travel through soil with or without groundwater, following the path of least resistance, and can evaporate to contaminate soil vapor.

- Asbestos-containing materials currently physically bound in building materials can be released to air and soil as the materials degrade or are broken.

2.13. Current/Future Land Uses

The VIIS Foundation Document states, "Public Law 111-261, enacted in October 2010, authorizes the Secretary of the Interior to enter into a lease transaction with the present owners of the retained use estate for the Caneel Bay Resort" (NPS, 2016). Considering the severe damage from Hurricanes Irma and Maria, VIIS is assessing various future-use scenarios, with input from the public and EHI/CBIA. A return to resort operations remains possible. If that occurs, Area 1 is likely to remain a staging area for equipment and materials, and Area 2 is likely to continue as the base of operations for the maintenance, landscaping, emergency generator, and vehicle fueling services.

There are no prohibitions in the VIIS management plan or foundation document to prevent future residential occupancy of the Site. NPS understands that housing for resort employees and their families is contemplated to the north of Areas 1 and 2. Area 3 is adjacent to Honeymoon Beach, where EHI/CBIA operates the Bikinis on the Beach bar and grill. Guests are shuttled to the beach from the Resort entrance and there are signs to discourage guests from walking back along the road, but no physical barriers prevent guest access to Area 3. VIIS and EHI/CBIA have no current plans to develop Area 3, but there are also no plans to prevent access or to close the landfill.

2.14. Conceptual Site Model (CSM)

A CSM helps to tell the story of how a site was contaminated, what media were affected, where the contamination migrated (pathways), and who or what is or could be potentially harmed from the contamination (receptors). In addition, a CSM provides a framework for assessing risks from contaminants, developing remedial strategies, determining source-control requirements, and

identifying methods to address unacceptable risks. Based on the information provided in this report, NPS developed an updated CSM for the Site, shown in Figures 6a (Area 2) and 6b (Area 3).

As described in Sections 2.10 and 2.11 the Site investigation results indicate that Site media impacted by contaminants include surface soil and subsurface soil, and groundwater seeps along the southeastern edge of the landfill. Migration pathways include windborne dust, soil carried by surface water runoff, contaminated groundwater reaching the ground surface as seeps on the southeastern landfill edge, and failure of the landfill side slope leading to possible surface water contamination. The CSM illustrates the potential human receptors (resident, Resort or NPS worker, and construction worker) and the contaminated media to which each receptor may be exposed; the exposure assumptions, routes, and risks associated with receptors are discussed in Section 3 below.

3. Risk Assessment Summary

Risk assessments provide an estimation of the potential threat to human health and the environment posed by site contaminants. The results of the risk assessment are used to determine if potential risks are unacceptable and, if so, to inform the selection of appropriate cleanup levels and help focus the removal action.

3.1. Baseline HHRA

The Human Health Risk Assessment (HHRA) was completed by VHB's contracted partner, Woodard & Curran, Inc. according to EPA guidance (EPA, 1989). The site investigation data used for the risk assessment were collected in February 2021 and are summarized in the EE/CA Investigation Summary Report (Appendix B).

The HHRA includes the following components (described in detail in the Risk Assessment Report; Appendix C):

- Hazard identification
- Exposure assessment
- Toxicity assessment
- Risk characterization (including an uncertainty analysis)

3.1.1. Hazard Identification

NPS identified contaminants of potential concern (COPCs) by comparing maximum detected concentrations in each media to the lowest appropriate human health risk-based screening levels, which were established in the EE/CA Investigation SAP. This step used the US EPA Regional Screening Levels (RSLs; EPA, 2020) and the Virgin Islands UST Rules and Regulations Soil Cleanup Target Levels for soil (Virgin Islands Rules and Regulations, 2014), which only include petroleum constituents. Similar screening levels would be used for groundwater (as included in the EE/CA investigation report in Appendix B), but groundwater risks were not evaluated because it is not a current or likely future water supply, as discussed in Section 2.5.2.

With the exception of lead, EPA developed these screening levels based on a target excess lifetime cancer risk of 1 in 1 million (1E-06) and a target non-cancer hazard quotient (HQ) of 0.1 that are protective of a residential exposure scenario.

NPS assessed risk posed by COPCs for which the 95% UCL for ISM samples—or maximum for discrete samples—exceeded the RSL. COPCs in soil are summarized below.

- Area 1 (ISM): arsenic, thallium, and benzo(a)pyrene
- Area 2 (ISM): arsenic, 4,4-DDD, 4,4-DDE, DDT, aldrin, chlordane, dieldrin, and benzo(a)pyrene
- Area 3 (ISM): arsenic and benzo(a)pyrene
- Area 3 (Discrete): arsenic and thallium

3.1.2. Exposure Assessment

The risk assessment estimated current and future potential risk to different receptor populations. NPS evaluated the following human health exposures for people who may be exposed to soil:

- NPS Park/Resort Worker. Someone who works for the NPS or the Resort full-time and may potentially access any of the three Areas. This receptor is expected to perform routine maintenance, surveillance, and cleanup within the three Areas. This receptor is assumed to be at the Site five days per week, eight hours per day, for 50 weeks (i.e., 250 days/year), which is the USEPA default value (EPA, 2014), for a 10-year occupational tenure at the Resort (based on communications with NPS).
- Site Visitor. A visitor or tourist who may access the Site. Because a visitor would spend only a fraction of the time that a Worker would spend at the Site, the other scenarios are more likely to result in risk.
- Construction Worker. An individual who is expected to be involved in excavation-related activities in the three Areas. This receptor may be exposed to COPCs in surface soil in Areas 1, 2, and 3. Additionally, it is assumed that there is potential for this receptor to encounter COPCs in subsurface soil in Area 3. The construction worker is an adult involved in future construction activities for 250 days/year (five days per week for 50 weeks year), eight hours per day, over a one-year period, which reflects default EPA assumptions.
- Hypothetical Resident. Someone who lives on the Resort property and may be exposed to COPCs in surface soil in Areas 1, 2, and 3 during daily activities such as playing or gardening. The resident is assumed to live at the Site 24-hours per day, 350 days per year, for 26 years, which are EPA default values for a residential scenario.

Human receptor populations are outlined in the human health pathway receptor diagram (see Figure 1 in Appendix C); complete, incomplete, or not applicable pathways are identified.

Exposure parameters are related to human behaviors that define the rates, time, frequency, and duration of exposure. It is expected there will be differences in the exposure among different individuals within a given receptor population due to differences in the exposure parameters.

There may be a wide range of average daily exposures among different individuals of an exposed population. In accordance with HHRA guidance, NPS focused on exposures near the central portion of the range (e.g., mean, median) and on exposures near the upper end of the range (e.g., 95th percentile). These two exposure estimates are referred to as central tendency exposure and reasonable maximum exposure (RME), respectively.

The NCP indicates that site decisions should be based on the RME estimates of exposure and risk. NPS used standard default values for RME exposure parameters (EPA, 1993b; 2014) in the HHRA. When standard default values were not available, NPS determined RME exposure parameters based on other sources (e.g., EPA, 2008; 2011) and professional judgment. The exposure parameters used in the HHRA are provided in Appendix C.

Exposure areas are defined based on the receptor, exposure medium, and the type and frequency of activities (EPA, 1989). The exposure area is the geographical area in which a receptor is randomly exposed to the contaminated medium for the assumed exposure duration, which is based on the frequency of visits to Site area by each type of receptor.

Because risk assessments are based on chronic health effects, the most appropriate expression for the exposure point concentration (EPC) is the long-term average concentration within the exposure area. The EPA guidance states, "because of the uncertainty associated with estimating the true average concentration [of a contaminant] at a site, the 95-percent upper confidence limit of the arithmetic mean should be used" as the EPC (EPA, 1992b). The EPCs for each medium and each exposure area evaluated in the HHRA are presented in Appendix C.

Depending on the sampling technique (ISM or discrete), calculation of the 95% UCL was conducted using either the Interstate Technical and Regulatory Council (ITRC) online calculator (for ISM samples) or the USEPA Pro UCL software, Version 5.1 (for discrete samples).

The amount of a chemical ingested, inhaled, or absorbed through the skin is referred to as "intake" or "dose." The average daily dose (ADD) is the dose rate averaged over a pathway-specific period of exposure expressed as a daily dose on a per unit body weight basis. The calculated ADD for each receptor and each exposure pathway are provided in the HHRA in Appendix C.

3.1.3. Toxicity Assessment

The objective of a toxicity assessment is to describe the adverse health effects caused by a chemical and identify how these adverse effects relate to exposure concentration. In addition, the toxic effects of a chemical frequently depend on the route of exposure (oral, inhalation) and the duration of exposure (subchronic, chronic, or lifetime).

There are typically major differences in the time, course of action, and the shape of the dose-response curve for cancer and non-cancer effects. Therefore, the toxicity assessment separates the non-cancer effects of chemicals from the cancer effects.

The potential for non-cancer effects is estimated by comparing a calculated exposure to a reference dose (RfD) for oral exposures or a reference concentration (RfC) for inhalation exposures for each individual chemical. The RfD and RfC represent a daily exposure that is

designed to be protective of human health, even for sensitive individuals or subpopulations, over a lifetime of exposure.

For a given chemical, the dose or concentration that elicits no adverse effect when evaluating the most sensitive response in the most sensitive species is referred to as the "no observed adverse effect level" (NOAEL). The NOAEL is used to establish non-cancer toxicity values. The RfD and RfC represent a daily exposure level that is not expected to cause adverse, non-cancer health effects.

Cancer effects are evaluated based on the assumption that any level of exposure to a carcinogenic compound can cause an effect. The EPA extrapolated from observed laboratory animal data using a mathematical model known as the linear multistage model. This model plots a line back toward the origin, adjusting the background cancer rate in the control (unexposed) animal populations. For oral exposures, the cancer slope factor (CSF) is the 95% upper bound on the slope of the dose-response curve in the low dose region. It is communicated as risk of cancer per unit dose. For inhalation exposures, cancer risk is characterized by an inhalation unit risk (IUR) value, which represents the upper-bound excess lifetime cancer risk estimated to result from continuous lifetime exposure to a chemical at a concentration of 1 microgram per cubic meter in air.

Chemicals are classified as known, probable, or possible human carcinogens based on an EPA weight-of-evidence scheme in which chemicals are systematically evaluated for their ability to cause cancer in humans or laboratory animals with the following descriptors:

- Carcinogenic to humans
- Likely to be carcinogenic to humans
- Suggestive evidence of carcinogenic potential
- Inadequate information to assess carcinogenic potential
- Not likely to be carcinogenic to humans

The EPA Regional Screening Levels (RSLs) tables (EPA, 2020) provide the latest toxicity values and physical and chemical properties for individual chemicals. The RfDs, RfCs, CSFs, and IURs identified for each COPC are provided in Appendix C.

3.1.4. Risk Characterization

Risk characterization is the process of quantifying the significance of residual chemicals in the environment in terms of their potential to cause adverse health effects. The quantitative estimates are expressed in terms of a probability statement for the potential excess lifetime cancer risk and an HQ for the likelihood of adverse non-cancer health effects. When there are multiple COPCs that cause non-cancer effects, the cumulative hazard index (HI) is calculated as the sum of HQs.

The NCP describes a potentially acceptable range of lifetime excess cancer risk between 1E-06 and 1E-04 and expresses a preference for establishing the acceptable target cancer risk at or near the more protective end of this range. Similarly, non-cancer health effects generally should not exceed an HI of 1. NPS generally considers cancer risks exceeding 1E-06 or non-cancer risks exceeding an HI of 1 to be unacceptable, absent compelling site-specific factors that preclude achieving these levels of protection. Selection of a target risk level of 1E-05 may be justified based on considerations of background concentrations for naturally occurring COPCs (i.e., the calculated 1E-05 concentration of a contaminant of concern is circum-background). However, 1E-04 is considered a threshold for emergency response and not adequately protective as a target risk level for final response actions within units of the National Park System.

The general methodologies used for estimating cancer risks and non-cancer hazards are described in Appendix C.

Text Table 3.1.4 summarizes the risk results by exposure media for each receptor and indicates which receptor scenarios have potential excess cancer risks greater than 1E-06 or non-cancer HIs greater than 1.

Text Table 3.1.4 Human Health Risk Characterization

Human Receptor	Cancer Risk	HI	Risk Driver
Area 1			
Resident	8E-06	N/A (Less than 1)	Arsenic
Adult Park/Resort Worker	N/A (less than 1E-06)	N/A (Less than 1)	None
Construction Worker	N/A (less than 1E-06)	N/A (Less than 1)	None
Area 2			
Resident	8E-05	1.3	Arsenic, aldrin, dieldrin
Adult Park/Resort Worker	8E-06	N/A (Less than 1)	Dieldrin
Construction Worker	2E-06	N/A (Less than 1)	Dieldrin
Area 3			
Resident	4E-06	N/A (Less than 1)	Arsenic
Adult Park/Resort Worker	N/A (less than 1E-06)	N/A (Less than 1)	None
Construction Worker	N/A (less than 1E-06)	N/A (Less than 1)	None

In summary, the HHRA determined the following:

- Although certain COCs were detected in Area 1, arsenic was the only COC for which a potentially unacceptable risk was calculated.

- Area 2 contaminants exceed minimal unacceptable cancer risk levels for residents, park or Resort workers, and construction workers. Pesticides are the primary risk driver, but arsenic also contributes to unacceptable risk for a resident in Area 2. As explained in Section 3.1.2, this worker scenario assumes the staff member would work full time for 10 years solely in Area 2. The risk assessment also assumes these workers would regularly be exposed to small amounts of soil and dust from the DUs with the highest contaminant concentrations.

- A resident in Area 2 could be exposed to a non-cancer HI of 1.3 based on the detected concentrations of certain pesticides; however, this is approximately equivalent to 1, which indicates that adverse non-cancer effects from pesticides are not a significant concern.

- Area 3 contaminants exceed unacceptable risk levels only for a residential scenario. The risk driver is arsenic.

- If a staff member lives and works at the Resort, the increased risk of cancer for that staff member is equivalent to the value for a resident, not to the resident's value plus the worker's value. This is because the residential scenario assumes the person spends 24 hours per day in one Area.

3.1.5. Uncertainty Assessment

The following section summarizes the uncertainties inherent to each component of the HHRA process and how they may affect the quantitative risk estimates and conclusions of the risk analysis. Two types of uncertainty are addressed:

1. **Measurement uncertainty** refers to the usual variance that accompanies scientific measurements such as the uncertainties associated with sampling and measurement variability.
2. **Informational uncertainty** stems from assumptions related to estimates of exposure and chemical toxicity. For example, in the HHRA, to account for uncertainties in the development of exposure assumptions, conservative assumptions are made to ensure estimated risks protect sensitive subpopulations or the maximum exposed individuals, resulting in a bias toward overpredicting both cancer and non-cancer risks.

Appendix C describes the uncertainties and assumptions made in estimating exposures relevant to the HHRA for this Site, which are summarized below:

- Analytical Data: ISM sampling could potentially underestimate the risk by diluting out discrete areas of elevated concentrations, or overestimate Site risk by biasing sample

results to a single or a few localized areas of contamination. Based on the relatively small size of each DU, and the apparent localized area of contaminant impacts in surface soil, the potential for underestimating EPCs and risk is assumed to be relatively low.

- Selection of COPCs: Constituents that were below the conservative EPA Regional Screening Levels (RSLs), or constituents not detected in any medium, were not carried through the quantitative risk evaluation. Although these constituents are below the EPA RSLs and are not expected to appreciably contribute to the overall risk, exclusion of these constituents potentially underestimates the total risk from constituents detected at the Site; however, this low bias is not expected to significantly impact the conclusions of the risk assessment.

- Exposure Assessment: The recreational user scenario exposure assumptions were conservative and may overestimate risk.

- The landfill contents are a mixture of wastes, and contaminated materials may have been placed anywhere in the landfill. Contaminants that sorb to soil, including pesticides and PCBs, may be present at higher concentrations than the investigations have detected. The possible presence of contaminants at higher concentrations may underestimate risk.

3.2. Ecological Risk Assessment

The first step in the ecological risk assessment process is a screening level ecological risk assessment (SLERA), which identifies and documents conditions that do not warrant further evaluation. The goal is to eliminate further consideration of insignificant hazards while identifying contaminants whose concentrations are sufficiently high to potentially pose risks to ecological receptors. A SLERA is a simplified risk assessment that can be conducted with limited data where site-specific information is lacking and assumed values are used to evaluate potential exposure and effects (EPA, 1997). For a SLERA, it is important to reduce the chances of concluding there is no risk when in fact a risk exists. Thus, selected exposure and toxicity values and assumptions are consistently biased toward overestimating risk. The sites that might pose an ecological risk are promoted for further study, i.e., a SLERA is deliberately designed to be protective in nature, not predictive of effects.

The SLERA identifies contaminants of potential ecological concern (COPECs), based on a comparison of maximum concentrations to lowest ecological screening levels. The results of the COPEC selection are neither designed nor intended "to provide definitive estimates of actual risk or generate cleanup goals and, in general, are not based upon site-specific assumptions" (EPA, 2001).

An ecological risk assessment includes the following components (described in detail in the Refined SLERA report; Appendix C):

- Problem formulation
- Exposure and effects assessment
- Risk characterization (including an uncertainty analysis)

3.2.1. Problem Formulation

During the problem formulation, the goals, breadth, and focus of the ecological risk assessment are established through the selection and description of site-specific assessment and measurement endpoints. Measurement endpoints are quantifiable environmental or ecological characteristics that can be measured, interpreted, and related to the valued ecological components chosen as the assessment endpoints (USEPA, 1997).

Ecological receptors are generally defined by available habitat. Habitats and potential receptors for the Site are upland areas potentially providing for a variety of terrestrial receptors including plants, invertebrates, reptiles, birds, and mammals.

NPS outlined ecological receptors in the ecological pathway-receptor diagram (see Figure 2-1 in Appendix C), which identifies pathways as complete, incomplete, or not applicable.

Standard ecological receptors recommended for risk assessment by EPA, such as the woodcock and short-tailed shrew, do not occur on St. John. NPS selected the following species to represent the ecological receptors at the Site:

- Plants: standard EPA values for plants
- Invertebrates: standard EPA values for invertebrates
- Avian invertivore bird: pearly-eyed thrasher (*Margarops fuscatus)*, whose diet consists primarily of large insects such as beetles, crickets, and other invertebrates, which it scavenges by probing into soil and leaf litter
- Mammalian herbivore: Jamaican fruit-eating bat, which eats fruit as well as other parts of plants, including leaves, nectar, and pollen

Two federally listed endangered species of plants, the St. Thomas prickly-ash (*Zanthoxylum thomasianum*) and Thomas' lidflower (*Calyptranthes thomasiana*), occur within the Park.

The bird and bat foraging ranges are expected to be larger than each of the Areas, which are all smaller than 1.5 acres. The risk assessment, however, assumes that the birds and bats spend all their time foraging at the Site, which is a conservative assumption.

The selected assessment and measurement endpoints for each ecological receptor type are described in Appendix C.

3.2.2. SLERA

Exposure and Effects Assessment

The 2021 EE/CA investigation characterized soil in Areas 1, 2, and 3 that may represent complete exposure pathways for ecological receptors. Typically, a risk assessment evaluates groundwater for its potential to affect surface water, where ecological receptors can be exposed to contaminants. At this Site, however, no groundwater was observed in any soil cores, nor was surface water observed at the Site Areas, except for the ocean near Area 3. Evidence of former seeps (e.g., groundwater discharge) was present along the southeastern edge of the landfill's eroded edge, and NPS collected soil samples to evaluate if contaminants were mobilized from the landfill and deposited on the surface soil on the side or bottom of the channel.

In the SLERA, COPECs are determined by comparing the maximum concentrations of contaminants in environmental media (e.g., water and soil) to corresponding medium-specific ecological screening values (ESVs) as provided in the *NPS Protocol for the Selection and Use of Ecological Screening Values for Non-Radiological Analytes* (NPS, 2018). The COPEC Selection ESVs, which are the lowest ESVs across multiple NPS-approved toxicity value sources, are used to identify COPECs.

Because of the conservative nature of ESVs and to reflect exposure assumptions more representative of future Site use scenarios, NPS further evaluated potential ecological risk by comparing maximum concentrations to the Refined SLERA ESVs in the NPS Protocol (NPS, 2018). This evaluation was performed to better refine the list of chemicals that have the potential to pose unacceptable ecological risks and thus warrant further evaluation. The evaluation identified the potential COPECs in soil listed in Text Table 3.2.2.

Text Table 3.2.2 Potential COPECs for Soil				
Receptor	**COPEC Type**	**Area 1**	**Area 2**	**Area 3**
Plants	*Metals*	Copper Thallium	Barium Copper Zinc	Copper
	Pesticides		DDT-total Aldrin Chlordane (technical)	Aldrin
Invertebrates	*Metals*	Copper Zinc	Copper Mercury Zinc	Copper Mercury
	Pesticides		DDT-total Chlordane (technical) Cis-Chlordane Dieldrin Endosulfan I Endosulfan II Endosulfan sulfate Trans-Chlordane	DDT-total Dieldrin
Birds	*Metals*	Chromium Copper Lead Mercury Zinc	Antimony (no ESV) Chromium Copper Lead Mercury Zinc	Antimony (no ESV) Cadmium Copper Lead Mercury Zinc
	Pesticides		DDT-total Chlordane (technical) Dieldrin	DDT-total
Mammals	*Metals*	Chromium Copper Zinc	Cadmium Chromium Copper Zinc	Antimony Cadmium Copper Zinc
	Pesticides		DDT-total Aldrin Chlordane (technical) Dieldrin	DDT-total Dieldrin

Ecological screening values are generally calculated from toxicology studies. No observable effect levels (NOELs) are chemical-specific soil concentrations at or below which effects are unlikely or not observed. Lowest observed effect levels (LOELs) typically are the lowest test concentration in toxicological studies where statistically significant adverse effects are documented. The actual concentration where effects begin lies somewhere between the NOEL

and the LOEL. For this study, plant and invertebrate values from EPA studies provided LOEL values, as described in Appendix C. For birds and mammals, NPS developed LOEL values using EPA food-chain models for the pearly-eyed thrasher and Jamaican fruit-eating bat, respectively, coupled with effect-based Toxicity Reference Values obtained from the EPA soil screening level (SSL) dataset.

NPS calculated Refined SSLs midway (i.e., the average) between the SLERA ESV (the NOEL) and the LOEL; these concentrations in soil conservatively represent levels below the LOEL where the onset of effects may occur. Site soil concentrations are then screened against Refined SSLs in the same manner they are with ESVs in the SLERA.

Risk Characterization

The final component of the Refined Analysis was the refined risk characterization. In this step, the exposure point concentration (i.e., the 95% UCL concentration at each DU) for potential COPECs in each DU are compared to Refined SSLs, with the result quantified as a Refined SSL hazard quotient, or RSSL-HQ.

RSSL-HQs are calculated by dividing the estimated environmental concentration by a toxicity benchmark for each receptor.

$$\text{RSSL HQ} = \text{EPC} / \text{Refined SSL}$$

If the RSSL-HQ is less than or equal to 1, harmful effects are not likely, and the exposure pathway can be eliminated from further evaluation. If the RSSL-HQ is greater than 1, that contaminant is a COPEC.

Based on the SLERA Refinement, NPS identified the following COPECs: barium, copper, zinc, DDT-total, and aldrin.

Areas 1 and 3 show no or low exceedances of Refined SSLs in most DUs, with exceedances consisting primarily of copper and zinc, which had a maximum RSSL-HQ of 1.4 (due to uncertainty, this value may be rounded to the nearest whole number, which is 1). In addition, one DU in Area 3 also had DDT-total over the Refined SSL, producing an RSSL-HQ 1.9 in IA-3-02. This value suggests a potential for risk to birds from DDT and metabolites in Area 3.

Area 2 has the highest number of COPECs and the highest RSSL-HQs across all receptors. With one exception, all exceedances were in DUs IA-2-01 or IA-2-02 and produced the highest RSSL-HQs for pesticides. In these two Area 2 DUs, elevated RSSL-HQs were obtained for all receptors: 11.4 for aldrin effects to plants, 41 for DDT and metabolites effects to invertebrates, 84.7 and 164.3 for effects to birds from DDT and metabolites and dieldrin, respectively, and 55 for dieldrin effects on mammals. No exceedances occurred in IA-2-03 or IA-2-05, and only aldrin slightly exceeded the Refined SSL for plants in IA-2-04, producing an RSSL-HQ of 1.2. These results suggest that a significant potential for risk may exist to all receptors in IA-2-01 or IA-2-02, primarily from dieldrin, aldrin, and DDT-total, for individuals that forage preferentially in those DUs. Because HQs in these two DUs at Area 2 were significantly above 1, NPS will not perform a baseline ecological risk assessment (BERA) to further evaluate toxicity.

3.2.3. Uncertainty Assessment

A summary of the uncertainties inherent to each component of the ecological risk assessment process and how they may affect the quantitative risk estimates and conclusions of the risk analysis is provided here. Details of the specific uncertainties and assumptions made in the ecological risk assessment for this Site are described in Appendix C. The list below represents a summary of the uncertainties and assumptions made.

- Ecological risk assessments must estimate or infer information about receptors, exposures, and toxicity to reach a conclusion about potential effects at both the individual and population level. While such assumptions do not negate the conclusions of the assessment, they influence how the conclusions are used when making risk-management decisions.

- Numerous assumptions underlie data collection, data evaluation, risk analysis, and risk characterization. These assumptions, and their tendency to lead to either an underestimation or overestimation of risk, are summarized in Appendix C Table 3.9.

- The assumption that birds and bats feed exclusively in individual areas, which are a maximum of 1.5 acres, is conservative.

- The evaluation of uncertainty shows that the cumulative effect of the assumptions adds a level of conservatism consistent with the literature-based approach of this process.

3.2.4. BERA

This Section is not applicable because no BERA was conducted. NPS has used the refined-SLERA approach to evaluate potential risks to ecological receptors.

4. Identification and Analysis of ARARs

ARARs are any applicable or relevant and appropriate standard, requirement, criteria, or limitation under any federal environmental law or any standard, requirement, criteria, or limitation under a state law[1] more stringent than the federal (CERCLA Section 121 (d)(2)(A)).

The identification of ARARs is the prerequisite to selecting a cleanup action (EPA, 1992c). "Under circumstances where a non-time-critical removal action is expected to be the first and final action at the site, the selected removal action must satisfy all adopted ARARs" (USDOI, 2016).

Other factors to be considered (TBCs) are non-promulgated criteria, advisories, guidance, and proposed standards issued by federal or state governments. TBCs are not enforceable but may be appropriate to consider in certain circumstances—for example, where there are no ARARs that identify protective goals.

There are four basic criteria that define ARARs (NPS, 2015b; EPA, 1988). ARARs are (1) substantive rather than administrative, (2) applicable or relevant and appropriate, (3) promulgated state requirements that are more stringent than comparable federal standards, and (4) categorized as one of the following:

- Chemical-specific: ARARs that define health- or risk-based numerical values that represent cleanup standards or processes that are used to establish numerical values for specific hazardous substances, pollutants, or contaminants. Chemical-specific ARARs often drive the magnitude and extent of the removal action.

- Location-specific: ARARs that restrict (1) the concentrations of hazardous substances, pollutants, or contaminants (e.g., Resource Conservation and Recovery Act [RCRA] land disposal restrictions prohibiting disposal of hazardous waste into landfills) or (2) the conduct of activities in sensitive areas (e.g., floodplains, wetlands, and locations where endangered species or historically significant cultural resources are present). Location-specific ARARs often focus on protecting resources in a specific area, therefore, NPS-specific ARARs fall within this category.

- Action-specific: ARARs that are technology- or activity-based requirements or limitations on actions conducted relative to specific hazardous substances, pollutants, or contaminants (i.e., restrictions on specific removal action alternatives or how those alternatives are implemented). Action-specific ARARs do not determine the removal

[1] For purposes of CERCLA, the term "State" is defined to include ". . . the United States Virgin Islands . . and any other territory or possession over which the United States has jurisdiction." 42 U.S.C. § 9601(27).

action alternative, rather they indicate how a selected alternative must be implemented.

Pursuant to its delegated CERCLA lead agency authority, NPS has identified ARARs and TBCs for the Caneel Bay Resort EE/CA. NPS has also requested that the Virgin Islands Department of Planning and Natural Resources identify state (Virgin Islands) ARARs. This request remains outstanding. The results of the ARARs analysis, including state (Virgin Islands) ARARs, specific to the Site are summarized in the following Text Tables 4.1, 4.2, and 4.3. Some other standards, requirements, criteria, or limitations were evaluated but not used because Site conditions are different from the conditions described (e.g., wetland regulations were not used because there are no wetlands in the Site); these are listed in the attached EE/CA Table 6.

4.1. Chemical-Specific ARARs

Text Table 4.1 Chemical-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**ARARs or TBC?**	**Comment**
ARARs				
Federal Ambient Water Quality Criteria	Clean Water Act 33 USC § 1314, 40 CFR Part 131	Sets criteria for water quality based on toxicity to aquatic organisms and humans	Applicable	Considered in risk assessments
National Primary Drinking Water Regulations Maximum Contaminant Levels (MCLs)	Safe Drinking Water Act 42 USC §§ 300f et seq. 40 CFR Part 141	Human health-based standards, MCLs for public water systems	Relevant and appropriate for development of removal action goals (RGs) and response options for contaminants that affect groundwater. Deep groundwater and surface water are potential drinking water sources.	Shallow groundwater is not a viable drinking water source because it is absent during the dry season. Surface water is collected from the ocean beside the Site but is treated at a desalinization plant before use.
Toxic Substances Control Act (TSCA)	15 USC §§ 2601 et seq. 40 CFR Part 761 Subpart D	TSCA and its implementing regulations address polychlorinated biphenyl (PCB) remediation, soil disposal, and capping.	Applicable. However, PCBs have not been identified as COCs or Contaminants of Ecological Concern (CECs) at the Site based on analytical data.	Although PCBs were not identified as COCs or CECs, the investigations detected PCBs below action levels.

Text Table 4.1 Chemical-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**ARARs or TBC?**	**Comment**
Amended Virgin Islands Water Quality Management Program Water Quality Standards	Rules and Regulations Title 12, Chapter 7, Subchapter 186	Sets criteria for domestic and industrial water supply and for the use of fish and aquatic life and for recreational use	Applicable to surface water and groundwater. Tables I and II provide numeric criteria for freshwater and saltwater.	Considered in risk assessments
TBCs				
NPS Protocol for the Selection and Use of ESVs for Non-Radiological Analytes	NPS, updated November 2018	Guidance on selecting ESVs for water, sediment, and soil.	TBC	Considered in risk assessments

4.2. Location-Specific ARARs

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort

Standard, Requirement, Criteria, or Limitation	Citation	Requirement Description	Applicable or Relevant and Appropriate or TBC?	Comment
NPS mandate to ensure the non-impairment of national park resources for the enjoyment of future generations and the non-derogation of NPS values and purposes	NPS Organic Act of 1916, as amended 54 USC §100101(a), *et seq.* General Authorities Act, as amended 54 USC §100101(b)	The NPS Organic Act, as recently recodified and modified in Title 54, directs the NPS "to promote and regulate the use of . . . national parks . . . by such means and measures as conform to the fundamental purpose of the said parks . . . which purpose is to conserve the scenery, natural and historic objects, and wild life in the System units and to provide for the enjoyment of the scenery, natural and historic objects, and wild life in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The General Authorities Act, as recently recodified and modified in Title 54, further provides that "the protection, management, and administration of the System units shall be conducted in light of the high public value and integrity of the System and shall not be exercised in derogation of the values and purposes for which the System units have been	Applicable to all NPS decisions and Site activities that may impact park resources and values	

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
		established, except as directly and specifically provided by Congress."		
NPS policy on implementation of the non-impairment mandate	2006 NPS Management Policies (MP), §1.4	**NPS MP §1.4.5**: "The impairment that is prohibited . . . is an impact that . . . would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact, the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts. . . . An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is: necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; or key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or identified in the park's general management plan or other relevant NPS planning documents	TBC	

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
		as being of significance. . . . An impact would be less likely to constitute an impairment if it is an unavoidable result of an action necessary to preserve or restore the integrity of park resources or values and it cannot be further mitigated." **NPS MP §1.4.3**: "The fundamental purpose of all parks also includes providing for the enjoyment of park resources and values by the people of the United States. The enjoyment that is contemplated by the statute is broad; it is the enjoyment of all the people of the United States and includes enjoyment both by people who visit parks and by those who appreciate them from afar. It also includes deriving benefit (including scientific knowledge) and inspiration from parks . . . ." **NPS MP §1.4.6** describes the 'park resources and values' subject to non-impairment. **NPS MP §1.4.7** provides that "before approving a proposed action that could lead to an impairment of park resources and values, an NPS decision-maker must consider the impacts of the proposed action and determine, in writing, that the activity will not		

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
		lead to an impairment of park resources and values. If there would be an impairment, the action must not be approved."		
VIIS Establishing Legislation	16 USC § 398a-f	The VIIS legislation protects customary uses or access for bathing and fishing subject to regulations for protection of natural conditions and prevention of damage to marine life and formations.	Applicable	
NPS restrictions of public use and recreation activities to protect national park resources	36 CFR §§ 2.1(a), 2.2(a)(1), 2.12(a), 2.14(a), 2.31(a)(3), 2.31(a)(5) 36 CFR Part 7: Special Regulations, Areas of the National Park System	These regulations authorize and prohibit certain activities by third parties within units of the National Park System. Introducing wildlife or plants into a park area ecosystem, damaging property, obstructing public passages, and polluting or contaminating park area water or water courses are prohibited. The NPS 36 CFR Part 7 regulations are Park-specific public use and recreational rules.	Applicable to on-site response activities that may impact park resources or otherwise entail a restricted or prohibited activity, and response actions should comply with these restrictions to the greatest extent practicable.	
NPS restrictions of commercial and private operations in national parks, including the	36 CFR Part 5: Commercial and Private Operations 36 CFR §5.13 (nuisances)	NPS restrictions of commercial and private operations in national parks, including the prohibition of nuisances	Applicable to on-site activities that may create a nuisance or that may involve commercial or private use of a park unit	

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
prohibition of nuisances		36 CFR §5.13 prohibits the creation or maintenance of a nuisance upon federal or private lands within a park area.		
Solid Waste Disposal Sites in Units of the National Park System	Federal statute 54 USC 100903 NPS implementing regulations, 36 CFR Part 6	The federal statute 54 USC 100903 prohibits operation of any solid waste disposal site that was not in operation on September 1, 1984, except for sites used only for disposal of wastes generated within the park unit, so long as such site will not degrade any natural or cultural resources of the park unit. The NPS regulations implementing 54 USC 100903 are codified at 36 CFR Part 6. Among other things, the regulations prohibit the operation of any solid waste disposal site, except as specifically provided for in the regulations. 36 CFR § 6.4 specifies 12 conditions that must be met before a new solid waste disposal site may be authorized in a National Park, including the condition that there will be no disposal at the site of solid waste containing	Applicable to creation and operation of solid waste disposal sites within park unit boundaries.	

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
		hazardous waste, polychlorinated biphenyls (PCBs), or radioactive materials.		
National Historic Preservation Act	16 USC §§ 470 *et seq.*, 36 CFR Part 800 54 USC §§ 306101 – 306131	The statute and its implementing regulations require federal agencies to consider the effect of any federally assisted undertaking on any district, site building, structure, or object that is included in, or is eligible for, the National Register of Historic Places and to minimize or mitigate reasonably unavoidable effects. Indian cultural and historical resources must be evaluated, and effects avoided, minimized, or mitigated.	Applicable; the Site may contain historically significant objects.	
Historic Sites, Buildings, and Antiquities Act	16 USC §§ 461 *et seq*. 54 USC § 320102(g)	Requires federal agencies to consider the existence and location of historic or prehistoric sites, buildings, objects, and properties of national historical or archaeological significance when evaluating response action alternatives.	Applicable to Site response activities involving soil disturbance that could impact areas of historical or archaeological significance	
Archaeological and Historic Preservation Act	16 USC §§ 469 *et seq*. 54 USC §§ 312502 – 312503	Establishes requirements for evaluation and preservation of historical and archaeological data, including Indian cultural and historic data, which may be destroyed through alteration of terrain as a result of federal construction	Applicable to Site response activities involving soil disturbance that could result in the discovery of archeological or historical resources	

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
		projects, *inter alia*. If eligible scientific, prehistorical, or archaeological data are discovered during site activities, such data must be preserved in accordance with these requirements.		
Archaeological Resources Protection Act	16 USC §§ 470aa-ii *et seq*., 43 CFR §§ 7.1 *et seq*. 16 USC §§ 470ee(a) 43 CFR §§ 7.4(a), 7.5, 7.8, 7.9, 7.33	Provides for the protection of archeological resources located on public and tribal lands. Establishes criteria that must be met for the land manager's approval of any excavation or removal of archaeological resources if a proposed activity involves soil disturbances.	Applicable to Site response activities involving soil disturbance that could result in the discovery of archeological resources	
Native American Graves Protection and Repatriation Act	25 USC § 3001; 25 USC § 3002(d); 43 CFR §§ 10.1 – 10.17 43 CFR §§ 10.3(b), 10.4 – 10.6	Provides for the disposition of Native American remains and objects inadvertently discovered on federal or tribal lands after November 1990. If the response activities result in the discovery of Native American human remains or related objects, the activity must stop while the head of the federal land management agency (in this case, NPS) and appropriate Indian tribes are notified of the discovery. After the discovery, the response activity must cease, and a reasonable effort must be made to protect the Native American human remains or related objects. The	Applicable to the discovery of Native American remains and objects during response action activities	

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
		response activity may later resume (43 CFR Section 10.4).		
TBCs				
NPS policy on implementation of the non-impairment mandate	2006 NPS Management Policies (MP), §1.4	NPS MP §1.4.5: "The impairment that is prohibited . . . is an impact that . . . would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact, the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts. . . An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is: necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; or key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or identified in the park's general management plan or other relevant NPS planning documents as being of significance . . . An impact would be less likely to constitute an impairment if it is an	TBC for guidance on the implementation of the non-impairment mandate as set forth in the NPS Organic Act	

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
		unavoidable result of an action necessary to preserve or restore the integrity of park resources or values and it cannot be further mitigated." NPS MP §1.4.3: "The fundamental purpose of all parks also includes providing for the enjoyment of park resources and values by the people of the United States. The enjoyment that is contemplated by the statute is broad; it is the enjoyment of all the people of the United States and includes enjoyment both by people who visit parks and by those who appreciate them from afar. It also includes deriving benefit (including scientific knowledge) and inspiration from parks . . ." NPS MP §1.4.6 describes the "park resources and values" subject to non-impairment. NPS MP §1.4.7 provides that "before approving a proposed action that could lead to an impairment of park resources and values, an NPS decision-maker must consider the impacts of the proposed action and determine, in writing, that the activity will not lead to an impairment of park resources and values. If there would be an impairment, the action must not be approved."		

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
EPA, Office of the Federal Environmental Executive; Guidance for Presidential Memorandum on Environmentally and Economically Beneficial Landscape Practices on Federal Landscaped Grounds	60 Federal Register 40837 (August 10, 1995)	Provides a framework for the use of environmentally and economically beneficial landscape practices on managed federal lands and federally funded projects	TBC in developing remedial alternatives and selecting a remedial action	
NPS Management Policies 2006	Available at: http://www.nps.gov/policy/mp2006.pdf	The 2006 NPS MP articulate NPS policies concerning management all the resources and values in the National Park System, including natural and cultural resources, restoration of natural systems, wildlife and biota, and wilderness areas. The potentially relevant MPs are listed below.	TBC in developing remedial alternatives and selecting a remedial action	
NPS Policies for Restoration of Natural Systems	2006 NPS MP §4.1.5	Section 4.1.5 provides: "The Service will reestablish natural functions and processes in parks unless otherwise directed by Congress.	TBC	

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Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
		Landscapes disturbed by natural phenomena, such as landslides, earthquakes, floods, hurricanes, tornadoes, and fires, will be allowed to recover naturally unless manipulation is necessary to protect other park resources, developments, or employee and public safety. Impacts on natural systems resulting from human disturbances include the introduction of exotic species; the contamination of air, water, and soil; changes to hydrologic patterns and sediment transport; the acceleration of erosion and sedimentation; and the disruption of natural processes. The Service will seek to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated. The Service will use the best available technology, within available resources, to restore the biological and physical components of these systems, accelerating both their recovery and the recovery of the landscape and biological community structure and function."		

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
NPS Policies for Managing Wildlife and Plant Resources	2006 NPS MP §4.4.1	Section 4.4.1 provides that the NPS "…will maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems…" by "….preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur; restoring native plant and animal populations in parks when they have been extirpated by past human-caused actions; and minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them."	TBC	
NPS Policies for Managing Species of Special Concern	2006 NPS MP §4.4.2.3	Section 4.4.2.3 requires that the NPS "…inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible." The NPS is also required to "…inventory other native species that are of special management concern to parks (such as rare, declining, sensitive, or	TBC	

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
		unique species and their habitats) and manage them to maintain their natural distribution and abundance."		
NPS Policies Concerning Surface Water and Ground Water Quality	2006 NPS MP §4.6.3	Section 4.6.3 states that NPS will, inter alia, "take all necessary actions to maintain or restore the quality of surface waters and groundwaters within the parks consistent with the Clean Water Act and all other applicable federal, state, and local laws and regulations."	TBC	
NPS Policies for Importation of Soil During Site Restoration	2006 NPS MP §4.8.2.4	Section 4.8.2.4 allows importation of off-site soil or soil amendments to restore damaged sites. It provides that "off-site soil normally will be salvaged soil, not soil removed from pristine sites, unless the use of pristine site soil can be achieved without causing any overall ecosystem impairment. Before using any off-site materials, parks must develop a prescription and select the materials that will be needed to restore the physical, chemical, and biological characteristics of original native soils without introducing exotic species."	TBC	

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Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
NPS Policies for Managing Cultural Resources	2006 NPS MP §5f	Section 5f addresses research on cultural resources and traditional associated peoples; planning to ensure that management processes "integrate information about cultural resources and provide for consultation and collaboration with outside entities;" and preservation, protection, and the making available for public understanding of cultural resources.	TBC	
NPS Policies Concerning Revegetation and Landscaping	2006 NPS MP §9.1.3.2	Section 9.1.3.2 requires that, to the maximum extent possible, plantings selected for revegetation will consist of species that are native to the park, and that low water use practices should be employed. This provision also addresses use of fertilizers and other soil amendments.	TBC	
NPS Policies Concerning Waste Management and Contaminant Issues	2006 NPS MP §9.1.6	Section 9.1.6.1 (Waste Management) states that all disposal of solid waste on lands and waters within the boundaries of a park system unit must comply with the regulations in 36 CFR Part 6 (see above), and further states that NPS will "remove landfill operations and associated impacts from parks where feasible."	TBC	

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
		Section 9.1.6.2 (NPS Response to Contaminants) provides that NPS "will make every reasonable effort to prevent or minimize the release of contaminants on or that will affect NPS lands or resources, and . . . will take all necessary actions to control or minimize such releases when they occur." This section further provides that NPS "will identify, assess and take response actions as promptly as possible to address releases and threatened releases of contaminants into the environment." Contaminants are broadly defined to include "any substance that may pose a risk to NPS resources or is regulated or governed by statutes referenced in this subsection."		
NPS Policies Concerning Climate Change	NPS Policy Memorandum (PM) 15-01, "Addressing Climate Change and Natural Hazards" (Jan. 20, 2015) and accompanying Level 3 Handbook PM 12-02, "Applying NPS Management Policies in the	NPS PM 15-01 and its accompanying Handbook provide guidance on the design of facilities in national parks to incorporate impacts of climate change and natural hazards. PM 15-01 is the third "policy pillar" of the Service-wide climate change response, joining NPS PM 12-02 addressing the implications of climate change on the guiding principles of NPS natural	TBC	

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
	Context of Climate Change" (March 6, 2012) http://www.nps.gov/policy/MPandCC.pdf PM 14-02, "Climate Change and Stewardship of Cultural Resources" http://www.nps.gov/policy/PolMemos/PM-14-02.htm 2006 NPS MP §9.1.1.5	resource management, and NPS PM 14-02 providing guidance on the stewardship of cultural resources in relation to climate change. PM 15-01 references NPS MP Section 9.1.1.5, which directs NPS to "strive to site facilities where they will not be damaged or destroyed by natural physical processes" and discusses siting considerations in areas where dynamic natural processes cannot be avoided.		
NPS Employee Guidance for Managing Cultural Resources	NPS DO #28: Cultural Resource Management NPS-28: Cultural Resource Management Guideline	DO #28 provides that: "[t]he NPS will protect and manage cultural resources in its custody through effective research, planning, and stewardship and in accordance with the policies and principles contained in the NPS *Management Policies[,]*" (Section 3.1) and requires that the NPS comply with the Secretary of the Interior's Standards and Guidelines for Archeology [stet] and Historic Preservation (Section 3.2).	TBC	

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
		"NPS-28: Cultural Resource Management Guideline" addresses park cultural resource management programs, compliance with Section 106 of the National Historic Preservation Act, and issues related to archaeological resources, cultural landscapes, structures, museum objects, and ethnographic resources. "Cultural resources" are defined as "the material evidence of past human activities" (NPS-28, Introduction).		
NPS Employee Guidance for Managing Natural Resources	NPS RM #77 Find at: https://irma.nps.gov/DataStore/Reference/Profile/572379	NPS RM #77 offers comprehensive guidance to NPS employees responsible for managing, conserving, and protecting the natural resources found in park units. It addresses management of natural resources (including air; disturbed land; endangered, threatened, and rare species; geologic resources; vegetation; etc.), resource uses, and planning (e.g., emergency management, and environmental compliance).	TBC	
Migratory Bird Treaty Act	16 USC§§ 703 *et seq*. as amended by	Establishes a federal responsibility for the protection of the international migratory bird resource and requires continued consultation by NPS with the FWS during response action	Relevant and appropriate in designing remedial alternatives	

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
	Pub. L. No. 116-9, 133 Stat. 580 (2019)	design and construction to ensure that the cleanup of the site does not unnecessarily impact migratory birds.	that minimize impacts to migratory birds	
Responsibilities of Federal Agencies to Protect Migratory Birds	Executive Order 13186	This Order directs executive departments and agencies to take certain actions to further implement the Migratory Bird Treaty Act, including supporting the conservation intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions.	TBC in designing remedial alternatives that minimize impacts to migratory birds	
Foundation Document VIIS	Available at http://npshistory.com/publications/foundation-documents/viis-fd-2016.pdf	The Foundation Document for VIIS provides a foundation for the planning and management of the Park in light of its purposes, significance, fundamental resources and values, other important resources and values, and interpretive themes. The Foundation Document identifies increased sedimentation as a threat to water clarity, affecting coral reef ecosystems that are	TBC in developing remedial alternatives and selecting a remedial action The Foundation Document provides a framework for determining what is required to attain the Organic Act non-impairment requirement.	

Text Table 4.2 Location-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
		important for the marine ecosystem and tourism.		

4.3. Action-Specific ARARs

Text Table 4.3 Action-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
ARARs				
Clean Air Act, National Primary and Secondary Ambient Air Quality Standards (NAAQS)	42 USC §§ 7409-7410; 40 CFR Part 50	NAAQS regulate ambient air quality to protect public health and welfare.	Applicable to response activities generating dust.	
Clean Water Act Effluent Guidelines and Standards	33 USC §§ 1311-12, 1316-17 40 CFR Part 450	The Clean Water Act and its implementing regulations provide requirements for point source discharges of pollutants.	Applicable to response activities that result in the point source discharge of pollutants to surface water bodies	
RCRA Subtitle C Requirements	42 USC §§ 6921 *et seq.*; 40 CFR Part 260 *et seq*.	Regulates the generation, transportation, treatment, storage, and disposal of hazardous wastes. RCRA Subtitle C requirements will apply to hazardous wastes generated, transported, or disposed of on-site as part of the Site response action activities. Off-site transportation and disposal are subject to applicable RCRA and Hazardous Materials Transportation Act requirements.	Certain provisions may be relevant and appropriate if Subtitle C wastes are generated, disposed, or transported off-site.	While waste samples tested have not been found to be hazardous, because of the heterogeneous nature of landfill waste, additional sampling will be necessary. Some wastes may be deemed hazardous and others non-hazardous

Text Table 4.3 Action-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
RCRA Subtitle D Solid Waste Landfill Closure and Post Closure Requirements	42 U.S.C. §§ 6944-6945; 40 CFR §§ 258.60 and 258.61	These regulations establish closure requirements, including a final cover system designed to minimize infiltration and erosion, as well as post-closure care requirements, such as maintenance of the cover and monitoring groundwater. The final cover system must be capable of sustaining native plant growth unless an alternative design is approved. The final cover should be maintained to ensure its integrity and effectiveness including "making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the final cover." Post-closure use of the property shall not "disturb the integrity of the final cover, liner(s) or any other components of the containment system . . . ."	Relevant and appropriate for alternatives that involve covering the landfill.	
Clean Water Act Storm Water Requirements	33 USC § 1342; 40 CFR Part 122	Regulates the discharge of stormwater from industrial and construction sites, *inter alia*. Requires implementation of best management	Applicable if more than 1 acre of land is disturbed; relevant and	

Text Table 4.3 Action-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
		practices, including run-on and run-off controls, sedimentation basins, etc.	appropriate for smaller areas	
RCRA Hazardous Waste Generation	42 USC § 6922 40 CFR Part 262	Specifies requirements for hazardous waste packaging, labeling, manifesting, and storage	Applicable to excavated RCRA hazardous waste that requires off-site disposal	While waste samples tested have not been found to be hazardous, because of the heterogeneous nature of landfill waste, additional sampling will be necessary. Some wastes may be deemed hazardous and others non-hazardous.
RCRA Treatment, Storage, and Disposal of Hazardous Waste	42 USC § 6924 40 CFR Part 264	Specifies requirements for the operation of hazardous waste treatment, storage, and disposal facilities	Applicable to response actions that require active on-site hazardous waste management and storage or off-site disposal activities	While waste samples tested have not been found to be hazardous, because of the heterogeneous nature of landfill waste, additional sampling will be necessary. Some wastes may be deemed hazardous and others non-hazardous.

Text Table 4.3 Action-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
U.S. Department of Transportation Hazardous Materials Transportation Act Regulations	49 USC §§ 5101 *et seq.*, 49 CFR §§ 171 – 180	Establishes classification, packaging, and labeling requirements for shipments of hazardous materials.	Applicable to response actions involving the off-site transportation of hazardous materials	While waste samples tested have not been found to be hazardous, because of the heterogeneous nature of landfill waste, additional sampling will be necessary. Some wastes may be deemed hazardous and others non-hazardous.
RCRA Transportation of Hazardous Waste	40 CFR Part 263 42 USC § 6923	Specifies requirements for transporters of hazardous waste to obtain an EPA identification number, compliance with manifest procedures and spill response	Applicable to excavated RCRA hazardous waste that is transported for off-site disposal. Note: RCRA hazardous waste has not been identified at the Site.	While waste samples tested have not been found to be hazardous, because of the heterogeneous nature of landfill waste, additional sampling will be necessary. Some wastes may be deemed hazardous and others non-hazardous.
Virgin Islands Rules and Regulations Solid and	Title 19, Chapter 56	Notification requirements and standards applicable to generators of solid and hazardous waste, standards for management of specific solid and hazardous wastes and	Applicable	While waste samples tested have not been found to be hazardous, because of the heterogeneous nature of

Text Table 4.3 Action-Specific ARARs: Caneel Bay Resort				
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Applicable or Relevant and Appropriate or TBC?**	**Comment**
Hazardous Waste Management Act		waste management facilities, landfill closure requirements and land disposal restrictions.		landfill waste, additional sampling will be necessary. Some wastes may be deemed hazardous and others non-hazardous.
Virgin Islands Underground Storage Tanks Regulations	Title 12, Chapter 16	Requirements for operating, upgrading, and closing USTs.	Applicable if a UST is present	A UST may be present at Cottage 7
TBCs				
EPA Climate Change Action Plan, Contaminated Waste Containment Systems	Climate Resilience Technical Fact Sheet: Contaminated Waste Containment Systems (EPA, 2019)	Guidance to evaluate the vulnerability of the containment system to climate change and site-specific measures for the remedy to continue to be protective. The fact sheet states: "Waste containment systems rely on effective control of water entering or exiting the system. As a result, these systems are commonly vulnerable to flooding that could cause cover material erosion, side slope failure or contaminant washout."	TBC	

5. RAOs and PRGs

RAOs define what the removal action is intended to accomplish. Specific RAOs are presented below. Applying the understanding of the CSM (Section 2), understanding of risk levels (Section 3), and ARARs (Section 4) to the scope of the EE/CA results in the RAOs.

5.1. Identification of RAOs

The RAOs for this EE/CA are:

- Eliminate unacceptable risks to human health and the environment, specifically:
    - Soil: Reduce total cancer risks in excess of 1E-06 to human receptors from Site-related arsenic in Areas 1, 2, and 3
    - Soil: Reduce total cancer risks in excess of 1E-06 to human receptors from Site-related COC pesticides in Area 2
    - Soil: Reduce risks to all ecological receptors that are potentially posed by pesticides and metals in Area 2 and Area 3
    - Soil: Reduce the potential for future releases of COC-containing sediment to surface water at Honeymoon Beach in the event of an extreme rainfall event or sea level rise
- Eliminate or minimize contaminant-related constraints to the full enjoyment and utilization of park resources for operational, scientific, and interpretive purposes consistent with NPS mandates
- Satisfy federal and state ARARs and associated cleanup standards
- The investigation results for Area 3 reflect the mixed contents of the landfill, where uncontrolled wastes were deposited over decades. There is a mixture of benign organic materials, plastics, metals, and CERCLA hazardous substances. Landfills used before the 1980s typically received both nonhazardous and hazardous wastes, including paints, pesticide containers, used oil, batteries, cleaning supplies, and other items. It is possible such materials were disposed of at this landfill. In surface soil, contaminants were detected sporadically, even within the same surface soil DUs. For example, DDT-total in the IA-3-02 decision unit ranged from nondetected to 0.182 mg/kg. PCBs were detected in one landfill waste sample in the 2021 EE/CA investigation and in two samples in the 2014 investigation (all detections were below the action levels). The landfill was constructed with no liner to control leaching, and the sides are confined by berms made from tree branches and soil. The risk of slope failure is high, and the slope on the southeastern side has already eroded and

exposed landfill wastes. Often, groundwater sampling can be used to locate a "hot spot" of contamination, but there is no groundwater in the dry season and the wet season, groundwater may remain near the top of wastes until it discharges as seeps. Because waste disposal was not systematic or controlled, high concentrations of contaminants with low mobility may be present anywhere in the landfill. As a result, it is not feasible to find and remove only the contaminant hot spots. All the landfill contents will be considered a unit of contamination to be addressed by the RAOs.

5.1.1. Determination of Removal Action Scope

This removal action will be conducted to meet the RAOs listed above. The removal action is intended to be the final response action taken at the Site to address unacceptable risks at Caneel Bay Resort in Areas 1, 2, and 3, with the exception of the data gaps identified in this report. Adequate documentation will be provided to demonstrate that this removal action is sufficient to meet the RAOs.

NPS recognizes there are data gaps associated with releases or possible releases in other areas of the Resort and related to arsenic (as discussed in Section 5.2.4) and not included in the scope of the EE/CA removal action, including those listed below. An EE/CA addendum or a separate EE/CA and additional removal action may be warranted to address these concerns:

- Asbestos releases to soil from damaged building materials. NPS was not aware of the extent of building damages from the 2017 Hurricanes Maria and Irma when the EE/CA Approval Memorandum was prepared. As building materials degrade or are moved without containment or cleanup, the potential increases for asbestos releases to soil and air. The extent of asbestos contamination in soil is currently unknown and may change in the future if debris deteriorates, is broken apart, or moved manually or by extreme weather events.

- Lead-based paint: NPS performed drip-line sampling around selected buildings and debris to evaluate the presence of lead-based paint. There is evidence that lead-based paint is or was present at several buildings, with the highest lead concentrations in soil near at the Turtle Bay Beach rooms (SC-Bldg-01) and the Self Center (SC-Bldg-19). The full nature and extent of lead-based paint contamination was not evaluated in this investigation, and these results were not included in the risk assessment, but these data gaps will be addressed in an EE/CA addendum and, if needed, by a separate removal action.

- The presence or absence of a UST at Cottage 7 could not be conclusively determined using methods that do not disturb soil. Assessment for the potential presence of a

UST will require additional exploration, which will be performed as part of an EE/CA addendum and, if necessary, addressed by a separate removal action.

- Excavation may be needed to identify what is buried near the Catchment Basin. The GPR survey identified a large anomaly approximately 2 feet below the ground surface. There is no evidence or prior information suggesting this anomaly represents a release or threat of a release of hazardous substances. Additional investigation will be conducted as part of an EE/CA addendum and, if necessary, addressed by a separate removal action.

5.1.2. Schedule

The following is a tentative schedule of major removal action milestones:

Activity	Tentative Date
EE/CA draft for public review	June 2021
Public comment period	June through July, 2021
Response to significant public comments	September 2021
Action Memorandum	October 2021
Removal action design/planning	To be determined, ~1 year duration
Removal action construction start	To be determined, ~2 months duration
Removal action construction completion	To be determined

5.2. PRGs

PRGs generally are concentrations of contaminants for each exposure medium that are believed to provide adequate protection of human health and the environment based on site information. PRGs are selected after considering human health and ecological risk-based cleanup goals (RBCGs) and Site background.

5.2.1. Selection of Human Health Risk-Based RBCGs

The NCP establishes an excess cancer risk of 1E-06 as the point of departure and sets a threshold value for cumulative non-cancer adverse effects at an HI of 1. RBCGs related to carcinogenic compounds are initially established at the point of departure. Final removal action goals (RGs) can deviate from the point of departure based on compelling site-specific factors relevant to risk management decisions. RBCGs are established using the same exposure parameters and toxicity values used in the HHRA but reversing the risk equation to solve for the RBCG. Generally, RBCGs are only developed for those chemicals that are identified as COCs in the risk assessment. COCs are defined as those chemicals for which the estimated cancer risk is greater than 1E-06 and/or the HQ is greater than 1.

The updated HHRA identified arsenic, aldrin, and dieldrin as COCs that present a potentially unacceptable risk to human receptors at the Site.

The Organic Act and the VIIS enabling legislation do not allow NPS to select response actions that will result in the permanent or long-term impairment of the Park's fundamental resources and values. In addition, numerous laws, regulations, and policies require NPS to protect park visitors and workers from site hazards including residual contamination.

RBCGs were developed for a range of target cancer risk levels (1E-06, 1E-05, and 1E-04). As it is a standard of practice to consider cleanup levels within this range of target cancer risks, NPS developed a corresponding range of PRGs. The NCP establishes, in effect, a "rebuttable presumption" that remedies should reduce the potential excess cancer risk to a level of 1E-06 and requires an analysis demonstrating there are compelling factors to overcome this presumption before the lead agency can consider a less protective risk level. The human health PRGs are summarized in Text Table 5.2.1. A target risk level of 1E-06 is considered protective and has been selected for the Site. Because all calculated HIs were less than or similar to the non-cancer hazard benchmark of 1.0, a non-cancer-based RBCG was not warranted and therefore not calculated.

Text Table 5.2.1 Summary of Human Health[a] RBCGs

Contaminant	RBCGs Based on Target Cancer Risk Level Shown (mg/kg)			Receptor	Selected RBCG
	1E-06	1E-05	1E-04		
Arsenic	0.68	6.8	68	**Resident**	0.68
Aldrin	0.039	0.39	3.9	**Resident**	0.039
Dieldrin	0.034	0.34	3.4	**Resident**	0.034
	0.36	3.6	36	Park/Resort Worker	
	1.2	12	120	Construction Worker	

Notes:
[a]RBCGs are developed based on the receptor with the highest potential for exposure.
The receptor with the lowest RBCG is shown in bold text.

5.2.2. Selection of Ecological Risk-Based PRGs

The ecological risk assessment identified seven soil CECs. These CECs and RBCGs and the respective receptors are as follows:

Text Table 5.2.2 Summary of Ecological RBCGs					
CEC	Plants	Invertebrates	Birds	Mammals	Selected Ecological RBCG
	Soil Concentration (mg/kg)				
Barium	**185**	None	None	None	185
Copper	109	**99**	104	1129.5	99
Zinc	205	**147**	223	3552	147
DDT-total	5.1	0.354	**0.17**	47.01	0.17
Aldrin	**0.018**	None	None	16.77	0.018
Chlordane	11.1	**1.20**	1.41	31.14	1.2
Dieldrin	None	12.5	**0.051**	0.15	0.051

5.2.3. Identification of ARAR-Based PRGs

Chemical-specific ARARs related to soil are identified in Text Table 4.1 and described herein. In addition, location-specific ARARs and TBCs (see Text Table 4.2), including NPS Organic Act and General Authorities Act, NPS nuisance regulations (36 CFR Section 5.13), and VIIS-specific documents, prohibit contamination at the Site that would otherwise impair scenery, natural and historic objects, and wildlife. Although location-specific ARARs do not provide numeric standards, their requirements must be addressed.

There are no chemical-specific ARARs with potentially related PRGs for soil at the Site that have not already been considered during the risk assessments as screening levels.

5.2.4. Identification of Background and/or Reference Values for the Site

To ensure cleanup will be technically feasible and cost effective and to reduce the potential for recontamination of clean areas from surrounding sources, the PRGs must be compared against background values for naturally occurring constituents (e.g., metals) in all media at the Site. They may also be compared to reference values for environmentally ubiquitous anthropogenic constituents (e.g., polycyclic aromatic hydrocarbons). Only background/reference concentrations for COCs and CECs for the Site will be discussed in this section.

Background Studies

As discussed in Section 2.11.2, VHB performed background sampling during the EE/CA field investigation to characterize Site-specific background soil conditions where impacts from Site activities were not anticipated. VHB collected surface soil samples from two background or reference DUs and subsurface soil samples from three reference soil borings. Surface soil background concentrations, shown in Text Table 2.11.2, were compared to risk-based RGs.

To evaluate whether the background concentrations are consistent with natural or ubiquitous anthropogenic conditions in the area, the Site-specific background values were compared to other local soil studies. A search of the National Geochemical Database (USGS, 2021) for sample locations within 2.4 miles of Area 3 identified results from more than 40 samples. As the sample settings and methodologies are not known, these data may not be directly comparable to the investigation results but establish a range of possible background values. Reported concentrations of barium and copper in soil ranged from 20 to 500 mg/kg and 10 to 200 mg/kg, respectively. The estimated Site-specific background concentrations fall within the lower ranges of regional concentrations. Arsenic and zinc were not detected in any of the USGS samples above the relatively high detection limit of 200 mg/kg. The detection limit for arsenic and zinc is significantly higher than the Site-specific background concentrations for both compounds, so regional background data are not useful for comparison.

Summary of Relevant Background Values

NPS calculated a background concentration for the soil COCs identified during the risk assessment, shown in Text Table 5.2.4.

Text Table 5.2.4 Recommended Background Values

Analyte	Background Concentration (mg/kg)
Arsenic	2*
Barium	83
Copper	85
Zinc	57
DDT-total	0.049
Aldrin	0.014
Chlordane	0.142
Dieldrin	0.013

Note:
* The arsenic background concentration is considered a data gap

Arsenic Background Data Gap

The background concentration of arsenic was calculated to be 2 mg/kg. One background DU was near Area 1, and another was on the hillside above the landfill at Area 3. Both locations were in forest and may contain high proportions of organic material relative to mineralized soil, which would reduce the arsenic concentrations. While many studies have been performed on the continental U.S. to evaluate arsenic in background soil, NPS could not locate any specific to the USVI or St. John. The worldwide "background concentrations in soil range from 1 to 40 mg/kg, with mean values often around 5 mg/kg" (Ng *et al*, 2001). In the continental U.S., background arsenic concentrations correlate well with underlying bedrock in the region (Vosnakis *et al*, 2010). Rock types associated with volcanic activity often contain higher concentrations of

arsenic, with concentrations in rock and volcanic fallout deposit ranging from 10 mg/kg to 17 mg/kg (Casentini *et al*, 2010).

As well as volcanic activity, there may be other naturally-occurring sources of arsenic on St. John. The USGS issued a report that discussed arsenic samples collected on St. John, in dust filters as part of the IMPROVE (Interagency Monitoring of Protected Visual Environments) program (Holmes *et al*, nd). Of 679 dust samples collected, 279 had detectable arsenic concentrations ranging from 0.5 to 44 mg/kg, with a mean of 17 mg/kg. The study authors state that dust storms originating in Africa's Sahara Desert transport dust across the Caribbean, particularly during summer storms. The mean arsenic concentration in dust samples indicates that there are naturally occurring sources of arsenic present in St. John.

Because the distribution of arsenic-containing dust deposition and volcanic fallout around the island is likely to be variable, background arsenic concentrations in surface soil will vary by location. NPS observed relatively wide variation between the two background soil sampling decision units.

The 95% UCL arsenic concentrations for Areas 1, 2, and 3 were relatively similar, ranging from 2.43 mg/kg in Area 1 to 8.45 mg/kg in the western side of Area 2. If Site arsenic concentrations are influenced by naturally-occurring sources, there are two potential concerns with attempting a cleanup to a background value of 2 mg/kg:

1. The removal action may include excavating and disposing of all surface soil outside buildings in Areas 1, 2, and 3. A physical boundary may need to be created to determine excavation limits in case confirmation sample results remain above 2 mg/kg. Although this is possible, NPS recognizes that this type of cleanup may leave arsenic above risk levels in surrounding soil, which could continue to be deposited to the cleanup area through natural processes (e.g., surface water runoff and dust) or could be moved there via grading or fill activities.
2. To properly restore the site, clean fill and topsoil would need to have lower concentrations than the background value. Because worldwide concentrations of arsenic are reported to be, on average, around 5 mg/kg, it is possible that cleaner soil would not be available. If this is the case, arsenic cleanup would not be technically practicable.

For these reasons, the level of uncertainty associated with the arsenic background result is too great for NPS to set a background concentration that may also be used as the removal goal. Therefore, NPS considers the arsenic background concentration and the availability of clean fill with arsenic concentrations below the background concentration as data gaps. NPS will perform additional investigation to evaluate both issues.

5.3. Risk Management: Recommended RG Selection

Recommended RGs are the lower of the risk-based RBCGs and ARAR-based PRGs. However, to ensure cleanup will be technically feasible and cost effective, the RBCGs and PRGs are compared to background for COCs and CECs.

Text Table 5.3 shows a comparison of the human health risk-based PRGs, ecological risk-based PRGs, ARAR-based PRGs, and representative background concentrations. When multiple PRGs exist, NPS selects the lower (i.e., more protective) value as the RG unless the background concentration of the contaminant in the medium judged to be representative of unimpacted conditions was greater than the RBCGs and PRGs, in which case NPS may select the background concentration as the RG.

The recommended RGs and the basis for selection are included in Text Table 5.3.

Text Table 5.3 Recommended RG Selection

COC or CEC	Background	Human Health RBCG	Ecological RBCG	ARAR-Based PRG	Basis for RG	Recommended RG
Soil (mg/kg)						
Arsenic	**2***	0.68	None	None	Background	To be determined
Barium	83	None	**185**	None	Ecological	185
Copper	85	None	**99**	None	Ecological	99
Zinc	57	None	**147**	None	Ecological	147
DDT-total	0.049	None	**0.17**	None	Ecological	0.17
Aldrin	0.014	0.039	**0.018**	None	Ecological	0.018
Chlordane	0.142	None	**1.20**	None	Ecological	1.20
Dieldrin	0.013	**0.034**	0.051	None	Human health	0.034

Note:

* To reduce uncertainty regarding this background concentration, NPS plans to perform additional background and clean fill source sampling.

The 2021 EE/CA investigation results are compared to the RGs in the attached EE/CA Tables 1 and 2.

6. Identification of Removal Action Alternatives

This section presents the removal action alternatives proposed to achieve the RAOs identified in Section 5.

Because an RG for arsenic will depend on additional arsenic sampling, decision units at which arsenic is the only COC or CEC are not included in the removal alternatives considered in this or subsequent sections of the EE/CA. Those DUs will be addressed in an EE/CA addendum or a separate EE/CA once the data gaps are filled.

The selected removal action must meet the RAOs and comply with ARARs. The location of the Site within a unit of the National Park System and the risk posed by surface soil in portions of Area 2 and landfill waste in Area 3—including subsurface soil that may become exposed due to erosion—must be considered when evaluating removal alternatives. The following potential removal process options were included in the screening of alternatives shown on Text Table 6, with additional discussion after the table:

- No action. No action would be taken; consideration of this alternative is required by the NCP. The contaminated materials remain in their existing condition.

- In-situ treatment. In-situ degradation of organics using microorganisms in an aerobic/anaerobic environment. Amendments are applied and tilled into the subsurface to promote biological activity. There are various vendors of pesticide-reducing chemicals, including Biotech Restorations and Peroxychem. Studies provided by these vendors indicate that the technology is successful in reducing concentrations by approximately half, which could leave pesticides on site at concentrations above RGs.

- Stabilizing and capping the landfill by installing physical barriers and applying institutional controls. Installing a low-permeability soil cover over the landfill to limit infiltration and contaminant migration via seeps, constructing retaining walls to reinforce slopes, and/or regrading the landfill to reduce the potential for slope failure. Implementing institutional controls to prevent soil disturbance in the future.

- Removal of soil and landfill debris. Excavating potentially impacted soil/debris where COC concentrations exceed RGs, transporting to and disposing at an appropriate disposal facility.

Text Table 6 Screening of Removal Action Options					
Removal Action	**Effectiveness**		**Implementability Administrative/ Technical**	**Relative Cost**	**Retained (Yes or No)**
	Protectiveness Threshold	**ARAR Compliance Threshold**			
No Action	No action would not achieve the protectiveness threshold. It does not remove, contain, or create a physical barrier between receptors and potentially impacted materials; therefore, it does not eliminate or reduce unacceptable human or ecological risks.	No action constitutes an impairment of Park resources and values and would be inconsistent with the NPS Organic Act and Park enabling legislation; this option would render invaluable land unavailable for public use and enjoyment in perpetuity and is not designed to eliminate impaired conditions on NPS-managed land to the greatest extent practicable.	Easily implemented as no additional action is taken. No removal action is implemented, resulting in no administrative constraints.	Capital: None Operation and Maintenance (O&M): None	Yes – The No Action alternative is retained as a "baseline" for evaluation as required by the NCP.
In-Situ Treatment	Low – would likely reduce pesticide concentrations in shallow soil but may leave concentrations above RGs (note – debris may interfere with the distribution of amendments); would not address debris and contaminated soil at depth.	Low – would not address debris and contaminated soil at depth.	Moderate – Amendments & equipment are easily acquired. May require several treatment cycles to reach RAOs for pesticides.	Capital: Moderate O&M: Low	No – would not address debris and contaminated soil at depth and uncertainty in achieving RAOs.
Stabilize/cap landfill	Low – likely not a permanent solution as the landfill location is vulnerable to sea level rise and increased erosion from extreme weather	Low- requires institutional controls to prevent soil disturbance, could require land use restrictions that would impose an impairment on park resources.	Moderate – Capping and stabilization design and construction is standard; low-permeability soil and retaining wall building materials would likely be sourced from continental USA; would require long-term maintenance	Capital: High O&M: High	No – would not address landfill contents and may be undermined by sea level rise

Text Table 6 Screening of Removal Action Options					
Removal Action	**Effectiveness**		**Implementability Administrative/ Technical**	**Relative Cost**	**Retained (Yes or No)**
	Protectiveness Threshold	**ARAR Compliance Threshold**			
Removal	High – would remove soil/debris, would be highly effective at reducing direct contact if all debris/soil is removed	High – can be designed and accomplished in a manner consistent with ARARs, is the least likely to represent an impairment of park resources	Moderate – excavation, transport, and disposal are commonly used construction techniques. The disposal will likely require transport to neighboring St. Thomas. Could be combined with cleanup of resort structures providing an economy of scale.	Capital: High O&M: Low	Yes

Given the limitations of the *in-situ* treatment (i.e., treatment would not address landfill contents and contaminated soil at depth and the uncertainty that concentrations would be reduced to below the RGs), it was excluded as an alternative.

Presumptive remedy guidance for landfills was considered and could involve various actions to stabilize, cover, or prevent disturbance of the wastes while leaving them in place. The elevation of the landfill's western side is approximately 2 feet above sea level. To prevent the landfill from being undermined by sea level rise, the waste would need to be extensively reworked to contain it in a smaller footprint higher on the hillside, and large retaining walls would need to be maintained. Placing low-permeability soil would be required to meet applicable RCRA landfill closure requirements, but soil meeting the required specifications would be difficult to source in the USVI. Finally, NPS seeks to avoid placing institutional controls at sites because they create a long-term burden for land and resource managers, require post-removal site controls (PRSCs), and can conflict with the Park's enabling legislation. Hence, this was excluded as an alternative.

The following removal action alternatives were retained for further analysis:

1. Alternative 1 - No action (as required by the NCP)
2. Alternative 2 - Remove surface soil in portions of Area 2, and soil and landfill contents from Area 3

Each alternative is described in the following subsections. Cost projection details for each alternative are provided in Appendix D.

6.1. Alternative 1: No Action/No Further Action

Consistent with the NCP and CERCLA guidance, a "no action" alternative is a baseline for comparison. Under this alternative, no additional monitoring or maintenance would be performed. Exposed surface soil in portions of Area 2 and Area 3 poses a current and future risk to human health and the environment. The eroded channel is likely to continue to erode with each rain storm and eventually be affected by sea level rise. Larger volumes of landfill waste and subsurface soils could be suddenly exposed by extreme weather events, or unrestricted digging within the landfill footprint and could be used as fill at other parts of the Site, which poses a potential future risk to human health and the environment. As a result, this alternative does not achieve the RAOs.

6.2. Alternative 2: Remove Surface Soil in Portions of Area 2 & Soil and Landfill Contents from Area 3

Pesticides and some metals in surface soil in portions of Area 2 are present at concentrations above human health and ecological screening levels. As part of this alternative, approximately 327 BCY of shallow soil from portions of Area 2 would be removed. During removal action implementation, accumulated sediment in the drainage channel would also be removed for disposal.

The steepness of the landfill's side slopes in Area 3 is a concern for future erosion. The resulting exposure of subsurface soil and associated landfill contents, which contains hazardous substances, poses a potential risk to human and ecological receptors. To remove contaminated materials in the landfill and reduce long-term maintenance requirements, this alternative includes excavation of approximately 19,267 BCY of soil and waste from the landfill down to bedrock (the presumed bottom of the landfill since the area was previously used as a quarry). This would be followed by grading along the edges of the landfill to return the area to pre-landfill conditions (i.e., historical quarry pit, not the original hillside slope, which could create another unstable slope).

Alternative 2 would include:

1. Installing sedimentation controls in Area 3 along the lower edge of the proposed disturbance area and maintaining those controls throughout soil disturbance and revegetation activities to prevent erosion from runoff
2. Clearing brush and trees in portions of Areas 2 and 3
3. Excavating 327 BCY of shallow soil from the DU-2-01 and DU-2-02 portions of Area 2 and 19,267 BCY of soil and landfill contents from the Area 3 landfill. Removing accumulated sediment from the drainage channel.
4. Transporting excavated soil and landfill contents to a landfill for disposal. The material could be disposed of at the Virgin Islands Waste Management Authority's (VIWMA) Bovoni landfill on St. Thomas or potentially at VIWMA's former Susannaberg landfill on St. John (pending local permission because this landfill is closed). For cost projection purposes, it is assumed that all material is brought to Bovoni landfill; however, if VIWMA allows soil to be used as cover for the nearby former Susannaberg landfill the costs would be significantly reduced (i.e., more material could be hauled per day, no barge costs, and no tipping fees). The wastes must be characterized for disposal. Because hazardous materials are known to be present, NPS assumes 1% of the waste volume (150 BCY) will be characterized as hazardous by toxicity. Hazardous waste cannot be transported to any landfill in the USVI or Puerto Rico, and would require transportation to and disposal at a hazardous waste landfill on the continental U.S.
5. Grading along the edges of the Area 3 landfill to reestablish the pre-landfill setting in a manner that achieves stability and erosion control.
6. Spreading topsoil over portions of Area 2 and across the perimeter of Area 3 to promote and support vegetative growth. Approximately 4,000 square yards of soil meeting NPS requirements, possibly obtained from the excavated debris-free material above the rock in Area 3, would be required. Alternatively, the organic vegetation at the landfill could be segregated, chipped, and distributed on the ground surface to create an organic base for shallow-rooted plants. For cost projection purposes, NPS assumed that all the soil would be imported.

7. Revegetating soil and surrounding disturbed areas with native species acceptable to NPS using a revegetative performance standard to be developed as part of the removal design.
8. Visually inspecting the new slopes for indications of erosion or runoff annually for five years. Repairing eroded areas annually for five years, as necessary. Monitoring vegetation and conducting selective vegetation management to control revegetation by undesired species until performance objectives established in the Park-approved specification are met. As this alternative would not require a constructed cover and would have no restrictions on the type of native vegetation allowed to grow (e.g., deep-rooted trees and shrubs), it is assumed that long-term maintenance would be minimal. Because it is expected that seeds from the surrounding area will be naturally deposited on the landfill and begin to establish vegetation that is consistent with the immediate vicinity over time, the cost projection assumes only limited reseeding efforts for five years after completion of the removal action.

This alternative would achieve the RAOs by removing surface soil in portions of Area 2 and soil and landfill contents from the Area 3 landfill, limiting the potential for the contact of contaminated soil and landfill contents by human and ecological receptors.

7. Comparative Analysis of Removal Action Alternatives

Section 7 provides a comparative analysis of each evaluation criteria for the alternatives presented in Section 6. This will identify the advantages and disadvantages of each relative to one another.

According to the NCP, each alternative described above was analyzed for effectiveness, implementability, and cost. The effectiveness of each alternative was evaluated by each alternative's protectiveness of human health and the environment; attainment of ARARs; reduction of toxicity, mobility, or volume through treatment; long-term effectiveness and permanence; and short-term effectiveness. The implementability criterion addresses the technical feasibility of implementing the response (including availability of services and materials), the administrative feasibility, and territory and community acceptance. Projected costs were calculated considering direct capital costs, indirect capital costs, and annual post-removal site inspection costs. Consistent with guidance, the opinions of costs presented were estimated using 2021 costs of labor and materials; actual costs are expected to range from 30 percent below to 50 percent above the costs presented. The projected costs presented for the removal action alternative are presented for the sole purpose of comparing alternatives and cannot be substituted for design- or construction-level cost projections. Details that formed the basis for the removal action alternative cost projections are provided in Appendix D.

7.1. Effectiveness

This section evaluates the selected alternative's ability to meet the RAOs identified in Section 5,in particular, its ability to protect human health and the environment and to attain ARARs. Other factors that affect the overall protectiveness of a removal action include a preference for treatment to reduce contaminant toxicity, mobility, or volume for principal threats, short-term effectiveness, and long-term effectiveness/permanence. Details regarding the effectiveness evaluation criteria are presented in the following subsections.

Overall Protection of Human Health and the Environment

Although Areas 2 and 3 are currently not encouraged for public use, these areas are accessible to Park and Resort workers. In the future, both areas may be accessed by residents and visitors. In addition, future exposure of subsurface soil and landfill contents due to future erosion poses a threat of release of contaminated soil. Therefore, Alternative 1 (no action) is not protective of human health or the environment.

Alternative 2 (remove surface soil in portions of Area 2 & soil and landfill contents from Area 3) would reduce risks to human and ecological receptors from pesticides in surface soil in portions of Area 2 and CERCLA hazardous substances in the Area 3 landfill. It would remove subsurface soil and associated landfill contents that were historically placed into the historic quarry pit, addressing the threat of release of hazardous substances within the landfill contents posed by future erosion. Removal in Area 3 would substantially reduce landfill contents and re-establish pre-landfill conditions while achieving stability and erosion protection. Once implemented, this alternative would protect human health and the environment. During implementation, excavation workers would be exposed to soil and landfill contents, and engineering controls and

personal protective equipment would be required to protect them. Air and dust monitoring and dust suppression during the work would be required to prevent potentially unacceptable exposure risks to workers and visitors. Subsurface soil and landfill contents excavation in Area 3 may mobilize buried hazardous substances, and precautions would be required to limit the erosion of material being uncovered during excavation to protect the environment.

Compliance with ARARs

Chemical-specific ARARs for pesticides and metals were considered in the risk assessment as screening levels.

Because the presence of the landfill is impairing the use and scenery of the Park, location-specific ARARs related to the use and preservation of the Park, including the Organic Act, the General Authorities Act, the National Park Resource Protection, Public Use, and Recreation regulations, and the National Park Nuisance regulations, and the VIIS Foundation Document will not be met for Alternative 1.

The landfill has not been operated or closed in accordance with ARARs related to solid and hazardous waste management. Alternative 1 would not comply with these regulations, or with NPS ARARs related to solid waste, particularly if the landfill is not closed.

Alternative 2 (remove surface soil in portions of Area 2 & soil and landfill contents and subsurface soil from Area 3) would comply with location-specific ARARs, and specifically, the Organic Act and the VIIS Foundation Document, by removing potentially impacted soil and landfill contents disposed of in the historical quarry pit. This would limit human and ecological receptor exposure to the potential contamination via the removal of most of the potentially impacted soil and landfill contents, allowing use and enjoyment of Park resources. It would also prevent future catastrophic impacts to ocean clarity from a slope failure, which is consistent with the VIIS Foundation Document.

In addition to habitat protection ARARs, the soil disturbance activities (e.g., excavation, topsoil placement) required by Alternative 2 must comply with the action-specific fugitive dust and stormwater control requirements of the Clean Air Act and the Clean Water Act. Compliance with fugitive dust requirements would be attained through air monitoring and dust suppression. Compliance with stormwater control requirements would be met with the use of stormwater/silt fencing and other recommended "Best Management Practices." Alternative 2 will also require transporting and disposing of a large amount of contaminated soil and some landfill contents off-Site; therefore, additional profiling would be required to determine applicable transportation and disposal requirements.

Because contaminated soil is vulnerable to erosion in both Areas 2 and 3, Alternative 1 does not meet ARARs related to resiliency or siting waste treatment and disposal facilities in areas where they are not vulnerable to climate change. Removal of soil under Alternative 2 will address these considerations.

Reduction of Toxicity, Mobility, or Volume through Treatment

On-site treatment is not contemplated in either alternative. Alternative 1 would not include any active measures to reduce the toxicity, mobility, or volume of contaminants. Alternative 2 would be effective in the long term in reducing the on-Site volume of potential contaminants through excavating and transporting soil and landfill contents to off-Site disposal facilities, but it could result in short-term releases of potential contaminants during transport.

Short-Term Effectiveness

Alternative 1 will not be effective in the short term, because it does not address the continued exposure of surface soil in portions of Area 2 and threat of release of contaminated soil and landfill contents posed by future erosion from Area 3.

Alternative 2 would have low effectiveness in the short term due to the intrusiveness of the remedy. Clearing and tree removal would temporarily destroy existing habitat over portions of Area 2 (approximately 0.5 acres) and the Area 3 landfill (approximately 1.5 acres). The level of effort and construction duration would also increase the potential for natural resources and community impacts associated with construction. Because of the size and duration of the construction project, more effort would be required to control fugitive dust during clearing, tree removal, and grading, and there would be greater potential for impacts to Caneel and Solomon Bays. It would also be challenging to limit impacts to Park visitors due to increased truck traffic for hauling contaminated soil and landfill contents generated under this alternative.

Long-Term Effectiveness

Alternative 1 will not be effective in the long term as it does not address the continued exposure of surface soil in portions of Area 2 and threat of release of contaminated soil and landfill contents posed by future erosion from Area 3.

Alternative 2 would be effective in the long term as it addresses the future threat of release of contaminated subsurface soil by removing landfill contents and associated soil from the landfill, removing contaminated surface soil from DUs at Area 2, establishing natural, vegetated conditions, and essentially eliminating potential future erosion.

7.2. Implementability

This section provides an evaluation of the technical and administrative feasibility of implementing the alternative and the materials and services that would be required for its implementation.

Technical Feasibility

Alternative 1 is the most technically feasible alternative to implement.

Alternative 2 would be technically feasible, although this alternative would be disruptive and would require increased logistics planning due to the large amount of material that would be excavated and transported off-Site. A staging area to support soil and landfill content transport

from the Site would be required in Area 3; the stockpiles would require engineered barriers to prevent loss of soil, runoff, and generation of airborne dust. This alternative would require placement of topsoil in Areas 2 and 3 and proper grading of the Area 3 hillside before seeding or replanting. Establishing vegetation to meet NPS performance standards on the reestablished grades is not expected to be a challenge. In the long term, it is expected that seeds from the surrounding area will be naturally deposited on the new slopes to establish vegetation that is consistent with the immediate vicinity.

Administrative Feasibility

This section provides an evaluation of the activities needed for coordination with other offices and agencies. Under CERCLA, federal, state, and local permits are not required for on-site CERCLA response actions; however, the substantive requirements of all permits that would otherwise be required must be met (40 CFR Section 300.400(e)).

Alternative 1 is administratively feasible because concentrations do not exceed USVI soil standards.

Alternative 2 would be administratively feasible. Administrative work would be required to identify which off-Site disposal facility (Bovoni landfill on St. Thomas or former Susannaberg landfill on St. John) to send the material to. Identifying an imported topsoil source to backfill the landfill will require additional administrative considerations to avoid importing invasive species and other contaminants to the Site.

Territory (Support Agency) Acceptance

The Territory did not provide input on the alternatives during the public comment period and has not responded to NPS's request to identify territory-specific ARARs.

Community Acceptance

NPS requested community review and comment on the removal alternatives under consideration. A notice of availability and a brief description of the EE/CA Report was published in a news release sent to interested parties and the Virgin Islands Daily News, the newspaper preferred by community members according to interviews during the preparation of the Site Community Involvement Plan. NPS held a public meeting on June 10, 2021 to convey the EE/CA report findings and proposed cleanup actions. NPS hosted a listening session on June 24, 2021 to hear additional comments from the public related to the cleanup action and additional investigation identified in the EE/CA report. NPS requested all comments be made within 30 days, and one 15-day extension to the public comment period was granted upon request. NPS considered all public comments received before the deadline and made changes to the EE/CA where appropriate.

Following receipt and evaluation of public comments, NPS will prepare an Action Memorandum, which as the decision document selecting a Non-Time Critical Removal Action (NTCRA), summarizes the need for the removal action, identifies the selected action for the Site, provides

the rationale for the action, and addresses significant comments received from the public, including those from other jurisdictions (e.g., states, tribes, USEPA). The Action Memorandum will be placed into the Site administrative record file, which is housed in the information repositories established for the Site as detailed in the Site Community Involvement Plan.

7.3. Cost

This section provides an evaluation of the costs associated with implementing the removal action alternatives. Cost estimates are based on currently available costs and approximate time and materials requirements developed for the sole purpose of comparing alternatives. These cost projections should not be considered design-level estimates. They are representative within −30 to +50 percent. Detailed cost projections are provided in Appendix D.

Alternative 1 has no associated cost.

Alternative 2 would include the cost to clear vegetation from portions of Areas 2 and 3; remove sediment from the drain channel; excavate, transport, and dispose of soil and landfill contents at an off-Site disposal facility; regrade Area 2 to pre-removal conditions and Area 3 to achieve pre-landfill conditions; place topsoil; and establish vegetation. These costs also include short term-monitoring for five years after remedy implementation. The estimated (undiscounted) and present value cost for Alternative 2 is $6 million. The costs assume that all non-hazardous soil and waste would be disposed on St. Thomas, and that a tipping fee will be required. These costs also assume that landfill waste will be characterized and 1% will be hazardous by toxicity, requiring disposal at a landfill on the continental U.S.

7.4. Summary of the Alternatives Comparative Analysis

Text Table 7.4 summarizes the results of the evaluation of the effectiveness, implementability, and cost criteria for each alternative.

Text Table 7.4 Comparison of Alternatives											
Criterion	**Effectiveness**						**Implementability**				**Cost**
Alternative	**Protective of**		**Complies with ARARs?**	**Reduces Toxicity, Mobility, or Volume**	**Effectiveness Duration**		**Feasibility**		**Acceptance**		**Cost**
	Human Health?	**The Environment?**			**Short Term**	**Long Term**	**Technical**	**Administrative**	**State**	**Community**	
1-Alternative 1: No action	No	No	No	No	No	No	Good	Good	To be determined (TBD)	TBD	$0
2-Alternative 2: Remove soil and landfill debris	Yes	Yes	Yes	Yes	Poor	Good	Fair	Fair	TBD	TBD	$6M

8. Recommendations

8.1. Removal Action Alternative

Taking into consideration the evaluation criteria presented in this EE/CA Report, Alternative 2 is the recommended removal action alternative for surface soil in portions of Area 2 and soil and landfill contents in Area 3.

8.2. Separate Items Requiring Additional Consideration

NPS observed additional conditions during the EE/CA investigation that are outside this EE/CA scope but warrant more consideration. NPS will conduct additional investigations to address these data gaps before the RUE expires, if possible. These conditions are:

1. **Asbestos-containing material**. NPS identified potential asbestos-containing materials in buildings, pipe insulation, buried pipes, and hurricane debris scattered throughout various parts of the Resort property. Asbestos releases to soil and air may have occurred or could occur in the future as the material degrades. Appropriate debris removal and asbestos abatement, performed according to applicable solid waste regulations, should be conducted as soon as possible to avoid future releases. Additional soil sampling may be required to evaluate risks to human health and the environment that may result from existing concentrations. Asbestos released to the environment is a CERCLA hazardous substance release and will be further investigated.

2. **Lead-based paint**. NPS found lead in soils at building and debris driplines at concentrations, in some areas, that indicate lead paint was used on the buildings. Lead-paint abatement should be performed to avoid future releases of lead to soil. Additional soil sampling may be required to evaluate risks to human health and the environment that may result from existing concentrations. Lead released to the environment is a CERCLA hazardous substance release and will be further investigated.

3. **UST at Cottage 7**. Based on a gauge and pipes in the Cottage 7 basement, an underground storage tank (UST) was, and may still be, present outside the building. Soil excavation will be necessary to definitively establish if the UST has been removed. If the location (or former location) of the UST and/or fill pipe can be determined, surface and subsurface soil sampling will be performed to identify potential releases to the environment.

4. **Petroleum in soil in Area 2**. A 2010 accidental diesel release from a buried fiberglass pipe at the AST was addressed by a 2010 emergency response and possibly later. A list of reports related to this release from DPNR indicates that DPNR requires no additional action. However, in 2021, NPS encountered petroleum odors in soil near the release area.

NPS has reviewed the DPNR's release files and will conduct additional investigation to evaluate the nature and extent of residual contamination in soil and, if possible, groundwater.

5. **MW-1 closure.** The monitoring well installed to monitor the former UST closure is functioning as a conduit to the subsurface, rather than a groundwater monitoring well. If petroleum or other chemicals enter the well at the surface, they could contaminate underlying soils. The 2021 groundwater analysis from MW-1 did not indicate a reason to collect additional samples from this location. The monitoring well should be closed in accordance with USVI well abandonment requirements.

6. **Catchment Basin buried items.** In 2021, a GPR survey detected evidence of a large, unidentified buried, rectangular item. This, in combination with anecdotal reports that wastes may have been buried near the catchment basin, raises a question about possible contaminant burial and related releases. The top of the buried item, which is 2 feet below the surface, will be uncovered to evaluate if additional investigation is required. NPS will collect and analyze additional soil samples in the area.

7. **Arsenic background and clean fill values.** In 2021, NPS collected background samples at the Resort and calculated a background value of 2 mg/kg for arsenic. Because this concentration is lower than worldwide averages, NPS is uncertain about whether this value represents the possible range of local concentrations, and whether clean fill is available to restore areas subject to soil removal. NPS plans to collect additional background and possible clean fill samples to address this uncertainty. This work is expected to result in an arsenic removal goal.

8. **Possible migration of contaminants in groundwater at the landfill** In 2021, no evidence of intermittent groundwater was observed in any soil borings, but whitish stains were present on the eroded edge of the landfill. These stains indicate rainwater moves through part of the landfill and could carry contamination with it. NPS installed a monitoring well in the landfill near the seeps and plans to collect a groundwater sample in the rainy season.

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TABLES

List of Tables:

EE/CA Table 6 Standards, Requirements, Criteria, or Limitations Not Used as ARARs			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Reason for Not Being ARARs or TBC**
National Secondary Drinking Water Regulations, Secondary MCLs	Safe Drinking Water Act 42 USC §§ 300f et seq. 40 CFR Part 143	Establishes aesthetic standards (secondary MCLs) for public water systems	Shallow groundwater is not a viable public water source
Fish and Wildlife Coordination Act	16 USC §§ 661 *et seq*. as amended by Pub. L. No. 116-9, 133 Stat. 580 (2019)	Requires consideration of impacts to wildlife resources resulting from the modification of waterways	No wetland/waterway modification is contemplated
NPS Policies Concerning Floodplains	2006 NPS MP §4.6.4 NPS Director's Order (DO) #77-2: Floodplain Management; http://www.nps.gov/policy/DOrders/DO_77-2.pdf NPS Procedural Manual #77-2: Floodplain Management http://www.nature.nps.gov/rm77/floodplain.cfm	Section 4.6.4, DO #77-2, and Procedural Manual #77-2 implement Executive Order No. 11988 requiring that federally funded or authorized actions within the 100-year floodplain avoid, to the maximum extent possible, adverse impacts associated with development of a floodplain.	Caneel Bay Resort is mapped in an area of Minimal Flood Hazard (Federal Emergency Management Agency (FEMA), 2007). No Areas are in floodplains.
Federal Floodplain Management Orders	Executive Order No. 11988 NPS DO No. 77-2 [exp. 2007]	These orders require consideration of impacts to areas within the 100-year floodplain to reduce flood loss risks; minimize flood impacts on human health, safety, and welfare; and preserve and/or restore floodplain values.	Caneel Bay Resort is mapped in an area of Minimal Flood Hazard (Federal Emergency Management Agency (FEMA), 2007). No Areas are in floodplains.

EE/CA Table 6 Standards, Requirements, Criteria, or Limitations Not Used as ARARs			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Reason for Not Being ARARs or TBC**
NPS Policies Concerning Wetlands	2006 NPS MP §4.6.5 NPS DO #77-1: Wetland Protection; http://www.nps.gov/policy/DOrders/DO77-1-Reissue.html NPS Procedural Manual #77-1: Wetland Protection (January 2012) http://www.nature.nps.gov/water/wetlands/Wetlands_Protection_Manuals.cfm	Section 4.6.5, DO #77-1, and Procedural Manual #77-1 implement Executive Order No. 11990 concerning the protection of wetlands. Among other important things, in procedural manual #77-1, NPS adopts the "Classification of Wetlands and Deepwater Habitats of the United States" (FWS/OBS-79/31; adapted from Cowardin *et al.*, 1979) standards for defining, classifying, and inventorying wetlands. These standards encompass more aquatic habitat types than the definition and delineation manual used by the Army Corps of Engineers for identifying wetlands subject to Section 404 of the Clean Water Act. DO #77-1 directs NPS to avoid direct or indirect support of new construction in wetlands unless there are no practicable alternatives to such construction and the proposed action includes all practicable measures to minimize harm to wetlands, with the goal of no net loss of wetlands.	No actions are contemplated in wetlands.

EE/CA Table 6 Standards, Requirements, Criteria, or Limitations Not Used as ARARs			
Standard, Requirement, Criteria, or Limitation	**Citation**	**Requirement Description**	**Reason for Not Being ARARs or TBC**
Protection of Wetlands Order and Section 404 of the Clean Water Act	Executive Order No. 11990 and 33 USC § 1344(b)(1), 40 CFR Parts 230 and 231	Requires consideration of impacts to wetlands to minimize their destruction, loss, or degradation and to preserve/enhance wetland values. Also prohibits the discharge of dredged or fill material into waters of the United States if there is a practicable alternative considering aquatic ecosystem and other significant adverse environmental consequences.	No actions are contemplated in wetlands
NPS Employee Guidance for Managing Wilderness	NPS DO #41: Wilderness Stewardship Reference Manual (RM)-41	DO #41 and the related RM-41 offer comprehensive guidance to NPS employees responsible for managing, conserving, and protecting wilderness character and resources found in park units.	No action contemplated in wilderness area

FIGURES

APPENDICES

Appendix A – Photographic Log

Photo 1 – Dumped paint in Area 1. Orientation: North.

Date: 2/18/21. Time:16:21

Photo 2 – Rusted drums in Area 1. Orientation: East.

Date: 2/18/21. Time: 15:49

Photo 3 – Two diesel and one gasoline AST in Area 2. Orientation: Southwest.

Date: 2/11/21. Time: 14:10.

Photo 4 –Fuel dispenser pump in Area 2. Orientation: Northwest.

Date: 2/11/21. Time: 14:10

Photo 5 – MW-1 in Area 2 screened to ground surface. Orientation: North.

Date: 2/25/21. Time: 10:55

Photo 6 – Drilling at SC-3-02 on landfill in Area 3. Orientation: East.

Date: 2.19/21. Time: 9:02

Photo 7 – View of the eroded southeastern side of the landfill; plastic and metal exposed. Orientation: Northwest.

Photo 8 – Roofing debris to the east of Scott Beach rooms; tar paper has visible fibers (suspected asbestos-containing material). Orientation: South.

Date: 2/13/21. Time: 12:22

Date: 2/19/21. Time: 15:31	
 Photo 9 – Cottage 7 fuel line traced to beneath air conditioning units before signal was lost. Orientation: Not recorded. Date:2/12/21. Time: 13:30	 Photo 10 – Buried anomaly identified by GPR in storage area below the Catchment Basin. Orientation: North. Date: 2/12/21. Time: 14:43

Appendix B – EE/CA Investigation Summary Report

Appendix C – Human Health and Ecological Risk Assessment

Appendix D – Detailed Cost Estimates

Appendix E - 2014 Level 2 Environmental Site Assessment