

TURPENTINE RUN

ST. THOMAS, U.S. VIRGIN ISLANDS

FLOOD RISK REDUCTION STUDY

DRAFT

CAP CONVERSION STUDY

DRAFT

TURPENTINE RUN ST. THOMAS, U.S. VIRGIN ISLANDS FLOOD RISK REDUCTION STUDY

Executive Summary

Background The purpose of this report is to reaffirm the economic justification, environmental acceptability and engineering feasibility of the plan previously identified in the Turpentine Run Detailed Project Report and Environmental Assessment prepared in 1990 and updated in 1994. This is an expedited review of the previously approved plan without additional plan formulation, hence this is not a stand-alone report but instead a supplement to the 1994 report with updates. Turpentine Run provides drainage for the largest watershed on St Thomas, also the home of 13.5% of the population and frequently floods the adjoining neighborhoods.

Study Location The study area is the Nadir development along Turpentine Run, located on the southeastern end of the island of St. Thomas, U.S. Virgin Islands. Turpentine Run drains into the Mangrove Lagoon. Nadir is a completely developed urban, principally residential area. Turpentine Run in Nadir is an existing concrete channel with insufficient capacity to contain flood flows resulting in regular flooding of the developed area.

Authorization

- Section 205 of the 1948 Flood Control Act.
- Bipartisan Budget Act of 2018 (Public Law 115-123)
- Section 209 of the Flood Control Act of 1966 (Public Law 89-789)

Project Changes There are no proposed changes to the previously authorized NED plan; principally the construction of interior drainage features, concrete lined channel, sheep pile wing-walls, a drop structure, utility relocations, and recreation areas

Project Costs and Benefits The updated Certified Project Cost for Turpentine Run is \$54.4 M, compared to the benefits determined in the 1994 study the BCR is 0.081

Compliance with USACE Quality Control Standards The Turpentine Run project is fully compliant with current USACE Quality Control Standards

Recommendation While this review finds the BCR is low, there are significant life safety issues and other factors that suggest this project should be allowed to proceed into the PED phase to allow for a more detailed review of the previously approved remedy and reduce the cost to provide desperately needed flood damage reduction project to the residents of the project area.

TURPENTINE RUN
ST. THOMAS, U.S. VIRGIN ISLANDS
FLOOD RISK REDUCTION STUDY

Contents

1	STUDY OVERVIEW.....	0
1.1	Introduction.....	0
1.2	Study Location, Purpose and Need	0
1.3	Authorization and Prior Reports	0
1.4	Project Design	2
1.5	Construction Status.....	4
2	OVERVIEW OF CHANGED CONDITIONS FROM AUTHORIZATION	4
2.1	Economic conditions	4
2.2	Engineering conditions.....	5
2.3	Environmental conditions	5
2.4	Cultural Resources.....	6
2.5	Impacts of Maria	6
3	VALIDATION OF AUTHORIZED/MODIFIED PROJECT.....	8
3.1	Project Design Components.....	8
3.2	Cost Update.....	9
3.3	Economic Update	9
4	RISK AND UNCERTAINTY.....	11
5	COMPLIANCE WITH USACE QUALITY CONTROL STANDARDS.....	11
6	IMPLEMENTATION STRATEGY/RECOMMENDATIONS	11

1 STUDY OVERVIEW

1.1 Introduction

The purpose of this report is to reaffirm the economic justification, environmental acceptability and engineering feasibility of the plan previously identified in the Turpentine Run Detailed Project Report and Environmental Assessment (See Attachment A) completed in 1994. This is an expedited review of the previously approved plan without additional plan formulation, hence this is not a stand-alone report but instead a supplement to the original report with updates and changes contained. A Feasibility report was completed in 1990 and then updated and approved in 1994 but construction was delayed until the completion of other projects within the Territory. Due to the impacts of Hurricanes Irma and Maria in 2018 and sponsor request, the project was selected in the Supplemental Appropriations Bill, P.L. 115-123, to be converted to a specifically authorized project through the Investigations account.

1.2 Study Location, Purpose and Need

The study area is the Nadir development along Turpentine Run, located on the southeastern end of the island of St. Thomas, U.S. Virgin Islands. Turpentine Run drains into the Mangrove Lagoon and is the largest watershed on St. Thomas. Nadir is a completely developed urban, principally residential area. Turpentine Run in Nadir is an existing concrete channel with insufficient capacity to contain flood flows resulting in regular flooding of the developed area. See Figure 1.

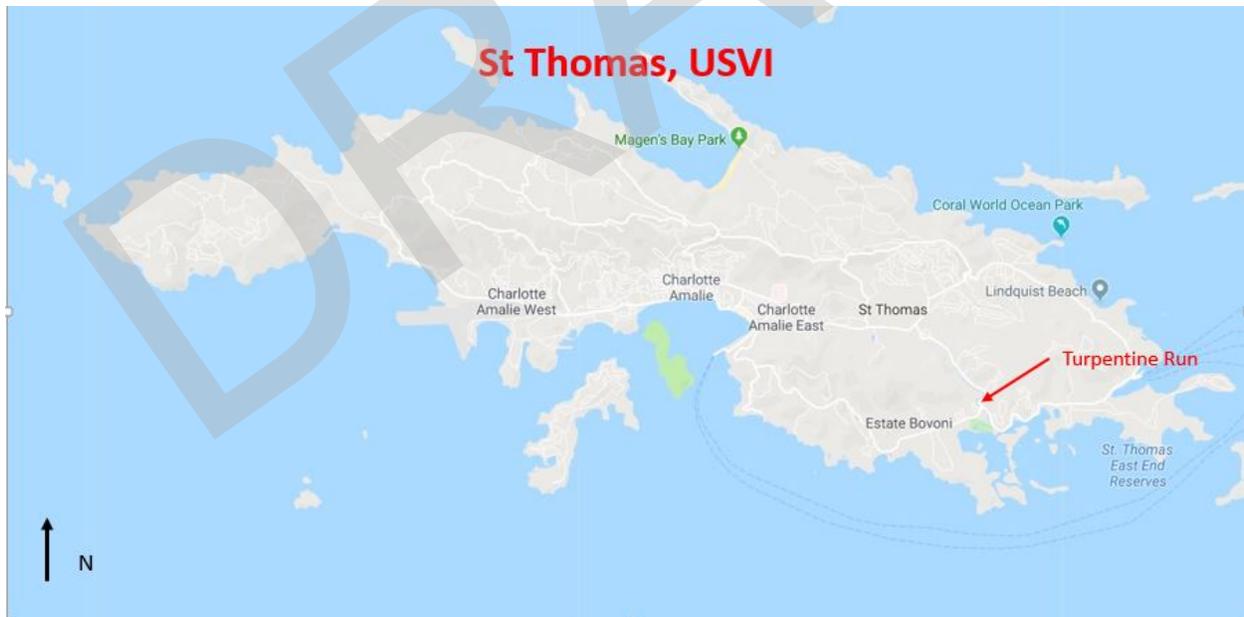


Figure 1 – Turpentine Run Location

1.3 Authorization and Prior Reports

The Turpentine Run, Section 205 Detailed Project Report (DPR) and Environmental Assessment (EA) was completed in 1990 under authority provided by Section 205 of the 1948 Flood Control Act, as amended;

Section 205 of the 1948 Flood Control Act, as amended, which states: "The Secretary of the Army is hereby authorized to allot from any appropriations heretofore or hereafter made for flood control, not to exceed \$40,000,000 for any one fiscal year, for the construction of small projects for flood control and related purposes not specifically authorized by Congress, which come within the provisions of Section 1 of the Flood Control Act of June 22, 1936, when in the opinion of the Chief of Engineers such work is advisable. The amount allotted under this Section for a project shall be sufficient to complete Federal participation in the project. Not more than \$5,000,000 shall be allotted for a project at any single locality. The provisions of local cooperation specified in Section 3 of the Flood Control Act of June 22, 1936 as amended, shall apply. The work shall be complete in itself and not commit the United States to any additional improvements 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."

The 1990 Turpentine Run DPR and EA reported an estimated cost of \$8.7 M to construct the project with a benefit cost ratio of 1.10 and was approved on 22 Nov 1984.

The Bipartisan Budget Act of 2018 (Public Law 115-123), Division B, Subdivision 1, Title IV;

Title IV of the Bipartisan Budget Act of 2018 states: "For an additional amount for " Investigations" for necessary expenses related to the completion, or initiation and completion, of flood and storm damage reduction, including shore protection, studies which are currently authorized or which are authorized after the date of enactment of this subdivision, to reduce risk from future floods and hurricanes, at full Federal expense, \$135,000,000, to remain available until expended: Provided, That of such amount, not less than \$75,000,000 is available for such studies in States and insular areas that were impacted by Hurricanes Harvey, Irma, and Maria: Provided further, That funds made available under this heading shall be for high-priority studies of projects in States and insular areas with more than one flood-related major disaster declared pursuant to the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5121 et seq.) in calendar years 2014, 2015, 2016, or 2017: Provided further, That such amount is designated by the Congress as being for an emergency requirement pursuant to section 251 (b)(2)(A)(i) of the Balanced Budget and Emergency Deficit Control Act of 1985: Provided further, That the Assistant Secretary of the Army for Civil Works shall provide a monthly report to the Committees on Appropriations of the House of Representatives and the Senate detailing the allocation and obligation of these funds, including new studies selected to be initiated using funds provided under this heading, beginning not later than 60 days after the enactment of this subdivision."

Section 209 of the Flood Control Act of 1966 (Public Law 89-789);

Sec. 209. 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

1.4 Project Design

The 1990 DPR and EA's selected plan involved the replacement of the existing concrete channel with a new channel having greater capacity. The recommended design would provide flood damage reduction benefits for a 25 year storm. Improvements would begin at the north end of the Nadir development with an excavated transition area. A small (260' in length) levee would be constructed along the northern edge of Nadir. A 170' long sheetpile wall would be constructed along the development side of the channel and a drop structure. The new concrete channel, with a "U" shape of approximately 460' then transitions to a trapezoidal, earthen channel lined with rip rap for 1,385'. A levee of 1,300' is proposed south of the new Bovoni Rd Bridge, ending at the Nadir racetrack. Rip rap will be placed on the left side of the channel as it flows around the corner of the racetrack. Interior drainage would be conveyed from the existing small concrete channel by a 72" underground pipe with a length of 1,745' to run under the levee footprint and under the racetrack to discharge into Mangrove Lagoon. See Figure 2 for an outline of the project footprint.

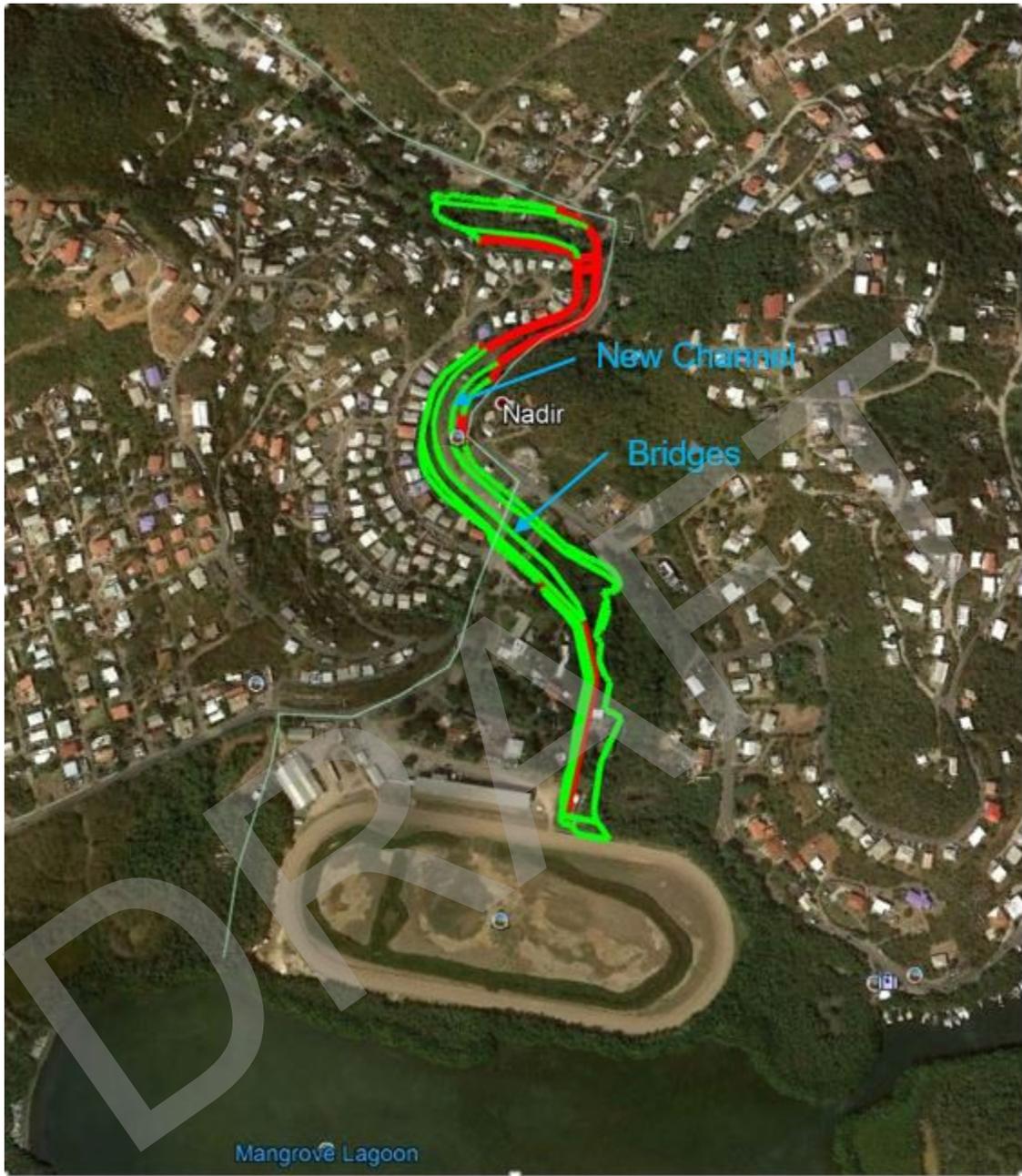


Figure 2: Turpentine Run Project Footprint

1.5 Construction Status

No construction of this previously approved Federal project has been initiated or completed.

2 OVERVIEW OF CHANGED CONDITIONS FROM AUTHORIZATION

2.1 Economic conditions

Population - According to the USVI Bureau of Economic Research, the population of the US Virgin Islands has been increasing from 1990 to 2000, an increase of 6.7 percent for the ten year period. However, from 2007 to 2017 the Territory has experienced a decline in population at the rate of 1.9 percent every five years or 0.6 percent annually. As of 2010 Census, the population of St. Thomas was 51,634 compared to 48,166 in 1990, an increase of 7 percent growth over the ten year period. However from 2010 to 2017, the population has been in steady decline at the rate of 0.6 percent annually or 1.5 percent every five years. Declining population could be associated with decrease in development and benefits. Table 1 presents the population of US Virgin Islands and St. Thomas for selected years since 1990.

Table 1¹: Population of US. Virgin Islands and St. Thomas

	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

Socio-Economic Assessment – The DPR & EA indicate that at that time the Turpentine Run basin had 13,000 residents, 13 % of the islands’ population at the time. Approximately 118 structures, principally single family homes, were identified within the study area subject to flooding impacts and used to calculate potential benefits. Recent site visits indicate the neighborhoods appear to be houses with ground floor elevation equal to adjacent land. The structure inventory does not appear to have changed since the original report. The houses are in various states of disrepair and appear to be the same housing inventory as was previously documented in the 1990 DPR & EA. A majority of the structures appear to be inhabited and all show considerable signs of aging. There are numerous vehicles on every street in the study area, with a mix of operational and abandoned. It appears that numerous residents also operate businesses out of the home. The neighborhoods would not be a destination for tourists, but the adjacent recently renovated horse track (Clinton Phipps Racetrack) likely brings in local and regional VI residents for the races. Not far from that area is a basketball court that is open to the public.

Tourism, trade, and other services are the primary economic activities, accounting for nearly 60% of the USVI’s gross domestic product (GDP) and about half of total civilian employment². Close

¹ U.S. Virgin Islands Annual Economic Indicators, VI Bureau of Economic Research

² U.S. Virgin Islands Economic Review, VI Bureau of Economic Research, May 15, 2016.

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% of GDP while exports of goods and services, including spending by tourists, accounted for nearly 47%. 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 8,136.6 million proof gallons.

2.2 Engineering conditions

Preliminary review of the current conditions from aerial imagery, a PL 84-99 assessment made on 31 Oct 2017 following Hurricane Maria and a more recent site visit on 9 Nov 2018 suggests that the project features would be valid as designed. The new Bovina Bridge is complete, which will allow for the traffic pattern to change and the old culvert crossing bridge to be removed, which is critical to the completion of the project.

Updating of the hydrologic analysis of the rainfall used in the previous design would be prudent during PED phase to assure the designed project would provide the authorized 25-yr benefits. A new Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) model would need to be developed for this analysis. The hydraulic model used in the past design is superseded by the Hydrologic Engineering Center – River Analysis System (HEC-RAS) analysis model. An HEC-RAS model of the project does not exist. The validity of the design has not changed over time, but the hydrology may differ due to new analysis procedures and longer term historical records. To what extent the hydrology would differ is not known until this analysis is performed. A significant departure in the hydrologic runoff in timing (less probable) and/or amount (more probable) would determine if a new HEC-RAS model would be warranted to validate or optimize the design. If the hydrologic runoff is similar, the design would be valid and an HEC-RAS model is not anticipated unless refinements or a Value Engineering proposal would require the development of a HEC-RAS hydraulic model of the project.

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 Turpentine Run/Nadir Area, St. Thomas, U.S. Virgin Islands, Detailed Project Report and Environmental Assessment (EA), dated November 1994. The 2019 draft EA updates the 1994 EA analysis and adopts the 1994 EA, by reference, where the information is valid and applicable (See Attachment E).

Few changes in the environmental conditions of the project area have occurred. The freshwater swamp forest present during the 1994 investigations is no longer intact due to recently completed construction of the Bovoni Road bridge. The ongoing erosion and scouring of gut bed and banks have continued to degrade the streambank wetlands. The 1994 project did not include mitigation; however, debris and vegetation would be removed during the channelization, clearing, and grubbing activities. If effects to wetlands require mitigation, a plan will be

developed, proposed, and refined during the project's PED phase. Pursuant to the Endangered Species Act of 1983 (16 U.S.C. §1531 *et seq.*), coordination with National Marine Fisheries Service and U.S. Fish and Wildlife Service ongoing. Construction activities may affect, but are not likely to adversely affect, the Virgin Island tree boa (*Epicrates monensis granti*). Standard protection measures for the boa will be implemented to protect any boas that may be in the area.

2.4 Cultural Resources

In 1988, the Corps identified no cultural resources eligible or potentially eligible for listing in the National Register of Historic Places (NRHP) within the project footprint; however, the project design subsequently changed after the cultural resources surveys were completed. Recommended additional Phase I cultural resources survey to include a 1,200-foot corridor at the southern end of the project where a levee would be constructed and riprap emplaced; a 900-foot corridor spanning the Bovoni Road Bridge; and a 1,745-foot corridor for a 72-inch diameter pipeline during PED.

Heavy ground disturbance within the project footprint since the initial study may have impacted cultural resources. A phase I cultural resources field study is needed to identify cultural resources within the project footprint to determine NRHP eligibility and make a determination of effects on historic properties. The Jacksonville District is currently coordinating a programmatic agreement with U.S. Virgin Islands SHPO to conduct a phased identification and evaluation of historic properties in PED.

2.5 Impacts of Maria

Imagery prior to Hurricane Maria shows evidence that there was a home adjacent to channel wall that was washed into and caused the wall to collapse into the channel. In addition, 640 feet downstream at the Bovina Road bridge culvert crossing the flood flows went over the channel wall and scoured a hole and undermined a house foundation. Remaining features of the channel in this area were in good condition. See Figures 3 thru 5 from the October 2017 timeframe. The collapsed wall section had been repaired when a site visit on 9 Nov 2018 was made.



Figure 3 - Collapsed section of channel wall, house missing



Figure 4 - Home no longer present at collapsed wall section



Figure 5 - Erosion on back side of channel wall

3 VALIDATION OF AUTHORIZED/MODIFIED PROJECT

3.1 Project Design Components

Construction of the Turpentine Run channel improvements shall be carried out in three main phases.

Phase I - The first order of work shall be the installation of all interior drainage items. Then the protective steel sheet piling for the overflow channel and along the Turpentine Run Road shall be placed, the channel excavated from the project south end to Station 26+86, and the embankment along the west side of the overflow channel wall constructed.

Phase II - Work in phase II consists of construction of the concrete channel (including its steel sheet pile wing-walls) and drop structure.

Phase II (a) - Stormwater Bypass Channel. Construction of the concrete channel and drop structure begins with the driving of the permanent and temporary steel sheet piling along the length of the concrete channel. Four stages of excavation are then performed with soil anchors and internal bracing being installed. After stage IV excavation, the east side channel bottom and wall foundation concrete is placed and water is diverted through the completed bypass channel.

Phase II (b) - Channel Construction. With the bypass channel in place, the remainder of the channel and drop structure can be completed. The west side excavation is performed by driving steel sheet piling and placing internal bracing. The retaining wall and channel bottom concrete is then placed up to the bypass channel. Next, the bypass wall is removed and the unfinished bottom slab is isolated using sandbags. The bottom slab concrete and remaining east wall concrete is then placed and the sandbags removed to finish the channel.

Phase III - The permanent steel sheet pile upper east and west walls are placed and the channel excavated from Station 32+69 to the north end of the project.

Utility Relocation - Utility relocations (water and electric) along the channel shall be performed concurrently with each phase of construction.

Recreation Areas - Work in any of the three recreation sites (Stomboni Circle Park, Stomboni Road Park and Bovoni Bridge Park) may commence once all channel construction in these recreational areas is complete or no longer needed for other purposes.

3.2 Cost Update

The total estimated cost of the authorized project has increased significantly since the project was authorized in December 1994. Main factors contributing to the cost increase includes but not limited to the following: 1) rising costs in materials, 2) rising costs in labor rates, 3) changes in design criteria. Recently, the island was devastated by hurricane(s) and is undergoing reconstruction with substantial government investment on the island. Therefore, it is anticipated that there will be other risk factors that affect the cost of the project such as: 1) availability of skilled labor on the island, 2) availability of local and/or worldwide contractors to perform all the work needed on the island, 3) availability of material, 4) future funding stream, and 5) acquisition strategy. The current fully funded cost of the project is \$59.4 M as reflected in the certified cost estimate (See Attachment B).

3.3 Economic Update

Previously Approved Benefits - Flood Control prevention benefits from the 1990 DPR were calculated at a discount rate of 8.875% based on the November 1990 price levels. Cost and benefits from the 1990 DPR are shown in Table 2.

Table 2: Annual Benefits and Costs Benefits

November 1990 Price Level	Discount Rate = 8.875%
Initial Cost	\$7,390,000
IDC	\$336,600
Total Project Cost	\$7,726,600
Interest and Amortization	\$695,700

Operation, Maintenance & Replacement	\$6,400
Total Cost	\$702,100
Total Annual Benefits	\$770,400
Benefit to Cost Ratio	1.1
Net Benefit	\$68,300

Current Project Cost Estimate FY19 Price Level - Total project cost estimates for the Feasibility study were used for the evaluation. To be consistent with the benefit stream of the last approved report (1990), the current certified costs, \$27,556,000, were normalized to November 1990 price levels using the Civil Works Construction Cost Index System (CWCCIS) quarterly cost index from the March 30, 2018 report. Deflated cost were annualized at the FY19 interest rates, 2.875 percent, over the 50-year period of analysis.

The benefit cost ratio (BCR) were updated following the Bipartisan Budget Act of 2018 (Public Law 115-123), Division B, Subdivision 1, Title IV. The current discount rate 2.875% (FY19) was used along with the last approved report discount rate of 8.875% (FY90), since the benefits are derived from the last approved report. A benefit to cost ratio for the total project was computed for the economic update costs estimates provided by USACE Cost Engineer. Table 3 presents the current cost estimate, IDC, annualized cost and the annualized benefits from the 1990 approved report.

The average annual benefits are divided by the average annual costs to calculate the BCR for the project. The updated BCR is estimated at 0.81, which is derived from \$770,400 in annual average benefits divided by \$952,458 in average annual costs. The average annual net benefit is \$248,916. Hence the results affirm that the project is still economically justified.

Table 3: Turpentine Run BCR Update at FY19 Price Levels

FY19 Price Level	Discount Rate 2.875%
Project Costs	\$ 50,353,000
Interest During Construction	\$ 3,847,110
Total Economic Cost	\$ 54,200,110
Total Cost in 1990 Dollars	\$ 24,730,050
Interest & Amortization	\$ 938,458
Operation Maintenance & Replacement	\$ 14,000
Average Annual Cost	\$ 952,458
AAB from 1990 Approved Report	\$ 770,400
Net Benefits	(\$ 182,058)
Benefit to Cost Ratio @2.875%	0.81

Conclusion - The Validation Report provides current economic information for Turpentine Run Flood Risk Management. A field survey conducted by SAJ Economists in November 2018 reveal

that the houses are in various states of disrepair and appear to be the same housing inventory as was previously documented in the 1990 Report.

The results of the analysis show that the project does not appear to be economically justified with BCR of 0.81 and a net benefit of (\$182,058) at the FY19 federal discount rate of 2.875 percent.

4 RISK AND UNCERTAINTY

Site conditions and other characteristics detailed in the original planning report may have changed over the ensuing years. This expedited review of the project suggests that changes in the physical conditions, watershed hydraulics, and design standards and practices that have changed over time are potential risks that can be addressed if this project is moved into the design phase for eventual authorization and construction. See the attached Turpentine Run Risk Register (Attachment F).

5 COMPLIANCE WITH USACE QUALITY CONTROL STANDARDS

This report addendum is prepared in accordance with the Turpentine Run Project Management Plan, ER 1105-2-100, Planning Guidance, and will undergo feasibility phase reviews in accordance with EC 1165-2-214. 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, a request for exclusion from completing a Type I Independent External Peer Review was submitted on November 16, 2018.

6 IMPLEMENTATION STRATEGY/RECOMMENDATIONS

Hurricanes Irma and Maria in 2017, and previous storm events have caused multiple damaging flooding events in to the Nadir neighborhood on St. Thomas. This review of the previously recommended project to reduce adverse impacts due to flooding may no longer be viable as the costs to construct the recommended plan exceed the previously determined benefits. There are identified risks as discussed above, but those risks can be adequately managed during the design process.

It is recommended that the Turpentine Run flood risk management project be approved and proceed to the Preconstruction, Engineering and Design Phase. This review finds the BCR less than unity but there are other factors that must be considered. The island of St Thomas is densely populated and there are few options for residents seeking alternative housing options due to the islands topography. Approximately 13% of the islands population resides within the project watershed. There have been at least two documented fatalities associated with flooding events in the project area. The original DPR highlights an unfortunate death occurred in 1987 when a car was washed off the nearby roadway and the driver drowned. Sadly, during the recent storm season the occupant of the lost home depicted in Figure 4 drowned as well. Additionally, due to

the age of the project report upon which the current cost estimate is based, there is a rather large contingency added due to the inherent uncertainties involved. Allowing this project vital to the residents of within this watershed to move into PED will allow a more detailed review of the previously selected recommended plan and exploration of potential cost saving measures and/or design refinements to achieve the needed flood damage reduction goal.

The project is in compliance with NEPA and USACE regulation ER-200-2-2 for implementing NEPA on Civil Works actions. Coordination with resource agencies concerning project revisions will be conducted and included in the Finding of No Significant Impact that will be completed for this project. Finally, this 2019 CAP Conversion Addendum will require approval at the MSC and approval of the associated Chief's Report for appropriations in order to initiate the design and implementation phase of the project.

Andrew D. Kelly, Jr.
Colonel, U.S. Army
District Commander

Attachments

- A) Turpentine Run Detailed Project Report and EA, 1990
- B) Turpentine Run Total Project Cost Summary
- C) Turpentine Run Cost Estimate Abbreviated Risk Analysis
- D) Turpentine Run Cost PCX TPCS Certification
- E) Turpentine Run NEPA Documents
- F) Turpentine Run Risk Register