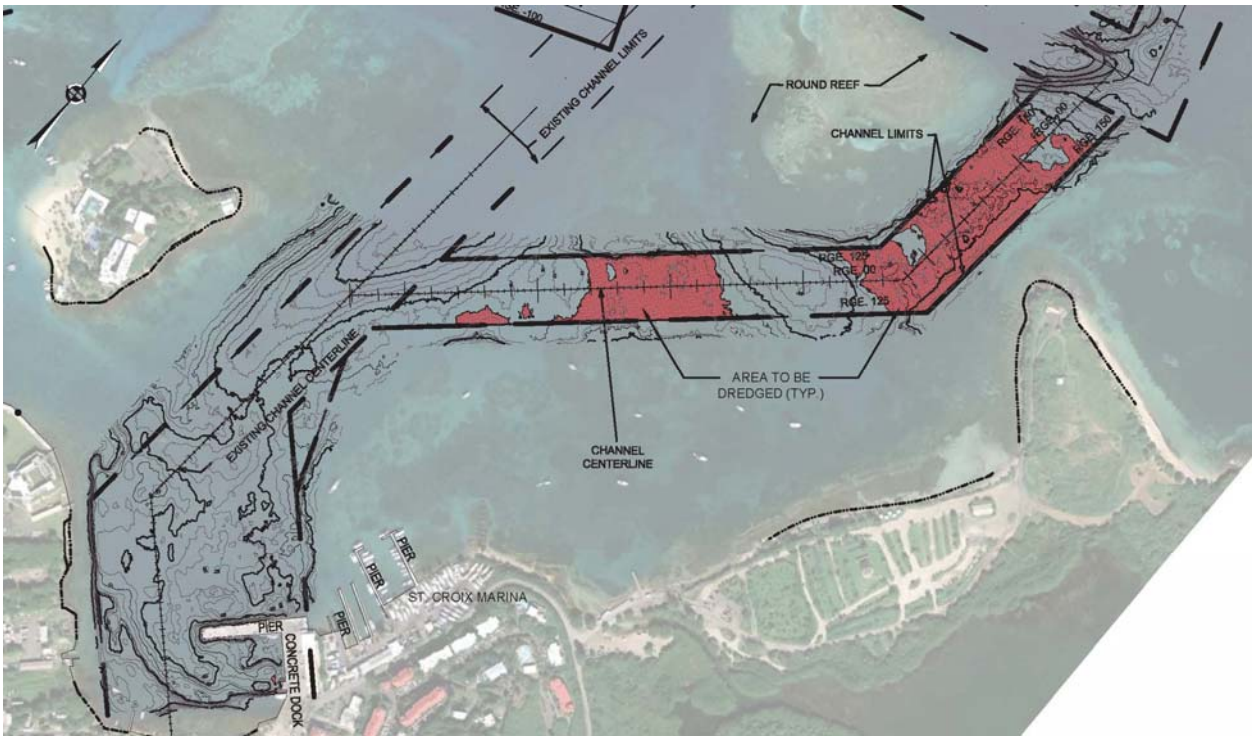
Environmental Assessment Report
For
Maintenance Dredging of Schooner Channel

St. Croix, US Virgin Islands



CZM Application
November, 2014
By
Virgin Islands Port Authority

Prepared by
CDR Maguire.
1142 King Street
Christiansted, St. Croix, USVI

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Appendix E - Army Corps of Engineers Application

1.00 NAME AND ADDRESS OF APPLICANT

Virgin Islands Port Authority
Carlton A. Dowe, Executive Director
PO Box 1707, St. Thomas, VI 00803

Tel: 340 774-1629

2.00 LOCATION OF PROJECT

The proposed maintenance dredging will take place on the north side of St. Croix in Schooner Channel, Christiansted Harbor.

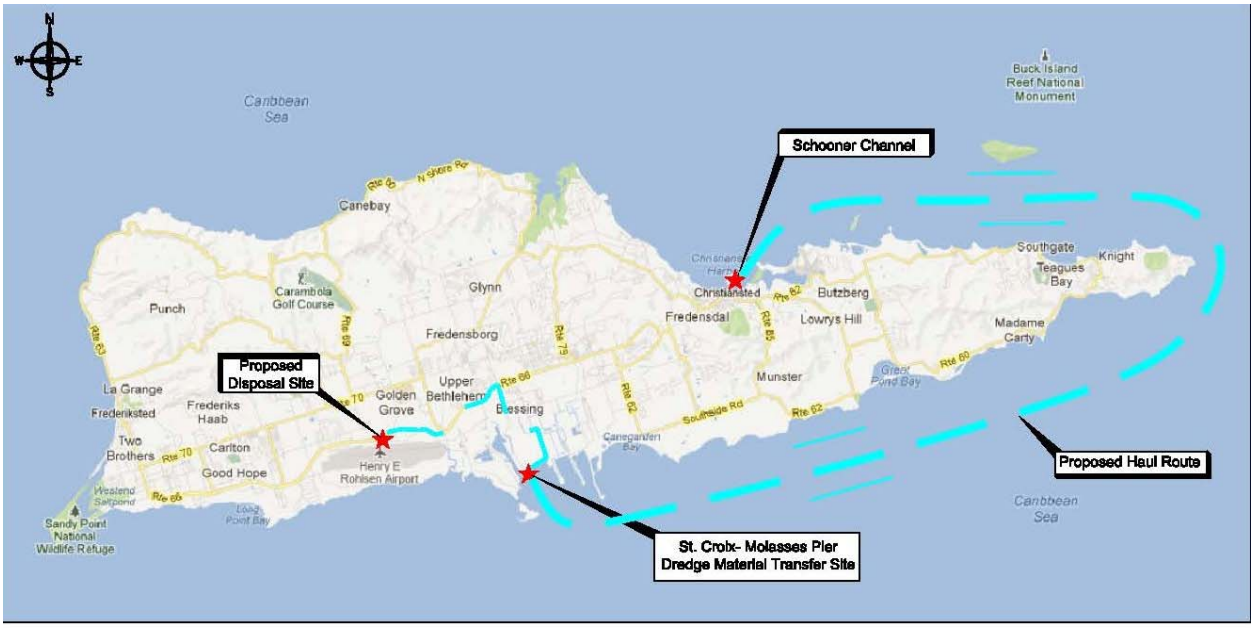
The proposed work area is bounded by:

North: Caribbean Sea

East: Altona Lagoon

South: Gallows Bay Marine Terminal

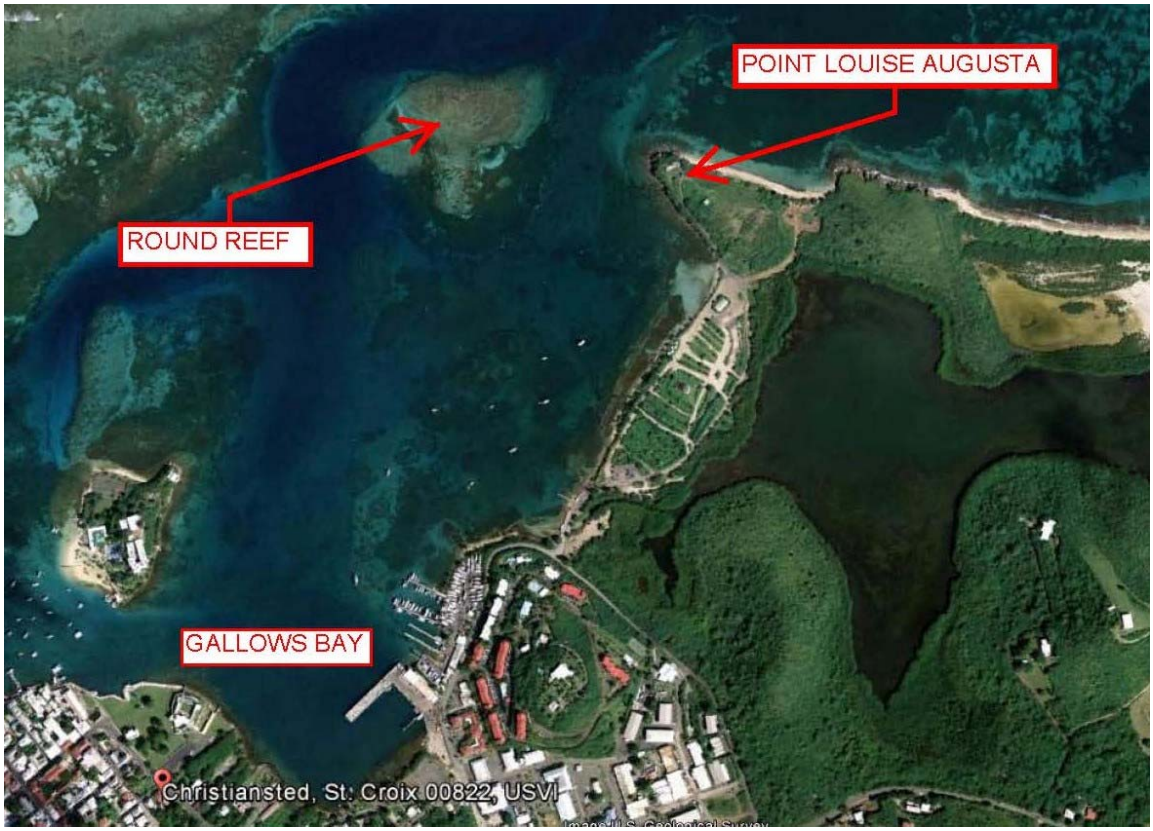
West: Protestant Cay, Christiansted Harbor



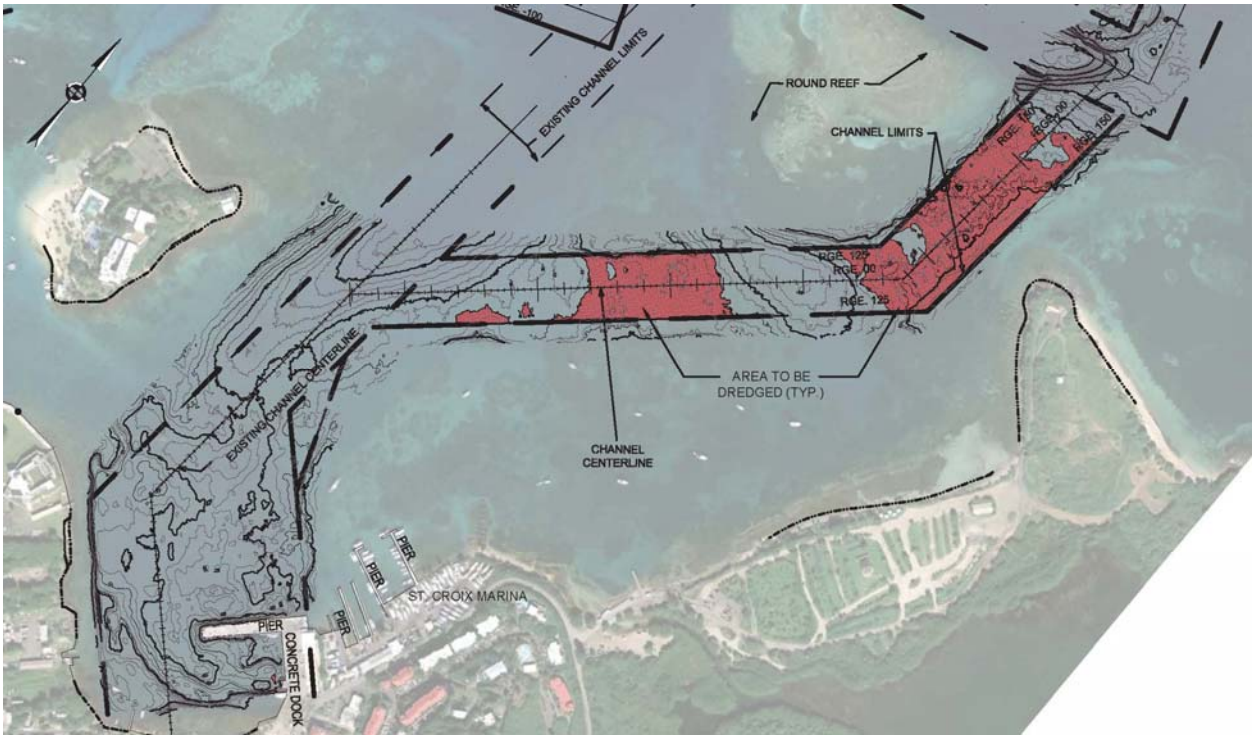
St. Croix

Not to Scale

Vicinity Map



Location Map – n.t.s.



Schooner Channel – n.t.s.

3.00 ABSTRACT

The Virgin Islands Port Authority (VIPA) needs to conduct maintenance dredging of Schooner Channel to the previously approved depth of -18' to allow its Gallows Bay Marine Terminal to be used by Mini- Cruise Ships and other deep draft vessels.

Dredged spoils will be disposed of at an old quarry site north of the Henry E. Rohlsen (HERA) Airport and to the west of the William D. Roebuck Croix Industrial Park.

4.00 STATEMENT OF OBJECTIVES SOUGHT BY THE PROPOSED PROJECT

The objective of the Proposed Maintenance Dredging Project is to increase tourism to the Town of Christiansted by encouraging the smaller Cruise Ships and other deep draft vessels to use the VIPA Gallows Bay Marine Terminal. The dredging is a priority of the VI Government to improve the economy of St. Croix.

It is proposed that the Objective be accomplished by:

- Dredging the existing Schooner Channel to the previously approved depth of -18", where needed.

- Selecting a dredge spoils disposal site that has the least impact on the environment.

5.00 DESCRIPTION OF THE PROJECT

5.01 Summary of Proposed Activity

Schooner Channel was previously dredged in 1991. In April, 2013, Christiansted Harbor and Schooner Channel were surveyed and certain portions of Schooner Channel were above -18'. Sand has accumulated in the western portion of the channel and boulders have tumbled down into the outer portions of the channel. There is also remaining rock pavement or hardpan in the outer portion of the channel which was not completely removed in 1991.

The proposed Dredge Spoils disposal site will be an old quarry site located to the north of the HER Airport and to the west of the William D. Roebuck Croix Industrial Park. All dredge spoils will be barged to the VIPA Molasses Pier, offloaded onto trucks and hauled to the quarry site.

5.02 Proposed Method of Construction

The area to be dredged consists of sand and rock. It is proposed that mechanical means for dredging be used in Schooner Channel. Mechanical excavation (clamshell or backhoe dredge) have the inherent advantage of directly loading low water content material onto disposal barges.

For those areas where rock is encountered, removal will depend on the rock's compressive streng[[[th. When a rock's compressive strength is less than 6,000 psi, conventional mechanical excavation will be used to dredge the rock. Above the 6,000 psi threshold, the use of a punch (drop hammer), hydraulic powered hammer, or pre-drilling will be used.

At the proposal quarry disposal Site, standard earthmoving equipment will be used to spread and compact the dredge spoils.

5.03 Erosion and Sediment Control Methods

During the dredging operation, turbidity curtains will encircle the dredge and barge to minimize

the spreading of suspended sediment within Schooner Channel. With the use of mechanical dredging equipment and the mostly large particle size of the spoils, the spoils will not have high water content and will be further dewatered as it sits on the barge.

At the disposal site, the existing vegetative cover that is removed prior to the site accepting the dredged material will be used to create a berm paralleling the silt fence which will enclose the disposal site. The silt fence will consist of metal posts, wire mesh and silt fence fabric and will be installed prior to any filling starts. The site will be graded consistently and when the final elevation is achieved it will be covered with erosion control blankets and natural vegetation allowed to grow. A stabilized 50' construction entrance consisting of 6" of 2" stone will be in place prior to hauling of dredged spoils to the disposal site.

5.04 Construction Schedule

It is anticipated that dredging will start four months after all permits are received and dredging will be continuous until completed. Exact time frame depends on the strength of the rock, but it is estimated to be three months to complete after dredging starts.

5.05 Drawings: See Appendix A

Cover Sheet
Index Sheet
Maintenance Dredging Plan
Section Location Plan
Section Plan
Molasses Pier
Dredge Spoils Site
Dredge Spoils Sections

6.00 Setting and Probable Impacts on the Natural Environment

6.01 Climate and Weather

The Virgin Islands of the United States lie directly in the belt of sub-tropic easterly trade winds. The climate is maritime tropical and is characterized by generally fair weather, steady winds, and slight but regular seasonal and diurnal ranges in temperature.

Temperatures remain relatively constant throughout the year. Temperatures normally range from 70 to 85 degrees, with a mean of 79 degrees. Highest temperatures occur in August and September, and the lowest in January or February. Seldom does the temperature drop below 70 degrees or rise far above 90 degrees.

Lying directly in the path of the trade winds, the Virgin Islands generally receive an easterly wind. According to the U.S. Naval Oceanography Office, the easterly winds range from 11 to 20 knots about 60 percent of the time. Winds above 20 knots occur more frequently in winter than in other seasons.

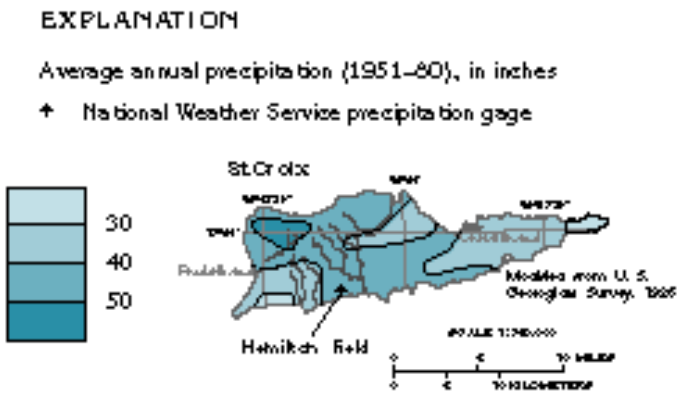
The islands are occasionally affected by tropical storms and hurricanes. The generally acknowledged storm season occurs from August through October, with peak activity occurring in September. At least 33 hurricanes, which have sustained winds over 74 miles per hour, have passed within 50 miles of the Virgin Islands since 1876. Hurricanes Hugo and Marilyn, 1989 and 1995, respectively, were both Category II hurricanes that struck the Virgin caused serious damage throughout the Territory.

The climate is maritime tropical and is characterized by generally fair weather, steady winds, and slight but regular annual, seasonal, and diurnal ranges in temperature. Rain-producing weather systems generally move into St. Croix from the east in summer and from the northwest in winter.

Major rainfall events are associated with weather systems that enhance the uplift of moist air in the region. Orographic lifting of moist air over hilly terrain is the most common cause of rainfall in St. Croix. The amount of rainfall increases with increasing elevation. The total annual rainfall differs substantially at various locations throughout the island. The total annual rainfall is more than 50 inches in the northwestern part of the island, about 25 to 35 inches on the southwestern coast, about 40 to 50 inches on the south-central coast, and about 20 to 30 inches in the eastern part of the island. Rainfall in the Project area will average 35” to 40” per year.

Leeward aspects receive greater amounts of rain because clouds develop over the slopes on a daily basis. In general, days have a higher incidence of rainfall than nights. St. Croix's wettest period generally is from September to November, and the driest period is from January to June.

During dredging operations, if weather makes the turbidity barriers ineffective, the dredging will stop until the weather improves.



Rainfall Map

6.02 Landform, Geology and Soils

Schooner Channel is in the eastern portion of Christiansted Harbor which is semi-circular in shape. It is surround by Point Louise Augusta to the east, Round Reef to the west with a large coral reef to the north and Gallows Bay to the south.

It is ringed by soils classified as Southgate – Rock to the south, east and west. Southgate –Rock are generally stony, gravelly and rubble over moderate deep bedrock. Schooner Channel basically has a hardpan bottom with some sandy overburden less than 2' deep. See Soils Map below.

The project area is underlain and flanked by Cretaceous Volcanic rock which is among the oldest in the northeastern Caribbean. The rock was formed by lava flows which have been uplifted, folded, faulted, and partially buried by recent alluvium.

Soils Map

6.03 Construction Methods and Turbidity Control

6.03.1 Dredging:

The proposed work is the maintenance dredging of Schooner Channel. Dredging will be done only within the defined channel borders and there are no other alternatives except no dredging.

VIPA provided bathymetric surveys for Christiansted Harbor and Schooner Channel. The survey was performed by Arc Surveying & Mapping Inc. in April, 2013. This survey data was utilized to estimate dredge quantities for the proposed project. BioImpact performed benthic surveys and probes to preliminarily identify the top of rock elevation in the proposed dredge areas and potential impacts on the benthic community. The probe information was utilized to estimate what portion of the dredging would require rock removal. Based on this information CDR Maguire estimates the extent of dredging for both overburden and rock as indicated below:

	Overburden Material	Rock	Total
Schooner Channel	10,450 cy	28,350cy	38,800 cy

A through characterization of subsurface material within the dredge footprint is critical to determining dredge method, production, and timeframe. Mechanical methods of dredging are indicated based on the assumed unconfined compressive strength of the rock. Another critical factor is the geometric configuration of the rock. A deep face of rock over a smaller area will be more easily dredged as a dredge operator's concern over grade control is significantly reduced. This leads to a reduced dredge timeframe. Conversely, a thin layer of rock over a large area is more difficult to dredge as depth control becomes more paramount, which can significantly extends the dredge timeframe. Based on preliminary observations of Schooner Channel, it appears the dredge face is rather shallow over a large area.

A detailed geotechnical investigation will be initiated to better understand the thickness and strength of rock, and provide a more definitive dredge schedule. The preliminary site investigation performed identified the top elevation of the rock layer and preliminary quantification of rock versus sand/silts quantities in addition to testing, potential dredge spoils for chemical composition and assessing the benthic community.

Dredging Methods

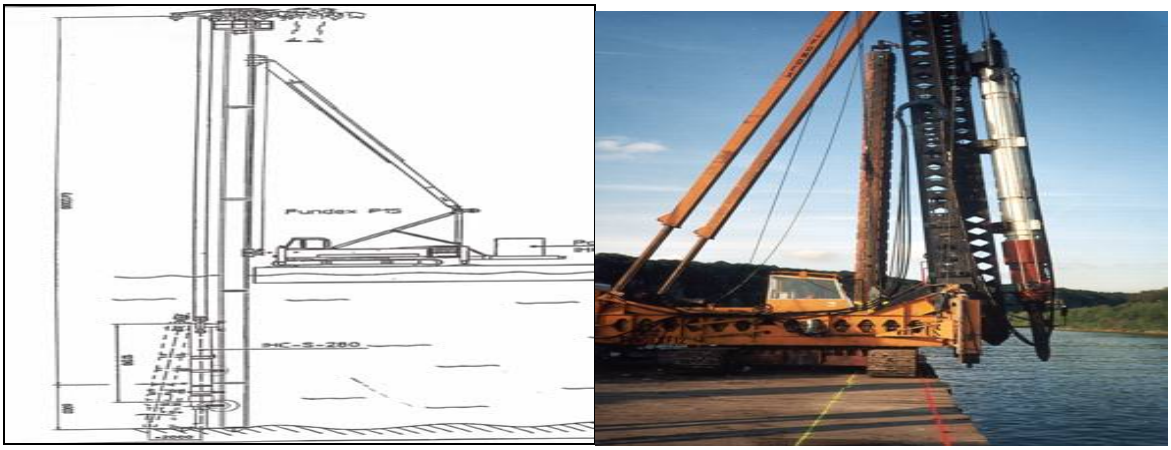
Mechanical (crane/bucket or backhoe) dredge equipment will be used to remove material in the cruise ship berth and the turning basin. If rock has a compressive strength of less than 6,000 psi, it will be dredged by competent mechanical equipment. Once the rock's compressive strength exceeds 6,000psi, the use of a punch (drop hammer), hydraulic powered hammer or pre-drilling, will be used to fracture or loosen the rock. Exact method will be decided by the Dredging Company. Once loosen, the loosened material will be deposited on to the disposal barge.

Mechanical excavation (clamshell or backhoe dredge) has the inherent advantage of directly loading low water content material into disposal barges.

If the compressive strength is greater than 8,000psi, then the rock may be fractured by pre-drilling, or by the use of a hydraulic powered hammer. A punch or drop hammer is not effective in fracturing this hard rock.

Clamshell Dredge Equipment

Large Backhoe Dredge Equipment



Hydraulic Powered Hammer

The less dense material (sands) will be excavated using a long-arm track backhoe mounted on a barge or by a barge mounted crane using a clam bucket. The material would then be placed into a disposal barge for transport.

A deck barge will be used to transport the dredged material to the Molasses Pier. A deck barge will also facilitate unloading the material at the Molasses Pier. A deck barge of 270'x72'x12' with a 3 feet high steel knee wall with a capacity of 2000cy is assumed. The dredge material would be stacked 5 to 7 feet above the deck within the deck surface surrounded by the knee wall. The steel knee wall is not completely watertight, allowing low volume amount of excess water to drain back into the dredge area and proposed mixing zone area. The material will be pretty dry during shipment and barge transport will not occur if sea conditions could compromise barge stability.

6.03.2 Disposal

Disposal will be at an old quarry site north of the HERA Airport and to the west of the William D, Roebuck Industrial Park located off of the Melvin Evans Highway. The dredged spoils will be off-loaded at the VIPA Molasses Pier and transported in water-tight trucks to the quarry.

The barge operation will consist of a 3 barge 24 hour transport schedule. Once the barge arrives at the Pier, a front loader will drive onto the deck barge, load material, drive off barge and unload material directly into water-tight dump trucks. Barges will be off-loaded within a 24 hour period and then returned to the dredge site at Schooner Channel. If trucking it directly to the quarry cannot be completed within a 24-hour timeframe, then the material will be stored on a cleared area of land immediately adjacent to Molasses Pier; see Temporary Storage Area figure below. The temporary storage area will be enclosed by reinforced silt fencing.

Molassas Pier - Temporary Storage Area

Once at the quarry, the material will be spread and compacted. This area could then be used for VIPA activities. See Appendix A for drawings of the Disposal site. Prior to disposal, a SWPPP will be submitted and a permit obtained.

6.03.3 Turbidity Controls

Best management practices (BMP) shall be employed during dredging to reduce the potential for adverse environmental impacts. The highest level of attention to environmental quality will be given to this project. The dredge contractor shall be required to employ standard BMPs for dredging in coastal waters, such as daily inspection of equipment for conditions that could cause spills or leaks; cleaning of equipment prior to operation near the water; proper location of storage, refueling, and servicing sites; and implementation of adequate spill response procedures, stormy weather preparation plans, and the use of floating turbidity barriers and other containment devices.

Floating turbidity barriers shall be deployed during all in-water activities to isolate the dredging activity and avoid degradation of marine water quality and impacts to the marine ecosystem. Double rows of turbidity barriers will be installed around the dredge area, the dredge equipment, and the receiving barge. A single row of turbidity curtains will be employed around the barge at the offloading point at Molasses Pier in St. Croix. The turbidity curtain will consist of nylon reinforced PVC fabric panels supported by closed cell solid plastic foam floatation. Vinyl sheathed steel cables on the top of the panel and galvanized steel channel at the bottom would link each panel, with a slotted PVC connector pipe to maintain panel spread. The floating barrier would extend 10 feet below the surface of the water. In-water dredging shall be curtailed during sea conditions that are sufficiently adverse to render the turbidity curtains ineffective.

See Appendix B for examples of the turbidity curtains materials.

6.04 Fresh Water Resources

The dredging project will have no impact on Fresh Water Resources on the island of St. Croix.

6.05 Oceanography & Water Quality

6.05.1 Oceanography

VIPA is proposing the maintenance dredging of the Schooner Channel. The channel was previously dredged in 1991.

Tides and Currents

The Virgin Islands coastal areas are not subject to significant tidal ranges or tidal currents. Due to the small size of the islands, the sea flows around the island causing an average tidal height of only a few inches and maximum change of only a little over a foot. Only very narrow intertidal zones are found because of this lack of tidal amplitude and the steepness of the island rising out

of the sea. Normal tidal ranges may be greatly exceeded during storm conditions, when a combination of lower barometric pressure at the ocean surface and storm winds amplifies the tidal crest. St. Croix's tides are primarily diurnal in nature. There is a slight secondary cycle (semi-diurnal), but this is almost indistinguishable and is reduced to very small ebbs and floods. The mean tides range from 0.8 feet to 1.0 feet and the spring tidal ranges reach up to 1.3 feet (IRF 1977). The closest NOAA tidal station is located in Christiansted Harbor, St Croix, VI and is Station ID: 9751364. This is located on the Gallows Bay dock at Latitude: 17° 45' N and Longitude: 64° 42.3' W. The mean range is 0.69 ft. and the diurnal range is 0.74 ft. Tidal data from the station is shown below.

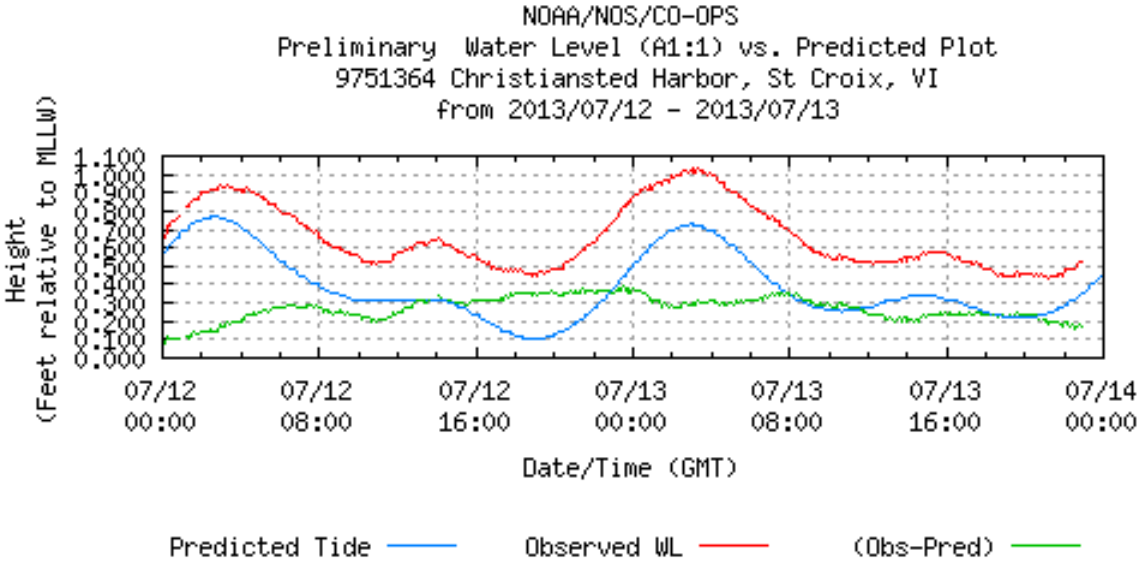


Figure 1. Tides as measured at tidal station 9751364 Christiansted Harbor

The surface currents throughout the Caribbean are driven by the North Equatorial Current that runs through the islands west-northwest and then joins the Gulf Stream. These currents change very little from season to season with the currents originating more from the south during the summer months. Because of the shallowness of the Caribbean basin, less than 3200 feet, mainly surface water from the Atlantic flows through the islands, Figure 4. Currents off shore of St. Croix average around 0.7 knots (IRF 1977), Figure 5. The current movements in Christiansted Harbor have been well documented. Waves approaching from the northeast break on Long Reef and drive water into the harbor. The water mass then moves to the east and flows out of the harbor on either side of Round Reef, including through the Schooner Channel. Out flow velocities have been measured between 5 and 18 cm/sec under normal conditions. Point Louise Augusta tends to protect the channel mouth and allows for outward flow even during periods of high wave action. Current measurements were taken in 2003 in the Sand Channel (the other main channel) in preparation of the permits for the channel dredging over a period of six months in 4 locations. Current measurements were only noted to the west on two occasions out of 18 days sampled over 6 months. The result of that sampling is shown in Table 1 below and the location of the sampling points is shown in Figure 2 below. During the dredging of the Sand Channel in 2007, currents were noted to change with the tides, wind and sea conditions depending on the location along the channel. When seas are calm the currents can shift to the west with the rising tide. When large seas or heavy winds push large volumes of water in the harbor a very strong easterly flowing current develops and is maintained even during the rising tide.

DATE	NTU	Currents m/s	1	2	3	4
1/28/2003	1.00		0.03NE	0.03E	0.04E	0.05N
2/19/2003	0.85		0.06E	0.07E	0.09NE	0.10N
2/27/2003	0.50		0.04E	0.06E	0.06NE	0.06NW
3/8/2003	0.85		0.06E	0.07E	0.06E	0.07N
3/18/2003	1.17		0.06NE	0.07E	0.07E	0.08NW
3/23/2003	0.83		0.01N	0.03NE	0.05NE	0.07N
3/28/2003	0.93		0.03E	0.03NE	0.03NE	0.03W
4/4/2003	0.58		0.01W	0.00	0.03NE	0.05W
4/6/2003	1.83		0.01E	0.05E	0.04E	0.04N
4/8/2003	0.72		0.09E	0.11E	0.12NE	0.05W
4/17/2003	1.32		0.06E	0.08E	0.08NE	0.08N
4/16/2003	1.44		0.04E	0.06E	0.07NE	0.08N
4/25/2003	0.55		0.05W	0.07E	0.07NE	0.06S
4/28/2003	1.20		0.04E	0.06E	0.06NE	0.05NW
5/13/2003	0.62		0.07E	0.08E	0.09NNE	0.12NW
5/28/2003	0.87		0.02E	0.05E	0.06NE	0.08S
6/17/2003	1.29		0.05E	0.06E	0.04E	0.05W
7/4/2003	1.14		0.04E	0.06E	0.07NE	0.09SW

Table 1. Currents measure in the Richmond Channel in 2003

Figure 2. Location of sampling points for current study in 2003.

Currents were measured over 14 days during water sampling for this dredging project. Currents were noted flowing out the channel on all days when currents were noted. On two of the 14 days

no current movement was detected. The current measurements are found in Table 1 above.

Waves

The deep-water waves off of St. Croix are primarily driven by the northeast trade winds that blow most of the year. Waves average from 1 to 3 ft from the east, 42% of the time throughout the year (IRF, 1977). For 0.6% of the time easterly waves reach 12 ft. in height. The southeasterly swell with waves one to twelve feet high become significant in late summer and fall when the trade winds blow from the east or when tropical storms and hurricanes pass the islands at a distance to the south. During the winter months, long length, long period northern swells develop to a height of 1 to 5 feet. The roughest sea conditions prevail between June and August, and the second highest seas occur from December through February. September through November is the calmest period for waves, refer to Figure 6 on page 25.

The harbor and project area is protected by long reef which serves to dampen the incoming waves. Some waves enter the channel mouth and are attenuated up the channel. Waves frequently are noted breaking on Fort Louise Augusta Point and on Round Reef. Other waves with a more easterly approach impact the channel and the surrounding shallow reef area. Most of the time these waves are 2 ft. or less. During periods of heavy seas waves are attenuated over the reef and impact the harbor and shoreline.

NOAA buoy CHSV3-9751364 in Christiansted typically notes waves to be 1 ft. or less within the harbor.

Figure 3 below, is a model from the NOAA Wavewatch III for the Virgin Islands - Puerto Rico area.

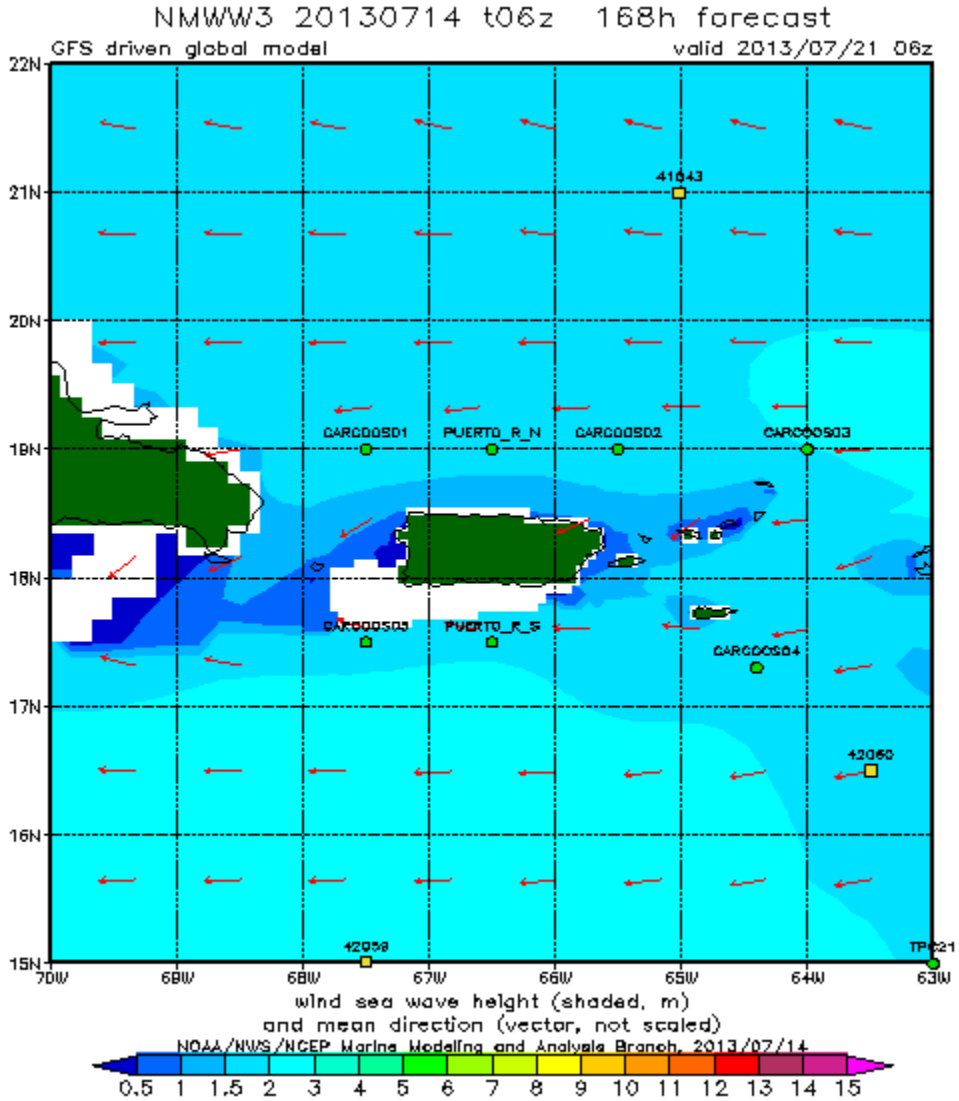


Figure 3 Wave predictions July 21, 2013.

6.05.2 Water Quality

The offshore waters within Christiansted Harbor classified as Class B, and the best usage of these waters is listed as the propagation of desirable species of marine life and for primary contact recreation (swimming, water skiing, etc.). The quality criteria include dissolved oxygen not less than 5.5 mg/l from other than natural conditions. The pH must not vary by more than 0.1 pH unit from ambient; at no time shall the pH be less than 7.0 or greater than 8.3. Bacteria (fecal coliform) cannot exceed 70 per ml. and turbidity should not exceed such that a secchi disc is not visible at minimum depth of one meter.

As part of the U.S.V.I. Ambient Water Quality Monitoring Program, water samples are taken on a quarterly basis at STC1, STC 37 and STC 38. The data for these sites the last year are provided below.

Station ID	Date	Time	Depth	Temp (°C)	Salinity (ppt)	DO (mg/L)	pH (s.u.)	Turbidity (NTU)	Secchi (m)	Depth (m)
STC 37	9.28.13	820	Surface	30.25	35.20	6.00	9.04	0.64	B	4.85
			Bottom	30.24	35.19	6.12	9.05	0.66		
STC 38	9.28.13	832	Surface	30.22	35.18	6.20	9.12	0.71	B	5.2
			Bottom	30.22	35.18	6.15	9.13	0.69		
STC 1	9.28.13	1121	Surface	30.32	35.16	6.12	9.17	0.83	B	1.8
			Bottom	30.31	35.19	6.24	9.19	0.87		
STC 38	12.12.13	1509	Surface	26.95	35.01	6.30	9.70	7.06	B	5.49
			Bottom	26.95	35.01	6.40	9.73	7.06		
STC 37	12.12.13	1438	Surface	26.93	35.00	6.40	9.86	6.40	B	4.88
			Bottom	26.90	35.00	6.49	9.80	6.40		
STC 1	12.11.13	1455	Surface	27.80	35.2	6.78	9.83	13.7	1	1.52
			Bottom	27.80	35.2	6.78	9.83	13.7		
STX 1	6.24.14	1131	Surface	28.3	37.18	6.22	8.33	0.54	B	1.83
			Bottom	28.3	37.18	6.22	8.33	0.54		
STX 37	6.24.14	910	Surface	28.19	37.29	6.11	8.23	0.81	B	4.82
			Bottom	28.19	37.3	6.11	8.23	0.82		
STX 38	6.24.14	1115	Surface	28.13	38.3	6.69	8.41	0.32	B	5.3
			Bottom	28.13	38.3	6.6	8.41	0.32		

Table 2. Results of the Ambient Water Quality Monitoring Program.

Water Quality measurements have also been taken during May, June, July and August 2014 in association with this project.

DATE	TURBIDITY (NTU)	Secchi	Current Ft/sec	DATE	TURBIDITY (NTU)	Secchi	Current Ft/sec
5/16/2014	0.71	B	0.09N	7/9/2014	0.99	B	0.06N
5/22/2014	0.81	B	0.07N	7/14/2014	0.81	B	0.0
6/07/2014	0.76	B	0.1N	7/22/2014	1.01	B	0.08N
6/13/2014	0.91	B	0.06N	8/5/2014	0.70	B	0.11N
6/20/2014	0.76	B	0.0	8/13/2014	0.69	B	0.03N
6/26/2014	0.71	B	0.04N	8/15/2014	0.84	B	0.05N
7/1/2014	0.59	B	0.12N	9/17/2014	0.95	B	0.04N

Table 3 Turbidity measurements taken at 17° 45.250'N; 64° 41.728'W

As noted in all the above water quality sample collection the area typically has turbidities under 1 NTUs.

Chemical analysis and Elutriate Analysis was done of sample take from within the proposed dredging foot print where there was a notable sand overburden. NOAA has created limits to assess the impact of contaminants in soil and in the water column. These are called the Effects Ranges. There are two levels considered. Effects Low range is where 10% effects are noted and Effects Range Median (ERM) is 50% effects.

ERLs were intended to represent concentrations below which effects were rarely observed, low percentages of studies were expected to indicate effects within the ranges below the ERLs. For trace metals the percent of studies indicating adverse effects was less than 10% when concentrations were below the ERL values. For most organics, the incidence of effects was less than 25% when concentrations were below the ERLs.

The sample analysis were done by TestAmerica, a testing laboratory which conducts Elutriate analysis. Because this is a dredging projects and there is the potential for sediments to become mixed in the soil it is important to conduct Elutriate analysis to determine what contaminant could be released from the sediment during the dredging. It is important while reading the analysis to understand that the analysis are done as a blind test by the laboratory. The laboratory does not know what regulatory limits or concentration levels are being looked for. The laboratory report is just that: results. The abbreviations which are important to note while looking at the results are found in the definitions and glossary. These include the following:

B : Compound found in Blank and Sample.

J : Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

MDL : Method Detection Limit – this is the lowest level of that contaminant the test can detect. This is not related to regulatory limits.

RL : Reporting Limit or Requested Limit - The reporting limit is the limit at which the value is considered okay to list as a value. Below this limit the data is considered suspect and could be in error. The Requested Limit is a value below which the results are not reported. Again this is not related to regulatory limits.

	Guidelines		Percent incidence of effects*		
Chemical	ERL	ERM	<ERL	ERL - ERM	>ERM
Arsenic	8.2	70	5.0	11.1	63.0
Cadmium	1.2	9.6	6.6	36.6	65.7
Chromium	81	370	2.9	21.1	95.0
Copper	34	270	9.4	29.1	83.7
Lead 46.7	218	8.0	35.8	90.2	
Mercury	0.15	0.71	8.3	23.5	42.3
Nickel	20.9	51.6	1.9	16.7	16.9
Silver	1.0	3.7	2.6	32.3	92.8
Zinc	150	410	6.1	47.0	69.8

*Number of data entries within each concentration range in which biological effects were observed divided by the total number of entries within each range.

Table 3. NOAA Effect Ranges Table

Lab Sample ID Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
180-35998-1	**SAMPLE # 1**					
Aluminum		410		22	mg/Kg	6020
Arsenic		7.2		0.75	mg/Kg	6020
Cadmium		0.073	J	0.75	mg/Kg	6020
Barium		6.0	J	7.5	mg/Kg	6020
Chromium		6.1	B	1.5	mg/Kg	6020
Copper		2.3		1.5	mg/Kg	6020
Lead		5.8		0.75	mg/Kg	6020
Nickel		1.9		0.75	mg/Kg	6020
Zinc		3.5	J	3.7	mg/Kg	6020
Mercury		0.030		0.024	mg/Kg	7471A
Percent Moisture		31		0.10	%	2540G
SGT-HEM		62	J	240	mg/Kg	9071B

B Compound was found in the blank and sample.

J Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Table 4. Results of Soil Analysis

Lab Sample ID Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
180-35998-3	**SAMPLE # 1**					
Dissolved						
Arsenic		11		10	ug/L	6020
Barium		6.8	J	100	ug/L	6020
Copper		4.6	J	20	ug/L	6020
Nickel		3.6	J	10	ug/L	6020
Selenium		17	J	50	ug/L	6020
Zinc		11	J	50	ug/L	6020
TPH-Dissolved		1.9	J	5.3	mg/L	1664A

J Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Table 5. Results of Elutriate Testing – note these are µg/l not mg/l except for TPH.

None of the compounds detected had a concentration higher than NOAA's Effects Range Low level (ERL). There should be no negative effects created by the release of compounds into the water column during dredging and there should be no contamination issues in disposing of the dredge spoils.

Impact of Proposed Maintenance Dredging Project

The proposed maintenance dredging of the existing channel will result in a significant resuspension of bottom sediments. Turbidity barriers (type II or III) will be installed to control

turbidity during all in-water activities to minimize impacts of turbidity on the surround marine environment and a water quality monitoring plan will be implemented to monitor the control devices and to assess their efficiency, if the control devices are found to be inadequate additional measures will be implemented. The resuspension of fines could have significant impact on the surrounding coral resources, including ESA listed species on Round Reef, Long Reef, and off of Fort Louise Augusta Point. Suspended sediments and settling sediments could also impact seagrass beds which are found immediately adjacent to the channel.

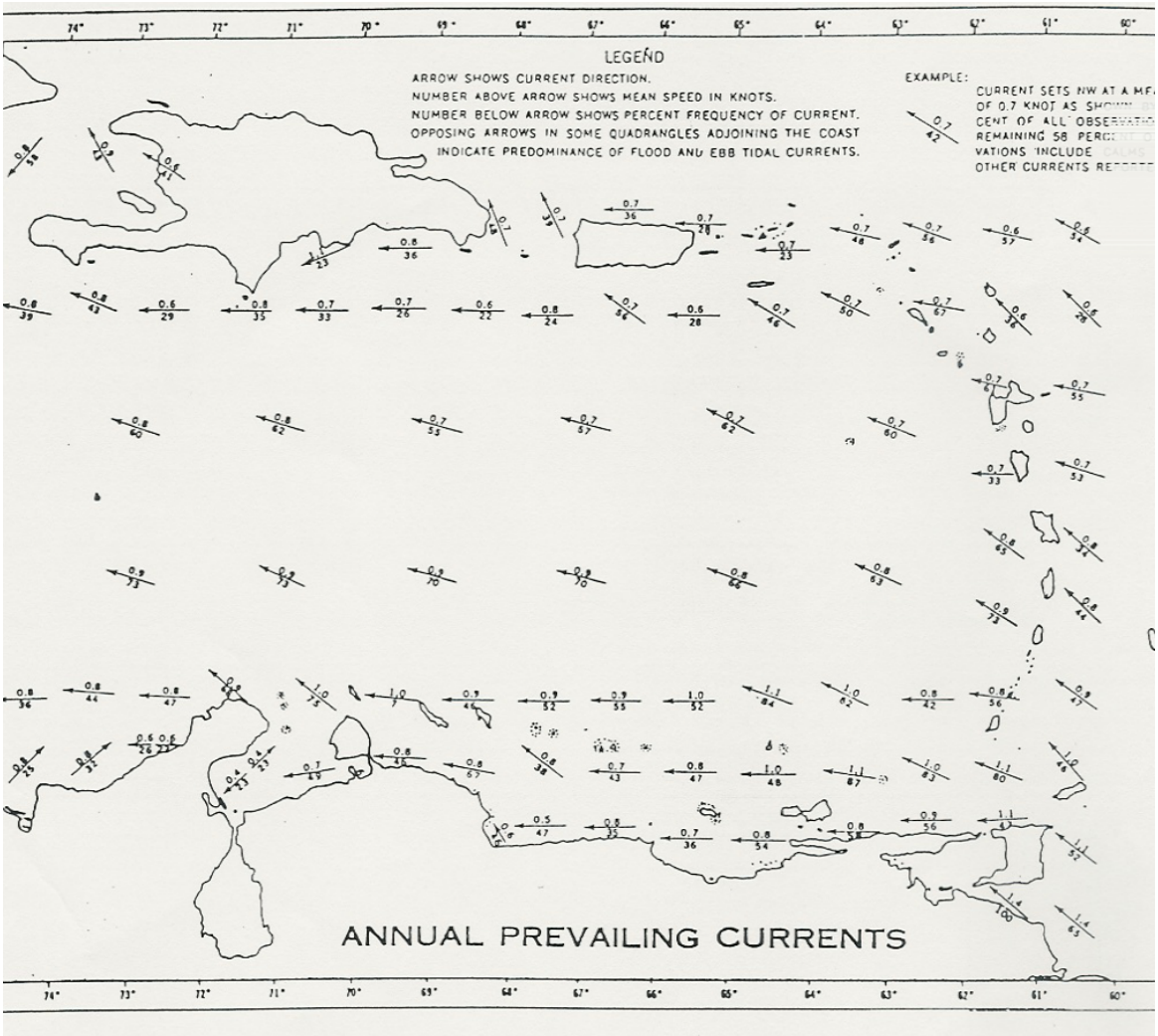


Figure 4. Caribbean Sea, Prevailing Currents (IRF, 1977)

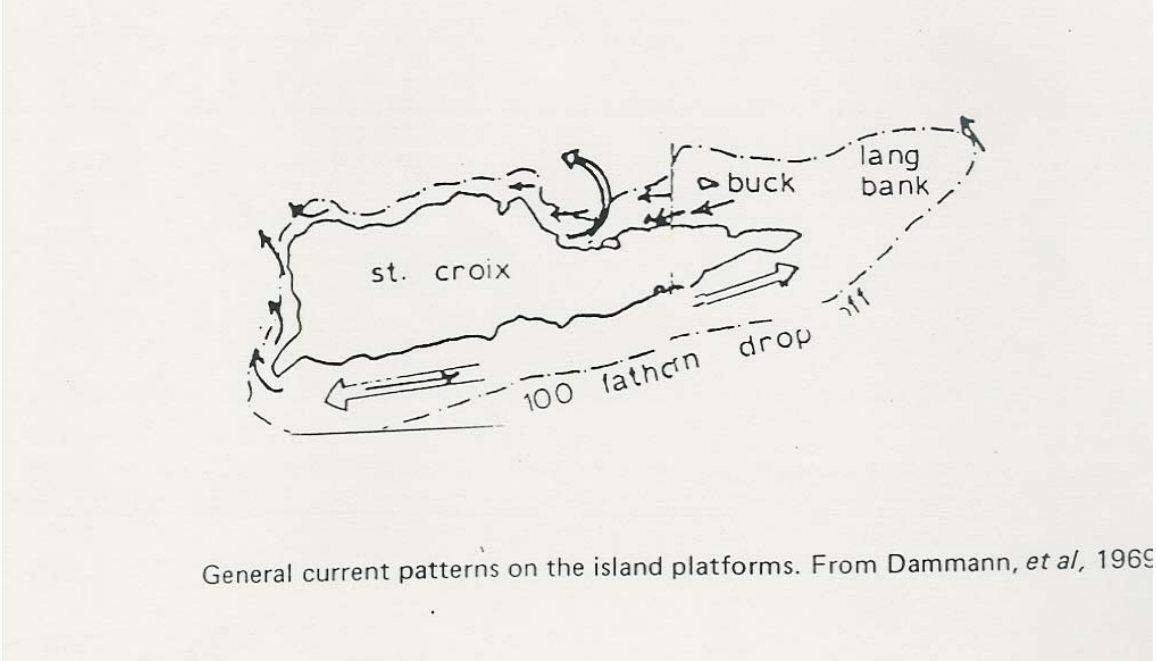


Figure 5 General Currents off of St. Croix (IRF, 1977)

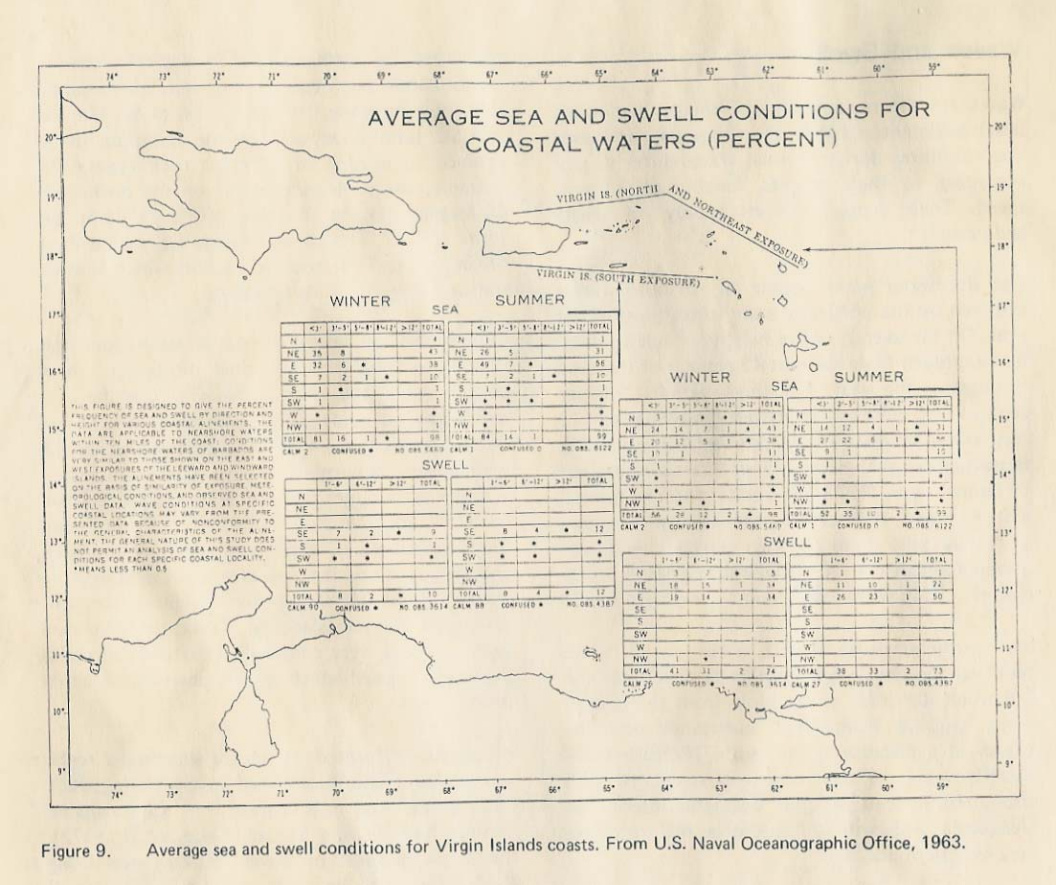


Figure 6 Average Sea and Swell conditions for the Virgin Islands Coast.

6.05.3 Water Quality Monitoring Plan

The following is the proposed water quality monitoring program for the maintenance dredging of the Schooner Channel. The Schooner Channel was dredged in 1991 to create an easier access to the Gallows Bay Marine Terminal. Sand has accumulated in the western portion of the channel and boulders have tumbled down into the outer portions of the channel. There is also remaining rock pavement or hardpan in the outer portion of the channel which was not completely removed in 1991.

Over the last 23 years, since previous dredging project, some seagrass and corals have returned to the channel. The seagrass and coral species within the project area would be lost due to the dredging and therefore will be transplanted out of the foot print. In total 31,250sq. ft. 30-70% SAV, 248,960 sq. ft. of hardpan with sparse coral colonization and 127,500 sq. ft. of algal colonized sand will be impacted. It is probable that at total of 250 corals lie within the dredging footprint.

In any marine construction the potential for negative impacts to marine life and degradation of water quality exist**.** When sediments are suspended in the water column through dredging or deposition of fill, these suspended sediments add to the turbidity of the water. The lowering of the transparency of seawater can greatly affect sessile marine organisms that rely on the transmission of the light for their existence. Settling sediments can also smother coral colonies and prevent larval sediment of reef organisms. There are coral colonized reefs close to the area which contain federally listed threatened species. Through careful planning and monitoring, such potential impacts can be minimized and abated.

In order to ensure that water quality is maintained this water quality monitoring program will be implemented during dredging. This plan will monitor turbidity and look at the effectiveness of the sedimentation control. If any degradation of water quality is detected immediate measures will be taken to abate the impacts. This plan will also monitor the benthic community adjacent to and within the potential impact area of the proposed dredging.

The purpose of this monitoring plan is to document any degradation in water quality or in the health of the benthic community and detail a course of action that can be immediately implemented to abate that degradation if significant changes are observed.

Water Quality Monitoring

Prior to the start of construction a baseline of water quality conditions will be established. A total of 3 sampling location will be established near the Schooner Channel and 2 control sampling sites. The monitoring samples will be placed in the areas most likely to be impacted by the project. The control sites will be placed in areas which should be exposed by the same ambient conditions, but should not be impacted by the dredging.

At each site the turbidity expressed as NTUs will be sampled. Samples will be taken on a weekly basis for 2 months prior to the start of construction.

Baseline data will be used to compare with data collected during the construction project to help assess whether readings are a result of the construction project or are due to ambient conditions.

Figure 1: Water Quality Monitoring Locations. Please note during dredging the sampling stations will be 30m outside turbidity barriers not at the baseline locations.

During Construction

During the dredging, 3 samples will be taken around the area of in-water work; these samples will be taken in a radial pattern around the area of work at a distance of 30 meters outside the turbidity booms. Samples will be taken 1 meter below the surface and will be analyzed by either a Hach 2100 Turbidity meter or a YSI Multi-meter for turbidity expressed as NTU. Samples will be taken twice for each 8 hour shift worked. It is anticipated that the dredging may be done on a 24 hour a day basis.

The control samples will be utilized to determine whether elevated turbidity is a function of the project or due to ambient conditions. As per the Virgin Islands Code, visual depth visibility readings (Secchi disk measurements) should not fall below 1 meter.

Baseline samples will be utilized to determine if elevated readings are the result of sea conditions.

Wind speed and direction, wave height and direction, and rainfall will be recorded at the time of sampling.

During construction if the water samples show NTUs readings in excess of the allowable limits, Department of Planning & Natural Resources (DPNR), Division of Environmental Protection (DEP), Virgin Islands Port Authority (VIPA), Army Corp Of Engineers (ACE) and National Marine Fisheries Service (NMFS) will be notified, in writing. The baseline samples will be utilized to determine if an increase in turbidity is a result of natural phenomena or if the monitoring sample is elevated above the ambient background as a result of the dredging project.

If it is determined that the elevated turbidity is the result of the dredging project, the source of the problem will be identified and methods worked out to reduce suspended sediments. Someone will be on hand at the dredging site at all times who has the authority to implement sediment control devices, so that problems can be solved or resolved by the monitor, VIPA, DEP, DPNR, COE, and NMFS.

If elevated readings are encountered, the dredging will stop and if any deficiencies in the deployed turbidity control are encountered they will need to be corrected. Dredging may resume once turbidity has fallen to allowable levels. If there are no deficiencies in the deployed turbidity control, additional curtains will need to be deployed or discharge from the barge may need to be slowed or dredging may need to be slowed. Dredging will have to stop until turbidities reach allowable levels before resuming. If the additional measures cannot be deployed which are adequate to control turbidity then dredging will have to be shut down every time readings become elevated over acceptable ranges and halted until turbidity meets allowable levels.

Environmental Monitoring

Fauna and flora that will be affected by the project shall be surveyed and monitored. They are the true indicators of the water's ability to sustain its existing residents.

Five permanently marked modified meter square photoquadrats will be established on the Round Reef and three quadrat will be established on the reef off of Fort Louise Augusta Point, both are within the area of potential impact of the dredging (Figures 2).

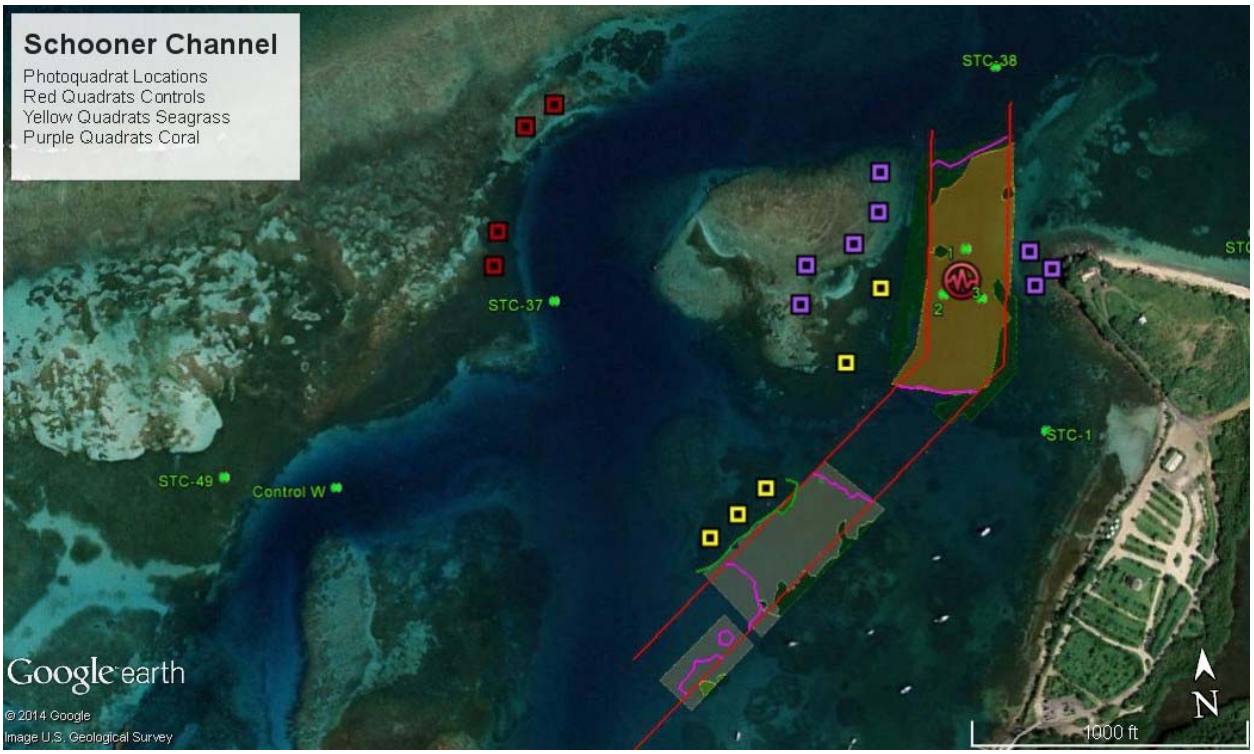


Figure 2. Coral monitoring quadrats are shown in purple, coral control quadrats are shown in red. Seagrass monitoring quadrats are shown in yellow and seagrass control quadrats are shown in red.

The quadrats will be selectively placed within the areas of potential impact to encompass the greatest diversity of sessile organisms and flora, including coral and sponge species. Quadrats will be positioned so they encompass some of the *Acropora palmata*, *Orbicella annularis, O. faveolata,* and *Dendrogyra cylindrus* colonies that are present within the area. Five seagrass quadrats will also be established along the northern/western side of the channel. Control quadrats for both coral (4) and seagrass (2) will be establish as shown above. These are close enough that they should be impacted by the same ambient phenomena but not impacted by the dredging.

Metal pins will be inserted into the substrate to serve as markers for the camera stand to insure the exact relocation of the photograph in repetitive samplings. Organisms will be identified and quantified as to percent cover and health prior to the commencement of development. The amount of viable living coral tissue cover, coral color, presence or absence of an excessive mucus coat, algal over growth, and sediment sloughing, will be used to determine health.

PVC stakes will be used to identify seagrass quadrats. Blade density, sloughing and new growth will be used to determine health.

The quadrats will be established and monitored monthly for a period of two months prior to the commencement of dredging to establish a baseline.

The photoquadrats will be monitored on a monthly basis during in-water work. All visible changes will be documented and reasons for these changes assessed. Coral health will be evaluated as to changes in coral color, amount of mucus, amount of sediment on the corals, and amount of algal growth and grazing marks will be noted. Photographs and detailed survey information containing the above listed parameters will be given to the DPNR, DEP, VIPA, COE and NMFS on a monthly basis.

If at any time any of the monitoring sites shows significant deterioration that does not appear to be natural phenomena, DPNR, DEP, VIPA, COE and NMFS will be immediately notified in order that remedial measures can be implemented to prevent future negative impacts. Within each quadrat the number and health of all benthic invertebrates such as sea cucumbers, anemones, urchins and mollusk will be assessed as part of the monitoring. If significant changes in numbers are noted the agencies will be immediately notified. If a deterioration of health of any of the organisms are noted the agencies will be notified immediately.

Reporting Of Data

In the event of any emergency or noted increase in any of the water quality parameters above the allowable limit, VIPA, DPNR, DEP, COE, and NMFS will be immediately notified by e-mail or by hand delivery. Weekly water quality reports will be delivered to the agencies. The photoquadrat reports, and reports containing all collected environmental data will be delivered on a monthly basis to the agencies. A report will be filed after the completion of all dredging summarizing any impacts noted.

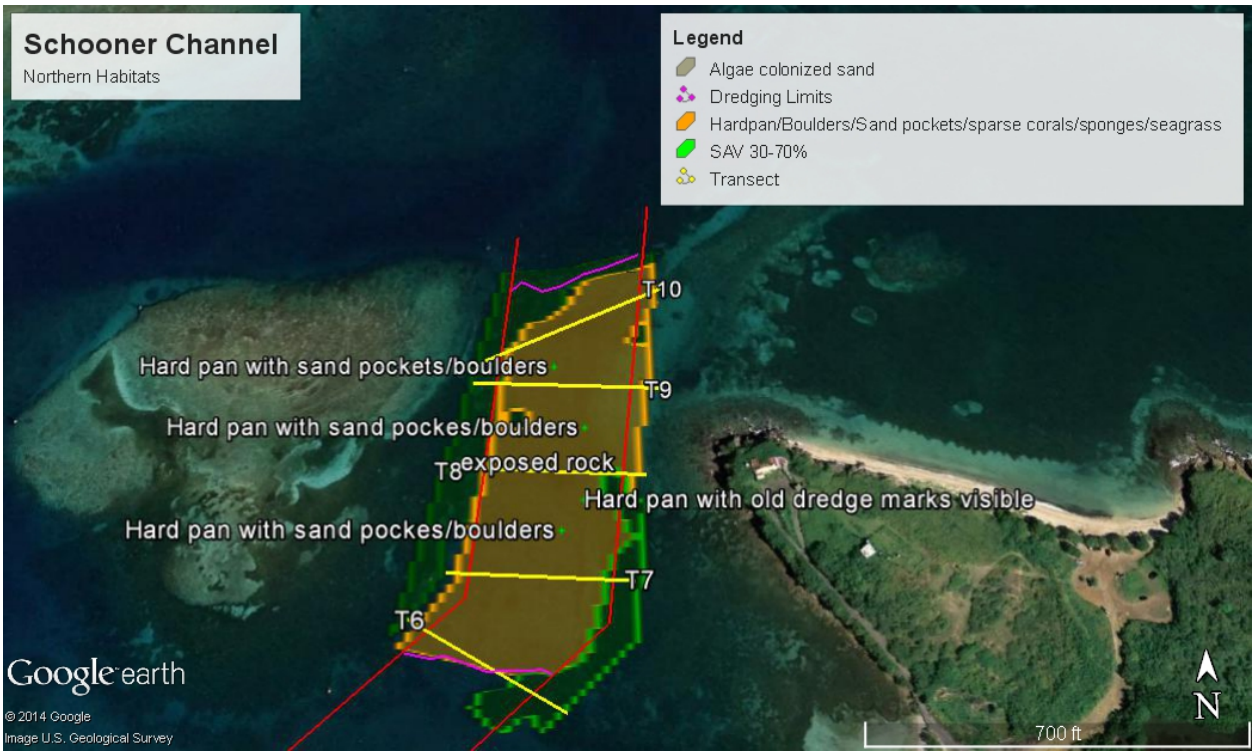
6.06 Marine Resources

Introduction

In order to prepare a permit application for the proposed maintenance dredging of the Schooner Channel a benthic assessment was undertaken. The Schooner Channel was dredged in 1991 to create an easier access to the Gallows Bay Marine Terminal. Sand has accumulated in the western portion of the channel and boulders have tumbled down into the outer portions of the channel. There is also remaining rock pavement or hardpan in the outer portion of the channel which was not completely removed in 1991.

Methods

The study was done during the months of May, June, July and August 2014. The study was conducted on SCUBA and quadrat analysis of percent bottom coverage was made along transect lines (Rogers 1995). Figure 1 provides the location of the transects conducted as part of this assessment and the approximate boundaries of the benthic habitats as delineated during the survey. The areas were mapped utilizing a Garmin GPSmap76 and spot dives were made to assist in the delineation of species composition boundaries. These boundaries are fairly well defined and highly influenced by the bottom substrate. There are isolated small patches of seagrass/seavine and algae in areas with minimal colonization usually measuring less than 4 sq. ft. The cutter head marks in the outer channel areas is clearly visible in the pavement or hardpan. Sand has accumulated in the outer channel in depressions within the hardpan. Figure 2 provides the NOAA NOS benthic habitat map of the area. Transect data is found in the attached tables.



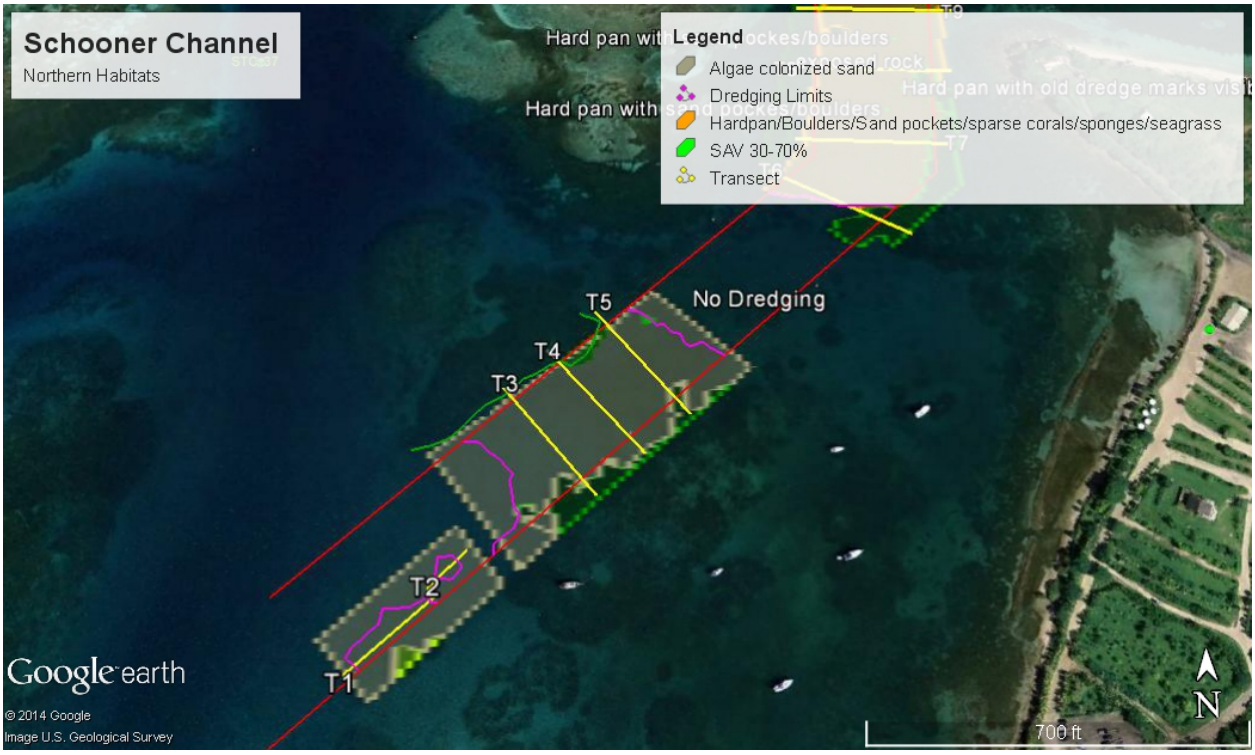


Figure 1. Location of benthic transects and habitats delineated within the proposed maintenance dredging area.

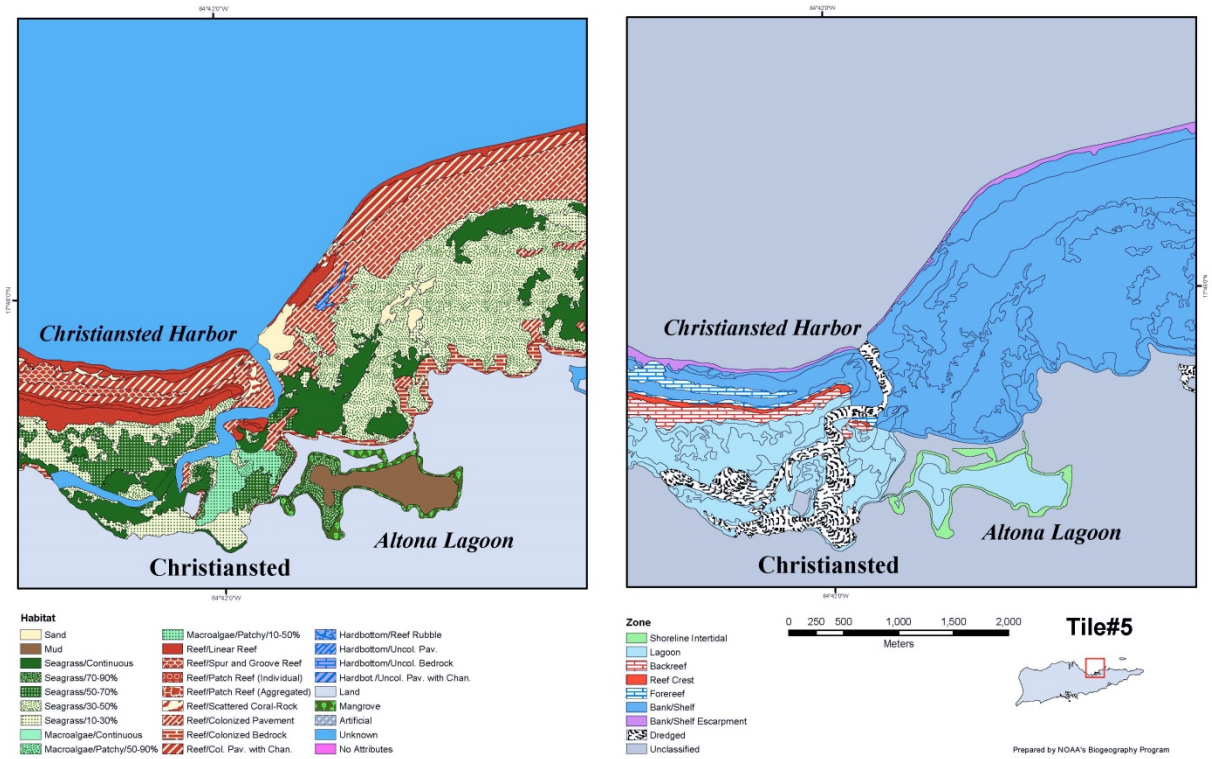


Figure 2. Tile 5 of the NOAA NOS benthic habitat map.

The NOAA NOS benthic map does not show the Schooner Channel, but the habitats delineated during the study are similar to those shown on the NOS map.

Assessment of Proposed Dredging Area

The channel was last dredged to a depth of 16ft. in 1991, since that time the area has been recolonized by seagrass, seavine, algae, coral and sponge species.

Probes were also done to look at depth of underlying rock. The sand throughout the area is relatively coarse with limited fines. Rock was encountered in all probes and it was noted that seagrass colonization only occurred where sand was deeper than 1ft. Sand was deepest in the inner channel areas to the southwest and the area was full of invertebrate mounds (burrowing shrimp). Where sand was less than 1 ft. and in sand pockets amid the hardpan (pavement) only algal species were present.

There are dense patches of seagrass which occur within the harbor and some of these have extended into the dredged channel as sand has built up in the channel. The grasses on the south side of the channel are mainly *Syringodium filiforme* with intermixed *Thalassia testudinum*. These beds range in density from 30 to 70% bottom coverage and intermixed with these seagrasses are *Penicillus capitatus, Caulerpa sertularioides, Hypnea sp., Laurencia papulose, Dictyota sp.* and *Halimeda opunta*. Queen conch (Strombus gigas) and milk conch (S. costatus) were noted within these beds. Along the northern and eastern side of the channel the cut from the previous dredging is still visible and only in areas where the sides have slumped into the channel are seagrasses present. To the northern and eastern side *Thalassia* is the more dominant seagrass and is in a higher abundance usually 50-70% than the beds to the south. While Syringodium is present it only represents approximately 15% of the grass bed. The Thalassia along the northern and western side of the channel have helped stabilize this slope. To the east of the channel in the northern area are primarily Syringodium with some scattered patches of denser Thalassia, again these have colonized in areas where sand has accumulated in the channel. There are also several patches of *Thalassia* and *Syringodium* which have colonized some of the deeper sand pockets in the hardpan (pavement).

The depths of penetration found during the probes is shown in Figure 3 below.

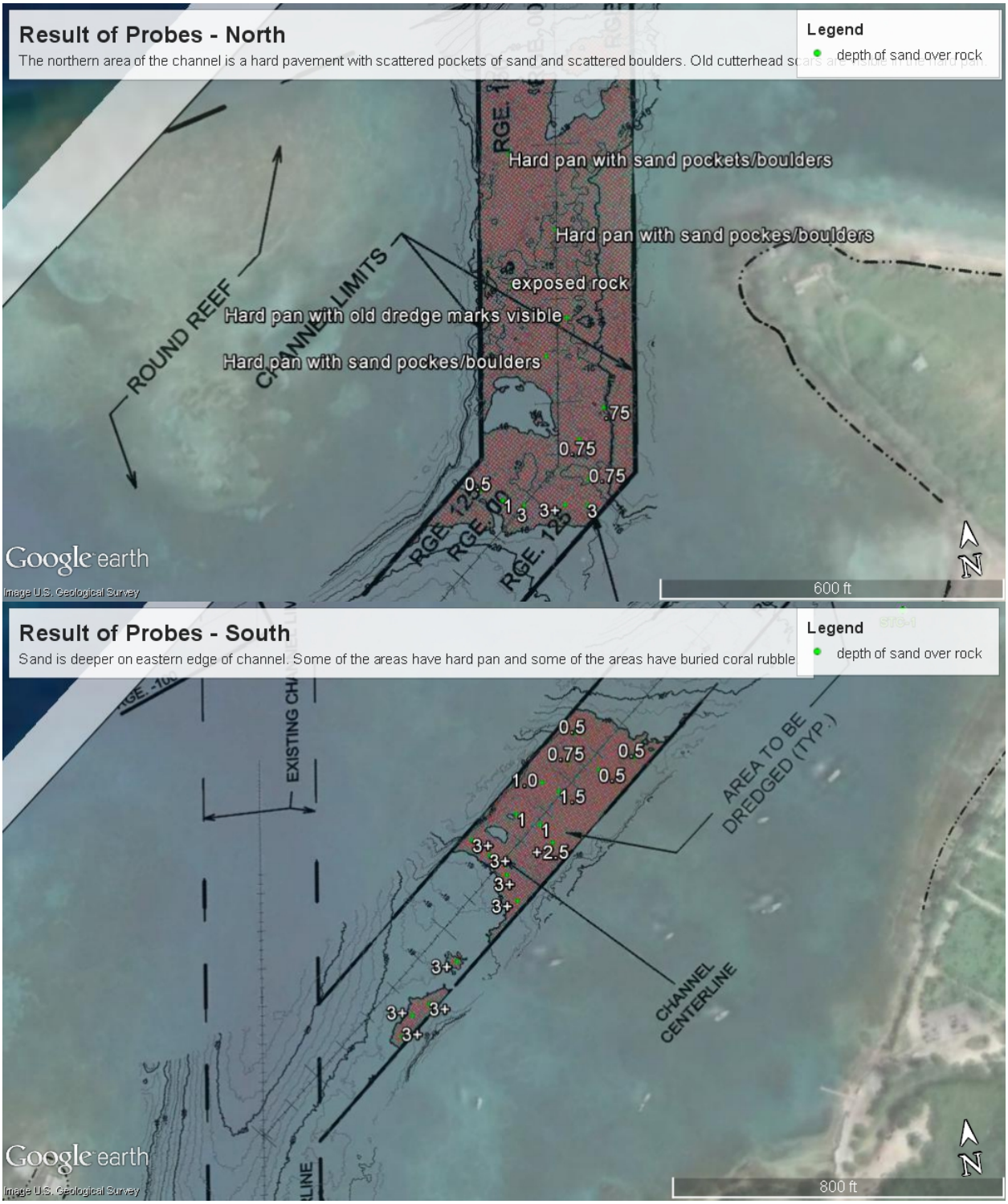


Figure 3. Location of probes.

The northern area is primarily hardpan or pavement. There are obvious dredge cutterhead marks within area. There are scattered boulders, coral rubble, rock rubble, and sand pockets on top of the pavement. There are some abrupt small rock ledges at some of the channel sides. The area has some algal colonization with *Dictyota* being the most common species, other species present include *Laurencia papillosa, Caulerpa sertularioides, Halimeda opuntia, Hypnea sp.* and *Padina* sanctae-crucis. There are widely scattered corals, some on the boulders and some having

colonized the rock pavement, *Porites porites* is the most abundant followed by *Porites astreoides, Siderastrea sidereal, Diploria labyrinthiformes, Diploria strigosa,* and *Agaricia agarcites*. No currently ESA listed corals were noted in the dredging foot print. *Acropora palmata* (Elkhorn coral), *Acropora cervicornis* (Staghorn coral), *Dendrogyra cylindrus* (Pillar coral), *Mycetophyllia ferox* (Rough cactus coral), *Orbicella annularis* (Lobed star coral), *Orbicella faveolata* (Mountainous star coral) and *Orbicella franksi* (Boulder star coral) are all ESA listed Threatened species and the *Acropora* species have critical habitat protected under the 4D Rule. *Acropora palmata, Orbicella annularis, O. faveolata* and *Dendrogyra cylindrus* all occur on Round Reef which is immediately adjacent to the channel footprint. *Acropora palmata, Orbicella annularis, O. faveolata, O. franksi, Mycetophyllia ferox* and *Dendrogyra cylindrus* all occur on Long Reef which is on the northern edge of the channel, and *Orbicella annularis, O. faveolata,* and *Dendrogyra cylindrus* are found on Ft. Louise August Point. Round Reef, the hard bottom areas off Ft. Louise Augusta Point, and Long Reef are critical habitat.

Within the channel there were a few feather duster worms and some spaghetti worms, *Pomatostegus stellatus, Spirobranchus spp., Sabellastarte magnifica, Bispira brunnea, B. variegate,* and *Loimia medusa* were seen. A very few *Diadema antillarum, Echinometra lucunter* and *Tripneustes ventricosus* were noted within the hardbottom area within the channel.

Within the channel there were very few fish seen within the channel proper only damsel fish (*Stegastes partitus*, and *S. leucostictus*) and lion fish (*Pterois volitans*) were noted around the boulders in the northern area of the channel. Within the seagrass beds only a juvenile Puddingwife (*Halichoeres radiatus*) was noted.

The seagrass beds surrounding the channel and the surrounding reefs are essential fish habitat. The channel itself, although some of the resources are present is a significant fish habitat.

Impact Of Maintenance Dredging

The project is the maintenance dredging of areas which have been previously dredged, over 23 years ago. The seagrass and coral species within the project area would be lost due to the dredging and therefore will be transplanted out of the foot print. In total 31,250sq. ft. 30-70% SAV, 248,960 sq. ft. of hardpan with sparse coral colonization and 127,500 sq. ft. of algal colonized sand will be impacted. It is probable that at total of 250 corals lie within the dredging footprint.

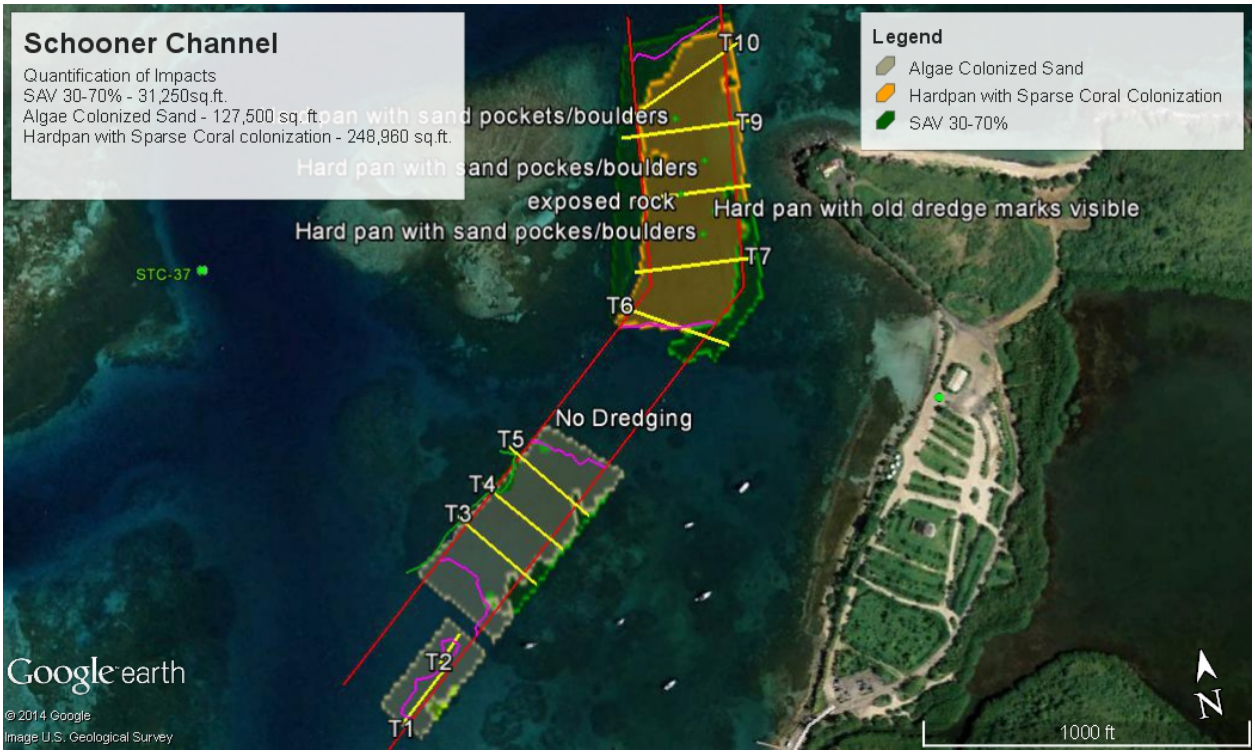


Figure 4. Impacts of dredging.

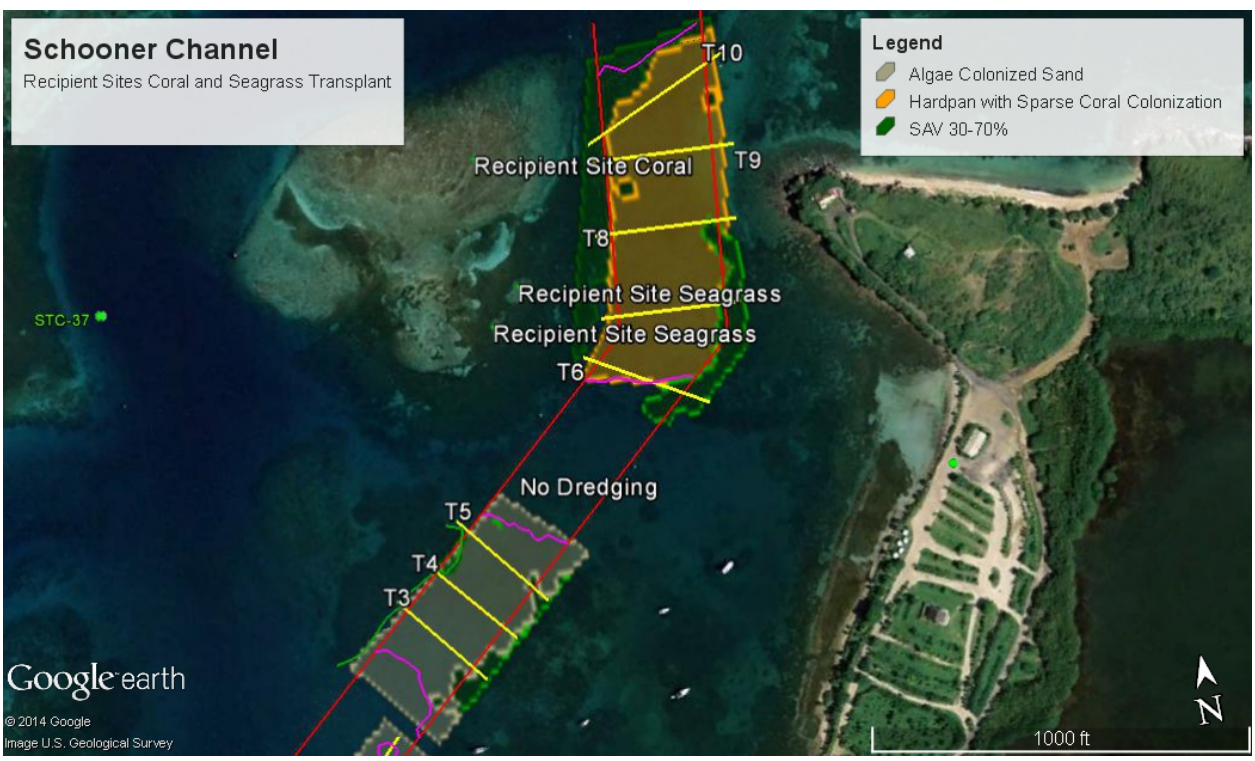


Figure 4. Recipient site for transplants.

In any dredging project there is the potential for physical damage to marine life as well as the degradation of water quality exist. When sediments are suspended in the water column through dredging or deposition of fill, these suspended sediments add to the turbidity of the

water. The lowering of the transparency of seawater can greatly affect sessile marine organisms that rely on the transmission of the light for their existence. Settling sediments can also smother coral colonies and prevent larval sediment of reef organisms. Through careful planning and monitoring, such potential impacts can be minimized and abated. There are ESA listed species, coral colonized reefs and dense seagrass beds in the vicinity of the project area. It is imperative that stringent water quality control measures be designed and implemented during the dredging project.

In order to ensure that water quality is maintained a water quality and environmental monitoring program will be implemented during dredging.

All three federal rare and endangered sea turtle species are known to occur in the offshore waters and could be found within the project area. These include: hawksbill (*Eretmochelys imbricata*), leatherbacks (*Dermochelys coriacea*) and green turtles (*Chelonia mydas*). Foraging habitat for both hawksbill and green turtles occurs either in or immediately adjacent to the proposed dredge area. No turtles were noted during the benthic surveys of the area but they have been seen in the past within the channel area.

It is anticipated that because of the rock in the project footprint, it will have to be broken mechanically. This will result in the ensonification of area. Mitigation measures will be implemented to minimize the noise that will be created during the rock breaking. See Section 6.08, Rare and Endangered Species.

Figure 6. Proposed monitoring locations.

6.08 Wetlands

The U.S. Army Corps of Engineers defines wetlands as "those areas that are periodically inundated or saturated by surface or groundwater at a frequency and duration sufficient to support and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, bogs, marshes and similar areas." (U.S. Army Corps of Engineers, 1986). There are no terrestrial wetlands at the site.

6.09 Rare and Endangered Species

6.08.1 Rare and Endangered Species

A detailed survey has been made of the Schooner Channel area. No currently listed ESA corals were noted in the dredging foot print. *Acropora palmata* (Elkhorn coral), *Acropora cervicornis* (Staghorn coral), *Dendrogyra cylindrus* (Pillar coral), *Mycetophyllia ferox* (Rough cactus coral), *Orbicella annularis* (Lobed star coral), *Orbicella faveolata* (Mountainous star coral) and *Orbicella franksi* (Boulder star coral) are all ESA listed Threatened species and the *Acropora* species have critical habitat protected under the 4D Rule. *Acropora palmata, Orbicella annularis, O. faveolata* and *Dendrogyra cylindrus* all occur on Round Reef which is immediately adjacent to the channel footprint. *Acropora palmata, Orbicella annularis, O. faveolata, O. franksi, Mycetophyllia ferox* and *Dendrogyra cylindrus* all occur on Long Reef which is on the northern edge of the channel, and *Orbicella annularis, O. faveolata,* and *Dendrogyra cylindrus*

are found on Ft. Louise August Point. Round Reef, the hard bottom areas off Ft. Louise Augusta Point, and Long Reef are critical habitat. It will be imperative that water quality be maintained, and as such a water quality and environmental monitoring program will be implemented and stringent turbidity measures will be installed.

All three federal rare and endangered sea turtle species are known to occur in the offshore waters and are found within the Schooner Channel area. These include: hawksbill (*Eretmochelys imbricata*), leatherbacks (*Dermochelys coriacea*) and green turtles (*Chelonia mydas*). Hawksbills sea turtles and Green sea turtles have been seen with some frequency over the years during the surveys associated with the harbor and the channel. Even a leatherback turtle hatchling was seen swimming in the western portion of the channel during surveys for the seagrass transplant for the Richmond Channel dredging. The turtle and the hatchlings would need to exit the harbor through the opening of the reef to the north of the dredging area. There are beaches within the harbor which are suitable turtle nesting habitat.

In order to minimize and abate impacts to the listed sea turtle species the permittee shall comply with the following NMFS construction conditions:

Sea Turtle and Smalltooth Sawfish Construction Conditions

The permittee shall comply with the following protected species construction conditions:

a. The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.
b. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.
c. Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.
d. All vessels associated with the construction project shall operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.
e. If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.

f. Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.
g. Any special construction conditions, required of your specific project, outside these general conditions, if applicable, will be addressed in the primary consultation.

In order to avoid and minimize an injury or death to marine mammals and sea turtles the following NMFS measures form the Vessel Strike Avoidance Measures and Reporting for Mariners will be taken by all vessels associated with the project and fuel transfer operation:

1. Vessel operators and crews should maintain a vigilant watch for marine mammals and sea turtles to avoid striking sighted protected species.
2. When whales are sighted, maintain a distance of 100 yards or greater between the whale and the vessel.
3. When sea turtles or small cetaceans are sighted, attempt to maintain a distance of 50 yards or greater between the animal and the vessel whenever possible.
4. When small cetaceans are sighted while a vessel is underway (e.g., bow-riding), attempt to remain parallel to the animal's course. Avoid excessive speed or abrupt changes in direction until the cetacean has left the area.
5. Reduce vessel speed to 10 knots or less when mother/calf pairs, groups, or large assemblages of cetaceans are observed near an underway vessel, when safety permits. A single cetacean at the surface may indicate the presence of submerged animals in the vicinity; therefore, prudent precautionary measures should always be exercised. The vessel should attempt to route around the animals, maintaining a minimum distance of 100 yards whenever possible.
6. Whales may surface in unpredictable locations or approach slowly moving vessels. When an animal is sighted in the vessel's path or in close proximity to a moving vessel and when safety permits, reduce speed and shift the engine to neutral. Do not engage the engines until the animals are clear of the area.

Rock will have to be cut or broken as part of the dredging project in order to achieve appropriate depth. Therefore there could be acoustic impacts to listed species. Sea turtles are known to be affected by the ensonification of the water created by pile driving activities. VIPA will implement an acoustical monitoring plan during all rock breaking. A 500-m safety zone shall be established around the project area for sea turtles and marine mammals. Trained observers will be used to visually monitor the safety zone for at least 30 minutes prior to beginning all noise creating in-water activities. If at any time a sea turtle or marine mammal is observed in the safety zone the operation will be shut down until the animal has left the safety zone of its own volition.

Observations for protected species will occur at least twice a day to maintain watch for animals in the area, and ensure the curtains are functioning properly. If at any time an animal is observed in the safety zone during the noise creating in-water activity, work shall cease until the animal has left the area of its own volition, or coordination with a DPNR representative has occurred, if the animal is injured.

Records will be maintained of all sea turtle and marine mammal sightings in the area, including date and time, weather conditions, species identification, approximate distance from the dredging

area, direction and heading in relation to the dredging area, and behavioral observations. When animals are observed in the safety zone, additional information and corrective actions taken such as a shutdown of rock breaking/dredging equipment, duration of the shut-down, behavior of the animal, and time spent in the safety zone will be recorded. Reports will be provided to NMFS, COE, and CZM.

Pelicans (*Pelecanus occidentialis*), a federally listed endangered species, frequent the nearby shorelines and often roost on vessels in the harbor. These species will not be affected by the dredging of the Schooner Channel; these birds have been seen to roost on the dredge barge during dredging.

Impact of Development

No rare and endangered species, or any species for that matter, use Christiansted Harbor as an exclusive habitat. The permitting of this facility will not displace any rare, endangered, or threatened species from its natural niche or habitat. The proposed methods above will help minimize impacts to endangered species during construction and operation.

The dredging will result in resuspension of sediment during the dredging and dewatering. Turbidity barriers (type II or III) will be installed to control turbidity during all in-water activities and dewatering to minimize impacts of turbidity on the surround marine environment and the listed and nominated coral species and a water quality and environmental monitoring plan will be implemented to monitor the control devices and to assess their efficiency, if the control devices are found to be inadequate additional measures will be implemented. ESA listed species and critical habitat are within the immediate vicinity of the dredging area.

6.09.2 Acoustic Impact Minimization and Protected Species Protection

It is anticipated that because of the rock in the channel it will have to be broken mechanically. This will result in the ensonification of area. Both dredging and pile driving have been studied for their impact on noise in the marine environment and its residents. The proposed rock breaking will be very similar to the noises generated during pile driving. Underwater noise from impact pile driving is impulsive in nature and the sounds are created by the pile and the substrate it strikes. A fair amount of research has been done to determine how to reduce noise from pile driving. To be effective a bubble curtain has to completely surround the pile (or area in which the noise is being created) through the entire water column and with the currents within the channel bubble curtains may or may not be effective. Creating a physical barrier has been seen to be effective to reduce the noise between 15-23dB (Peak). (Spence et al, 2007).

Underwater sound in the marine environment is generated by a broad range of sources, both natural and human (anthropogenic). Open ocean ambient sound has been recorded between 74 and 100 dB off the coast of central California (Heathershaw et al. 2001). Ambient noise levels for other water bodies based on surveys generally follows in this range. Based on deep-water studies in the Northeastern Pacific, low-frequency background sound has doubled each decade for the past forty years as a result of increased commercial shipping (Andrew et al. 2002, McDonald et al. 2006) resulting in a 15 to 20 dB increase in ambient conditions compared to preindustrial levels. Table 1 identifies ambient underwater sound levels at various open water and coastal water locations.

Environment	Location	Ambient Noise Levels (dB_{PEAK} unless noted)	Source
Open ocean	Central coast, CA	74 – 100	Heathershaw et al. 2001
Open ocean	Beaufort Sea, AK	80 – 83	Roth 2012
Coastal water	Prudoe Bay, AK	80 – 87	Roth et al. 2012
Marine surf	Fort Ord Beach, CA	138	Wilson et al. 1997
Large marine bay, heavy industrial use, and boat traffic	San Francisco Bay, CA	120 – 155 or 133 dB_{RMS}	Strategic Environmental Consulting, Inc. 2004
Large marine bay, heavy commercial boat traffic	Elliot Bay, WA	147 – 156 or 132 – 143_{RMS}	Laughlin 2006
Large marine bay, nearshore, heavy commercial, recreational boat traffic	Monterey Bay, CA	113	O'Neil 1998

Table 1 Ambient Noise Levels (RMS refers to rate-mean-square)

Based on the above it can be predicted that Christiansted Harbor would have a dBPEAK of somewhere below 113 to 130dB because of the light commercial and recreational boat traffic.

US Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS), have developed threshold values, values that elicit some response from a target species, for making effect determinations for Endangered Species Act (ESA) listed species as follows:

- Detectability threshold (where the noise is detectable, but reactions are not observable).
- Alert and disturbance threshold (alert is where the noise has been identified by the target species, interest is shown; disturbance is where the target species shows avoidance of the noise by hiding, moving, or postponing feeding).
- Harassment/injury threshold (where the target species is actually injured).

NMFS's current thresholds for impulse noises (ex. impact pile driving or in our case rock breaking) and non-impulse noises (ex. vibratory pile driving, dredging, etc.) for marine mammals are listed in the table below.

Criterion	Criterion Definition	Threshold
Level A	PTS (injury) conservatively based on TTS	190 dB_{rms} for pinnipeds 180 dB_{rms} for cetaceans
Level B	Behavioral disruption for <u>impulsive</u> noise (e.g., impact pile driving)	160 dB_{rms}
Level B	Behavioral disruption for <u>non-pulse</u> noise (e.g., vibratory pile driving, drilling)	120* dB_{rms}

All decibels referenced to 1 micro Pascal (re: 1μPa). Note all thresholds are based off root mean square (rms) levels.

* The 120 dB threshold may be slightly adjusted if background noise levels are at or above this level.

Note based on the estimates above that Christiansted Harbor most probably is below the 113-130dB range but it is possible that some current activities may already be causing behavioral disruptions.

Based on recommendations of the Fisheries Hydroacoustic Work Group (FHWG) in June of 2008, the current sound thresholds from impulse noises (such as pile driving) that cause injury to fish are:

- 206 dBPEAK
- 187 dB cSELfor fish > 2 grams
- 183 dB cSEL for fish < 2 grams

The threshold for behavioral impacts for all fish is 150 dBRMS (FHWG 2008).

The designation cSEL indicates the "sound exposure level in octave C".

Dredging within the channel will be performed using mechanical equipment (bucket/clamshell or grab dredges), with the possible use of a hydraulic hammer to loosen the rock prior to removal. The underwater noise generated by mechanical dredging equipment differs from the hydraulic hammer; the latter is similar to that produced by pile driving activities as discussed above. Dredging operations (hydraulic and mechanical) generally produce lower levels of sound energy (less than 1000 Hz; source sound levels of 150 to 190 dB) over more prolonged periods compared to other in-water construction activities. These resulting sounds are strongest at low frequencies and can travel quite far.

Bucket/clamshell or grab dredges, the type of mechanical dredged equipment that would be used during dredging, have repetitive sequences of sounds (i.e. winch, bucket impact, bucket closing and bucket emptying, etc). They often produce a wider range of sounds (both lower and higher) than other types of dredging due to the bucket, winch and vessel (Clarke et al. 2002). Clarke et al. (2002) conducted one study in Cook Inlet, AK with grab dredgers, which indicated that the underwater sound was quite low (although it travelled quite far; 7 kilometers or just over 4 miles from the impact point). The sound of the bucket striking mixed sand/gravel substrate was the most intense sound generated and peak sound pressure levels for this study were 124 dB at a peak frequency of 163 Hz measured at 150 meters from the bucket strike.

Due to the rock within the northern portion of the channel, a hydraulic hammer may be used. The hammering produces noises that are considerably stronger than those of routine mechanical dredging activities. Hydraulic hammering produce intense impulsive in-waters sounds of short duration that are similar to the in-water sounds produced by pile driving. The in-water sound energy from the hammering or pile driving occurs at lower frequencies between 100 Hz and 1 kHz. Typical sound levels from a single strike on a pile or hammer can range from 208 dBPEAK to 220 dBPEAK (Reyff 2003). The in-water sound is affected by hammer equipment and material (steel), the size of the hammer, the geotechnical conditions (e.g.driving resistances), and the water depth. This level is within the range of NOAA's predicted injury to whales and dolphins and injury to fish. If an attenuation system is used (e.g. bubble curtain or similar performing system), the in-water sounds produced by the hammer may be reduced.

Based on the information reviewed the rock breaking will create a significant esonification of the

area. This impact will be significantly less than originally proposed as the amount of dredging has been drastically reduced. The use of the double turbidity barriers/acoustic curtains around all rock breaking activity should help decrease the noise by 15 to 23 dB.

All three federal rare and endangered sea turtle species are known to occur in the offshore waters of St. Croix and could be found within the project area. These include: hawksbill (*Eretmochelys imbricata*), leatherbacks (*Dermochelys coriacea*) and green turtles (*Chelonia mydas*). Abundant foraging habitat for both hawksbill and green turtles occurs immediately adjacent to the proposed dredge area.

It is not anticipated that the rock breaking will result in direct injury to these species but it is probable that this could result in changes to their behavior if they were to come into in the area. It is probable that they would be stressed by the noise. In order to minimize that impact to sea turtles and all of the other protect species mitigation measures will be implemented to minimize the noise that will be created during the rock breaking and dredging.

Proposed Minimization Methods

The following measures will be implemented to minimize impacts to protected species of sea turtles, and marine mammal.

Numerous methods of noise reduction have been considered and it has been determined that the most feasible methods will be deploying a double turbidity booms barrier. These will be used in all areas of in-water work, and will act not only as a turbidity control, but will also attenuate underwater noise levels in the project area. It is anticipated that this barrier will result in a reduction of noise of between 15 and 23 dB.

In order to determine the impact of the project and the effectiveness of the double barriers, a noise baseline will be established prior to all work using a Sparton Acoustic Sensor with a 10 meter underwater capability. Once the project begins sound measurements will be analyzed in and outside of the curtains and at distance from the dredging activity. The distance at which the sound has sufficiently been attenuated will be determined. If the barriers are found to be effective in limiting the sound below that which results in injury to the species they will be maintained throughout the project. If the barriers are found to be ineffective additional methods will be devised to abate the noise below the level at which they result in harm to the listed species.

A baseline of existing noise will be established by taking readings at all water quality monitoring stations for one month prior to start of dredging. Readings will be taken during both periods where vessels are traversing the area as well as when there is limited activity. This data will be used to determine what the ambient noise is within the harbor.

Once the project starts and the distance at which the noise can cause potential injury to the animals is determined a knowledgeable monitor will monitor the potential impact area during all rock breaking activity.

In addition a 500-m safety zone shall be established around the project area for sea turtles and marine mammals. Trained observers will be used to visually monitor the safety zone for at least 30 minutes prior to beginning all noise creating in-water activities.

If at any time a sea turtle or marine mammal is observed in the safety zone or the zone at which noise is known to be injurious the operation will be shut down until the animal has left the safety zone of its own volition.

Observations for protected species will occur at least twice a day to maintain watch for animals in the area, and ensure the curtains are functioning properly. If at any time an animal is observed in the safety zone during the noise creating in-water activity, work shall cease until the animal has left the area of its own volition, or coordination with a DPNR representative has occurred, if the animal is injured.

Records will be maintained of all sea turtle and marine mammal sightings in the area, including date and time, weather conditions, species identification, approximate distance from the dredging area, direction and heading in relation to the dredging area, and behavioral observations. When animals are observed in the safety zone, additional information and corrective actions taken such as a shutdown of rock breaking/dredging equipment, duration of the shut-down, behavior of the animal, and time spent in the safety zone will be recorded. Reports will be provided to NMFS, COE, and CZM on a monthly basis.

6.09 Air Quality

This area of St. Croix is designated Class II by the Environmental Protection Agency in compliance with the National Ambient Air Quality Standards. In Class II Air Quality Regions the following air pollutants are regulated: open burning, visible air contaminants, particulate matter, volatile petroleum products, sulfur compounds and internal combustion engine exhausts. The site is not affected by atmospheric pollutants (other than natural marine aerosols) since it is downwind mostly of the sea.

There will be a minor increase of air pollution at the site during the operation of dredging equipment and transporting of the barges. On St. Croix, there will be minor increase in air pollution due to equipment exhausts from the off-loading, trucking and earth moving at the Quarry site. This unavoidable minor pollution will be temporary. The project will not permanently generate any air pollutants.

7.00 Impact of the Proposed Project on the Human Environment

7.01 Land and Water Use Plans

The upland to the south and east of the proposed maintenance dredging operation is zoned W-2, Waterfront Industrial and P, Public. The W-2 zoning allows for Cruise Ship operation, Marine Terminal operation and associated services.

7.02 Visual Impacts

There will be no permanent visual impacts on Schooner Channel other than the short term sighting of the dredging equipment.

7.03 Impacts on Public Services

Since all work will be done within the Channel, there will be no impacts to the public utilities and infrastructure. Since it is anticipated that most of the dredging workers will be local Virgin Islands residents, there will be minimal impact on the schools.

Minimal additional impact on health facilities should occur due to this project. At most there might be an occasional trip to the emergency facilities of the hospital caused by dredging accidents.

7.04 Social Impacts

Due to the nature of the project, it will have minimal social impacts. It will provide some jobs during the dredging phase. It is expected that the dredging will allow for an increase use of the Gallows Bay Marine Terminal, which will have more vested interests in the overall prosperity of the Island.

7.05 Economic Impact

The proposed maintenance dredging has been requested by VIPA in order to meet the previously approved depth of -18'. This is needed to insure that the channel depth is sufficient for mini-cruise ships and other deep draft commercial ships and private yachts to have access to Gallows Bay Marine Terminal. The dredging will allow for the increase use of Gallows Bay and the Marine Terminal Gallows Bay Marine Terminal which is crucial for development of St. Croix.

7.06 Impacts on Historical and Archaeological Resources

The proposed dredging will be done in areas already dredged and previously surveyed and will have no impacts on any cultural and archaeological resources.

7.07 Recreational Use

The proposed dredging will be done in areas that aren't used for recreational and is basically used for boat traffic out of Gallows Bay to other ports and areas of St. Croix.

7.08 Waste Disposal

No hazardous wastes are anticipated to be generated during the dredging of Schooner Channel. All waste generated on the dredging barges will be hauled off to an approved site. All dredged spoils will be disposed of at the old Quarry site north of the HER Airport.

7.09 Accidental Spills

No hazardous materials will be utilized in the dredging nor there be any storage of any such hazardous materials on the dredging barges.

7.10 Potential Adverse Effects Which Cannot Be Avoided

The seagrass and coral species within the project area would be lost due to the dredging and therefore will be transplanted out of the foot print. In total 31,250sq. ft. 30-70% SAV, 248,960 sq. ft. of hardpan with sparse coral colonization and 127,500 sq. ft. of algal colonized sand will be impacted. It is probable that at total of 250 corals lie within the dredging footprint.

The material to be dredged ranges from dense sand to hardpan and stringent turbidity controls will be required in order to minimize impact to the surrounding benthic communities.

Most of the channel has been impacted by shipping and past dredging activities. There is no alternative to the maintenance dredging other than no dredging.

There are sparsely scattered sponges within the project area which will be lost as a part of the project.

Water quality impacts have the potential for impacting the benthic habitat within the area and there are listed coral species as well as other coral species within the vicinity. It will be imperative to maintain existing water quality to the greatest extent possible.

It is anticipated that because of the rock in the project footprint, it will have to be broken mechanically. This will result in the ensonification of area. It is not anticipated that the rock breaking will result in direct injury to turtles but it is probable that this will result in changes to their behavior and that turtles if in the area will be stressed by the noise. Mitigation plans have been developed to minimize the noise that will be created during the rock breaking. In order to minimize and abate impacts to the listed turtles species NMFS's construction conditions will be followed.

8.00 Mitigation Plans

Several aspects of the Project are expected to mitigate the environmental impacts. These are:

1. Use of best available management practices for the control of turbidity.

2. Provide construction employment opportunities for residents of St. Croix.

3. Maintain and provide additional tax revenue to the V.I. Government.

4. The development will not alter the shoreline.

5. The seagrass within the channel will be transplanted into the many boat scars in the seagrass around Round Reef.

6. The corals will be transplanted to shallow depths but will be in the same water quality at which they currently thrive.

7. A Maintenance Dredging Mitigation Plan has been developed, see Appendix D.

9.00 Alternatives to Proposed Action

9.01 Dredging Alternatives

The proposed project is the maintenance dredging of Schooner Channel and there is no alternative other than not dredging at all.

9.02 Disposal Sites Alternatives:

Dredging projects are typically driven by the type and location of the dredged material disposal sites. An evaluation of potential disposal sites was conducted utilizing this criterion: location, physical features, capacity, and environmental and regulatory constraints. Five sites were identified and include:

Yabucoa Ocean Dredged Material Disposal Site (ODMDS)
St. Croix Renaissance Group, Red Mud Pile Cap
PWD Veterans Drive Project
Former dredge hole in Lindberg Bay
St. Croix Quarry Site

Yabucoa Ocean Dredged Material Disposal Site (ODMDS)

The Yabucoa ODMDS was authorized by the US Environmental Protection Agency (USEPA) through a US Army Corps of Engineers individual permit in the mid 1970's to accept material dredged from Yabucoa Harbor, Puerto Rico. Yabucoa ODMDS is a 1.4 square mile area approximately 8 miles offshore of Yabucoa Harbor and approximately 60 miles southeast of Crown Bay. The ODMDS is only designed to receive from Yabucoa Harbor and is currently closed.

Material is discharged in the ODMDS using split scows transported to the site by tug. The rate of discharge from the scow is governed by permit conditions, which typically require a slow release over a period of time to uniformly distribute the material on the ocean bottom. At this time, this site is closed. The considerable distance (60 miles) between dredge and disposal sites and the time to discharge the material at the site, production rates at the dredge site may be limited by the towing production rate. A minimum of three split scow/tug combinations will be required to maintain minimum production.

The use of the Yabucoa ODMDS will require modification of the USACE permit to open the site for use as a disposal site. Due to the uncertainty of the use of this site, it is not being considered.

St. Croix Renaissance Group Site

The St. Croix Renaissance Group (SCRG) operates the St. Croix Renaissance Park (SCRP), a 1244-acre industrial park located on the south coast of St. Croix. Former tenants of the park operated a plant that produced alumina, a white granular material that is used to create aluminum steel during the smelting process. A byproduct of alumina production is red mud or sludge, a

solid waste product consisting of oxidized iron, silica, unleached residual aluminum, and titanium oxide. The red mud has been stored on-site in storage in Areas A and B, a lawsuit filed by VIDPNR indicated that the red mud had leeched into the aquifer, contaminating the sea and the mangrove swamps to the south and was being spread by wind, affecting the surrounding community. A recent settlement of a lawsuit requires SCRG to contain and cap Areas A and B. Clean fill material will be required as part of the capping process and SCRG is currently evaluating the use of material dredged from Crown Bay.

The disposal of material at the SCRG site will require shipping of the dredge material to an offloading site for transportation to SCRG. There are potentially two active offloading areas within SCRG. These two sites are currently used by GeoNet Ethanol, who operates an ethanol dehydration facility and Diageo, who operates a rum distillery. These two active unloading areas do not have sufficient room to accommodate unloading and temporary storage of dredged material.

Molasses Pier, which is located a short distance from SCRG, is owned by VIPA. This unloading site has sufficient transfer and temporary storage areas and has been used to evaluate this disposal option. Deck barges would be used to reduce temporary storage and transfer requirements. It is assumed that the SCRG will be responsible for transporting the material from the molasses pier and stockpiling it on their property.

Preliminary discussions with the SCRG indicate that they are interested in receiving dredge spoils. However, due to the potential for long term liability to VIPA and the possibility that SCRG would require a disposal fee which would increase costs, this option is no longer being considered.

PWD Veterans Drive Project

The VI Department of Public Works is undertaking the expansion of Veterans' Drive from the east at Yacht Haven to Tortola Wharf on the western end of the Charlotte Amalie Harbor. The Project will be constructed in two Phases. Phase I is from Yacht Haven to Charlotte Amalie Parking Lot. Phase II is from the Parking Lot around the Senate building and along the Waterfront to Tortola Wharf.

DPW has applied for a CZM and ACOE Permits for Phase I. They have received approval of the CZM Permit by the St. Thomas CZM Committee and the VI Senate and is in the process of obtaining COE permits for the entire project. DPW wants to start construction in early 2014, but will need the ACOE Permit before they can proceed.

The proposed construction method would be to build a retaining wall first and deposit fill behind (upland) it to meet the proposed road grade. Phase I will only need 28,000 cy of fill. The Draft Geotechnical Report described the gradation of fill needed. Preliminary review of the Schooner Channel Spoils indicate that to be used it would have to be mixed with clean fill.

Phase II would be similar in construction and would need about 100,000 cy of fill. This means at the most, it could only use approximately 50,000 cy of dry dredge spoils. An application for a modification to the CZM permit for Phase II of the project has been filed.

It doesn't seem that the timing of the two projects would make this possible. In addition, the cost of transporting dredge spoils to St. Thomas would be excessive.

Lindberg Bay

The Lindberg Bay Dredge Hole was surveyed and considered by the West Indian Company (WICO) as a potential dredge spoils site for its dredging of Charlotte Amalie Harbor. However, very strong and outspoken opposition to it use caused WICO to withdraw its CZM Permit Application. This site was not further considered due to this opposition. In addition, the cost of transporting dredge spoils to St. Thomas would be excessive.

St. Croix Quarry Site

The old Quarry site on St. Croix north of the runway and to the west of the Industrial Complex was evaluated. The site is easily accessible with the dredge spoils being offloaded at the Molasses Pier and trucked to the site. While the cost for transportation is high, the advantage of this site is that it is land based and owned by VIPA.

It is proposed that the St. Croix Quarry site be used for the disposal of the dredge spoils.

Transporting the material to St. Croix would be by a deck barge, not a hopper barge. This would make unloading at St. Croix easier. Assuming a deck barge of 270'x72'x12' with a 3 feet high steel knee wall, it would hold up to 2000cy. The dredge material would be stacked 5 to 7 feet above the deck. The steel knee wall is not watertight. The benefit of the deck barge is that the small amount of water contained in the dredge material drains off at the dredge site within a CZM/USACE approved mixing zone area. The material will be pretty dry during shipment.

The barge operation would consist of a 3 barge 24 hour transport schedule. Once the barge arrives at St. Croix, a front loader drives on, scoops up the material, and then dumps it directly into the trucks. A barge will need to be off-loaded within 24 hours. If trucking it directly to the quarry cannot be done in that timeframe, then the material will be stored on a cleared area of land immediately adjacent to the Molasses Pier. Once at the quarry, the material will be spread and compacted. This area could then be used for VIPA activities.

The use of a hopper barge is not recommended as it is "watertight" and we would be shipping more water and less sediment. The other drawback is at St. Croix, a crane would be needed to offload the material and store it in a stockpile area. The stockpile area will need to be sized for the entire 2,000 cy barge capacity and designed to handle additional dewatering.

See Appendix A for drawings of the St. Croix Quarry Site.

10.00 Relationship Between Short and Long Term Uses of Man's Environment

The proposed development is consistent with the goals and policies of the Virgin Islands CZM Act and with the stated policies of the Government of the Virgin Islands and will be revenue-producing over the long term.

Gallows Bay is an active port and the dredging of the channel is necessary so that the Gallows Bay Marine Terminal may be used to its fullest capacity.

The Project is not expected to have any long term negative impacts on the marine environment. It may have limited short-term impacts.

This proposed project is economically feasible and checks and balances will be in place to ensure the successful operation and completion of the dredging.

11.00 References

Organizations and Persons Consulted

Principle Preparers:

William F McComb – Environmental & Civil Engineering Consultant, Principal Writer

Dale Gregory – Director of Engineering, VIPA

Damian Cartwright – Senior Engineer, VIPA

Jeff Lawlor – Consultant to VIPA

Amy Dempsey – BioImpact Inc.

Mark Pirrello – Moffatt & Nichol

James Jackson – CDR Maguire Inc

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