VESSUP BAY/EAST END
AREA OF PARTICULAR CONCERN
(APC)

A COMPREHENSIVE ANALYTIC STUDY

V.I. DEPARTMENT OF PLANNING AND NATURAL RESOURCES
Coastal Zone Management Program

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LIST OF KEY ACRONYMS

Area of Particular Concern	APC
Base Flood Elevation	BFE
Biological Oxygen Demand	BOD
Coastal Barriers Resource System	CBRS
Coastal Zone Management Act	CZMA
Coastal Zone Management Program	CZMP
Department of Housing, Parks, and Recreation	DHPR
Department of Planning and Natural Resources	DPNR
Department of Public Works	DPW
Division of Archaeology and Historic Preservation	DAHP
Division of Environmental Protection	DEP
Division of Fish and Wildlife	DFW
Environmental Assessment Report	EAR
Federal Emergency Management Agency	FEMA
Gallons Per Day	GPD
Mean High Water	MHW
Mean Low Water	MLW
Million Gallons Per Day	MGD
National Ambient Air Quality Standards	NAAQS
National Flood Insurance Program	NFIP
National Park Service	NPS
National Register of Historic Places	NRHP
Our Town Frederiksted	OTF
Sea Level Rise	SLR
Sewage Treatment Plant	STP
Significant Natural Area	SNA
Territorial Pollutant Discharge Elimination System	TPDES
Total Suspended Particulates	TSP
U.S. Army Corps of Engineers	USACOE
U.S. Environmental Protection Agency	USEPA
U.S. Fish and Wildlife Service	USFWS
U.S. Geological Survey	USGS
University of the Virgin Islands	UVI

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1. INTRODUCTION

1.1 General

Vessup Bay/Red Hook is one of 18 Areas of Particular Concern (APC's) designated by the Planning Office in 1979 after public nominations and comment had been received (Figure 1). The Vessup Bay/Red Hook APC is located on the eastern end of St. Thomas and includes Nazareth, Muller, Vessup, Red Hook, Great, and Cowpet Bays; Cabrita, Deck and Water Points; Great and Little St. James Islands; also Dog Island. Also included is the Virgin Islands National Park Service Headquarters.

This APC has a high diversity of important natural, geological, cultural, recreational, and scenic features. These include extensive fringing mangroves, seagrass beds, salt ponds, popular beaches, spectacular cliffs, and protected waters for mooring and anchoring. The APC encompasses important hotels and resort condominiums and marinas which are of significant economic importance to the Virgin Islands.

On July 26th, 1991, the CZM Commission adopted the 18 APC's recommended in the Final Environmental Impact Statement (USDOC, 1979), which accompanies the Virgin Islands CZM Act. The Final Environmental Impact Statement notes "the importance of the entire coastal zone", but declares that "certain areas are of yet greater significance." It also establishes the criteria for the designation of Areas of Particular Concern which are as follows:

- Significant Natural Areas
- Culturally Important Areas
- Recreation Areas
- Prime Industrial or Commercial Areas
    - Developed Areas
    - Hazard Areas
    - Mineral Resource Areas

In September 1991, the Coastal Zone Management (CZM) Commission met and held public hearings on all three islands on the boundaries for all 18 APC's. The Commission met again on October 1, 1991 and, based upon public input and staff recommendations, approved the boundaries of the APC's.

APC management requires knowledge of an area's historical development and traditional uses, and an action-oriented plan for the area's future utilization. This Study and proposed management plan is intended to serve as an overall planning and management framework within which the various regulatory entities carry out their respective decision-making duties under their authority.

The APC planning effort recognizes that permit decision-making is most often reactive; that is, the decision to approve or disapprove a proposed development is made in response to a permit request, not in advance of it. The general goal of developing an APC management framework is to be able to make a priori decisions about the allowable extent of modification of an entire landscape unit or

marine ecosystem. In other words, to raise the level of decision-making from the site-specific to that of functional ecosystems and the maintenance of a wide array of interactive resource uses.

1.2 Relationship to Other Plans and Regulations

The Vessup Bay/Red Hook APC Comprehensive Analytic Study was prepared under the authority of the Coastal Zone Management Commission. The Study and proposed management plan is intended to serve as the overall planning and management framework within which various planning and regulatory entities carry out their respective authorities. It is intended that the policy framework proposed herein will be incorporated into the policies and review criteria of the appropriate entities, including, but not limited to, the Department of Planning and Natural Resources (DPNR), the Port Authority, the Department of Public Works (DPW), the U.S. National Park Service (NPS), the U.S. Environmental Protection Agency (USEPA), the Water and Power Authority (WAPA), and the Department of Property and Procurement. Once adopted and passed by the Legislature and approved by the Governor, this Study and proposed plan will serve as a legal basis for future decisions concerning the area. Any future development activity must be consistent with Study and proposed plan.

In essence, the intent of this Plan is for all participating territorial and federal agencies to utilize the broad policy framework to guide planning and permit decisions with respect to their own authorities. For those agencies that issue permits or review and comment on permit applications, the Plan does not eliminate the authority of those agencies, but does increase the predictability and timeliness of the permitting process since many of the issues that must be addressed in a specific permit application are already addressed and mandated in the Plan.

The issues surrounding any proposed use or activity within the coastal environment are complex. The decision on such a proposal is therefore rarely based on a simple "right or wrong", or "good or bad" evaluation. Because of this, it is not possible to simply turn to page 16, for example, to find "the right answer" to the question of a specific allowable use. Moreover, a proposed use immediately outside the boundary of the APC planning area may result in significant adverse impacts on the APC, and impair the ability of society to achieve the goals of the APC management framework described herein. It is therefore an error to think that the boundaries of the APC are "absolute" limits to guide decision- making. This Plan contains several different forms of guidance **which all must be considered** to determine what is "right". Both the individual property owner who is considering a specific proposal and the decision-maker who is evaluating the proposal must use all of the guidance of this Plan to achieve balance and sustainable solutions in making final judgement.

1.3 Historical Perspective and Overview

Vessup Bay/Red Hook is an APC because of the intense concentration of activity in the area coupled with the importance of the harbor and its facilities. It is a heavily utilized basin and water body (made up of three bays), Red Hook Bay being the outermost (easternmost) and most open bay of the three. Vessup Bay is the innermost (westernmost) and most restricted of the three bays. Muller Bay, a southern indentation of the main portion of Red Hook Bay, is roughly central to the three bays.

Within the APC boundaries (Figure 2) are three salt ponds, the largest of which is the Red Hook salt pond, just east of the Red Hook Ferry dock and the Roll On/Roll Off facility at Red Hook, and two smaller ponds on Cabrita Point. Historically, there were three other salt/fresh ponds within this APC boundary, on parcel 9-B Nazareth. The central pond was filled prior to 1965 and the others filled in 1969, along with a filling of the western end of Red Hook salt pond.

Because of its geographical location, its importance as the main transportation link between St. Thomas and St. John, and its status as a major center for yachting activities, the Vessup Bay/Red Hook area has been described as the focal point for the entire east end of St. Thomas (U.S. Department of Commerce 1979).

1.4 Other Classifications

Coastal Barrier Resources System

The Red Hook Salt Pond has been placed within the Coastal Barrier Resources System (CBRS) Act as site VI 32. In addition, the northwestern boundaries of CBRS site VI 33 (Great Bay) covers a portion of this APC, and part of the Mangrove Lagoon/Benner Bay CBRS site is within the APC(see Figure 6).

The Federal Coastal Barrier Improvement Act of 1990 established areas in the USVI as part of the CBRS. The purpose of the system is threefold (Island Resources Foundation, 1986):

1. To halt development in low-lying areas subject to natural disasters (1.e.,flooding, hurricanes, etc.);
2. To stop wasteful federal expenditures in these areas; and
3. To protect valuable natural resources from being destroyed by unwise economic development.

By law, federal expenditures (e.g., grants, loans, federally backed insurance, etc.), including federal flood insurance, are prohibited for development projects within a designated CBRS site. The law does not, however, prevent projects from moving foward with private backing. Certain exceptions are allowable for park lands, recreational areas, public recreation infrastructure, and land aquisition.

The Red Hook area was investigated during the 1990 DPNR-funded Hurricane Hugo Damage Assessment/Virgin Islands Territorial Park System Planning project by the Island Resources Foundation. It was designated site number T13. The Pond is a salt water pond which is not navigable, however, the pond waters do rise and fall with the tides. The lands underlying the Red Hook Pond are "lands beneath tidal waters" (also referred to as "tidelands" or "submerged lands") and title to these lands is and at all relevant times has been vested in the Government of the U.S. Virgin Islands. (Letter dated April 4, 1990 to Commissioner of DPNR from Karl R. Percell, Acting Attorney General, Dept. of Justice, St. Thomas, U.S.V.I.)

Floodplain

Nearly the entire shoreline of the APC and portions of the upland areas of both Chocolate Hole and Great Cruz Bay are situated within a designated 100-year floodplain (Figure 4). Both A-zones and V-zones are identified. Extensive floodplains are found in the low lands and gut behind Vessup Bay and in the gut draining into the Red Hook Salt Pond. Much of Cabrita Point is also in a flood zone. The lower areas of the Palazzo Hotel and Cowpet and Elysian Resorts are in V and A zone floodplains.

2. DESCRIPTION OF THE SITE

2.1 APC Boundary

The boundary for the Vessup Bay/Red Hook APC, established by the Coastal Zone Management Commission, is described as follows:

> Beginning at Cabrita Point, the boundary line extends along the shore due north for five hundred (500) feet; then extends in a westerly direction to Red Hook point; then over Red Hook Hill to Route 32; then along the ridge line to Benner Hill; then continues in a westerly direction to the Benner Hill road; then south along the Benner Hill road to the Route 32 and 322 intersection; then continues south along the ridge line that separates Nazareth and Frydenhoj Estates to the shoreline; then south to the shelf edge or three mile limit (whichever is closer), passing to the east of Cas Cay; then east along the shelf edge or three mile limit to a point directly south of Dog Rocks; and then northerly, passing to the east of Dog Rocks and Great St. James Island and continuing north to Cabrita Point, the point of origin.

2.2 Ownership Summary

Land ownership within the APC boundary is both public and private. The Government owns a number of properties in the area in the APC including the Eudora Kean High School, Dog Island, Dog Rocks, Welk Rocks, Cow and Calf Rocks, The Stragglers, Frenchcap Island, and the Red Hook Salt Pond, along with other submerged lands. The Port Authority also owns and operates the ferry dock. Also located in the area is the National Guard, several private marinas, hotels condos, and many private homes. Little and Great St. James Islands are privately owned.

2.3 Physical Environment

2.3.1 Climate

Rainfall in the Virgin Islands generally increases with increasing elevation and exhibits a trend on each island of a dry-to-wet cline from east to west. The east end of St. Thomas receives an average of less than 35 inches or rainfall -- less than the rest of the island which averages 45 inches of rain per year. February to July are normally the driest months, September to December are the wettest, with most rainfall coming in brief showers. Heavy rainfall sometimes occurs during the passage of an easterly flowing tropical wave. Occasionally, these waves intensify into tropical depressions, tropical storms,

or hurricanes. The vegetation, a dominance of dry scrub and cactus, reflects the dry climatic conditions in the area.

The Virgin Islands experience the eastern flow of the prevailing trade winds. At this latitude (about 18° degrees N), at sea level, the temperatures range from mid to high 70°s at night to low to mid 90°s in the heat of the day during the summers and low to mid 70°s at night to mid to high 80°s in the day during the winter months.

2.3.2 Geological Setting

St. Thomas is on the eastern extension of the Puerto Rican plateau, within the "Northern Virgin Islands Zone", which extends from Puerto Rico east-north-east to Virgin Gorda in the British Virgin Islands. The Northern Virgin Islands Zone consists of Albian (and possibly earlier) volcanic and plutonic rocks intruded by minor Upper Cretaceous dikes and plugs.

The Vessup Bay/Red Hook area is underlain by andesitic pyroclastic rock of the Louisenhoj Formation (Lewis and Draper, 1990). The alluvial cobble region at the head of the bay is an indication that this area has functioned as an outwash floodplain for the upland watershed. Sandy, porous soil commonly found around Muller Bay is generally calcareous in nature and of marine origin.

Most of the bottom sediments of the bay consist of sand and gravel over hard rock. Coarse sand and shell fragments are commonly found at the head of the embayment and along the western periphery. The inner reaches of the harbor are overlain by a heavy layer of silt and mud as a result of upland runoff.

Cramer Gravelly Clay Loam, 12-40 percent slopes (CrE). This soil is on the ridges and side slopes of dissected volcanic uplands throughout the Virgin Islands. This soil is suitable for pasture and woodland, and the entire acreage is used for those purposes. Shallowness over rock, moderately steep slopes, susceptibility to erosion, a large number of coarse fragments, and a low water-holding capacity preclude cultivation. Limitations are severe for nonfarm uses as well as industrial.

Jaucus Sand, 0-5 percent slopes (JuB). This soil occurs as low, hummocky,, sandy coastal areas on all three islands and on some small islands offshore. Severe conditions limit both farm and nonfarm uses.

Tidal Flats, (Tf). Tidal flats occurs as nearly level, essentially barren areas that are periodically covered with tidal water. This land type can be used only for wild-life habitat or aesthetic purposes. Extreme wetness precludes its use for commercial production of crops, forage, and trees. The limitation is severe to very severe for most engineering and recreational uses.

Volcanic Rock Land, (Vr). Volcanic rock land is made up of areas where volcanic rock outcrops cover 50 to 70 percent of the surface. Loose stones and boulders are common. The slope gradient is 60 to 70 percent. The vegetation is brushy forest pasture. This land type is restricted to wildlife habitat and aesthetic purposes. The very steep slopes, exposed rock, and shallow soil material

preclude its use for commercial production of crops, forage, or trees and severely limits all engineering and recreational uses.

Historical seismicity in the USVI

As a result of convergence between the Caribbean and North American tectonic plates, the Virgin Islands are located in one of the most earthquake prone regions of the world. During the past 450 years, damage has occurred from earthquakes and associated tsunamis. Strong seismic shocks were recorded for the Virgin Islands in 1777, 1843, 1867, and 1918. Destructive tsunamis occurred in the U.S. Virgin Islands in 1867 and in 1918; the latter resulted in 116 deaths and economic losses estimated at $4 million (in 1918 dollars) (USGS, 1984a). The 1867 tsunamis was reported to have a wave height of 27-feet above sea level (Geoscience Associates 1984b).

Potential human and economic losses for a similar event occurring today would be several orders of magnitude higher. Scientists report high seismic potential for a major fault rupture in the Puerto Rico Trench north of Puerto Rico and the Virgin Islands (USGS, 1984a). The Virgin Islands are classified as "Zone 4" for earthquake vulnerability, the highest damage zone and the same classification given to many parts of California (International Conference of Building Officials, 1988).

Studies prepared in 1984 estimated that an earthquake of MMVIII intensity (Modified Mercalli Scale) has a recurrence period of between 110 and 200 years for the St. Thomas/St. John area. The probability of such an earthquake occurring in the next twenty years is between 50 and 70 percent, and between 60 and 80 percent during the next 50 years (Geoscience Associates, 1984a and 1984b). The waterfront areas of Charlotte Amalie and Christiansted are especially vulnerable to impacts from earthquakes due to substantial construction on recently filled (reclaimed) land. It is these areas where liquefaction and ground settling are likely to be the greatest. Buildings constructed on loose alluvial or man-made fill soils along the waterfront are at risk of destruction should an earthquake occur (Geoscience Associates, 1984b.) The majority of the waterfront area is built on reclaimed lands, with fill material deposited on top of an alluvial base (USVI Govt/DPNR, 1992a).

2.3.3 Hydrological Setting

Watershed Drainage - The major drainage flow in the Vessup Bay/East End APC is from the west to east along the valley formed between Benner and Nazareth hills. A significant addition to the drainage for the APC flows easterly from the north side of Benner Hill and southward from Red Hook Hill into the Red Hook salt pond (see Figure 3). The total drainage area is 542 acres.

Isolated storm events have shown that heavy surface runoff from the watersheds apparently results in significant nutrient inputs in coastal embayments. Runoff resultant from heavy rainfalls associated with Hurricanes David and Frederick in the fall of 1979 were responsible for heavy nutrient loadings resulting in algal blooms in Vessup Bay. At the same time, algal blooms were also reported in the Mangrove Lagoon, Cowpet Bay and Water Bay (Wernike and Towle, 1983).

Wells - The U.S. Geological Survey has identified at least eleven wells within the watershed areas affecting this APC (Figure 3). Two test wells were drilled near the armory by the U.S. Geological Survey (USGS) during the summer of 1991 to prospect for usable water sources. The first was backfilled because of unstable ground conditions. The second well (Figure 3, #2) struck water, but the pumping yield was low because the aquifer is mostly clay material. This well will likely be used as a monitoring well for water quality and water table height, but because of the yield, the well will not become a production well (Judy Steiger, USGS, 1991, written communication).

Tides - The diurnal tidal range is generally less than one foot which limits the water exchange in the bays. Vessup Bay was categorized as a partly enclosed embayment by Nichols, et al. (1979). They estimated that 27 tidal cycles would be required to completely exchange the water in Vessup Bay. This is compared to their estimates of 14 tidal cycles (days) to exchange the waters in the more open Red Hook/Muller Bays portion of the embayment.

Sigma Environmental Sciences (1979) measured current flow in Muller Bay. Velocities averaged 0.06 kts to the west, independent of tidal flow. This would indicate either that a clockwise gyre exists in the Vessup Bay/Red Hook APC waters or that the westerly surface flow is coupled with an easterly bottom flow of the waters.

2.3.4 Coastal Environment

Good quality beaches throughout the APC. Muller Bay Beach, commonly known as Vessup Beach, is of high recreational value, and lies along the western shore of Muller Bay. In 1979, a series of three jetties was built east of the existing jetties along the southeastern shore of Muller Bay in an attempt to create a swimming beach for residents of the adjacent Cabrita Point condominium development. Recent aerial photos show that the project was unsuccessful in that virtually no sand collected within the down-current side of the jetties. Good beaches also exist to the western sides of the jetties along the southwestern shore of Muller Bay. Another beach popular with residents is Bluebeard's Beach. Most of the rest of the beaches in the APC are fronted by hotels or condominiums and are not commonly used by residents of the Virgin Islands.

Red mangroves (*Rhizophora mangle*) grow around the perimeter of Vessup Bay, especially at the head of the bay, and around the perimeter of the Red Hook Salt Pond and the salt ponds on Cabrita Point. The abundance of red mangrove trees around the bays, especially around Vessup Bay, has made this area important as a nursery for juvenile fish, conch, lobster, sea turtles and other marine animals. However, because of heavy boating usage and stress from sewage, oils and sediment runoff, the significance of Vessup Bay as a nursery has diminished -- although juvenile fish are still frequently seen.

2.4 Biological Environment

2.4.1 Terrestrial

The following descrition of the terrestrial environment is paraphrased from J. McCrain (1981):

The dry climate of the eastern end of St. Thomas is indicated by a vegetation regime dominated by Tan Tan (*Leucaena glauca*), Casha (*Acacia farnesia*), cacti (*Cephalocereus* and *Opuntia*) and several types of grasses.

2.4.2 Marine

The Redhook/Vessup Bay area of this APC includes three separate embayments totalling 138 acres surrounded by a 542 acre upland watershed.

> Vessup is the innermost embayment and the most heavily impacted of the three. The 34 acre Vessup Bay is 780 yards long and 258 yards wide at its entrance with an average depth of 2.75 feet. Water contact recreational activities are limited because of a variety of undesirable impacts that have reduced the water quality relative to the outer bays, occasionally below the prescribed limits for Class B waters, however, much of the boating activity for the system is centered in this area.
>
> In contrast, Muller and Red Hook Bays located eastward of Vessup have fewer pollution problems and the water quality is relatively good. This area is much deeper (approximately 30 feet deep) and wider (670 yards) than Vessup and is more open to prevailing winds and sea conditions resulting in better flushing. The Vessup Bay/Red Hook APC contains a multiplicity of land and water uses, and the conditions of its natural resources range from highly degraded (water quality in Vessup Bay) to largely undisturbed (the southern quarter of Red Hook Hill).

The salt ponds in the area, especially Red Hook Pond, are important feeding and roosting features for resident and migratory birds alike.

Moderate fringing reefs consisting primarily of *Acropora* sp. (elkhorn and stagorn coral) and *Porites* sp. (finger corals and mustard hill coral) grow from the north and south shores in the outer portions of Red Hook Bay. In fact fringing reefs are found extending from almost all the headlands in the APC. The arms of Great Bay are characterized by carbonate platforms. The southern platform is more protected from prevailing winds and has extensive seagrass beds. The northern platform has more coral development. Patch reefs of predominately mountainous star coral (*Montastrea annularis*) are found throughout Great Bay.

Seagrass beds are found throughout the APC, particularly in front of Turtle Bay (site of the Grand Palazzo Hotel), on the western side of Great St. James Island and in St. James Cut. There are, also, large expanses of seagrass beds, mostly turtle grass (*Thallasia testudinium)*, but with some manatee grass (*Syringodium*) and some shoal grass (*Halodule*) in the main and outer portion of Red Hook Bay; however, large scour marks, visible in aerial photos, along the northern shore of Red Hook Bay near the ferry and RO/RO facility, indicate that the seabed suffers from anchor dragging and other disturbances related to the operation of marine vessels. These seagrass beds are important foraging grounds for sea turtles, and an effort must be made to minimize activities that, directly or indirectly, further damage or weaken the beds.

Dredging to fill salt ponds behind Vessup Beach and the western pond on Cabrita Point in 1969 and earlier left large holes up to 30 feet deep in Muller Bay. These holes are clearly visible in current aerial photographs. Water quality in the dredge holes is lower than the surrounding waters because the fine particulate matter lying on the bottom is frequently resuspended, lowering the light penetration to the bottom of the holes.

Degraded water quality in Vessup Bay, especially in the inner reaches of the bay, has limited marine plant growth in the bay to the deeperwater seagrass, *Halophila,* and the algae, *Diplanthera,* and scattered algal species.

2.4.3 Endangered Species

Endangered species such as the Virgin Islands Tree Boa, *Epicrates monensis,* and other species on the Federal List of Endangered Species, have been sighted within this APC.

The U.S. Endangered Species Act defines "endangered species" to mean a species or subspecies that is in imminent danger of extinction throughout all or a significant portion of its range. "Threatened species" are those likely to become endangered in the foreseeable future unless current trends are reversed. Such species are protected by Federal law; neither the whole animal or any products from it may be taken, sold, or possessed. Alteration of the habitat in which any of these species occurs may be, in certain cases, prohibited or constrained.

The V.I. Legislature has also passed endangered species legislation. Known as the Indigenous and Endangered Species Act of 1990, the bill (Act 5665) signed into law in December 1990, authorizes the Commissioner of DPNR to promulgate a list of endangered and threatened species in the Virgin Islands. The V.I. Government, Department of Planning and Natural Resources, Division of Fish and Wildlife maintains a list of locally endangered or threatened species. These species may be abundant elsewhere and are not, as yet, specifically protected by local or federal laws.

Of those animals listed by Brill and Associates (1991) as occurring, or likely to occur at least seasonally, at the Vessup Bay/Red Hook APC, the following species are listed as either federally or locally endangered (DPNR/DFW, 1991): Green Sea Turtle (*Chelonia mydas*); Hawksbill Sea Turtle (*Eretmochelys imbricata*); and LeatherBack (*Dermochelys coriacea*). All are on the federally listed endangered species list.

2.6 Built Environment

2.6.1 Roads and Ports

Roads: The major road bounding this APC is Routes 32 with Route 322 intersection. Regular users of the St. John ferry often park their vehicles along the shoulder of the Red Hook Road (Route 32/38), adjacent to the Red Hook Salt Pond (see Figure 5, #1). Daily counts made during the summer and fall of 1991 indicated that during weekdays, 30 to 50 cars were parked along the roadsides, and during Sundays or holidays, 70 or more vehicles were parked lining the road.

A large parking lot is provided at the Red Hook ferry dock site and a second lot is located directly across the road from the dock (on the NW side of the road). At any time, there are parking spaces available in either lot. Persons who must use the ferry for daily travel back and forth to St. John, at a cost of $6.00 per day, are probably reluctant to pay additional monies for car parking (at $5.00 per day). Thus, the unregulated parking conditions which prevail in the Red Hook area encourage persons to park along the roadside instead of in the pay lots.

Problems of safety arise from parked vehicles occupying all shoulder space along the side of the main road. Most of the parking occurs along the bend in the road beside the salt pond, which effectively narrows the road. Vehicles commonly travel at 30 mph or faster along this stretch, and pedestrians, forced to walk on the road surface, find their safety jeopardized.

Secondly, vehicular parking along the southeastern side of the road by the mangroves is stressing the mangrove trees by encroaching on their space. These trees are important for the health of the pond and also seem to be of importance in keeping the roadbed from washing into the pond.

A sidewalk, elevated above road level, is being constructed along the roadside in front of the new American Yacht Harbor building (see Figure 5, #2). Unfortunately, during the permitting process for construction of the AYH building now housing the East Coast Bar and Grill, similar requirements for constructing a raised sidewalk to separate pedestrian traffic from vehicles was overlooked.

In this busy commercial area, a raised sidewalk should be built extending at least from the western end of the IEKHS property eastward to the Red Hook ferry dock/parking lot area, along both sides of the road with a marked crosswalk at each entrance of the school and at both entrances to the Red Hook Plaza. A sidewalk would also regulate vehicular parking along the road (which is haphazard at present), will ensure pedestrian safety and will also help divert runoff water into the Red Hook salt pond (thus helping to cleanse the water before it enters the sea).

The long stretch of road from the west at the crest of the hill at Ridge Road/Rte 32 intersection to the NE sweeping turn in front of the National Park Service Headquarters road and the DPW sewage treatment plant has become a haven for speeders (in cars, motorcycles and commercial vehicles) (Figure 5, #19). The speeding vehicles continue past the IEKHS, the Red Hook Plaza and around the bend of Rte 32, NE past the salt pond. There have been several serious vehicle accidents along this stretch of road. In some cases, vehicles (especially motorcycles) have been estimated to be travelling at more than 70 mph. Commercial trucks using this route to go to the RO/RO ramp at Red Hook also travel well in excess of the 20 mph limit a truck is required to travel outside of town areas.

There are two ways to reduce vehicular speed in this area:

1. With the active presence of uniformed police with radar-equipped vehicles monitoring vehicular speed and issuing tickets to offenders;
2. With the placement of speed bumps or other speed-retarding devices on the road along the entire stretch of highway.

There are no "School Zone" signs posted along the road in front of the high school. Virgin Islands traffic code dictates a speed of 10 mph in a school zone. A speed zone by the school should be established, and the speed limit rigorously enforced.

A part of the Tamarind Resort Associates (TRA) Hans Lollick development plan involves the building of a 100-space parking lot at the site of Red Hook Villas (Figure 5, #17). The lot, to be accessed via the existing alleyway between Eastern Market and Fish Shack, is planned to be used as a staging area for construction materials and a parking area for workers for the duration of the project -- a projected development time of 10 to 15 years. The developers expect that as many as four semi-trailer loads of construction materials would be offloaded there per day during peak activity periods. Additionally, TRA is planning to offload 1,200 to 4,000 pounds of garbage from the Hans Lollick project at Red Hook with no clear scheme as to how the garbage is to be handled (i.e., for storage and movement to the solid waste landfill).

The Nazareth Community Association, a citizens group, has expressed strong opposition to this development plan and has produced a public information statement and petition for presentation to the CZM Commission.

The Tamarind Resort Associates Hans Lollick development proposal will add heavy traffic loads and congestion to the Red Hook area for an expended period of time. TRA should demonstrate that this increase in traffic will not adversely affect the economy of the Red Hook area. The 1992 road construction project for the St. Thomas Race Track Road has already demonstrated how increased traffic congestion can result in lower commercial activity for businesses in a construction area.

Additionally, TRA should be required to clearly outline its plans for supply and personnel movement from Red Hook to Hans Lollick via the sea port, including type of vessels to be used and frequency of shuttle trips.

Ports: The Red Hook ferry dock is the focal point for the marine transportation link between St. Thomas and St. John and is an important port for ferry service between St. Thomas and Tortola and between St. Thomas and Virgin Gorda.

Two to three thousand persons, mostly commuters, are moved each day between St. Thomas and St. John, in 19 round trips. Varlack Ventures Inc. and Transportation Services Inc. each operate one vessel at a time on the shuttle run between Red Hook (RH) and Cruz Bay (CB) (one vessel leaves RH as the other leaves CB) with trips leaving every hour on the hour from 6:00 AM to 12:00 midnight. There are three ferry trips daily between Red Hook and West End Tortola and two trips weekly between Red Hook and Virgin Gorda.

Each company has several vessels. One vessel is on standby for the shuttle run to carry overloads, or as a replacement if a breakdown of the vessel in use occurs. Others are used for charter groups or are rotated out of service for regular maintenance work. For special occasions, like the St. John Carnival, vessels make extra trips to serve the higher demand.

The safety of the ferry dock at Red Hook was already in question before its recent collapse in the spring of 1991 (Figure 5, #14). Following the repairs of the outer portion of the dock, the structure was returned to service at the end of June 1991, in time for the expected rush of traffic bound for the St. John carnival. Concern remains about the integrity of that portion of the original dock structure remaining which appears corroded and generally in poor repair.

Engineering studies must be done shortly, and any recommended repairs made as soon as possible. A recent press release by the Government indicates that $2 million dollars are to be spent to upgrade both the Red Hook and the Cruz Bay docks and the Tortola Wharf (downtown Charlotte Amalie) (see *Virgin Islands Daily News*, October 24, 1991 article).

The Roll On/Roll Off (RO/RO) ramp (Figure 5, #25) located just east of the Red Hook ferry dock is the primary staging point for heavy trucks, other commercial vehicles and heavy equipment, as well as private vehicles, to be transported to St. John. These vehicles, some carrying the main volume of consumer wholesale items for St. Johnians, are trucked to the Red Hook RO/RO site and then driven onto one of the two vessels used to shuttle between the Red Hook dock and the commercial wharf at The Creek in Cruz Bay.

The landing craft *P'ti Bleu II* and the vessels *Admiral* and *General* are equipped to handle several semi-trailers or the equivalent at one time on frequent runs between Red Hook and The Creek. Some problems arise with traffic congestion around the loading ramps, especially when the crafts are unloading large trucks. Nevertheless, this service is vital to St. John, and efficiency might be improved when new port facilities are built at Enighed Pond, St. John and when the V.I. Port Authority (VIPA) upgrades the RO/RO ramp and ferry dock at Red Hook.

With about 200 boats using the Vessup Bay/Red Hook APC waters, available mooring and anchoring areas for Vessup, Muller and Red Hook Bays are crowded during the winter season (see Figure 7, Number of Boats in Vessup Bay/Red Hook). Occasional problems occur when one boat occupies another's mooring. Other problems arise when moored boats encroach upon the central navigation channel. At the outer part of the mooring area, in Red Hook Bay, there are problems with ferries and other vessels moving with enough speed to create large wakes, resulting in uncomfortable living conditions for moored live-a-board residents.

A "water use plan" for the Territory should be designed and implemented based on the Mooring and Anchoring of Vessels and Houseboats Act, with mooring/anchoring areas defined and speed limits for boats set and enforced within designated areas.

The American Yacht Harbor (AYH) Marina built a boat launching ramp at the western edge of its property (Figure 5, #6) to replace the previous boat ramp located near the center of the property. AYH blocked the "old" boat ramp during the construction of the boardwalk for its "new" marina dock project in 1990.

From the outset, the new western ramp was improperly built and could not easily be used as a boat ramp because it lacked a gradual sloping run into the water. An unsubstantial, and likely illegal,

attempt was made to create a grade into the water for boat trailers. Fill was dumped into the water at the end of the concrete portion of the ramp in early 1990, with no retaining walls in place in the water. Consequently, within a few days, the fill had slumped westwards into the adjoining property, shallowing boat parking areas at the nearby dock.

At this time, the boat ramp area is mostly used as a boat repair yard where major dingy and small boat repairs are made. Dust from fiberglass grinding and noxious fumes from marine paints and other chemicals used in boat repair often cause disruption of work at the neighboring environmental research facility, which is downwind from the ramp.

AYH must be held responsible for the aggregate fill dumped into the water off the western boat ramp. AYH should remove that portion of the fill which slumped west of the ramp into the neighboring dock spaces and should install a small retaining wall to prevent a recurrence of the sediment slump. Major boat repair activities should not be allowed at the boat ramp, and the facility should be upgraded so that it can be used as originally intended.

2.6.2 Water Systems

The principal sources of water on in the APC are desalinated seawater, rainfall collected from residential roof-top catchments, and groundwater. The hotels, resorts and condominiums not only have rainwater catchment systems but use reverse osmosis systems to augment their freshwater supply. Groundwater use along the south shore St. Thomas, from Krum Bay to Red Hook, is very limited, with saltwater intrusion a problem in some locales (USGS, 1984c).

2.6.3 Wastewater Systems

The Vessup Bay sewage treatment plant serves the local Red Hook community and some residential areas. This plant discharges secondary treated sewage high in nutrients into the mangroves at the head of Vessup Bay. This is a probably the best functioning sewage treatment plant in the Virgin Islands. DPW has plans to eventually connect the Vessup Bay plant to the planned Long Point plant adjacent to Mangrove Lagoon. Most residential homes utilize on-site septic tank systems. The hotels, resorts and condominiums in the area have their own sewage treatment plants and generally use the effluent to irrigate. The sludge from this plants is periodically hauled away and discharged into a manhole connected to a sewage treatment plant.

2.6.4 Energy Systems

Power for St. Thomas and St. John is generated by the combined power and water production facilities at Krum Bay. The plant consists of two steam generating units, one diesel, three gas turbines, and four desalination units. A new 24 megawatts (MW) combustion turbine will become operational in 1993 (Rothgeb, 1993).

Power is generated by combustion of No. 6 and No. 2 fuel oils which are delivered by barge to a fuel pier and pumped to storage tanks. The fuel is drawn off as needed from the storage facilities to fire

the combustion equipment. Total current power production capability is approximately 128 MW, while daily peak demand is approximately 63 MW. Growth projections for power demand indicate a peak demand of 77 MW by the year 2000 (R.W. Beck, 1988). An underwater cable supplies power to St. John.

The Grand Palazzo Hotel produces all their own electricity with a total energy plant located under their tennis courts. In there EAR they indicated that in case of a major power loss such as occured after Hurricane Hugo, they would be able to supply some power to the surrounding area.

2.6.5 Solid Waste Disposal Systems

The Department of Public Works, Solid Waste Division, is responsible for the collection, transport, treatment (if necessary), and disposal of solid waste in the Territory. For most areas of the island, dumpsters are strategically located along main roads and residents are responsible for disposing of household wastes at these locations. In a few limited areas, however (e.g., Tutu, Anna's Retreat, and parts of the Savan area in Charlotte Amalie) curbside refuse collection is provided by DPW. One problem with curbside collection is that trash is often found scattered by domesticated animals before it can be picked up (per. comm., G. Patrick, DPW).

The location of a trash dumpster on the north side of the Red Hook Road (Rte. 32) at the intersection of the National Park Service Road and the Vessup Bay Estates access road (Rte. 322), is extremely dangerous. Vehicular speed along the straight, downhill, eastbound stretch of Rte. 32 is often high (more than 35 mph); additionally, the road is generally very busy. With the current trend of increasing development for the Vessup Bay/Red Hook area, traffic volume along the road will only increase. The pullover space by the dumpster is marginal, the ground is often soft during and following a rainfall, and visibility towards oncoming traffic for someone driving into or out of the space is poor to nonexistent (depending on whether the individual is on the east or west side of the dumpster).

Hopefully the "new" Solid Waste Management Plan, recently submitted by R.W. Beck and Associates, will deal with the public safety issues associated with the location of this dumpster by recommending an alternative for the pullover.

The beach at Muller Bay receives heavy public use on weekends (Figure 5, #7). A major problem associated with this activity is an abundance of garbage left following the gatherings. Owners of the property behind the high water mark at this beach report that they provide trash receptacles and even hire an individual to do a cleanup on a regular basis at the owner's expense, but they are unable to keep up with the amount of trash being left behind. Regulations concerning litter (19 V.I.C. SS 1551 et seq.) should be enforced by uniformed police officers and DPNR officials at this and other beaches used by the public. Also, if Government is not sharing in the costs of beach cleanup at this site, funding should be identified to help the property owners maintain the beach and to eliminate the now fairly constant garbage and trash problems at the site.

During Hurricane Hugo, four sailboats were grounded at Muller Bay. The vessels were not recovered by their owners and remained there until mid-November 1991 when they were removed by a group of volunteers and DPNR personnel. The Derelict Vessels section (T.12 V.I.C. Ch. 21 ss 715) of the V.I. Code allows for the removal of abandoned vessels in territorial waters by the Government.

Cleanup campaigns focusing on debris removal from the mangroves could be organized through special events like Coastweek and hosted by appropriate citizen, community and environmental groups. Additionally, larger commercial establishments might be approached to act in support roles. A citizens-based or commercial-based "Adopt a Beach" or "Adopt a Mangrove Forest" is located south of the Red Hook Road, opposite the Red Hook Plaza shopping complex (see Figure 5, #3). This depot was established by American Yacht Harbor Marina to serve its boating clientele. It is unclear if the depot was built in conjunction with the government-sponsored oil collection program set up shortly after Hurricane Hugo.

The location, legality and operation of the AYH waste oil collection facility is questionable, certainly the need for such a site is evident. As an interim measure, the AYH facility must be bunded immediately. Guidelines on page 82 of the Virgin Islands Coastal Zone Management Program's Handbook for Homebuilders and Developers state that:

> Tanks should be surrounded by a continuous berm capable of containing the entire liquid contents of such tank.

3. RESOURCE USE, USE CONFLICTS, AND ADVERSE IMPACTS

3.1 Resource Use

Figure X identifies the existing land uses within the Vessup/Red Hook APC, which were interpreted from aerial photography and groundtruthed for accuracy. The classification system, based on the Teytaud/U.S. Geological Survey (TUSGS) land use/land cover classification system (DCCA-DCZM, 1981), is hierarchical, with three levels of categories, increasing in specificity from level I (e.g., 100 series, the most general - Urban or Built-up Land) to level II (e.g., 110 series - Residential) to level III (e.g., 111 - Single Unit, Low Density [less than 2 DUPA], the most detailed).

Residential

During 1989 and 1990, a residence was built on a lot between the Virgin Islands National Park (VINP) headquarters road and Lower Road on the south side of Vessup Bay, in an area zoned R1 (low density). The house was constructed with five apartment units on the lower level (Figure 5, #10) in an attempt to make the house into a bed-and-breakfast/dormitory facility. A site inspection revealed the situation (which constituted a violation of the zoning density for the area), and the applicant was refused authorization to build a kitchen facility on that level.

Major permits (more than $75,000 value), such as the one for the building project described above, are reviewed by the CZM Commission (T.12 SS 910). This episode emphasizes the importance of careful

review of major building permit applications by qualified, knowledgeable staff from DPNR and of frequent, unscheduled building site inspections once permits have been issued. Occupancy permits should not be issued for structures constructed in violation of existing permits until the deficiencies are rectified and alterations completed.

Biulding activity on Cabrita Point has, to some degree, compromised deer and iguana habitat (Figure 5, #20). More importantly, the Cabrita Point condominium development was built on a (mostly) filled salt pond (Figure 5, #8). The salt pond was initially entirely filled (1971 aerial photography shows a completely filled pond), but protests by environmentalists pressured DCCA officials to visit the site. The developers were required to excavate a portion of the fill to retain a token amount of salt pond.

A series of articles printed in the *Virgin Islands Daily News* during September and October of 1985 details the chain of events leading to construction of the Cabrita Point condominium development. It was evident that legal title to the filled salt pond was not fully investigated at that time. A subsequent (1990) finding by the V.I. Attorney General's Office regarding ownership of the Red Hook salt pond could have been a model for the Cabrita salt pond, with ownership (as in the Red Hook case) deemed a public trust.

The Cabrita Point condominium development is in a flood zone, only a few feet above sea level and is certainly at risk of severe damage if a storm serge of more than a few feet is experienced at the east end of St. Thomas. Although the site was historically a salt pond/beach berm system, it is not included within the CBRS and therefore federal flood insurance should be available for structures there.

Building activity on Cabrita Point has not been aggressive because the planned community development scheme that was envisioned during the early 1970s is restrictive in the types and clustering of buildings and services allowed. The higher density condominium development is a tradeoff to the lower density duplexes built on the Point, because the entire point is zoned R-1.

The Government of the Virgin Islands should inventory all existing and historic salt ponds within the Territory and catalogue them according to current status and pending development pressure. The "land trust" doctrine as recently interpreted by the Attorney General's Office must be fully reviewed, and specific guidelines promulgated as to the legal status of individual salt ponds.

Additionally, the Virgin Islands Government should restrict the type and amount of building activity in flood-prone areas.

The upper portion of the south side of Benner Hill in the Vessup/Red Hook watershed is slated as the development area for the Abbey Hills 40 home subdivision and 144 unit condominium project (Figure 5, #29). Development roads have already been bulldozed along the ridge line, with spurs off both sides (south and north) of the ridge (Figure 5, #22).

This development activity will further stress the watershed by adding to runoff and siltation loading in Vessup Bay. However, the development's sewage system is scheduled to be connected to the existing sewage treatment plant at Vessup Bay. This collection system will reduce the potential for additional

groundwater contamination occurring from conventional septic leach systems used elsewhere in the basin, but direct impacts on the bay are dependant upon the performance of the Public Works-operated Vessup Bay wastewater treatment plant.

The Vessup Bay treatment plant is underloaded at present and should be able to handle the increased flow resultant from the new Abbey Hills housing development *provided* that the plant is well-maintained and continuously monitored. Effluent samples should be taken on a regular schedule and split, with splits analyzed at an independent water quality lab for verification.

Commercial

The proposed 1988 Virgin Islands Port Authority (VIPA) commercial/marina development project in the Red Hook salt pond encountered tremendous opposition from the general public, environmental groups and members of DPNR's Fish and Wildlife Division. The salt pond itself should not be altered from its present state (Figure 5, #13). If anything, solving the roadside parking problem along the salt pond, and allowing a slightly wider buffer of mangrove trees to grow there, is required.

Development of a new marine transportation facility near the existing Red Hook ferry dock and RO/RO ramp can be done with thoughtful planning which would not compromise the surviving natural system at the salt pond.

Several small businesses are located in the mangrove fringe along the north side of Vessup Bay (Figure 5, #15). For some of the businesses, there could be potential problems associated with sewage disposal (i.e., inadequate systems) and/or encroachment into the mangroves (cutting and filling for more work space). These shoreline sites should be regularly investigated for compliance with CZM regulations pertaining to structures in the wetlands.

Along the north side of Vessup Bay, the AYH marina expansion project destroyed several hundred feet of mangrove shoreline. There has been an attempt at reestablishing a fringing mangrove community between the boardwalk and the shoreline. Seedlings have been planted but 10 to 20 years might be required for the trees to grow to full stature.

AYH marina should attempt to transplant more and larger seedlings along the shoreline behind the boardwalk of the marina dock development.

Infrastructure Development

The Vessup Bay/Red Hook APC is the focus of major inter-island transportation activity. This convergence of activity has also led to an increase in residential and commercial development in the area. Paralleled with these activities has been the development of the DPW Vessup Bay sewage treatment plant (Figure 5, #4) and wastewater collection system and a Vitelco telephone nodal point (Figure 5, #24). Roads have been upgraded to handle heavier traffic flows, but parking problems continue to increase.

There has not been a decentralization of electrical power distribution in St. Thomas. Malfunctions at the WAPA generation facility in the Sub Base can affect the Red Hook feeder system causing power outages and power serges in the electrical distribution system of the APC. Most businesses and many private residences in the area have standby generators to supply power in the event of a failure within the WAPA system.

Centralization of utilities would facilitate development of Red Hook as a separate community. It should be relatively easy to connect any new and most existing residential and commercial developments with the sewage plant and telephone nodal point. This does leave the area vulnerable for infrastructure upset should a major localized catastrophic event happen but reduces the area's vulnerability to problems occurring at other locations on the island.

Hurricane Hugo upset electricity distribution on the entire island and left the APC's sewage treatment plant without a power source. The sewage plant was not capable of self-sustainment, as it should have been, and the area suffered from direct discharge of untreated waste into Vessup Bay.

A similar event could also upset telephone communications for the east end of the island, which could be detrimental to the safety of residents and to the welfare of area businesses - many of which, like charter businesses, are dependent upon telephone service for the majority of their activities and commerce.

3.2 Use Conflicts

Yachting and related activities have been responsible for the phenomenal growth of the area in recent years. Approximately 200 vessels are presently anchored or berthed in the harbor, vying for space and access to support services. There are several marinas, the largest being American Yacht Harbor Marina which has 102 wet slips. Other marinas are Vessup Bay Marina (36 slips), Per Dohm Marina (15 slips) and St. Thomas Sport Fishing Center (23 slips). Services provided by these marinas include storage and sale of diesel and gasoline fuels, water and electrical hook ups for vessels, and access to showers and other amenities. However, there are no marina waste holding tank pump-out facilities in the embayment. The only such facility on St. Thomas as of 1990 was at Compass Point Marina in Benner Bay (SPG, 1990). Most vessels must discharge their wastes directly into the water.

3.3 Adverse Impacts

3.3.1 Water Quality

U.S. Clean Water Act (sea) water standards specify that the bays and ocean waters of this APC must remain Class B -- "fishable/swimmable". Class B specifies the following quality criteria:

Dissolved oxygen: not less than 5.5 mg/l from other than natural conditions.
Bacteria: shall not exceed a geometric (log) mean of 70 fecal coliforms per 100 ml. by Milepore Filtration (MF) or Most Probable Number (MPN) count.
Color and turbidity: a secchi disc shall be visible at a minimum depth of one meter.

There are two DPNR water quality monitoring sites within the APC. One is located "near" Red Hook Dock (Station 22A) and the second in inner Vessup Bay "Near Small Dock" (Station 22B.) Data published in past Clean Water Act Sec. 305b Reports have shown that only infrequently Vessup Bay did not meet the class B standard.

These sample locations are monitored by DPNR's Division of Environmental Protection (DEP) on a three month sampling cycle. The sampling is frequently done from the dock or using waders, in shallow waters. The original mandate for marine water sampling called for samples to be taken 100 feet or more from the shoreline to reduce shoreline effect. However, without access to adequate boating equipment, it has proven difficult for departmental personnel to do this on a regular basis. Of the three bays within this APC, Vessup Bay is a shallow, relatively long, narrow, east-west oriented bay which normally receives an easterly wind. These factors in combination result in poor circulation and a poor flushing rate of the bay's waters.

Secondly, partly because of its location at the east end of St. Thomas and mostly because it is a fairly well-protected anchorage, Vessup Bay endures heavy boat use as a mooring/anchoring area and as a major marine transportation nodal point between St. Thomas and St. John.

Thirdly, the Vessup/Red Hook Bay watershed has witnessed a significant increase in both residential and commercial development during the past ten years. Accelerated building activity has exposed more of the easily erodible soil to the elements. The result is much more sediment in runoff waters during rainy periods with eventual deposition into the waters of the bay. Development activity has also increased nutrient loading to the ecosystem with greater septic loading (from single-home septic systems) to groundwaters and added volume to the sewage treatment plant at the head of Vessup Bay.

A study of Vessup Bay by Wernike and Towle (1983) showed that vessel waste contributed only 5% of the nutrient loading to the bay, while 95% came from a combination of a poorly-functioning sewage treatment plant and non-point source (NPS) terrestrial pollution and sedimentation. At that time, there were about 125 vessels using the bay. That number has increased to about 200 vessels, but building activity within the watershed has likely doubled since 1977, indicating that this percentage ratio probably is still valid.

3.3.2 Air Quality

Air pollution has not become a significant problem in the Virgin Islands. Instances of violations might result from point source discharges at the WAPA generating plants on St. Thomas and St. Croix, the industrial facilities of Hess Oil and Vialco on St. Croix, and from fires (deliberately set and from spontaneous combustion) at solid waste landfill sites on all three islands. Construction and brush fires are additional sources of air pollution in the Virgin Islands, but they are not common enough to cause prolonged air quality problems. Generally, with the prevailing winds from the east, there is little opportunity for the smoke and odors to linger in the area.

In the Vessup Bay/Red Hook APC, the main source of air pollution come from the ferry engines, buses and large trucks using the RO/RO ramp at Red Hook Salt Pond; odors from the sewage

treatment plant (particularly when it malfunctions); occasional fires at the St. John landfill site; and grinding dust and paint fumes during boat repair activities at various docks in the area and especially at the AYH boat ramp.

In most cases, air quality violations probably do not occur in the Vessup Bay/Red Hook APC. Instances of excess grinding dust is only experienced by immediate neighbors of the work area, and often the activities are short-lived and can be stopped by addressing the offending worker.

3.3.3 Noise Pollution

Noise pollution has become a significant problem in the Vessup Bay/Red Hook APC. Noise from the ferries, racing automobiles and motorcycles, boat horns, stereo systems in passing cars, etc. are all nuisances in the APC. But the dominant noise problem, as perceived by at least 12 area residents interviewed, arises from Sunday parties at Vessup Beach (on Muller Bay), and occasional outdoor live band performances at a shoreline cafe. Often, the problem is raised to offensive levels.

Abatement of unlawful levels and occurrences of noise must be pursued by law enforcement officials pursuant to 27 V.I.C. Chapter 11 SS 352. However, the amended version of this law has made it less specific with regard to noise, and all versions provide considerable room for subjectivity in determining when an offense has occurred. Offenders may find it possible to challenge the ambiguities of the statue.

An effort to amend the existing Virgin Islands noise laws with wording similar to that which has recently been adopted in Anguilla would be prudent. The Anguilla legislation is written such that if any noise is perceived as loud or offensive to someone, it is just that! Offenders are liable to a fine of up to $2000. Permits are required for special occasions that still allow beach parties and other events, but the events must be planned and the sound levels still must be kept within reason. A similarly worded regulation is urgently needed in the Virgin Islands to protect the rights of all residents and visitors.

3.3.4 Impacts to Biological Resources

Several wrecks remain in and around the mangroves near the head of Vessup Bay (see Figure 5, #30). These wrecks should also be removed because they pose a danger to children (and adults) who might play on or inside them; they might also become a source of debris during the next major storm and are hindering growth of new mangrove trees immediately around them. Also, there is a problem of liability in the case of personal injury resulting from activity on or around the wrecks. The wrecks, deemed abandoned, likely become the property of -- and hence the responsibility of -- the Virgin Islands Government.

The mangrove community rimming Vessup Bay receives heavy amounts of marine debris, because the prevailing winds drive the floatables into the western reaches of the bay. The mangrove prop roots are littered with plastics, aluminum cans, bottles, oil cans, wood, boat parts, and other debris.

4. MANAGEMENT RECOMMENDATIONS

4.2 Planning and Permitting

The existing parking facilities should be expanded slightly, and a parking fee should be incorporated with the ferry fee. "No Parking" signs should be erected and "No Parking" regulations enforced by towing. Several episodes of towaways will discourage continued parking along the side of this major highway.

The amount of fuel and oil from boat bilges and fuel tank overflow/air vents entering marina and coastal waters should be minimized. Practices to implement this goal include as a minimum:

1. use the best available technology (BAT) on air vents or tank stems of fuel tanks to prevent fuel from overflowing through tank air vents and spilling into coastal waters; and
2. place oil-absorbing materials in bilge areas of all boats with inboard engines; check these regularly and replace as necessary; recycle, if possible, or dispose of properly.

There are currently very few places for the public to dispose of waste oil in the Territory, and so it is often illegally disposed of on the land or in the sea (rather than kept in sealed containers as is the "official" interim guideline).

The Government should quickly approve the rule that will allow incineration of oil. Companies that supply and distribute petroleum products should then act without delay to establish facilities to receive waste oil from the public. The strictest enforcement actions and penalties should be instituted for persons caught illegally disposing of waste oil. such actions should be undertaken in concert with a public awareness program on the environmental effects of improperly disposed oil.

The Vessup Bay/Red Hook APC is currently comprised of at least seven (7) different zoning designations (Figures 17a-d). From Nazareth to Vessup Bay including Red Hook Point, areas within the APC are zoned R-2 (residential medium density), R-3 (residential medium density), B-4 (Business-Residential area), W-2 (waterfront commercial-industrial). From Vessup Bay to Cabrita Point, current zoning consists of W-1 (waterfront pleasure) and R-1 (residential low density). From Nazareth Bay to Deck Point, zoning consists solely of W-1 (waterfront-pleasure). From Deck Point north to Great Bay, areas within the APC are zoned W-1 (waterfront-pleasure), R-1 (residential low density), and R-3 (residential medium density). Great St. James and Little St. James are zoned R-1 (residential low density). Both Dog Island and Cocolus Rock, which are part of the APC, are zoned P (public). Permitted uses for these zones can be found in the V.I. Code, Title 29, Chapter 3, Section 228.

In the early 1980s, DPNR/CZMP prepared and adopted the Coastal Land and Water Use Plan (CLWUP), which designates all coastal areas of the Territory as one of ten (10) classifications. The CLWUP designations were, in some locations in the Territory, in conflict with the existing zoning designations.

For the Vessup Bay/Red Hook APC, however, the CLWUP basically supported the earlier zoning designations, and provided new refinement of allowable water uses.

Since the late 1980s, DPNR/Comprehensive Planning staff have worked to prepare a Comprehensive Land and Water Use Plan that will re-designate all land and water in the Territory as one of ten (10) new designations, known as "Intensity Districts". The purpose of the proposed Comprehensive Plan is to allow the territorial Government to begin providing public services and facilities concurrent with the demand for those services and facilities; that is, to ensure that the provision of public services and facilities occurs at the proper level and at the proper timing during the course of development. The overarching goal of the proposed Comprehensive Plan is tot ensure that the quality-of-life for island residents is maximized by guiding the location and type of future growth through the provision of public facilities. DPNR/Comprehensive Planning is currently working to finalize the proposed Comprehensive Plan, including preparation of final maps for public review.

The proposed Comprehensive Land and Water Use Plan classifies the water portion of the Vessup Bay/Red Hook APC as either Intensity District

Natural Hazards Mitigation

There is a need in the Territory for an effective coastal storm hazard mitigation policy and plan. The siting of facilities along the coast increases a cumulative threat potential with respect to three types of coastal storm impacts: (1) threats to public health, safety, and welfare; (2) costs to tax payers for disaster relief and protection; (3) losses of irreplaceable natural resources (Godschalk, et al., 1989). Compounding the potential for catastrophic losses due to coastal storms is the possibility of significant sea level rise (SLR) in the decades ahead.

While average SLR over the last century has been less than one-foot (10-15cm), an increase in that much or more (10-20cm) is projected by 2025, and of between 1.5 and 6.5 feet (50-200cm) by the year 2100. Using an average of 1 meter of shoreline erosion per cm of SLR, the resulting average by 2025 would be 33 to 66 feet (10-20 meters) [Godschalk, et al., 1989].

There are generally three strategies that may be adopted to mitigate coastal storm hazards and SLR impacts. First, the natural coastline can be "hardened" by using designed protective structures, such as bulkheads, revetments, gabions, etc.. Second, facilities and structures built in high hazard areas can also be hardened through the use of stricter building standards to achieve increased wind and/or flooding resistance. These strategies often require resorting to and preparing for evacuation of people during a storm event, with its incumbent risk to human life.

Third, and a better approach, coastal development can be redirected away from high hazard areas through the use of shoreline setback standards and/or re-zoning of high hazard areas to achieve simultaneous risk reduction and other objectives such as open space preservation or wildlife management. This so-called "development management" strategy, is generally the most cost-effective option. As with the use of stricter building codes, increased costs associated with the alteration of land use patterns to reduce the exposure of people and property to storm damage are generally offset by long-term savings (from less

damage) and reduced insurance rates. It is always (politically) easier to add a hazard mitigation section to an existing plan, regulation, or program than it is to adopt a totally new set of tools. In fact, there is no better time than today guidelines for decision-making during the next re-building effort.

A coastal storm hazard mitigation policy and regulations should be developed for the Territory, and for the Vessup Bay/Red Hook area on a site-specific basis. A "development management" alternative to hazard mitigation is recommended, and will require that implementing legislation be enacted soon in preparation for the next disaster. Direct future public and private developments away from high hazard areas. For existing development, consider policies and regulations that can be implemented now to minimize losses during the next storm. Finally, establish now (i.e., prior to its need) a plan to guide reconstruction following the next storm so that design and siting mistakes are not repeated.

Moreover, proposed developments within the designated Coastal Barrier Resources System should be required to pass a strict "public need" criteria test, and approved only if no alternative site for the same use can be found.

As seen above (section 2.3.2), earthquake potential in the Territory is high. Slopes on lands adjacent to the APC boundary are considerable, while a large part of coastal development in this APC sits on man-made fill.

Appropriate attention should be paid in the design of major facilities, especially those which will house large assemblies of people, so that threats from seismic activity are absolutely minimized.

Although the liquefaction potential of landfill solid has not been determined for any landfills in the Territory, logic suggests that certain compaction standards be adhered to and a certified engineer's report required for all major facilities.

Within the APC watershed, seismic hazards should be incorporated into subdivision regulations, with strict controls on development in high hazard areas.

Flooding mitigation will be an ongoing concern for new developments in many locations in the APC and its watersheds. As mentioned above (section 2.3.3), A-Zone floodplains exist throughout the area.

Strict adherence to National Flood Insurance Program (NFIP) policies and regulations is recommended, and new developments prohibited where the hydrology and flooding potential of an area may adversely affect important wildlife habitat or other natural features. Channelization for flood flood control should be avoided wherever possible, and new developments directed away from floodplain hazard areas. Cumulative impacts from the increased use of non-porous surface materials should be assessed, and guidelines established for the use of "grassphalt" and other porous surface materials on access roads, parking lots, and other suitable areas.

In addition to the above efforts for flood mitigation, a stormwater management plan should be developed and adopted for the APC and its watersheds. Regular maintenance of drainage systems, and an assessment of proper culvert sizing should be given priority (see also nonpoint source controls below).

Water

One of the most significant coastal water quality concerns in the APC is that chronic turbidity due to propellor wash of bottom sediments and stormwater runoff. Recommendations for stormwater runoff are given below, but in the case of propellor wash, mitigation strategies are limited. Given that much of the marine benthic environment in Vessup Bay/Red Hook is already degraded and that the area is highly dependent on its marine transportation network, perhaps this is a classical trade-off. Where warranted, however, small-scale, site-specific mitigation of sedimentation effects can be accomplished through the use of siltation curtains, wiers, cascaded settling ponds, and improved dredging practices. Such devices should be routinely used on dredge and fill operations. Dredging can result in resuspension of fines and contaminant-laden sediments, with significant adverse impacts on coral reefs, seagrass beds, and other benthic communities. However, routine maintenance dredging (utilizing siltation curtains) at key locations in the APC could serve to maintain sufficient depths to minimize turbidity effects from propellor wash.

Coastal water quality is adversely affected by oil spills and the potential for a major oil spill is relatively high for the Vessup Bay/Red Hook area. Oil spill contingency plans are under preparation by both the V.I. Government (DPNR/DEP) and the U.S. Coast Guard. The DPNR/DEP currently awaits USEPA approval on a draft oil spill contingency plan. As for the USCG plan which will be developed in coordination with the relevant federal and local agencies, it will be a revision of an earlier plan (Oil and Hazardous Materials Response Plan for Puerto Rico and the U.S. Virgin Islands), and has a July 1993 scheduled completion date as stipulated under the Oil Pollution Act (OPA) of 1990 and its regulations.

Under the new OPA regulations, vessels and facilities that handle any kind of oil are required to demonstrate that response capability exists. Personnel training, equipment, and exercise drills are required components. As such, the private sector is in large part joining forces to support the development of "cooperatives" that will provide the required "on-call" oil spill response capability. One of these cooperatives, the Marine Spill Response Corporation (MSRC) will have facilities, including a 210' vessel, at the Hess Oil Corporation Refinery on St. Croix.

Government facilities (including the WAPA power plant at Krum Bay) must in the near future also meet the requirement to develop a site-specific oil and hazardous material spill response plan. Thus, it may be prudent for Government to investigate the development, in conjunction with the relevant private sector entities, of something like an oil spill cooperative for the Vessup Bay/Red Hook area.

Marina fueling and boat repair services in the APC must be designed, maintained, and operated to reduce the risk of accidental spill and to facilitate clean-up in the event of a spill. Design practices include as a minimum.

1. design boat hull maintenance areas to minimize contaminant-laden runoff;
2. locate and design fueling station and maintenance areas so that spills can be contained in a limited area;
3. implement source control practices such as vacuuming impervious areas; use of tarpaulins to collect paint chips, sandings, and paint drippings; and use of sanders with vacuum attachments to collect hull paint sandings;

4. design spill contingency plan; and
5. design areas to include appropriate spill containment equipment.

Liquid materials (i.e. oil, solvents, antifreeze, paints, etc.) should be prevented from entering coastal waters within the APC. Also, appropriate storage, transfer, containment, and disposal facilities should be provided and maintained, and recycling of liquid materials (especially oil) should be encouraged. Possible practices to implement these goals include as a minimum:

1. build curbs, berms, or other spill containment barriers around areas used for liquid material storage. Store liquid materials in areas that are impervious to those materials;
2. separate containers for disposal of waste oil, waste gasoline, used antifreeze, and oil-contaminated water; diesel, kerosene, and mineral spirits containers should be clearly labeled;
3. marina patrons and employees should be directed as to proper disposal methods for these materials through signs, mailings, training, etc.

The amount of fuel and oil from boat bilges and fuel tank air vents entering marina and coastal waters should be minimized. Practices to implement this goal include as a minimum:

1. use the best available technology (BAT) on air vents or tank stems of fuel tanks to prevent fuel from overflowing through tank air vents and spilling into coastal waters; and
2. place oil-absorbing materials in blige areas of all boats with inboard engines; check these once a year and replace as necessary; recycle, if possible, or dispose of properly.

Additional management measures for the control of pollution associated with marinas may be found in the (draft) 1993 Nonpoint Source Management Measures, co-produced by the USEPA and NOAA (available at DPNR/CZMP).

Nonpoint source pollution is a significant contributor to the overall degradation of nearshore environments in the U.S. Virgin Islands (Tetra Tech, 1991b). Although the islands have no perennial streams or rivers, episodic events of intense rainfall deliver pulses of fresh water laden with sediments, nutrients, organic matter, and potentially toxic chemicals to nearshore receiving waters. Control of nonpoint source pollution may have significant positive effects on pristine and otherwise valuable marine habitat. DPNR/CZMP has recently (1992) initiated a nonpoint source pollution control program.

The following list of recommendations for nonpoint source discharge control is adapted from Tetra Tech, Inc. (1991b):

1. separate storm and sanitary sewers;
2. collect and treat Combined Sewer Overflows (CSOs), using infiltration trenches/basins or chemical or filtration treatment systems;
3. regulate land use practices and behaviors that contaminate stormwater (e.g., waste oil disposal, establishment of green or infiltration areas on a portion of developed property, establishment of impervious surface limits);
4. impose routine inspection and management requirements for on-site (septic tank) wastewater systems;

5. develop treatment options for stormwater (e.g., detention basins, grassy swales, vegetation buffers, artificial wetlands);
6. implement source control practices such as street sweeping;
7. implement soil conservation measures on all construction projects (e.g., vegetation buffer zones, retention basins, silt-curtains, diversion ditches, etc.); and
8. establish performance standards to reduce the total area of non-porous surface materials used on access roads, driveways, and parking areas; encourage the use of permeable materials such as "grassphalt", gravel, or appropriate vegetation.

A well-designed and targeted Water Quality Monitoring (WQM) program is essential if territorial Water Quality Standards are to be met, and if specific management actions are to be undertaken in response to degraded water quality. Although DPNR has been monitoring water quality for over fifteen years, the data collected is largely not used to make management decisions. This is in part due to the lack of an Action Plan in the event that violations of Water Quality Standards occur (USVI Govt/DPNR, 1989).

Moreover, routine monitoring of the living (biological) resources in the Territory's coastal waters is not performed (e.g., submerged aquatic vegetation, benthic invertebrate communities, corals, mangroves, etc.) [USVI Govt/DPNR, 1992b]. Biological monitoring can provide valuable information on the health of the environment, and should be incorporated into an improved WQM program with adequate funding and achievable goals for targeted areas.

In the last quarter of 1992, DPNR/DEP curtailed WQM on St. Thomas and St. John due to a lack of funds for laboratory analysis and due to a lack of vessel in operable condition. The Division has only one vehicle.

There is a critical need for a better funded and goal-oriented Water Quality Monitoring program, with priorities assessed by a public/private sector or interagency task force. A strong water quality monitoring program is of fundamental importance and the advantages of privatization of this function should be assessed.

For several years, the Government has recognized that growing (and cumulative) problem of vessel waste discharges to the marine environment. With stimulus and funding from the USEPA, a Vessel Waste Control Plan (Wernicke and Towle, 1983) was prepared for the then Department Conservation and Cultural Affairs. The Plan's three principal recommendations are excerpted here in their entirety, as they remain valid and significant recommendations today, a decade later.

1. The first step, and the most important, is a clarification of goals. It is impossible to return the coastal embayments (now vessel anchorages and marina sites, etc.) to their original pristine environmental or ecological condition, and it is equally impossible to environmental risks or even pollutant inputs to zero. Stating (or pursuing) unrealistic goals is counter-productive. It encourages both a crisis orientation (short-term fixes to long-term problems) and, worse still, confrontations -- since environmentalists want the whole protective strategy now and Virgin Island users (residential, commercial, industrial) see no point in taking costly steps toward an unreachable goal.

What does the Virgin Islands want to do to preserve, to maintain, to develop, to have for an environment? How much are we willing to give up to enhance environmental quality? Some survey data suggests that the majority of the public supports environmental goals, but not at the cost of a large reduction in living standards or at the cost of significant changes in life styles or traditional, culturally conditioned practices. The public (and this includes both the resource users and the non-users) needs to be better informed about what would be gained by each initiative to protect coastal water quality and what it would cost -- in dollars and in life style adjustments.

2. A second step requires the improvement of the scientific basis of DCCA (now DPNR), the Virgin Islands Port Authority, the Department of Public Works, and other V.I. agencies making decisions regarding uses of the environmental resource base -- involving natural systems which functioned well until intruded upon by the development process and which have limits and carrying capacities of their own, some of which represent resource planning and management uncertainties.

   Agencies can, with scientific help, quantify risks. But the scientific basis of agency decisions can be improved without significant increases in costs or delays. Most important, of all, the decision making process is rendered more realistic and defensible.

3. The third step involves improved implementation and enforcement of environmental protection strategies. There are limits, however, to DCCA's (DPNR's) monitoring and enforcement responsibilities regarding existing standards for water quality and other environmental indicators. These responsibilities are hampered by personnel limitations, logistic costs, and jurisdictional constraints. Perhaps an alternative exists, even if partial, that would involve the corporate (and government agency) user conscience -- plus the threats of adverse publicity and lawsuits -- to promote and develop widespread compliance with suggested "voluntary" standards. Further, substituting economic incentives, such as sewage waste discharge tax on vessel discharges or on unacceptable MSDs (Marine Sanitation Devices) -- in certain designated anchorages -- could improve targeted vessel waste enforcement, lower its costs, and generate revenue to pay for the "enforcement" activity.

With respect to the foregoing and as a starting point, there is a need to examine Government's own role, both as contributor and regulator, in the marine sewage discharge problem. Moreover, the problem should be seen as the Territory-wide issue that it is. Priority issues need to be identified based on current information (which suggests a targeted update of the 1983 study), and involving the boating industry in true partnership fashion to achieve a specific work plan. The many commercial ferry boats which transport large numbers of passengers on a daily basis should be part of the development of a vessel waste control action plan. In other words, the solution is not so simple as to require that visiting yachts and the marinas which service them be the first and only component of the boating industry to comply with MSD requirements and/or the provision of shoreside pump-out facilities. Government should lead by setting example on this growing and fundamental problem.

Industrial Wastewater

Industrial wastewater discharges may also affect marine biological communities through the discharge of toxic or sub-lethal concentrations of organic chemicals and heavy metals. Sub-lethal effects of industrial

wastes are not well understood, but mitigation measures should focus on source reduction wherever possible. Efforts should be made to promote changes in industrial processes and encourage recycling of industrial wastes wherever possible.

Thermal effluents from power plants and other industrial processes, can result in adverse impacts to biological communities, both through temperature intolerance and the use of chemicals used to reduce biofouling of cooling systems. Thus, every energy conservation effort to reduce demands on public power plants will pay dividends for the coastal environment. In addition, thermal effluents should be adequately cooled, and chemicals that are used to reduce biofouling evaluated for their possible toxic or sub-lethal effects on the marine environment.

Impacts from the operation of desalination plants result from the discharge of warm hypersaline brine and associated chemicals used to reduce biofouling in the cooling systems. The type of desalination process used, the volume of water undergoing treatment, and the location of discharge outfalls determine the type of severity of environmental impact. As with effluents from power plants, a reduction (through conservation measures) in the volume of water undergoing treatment may in the long-term pay dividends for the protection of distinctive or valuable marine habitat. At the very least, hypersaline effluents should be adequately diluted with freshwater seawater and cooled prior to discharge (Tetra Tech, 1991b).

Solid Waste Management

The international Marine Pollution (MARPOL) treaty requires that member governments provide at least the potential to receive vessel wastes, in accordance with applicable regulations. The Animal And Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture is the Federal agency responsible for regulating receipt of foreign-sourced solid wastes entering the Territory. Thus, certain food products purchased in the British Virgin Islands, for example, if brought back into the USVI aboard yacht, are classified as foreign-sourced wastes, and are subject to USDA inspection and regulation. The USCG works in concert with the USDA to implement MARPOL regulations, and has required the V.I. Government to provide refrigerated containers to receive foreign-sourced solid wastes; these wastes must be shipped to Puerto Rico for processing since the approved processing equipment does not exist in the USVI.

The above requirements will be difficult to meet on a recurrent budgetary basis, and the V.I. Government should explore the possibility of contracting with a private firm to provide such service in accordance with regulations when and if it is needed. The V.I. Government could then demonstrate to the USCG that it has secured the necessary arrangements to provide such service when needed. All expenses should be passed on to the vessel operator who has imported foreign-sourced wastes. Fortunately, most new (large) vessels are now self-contained with respect to liquid and solid wastes, and so the cruise ship industry should generally not require such service in the USVI.

As for municipal solid waste, businesses in the Vessup Bay/Red Hook area are required to make their own arrangements to dispose of solid waste, either at the Bovoni landfill themselves or through a contracted service. While it is illegal to dump anything but "litter" into the DPW-provided litter receptacles placed

throughout the downtown area (Act 4176, Title 19), commercial solid waste is often dumped in these receptacles nonetheless (pers. comm., G. Patrick, DPW).

Obviously, if the larger problem of inadequate or inconvenient solid waste collection is not resolved, incidental trash will end up as marine debris as it is eventually blown or washed into VessupBay/ Red Hook area.

Likewise, Government needs to examine its own role, as contributor and regulator, with respect to a derelict vessel ordinance. Specifically, DPNR/CZMP should set an example of its resolve to clean up the Territory's shores, by requiring the responsible parties or Department to clean up Vessup Bay/Red Hook and the too-numerous-to-count derelict vessels, abandoned vehicles, discarded machinery parts, steel drums, and dilapidated structures in that area.

Air

There is little likelihood of serious air pollution problems within the APC. Garbage dump fires and construction site or brush fires are the most probable causes for air pollution infractions.

In cases where an infraction occurs, parties responsible for the source of the pollutants are to address and remedy the situation and be fined in accordance with the Clean Air Act.

Noise

Preparers of future environmental assessment reports should be required to assess cumulative noise impacts as they may affect particular target communities within an identifiable radius (or down wind corridor) of the proposed development. The development of a Noise Ordinance for at least portions of the APC may be warranted, but should be driven by the community's felt need for such regulation and Government's ability to effect enforcement.

Biological Resources

Cultural Resources

The Government should work to identify the most significant cultural resources worthy of protection within and adjacent to the APC, and establish a priority acquisition list for possible future acquisition. An alternative to acquisition is the encouragement of private sector cooperation in conservation measures, stimulated by the appropriate incentive mechanisms offered by Government.

In this regard, there are several non-governmental organizations on St. Thomas that would be ideal targets for Government effort to create private/public partnerships for ongoing cultural resource preservation projects. These are the St. Thomas Historic Trust, the Virgin Islands History Society, and Friends of Denmark, and for historic buildings, the local chapter of the American Institute of Architects. As has occurred elsewhere, particularly in the United States, groups such as these could conceivably be the loci to organize direct community assistance programs for a more proactive strategy of cultural resource conservation. For example, one group might concern itself with salvaging and recycling (historic)

construction materials and fittings, to be used elsewhere on renovation or new construction projects. Another group might organize to provide direct labor and/or funding assistance to low-income owners of historic buildings who otherwise are unable to undertake the proper maintenance of the structure. With the longer view in mind, community action will be needed if the Historic District and its adjacent environs are
to be kept with historic character intact.

4.3 Legislative Change

Although there are many good laws and regulations on the books which speak to the many resource management issues, enforcement is either lacking or only selectively applied. The DPNR/Division of Environmental Enforcement is called upon to undertake a wide range of enforcement issues, including enforcement of all the Fish and Wildlife regulations, water quality standards, and Coastal Zone Management regulations. Although the enforcement officers are well trained, there needs to be more definition of specific enforcement activities expected of the Division.

There is no V.I. law regarding the use of jet skis. Although they are considered to be motor vessels, there are no standards (noise, speed, etc.) by which they operate, and no provisions in the law to consider the needs and safety of other water users, including swimmers and various aquatic or wildlife species. The DPNR should move to close this legal loophole and identify specific, enforceable standards for operating jet skis and other similar pleasure motor craft in the Territory.

Finally, legislative action is needed to pass the Cultural, Historic, Architectural, and Archaeological Preservation (CHAAP) Act, which is scheduled to be submitted to the Legislature during 1993. The CHAAP Act was conceived 4-5 years ago by two Senate members wanting to improve on the existing historic preservation institutional arrangements, and to include antiquities protection. Three versions of the Bill were subsequently produced and, as directed by the Legislature, these have finally been brought together in a compromise Bill now ready to submit. The CHAAP Act will ostensibly bring greater clarification to the question of overlapping jurisdictions on historic protection matters, and will generally strengthen the overall authority and mandate of the Historic Preservation Commission (HPC). While such development is good, lawmakers should not lose sight of the long-term institutional and legal framework needed to bring about a comprehensive, coordinated, streamlined permitting system.

In this regard, the Division of Coastal Zone Management is working to produce legislation that will abolish the two-tier system of permitting, and require the CZM permits be obtained for developments anywhere in the Territory. This change is overdue, and should be pursued expeditiously by planners and lawmakers alike. Aside from the intent and purpose of the Federal Coastal Zone Management Act, established in 1972, that small islands be managed as an integral, complete ecosystem, a single tier system only makes ecological sense given the fact that all watersheds on small islands are closely linked with coastal waters.

The point, however, for this discussion, is that passage of the CHAAP Act should proceed, but with the recognition that future jurisdictional changes to the permitting system are likely, and that regardless of such changes, there is a need to improve upon the coordinated review of development proposals. Such

is the intended function of the CZMP and the funds provided to it under the Coastal Zone Management Act. A comprehensive, coordinated (or "networked") permitting system would thus involve the technical input, review, and conditional approvals from several different authorities (including, for example, the Historic Preservation Commission), but the ultimate approval or denial for a given development should rest with the Coastal Zone Management Commission as the permitting authority for all land use developments.

To be more specific, the Historic Preservation Commission should continue to manage the Historic District and any other historic resources under its authority, and to develop mitigation measures and specific permit conditions that relate to the protection of historic resources. The Commission would be essentially powerless to override the concerns and particular conditions of the HPC (with respect to historic resources protection), but would have the authority to deny a proposal in the event that it did not conform to accepted land use designations (zoning) and/or performance standards. Clarification between Commissions should be made, if necessary, to ensure that the CZM Commission retains its authority and mandate to consider all environmental (natural and human) impacts of a proposed development.

4.4 Institutional Development

A shortcoming in Government's ability to adequately enforce existing environmental regulations is the lack of sufficient numbers of trained staff to carry out effective monitoring and enforcement. DPNR/DEP (St. Thomas) would perhaps benefit by addressing this situation from an organizational development perspective, looking closely at needed staffing levels and budgetary support to accomplish the Division's goals. DPNR/DEP may want to consider utilizing a portion of the $150,000 currently in the Coastal Protection Fund (as of January 1993) to make needed maintenance expenditures to ensure adequate vehicle and vessel support for its monitoring and enforcement programs.

But the use of special funds alone is not a sufficient force to turn around the present lack of enforcement or, more importantly, the community's own involvement in "voluntary compliance" and self-management. Government must recognize that environmental enforcement is a growing (not a shrinking) budgetary item. New regulations are coming online, the population is growing, and environmental degradation is increasing to critical levels on certain issues. Government must be in a position to keep abreast of such developments. Office and field equipment must be properly maintained, and an ongoing training program instituted for all levels of management and staff.

There is also room for increased private/public sector collaboration on several resource management issues. One area that requires considerable institutional development is that of historic preservation. Successful management of the Vessup Bay/Red Hook District, will come about quicker and with more lasting results if the local community is drawn into the process in a way that promotes self-responsibility and accountability by the various user groups. Government should call upon the non-governmental community (the various associations, churches, and other commercial and philanthropic organizations) to address certain specific components of the overall management framework, and even to finance certain elements that will have obvious payback benefits to the community. Government's best tool in such a strategy is the quid-pro-quo offer of incentives, and to participate as a partner, rather than as big-brother, in the betterment of the local community.

The same type of strategy could be applied to the establishment and operation of neighborhood collection centers for toxic and hazardous wastes, including waste oil, and/or for recycling of household solid wastes. In short, community involvement is essential if the fast growing burdens and challenges of growth and waste management are to be effectively met.

A good example of such public/private collaboration is currently underway between the V.I. Government and the V.I. Community Foundation, a non-profit organization that is administering private sector donations to assist a federally funded project to improve sidewalks and landscaping along a row of businesses facing the waterfront. Such a community effort should be encouraged for the Vessup Bay/Red Hook area public/private partnerships are the way of the future, and the federal government, especially the USEPA, is actively encouraging such creative efforts to develop local capacity for self-management on a number of resource issues.

5. CONCLUSION

The Vessup Bay/East End APC is a rapidly growing area. Vessup and Red Hook Bays are the major transportation nodal point and supply link to St. John. The bays play a major role in the marine recreation industry for St. Thomas and the Virgin Islands. Numerous hotel/condominiums and hotels play an important role in the Virgin Islands tourist industry. Private residences are scattered throughout the APC. The off-shore islands and cays are largely in their natural state and provide an important refuge for the native flora and fauna. The APC is rich in marine habitats with numerous salt ponds, extensive mangroves, seagrass and algal beds and coral reefs throughout the APC.

REFERENCES CITED

Alexander, J., Sr., May, 1981. Virgin Islands park system (Draft), Department of Conservation and Cultural Affairs.

Aley, J., et al., February 20, 1989. Natural and cultural resources in the United States Virgin Islands -- research, education and management needs with special reference to St. Thomas, U.S.V.I. and case studies of Estate Botany Bay. Yale School of Forestry and Environmental Studies, New Haven.

Anderson, J.R.., et al., 1976. A land use and land cover classification system for use with remote sensor data. U.S. Geological Survey, Professional Paper 964.

Banus, M., Grigg, D., and Olsen, D., 1977. Biological and physical assessment of the municipal ocean outfall at Manning Bay, St. Croix. Government of the U.S. Virgin Islands, Department of Conservation and Cultural Affairs, Division of Natural Resources Management.

Barry, D. and Boulon, R., et al., July 1987. Cas Cay wildlife sanctuary.

Curtis, R.E., Aquino, Z., Diaz, P.L. and Vachier, R.J., 1990. Water resources data, Puerto Rico and the U.S. Virgin Islands, U. S. Geological Survey water - data report PR-90-1, 514 pp.

DeGraft, Joan, 1989. SNA resource protection and management issues pre- and post-hurricane Hugo. DPNR.

Donnelly, T.W., 1966. Geology of St. Thomas and St. John, Virgin Islands. In: Hess, H.H., ed.,Caribbean geological studies. Geological Society of America memoir no. 98, pp. 85-176.

Federal Emergency Management Agency, Revised March 18, 1987. National flood insurance program, flood insurance rate map, U.S. Virgin Islands, Community-Panel Number 780000 0010 D and 7800000015 D.

Government of the United States, 1972. Coastal Zone Management Act of 1972, PL 92-583, October 27, 1972. Bureau of National Affairs, Inc., Washington, D.C.

Government of the Virgin Islands, 1971. Open Shorelines Act, No. 3063.

Government of the Virgin Islands, 1979. Proposed rules and regulations for the Virgin Islands (Chapter 21) Coastal Zone Management Program. St. Thomas.

Government of the Virgin Islands, March 18, 1991. Rules and regulations for the Virgin Islands (Title 12, Chapter 21), Coastal Zone Management.

Government of the Virgin Islands, n.d. Federal Coastal Zone Management Regulations.

Government of the Virgin Islands, n.d. Guidelines for the development of a long range comprehensive plan for the United States Virgin Islands.

Grigg, D., Crean, R., and vanEepoel, R., 1971. Marine environment of Brewers Bay, St. Thomas, V.I., with a summary of recent changes. Government of the Virgin Islands, Department of Health, Division of Environmental Health.

Grigg, D., and vanEepoel, R., 1972. Water pollution report no. 19, status report on bays of St. Thomas and St. John, Virgin Islands. Government of the Virgin Islands, Department of Health, Division of Environmental Health.

Grigg, D., et al., June 1978. Environmental assessment report: channel dredging and docking improvements, Cruz Bay, St. John, Prepared for the Virgin Islands Port Authority. Insular Environments, Inc., 1975. Environmental reconnaissance Surveys of Selected Bays. Government of the Virgin Islands of the United States, Department of Conservation and Cultural Affairs, Division of Natural Resources Management.

McCrain, J., 1981. Status report and management recommendations for the Vessup/Muller/ Red Hook Bay complex area of particular concern (APC). Division of Coastal Zone Management, Department of Conservation and Cultural Affairs, Government of the Virgin Islands.

McKinzie, W., Scott, B., and Rivera, L., 1965. Soils and their interpretations for various uses. Soil Conservation Service, U.S. Department of Agriculture, Virgin Islands Government, St. Croix, Virgin Islands.

Nichols, M., et al., April 1979. Virgin Islands bays: modeling of water quality and pollution susceptibility, technical report 3.

Rogers, C., et al, 1984. Comprehensive report on ambient water quality monitoring, St. Croix, St Thomas, and St. John, 1973-1983.

Schouten, F., July 27, 1991. "CZM Commission selects 18 areas for special care" (about the 18 APC's). In: Virgin Islands Daily News.

Strategic Planning Group, Inc. (SPG), 1990. United States Virgin Islands comprehensive land and water use plan.

Teytaud, A., May, 1981. A Virgin Islands land use/land cover classification system. Division of Coastal Zone Management, DPNR.

Teytaud, A., March 18, 1989. Suggested methods for SNA field evaluation and priority ranking. Virgin Islands Conservation Society, Inc.

Teytaud, A., n.d. A framework for environmental planning and management in the Virgin Islands coastal zone.

Tyson, G., October 17, 1985. Guest editorial. In: Virgin Islands Daily News.

U.S. Department of Commerce, 1976. Coastal recreation: a handbook for planners and managers. NOAA, OCZM, Washington, D.C.

U.S. Department of Commerce, 1979. The Virgin Islands coastal management program and final environmental impact statement. Chapter Six, "Areas of Particular Concern". NOAA.

U.S. Department of Commerce, 1980. Improving your waterfront: a practical guide. NOAA, Washington, D.C.

U.S. Department of Commerce, April, 1981. The St. Thomas national marine sanctuary and draft environmental impact statement. NOAA, Office of Coastal Zone Management.

U.S. Department of Commerce, 1988. Coastal management: solutions to our nation's coastal problems. Technical assistance bulletin no. 101. NOAA, OCRM.

U.S. Department of Commerce, April 1990. Coastal management solutions to nonpoint source water pollution. NOAA, National Ocean Service, Office of Ocean and Coastal Resource Management.

U.S. Department of Interior, National Park Service, 1960. Park and recreational area plan -- Virgin Islands, a report on the recreational resources.

U.S. Environmental Protection Agency, May 1988. EPA Region II final environmental impact statement, Cruz Bay wastewater facilities plan, St. John, U.S. Virgin Islands.

U.S. Environmental Protection Agency, 1990. EPA Region II Caribbean distinctive habitats module.

U.S. Environmental Protection Agency, April, 1990. Coastal management solutions to nonpoint source water pollution.

U.S. Dept of Commerce Technical Assistance, bulletin # 102.

U.S. Environmental Protection Agency, May, 1991. Proposed guidance specifying management measures for sources of nonpoint pollution in coastal waters.

Virgin Islands Coastal Zone Management Program Staff, 1991. Areas of particular concern (descriptions, July 18). Department of Planning and Natural Resources.

Virgin Islands Department of Conservation and Cultural Affairs, 1975. Report on water quality, Virgin Islands United States of America, 1970-1975. See especially Appendix D, "Water quality standards for coastal waters of the Virgin Islands."

Virgin Islands Department of Conservation and Cultural Affairs, 1981. Appendix 1: Vessup Bay, Red Hook Bay APC.

Virgin Islands Department of Conservation and Cultural Affairs, 1982. A report on the environmental quality and documented physical and biological conditions of bays to be included in the proposed coastal water use policies. Office of Natural Resources Management, DCCA.

Virgin Islands Department of Conservation and Cultural Affairs, n.d. Preliminary recommendations for the water and shoreline use plan.

Virgin Islands Department of Conservation and Cultural Affairs, Coastal Zone Management Program, 1984. Handbook for homebuilders and developers.

Virgin Islands Department of Conversation and Cultural Affairs, Division of Coastal Zone Management, May 1981. A Virgin Islands land use/land cover classification system (based on the U.S. Geological Survey and state of Florida classification systems).

Virgin Islands Department of Conservation and Cultural Affairs, Division of Natural Resources Management, 1975.
Environmental reconnaissance surveys of selected bays.
Government of the Virgin Islands of the United States.

Virgin Islands Department of Conservation and Cultural Affairs, Division of Natural Resources Management, May 1986. Water quality assessment report 305(b).

Virgin Islands Department of Planning and Natural Resources, Division of Environmental Protection, March 1988. Water quality assessment report 305(b).

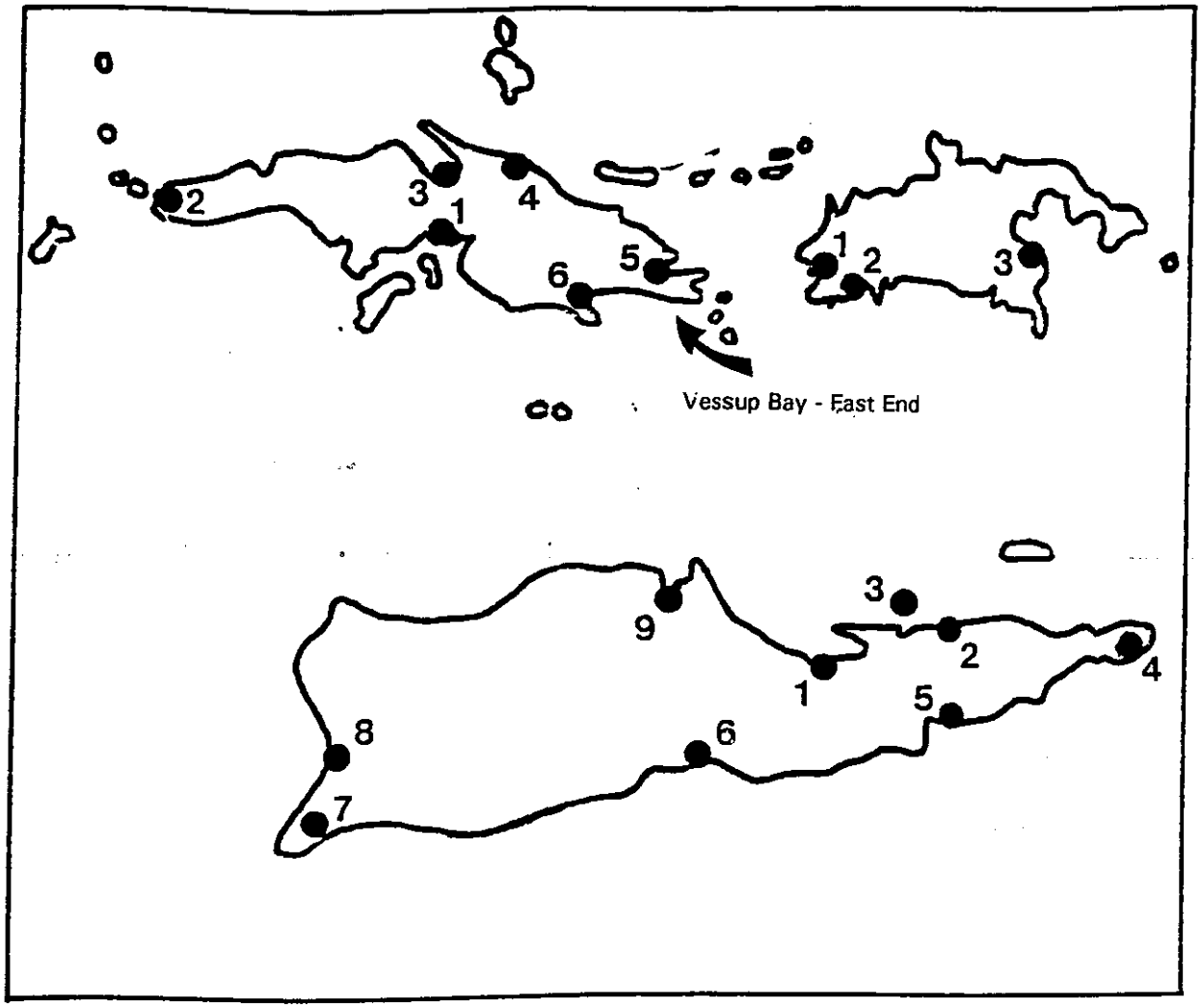
Virgin Islands Department of Planning and Natural Resources, Division of Environmental Protection, June 1990. Water quality assessment report 305(b).

Virgin Islands Planning Office, Coastal Zone Management Program, 1977. Marine environments of the Virgin Islands, technical supplement no. 1. Prepared by Island Resources Foundation, St. Thomas, V.I.

Virgin Islands Soil and Water Conservation District, 1971. Environmental protection handbook, a guide to assist in the implementation of the Environmental Protection Act of the United States Virgin Islands.

Wernike, W. and Towle, E., 1983. Vessel waste control plan for the U.S. Virgin Islands.

AREAS OF PARTICULAR CONCERN



AREAS OF PARTICULAR CONCERN

St. Thomas

1) St. Thomas Harbor and Waterfront
2) Botany Bay (APR)
3) Magens Bay and Watershed
4) Mandahl Bay (APR)
5) Vessup Bay - East End
6) Mangrove Lagoon - Benner Bay (APR)

St. John

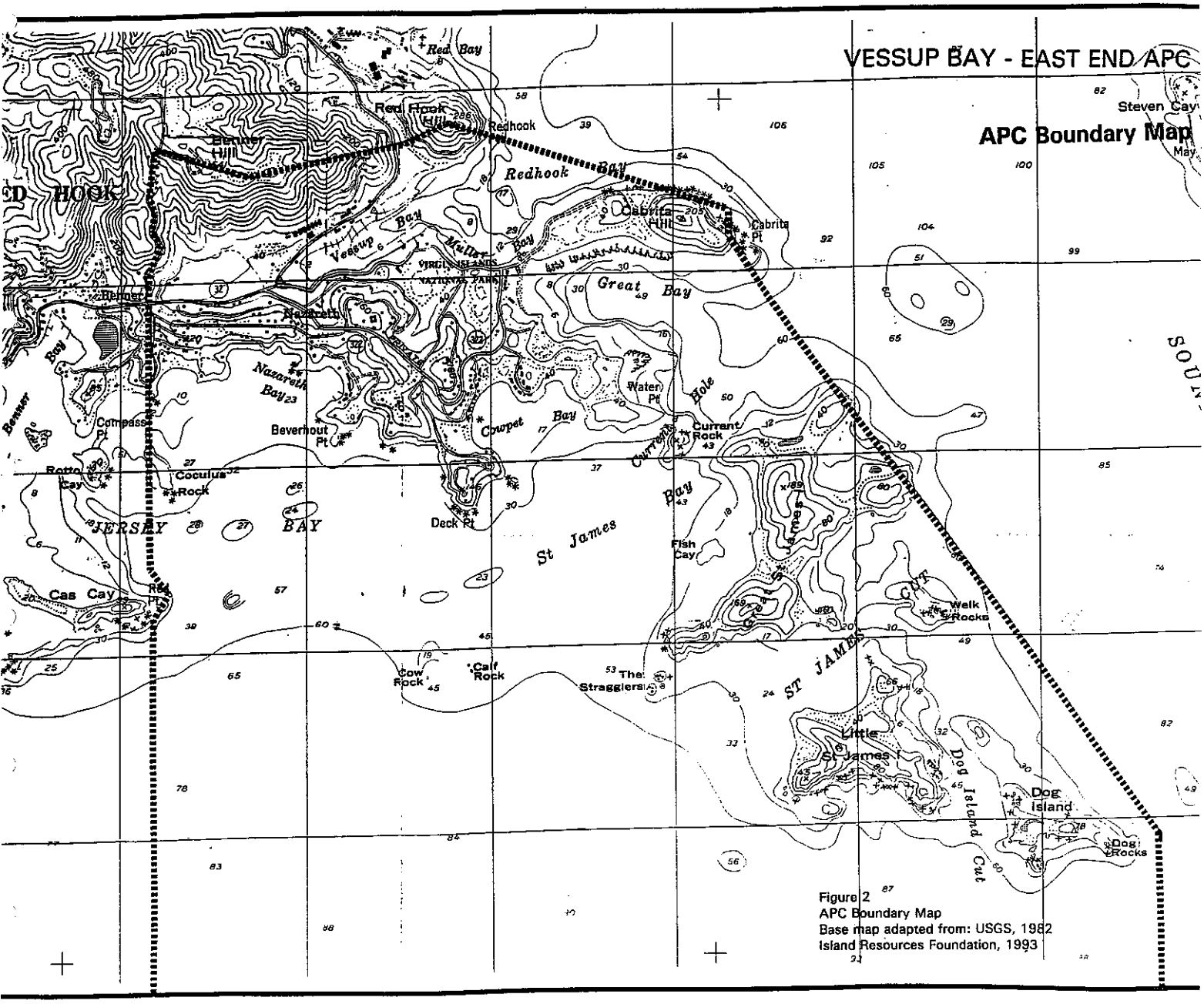
1) Enighed Pond - Cruz Bay
2) Chocolate Hole - Great Cruz Bay (APR)
3) Coral Bay (APR)

St. Croix

1) Christiansted Waterfront
2) Southgate Pond - Chenay Bay (APR)
3) St. Croix Coral Reef System (APR)
4) East End (APR)
5) Great Pond and Great Pond Bay (APR)
6) Southshore Industrial Area
7) Sandy Point
8) Frederiksted Waterfront
9) Salt River Bay and Watershed (APR)

Figure 1
Regional APC Map
Adapted from: USDOC, 1979

N


VESSUP BAY - EAST END APC
APC Boundary Map
Red Bay
Red Hook Hill
Redhook
Benner Hill
Redhook Bay
Cabrita Hill
Cabrita Pt
Vessup Bay
Great Bay
Nazareth
Nazareth Bay
Water Pt
Hole
Current Rock
Compass Pt
Beverhout Pt
Cowpet Bay
Rotto Cay
Coculus Rock
JERSEY BAY
Deck Pt
St James
Fish Cay
Cas Cay
Cow Rock
Calf Rock
The Stragglers
Walk Rocks
ST JAMES
Little St James
Dog Island Cut
Dog Island
Dog Rocks
Steven Cay
Figure 2
APC Boundary Map
Base map adapted from: USGS, 1982
Island Resources Foundation, 1993

VESSUP/RED HOOK APC

USE CONFLICT MAP (RF Dec/91)

1. Parking along roadside (along shore of Salt Pond); 30 - 60 cars per week day, + 70 cars on holidays.
2. Lack of sidewalk - pedestrian safety at risk - also car parking along roadside.
3. Waste oil depot - inadequate retention in case of spill (inadequate storage facility), not permitted.
4. Sewage treatment plant (300,000 gpd.) in the past, not working at all times/working poorly; current performance very good.
5. Surfacing of sewage effluent from septic systems in the watershed when ground is saturated by heavy rain.
6. Use of AYH boat ramp for boat repair (fiberglass refinishing, painting, etc.).
7. Continual trash problem - garbage strewn around beach (visual eyesore). Beach owners provide trash receptacle and hire persons to remove garbage on a regular basis at their own expense, but cannot keep pace with the beach area's use by user public. Sunday and holiday "beach parties" often become loud and disruptive to neighborhood residents. (See 21)
8. Cabrita Point condominium development - built on mostly filled salt pond near sea level, flood zone.
9. Past water quality questionable at times when Vessup WWTP malfunctions; currently ok for swimming.
10. Residence density exceeding zoning for area (6 apartments in house zone R1). Occupancy of apartments has been disallowed.
11. Lack of pump out facilities at marina - leads to boats' discharging of sewage in harbor/at mooring.
12. Fuel spills at refueling facility.
13. Expected Ferry Dock upgrade may impact pond, marine life and Red Hook infrastructure.
14. Safety of Ferry Dock - outer portion repaired by June/91, but rest might collapse! Main transportation link between St. John and St. Thomas, + 2000 users per day
15. Small businesses set up in mangroves/ questionable sewage disposal/ encroaching on mangroves (i.e. destroying mangroves to expand business).
16. Mooring areas, at times insufficient, anchor damage in seagrass beds.
17. Steep slopes/exposed soil/erosion problems.
18. Storm sewer drains.
19. Excessive vehicle speed along road, especially in front of school and commercial buildings; heavy pedestrian traffic.
20. Residential development diminishes deer and iguana habitat, encroaching on Cabrite Salt Ponds.
21. Filled salt ponds (approx. 14 acres), originally filled under permit from Federal Government prior to the passage in 1974 of P.L. 93-435, codified at 48 U.S.C. Section 1705, which conveyed to the Government of the Virgin Islands, all lands "permantly" or periodically covered by tidal waters. Owners wish to do some type of development with portion of revenue used for maintenance of Muller Beach and establishment of a public park (baseball, basketball etc.).
22. Public housing development - bulldozing of roads, clearing lots will add sediment to runoff water - adequate precautions to be taken.
23. Trash dumpster on corner of Red Hook Road at intersection of Nazareth and NPS Headquarters Roads is a major traffic safety hazard - must be relocated to a site with adequate and safe pullover space.
24. Vitelco nodal point for telephone service to east end of St. Thomas.
25. Roll On/Roll Off ramp facility - main commercial link for St. John.
26. National Guard Armory.
27. Location for proposed St. Thomas Community Aquatic Center.
28. New gymnasium for Ivanna Eudora Kean High School
29. Abbey Hill housing development proposal.
30. Wrecked boats in mangroves from Hurricane Hugo - removal required.

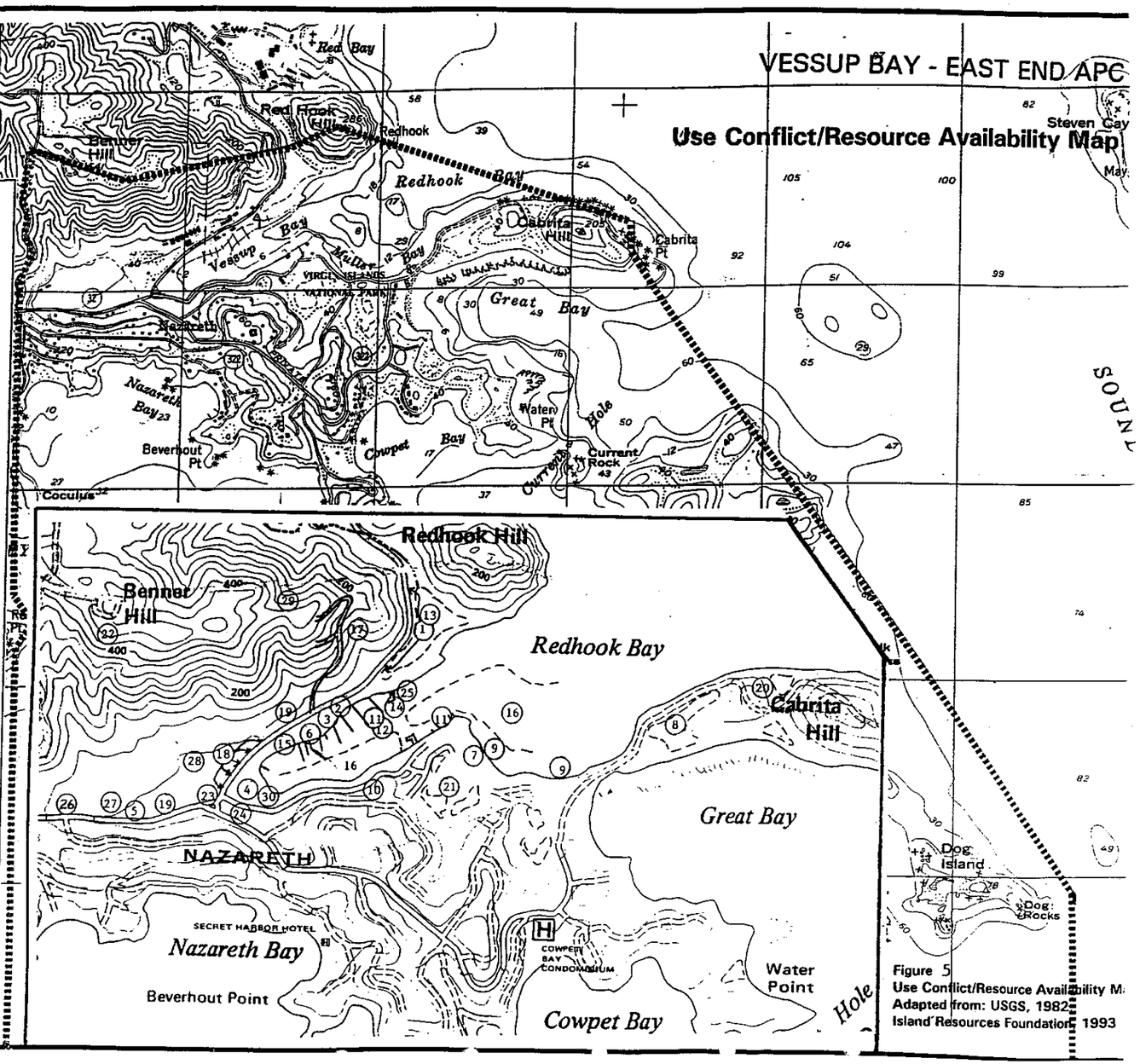
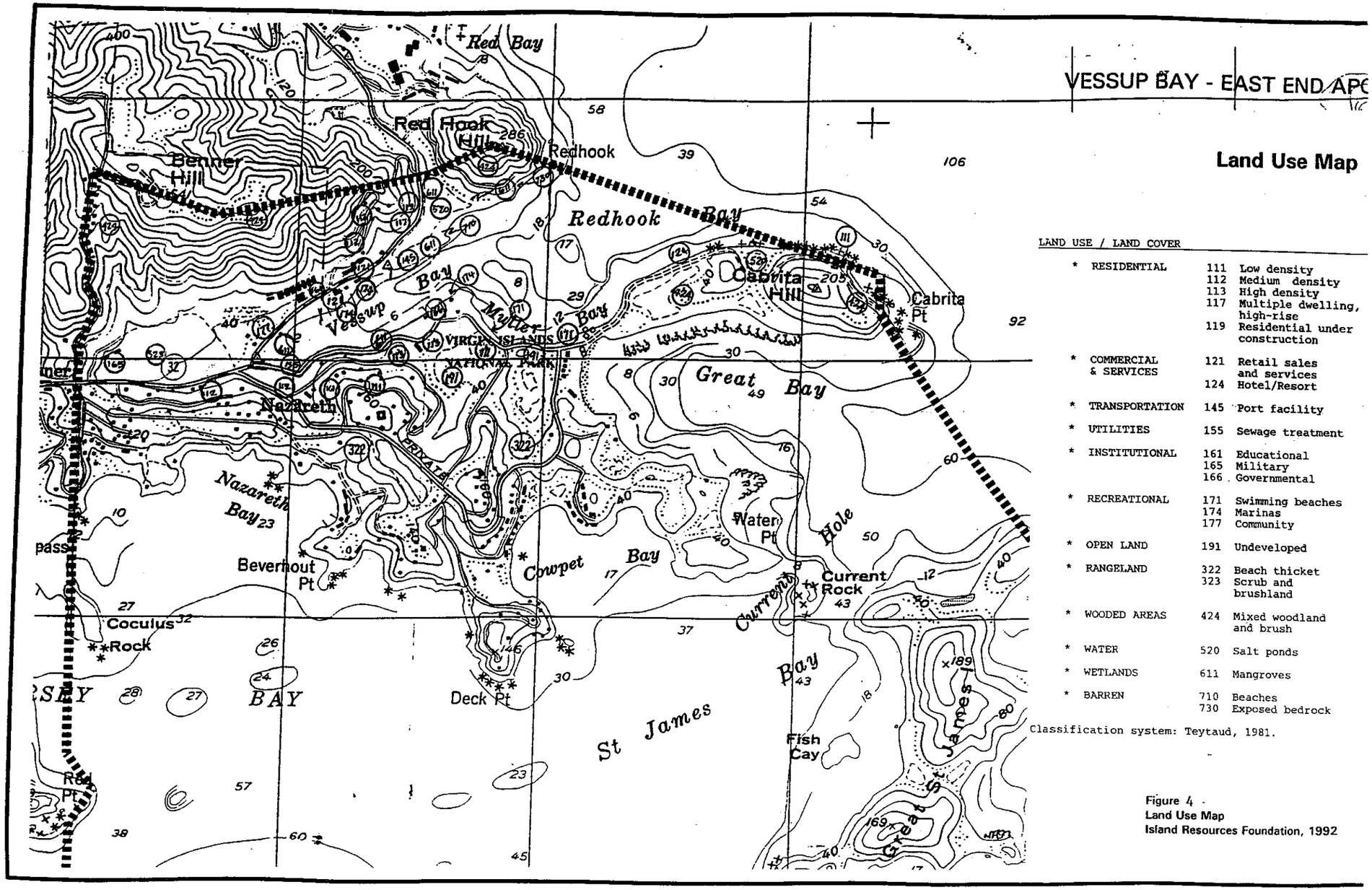


Figure 5
Use Conflict/Resource Availability M
Adapted from: USGS, 1982
Island Resources Foundation 1993



LAND USE / LAND COVER

*	RESIDENTIAL	111	Low density
		112	Medium density
		113	High density
		117	Multiple dwelling, high-rise
		119	Residential under construction
*	COMMERCIAL & SERVICES	121	Retail sales and services
		124	Hotel/Resort
*	TRANSPORTATION	145	Port facility
*	UTILITIES	155	Sewage treatment
*	INSTITUTIONAL	161	Educational
		165	Military
		166	Governmental
*	RECREATIONAL	171	Swimming beaches
		174	Marinas
		177	Community
*	OPEN LAND	191	Undeveloped
*	RANGELAND	322	Beach thicket
		323	Scrub and brushland
*	WOODED AREAS	424	Mixed woodland and brush
*	WATER	520	Salt ponds
*	WETLANDS	611	Mangroves
*	BARREN	710	Beaches
		730	Exposed bedrock

Classification system: Teytaud, 1981.

Figure 4
Land Use Map
Island Resources Foundation, 1992

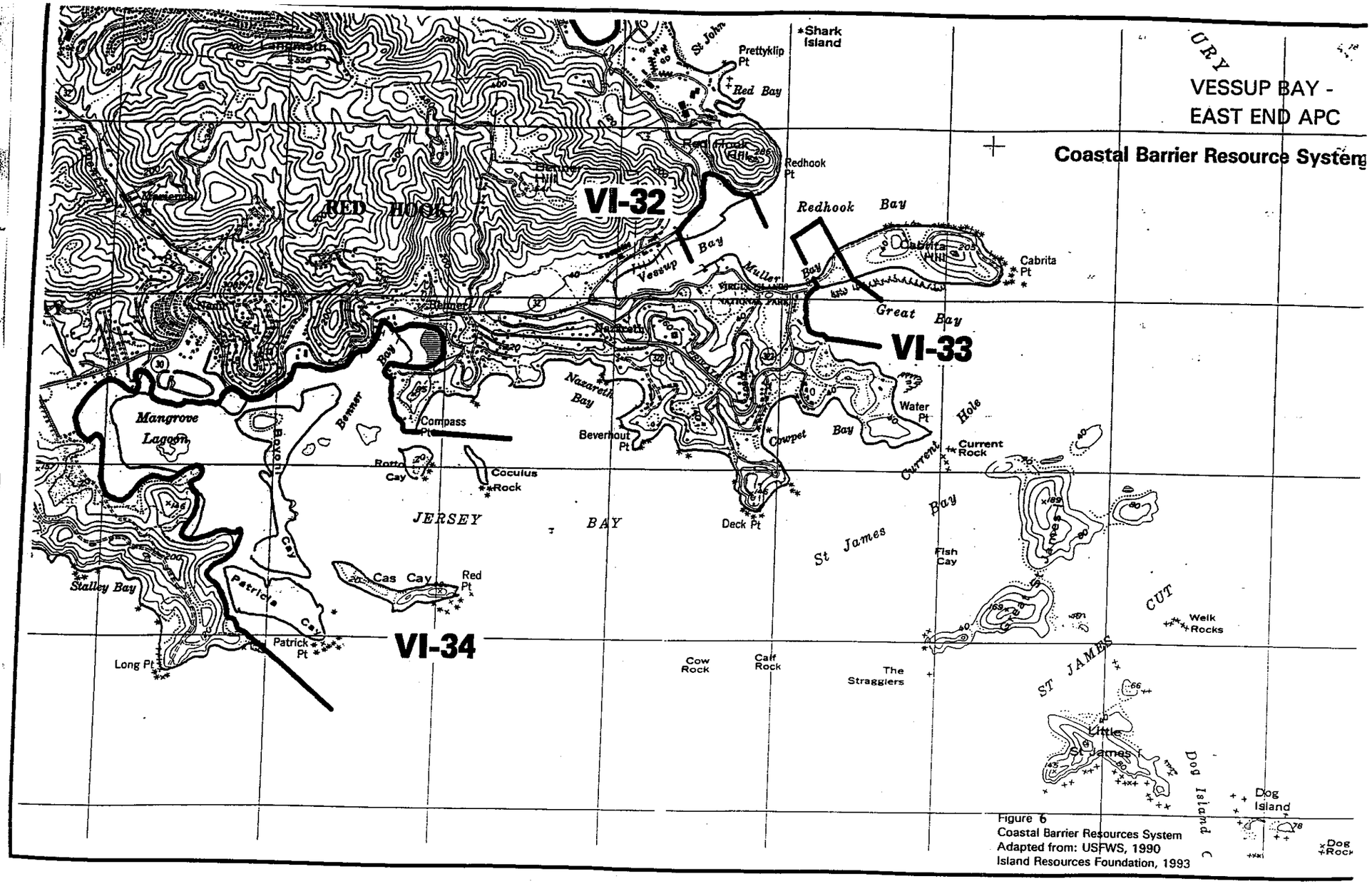


Figure 6
Coastal Barrier Resources System
Adapted from: USFWS, 1990
Island Resources Foundation, 1993

VESSUP BAY - EAST END APC

Watershed and Well Location Map

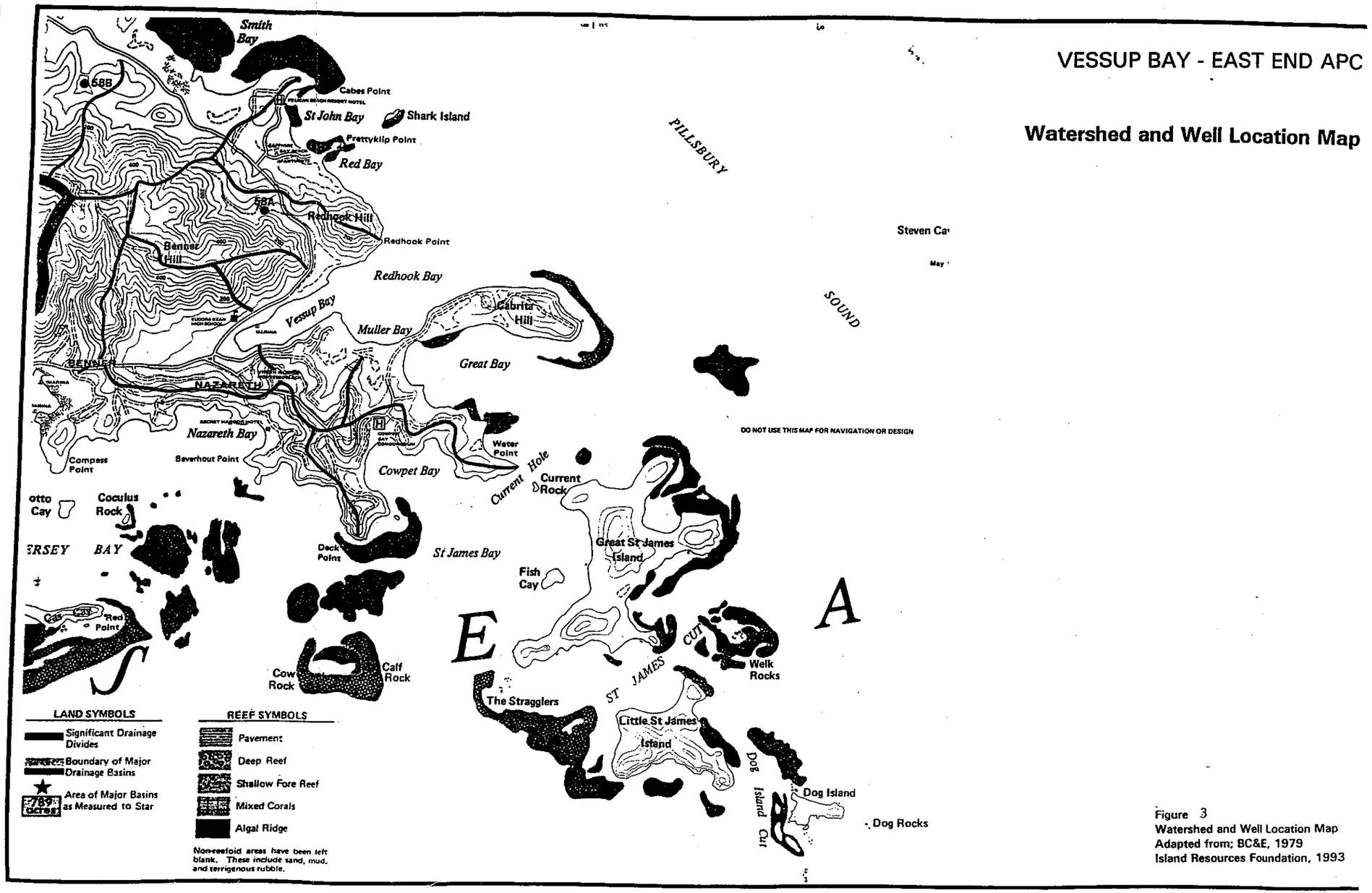


Figure 3
Watershed and Well Location Map
Adapted from; BC&E, 1979
Island Resources Foundation, 1993