# FINAL SAVAN GUT, CONTINUING AUTHORITIES PROGRAM (CAP) CONVERSION FEASIBILITY REPORT, ST. THOMAS, UNITED STATES VIRGIN ISLANDS

March 2020

U.S. Army Corps of Engineers
South Atlantic Division
Jacksonville District

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# FINAL SAVAN GUT, ST. THOMAS, UNITED STATES VIRGIN ISLANDS, CONTINUING AUTHORITIES PROGRAM CONVERSION FEASIBILITY REPORT

## Executive Summary

## Purpose and Background

The purpose of this report is to:

a. Demonstrate that the entire project (Phase I and II) is economically justified, environmentally acceptable, and feasible from an engineering perspective (3-E);

b. Demonstrate that the unconstructed portion (Phase II) is economically justified, environmentally acceptable, and feasible from an engineering perspective; and

c. Serve as documentation to support preparation of a Chief's Report to convert the full project from a Continuing Authorities Program (CAP) project to a specifically authorized project.

The purpose of the project is to reduce flood damages to the Jane E. Tuitt Elementary School and the Central Business District in downtown Charlotte Amalie. Heavy rainfall in the upland catchment basin of Savan Gut causes rocks and other debris to be washed down the channel toward the sea. Two constrictions reduce flows so that the flood waters overflow the channel banks and flood the school as well as the business district. The Savan section of Charlotte Amalie has extremely high runoff rates due to the steep slopes in the upper basin. Flash floods from intense thunderstorms are a common event affecting this area and can occur anytime during the year. Effects from Hurricane Maria, which hit the island in September 2017, prompted the Corps to include the project for consideration for funding under the Bipartisan Budget Act of 2018.

The Savan Gut area is located in the capital of Charlotte Amalie, on the south side of St. Thomas, U.S. Virgin Islands. The Savan section of Charlotte Amalie is within the 100-year flood plain. Located within the flood plain are 91 residential structures and 288 commercial and public structures. The 1982 Recommended Plan ((Corps), 1982) consists of the following features, portions of which have since been constructed:

- Construction of a Gabion Channel (328-feet long)
- Debris barrier located at the downstream end of the gabion channel;
- A series of drop structures;
- Catchment basin approximately 240 feet long;
- Trash barrier (rack) at the velocity check dam located at the downstream end of the drop structures before entering into the box culvert;
- Approximately 2,300 foot covered channel (box culvert) from the Jane E. Tuitt Elementary School to St. Thomas Harbor;
- Replacement of three bridges (to maintain traffic flow over proposed box culvert); and
- Mitigation for cultural resources.

The authorized project was divided into two phases for preparation of plans, specifications, and construction with the US Virgin Islands Department of Public Works (USVI DPW) as the Non-Federal Sponsor (NFS). Construction was complete on Phase I in April 1989. Phase II has not been constructed.

Phase I consisted of the construction of approximately 800 feet of the covered channel (box culvert) from St. Thomas Harbor to Wimmelskafts Gade (also known as Back Street). The constructed covered channel (box culvert) is 12 to 16 feet wide by 6 to 8 feet deep beneath a paved street (Cutters Gade). See Figure ES-1 for an aerial view of Phase I.

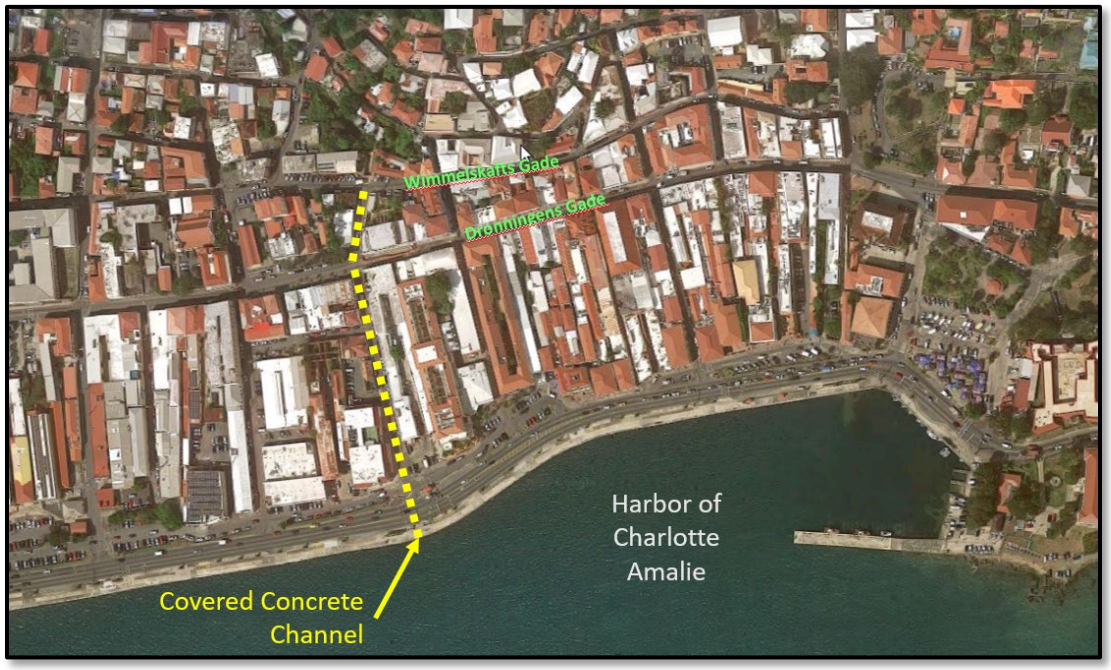


Figure ES-1: Aerial View of Savan Gut - Phase I

Phase II consists of the following features (See Figure ES-2):

- Construction of a Gabion Channel (328-feet long)
- Debris barrier located at the downstream end of the gabion channel;
- A series of drop structures;
- Catchment basin approximately 240 feet long;
- Trash barrier (rack) at the velocity check dam located at the downstream end of the drop structures before entering into the box culvert;
- Construction of the remaining approximately 1,500-ft covered concrete channel (box culvert) from Wimmelskafts Gade (also known as Back Street) to and around the Jane E. Tuitt Elementary School (the portion of the box culvert that redirects water around the school is also referred to as a diversion channel);
- Replacement of three bridges (to maintain traffic flow over proposed box culvert); and
- Mitigation for cultural resources.

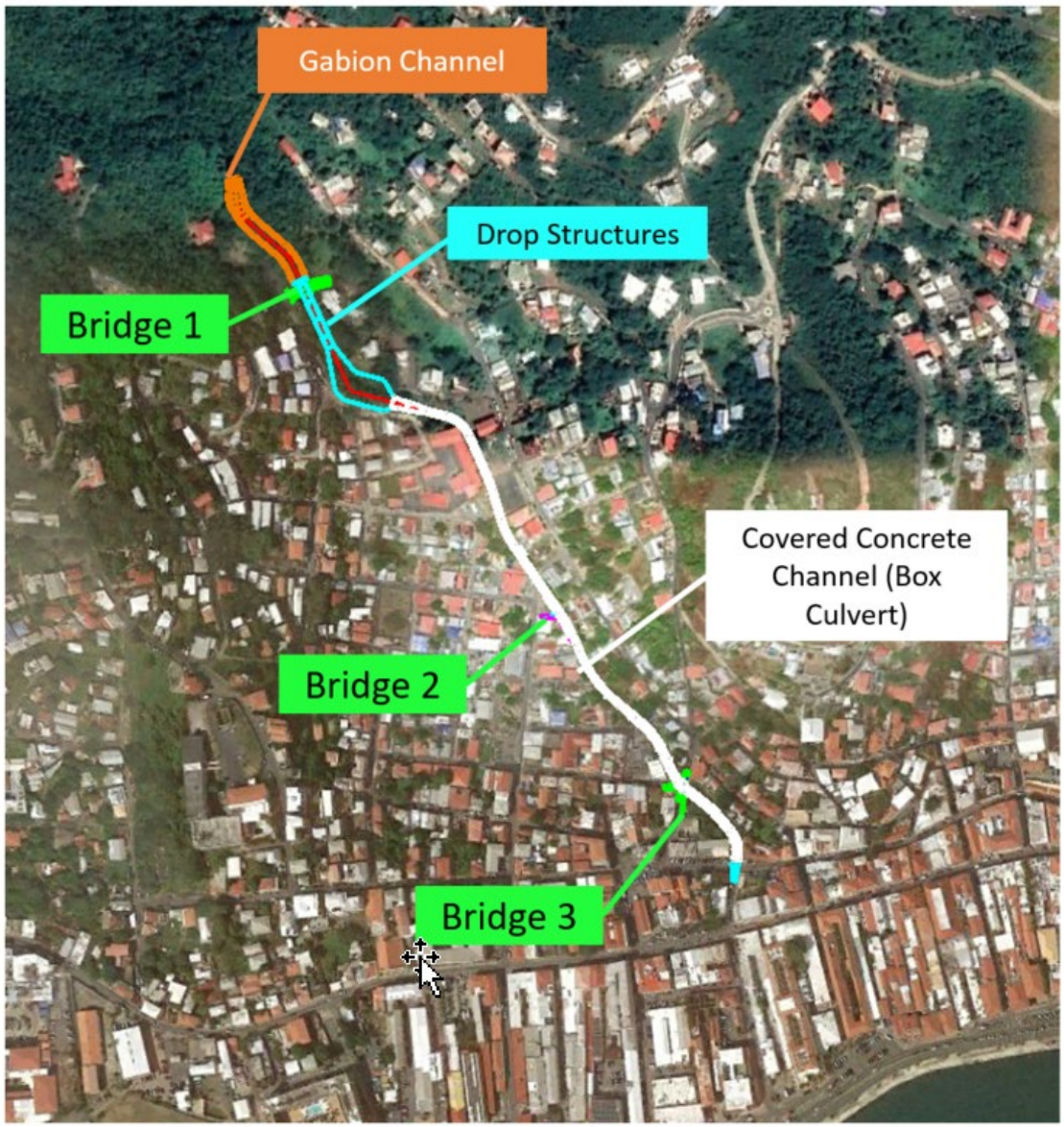


Figure ES-2: Aerial View of Savan Gut – Phase II

Phase II was advertised in 1999, but due to the bids exceeding the government estimate and costs exceeding the Corps' statutory limit for cost sharing, Phase II of the project was not awarded for construction. Since Phase II has not been constructed, significant residual flooding impacts occur in Charlotte Amalie, the capital city of the U.S. Virgin Islands on St Thomas. Since Phase II of the project exceeds the statutory limit of Federal participation for the CAP authority ($10M), additional authorization is required to construct Phase II of the project. This report is intended to demonstrate that the entire project (Phase I and II) meets the 3-E's; demonstrate that the unconstructed portion (Phase II) meets the 3-E's; and serve as documentation to support preparation of a Chief's Report to convert the full project to a specifically authorized project. This report verifies the full project and Phase II as a standalone project (the unconstructed features) are both economically justified, environmentally acceptable, and feasible from an engineering standpoint and that no additional reformulation is needed.

## Study Location

The study area is located on the southern shore of St. Thomas, within the Central Business District of Charlotte Amalie, the capital and largest city of the U.S. Virgin Islands. Savan Gut is located in a high density urban area, with the headwaters in the mountainous and heavily vegetated region north of the Charlotte Amalie harbor and the mouth of the Gut in the harbor.

## Authorization

The Savan Gut Section 205 Project was initially authorized under the Continuing Authorities Program (CAP), Section 205 of the Flood Control Act of 1948 (Public Law 80-858), as amended (33 U.S.C. § 701s).

Phase I construction was completed in 1989 under the CAP authority of Section 205 of the Flood Control Act of 1948. Phase II of the project was advertised in 1999 with bids exceeding the government estimate and the capacity of the statutory CAP budget limits. Phase II of the project is now being planned under the authority of Section 209 of the Flood Control Act of 1966, Public Law 89-789, which authorizes studies for flood control in the United States and its territories. Title IV, Division B of the Bipartisan Budget Act of 2018, Public Law 115-123, enacted February 9, 2018 ("BBA 2018"), authorizes the Government to conduct the study at full federal expense to the extent that investigations appropriations provided under the BBA 2018 are available and used for such purpose. The BBA 2018 also allows for the construction of flood and storm damage reduction projects "which are studied using funds provided under the heading ''Investigations'' if the Secretary determines such projects to be technically feasible, economically justified, and environmentally acceptable." Upon the Secretary's approval, the Corps can proceed to Preconstruction Engineering and Design (PED) and construction under the BBA 2018. Alternatively, if BBA 2018 funds are unavailable, the project can be considered for specific congressional authorization.

## Project Changes

The analysis and findings in the 1982 report and the 1999 plans and specifications were revisited and reevaluated for this CAP Conversion effort along with a site visit in November 2018. Through these efforts, it was confirmed that no significant changes are required to the recommended plan for Phase II. A new Programmatic Agreement was completed as part of this CAP conversion effort and was signed on October 30, 2019. Mitigation for cultural resources is likely to be required, but the details will be determined during PED as described in the programmatic agreement.

## Project Cost

The Certified Project First Cost for Savan Gut Phase II is $71.7M, not including the sunk costs of Phase I ($7.4M). The fully funded estimate is $81.8M.

## Project Economics

A Level 1 Reaffirmation Report, as defined by Director of Civil Works Policy Memorandum (CWPM) 12-001, *Methodology for Updating Benefit-to-Cost Ratios (BCR) for Budget*

*Development* (March 8, 2012), also known as a Level 1 Economic Analysis, was conducted for this report. Congruent with the emergency nature of the 2018 Bipartisan Budget Act, the objective of the Level 1 economic assessment is to expeditiously confirm the continued existence of the structures that the Federal project was designed to protect, and to confirm that the assumptions and corresponding benefits made in the original study continue to be realistic. The project scope, area, and purpose remain the same as stated in the 1982 Detailed Report. The inventory of property in the study area has not changed significantly, nor has the population. Because no major changes have occurred in the study area, it is reasonable to assume that the inventory and susceptibility of property subject to flooding is comparable to the 1982 assessment.

Table ES-1 represents the economic justification of the Savan Gut project by incorporating the sunk cost of Phase I and the Phase II remaining cost to complete, adjusting those respective price levels to FY 1981 and comparing the resulting average annual costs to the previously calculated average annual benefits. Included in the costs are interest and amortization, operation maintenance and replacement cost. The current discount rate of 2.75% was used to amortize costs and the March 2019 CWCCIS was used to adjust the price levels of sunk and current costs. The project as approved in 1982 had a benefit to cost ratio (BCR) of 11.4 to 1, which has decreased to 5.5 to 1, as a result of costs increasing greater than inflation. The project remains economically justified with net annual NED benefits of over $4M in 1981 price levels.

Table ES-1: Economic Justification Summary for the Savan Gut Project.

| | Savan Gut Phase I and II BCR Discount Rate 2.75% |
|---|---|
| **Phase I Costs** | |
| Phase I Project Costs (FY 98 Price Level) | $7,400,000 |
| Interest During Construction | $340,000 |
| Total Phase I Economic Cost (FY 98 PL) | $7,740,000 |
| **Phase I Total Cost in 1981 PL** | **$5,880,000** |
| **Phase II Costs** | |
| Phase II Project Costs (FY 20 Price Level) | $71,700,000 |
| Interest During Construction | $3,800,000 |
| Total Phase II Economic Cost (FY 20 PL) | $75,500,000 |
| **Phase II Total Cost in 1981 PL** | **$25,450,000** |
| | |
| Phase I & II Total Cost in FY 81PL | $31,330,000 |
| Interest and Amortization | $940,000 |
| OMRR&R (FY 81 PL) | $8,500 |
| Total Annual Cost (AAEQ) | $948,500 |
| AAB from 1982 Approved Report | $5,252,000 |
| Net Benefits | $4,303,500 |
| Benefit to Cost Ratio @2.75% | 5.54 |

The economic evaluation did not incorporate new hydrologic and hydraulic (H&H) modeling, nor updated economic modeling. However, as described in Section 3, an economic sensitivity analysis was conducted via adjusting project benefits to FY 20 price levels using the RSMeans historical cost index 30 city average and compared those to FY 20 price level total project costs. RSMeans is the leading database for construction cost in North America. This analysis yields a BCR of 6.45, demonstrating that while the overall BCR has declined from the original approved report, the project remains economically justified. Additional economic analysis described in Section 3 demonstrate the remaining cost remaining benefits of Phase II with a BCR ranging from 1.3 – 4.0 depending on assumptions used in benefits representation. These results also lead to the conclusion that the non-constructed elements of the project remain economically justified.

## Environmental

Pursuant to the National Environmental Policy Act of 1969, as amended, the Corps assessed the effects of the proposed action in the Savan Gut, St. Thomas, U.S. Virgin Islands, Detailed Project Report and Environmental Assessment (EA), dated March 1982. The 1982 EA assessed the impacts of the entire project. The 2020 EA assesses Phase II of the project and adopts the 1982 EA, by reference, only where the information is valid and applicable.

Few changes in the environmental conditions of the project area have occurred. The ongoing erosion and scouring of the gut bed and banks have continued to degrade the streambank vegetation. The Recommended Plan includes debris and vegetation removal during the channelization, clearing, and grubbing activities associated with the construction of the debris basin. While there appear to be degraded wetlands in the project's vicinity near the debris basin, the clearing and re-grading actions to create the basin are not expected to reduce the value or function of the existing degraded wetlands. Project construction will result in removal of debris and refuse from the area, and revegetation is expected to occur promptly within the project footprint. Upon construction completion, areas outside of the construction footprint will be restored. Therefore, consistent with the 1982 Recommended Plan, mitigation is not required as there will be no loss of wetland function.

Pursuant to Section 7 of the Endangered Species Act of 1973, as amended, the Corps coordinated with National Marine Fisheries Service (NMFS) and consulted with U.S. Fish and Wildlife Services (USFWS) during completion of the 1982 EA. During the development of the 2020 EA, the Corps determined that the project would have no effect on listed species under NMFS jurisdiction and the project may affect, but is not likely to adversely affect, (MANLAA) listed species under USFWS jurisdiction. The Corps completed Section 7 consultation with USFWS. In a letter dated March 7, 2019, USFWS concurred with the Corps' MANLAA determination. The Corps coordinated the project with NMFS during the public review of the draft EA. All coordination and consultation with resource agencies is complete, and pertinent correspondence is located in Appendix A of the 2020 EA.

## Cultural Resources

The Corps reinitiated consultation for the Recommended Plan with the USVI Historic Preservation Office (SHPO) pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended. A Programmatic Agreement was executed on October 30, 2019 with the

USVI Historic Preservation Officer and the USACE SAJ, specific to Phase II only. The Programmatic Agreement outlines the process by which the Corps will consult with the agencies to avoid, minimize, and mitigate adverse effects to historic properties. In summary, Section 106 consultation regarding cultural resources is complete for NEPA purposes. Ongoing coordination with the USVI SHPO will continue in accordance with the programmatic agreement that was executed on October 30, 2019 to avoid, minimize, or mitigate for adverse cultural resource impacts.

## Compliance with USACE Quality Control Standards

District Quality Control (QC) was implemented throughout the report development process and at each delivery level. Engineer Circular (EC) 1165-2-217 requirements and guidelines were implemented for the reviews for this report. A project Review Plan was developed and endorsed by the FRM-PCX and approved by South Atlantic Division. The procedures outlined in the EC were utilized to complete District Quality Control (DQC) and Agency Technical Review (ATR) for the report. Documentation for reviews are provided in Appendix B.

## Recommendation

It is recommended that the unconstructed features (Phase II) from the Recommended Plan detailed in the 1982 Savan Gut St. Thomas, U.S. Virgin Islands, Detailed Project Report and Environmental Assessment, approved previously under Section 205 of the 1948 Flood Control Act, as modified in this Continuing Authorities Program (CAP) Conversion Feasibility Report, at an estimated first cost of $71.7M, be authorized. The updated CAP Conversion Report concludes that the project as previously planned and modified based on current conditions is economically justified, environmentally acceptable, and feasible from an engineering standpoint.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

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# 1. Study Overview

The following sections describe the project location, the purpose of the report, the need for the project, study authorization, and the recommended plan.

## 1.1. Purpose

The purpose of this report is to:

a. Demonstrate that the entire project (Phase I and II) is economically justified, environmentally acceptable, and feasible from an engineering perspective (3-E);

b. Demonstrate that the unconstructed portion (Phase II) is economically justified, environmentally acceptable, and feasible from an engineering perspective; and

c. Serve as documentation to support preparation of a Chief's Report to convert the full project from a Continuing Authorities Program (CAP) project to a specifically authorized project.

The purpose of the project is to reduce flood damages to the Jane E. Tuitt Elementary School and the Central Business District in downtown Charlotte Amalie. Heavy rainfall in the upland catchment basin of Savan Gut causes rocks and other debris to be washed down the channel toward the sea. Two constrictions reduce flows so that the flood waters overflow the channel banks and flood the school as well as the business district. The Savan section of Charlotte Amalie has extremely high runoff rates due to the steep slopes in the upper basin. Flash floods from intense thunderstorms are a common event affecting this area and can occur anytime during the year. Effects from Hurricane Maria, which hit the island in September 2017, prompted the Corps to include the project for consideration for funding under the Bipartisan Budget Act of 2018.

The Savan Gut area is located in the capital of Charlotte Amalie, on the south side of St. Thomas, U.S. Virgin Islands. The Savan section of Charlotte Amalie is within the 100-year flood plain. Located within the flood plain are 91 residential structures and 288 commercial and public structures. The 1982 Recommended Plan ((Corps), 1982) consists of the following features, portions of which have since been constructed:

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- Catchment basin approximately 240 feet long;
- Trash barrier (rack) at the velocity check dam located at the downstream end of the drop structures before entering into the box culvert;
- Approximately 2,300 foot covered channel (box culvert) from the Jane E. Tuitt Elementary School to St. Thomas Harbor;
- Replacement of three bridges (to maintain traffic flow over proposed box culvert); and
- Mitigation for cultural resources.

The authorized project was divided into two phases for preparation of plans, specifications, and construction with the US Virgin Islands Department of Public Works (USVI DPW) as the Non-

Federal Sponsor (NFS). Construction was complete on Phase I in April 1989. Phase II has not yet been constructed.

Phase I consisted of the construction of approximately 800 feet of the covered channel (box culvert) from St. Thomas Harbor to Wimmelskafts Gade (also known as Back Street). The constructed covered channel (box culvert) is 12 to 16 feet wide by 6 to 8 feet deep beneath a paved street (Cutters Gade). See Figure 1 for an aerial view of Phase I.

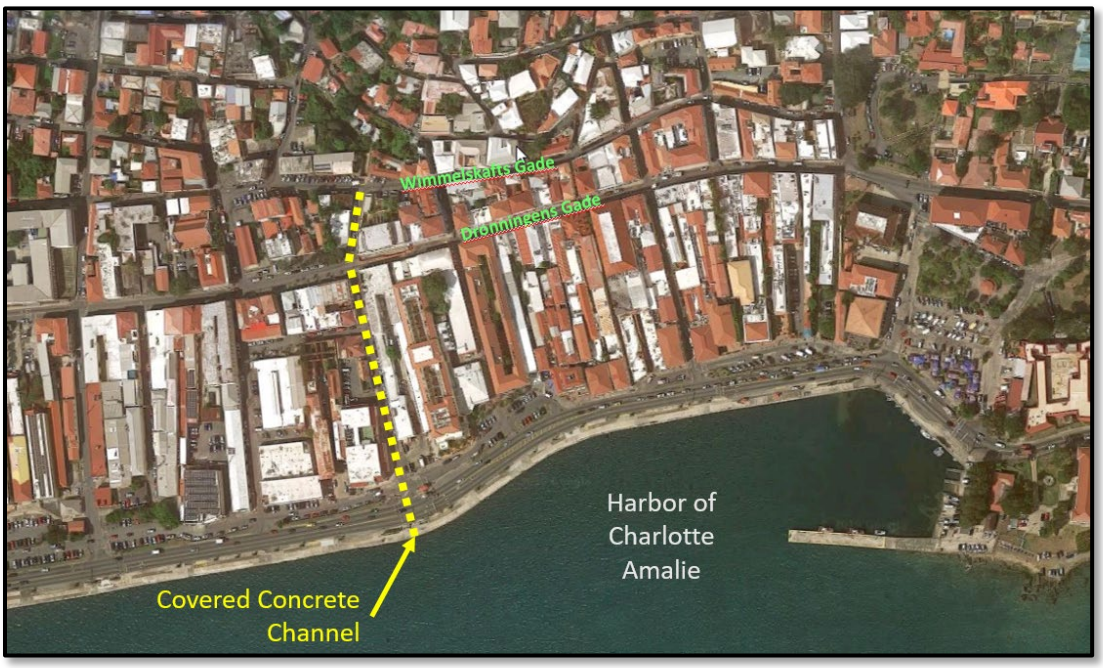


Figure 1: Aerial View of Savan Gut Phase I only (yellow dashed line)

Phase II consists of following features (See Figure 2)

- Construction of a Gabion Channel (328-feet long)
- Debris barrier located at the downstream end of the gabion channel;
- A series of drop structures;
- Catchment basin approximately 240 feet long;
- Trash barrier (rack) at the velocity check dam located at the downstream end of the drop structures before entering into the box culvert;
- Construction of the remaining approximately 1,500-ft covered concrete channel (box culvert) from Wimmelskafts Gade (also known as Back Street) to and around the Jane E. Tuitt Elementary School (the portion of the box culvert that redirects water around the school is also referred to as a diversion channel);
- Replacement of three bridges (to maintain traffic flow over proposed box culvert); and
- Mitigation for cultural resources.

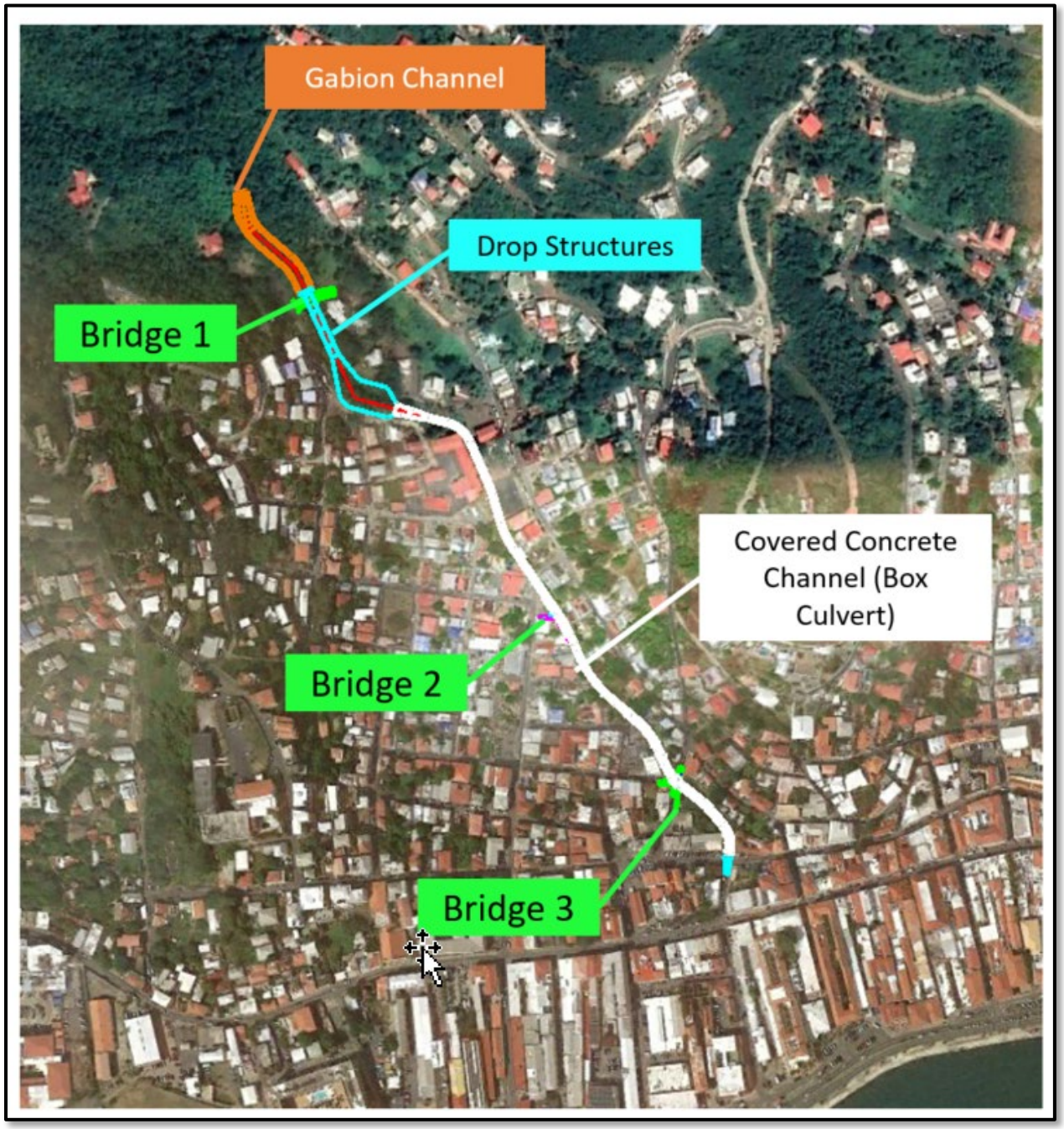


Figure 2: Aerial of Savan Gut Phase II

Phase II was advertised in 1999 but, due to the bids exceeding the government estimate and costs exceeding the Corps' statutory limit for cost sharing ($10M), Phase II of the project was not awarded for construction. Since Phase II has not been constructed, significant residual flooding impacts occur in Charlotte Amalie, the capital city of the U.S. Virgin Islands on St Thomas. Since Phase II of the project exceeds the statutory limit of Federal participation for the CAP authority ($10M), additional authorization is required to construct Phase II of the project.

This report serves as documentation to support preparation of a Chief's Report to convert the CAP project to a specifically authorized project for the full project, both Phase I and Phase II. This report verifies that the entire project meets the 3-E's and the remaining features in Phase II (the unconstructed features) meets the 3-E's and no additional reformulation is needed.

In response to the impacts caused by Hurricane Irma and Hurricane Maria the Bipartisan Budget Act (BBA) of 2018 (Public Law 115-123) was passed and Title IV, Division B of the BBA authorizes the Government to conduct the study at full federal expense to the extent that appropriations provided under the Investigations heading of the 2018 BBA are available and used for such purpose.

## 1.2. Study Location and Need

The study area is within the Central Business District of Charlotte Amalie, the capital and largest city of the U.S. Virgin Islands. Charlotte Amalie is on the southern shore of the island of St. Thomas (See Figure 3). Savan Gut provides the drainage for a watershed area of approximately 260 acres, flowing through densely developed Charlotte Amalie to St. Thomas Harbor in a constructed channel.

Savan Gut (known locally as Deyoung Gut) is located in the highly developed urbanized area of Charlotte Amalie, St. Thomas, USVI. The gut's headwaters begin in the mountainous and heavily vegetated region north of the Charlotte Amalie harbor. The gut drains directly into the harbor via a combination of a natural gut from the vegetated area, to a combination of a intermixed lined and unlined degraded concrete channel from the Jane E. Tuitt Elementary School (flowing under the school and the school's basketball court) to the intersection of Guttets Gade and Norte Gade, where the culvert is then inaccessible and flows underneath businesses and roads of downtown Charlotte Amalie until it exits into St. Thomas Harbor.

Figure 3: Savan Gut Project Location

## 1.3. Authorization and Prior Reports

### 1.3.1. Section 205 of the Flood Control Act of 1948

The Savan Gut Section 205 Project was initially authorized under the Continuing Authorities Program (CAP), Section 205 of the Flood Control Act of 1948 (Public Law 80-858), as amended (33 U.S.C. § 701s). Phase I construction was completed in 1989 under this authority. Phase II of the project was advertised in 1999 with bids exceeding the government estimate and the Corps' statutory limit for cost sharing. The project is now being planned under the authority of Section 209 of the Flood Control Act of 1966 (Public Law 89-789) which authorizes studies for flood control in the United States and its territories. Title IV, Division B of the Bipartisan Budget Act (BBA) of 2018 (Public Law 115-123) authorizes the Government to conduct the study at full federal expense to the extent that appropriations provided under the Investigations heading of the 2018 BBA are available and used for such purpose.

The Savan Gut, Section 205 Detailed Project Report (DPR) and Environmental Assessment (EA) was completed in 1982 under the authority of Section 205 of the 1948 Flood Control Act, as amended, with an estimated construction cost of $6.3 M and benefit to cost ratio of 11.4 to 1. Phase I was also constructed under this authority. The language in Section 205 reads as follows:

> *The Secretary of the Army is authorized to allot from any appropriations heretofore or hereafter made for flood control, not to exceed $68,750,000 for any one fiscal year, for the implementation of small structural and nonstructural projects for flood control and related purposes not specifically authorized by Congress, which come within the provisions of section 701a of this title, when in the opinion of the Chief of Engineers such work is advisable. The amount allotted for a project shall be sufficient to complete Federal participation in the project. Not more than $10,000,000 shall be allotted under this section for a project at any single locality. The provisions of local cooperation specified in section 701c of this title shall apply. The work shall be complete in itself and not commit the United States to any additional improvement to insure its successful operation, except as may result from the normal procedure applying to projects authorized after submission of preliminary examination and survey reports.*

### 1.3.2. Section 209 of the Flood Control Act of 1966

Phase II of the project is now being planned under the authority of Section 209 of the Flood Control Act of 1966 (Public Law 89-789) authorizing studies for flood control in the United States and it territories. The authorizing language reads as follows:

> *The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes, including channel and major drainage improvements, and floods aggravated by or due to wind or tidal effects, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the localities specifically named in this section. After the regular or formal reports made on any survey authorized by this section are submitted to Congress, no supplemental or additional report or estimate shall be made unless authorized by law except that the Secretary of the Army may cause a review of any*

*examination or survey to be made and a report thereon submitted to Congress, if such review is required by the national defense or by changed physical or economic conditions.*

*Watersheds and streams of Puerto Rico and the Virgin Islands, with respect to a framework plan for developing water resources of the region.*

#### 1.3.3. Title IV, Division B of the Bipartisan Budget Act of 2018

Title IV, Division B of the Bipartisan Budget Act of 2018, Public Law 115-123, enacted February 9, 2018 ("BBA 2018"), authorizes the Government to conduct the study at full federal expense to the extent that investigations appropriations provided under the 2018 BBA are available and used for such purpose. The BBA 2018 also allows for the construction of flood and storm damage reduction projects "which are studied using funds provided under the heading ''Investigations'' if the Secretary determines such projects to be technically feasible, economically justified, and environmentally acceptable." Upon the Secretary's approval, the Corps can proceed to Preconstruction Engineering and Design (PED) and construction under the BBA 2018. Alternatively, if BBA 2018 funds are unavailable, the project can be considered for specific congressional authorization.

### 1.4. Project Design

The 1982 DPR and EA identified the National Economic Development (NED) Plan to construct a 2,300-ft covered concrete channel (box culvert) from the harbor upstream, terminating at a velocity check dam just above the Jane E. Tuitt Elementary School, replacement of three bridges with sections of covered channel, and the construction of a velocity check dam and debris trap. The Recommended Plan provides flood damage reduction benefits to the Standard Project Flood level.

### 1.5. Construction Status

Phase I construction was completed in 1989. Phase II remains unconstructed. Phase II of the project was advertised in 1999, but bids exceeded the government estimate and the statutory limit of Federal participation of Section 205 of the Continuing Authorities Program (CAP).

## 2. Overview of Changed Conditions from Authorization

### 2.1. Economic Conditions

#### 2.1.1. Population

According to the USVI Bureau of Economic Research, the population of the U.S. Virgin Islands increased 6.7 percent from 1990 to 2000. However, from 2007 to 2017 the Islands experienced a decline in population at the rate of 1.9 percent every five years, or -0.6 percent annually. As of the 2010 Census, the population of Saint Thomas was 51,634 compared to 48,166 in 1990, an increase of 7 percent growth over the ten year period. However, the current population is very similar to the population that existed when the original benefits were evaluated so it is reasonable to assume that the benefits would be at least similar in scale to those calculated in 1982. Table 2-1 presents the population of U.S. Virgin Islands and St. Thomas for selected years since 1990.

Table 2-1: Population of US. Virgin Islands and St. Thomas [1]

| | 1990 | 2000 | 2007 | 2008 | 2009 | 2010 | 2017 | Annual Percent Change | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 5-year | 1-year |
| US Virgin Islands | 101,809 | 108,612 | 114,743 | 115,852 | 107,343 | 106,405 | 96,815 | 1.9 | 0.6 |
| St. Thomas | 48,166 | 51,181 | 54,070 | 54,592 | 50,583 | 51,634 | 46,600 | 1.5 | 0.6 |

### 2.1.2. Socio-Economic Assessment

Tourism, trade, and other services are the primary economic activities, accounting for nearly 60 percent of the USVI's gross domestic product (GDP) and about half of total civilian employment.[1] Close to two million tourists per year visit the islands. The government is the single largest employer. In 2016, government spending (both federal and territorial together) accounted for about 27 percent of GDP while exports of goods and services, including spending by tourists, accounted for nearly 47 percent. The agriculture sector is small, with most food being imported. The manufacturing sector consists of rum distilling, electronics, pharmaceuticals, and watch assembly. Rum production is significant. Shipments during a six-month period of fiscal year 2016 totaled approximately 8.1 billion gallons.

The 1982 DPR & EA divided the study area into 44 blocks with 379 structures identified. The existing development was surveyed to determine structure type, value, size, location and commercial content value. Ground elevations and flood frequency elevations were interpreted and flood depths were calculated for each structure for the flood frequencies evaluated. Structures were separated into 41 commercial and two residential damage relationship classifications and damages estimated by applying depth damage relationships to each structure's content and physical value for all flood frequencies.

The structure inventory does not appear to have changed significantly since the 1982 report. A majority of the structures appear to be inhabited and all show considerable signs of age, with many of the buildings constructed in the downtown area over a century old. The Jane E. Tuitt Elementary School appears to have been constructed in the 1930s with a major upgrade and renovation in the 1950s. There are numerous vehicles on every street in the study area. Savan Gut flows through the main tourist area in Charlotte Amalie, which is undergoing a significant revitalization with decorative paver streets and expansion of the main route to a multi-lane highway. Since the previous report was completed, the cruise ship industry has seen a dramatic increase in visitation, which has had a substantial economic impact on the infrastructure development in the Charlotte Amelia region.

### 2.1.3. Regional Economic Development

Temporary closure of the roads and bridges during construction may lead to temporary impacts on local business in the vicinity of the construction. The cruise industry based shopping district in Charlotte Amalie is a large source of tax revenue and employment for the USVI.

[1] U.S. Virgin Islands Economic Review, VI Bureau of Economic Research. May 15, 2016.

### 2.1.4. Other Social Effects

Current enrollment at the Jane E. Tuitt Elementary School is 172 students plus additional teachers and staff, and has had relatively stable enrollment over the past decade.[2] This school is the primary public school for elementary-aged children in the Savan Area of Charlotte Amalie. The school remains at risk of flooding, potentially placing students, teachers, and school personnel at risk if a significant flood event were to occur during school hours. The project resides in a highly urbanized environment which is residential and businesses. This also raises concerns for potential life loss to residents and tourist visiting the downtown area during significant flooding events.

## 2.2. Engineering Conditions

Preliminary review of the current conditions from aerial imagery, an emergency assessment under Public Law 84-99 made on October 31, 2017, following Hurricane Maria, and a more recent site visit on November 9, 2018, suggest that the project features in the original plan of 1982 and updated 1999 plans and specifications are still valid to address the project needs for flood risk management.

The 1982 hydrologic and hydraulic analysis was based on the selected design storm for the project, the Standard Project Flood (SPF), which is defined as fifty percent of the Probable Maximum Flood (PMF) occurring from the Probable Maximum Precipitation (PMP) rainfall event. The PMP is theoretically the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographic location at a certain time of year. The PMP used for the project was derived from Technical Paper No. 42, (TP-42) Generalized Estimates of Probable Maximum Precipitation and Rainfall-Frequency Data for Puerto Rico and Virgin Islands published in 1961. The PMP rainfall event in the USVI has not changed or been updated over the timeframe of the project development (updates to the PMP are the responsibility of the NOAA's National Weather Service) and therefore is still a valid rainfall total for the SPF design event for this project. The National Weather Service has provided PMP guidance and studies since the late 1940s at the request of various federal agencies and with funding provided by those agencies. The 1982 hydrologic analysis rainfall runoff was computed using the U.S. Soil Conservation Service (SCS) loss methodology and the Snyder unit hydrograph transform method, which are still considered as technically acceptable. Additionally, the hydrologic analysis was based on the antecedent moisture condition III (AMC III), which represents a saturated basin, with higher SCS curve numbers, resulting in a conservative peak flow value.

The hydraulic design was based on criteria outlined in Engineer Manual 1110-2-1601 Hydraulic Design of Flood Control Channel, which although was updated in 1991, is still complaint with the current standards. The Hydrologic Engineering Center HEC-2 (1D) hydraulic routing model was used to determine design water surface profiles for the project area.

Significant events such as Hurricanes Irma and Maria could affect rainfall event frequencies as a result of re-analyzing a longer historical record but these two hurricanes would not affect the PMP which is based on an atmospheric maximum.

The project's last hydrologic and hydraulic analyses was conducted prior to 1982, giving the age of the previous analyses of over 35 years. The practice in the Hydrologic and Hydraulic

[2] USVI Department of Education Enrollment Figures

Community of Practice (H&HCoP) today is to remodel basins if they are 10 years old or more often if significant changes may have occurred since last simulated. This is because of potential land use changes, climate (rainfall depth) change, better computing tools availability, etc. For this project, land use and rainfall depths have not changed significantly. Additionally, computing tools with technological advances in data collection, have made strides in improved accuracy (mainly in the 2D capabilities) and may impact project flood stages, velocities, and other design parameters. The new models are the Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) model and the Hydrologic Engineering Center – River Analysis System (HEC-RAS) hydraulic analysis model. However, this project design requires mainly 1D capabilities, and even with these computing model upgrade changes, there is no reason to expect a significant change of design as many of the design assumptions used in the HEC-2 model were conservative. Assumptions included a conservative tidal boundary and channel freeboard.

Updating of the hydrologic analysis of the PMP rainfall used in the previous design is likely not warranted as the rainfall totals have not changed.

The development of both the HEC-HMS model and HEC-RAS hydraulic model would be required in PED if a Value Engineering proposal, such as an alternative to change the channel size or invert elevation is needed to be analyzed. Additionally, if unanticipated modifications to the velocity check dam or debris barrier are necessary or if real estate, utility, or construction requirements call for a change in the design, updates to the hydraulic model, at minimum, would be necessary. If the project design moves forward as proposed in the Recommended Plan, and no modifications are proposed, remodeling of the 1982 design will likely not be necessary.

It should be noted that the structural engineering design and other engineering details, including geotechnical analysis, still appear valid. The structural design from 1982 was based on Engineering and Design manuals from USACE. During PED, updates to the structural design may occur, including modification of construction material, but are anticipated to be minor. Additionally, updated geotechnical boring information may be required to confirm assumed foundation and excavation conditions and geotechnical analysis.

### 2.2.1. Sea Level Change Rise Due to Climate Change

The climate assessment for sea level change follows the USACE guidance of Engineer Regulation (ER) 1100-2-8162, Incorporating Sea Level Change in Civil Works Programs, and Engineer Technical Letter (ETL) 1100-2-1, Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation. ER 1100-2-8162 and ETL 1100-2-1 provide guidance for incorporating the direct and indirect physical effects of projected future sea level change across the project life cycle in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of projects. However, it is important to note that the climate change analysis included within this Validation report is limited in scope and therefore the climate assessment is scaled back based on project purpose and complexity.

Per the guidance, projected sea level changes should first be calculated using either of the following USACE web-based statistical tools for the respective project: the Sea Level Change Curve Calculator or Sea Level Tracker. These tools provide estimates on when sea levels may impact threshold elevations for the critical infrastructure of the project. If the projected sea level elevations indicate that the project may be vulnerable to sea level change and that the project

may not function as intended over time, then additional analysis may be required by the project team to assess the resiliency and potential adaptation measures needed for the project.

The earliest data available for analysis on the USACE Sea-Level Change Curve Calculator (Version 2017.55) is 1986 for the Charlotte Amalie, VI gauge location. An analysis starting at 1992 to 2042 for a 50-year project life cycle and to 2092 for a 100-year life cycle will be presented. 1992 corresponds to the midpoint of the current National Tidal Datum Epoch of 1983–2001.

Figure 4 shows the alignment of the Savan Gut Project on the terrain profile. The ground elevation profile of the alignment is also shown with the headwater elevations starting at approximately 15 meters Virgin Islands Vertical Datum of 2009 (m-VIVD09) and the low-lying terrain at the bay just below 1.0 m-VIVD09. Figure 5 shows the street elevation of approximately 0.95 m-VIVD09 with a street view from Google Earth looking south with the sea wall in the foreground. The sea wall elevation is assumed to be approximately the same as 0.95 m-VIVD09.

Figure 6 and Figure 7 show the estimated Relative Sea Level Change (RSLC) Low, Intermediate and High prediction curves from the USACE Sea-Level Change Curve Calculators for the 100-year life cycle previously mentioned. The critical elevation line at 0.95 m-VIVD09 corresponds to the approximate sea wall and adjacent low-lying lands elevations as shown in Figure 6. Figure 7 shows the NOAA Tides and Currents Relative Sea Level Trend at the same tide gauge location. The relative sea level trend is 2 millimeters/year with a 95 percent confidence interval of +/- 0.63 mm/yr based on monthly mean sea level data from 1975 to 2018 which is equivalent to a change of 0.68 feet in 100 years. This trend, if imposed on the USACE Sea-Level Change Curves, would lie between the Low and Intermediate Curves. Figure 8 shows the different datums at the gauge location, which illustrates that the VIVD09 is 0 ft relative to MSL. It is important to note that within the Sea Level Change Curve Calculator tool, the datum values relative to Local Mean Sea Level (LMSL) are the same as to MSL, as illustrated in Figure 9. Therefore the Local MSL reported along the y-axis in the RSLC graphic is being used interchangeably as MSL, which is the same value as VIVD09.

This analysis of the predicted SLC curves show that the sea wall and low lying ground elevation will begin to experience flooding from the Local MSL level in 2078 if the High curve was to occur and well past 2100, if the Intermediate curve occurs. Therefore, although sea levels relative to the Savan Gut outlet structure are projected to rise, the project features or benefits would not be impacted for at least 58 years (high curve) and over 100 years for the intermediate curve. Additionally, the Sea Level Curve Calculator tool was utilized to determine when the sea level change and other components of the total water level may potentially reach the critical elevations. Figure 10 through Figure 13 illustrate various combinations of water levels and sea level curves to gain a better understanding. The 10% extreme water level (EWL) and the high sea level curve may impact the project features beginning in 2051. The intermediate + 10% EWL would potentially see impacts to the project features around 2105. No impacts to the project features would be experienced due to the 10% EWL and the low curve. Similarly with the tides, MHHW and the high curve will not impact the project until 2072. No impacts to the project would be experienced due to MHHW and the low curve.

The hydraulic design of the storm water culvert changes the tailwater condition during a storm event, but all of the runoff area being protected from flood damages is above elevations affected by SLC. The project is designed for the SPF event (50% PMP) and the channel has a relatively steep slope, limiting the backwater influence that may occur from any future elevated sea levels. The projected sea level elevations, however, under the high curve scenario indicate that the project may be vulnerable to sea level change and the project may not function as intended over time. Therefore, during PED, additional analysis may be performed by the project team to assess the resiliency and potential adaptation measures needed for the project. These measures may include potential modifications or additional resiliency to the sea wall. The sea wall is not a project feature and the cost of such a measure would probably be borne by the local government.

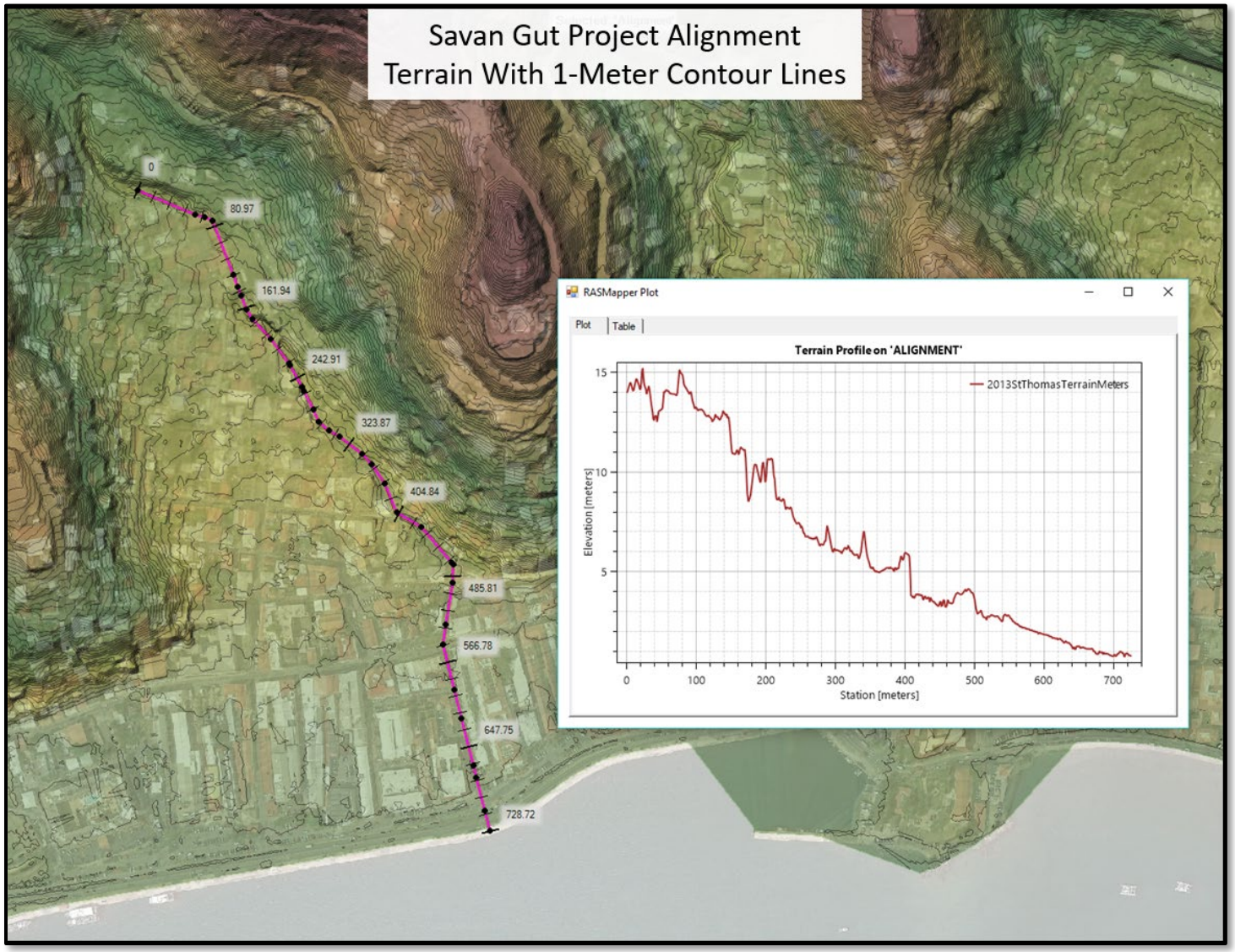


Figure 4: Savan Gut Alignment Terrain Profile

Figure 5: Approximate Terrain Elevation and View of Sea Wall Looking South

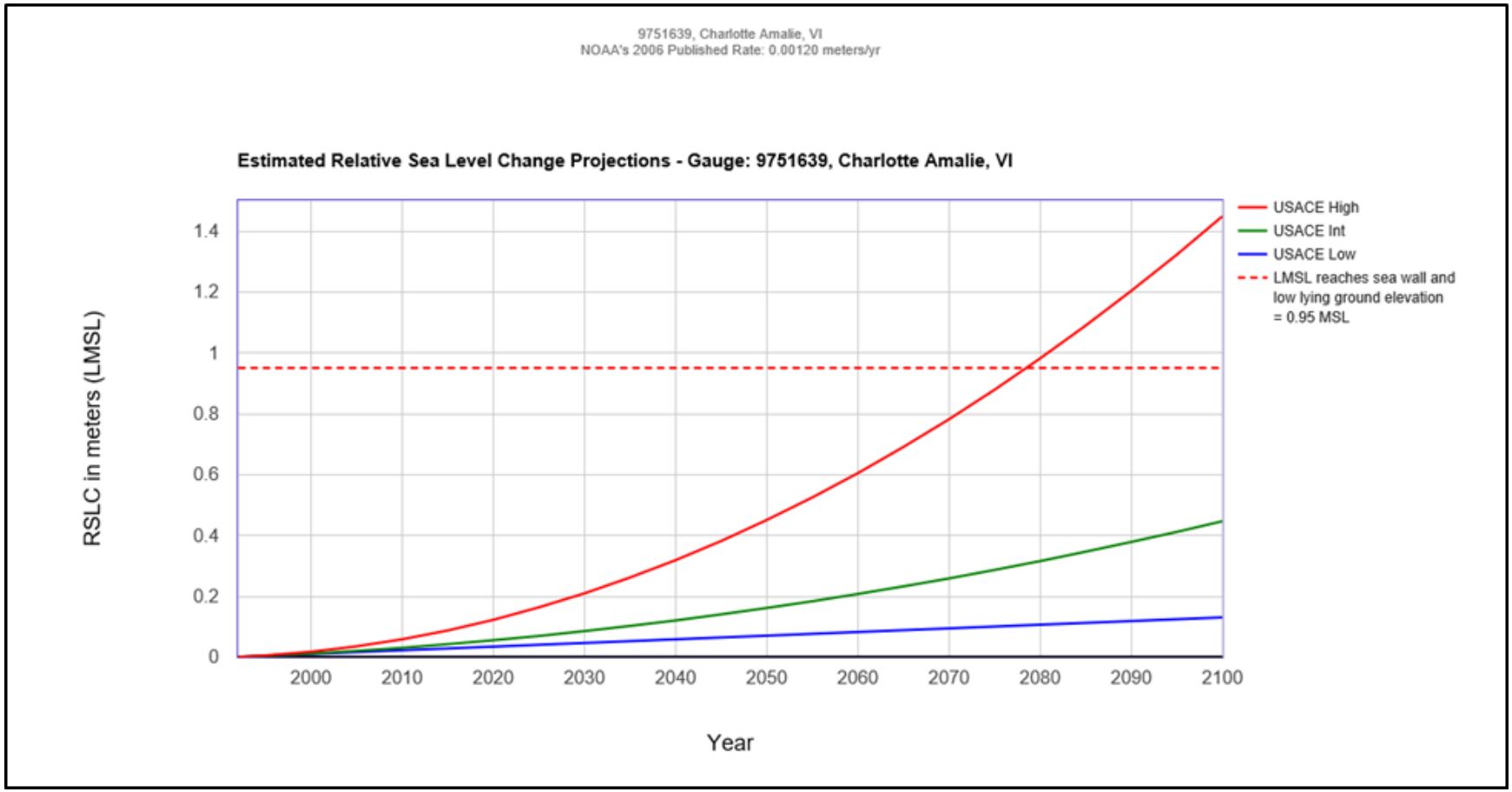


Figure 6: Tidal Prediction Curves and Critical Threshold Elevation at Charlotte Amalie, USVI

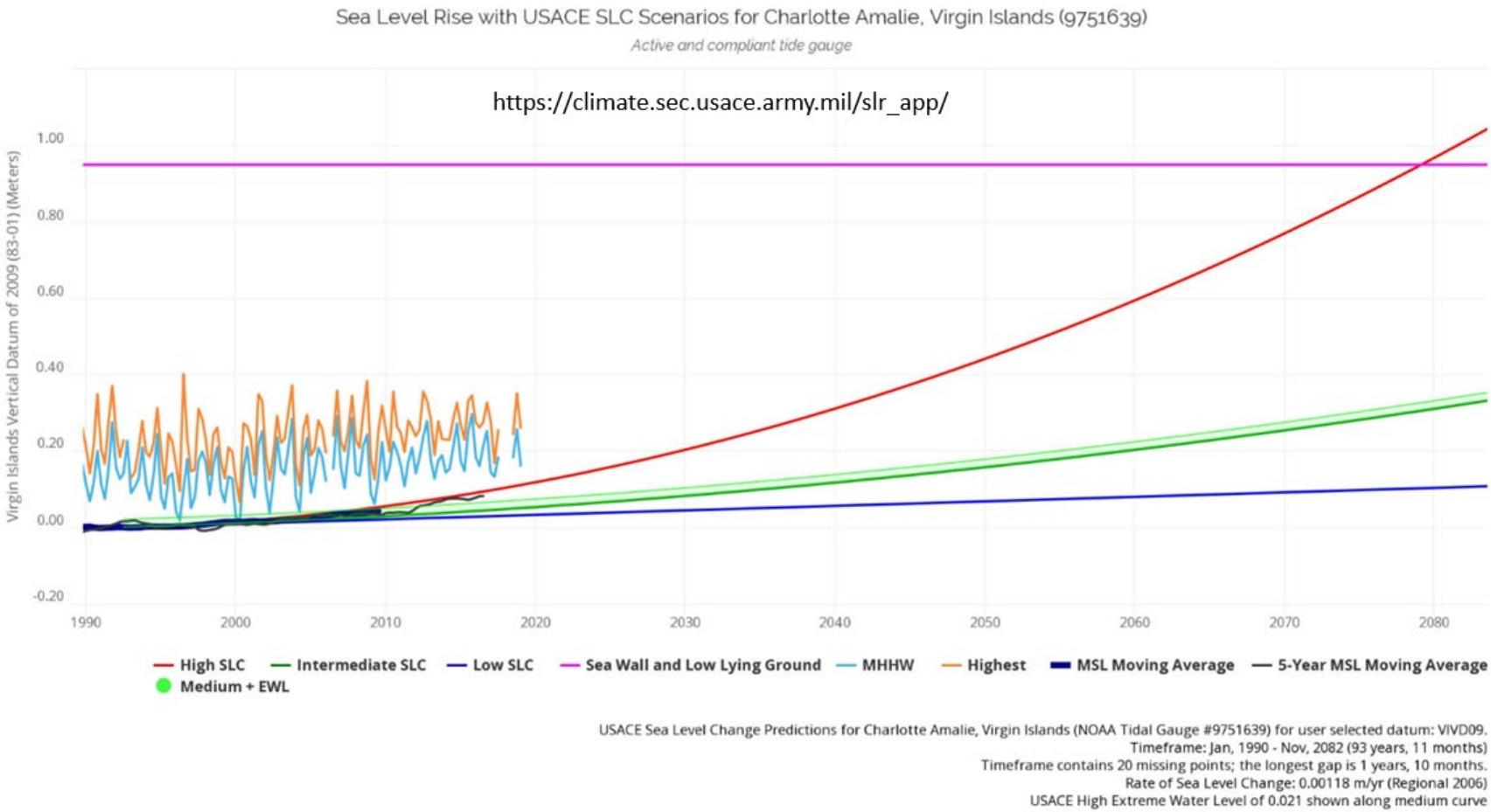


Figure 7: Tidal Prediction Curves at Charlotte Amalie, USVI with Extreme Water Levels (EWL)

## Elevations on Mean Sea Level

**Station:** 9751639, Charlotte Amalie, VI
**Status:** Accepted (Sep 7 2017)
**Units:** Feet
**Control Station:**

**T.M.:** 0
**Epoch:** 1983-2001
**Datum:** MSL

| Datum | Value | Description |
|---|---|---|
| MHHW | 0.41 | Mean Higher-High Water |
| MHW | 0.37 | Mean High Water |
| MTL | 0.02 | Mean Tide Level |
| MSL | 0.00 | Mean Sea Level |
| DTL | 0.02 | Mean Diurnal Tide Level |
| MLW | -0.33 | Mean Low Water |
| MLLW | -0.38 | Mean Lower-Low Water |
| VIVD09 | 0.00 | Virgin Islands Vertical Datum of 2009 |
| STND | -5.63 | Station Datum |
| GT | 0.79 | Great Diurnal Range |
| MN | 0.70 | Mean Range of Tide |
| DHQ | 0.04 | Mean Diurnal High Water Inequality |
| DLQ | 0.05 | Mean Diurnal Low Water Inequality |
| HWI | | Greenwich High Water Interval (in hours) |
| LWI | | Greenwich Low Water Interval (in hours) |
| Max Tide | 3.34 | Highest Observed Tide |
| Max Tide Date & Time | 09/16/1995 05:00 | Highest Observed Tide Date & Time |
| Min Tide | -1.85 | Lowest Observed Tide |
| Min Tide Date & Time | 02/06/1985 02:00 | Lowest Observed Tide Date & Time |
| HAT | 0.82 | Highest Astronomical Tide |
| HAT Date & Time | 10/17/1989 15:36 | HAT Date and Time |
| LAT | -0.88 | Lowest Astronomical Tide |
| LAT Date & Time | 01/28/1987 04:06 | LAT Date and Time |

Figure 8: Station 9751639 Charlotte Amalie, VI Datum Values

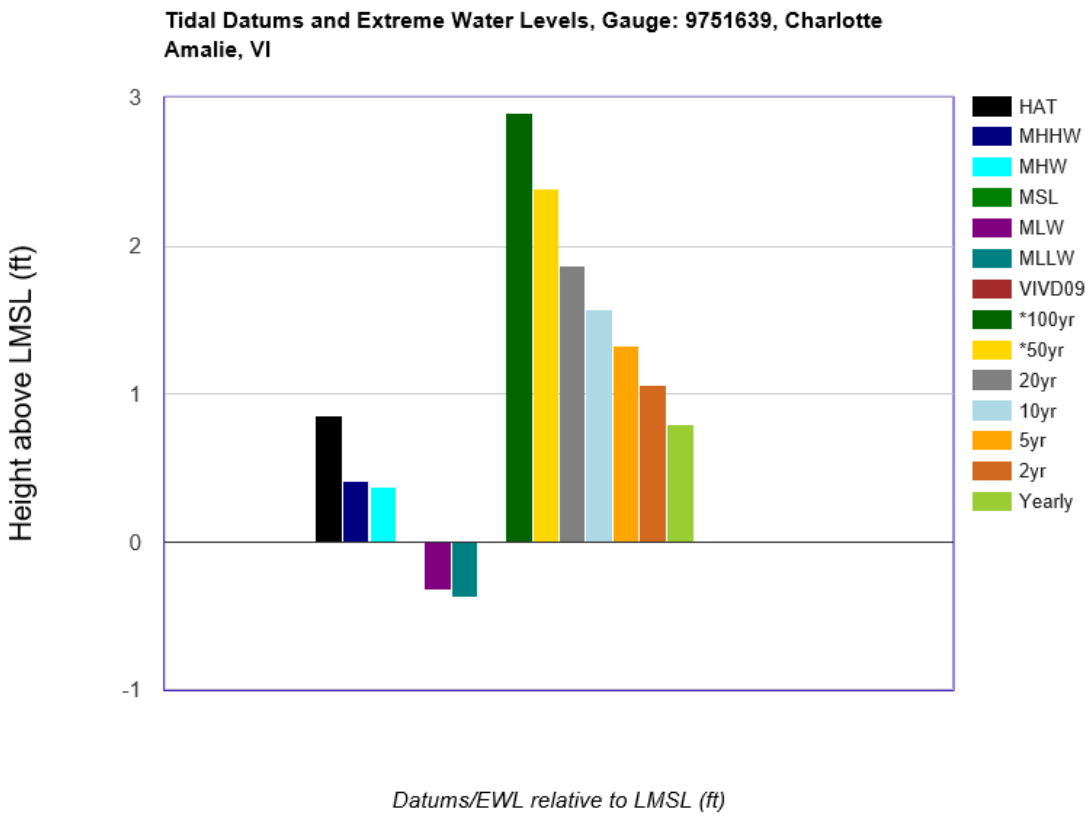


Figure 9: Tidal Datums and Extreme Water Levels, Gauge 9751639

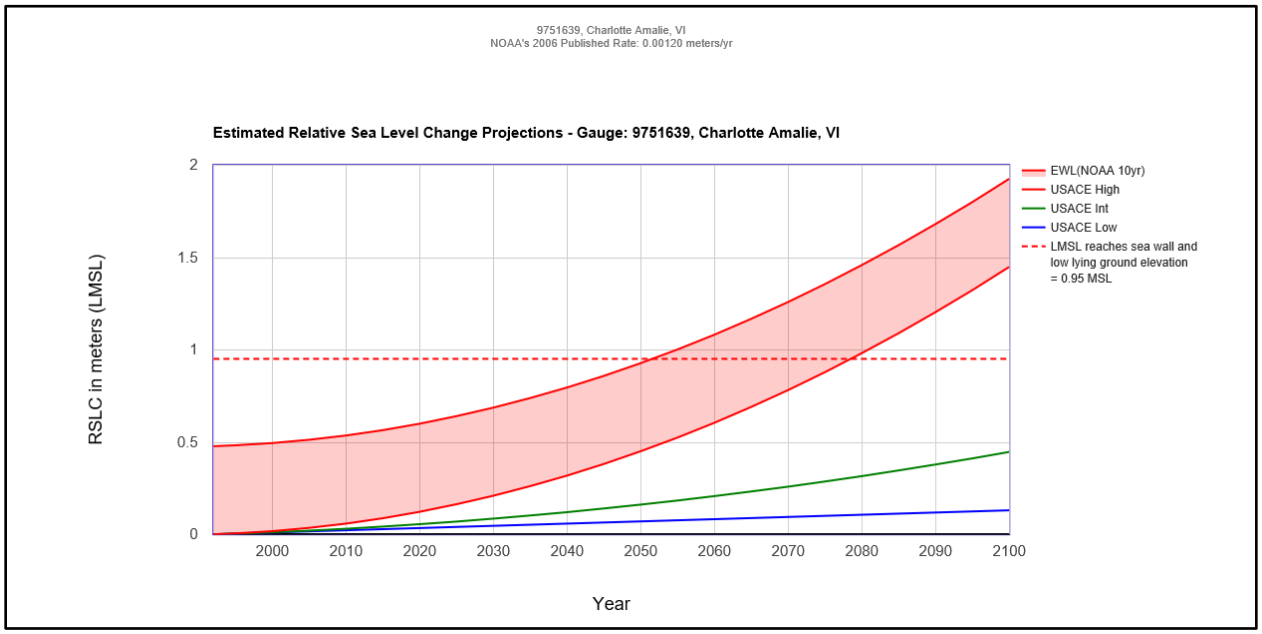


Figure 10: 10-year EWL with High Sea Level Curve Versus Critical Threshold for Gauge 9751639

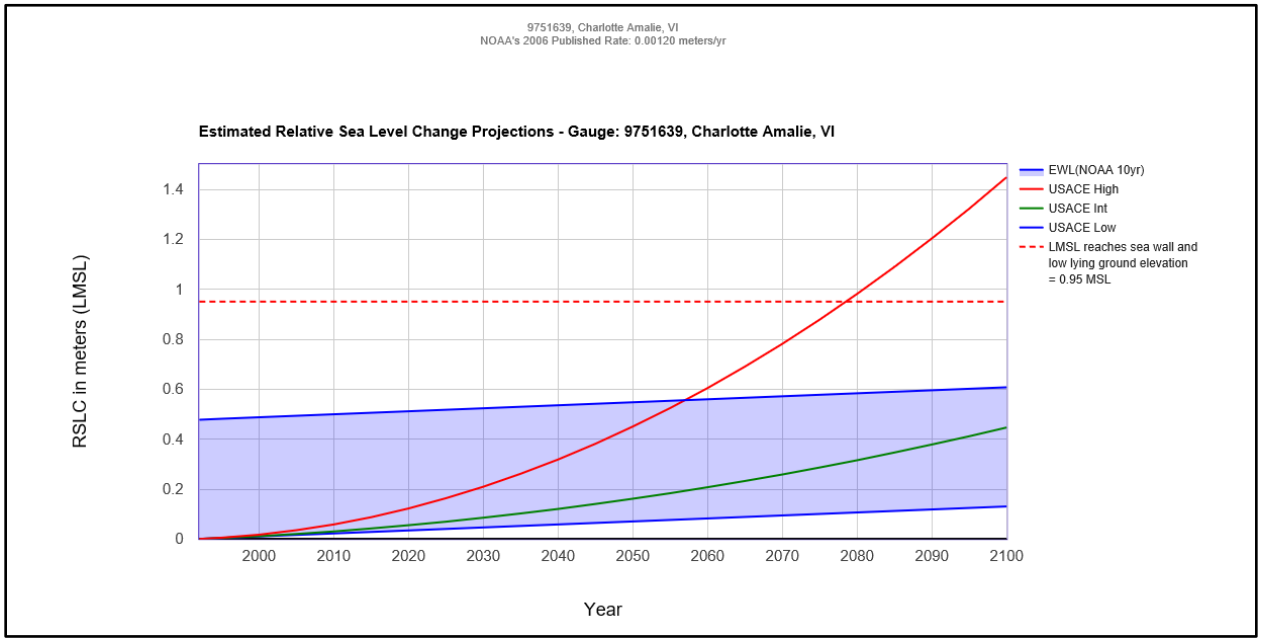


Figure 11: 10-year EWL with Low Sea Level Curve Versus Critical Threshold for Gauge 9751639

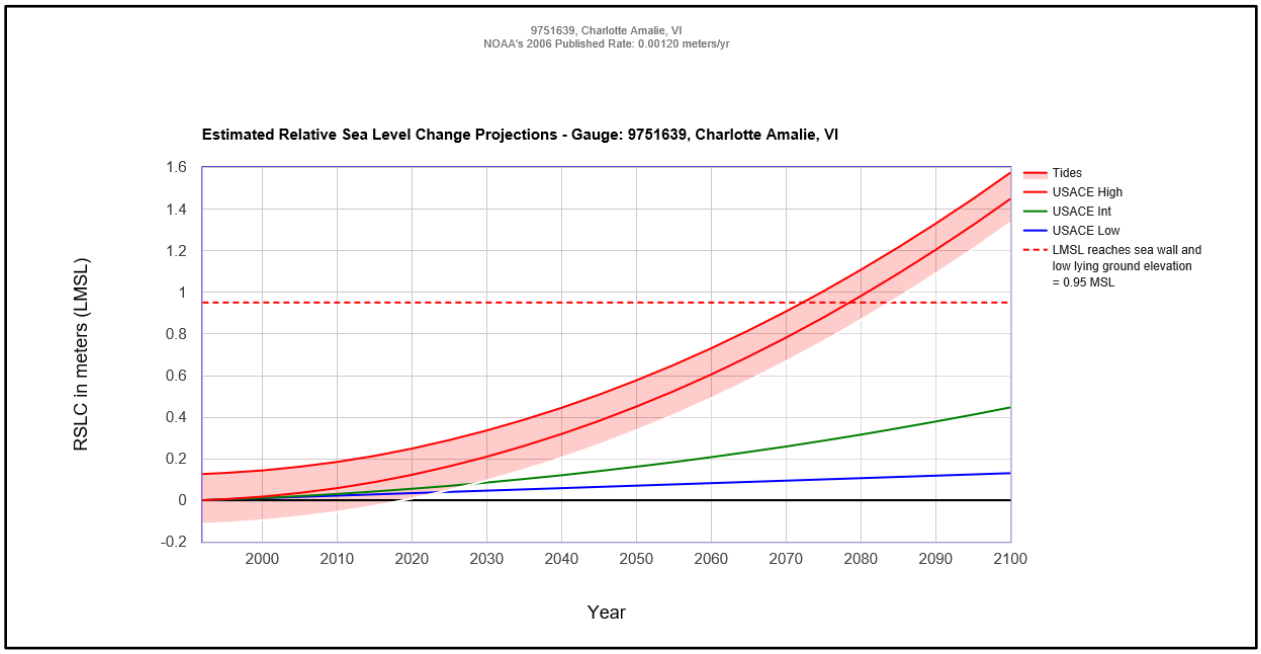


Figure 12: Tidal Signal with High Sea Level Curve Versus Critical Threshold for Gauge 9751639

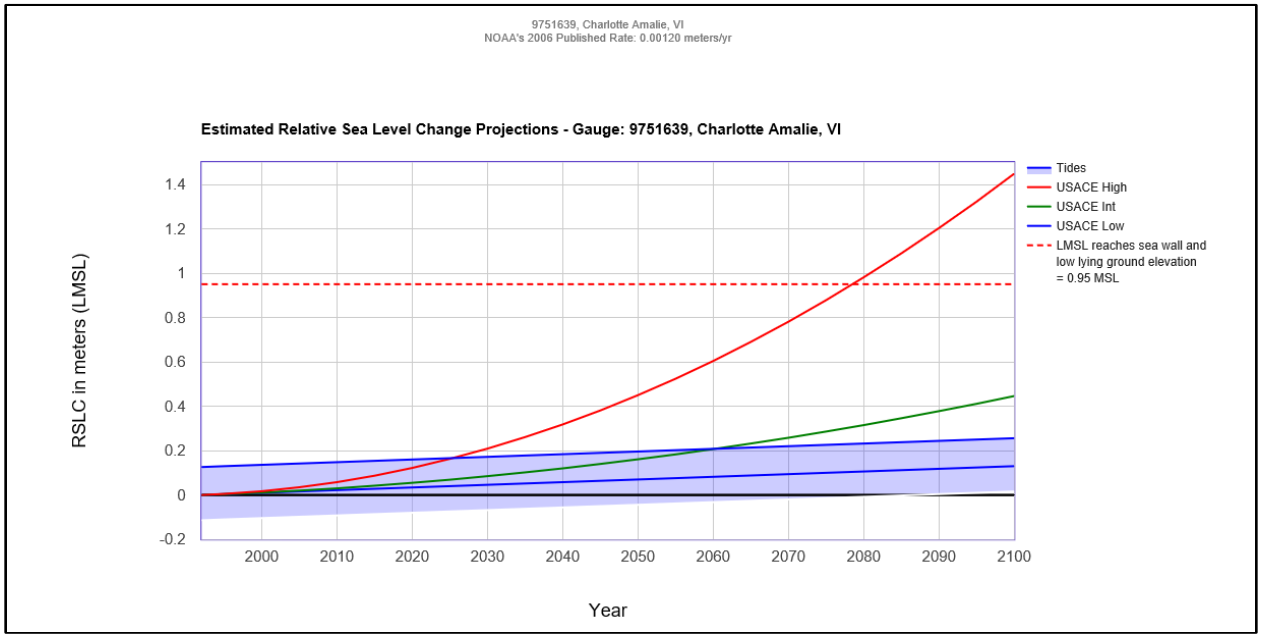


Figure 13: Tidal Signal with Low Sea Level Curve Versus Critical Threshold for Gauge 9751639

### 2.2.2. Inland Hydrology Project Vulnerabilities Due to Climate Change

The climate assessment for inland hydrology follows the Engineering and Construction Bulletin (ECB) 2018-14, Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects. ECB 2018-14 provides guidance for incorporating climate change information into the hydrologic analyses in accordance with the USACE climate preparedness and resilience policy and ER 1105-2-101, Risk Assessment for Flood Risk Management Studies. A full hydrologic assessment of the project using ECB 2018-14 was not performed because the USACE hydrologic climate tools are not available in the project area. A hydrologic literature review was conducted on observed climate trends and projected climate trends in the project area. A synthesis of USACE peer reviewed climate literature (U.S. Climate Change and Hydrology Literature Applicable to U.S. Army Corps of Engineers Missions – Caribbean Region 21) is available for the Caribbean Region and is the primary source of information in this literature review. The literature review shows that observed precipitation trends are unclear in the Caribbean Region and there is little evidence that indicates change in observed average streamflow. The literature review also shows there is reasonable consensus that the intensity and frequency of extreme storm events will increase in the future for the Caribbean Region. There is, however, no clear consensus that projected streamflow will change in the future.

It is determined that the project is not vulnerable to Inland Hydrology due to climate change. The project was analyzed and designed for the Probable Maximum Precipitation (PMP) event, which is the most intense atmospheric maximum event that has not changed since last published and has not been updated. In addition, the small size of the runoff basin and short time of concentration for the basin would not be as sensitive to an increased frequency of storms as compared to large watersheds.

## 2.3. Environmental Conditions

Pursuant to the National Environmental Policy Act of 1969, as amended, the Corps assessed the effects of the proposed action in the Savan Gut, St. Thomas, U.S. Virgin Islands, Detailed Project Report and Environmental Assessment (EA), dated March 1982. The 2020 EA updates the 1982 EA analysis and adopts the 1982 EA, by reference, where the information is valid and applicable.

Few changes in the environmental conditions of the project area have occurred. The ongoing erosion and scouring of the gut bed and banks have continued to degrade the streambank vegetation. The Recommended Plan includes debris and vegetation removal during the channelization, clearing, and grubbing activities associated with the construction of the debris basin. While there appear to be degraded wetlands in the project's vicinity near the debris basin, the clearing and re-grading actions to create the basin are not expected to reduce the value or function of the existing degraded wetlands. Project construction will result in removal of debris and refuse from the area, and revegetation is expected to occur promptly within the project footprint. Upon construction completion, areas outside of the construction footprint will be restored. Therefore, consistent with the 1982 Recommended Plan, mitigation is not required as there will be no loss of wetland function.

Pursuant to Section 7 of the Endangered Species Act of 1973, as amended, the Corps coordinated with National Marine Fisheries Service (NMFS) and consulted with U.S. Fish and Wildlife Services (USFWS) during completion of the 1982 EA. During the development of the 2020 EA, the Corps determined that the project would have no effect on listed species under NMFS jurisdiction and the project may affect, but is not likely to adversely affect, (MANLAA) listed species under USFWS jurisdiction. The Corps completed Section 7 consultation with USFWS. In a letter dated March 7, 2019, USFWS concurred with the Corps' MANLAA determination. The Corps coordinated the project with NMFS during the public review of the draft EA. All coordination and consultation with resource agencies is complete, and pertinent correspondence is located in Appendix A of the 2020 EA.

## 2.4. Impacts of Hurricane Maria

Hurricane Maria resulted in uprooted trees, downed weather stations and cell towers, and damages to private and public infrastructure. Multiple media outlets reported electricity was cut off to 100 percent of the island leaving approximately 100,000 people without power. Heavy rains and flash floods brought on by the storm exacerbated widespread devastation, scouring existing guts and turning streets into rivers full of debris, sediment, and, in some areas, sewage. Various locations throughout the island also experienced mass die off of vegetation due to the sustained high winds and storm surge.

The main damages sustained in the project area are from flooding. Since the area is heavily urbanized, post-storm conditions for vegetation and wildlife are not substantially different than the pre-storm conditions. Site inspections conducted on October 31, 2017 after Hurricane Maria revealed Savan Gut overtopped its banks causing debris and sediment accumulation throughout the gut and surrounding infrastructure (see Figure 14 through Figure 17). Channel wall and soil erosion (one to two feet) was observed downstream of the low-water crossing on Gamble Street. Approximately 15 feet of a collapsed channel wall near the damaged road was also noted. Heavy and sustained rain over multiple days will cause the Savan Gut to continue to

flood in its current condition if protective measures are not in place, causing even more damage to property owners.

Based on site visits to the project area in November 2018, January 2019, and April 2019, most of the study area's residential property appears to have been reoccupied and businesses reopened. Local emergency management (EM) officials confirmed that a portion of the population evacuated and did not return; however, the remaining population continues to suffer hardships from the storm damages. In some cases, residents have opted to reoccupy their homes and attempt to adapt to "the new normal", which could include living with severe structural damages and/or without functional utilities, such as electricity and running water.

Figure 14: Sediment Buildup in Savan Gut Post Hurricane Maria

Figure 15: Channel Wall Damage and Erosion Post Hurricane Maria

Figure 16: Debris Accumulation in Savan Gut Post Hurricane Maria

Figure 17: Collapsed Channel Wall Post Hurricane Maria

In coordination with the Territory, the Federal Emergency Management Agency (FEMA) is executing a long term recovery and resilience program in the USVI following the damaging 2017 hurricane season. The 1982 DPR & EA note the presence of utility lines that occur in or cross the gut that may need to be relocated for this project. The FEMA recovery mission will likely include upgrades and repairs to some of these utility lines. Full coordination during the PED phase of this project with the Department of Public Works and USVI Waste Management Authority will occur to avoid potential conflicts during construction. USACE and FEMA have

been in coordination throughout this study and will continue to coordinate through PED and construction. USACE provided a set of the 1999 construction drawings to FEMA for their planning purposes in April 2019.

After discussing with the NFS, no additional impacts have occurred since Hurricane Maria besides small flood events. These events resulted in temporary impacts from nuisance flooding and all impacts have been resolved or disappeared once flooding receded.

# 3. Validation of Authorized/Modified Project

## 3.1. Validation of Plan Formulation from 1982 Report

Planning formulation for the Savan Gut watershed of the Charlotte Amalie area in St. Thomas U.S. Virgin Islands was completed in 1982. Analyzes of alternatives was performed to address problems of hours-long flash flood events affecting the town of Charlotte Amalie, particularly flooding problems at the Jane E. Tuitt Elementary School within the town's central business district (CBD). Planning objectives were centered on life safety, reduction of property losses, preservation of social unity, minimize adverse impacts on historical and cultural resources of Charlotte Amalie, preserve and provide additional recreational facilities, and preserve and enhance the natural environment within the study area. Constraints included floodway obstruction by homes, bridges and buildings within the CBD, and overall steep terrain and density of development within study area.

Overall criteria follows the Principles and Standards for the Planning Water and Related Resources and are supplemented by established technical, economic, environmental and social criteria including the National Environmental Policy Act of 1969. Engineering and economic assumptions and criteria were established for the evaluation of alternatives. National Economic Development (NED) and Environmental Quality are the two primary national objectives used for the study, while Regional Economic Development (RED) and other Social Effects (OSE) were also considered.

A range of structural and non-structural measures were investigated and six viable alternative plans encompassing both structural and non-structural measures were evaluated that included a "no action" plan. All measures and preliminary screening are summarized in Table 3-1.

Table 3-1: Summary of Nonstructural and Structural Measures Considered in the 1982 Report

| Measure | Description | Benefit | Limitations | Screening |
|---|---|---|---|---|
| **Nonstructural** | | | | |
| **Zoning and building codes** | Regulatory management of new development in flood plain. | Requires new development to be flood compliant. | No protection to existing structures. | **Considered** in all alternatives. |
| **Relocation** | Permanent relocation of residential and business structures and the school. | Removed people from hazard. | Lack of suitable relocation areas and high costs of relocation. | **Considered, low probability** due to social acceptability and costs. |
| **Flood forecasting, warning, and evacuation** | Temporary warning system and alternate evacuation locations. | Warning system can save lives. | Short response time and steep terrain make warning system success difficult. | **Not considered**, impractical, excluded. |
| **Structural** | | | | |
| **Flood Proofing** | Structural change by elevating out of base flood level or allowing flooding around individual structures. | Little or no damage to exterior of structures. | Low-cost frame housing difficult to flood proof, too costly. | Not economically feasible, **not considered**. |
| **Diversion** | 410 feet long enclosed concrete chute along the eastern side of Jane E. Tuitt School. | Spare school from flash flooding effects. | Relocation of two structures required, high density CBD area. | Absence of alternative flowage routes, **not considered.** |
| **Channel Improvements** | **Cleaning, deepening, and channel realignment.** | **Increased flood flow capacity.** | **None listed.** | **Most feasible, considered.** |
| **Levees** | Structure sufficient to preclude flood waters from entering susceptible areas. | Most protection from flooding events. | Residential and business structures abut channel. Easement purchase required, too costly. | Not technically or socially feasible, **not considered.** |

It was determined that channel modifications, including deepening of the existing channel and the construction of a short diversion channel, offered the most practical method reducing flood damages along Savan Gut in Charlotte Amalie.

Five channel designs that begin upstream of the Jane E. Tuitt school, flow through the CBD of Charlotte Amalie and empty a stilling basin adjacent to St. Thomas Harbor were analyzed. The major features within each of the five channel design frequencies include a new 750-foot-long box culver to replace the existing culvert through the CBD, a covered diversion chute around Jane E. Tuitt School and a stilling basin adjacent to St. Thomas Harbor. Based on 1981 costs, the 10-year flood event, the 25-year flood event, the 50-year flood event, the 100-year flood event, and the Standard Project Flood (SPF) event costs would be 4.5 million, 4.6 million, 4.7 million, 4.8 million, and 4.9 million, respectively.

The three plans carried forward for analyses were Relocation, SPF Design Channel Modification, and the No Action alternatives. The Relocation and No Action plans, though maximized environmental quality, were not feasible alternatives since they did not address existing flood damages and were not socially or economically feasible.

The SPF plan for the Savan Gut project would include a rapid flow channel for its entire length through the downtown and urban areas of Charlotte Amalie. Floods exceeding the level of protection that would be provided by this channel would be considered a catastrophe.

Consequently, in accordance with ER 1105-2-111, the SPF level of protection was considered as the selected alternative of the study.

This plan formulation and plan selection is still valid today based on the finding explained throughout this report. As noted the conditions today are very similar as they were in 1982. This is a highly urbanized area and site conditions were verified in 2018 and 2019 and no significant changes have occurred since the plan formulation in the early 1980's. Although construction costs have increased overtime due to escalation and the bidding environment, the plan recommended in 1982 is still economically justified, environmentally acceptable and feasible from an engineering perspective based on today's conditions.

## 3.2. Project Design Components

The analysis and findings in the 1982 report and the 1999 plans and specifications were revisited and reevaluated for this CAP Conversion effort along with a site visit in November 2018. Through these efforts, it was confirmed that no significant changes are required to the recommended plan for Phase II. A new Programmatic Agreement was completed as part of this CAP conversion effort and was signed on October 30, 2019. Mitigation for cultural resources is likely to be required, but the details will be determined during PED as described in the Programmatic Agreement (PA) signed October 30, 2019.

### 3.2.1. Covered Concrete Channel (Box Culvert)

Construction of the covered concrete channel (box culvert) is from Station 0+00 (end of existing Box culvert for Savan Gut Phase I) to Station 15+62. The covered concrete channel (box culvert) will be constructed in four stages and consists of 15 different increments (alignments) and includes a trash rack at its upstream end. The four construction stages of the covered concrete channel (box culvert) are explained in the following bullets. This feature also includes a channel diversion which is an enclosed concrete chute with an alignment along the eastern side of the Jane E. Tuitt Elementary School. Under current conditions flow passes underneath the school and the proposed condition will reroute the flows around the school.

#### *Construction Stage 1*

Remove existing surface material. Excavate as required to locate and mark all sewer laterals and existing utilities prior to installation of cofferdam.

#### *Construction Stage 2*

Install cofferdam and install pipe support members. Install 36" diameter corrugated steel by-pass pipe suspend pipe from struts with hangers. Transition flow from existing culvert into the 36" diameter pipe using sand bags. Excavate between cofferdam walls to the bottom of the new culvert mud slab and drainage blanket stone. Divert existing utilities for removal of existing systems.

#### *Construction Stage 3*

Install bedding material and dewatering system (stages 1 through 3 only). Place concrete mud slab. Construct the bottom slab of the covered concrete channel (box culvert). Install new sewer lines, connect existing laterals when existing sanitary line is removed. (Note: The sewer lines will be a relocation by the Non-Federal Sponsor, United States Virgin Islands (USVI) Department of Public Works, if it is not constructed by FEMA prior to construction.)

*Construction Stage 4*

Install storm drain pipe fittings and construct covered concrete channel (box culvert) wall placements. Install precast manholes as required. Construct top slab placements. Backfill along new covered concrete channel (box culvert) walls. Remove Cofferdam.

### 3.2.2. Catchment Basin

The proposed catchment basin will be constructed from Station 15+62 to Station 18+00. The trapezoidal catchment basin consists of a gabion bottom mat and soil nailed tie back retaining walls. The retaining walls contain bench planters and stone facing.

### 3.2.3. Drop Structures

The proposed drop structures will be constructed from Station 18+00 to Station 19+91. The U-framed concrete drop structure contains a series of 6 foot elevation drops along its reach, concrete retaining wingwalls on the upstream end, and a new Antoni Strade bridge crossing.

### 3.2.4. Gabion Channel

The proposed gabion channel will be constructed from Station 19+91 to Station 23+19. The gabion channel consists of a gabion mat and a series of 3'x3' gabion basket channel walls. The channel also contains a series of 3 foot elevation drops along its reach and a debris barrier located upstream of the Antoni Strade Bridge.

## 3.3. Environmental Updates

Pursuant to the National Environmental Policy Act of 1969, as amended, the Corps assessed the effects of the proposed action in the Savan Gut, St. Thomas, U.S. Virgin Islands, Detailed Project Report and Environmental Assessment (EA), dated March 1982. The 2020 EA updates the 1982 EA analysis and adopts the 1982 EA, by reference, where the information is valid and applicable.

During the development of the 2020 EA, the Corps determined that the project would have no effect on listed species under NMFS jurisdiction and the project may affect, but is not likely to adversely affect, (MANLAA) listed species under USFWS jurisdiction. The Corps completed Section 7 consultation with USFWS. In a letter dated March 7, 2019, USFWS concurred with the Corps' MANLAA determination. The Corps coordinated the project with NMFS during the public review of the draft EA. All coordination and consultation with resource agencies is complete, and pertinent correspondence is located in Appendix A of the 2020 EA.

## 3.4. Cultural Resources

Previous consultation with the USVI Historic Preservation Office (SHPO) and a current review of the listing of the National Register of Historic Places (NRHP) indicates the Savan Gut Phase II area of potential effect (APE) includes the Charlotte Amalie Historic District listed on the NRHP in 1976. The historic district then included 574 contributing buildings, three contributing structures, and a contributing object. The Charlotte Amalie Historic District includes buildings, dwellings, and sites that represent the town's early colonization and rich history. Important features in the district include Fort Christian, a National Historic Site constructed circa 1666 and completed in 1680; Skystborg (Blackbeard's Castle), a watchtower overlooking the harbor built by the Danes in 1678; and Emancipation Park, commemorating the emancipation of slaves by Governor Peter von Scholten in 1848. The extant architecture in the Charlotte Amalie Historic

District, especially in the project area's residential section known as "The Savanne" or "Savan," spans three centuries having great significance in understanding the historical development of the town of Charlotte Amalie. This area west of Denmark Hill was laid out in a grid plan in 1764, and is predominantly single family residential use with some commercial buildings bordering its eastern boundary. Cottages in the Savanne area are almost exclusively single-storied buildings of frame construction with shingled hip roofs.

Based on the presence of existing cultural resources and standing structures within the Charlotte Amalie Historic District and high probability for additional historic properties to be identified within the project's APE, a cultural resources survey of the proposed Savan Gut alignment was conducted (Righter and Mitchell 1981). As a result of this cultural resources survey, archaeological monitoring during construction and further documentation of extant structures and features to the Historic American Buildings Survey (HABS) and the Historic American Engineering Record (HAER) standards were recommended to be the most effective method for identifying and evaluating historic properties that would potentially be adversely effected by the proposed Savan Gut Phase II undertaking. Following this survey, and due to monetary constraints, the Corps developed a historic preservation mitigation plan with the USVI SHPO to divide the Corps' Savan Gut Phase II Project into two mitigation planning phases (identified as Phase II and Phase III in the historic preservation mitigation plan). As a result, the Corps' Savan Gut Phase II Project reduced the northern extent of the flood control footprint and eliminated the pedestrian park.

Subsequently, for both of the historic preservation mitigation Phase II and Phase III plans, it was agreed that the contractor would be required to monitor and control construction vibrations that may affect historic structures. Specifically, the Phase I plan called for the contractor to dismantle and record to HABS/HAER standards, the two historic ovens, the General Gade bridge arch and wall, and the historical architectural features in the deJongh wall. The historically significant brick from the dismantled historic properties was to be stored on the Department of Public Works property during Phase II of the historic preservation mitigation plan. The ovens were then to be rebuilt and the architectural features of the bridge arch and wall and the deJongh wall were to be incorporated into the project during Phase III of the historic preservation mitigation plan. In addition, all of the remaining restoration work, including the Banaba Well, and placement of the commemorative plaque were to be deferred to Phase III of the historic preservation mitigation plan.

Due to the age of these previous surveys and evaluations, the current Savan Gut Phase II Project requires renewed coordination and consultation with the USVI SHPO and National Park Service (NPS) as changes in criteria for evaluating historic properties need to meet current standards to fulfill the requirements of Section 106 of the National Historic Preservation Act (36 CFR Part 800). Additional cultural resources surveys are needed to conduct a phased identification and evaluation of historic properties during the project's PED phase. The Corps executed a Programmatic Agreement with the USVI Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation (ACHP) on October 30, 2019. The Programmatic Agreement outlines the process by which the Corps will consult with the agencies to avoid, minimize, and mitigate adverse effects to historic properties. Dependent on further consultation/reevaluation with these agencies and the results of monitoring and Phase I cultural resources investigations, project design modification may be necessary to avoid or minimize

impact to historic properties. Phase II NRHP eligibility testing or mitigation may be required if impacts cannot be avoided.

Data recovery is expected to be less than one percent of the total project cost and there is little risk of exceeding the one percent cap under 54 U.S.C. § 312507 . A waiver does not need to be obtained for the project.

## 3.5. Real Estate Acquisition and Relocations

Per the Local Cooperation Agreement amended 23 June 1992, the Non-Federal Sponsor is required to provide all Lands, Easements, Right-of-Way, Relocations, and Disposals (LERRDs) required by the project. Any conclusion or categorization contained in this report that an item is a utility or facility relocation to be performed by the Non-Federal Sponsor as part of its LERRD responsibilities is preliminary only. The government will make a final determination of the relocations necessary for the construction, operation, or maintenance of the project after further analysis and completion and approval of the final attorney's opinions of compensability for each of the impacted utilities and facilities.

Facilities to be relocated or altered may include streets, bridges, homes, buildings, electric transmission lines, utilities, and local drainage structures. For affected utilities which cannot be relocated by the Non-Federal Sponsor in advance of construction activities, some interruption in utility services could occur. To keep interruptions to a minimum, close coordination and cooperation would be necessary between the Corps of Engineers, Virgin Islands Department of Public Works, and the construction contractor. All real estate requirements from construction impacts to existing recreation facilities at the Jane E. Tuitt Elementary School will be determined during PED. The NFS will acquire the necessary LERRDs to construct the project.

Previous reports and plans indicate that existing recreation facilities in the area will be impacted during construction. These facilities include the Jane E. Tuitt Elementary School playground with a basketball court (Figure 18). The Corps is committed to working with the NFS and Jane E. Tuitt Elementary School to ensure any loss of recreational features on land identified as a public facility is offset through the restoration or replacement of resources lost. If recreational features are located on privately owned lands, the Corps will work with the NFS for approvals to use lands during construction. However, it is the NFS' responsibility to acquire all real estate required by the project and to perform all facility and utility relocations. The NFS must also fulfill the relocation assistance requirements of Public Law 91-646, the Uniform Relocation Act, as amended.

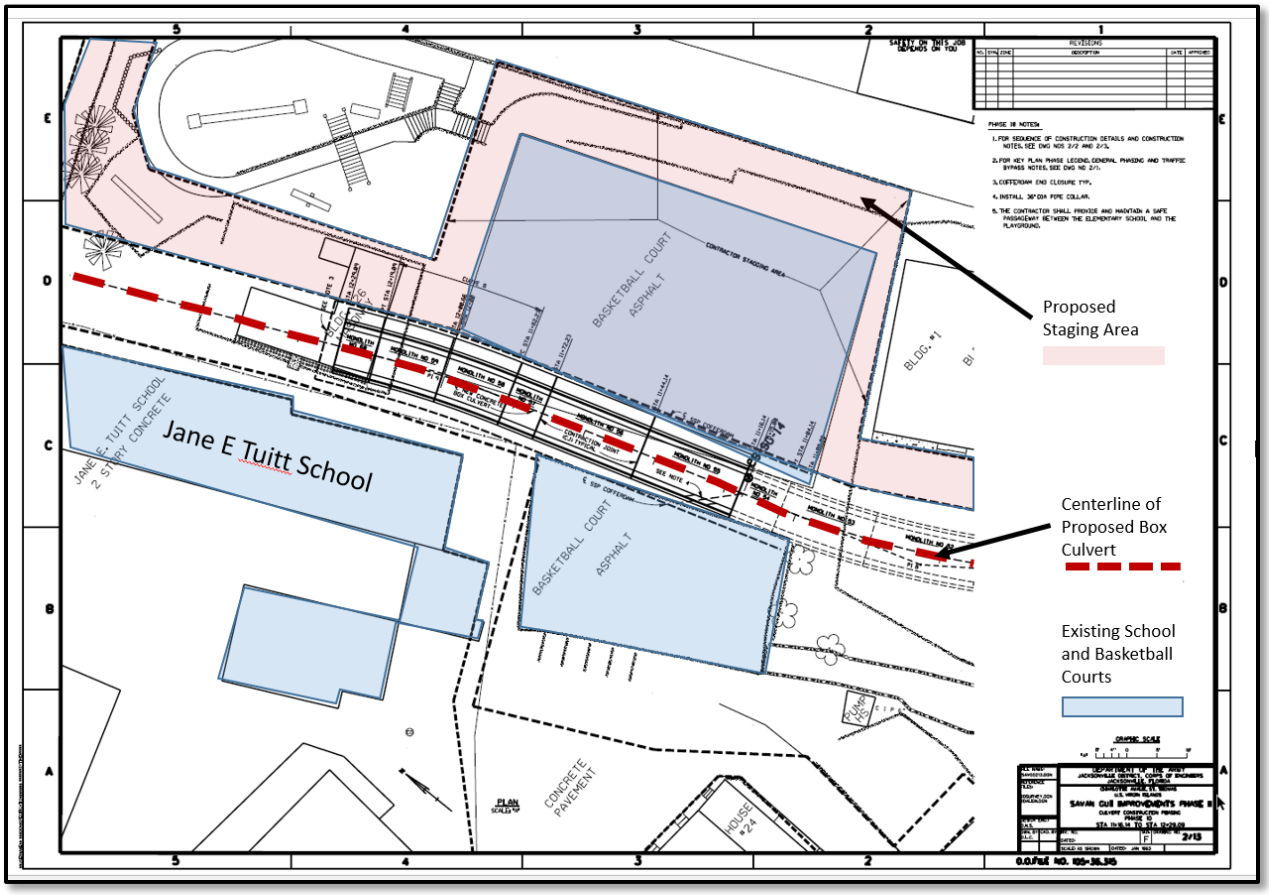


Figure 18: Construction Plan for Proposed Covered Concrete Channel (Box Culvert) at the Jane E. Tuitt Elementary School

### 3.5.1. Real Estate Cost Update

The NFS has already performed a significant amount of the permanent real estate acquisitions that were identified in the project plans. The U.S.V.I. Property Tax Records indicate that the average land assessment values in the project area are $204,000 per acre and the project footprint is 5.7 acres, therefore a rough land cost estimate is approximately $1,162,800. Additionally, a copy of the NFS' project land acquisition tracker from 1995 indicated that approximately $250,000 of permanent land interests were acquired. The non-Federal sponsor has acquired the lands for the project. However, there are public facilities and utilities that will need to be relocated during Phase II by the non-Federal sponsor prior to construction. The non-Federal sponsor may request the Corps to conduct the relocations during construction of the project. The remaining, temporary interests include USACE Standard Estates for Temporary Work Area Easements and Temporary Road Easements.

Per USACE HQ Real Estate Policy Guidance Letter #31 (dated January 2019) a Rough Order Magnitude Real Estate Cost Estimate (ROMRECE) appraisal report is required if the cost of the project's LERRDs as a percentage of total project costs is 15% or less. A ROMRECE is not being performed for Phase II construction. The justification for not performing a ROMRECE is because the land assessed values are a rough proxy for land market values and the

conservative decision was made to not subtract the documented acquisitions in the amount of $250,000. A Brief Gross Appraisal will be commissioned for the project land costs in the PED phase, once PED funds are received.

Real estate requirements will be more precisely identified during PED in accordance with the latest plans, maps, guidance, and polices, including the Engineering Federal Acquisition Regulation Supplement (EFARS) Appendix Q.

## 3.6. Operation and Maintenance

The NFS is responsible for the Operation, Maintenance, Repair, Replacement and Rehabilitation of the project at all times. The NFS is also responsible for inspection and maintenance during periods of low water. Proper maintenance and inspection of all project elements are essential for efficient operation of the project features. The NFS shall undertake measures to eliminate unauthorized encroachments and to conduct repairs found necessary by inspection. General overall maintenance requirements and procedures are provided below:

### 3.6.1. Channels

Channels shall be maintained as necessary to insure serviceability against floods at all times. Standards for accomplishing the foregoing are as follows:

a. The channel template shall be maintained to essentially the design invert and section by necessary excavation of the channel bottom and shaping of the slopes. Vegetation will be maintained to not impede conveyance and not affect the project feature or purpose.
b. The channel shall be maintained free of obstructions and debris. This includes periodically removing debris/trash from the debris barrier upstream of the Antoni Strade Bridge and the trash rack upstream of the box culvert.
c. The revetment along the channel shall be maintained to the design conditions.
d. Encroachment - No trespassing, construction or encroachment will be permitted on the channel right of way.

### 3.6.2. Box Culvert

The Box Culvert shall be maintained as necessary to insure that flows can be released to the outside of the protected area. Standards for accomplishing the foregoing are as follows:

a. A positive flow in the intake and outlet channels shall be maintained.
b. Vandalism to the structure shall be repaired and measures shall be taken to prevent vandalism.
c. Vegetation and debris shall be kept clear of the structure.
d. Shoaled material that may impede the box culvert flows shall be removed.

## 3.7. Cost Update

The development of this project's current cost estimate is in accordance with the latest USACE guidance and regulations. The estimated total project cost in FY20 dollars (including all contingencies) for Phase II is $81,845,000 (fully funded). The total First Cost of the project, including Phase I sunk costs of $7,400,000 and Phase II costs of $71,704,000, is $79,100,000.

The current cost estimate was developed using the information available in the feasibility report prepared in 1982 as well as additional information. Additional information includes the previous

estimates created in 1999 and 2000. The estimate primarily focused on escalating and updating the estimate from 1999. This estimate assumed no change to the current scope of work and applicable features in this estimate were updated based on the new Corps guidance. For example, this estimate assumes 15% of temporary sheet piles will remain and an area cost factor (ACF) of 1.51 and other assumptions as well. The site conditions include wet areas that reduce the overall productivity. Work will be performed in a flood area and the weather can impact the productivity and the duration of the project. Productivity was adjusted to reflect some delays due to wet conditions.

Essentially, the completed 1999 estimate and features of work such as the gabion channel construction, concrete culvert construction and the different construction phases as well as relocations of sanitary and sewer lines was reviewed and escalated to today's dollars. Other major tasks include the construction of the entrance channel and catchment as well as the construction of recreation facilities such as plazas and a basketball court.

### 3.7.1. Cost Risk Analysis

The cost risk analysis is the process of identifying and measuring the cost impact of project uncertainties on the estimated total project cost and schedule. This risk analysis was accomplished as a joint analysis between the cost engineer and the appropriate project delivery team (PDT) members. This section provides a summary of significant risk and the analysis that yields the results from the Cost and Schedule Risk Analysis (CSRA). Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes. Results also provide tools to support decision making and risk management as projects progress through planning and implementation.

In order to establish a contingency for the project cost estimate, the contingencies were removed from the estimate prior to running the analysis. The total estimated construction cost of the project excluding contingency was established at approximately $34,973,918. Land and damage cost for the project was established at approximately $2,280,000. The planning, engineering and design cost in addition to the supervison and administration cost was established at approximately $12,365,871. This yields a total CSRA base cost of approximately $49,619,790. The total baseline contingency was quantified as approximately $20,770,000. The cost risk elements that were evaluated through the risk analysis are project growth, acquisition strategy, construction elements, quantities for current scope, cost estimate assumptions, and external project risks. Each of these elements were given a risk level based on each feature of work for the project.

The key cost risk elements identified through the risk analysis were "construction elements" and "quantities for current scope" for the "roads and ramps" feature of work and "external project risks" for the utilities feature of work. This project is identified as a Class 3 estimate as defined in ER 1110-2-1302, Civil Works Cost Engineering. The technical information, including designs is approaching a 10 to 60% quality of project definition and there is greater confidence in project planning and scope, construction elements and quantity development. Class 3 estimates are a reflection of improved technical documents and the typical contingency ranges from 20 to 50%. Therefore, a contingency of 42% was generated from the CSRA and is considered reasonable for this stage of the project development per ER 1110-2-1302.

## 3.8. Economic Update

In accordance with the Bipartisan Budget Act (BBA) of 2018 (Public Law 115-123), the Recommended Plan has been evaluated for economic justification. Economic justification is presumed to be realized when the expected benefits of the Recommended Plan exceed the expected costs. Reformulation of project alternatives has not been conducted; consequently, the economic update examines the National Economic Development (NED) Plan identified and approved in the 1982 CAP report. The economic analysis included in this document includes:

A. Total Project Benefit Cost Analysis
   a. Total project costs compared to total project benefits at 1981 Price Levels
   b. Total project costs compared to total project benefits adjusted to FY 20 Price Levels.
B. Remaining Project Benefit Remaining Project Costs Analysis
   a. Phase II costs compared to expected project benefits

### 3.8.1. Methodology

The primary economic evaluation of Savan Gut used a risk-based evaluation that compares a recent certified project first cost for Phase II, includes sunk project costs of Phase I, and adjusts those price levels to be comparable to the benefits calculated in 1982. Traditional analysis would update benefits by production of new economic, and hydrologic and hydraulic models, to establish benefits at current price levels; however, this risk based approach relies on previous modeling results based on the following parameters:

- The hydrologic analysis is based on the PMP for the SPF design event, which was obtained from TP-42, and has not changed or been updated over the timeframe of the project development,
- The hydraulic design approach appears valid as project conditions are assumed to have not changed over time,
- Residential structure inventory is substantially unchanged,
- Commercial structures and inventory is improved

It is believed that using the benefits as calculated in the previously approved report is a conservative approach as the commercial inventory, which is predominantly historical stone structures, has largely been rehabilitated since the 1982 DPR and the effective age of the structures is no less than what existed when the original benefits were calculated. Additionally the original report only used a value of 40% (as opposed to current practice of 50%) for content to value relationship and the commercial content value was based on the less affluent business of 1982. It is likely that the damages prevented (benefits) would be greater in current conditions.

In order to remove some uncertainty in the analysis, a second scenario that adjusted project benefits by using the RSMEANS real estate index to update project benefits to FY 20 price levels and compare those results to the current certified costs of Phase II plus the Phase I sunk costs.

Finally, as Phase I has been constructed, a remaining project benefit/remaining project cost analysis was conducted that prorated the 1982 DPR benefits into expected benefits for Phase II.

### 3.8.2. Background

As discussed in Section 2, the residential structure inventory does not appear to have changed significantly since the 1982 report. A majority of the structures appear to be inhabited. There are numerous vehicles on every street in the study area. Savan Gut flows through the main tourist area in Charlotte Amalie which has undergone a significant revitalization with decorative paver streets and expansion of the main route to a multi-lane highway.

Tourism and related commercial infrastructure have increased substantially in the study area since the previous report was completed, as the cruise ship industry has seen a dramatic increase in visitation. It is expected that without project damages and resulting with project benefits would exceed those experienced in the 1982 report due to the improvements in retail and commercial infrastructure and higher value content damages resulting from the upscale shopping.

Over 99% of average annual benefits in the 1982 DPR were derived based on reductions in damages to commercial (downtown business district) and public (school and other public infrastructure) infrastructure.

### 3.8.3. Total Project Benefit to Cost Ratio

Flood Control prevention benefits from the March 1982 DPR were calculated at a discount rate of 7.625 percent based on the October 1981 price levels. Table 3-2 presents the initial costs, amortization, total annual cost, average annual benefits of $5,252,000 and a benefit cost ratio of 11.40 as identified in the 1982 report.

Table 3-2: 1982 Savan Gut Detailed Project Report Recommended Plan Economic Results

| 1982 DPR | (Discount Rate 7.625%) |
|---|---:|
| Total Project Cost – 1981 Price Level | $6,260,000 |
| Amortization | $452,500 |
| Operation Maintenance & Replacement Costs | $8,500 |
| Total Annual Cost (AAEQ) (Remaining Costs) | $461,000 |
| AAB from 1982 Approved Report | $5,252,000 |
| | |
| Net Benefits | $4,791,000 |
| Remaining Benefit Remaining Costs Ratio | 11.40 |

For the updated economic analysis as shown in Table 3-3 below, to be consistent with the benefit stream of the last approved report (March 1982), costs were normalized to October 1981 price levels using the Civil Works Construction Cost Index System (CWCCIS) quarterly cost index. Deflated cost were annualized at the FY20 interest rates, 2.75 percent, over the 50-year period of analysis. The current discount rate of 2.75 percent (FY20) was used along with the last approved report discount rate of 7.625 percent (FY81) used for benefit calculation, since the benefits are derived from the last approved report. This analysis demonstrated continued Federal justification with an economically justified project with a BCR over 5 to 1.

Table 3-3: FY20 Savan Gut Total Project Benefits Cost Ration based on FY20 Costs (Level 1 Analysis)

| | Savan Gut Phase I and II BCR Discount Rate 2.75% |
|---|---|
| **Phase I Costs** | |
| Phase I Project Costs (FY 98 Price Level) | $7,400,000 |
| Interest During Construction | $340,000 |
| Total Phase I Economic Cost (FY 98 PL) | $7,740,000 |
| **Phase I Total Cost in 1981 PL** | **$5,880,000** |
| **Phase II Costs** | |
| Phase II Project Costs (FY 20 Price Level) | $71,700,000 |
| Interest During Construction | $3,800,000 |
| Total Phase II Economic Cost (FY 98 PL) | $75,500,000 |
| **Phase II Total Cost in 1981 PL** | **$25,450,000** |
| | |
| Phase I & II Total Cost in FY 81PL | $31,330,000 |
| Interest and Amortization | $940,000 |
| OMRR&R (FY 81 PL) | $8,500 |
| Total Annual Cost (AAEQ) | $948,500 |
| AAB from 1982 Approved Report | $5,252,000 |
| | |
| Net Benefits | $4,303,500 |
| | |
| Benefit to Cost Ratio @2.75% | 5.54 |

- Cost indexed using March 2019 CWCCIS.

In order to remove some uncertainty in the analysis, a second scenario that adjusted project benefits by using the RSMEANS historical real estate index to update project benefits to FY 20 price levels and compare those results to the current certified costs of Phase II plus the Phase I sunk costs. The RSMeans historical cost index 30 city average was used as a general index for the entire benefit stream. When accounting for escalated benefits, there is stronger economic support for continued Federal justification with an economically justified project with a BCR over 6 to 1.

Table 3-4: Savan Gut Total Project Benefits Cost Ratio Based on FY20 Cost (Escalated Benefits)

| | Savan Gut Phase II BCR |
|---|---|
| | |
| Project Costs (FY 20 Price Level) | $79,100,000 |
| Interest During Construction | $4,140,000 |
| Total Economic Cost | $83,240,000 |
| Interest and Amortization | $3,080,000 |
| Operation Maintenance and Replacement | $30,000 |
| Total Annual Cost (AAEQ) | $3,110,000 |
| AAB from 1982 Approved Report | $5,252,000 |
| AAB Escalated to FY 20 | $19,670,000 |
| Net Benefits | $16,560,000 |
| | |
| Benefit to Cost Ratio @2.75% | 6.32 |

- Benefits escalated using RSMeans historical cost index 30 city average
- 1982 DPR O&M costs of $8,500 were updated to FY 20 price levels.
- Project Costs include $71,700,000 Phase II costs and $7,400,000 Phase I costs.

### 3.8.4. Remaining Project Benefits

Savan Gut Phase I was previously constructed in 1989. Therefore, a portion of the total benefits projected in the 1982 evaluation was realized by this construction. The covered concrete channel (box culvert) feature in Phase I is located at the downstream end of the project. As a result, this feature can have no effect on out of bank flood damages occurring further upstream of Phase I. In addition, Phase II covered concrete channel (box culvert) and lateral inflow points are designed to collect and route rainfall runoff efficiently as possible through the covered concrete channel (box culvert) and into the harbor. As a result of Phase II features not yet constructed, an expected but unknown amount of this upstream rainfall runoff will bypass the inlet where Phase I begins causing damages beyond that location.

As this risk-based, expedited planning effort did not incorporate production of new economic and H&H models, best engineering judgment was used to derive an estimate of the proportion of the total calculated benefits that pertains to Phase II. Recognizing that Phase I provides some benefits to the downtown business district, three scenarios were examined for Phase II capturing 25%, 50% and 75% of the overall project benefits, as depicted in Table 3-5. It is highly unlikely that Phase I provided for over 75% of the overall project benefits so no scenario was examined showing Phase II with less than 25% of overall project benefits.

The cost estimates in Table 6-1 represent the remaining cost to complete Phase II. Table 3-5 presents the project first cost for Phase II, interest and amortization, operation maintenance and replacement cost, total annualized remaining costs, and proportioned annualized benefits (75 percent of annualized benefits) from the 1982 approved report.

The proportioned average annual benefits are divided by the average annual costs to calculate the Remaining Benefit Remaining Cost Ratio (RBRCR) for Phase II. The updated BCR is

estimated at 1.38 to 4.15, which is derived from proportioned annual average benefits divided by average annual costs. The average annual net benefits range from $364,500 to $2,990,500.

Table 3-5: Remaining Benefit Remaining Cost Economic Analysis (Sensitivity)

| | Savan Gut Phase II BCR (75% project benefits) | Savan Gut Phase II BCR (50% project benefits) | Savan Gut Phase II BCR (25% project benefits) |
|---|---|---|---|
| Project First Costs (FY 20 Price Level) | $71,700,000 | $71,700,000 | $71,700,000 |
| Interest During Construction | $3,800,000 | $3,800,000 | $3,800,000 |
| Total Economic Cost | $75,500,000 | $75,500,000 | $75,500,000 |
| **Total Cost in 1981 Dollars** | **$25,450,000** | **$25,450,000** | **$25,450,000** |
| Interest and Amortization | $940,000 | $940,000 | $940,000 |
| Operation Maintenance and Replacement | $8,500 | $8,500 | $8,500 |
| Total Annual Cost (AAEQ) | $948,500 | $948,500 | $948,500 |
| AAB from 1982 Approved Report | $3,939,000 | $2,626,000 | $1,313,000 |
| | | | |
| Net Benefits | $2,990,500 | $1,677,500 | $364,500 |
| | | | |
| Benefit to Cost Ratio @2.75% | 4.15 | 2.77 | 1.38 |

The remaining benefit/remaining analysis demonstrates that even in the most unlikely of scenarios (Phase II only providing 25% of total project benefits) the remaining elements of the project are economically justified with an expected BCR exceeding 1 and as high as 4 to 1.

# 4. Risk and Uncertainty

The analysis and findings in the 1982 report and the 1999 plans and specifications were revisited and reevaluated for this CAP Conversion effort along with multiple site visits in 2018 and 2019. Through these efforts, it was confirmed that no significant changes are required to the recommended plan for Phase II. A new Programmatic Agreement was executed as part of this CAP conversion effort and was signed on October 30, 2019. Mitigation for cultural resources is likely to be required, but the details will be determined during PED as described in the programmatic agreement.

## 4.1. Residual Risk with Project Implementation

The selected channel conveyance improvement plan for Savan Gut and the Commercial Business District of Charlotte Amalie will pass the Standard Project Flood event with little or no damage to existing commercial, residential, and public facilities. It is never possible to completely eliminate flood risk; however, economic analysis and hydrologic and hydraulic analysis conducted for the 1982 CAP project concluded that the recommended project is highly effective at reducing flood risk in the study area. That report concluded that all without project damages are essentially eliminated with a well maintained project; however it should be

expected that still unknown residual damages could remain in extreme events with remote likelihood of occurrence.

One of the primary risk categories of the original approved plan centered on human safety and ensuring hydrologic and hydraulic function regarding an open box culvert design. The USVI requested during the original project design that the culverts be covered for safety concerns. There was also concern about debris dumping in the open culvert leading to potential obstructions and transferred flood risks. As a result of these risks, the design of the box culvert now includes a cover.

## 4.2. Uncertainty in the Engineering and Economic Analysis

As noted in the above Sections, there are sources of uncertainties associated with the engineering and economic analyses, including potentially changed conditions or updated design considerations. These uncertainties will have to be addressed during PED, using (as necessary) new survey and geotechnical data, applicable design guidance, and updated hydrologic and hydraulic models, if necessary. It is important to note that many of the design references, including multiple Engineering Regulations, Engineering Manuals, or Engineering Technical Letters have been superseded or replaced by updated guidance, thereby introducing risk that the design may change once up-to-date guidance is applied.

## 4.3. Implementation Risks

Some of the key implementation risks potentially affecting project schedule are:

- **Real Estate Acquisition:** In order to complete the project, additional Lands, Easements, Rights of Way, Relocations, and Disposal Areas (LERRD) must be acquired. Difficulty in acquiring the relevant LERRD could disrupt the project schedules and increase the cost.
- **Weather:** Unpredictable weather, particularly hurricanes, can present challenges to project implementation.
- **Underground Utilities:** Incomplete surveys of underground utilities have been one of the reasons that project cost has increased so significantly. Potentially, this issue could arise again in future contracts.
- **Funding Availability:** The current cost estimate is based on a relatively aggressive construction schedule, which assumes large and consistent funding packages in coming years. Disruptions in the funding stream have caused issues in the past.
- **Contracting:** One risk noted in other Puerto Rico and USVI studies is the limited availability of qualified contractors in the post Hurricane Maria environment. This could be particularly true if many projects in Puerto Rico and the USVI are being constructed simultaneously due to the BBA funding.
- **Cost:** There is a potential risk during PED that if costs increase it could impact the BCR.

## 4.4. Project Outcome Risks

Generally flood risk management projects have at least two broad outcome risks: increased flood hazards associated with project failures and increased development in the floodplain.

**Increased Flood Hazard:** The culvert was designed to handle floods up to the SPF event. However, significant flood damages would accrue in the study area from a less frequent event such as the Probable Maximum Precipitation (PMP) event. If, at some point after construction, the culvert were to become clogged or fail during an extreme rainfall event, subsequent flooding would result. Though this outcome is highly unlikely (very low probability), the consequences of this outcome could be large and adverse. Therefore, it is a risk that should be acknowledged.

**Increased Development in the Floodplain**: According to Executive Order 11988, the Federal government should not take any action that induces economic development in a floodplain. The floodplain is highly developed and these features will reduce the hazard and risk associated with floods thereby minimizing the effects of floods on life safety, health, and welfare. The Corps concludes that the proposed project will not result in harm to people, property, and floodplain values, will not induce development in the floodplain, and the project is in the public interest. The project will result in a reduction of flood damages.

## 5. Compliance with USACE Quality Control Standards

This report has been prepared in accordance with the Savan Gut Phase II Project Management Plan and ER 1105-2-100, Planning Guidance Notebook, and will undergo feasibility phase reviews in accordance with EC 1165-2-217, Review Policy for Civil Works. These reviews include District Quality Control, Agency Technical Review, and Mission Subordinate Command reviews of the project report and design. Since there are no changes proposed to the project design for this previously authorized project, an exclusion from completing a Type I Independent External Peer Review was granted by South Atlantic Division on March 5, 2019.

## 6. Implementation Strategy and Recommendations

The 1982 Detailed Project Report concluded that a flood problem exists along the drainage course (or "gut") in the Savan area within Charlotte Amalie, St. Thomas, United States Virgin Islands. The flood problem begins at Jane E. Tuitt Elementary School located about 1,800 feet upstream of St. Thomas Harbor. The school was built in 1959 astride the gut with a box culvert under the school being the only means of safely passing flood flows. Consequently, the school and several adjacent houses were seriously flooded in 1970 and 1974. The flood problem also exists to houses bordering the gut from the school downstream to the business district. The business area is heavily developed for tourist trade with shops and restaurants, but also includes homes, churches, banks, other businesses, and public utilities. Floods have caused severe financial losses and created sociological problems for the inhabitants and businesses employed within the affected area. It is concluded that the most practicable plan for reducing flood losses and other related impacts along the gut would be through channel diversion around the school and conveyance improvements from the school to St. Thomas Harbor. Nonstructural measures were studied but were found to be impractical for alleviating existing damages.

Hurricane Maria in 2017 and previous storm events have caused multiple damaging flooding events in Charlotte Amalie, the capital and largest city in the U.S. Virgin Islands since the 1980's. A site visit was conducted in November 2018 to determine if there were any changed conditions that would result in an impact to the 1982 recommendation. It was determined that the conditions have not substantially changed and the unconstructed features from the 1982 recommended plan (Phase II) are still economically justified, environmentally acceptable, and

feasible from an engineering standpoint. The remaining risks as discussed in this report and identified in the Savan Gut Phase II Risk Register can be adequately managed during PED. Table 6-1 shows a breakdown of the cost allocation for the project.

Table 6-1: Cost Allocation of the Recommended Plan

| Cost Allocation of the Recommended Plan | | |
|---|---|---|
| **Feature** | **Federal Share:** | **Non-Federal Share:** |
| Construction | 58,363,000 | $ 0 |
| LERRD | | 2,813,000 |
| Planning, Engineering & Design | 11,988,000 | $ 0 |
| Construction Management | 8,680,000 | $ 0 |
| **Total Cost Allocation** | **81,845,000** | **$ 0** |
| OMRR&R (annual) | $ 0 | $ 30,000 |

## 6.1. Non-Federal Sponsor Responsibilities

Federal implementation of the Recommended Plan would be subject to the Non-Federal Sponsor agreeing to comply with applicable federal laws and policies, including but not limited to:

(1) Provide a minimum of 35 percent, but not to exceed 50 percent, of total flood control project costs as further specified below:

A. Provide 35 percent of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work;

B. Provide, during construction, a cash contribution of funds equal to 5 percent of total flood control project costs;

C. Provide all lands, easements, and rights-of-way, perform or ensure the performance of all relocations, and provide relocation assistance, as determined by the Federal Government to be required for the initial construction or the operation and maintenance of the flood control components of the project, all in compliance with applicable provisions of the Uniform Relocation and Assistance and real Property Acquisition Policies Act of 1970, as amended (42 U.S.C. 4601-4655) and the regulations contained in 49 C.F.R. Part 24;

D. Provide, during construction, any additional funds necessary to make its total contribution for flood control components equal to at least 25 percent of flood control costs;

(2) For as long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace (OMRR&R) the project, or functional portions of the project at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable federal and state laws and regulations and any specific directions prescribed by the Federal Government;

(3) Inform affected interests, at least annually, of the extent of protection afforded by the project; participate in and comply with applicable federal floodplain management and flood

insurance programs; comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12); and publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

(4) Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities that may reduce the level of protection the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;

(5) Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Non-Federal Sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

(6) Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project, except for damages due to the fault or negligence of the United States or its contractors;

(7) Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, or maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction;

(8) Assume, as between the Federal Government and the Non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of- way that the Federal Government determines to be required for construction, operation, or maintenance of the project; and

(9) Agree, as between the Federal Government and the Non-Federal Sponsor, that the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA.

(10) Participate in and comply with applicable Federal floodplain management and flood insurance programs;

(11) Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the Project;

(12) If applicable, comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-

17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, operation, and maintenance of the Project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with the said Act;

(13) Comply with all applicable Federal laws and regulations, including, but not limited to Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army," and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying, and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c et seq.);

(14) Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the Project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Partnership Agreements to Commonwealth and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

(15) Do not use Federal funds to meet the Non-Federal Sponsor's share of total Project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

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## 6.2. Recommendations

It is recommended that the unconstructed features (Phase II) from the Recommended Plan detailed in the 1982 Savan Gut St. Thomas, U.S. Virgin Islands, Detailed Project Report and Environmental Assessment, approved previously under Section 205 of the 1948 Flood Control Act, as modified in this Continuing Authorities Program (CAP) Conversion Feasibility Report, at an estimated first cost of $71.7M, be authorized. The updated CAP Conversion Report concludes that the project as previously planned and modified based on current conditions is economically justified, environmentally acceptable, and feasible from an engineering standpoint.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Furthermore, the project is in compliance with NEPA and USACE regulation ER-200-2-2 for implementing NEPA on Civil Works actions. Consultation and/or coordination with the resource agencies concerning the revised project footprint has been conducted and included in the 2020 EA. This 2020 CAP Conversion study requires approval of a Chief's Report for the project to be specifically authorized for construction.

Date 06 MAR 2020

ANDREW D. KELLY, JR.
COL, EN
Commanding

# References

(Corps), U. A. (1982). *Savan Gut St. Thomas, U.S. Virgin Islands, Detailed Project Report and Environmental Assessment.* Jacksonville, Florida .