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ENVIRONMENTAL IMPACT OF DEPOSITING DREDGE SPOILS IN AN AREA
NORTHEAST OF HANSONS BAY, ST. JOHN'S, ANTIGUA

September 12, 1987

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Environmental Impact of Depositing Dredge Spoils in an Area Northeast of Hansons Bay, St. John's, Antigua

INTRODUCTION

On September 4 & 5, 1987, an assessment was undertaken to evaluate the impact of depositing dredge spoils, taken from St. John's deep water harbour, in the area of reclaimed land and salt pond northeast of Hansons Bay (Figure 1). Potentially impacted terrestrial and marine environments were surveyed to assess the impact on fauna, flora, nearby residents, the garbage dump and the impact of diverting the flow of natural run-off. The survey also included fact finding necessary for recommending the location of the containment dike and the outflow of supernatant from the settling ponds.

SURVEY

Terrestrial Survey. A survey was conducted of the land area proposed for depositing dredge spoils from St. John's harbour. This area is bordered by Five Islands Road around the northern end, the road to the municipal dump to the east, Five Islands Road and the continuation of a private road to the west and Hansons Bay and the Flashes around the southern end.

There are three major vegetation zones found in the area:

1. wasteland
2. coastal vegetation
3. mangrove swamp

Most of the area is wasteland consisting of exposed soil with very little vegetation cover. A vegetation map is provided (Figure 2). Figure 3 is a photograph looking northward towards St. John showing the wasteland area. The soil is primarily dredge spoils from the previous dredging of the St. John's harbour. Ground cover, which is sparsely distributed, consists of salt adapted grasses (Spartina patens and Sporobolus virginicus) and creeping succulents (Euphorbia buxifolia, Sesuvium portulacastrum, Batis maritima and Salicornia bigelovii). There are patches of small black mangrove plants (Avicennia germinans) throughout the area found along minor watercourses. There is one patch of tall black mangrove of about twenty trees located in the middle of the proposed spoils storage area (Figure 4). This will have to be sacrificed.

Some wildlife was found throughout the wasteland area. A very large population of laughing gulls (Larus atricilla) was observed resting on the hot dry mud. Several small birds were feeding near minor waterways: thick-billed plover (Charadrius wilsonia) and the common snipe (Gallinago gallinago). One yellow warbler (Dendroica petechia) was found within the area of black mangrove situated in the middle of the wasteland. The birds found in the wasteland area are all opportunistic species able to move freely to other areas. The filling of this land will not significantly effect birdlife of the area.

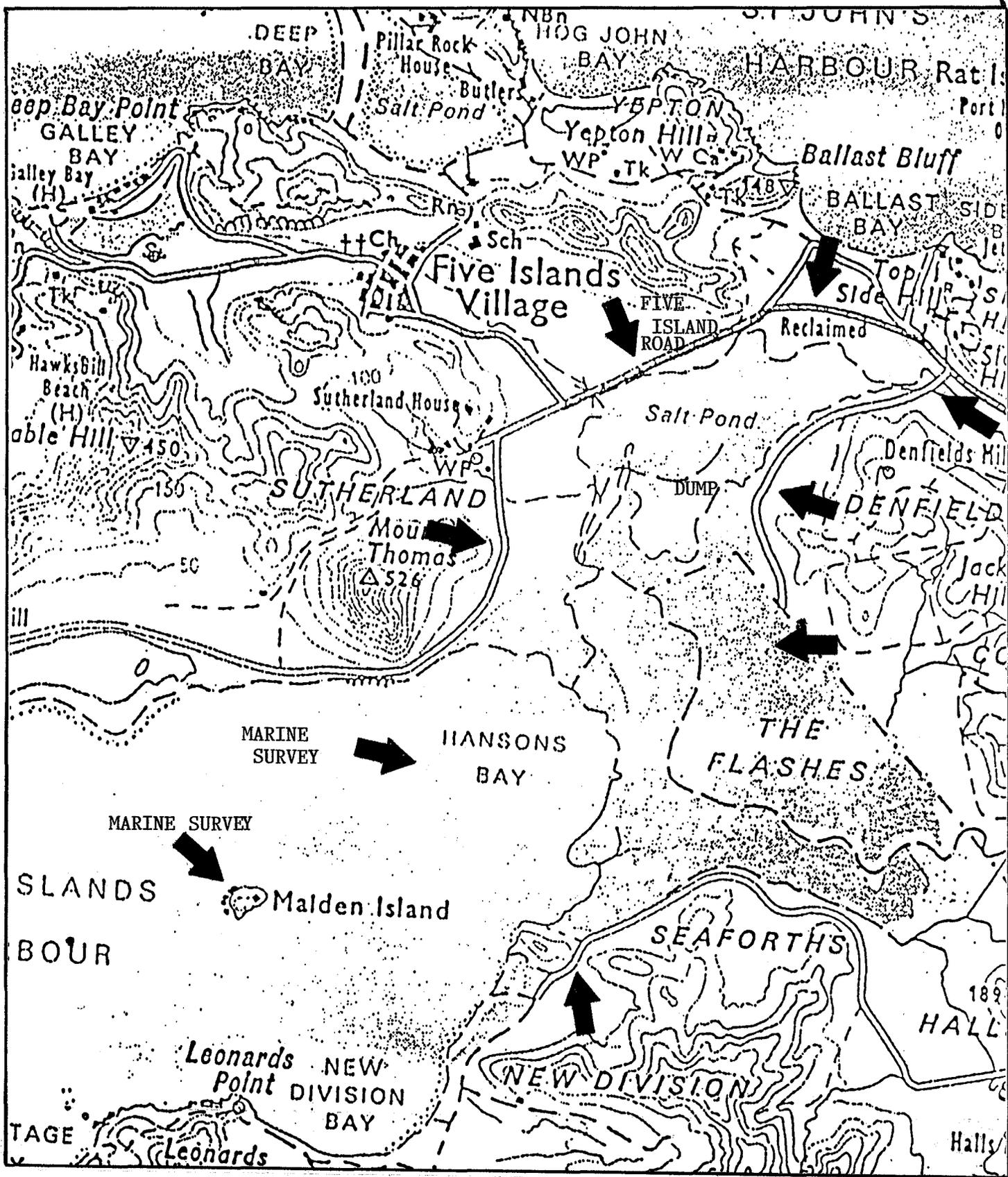


Figure 1. The area between Five Island Road, the roadway to the municipal dump, The Flashes and Hanson Bay was surveyed for evaluation of the impact of depositing dredge spoils from St. John's Harbour. The marine environment of Hanson's Bay was also surveyed.

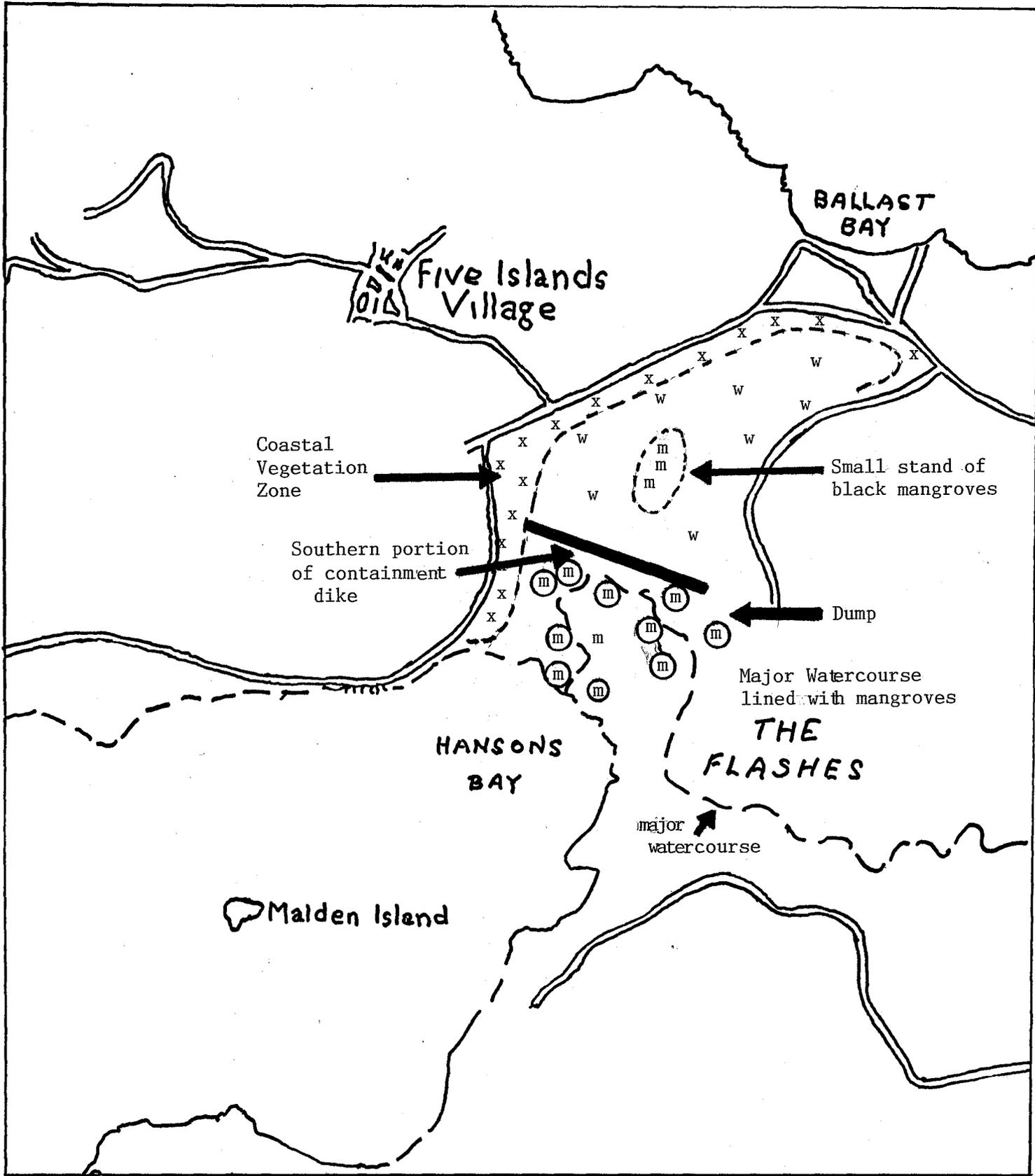


Figure 2. The three major terrestrial vegetation zones: wasteland (w), coastal vegetation (x) and mangrove (m). Also shown is the major mangrove surrounded watercourse, the southern limit of the containment dike and the municipal dump area.



Figure 3. Wasteland. Looking northward towards St. John's the proposed fill area is shown.



Figure 4. Wasteland. A small stand of black mangroves that are in the proposed fill area that will be within the containment dike.



Figure 5. In the center is a freshwater pond with a minor watercourse running east to west across the proposed fill area. On either side is typical coastal vegetation.

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A zone of coastal type vegetation runs along the roadsides and down to the waters edge of Hansons Bay on the eastern side. This vegetation is found growing at an elevation from two to six feet above that of the mud flat. Figure 5 is a photograph taken in the proposed fill area showing coastal vegetation on either side of a minor watercourse. The coastal type vegetation along the road is dominated by thorny acacias (Acacia nilotica and A. tortuosa) and logwood (Haematoxylum campechianum) with the occasional loblolly (Pisonia fragrans), bread-and-cheese (Pithecellobium unguis-cati) and tamarind (Tamarindus indica). A large number of blackbirds (Quiscalus lugubris) were found throughout the coastal vegetation area. Closer to Hansons Bay, manchineels (Hippomane mancinella) become dominant with scattered acacia and divi-divi (Caesalpinia coriaria). Trees of this area support large populations of bromeliads (Tillandsia utriculata).

The coastal vegetation that occurs along the roadways (Five Islands Road) should be preserved and the containment dike built behind this thin band of vegetation. The vegetation will provide stability to the soils outside of the dike during times when heavy rains can cause excessive run-off from the hills. The vegetation will also provide an aesthetically pleasing facade to the somewhat dismal look of the dike walls.

In the southeast portion of the area there is a major watercourse running west to east and turning south and emptying into Hansons Bay (Figures 6 through 9). The waterway is lined with red, black and white mangrove (Rhizophora mangle, Avicennia germinans and Laguncularia racemosa) along with scattered buttonwood (Conocarpus erectus). This mangrove and the waterway provide habitats for a great deal of wildlife. Dredge spoils **MUST NOT** be put in this area. The southernmost portion of the containment dike should remain in wasteland area and not encroach on the mangrove community.

Many lagoon dependent birds were sighted in this area including the great egret (Egretta alba), snowy egret (Egretta thula), little blue heron (Florida caerulea), lesser yellowlegs (Tringa flavipes) and several different sandpipers. Several species of terns were observed flying over the area (see species list, Appendix I, for those expected in the area). Doves (Columbina passerina and Zenaida aurita) were also observed flying throughout the area.

Small but healthy mangrove plants line the major watercourse. The waters of the channel were not clear enough to observe marine life but mullet were seen jumping and small fry were seen along the shoreline. A very large number of crabs (Uca pugnax rapax) were seen all over the mud flats with the greatest concentration around the mangrove areas. Holes of the large land crab (Cardisoma guanhumi) were also observed throughout the wetter areas.

Mangroves are essential coastline habitats which serve as biological filters for run-off containing sediments, nutrients and pollutants. The mangroves described above will act as a settling area to collect any remaining sediments and pollutants in the run-off leaving the collecting ponds. Almost all the remaining sediments should be contained preventing direct run-off into Hansons Bay.

Figure 5 also shows one of the minor vegetation zones present in the area: freshwater ponds and associated vegetation. There are numerous small freshwater ponds scattered throughout in the area with minor watercourses



Figure 6. Major mangrove lined watercourse at its northeast turn. Approximate location of where run-off from the settling ponds would enter the waterway. Figure 10 shows where this photograph was taken.



Figure 7. Major mangrove lined watercourse about 500 yards from where it enters Hansons Bay. The area is a bird feeding habitat having abundant supplies of fish and invertebrates.



Figure 8. Major mangrove lined watercourse showing the entrance to Hansons Bay. Maiden Island can be seen in the distance.



Figure 9. Hansons Bay looking toward the entrance to the run-off channel shown in Figure 8. The benthic marine survey was conducted in this area.

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leading to the major mangrove surrounded watercourse and out into Hansons Bay (Figure 10). The damp mud around the pond supports grasses and sedges including the sedge (Cyperus alopecuroides). Several ponds are outside the proposed dike area. Figure 10 shows several of the water collecting areas outside of the containment dike which might overflow and erode the dike. These areas need drainage guts to channel water along the dike and into the flats.

One important consideration is the effect the dredge spoil deposit will have on the residents of the area. The residents of Five Islands Village and those in transit to the resort areas of the peninsula will have to pass the dike on Five Islands Road. When the spoils are being deposited, and for sometime after, there will be an odor from decomposition. The top layer of sediment sampled in St. John's Harbour reveals a deep layer of fine, black anaerobic mud covered with a green algae (Codium sp.). This material will no doubt have a very noxious odor for some time after dredging. The prevailing wind pattern at the spoils site should take most of the odor out into the Bay. However, during times of changing wind patterns, no wind or when people are driving by close to the dike there will probably be complaints of very bad smells.

Marine Survey. A survey was conducted in Hansons Bay to assess the possible impacts of run-off into the Bay from the depositing of dredge spoils on adjacent land. About 100 yard from the mouth of the inlet (see Figures 8 and 9) the bottom was observed using a mask and snorkel. This area of the bay was very shallow, from 1 to 3 feet, with deep soft sediments. The entire area was covered by large patches of thick long shoal grass (Halodule wrightii). Both observers (Coulston and Mussington) agreed it was the thickest and longest grass, of this species, they ever observed. There were the occasional patches of turtle grass (Thalassia testudinum) and very sparse patches of algae (Halimeda incrassata, H. monile, Caulerpa sertularioides, C. mexicana, Acetabularia crenulata, and several Dictyota spp.). Very few fish were observed but there were the occasional juvenile of grey, lane, mutton and yellowtail snappers (Lutjanus griseus, L. synagis L. analis and Ocyurus chrysurus) and juvenile french grunts (Haemulon flavolineatum). Small cockles were found in the mud. Callianassa mounds were abundant, but no other invertebrates were found.

This area naturally experiences influxes of large amounts of sediments from run-off. The seagrasses collect the sediments accounting for the vast amount of fine sediment in the area. Visibility was several feet, however, during heavy rains and run-off the area is probably extremely turbid. The small amount of additional sediment expected from the settling ponds will have little impact on this area. Any impact in the area from settling pond run-off would be from the addition of nutrients. Monitoring of nutrients will be discussed.

The depth of water was taken in several areas of the bay using the anchor line. At a position about half way between the shore and Maiden Island the water depth increased to 12 ft. Grab samples obtained with the anchor indicated the presence of the seagrass (Halophila wrightii) and an additional algae species (Halimeda tuna).

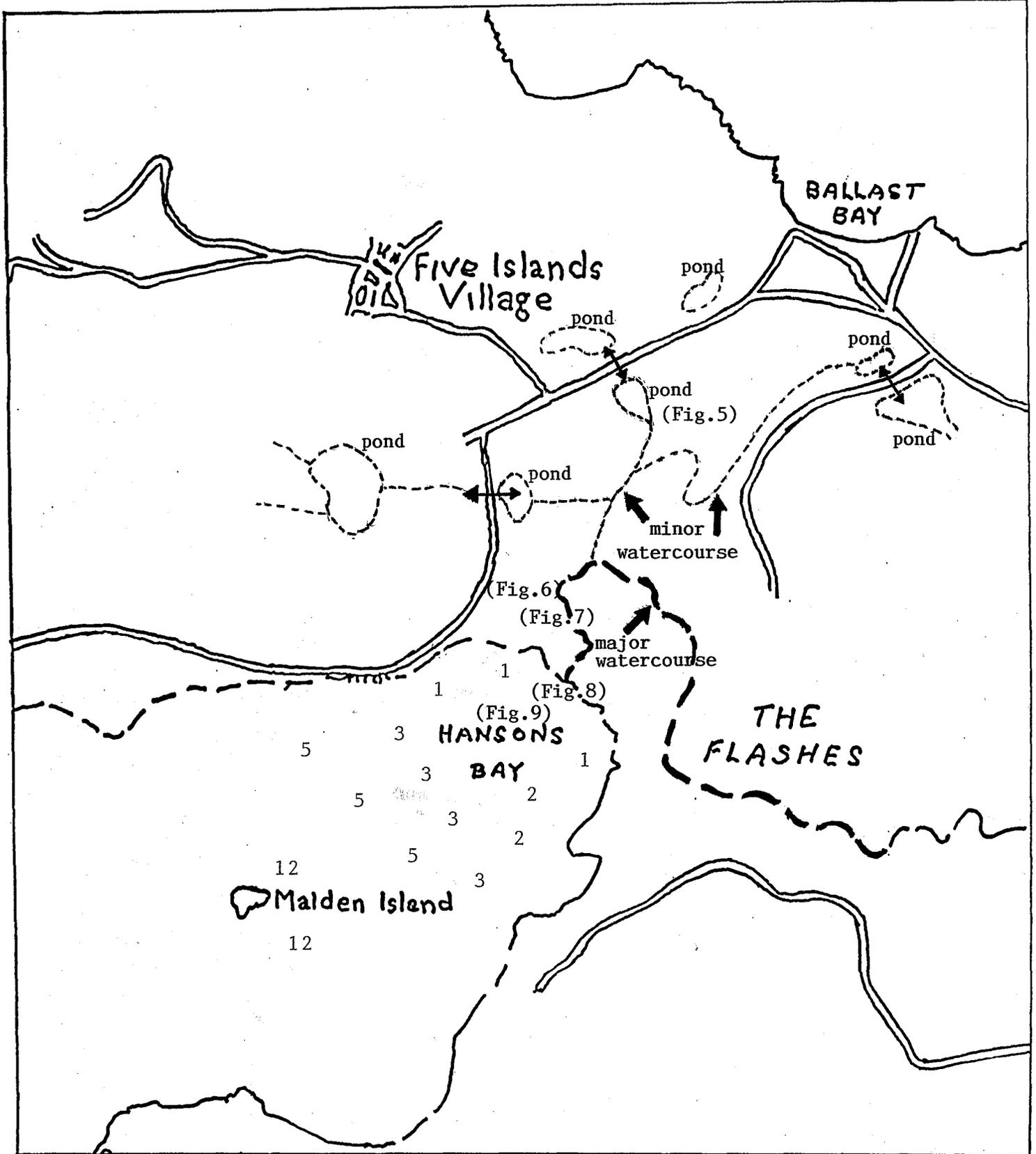


Figure 10. Shown are the ponds in the area. Some of these ponds are outside the proposed containment dikes. They will need to be diverted by constructing culverts so that they run outside of the dikes and intersect with natural watercourses. Depth contours within the bay are also shown.

The marine life around Maiden Island was also observed using mask and snorkel. The bottom contained turtlegrass and the algae Halimeda incrassata. There were several species of soft corals, much staghorn coral (Acropora cervicornis) with colonial anemones covering much of the rock surface. Fish life was abundant with many snapper, doctorfish, angelfish and parrotfish observed.

Maiden Island is a major bird roosting and probably nesting area. Even during the day, tree and shrub tops were covered with cattle egrets, snowy egrets, and great white egrets. Large numbers of laughing gulls were all around the area. Several lesser blue herons and a great blue heron were also observed.

LOCATION OF CONTAINMENT DIKES AND OUTFALL

The proposed approximate location of the containment dike is indicated in Figure 11. This recommendation is based on an evaluation of the least impact from a biological standpoint. The outfall should be located in the southernmost wall about two thirds down the wall from the dump and about one third from the east side. The outfall can be placed in close proximity to the mangroves allowing the mangrove plants to be one of the final filters.

The proposal recommends three settling ponds. The final run-off (supernatant) from settling pond III will filter through the mangrove, into the watercourse and out into Hansons Bay. The seagrasses of the bay will also act as a filter as it does for the natural land run-off.

The containment dike should be constructed to leave a vegetation barrier zone between the roads and the dike for both run-off control and aesthetic purposes.

WATER QUALITY CONTROL PLAN

A water quality control program should be initiated to insure that the discharge of fine sediments through the outflow system be kept to a minimum. As reported by Jones, 1987, 2-8% wt. of sediment to be deposited is very fine and most likely will pass through screens. In addition, nutrients and pollutants should also be monitored as the run-off will pass into several distinct ecosystems where it will be absorbed, converted or passed on before it has the chance of reaching open water.

A baseline survey of water quality is necessary prior to the beginning of the dike construction and filling. This baseline study should consist of sampling the water in the watercourse, at the entrance to the bay and at several stations within the bay itself. These samples should be done during dry periods and after a rainy period. It is important to separate characteristics of naturally occurring run-off and that which can be attributed to dredge spoil storage and run-off.

The dredged material contains unknown quantities of substances that have accumulated for years in the bottom of the harbor. Much of the material is sediment being washed down from the soils. Some of the material is sewage

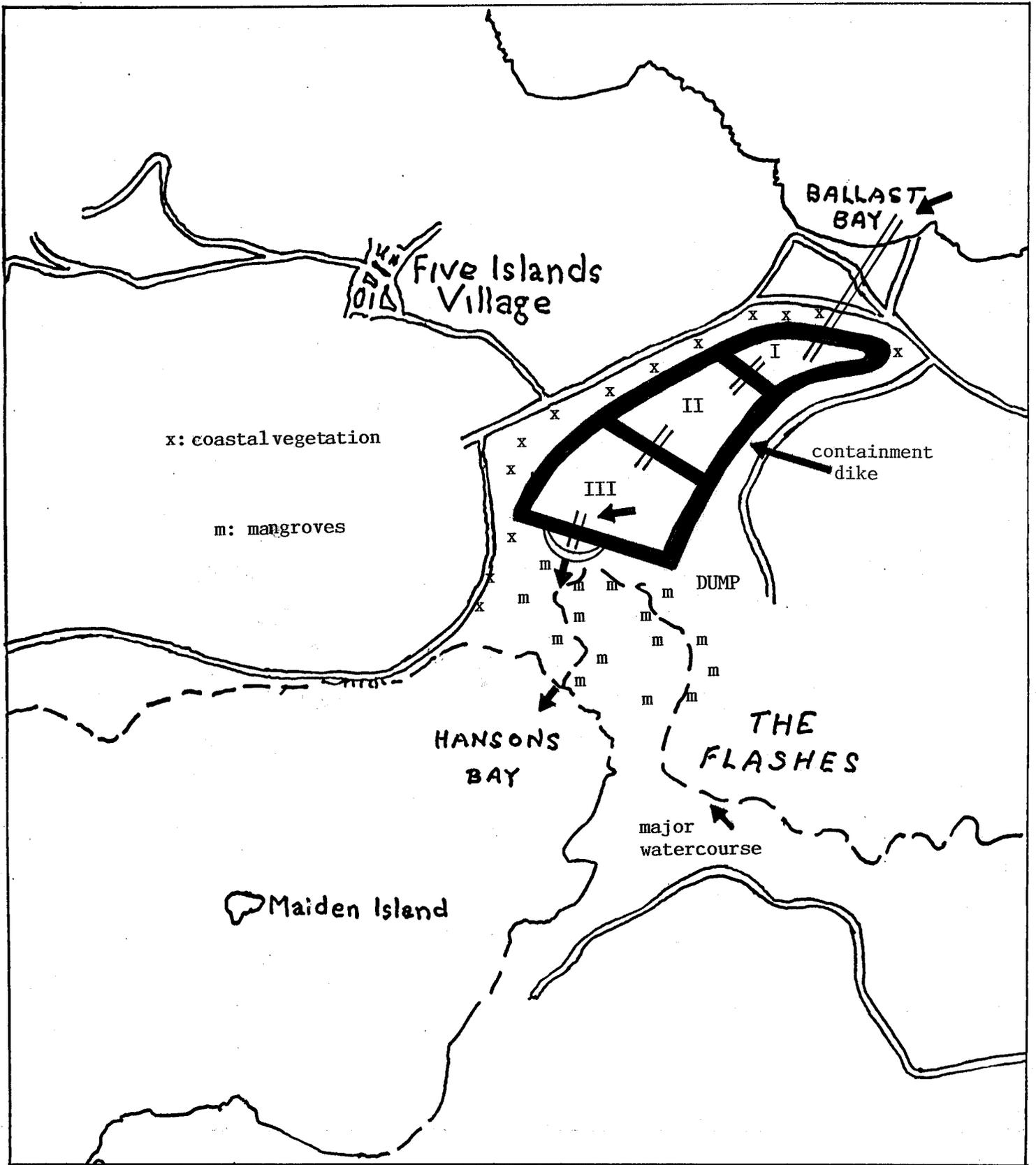


Figure 11. Proposed location of the containment dikes with a receiving pond (I) and primary (II) and secondary (III) settling ponds. The outfall is located at the southernmost wall. A vegetation barrier is recommended to be left between the roadways and the dike walls.

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and wastewater. Also expected to be found are quantities of other pollutants such as pesticides and detergents along with other disposable substances that can not be predicted at this time. Because this material is flowing through a mangrove, into a productive stream and out into a relatively undisturbed bay it is important to monitor as many of these water quality variables as possible.

The following tests should be done on the water samples: suspended solids, pH, turbidity, dissolved oxygen, nitrates, phosphates, salinity. Each measured water quality variable is a valuable indicator as to the quality of the water and the environmental effects that will occur as a result of the dredged material supernatant passing through the area. Five water quality monitoring stations should be set up (see Figure 12): (1) sample of supernatant taken at the outflow, (2) sample taken in the waterway at the closest point to where the outfall water enters the watercourse, (3) sample taken near the entrance where the channel enters Hansons Bay, (4) sample taken just off-shore and (5) sample taken mid-way between the shore and Maiden Island.

Total Suspended Solids. A considerable increase in total suspended solids (numbers above the baseline mean) is an indicator that materials are passing through the screens. Some material is expected to pass through the outflow, but how much is allowable becomes an important question. The situation that we have set-up here is that we expect the mangrove, the mangrove waterway and the shallow seagrass beds to act as the final filter for the run-off from the dredge spoils. However, a limit needs to be set on the amount that the dredge company is allowed to spill over.

It is suggested that the range of the dry and wet season baseline be established and that the dredge company not be allowed to exceed the maximum level that is reported. Also that the dredge company be expected, on a daily basis to maintain no more than the calculated average amount of total suspended solids in run-off for all seasons. Exceptions need to be considered during periods of heavy rains.

pH measurements. A sudden change in the pH of water is a warning that contaminants have been introduced to the system. Natural waters have a pH value between 5.0 to 8.5. Outside these limits is dangerous to living organisms and must be controlled. U.S. Virgin Islands minimum standards require 6.7 to 8.5.

Turbidity. Turbidity is an expression of the optical properties of the water which cause light to be scattered and absorbed rather than transmitted in straight lines through the sample. Turbidity is not directly related to the weight of the total suspended solids in the water even though turbidity is caused by particles in the water.

Dissolved Oxygen. Oxygen is essential for the respiration of most organisms living in the water. Organic and industrial wastes may overload the system and deplete oxygen. Nutrients may also cause oxygen depletion by causing increased algae growth resulting in increases in the consumption of oxygen during respiration and decomposition. Dissolved oxygen levels should not be allowed to go below 4.0 mg/l. U.S. Virgin Islands minimum standard is not less than 5.0 mg/l.

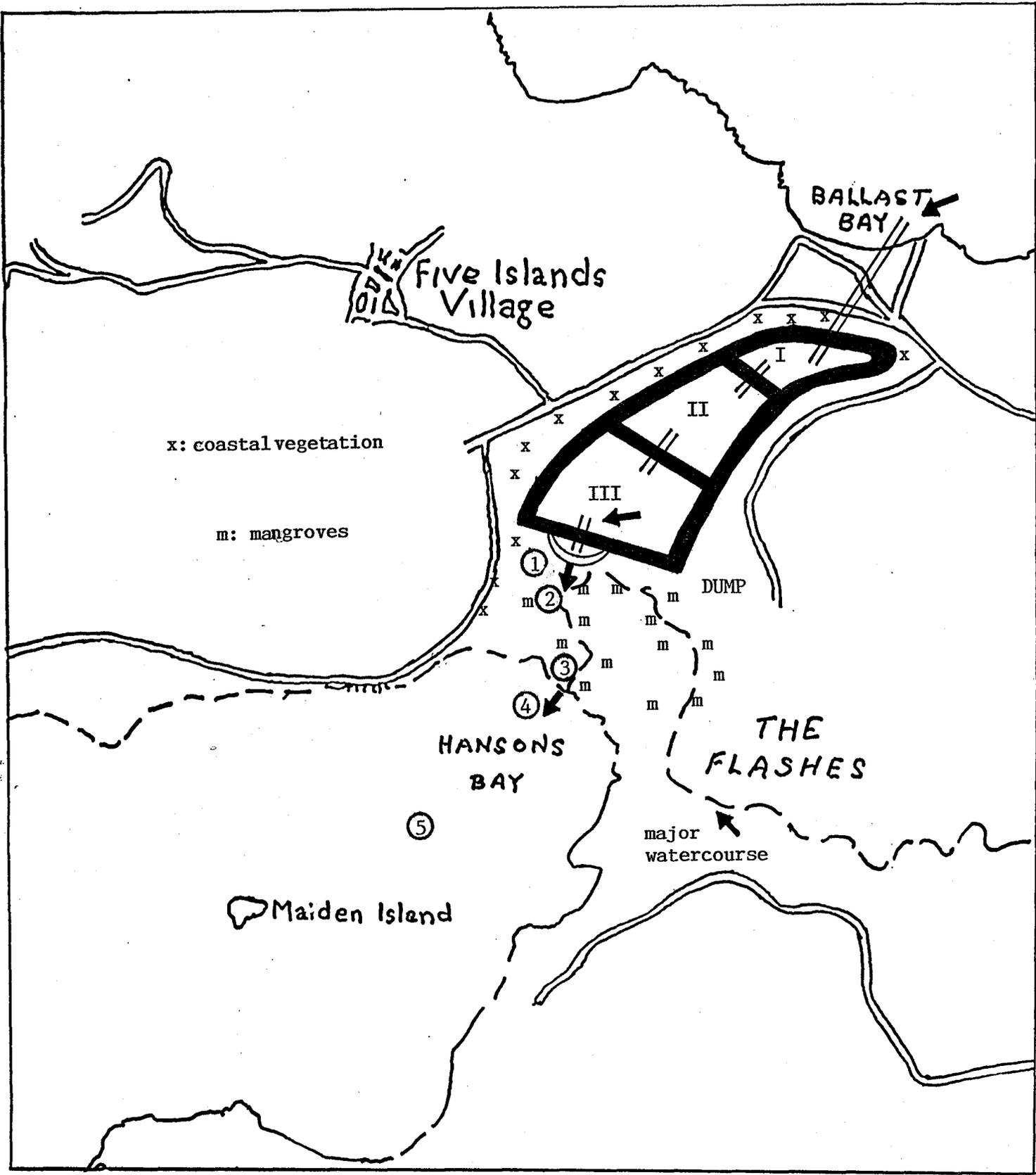


Figure 12. The five water quality monitoring stations recommended are indicated by the circled numbers: (1) sample of supernatant as it leaves the settling pond, (2) sample taken in the waterway at the closest point to where the outfall water enters the watercourse, (3) sample taken near the entrance where the channel enters Hanson's Bay, (4) sample taken just off-shore and (5) sample taken mid-way between the shore and Maiden Island.

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Nitrates. Nitrogen is essential for plant growth. Nitrogen compounds enter the environment as nitrates or are converted to nitrates. The nitrates come from many sources including agriculture, fertilizers, sewage, and drainage from livestock. Nitrate stimulate the growth of algae and could promote excessive algae growth.

Phosphates. Phosphorus is also an important nutrient for aquatic plants. The amount of phosphorus should not exceed 0.1 ppm. Excess phosphorus promotes algae growth giving rise to eventual depleted oxygen supply with resultant death of other organisms.

Salinity. Salinity of the water is an important consideration for animal life in the Channel and Bay. Animals do not tolerate salinity variances. Mangrove plants are much more tolerant of salinity variances, but certain species are favored under certain salinity regimes. Extremes in salinity are important to be controlled and should be monitored.

REDUCTION OF SEDIMENT DISCHARGES

The dredge company will be pumping very fine sediments into the settling basins. We recommended three settling ponds be constructed, one in which the dredge material will be received (receiving pond) and two others to pump material from the receiving pond into two additional settling ponds to further promote settling of particles before the water is allowed to flow through the mangrove and into the channel.

The receiving and settling pond(s) should be monitored to insure that the dredge company maintains the ponds. It may be necessary to remove the larger particles that have settled to insure that the dikes do not overflow. The dikes must be maintained against leakage, overflow or crumbling. At the present time, the dredge company plans only to use the available substrate in the construction of dikes. There is no plan for any stabilizing material such as rock or geofabric filter cloth to stabilize the soil. Stabilization is recommended.

The discharge of supernatant should be carefully controlled to minimize the amount of sediment running off into the mangrove. It is up to discretion of the dredge company engineers to designed the outfall or overflow system to insure proper filtration and confinement of sediment. Periodic monitoring must be carried out to insure that the outfall fall system is effective at containing sediment laden supernatant and that relatively clear water is allowed to overflow.

SUMMARY OF RECOMMENDATIONS

1. All the dredge spoils from St. John's Harbor be placed within containment dikes in the area of Hansons Bay as outlined in this report.

2. The area of Ft. James and Cove Bay be abandoned as a dredge spoils storage area and repaired according to a plan that would allow for enhancement of the property.

3. In the Hansons Bay proposal, it is recommended that the containment dikes be constructed leaving a vegetation barrier between the roads and the dike for both run-off control and aesthetic purposes.

3. In the Hansons Bay proposal the southernmost containment dike wall should be constructed in the wasteland portion of the area with the major watercourse and mangrove left undisturbed.

4. Additional drainage guts will have to be constructed outside of the dikes to channel run-off from surrounding hills around the dikes and into the flats.

5. A water quality control program needs to be established to monitor the run-off from containment ponds for sediment and nutrient content.

6. A agreement must be made between the Government of Antigua and the dredge company insuring that the burden of responsibility of maintaining water quality of run-off is with the dredge company. The dredge company must repair the outfall or establish additional filters if levels of sediment become too high and they must maintain and repair dike walls if they become damaged. The responsibility of monitoring water quality should be delegated to an independent monitor hired by the Government of Antigua.

CONCLUSIONS

The use of the alternate site at Hansons Bay proposed for storing dredge spoils will have considerably less impact on the environment than using the originally selected site between Ft. James and Cove Lagoon. It is recommended that this site, used formerly for the same purpose, be used again as the sole storage area for dredge spoils. The size of the area used be kept to a minimum to accommodate only the volume necessary to be stored with the option of adding ponds if the volume exceeds estimates.

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APPENDIX I

BIRDS OF ANTIGUA

<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>HABITAT</u>	<u>NESTING HABITS</u>	<u>STATUS</u>
PODICIPEDIDAE - grebes				
<u>Podilymbus podiceps</u>	pied-billed grebe	FW ponds/SW lagoons	water soaked vegetation	expected
PROCELLARIIDAE - shearwaters & petrels				
<u>Puffinus lherminieri</u>	Audobon's shearwater	seen mostly at sea	rock crevices	reported/Harris
PHAETHONTIDAE - tropicbirds				
<u>Phaethon aethereus</u>	red-billed tropicbird	small islands	cliff ledge/cave by sea	possible
<u>Phaethon lepturus</u>	white-tailed tropicbird	large islands		possible
PELECANIDAE - pelicans				
<u>Pelecanus erythrorhynchus</u> reported/Bond		American white pelican reported Antigua (Nov-Apr)	lagoons/lakes	
<u>Pelecanus occidentalis</u>	brown pelican	coastal areas	nests in low trees nesting cove lagoon	observed
FREGATIDAE -frigatebirds				
<u>Fregata magnificens</u>	magnificent frigatebird	colonies on cays	trees/rocks/mangrove nesting cove lagoon	observed
SULIDAE - bobbies & gannets				
<u>Sula leucogaster</u>	brown-faced booby	open sea/coastal	lg. colonies ground	expected

ARDEIDAE - herons and egrets

<u>Ardea herodias</u>	great blue heron	coastal areas	high trees/mangroves Hansons Bay, McKinnons Pond	observed
<u>Butorides virescens</u>	green heron	FW/SW habitats	bush/tree/swamp Cove Lagoon	observed
<u>Bubulcus ibis</u>	cattle egret	pastures/farmland	mangroves swamp nesting Cove Lagoon	observed
<u>Egretta alba</u>	great egret	FW/SW swamps & lagoons	trees mainly mangroves Cove Lagoon, McKinnons Pond, Hansons Bay	observed
<u>Egretta thula</u>	snowy egret	swamps/lagoons/rivers	trees in swamp Cove Lagoon, McKinnons Pond, Hansons Bay	observed
<u>Florida caerulea</u>	little blue heron	coastal/swamps		observed Cove Lagoon, McKinnons Pond, Hansons Bay
<u>Nyctanassa violacea</u>	yellow-crowned night heron	swamp	trees	expected
<u>Nycticarax nycticorax</u>	black-crowned night heron	SW/FW swamps & marshes	reeds or mangroves	expected
THRESKIORNITHIDAE - ibises & spoonbills				
<u>Plegadis falcinellus</u>	glossy ibis	FW/SW swamps & lagoons	trees, mod. elevation	possible
ANATIDAE - swans, geese & ducks				
<u>Dendrocygna bicolor</u>	fulvous tree duck	swamps/lagoons	grass	possible-vagrant
<u>Dendrocygna autumnalis</u>	black-bellied tree duck			possible
<u>Dendrocygna arborea</u>	West Indian tree duck	FW/SW swamps	ground/tree	reported/Bond
<u>Anas platyrhynchos</u>	mallard	FW/SW ponds & lagoons		expected
<u>Anas acuta</u>	Northern pintail	shallow swamps & lagoons		expected(Sep-Apr)
<u>Anas bahamensis</u>	white-cheeked pontail	FW/SW lagoons & ponds	grass/weeds/mangrove McKinnons Pond	observed

<u>Anas discors</u>	blue-winged teal	shallow swamps & lagoons		expected(Aug-May)
<u>Anas americana</u>	American widgon	lakes & lagoons		exected(Aug-May)
<u>Spatula clypeate</u>	northern shoveler	lakes & lagoons		expected(Sep-May)
<u>Aythya collaris</u>	ring-neck duck	FW lakes		expected(Oct-Mar)
<u>Qxyura jamaicensis</u>	ruddy duck	lakes & lagoons	sedges/mangrove McKinnons Pond	possible-rare
ACCIPITRIDAE - hawks & eagles				
<u>Buteo platypterus</u>	broad-winged hawk	wooded mts & lowlands	trees	reported/Bond
<u>Circus cyaneus</u>	marsh hawk	open marsh/savannas		expected(Aug-Apr)
PANDIONIDAE - ospreys				
<u>Pandion haliaetus</u>	osprey	coastal areas	tree/ground	expected
FALCONIDAE -falcons				
<u>Falco peregrinus</u>	Peregrin falcon	lagoons/rocky islets		expected(Aug-Apr)
<u>Falco columarius</u>	Merlin or pigeon falcon	near lagoons		expected(Sep-May)
RALLIDAE -Rails, Coots and Gallinules				
<u>Rallus longirastris</u>	clapper rail	mangrove swamps	mangrove roots	reported/Bond
<u>Porzana carolina</u>	sora crake	FW/SW swamps		expected(Sep-May)
<u>Porphyrule martinica</u>	purple gallinule	dense aquatic growth	cat-tails/sedges	expected
<u>Gallinula chloropus</u>	common gallinule	FW/SW swamps/rivers	ground near water	expected

CHARADRIIDAE - plovers & turnstones

<u>Charadrius semipalmatus</u>	semipalmated plover	forebeach/sand/mud flats		observed
<u>Charadrius melodus</u>	snowy plover	backbeach/sand/mud flats	sand	observed
<u>Charadrius wilsonia</u>	thick-billed plover	beaches/mud/sand flats	sand Hansons Bay	observed
<u>Charadrius vociferus</u>	killdeer	inland fields/savannas	ground	possible
<u>Pluvialis dominica</u>	American golden plover	field/savannas		expected(Jul-Dec)
<u>Squatarola squatarola</u>	black-bellied plover	on or near beached		expected(all year)
<u>Arenaria inerpres</u>	ruddy turnstone	coastal		expected(all year)

RECURVIVOSTRIDAE - avocets & stilts

<u>Himantopus himantopus</u>	common stilt	lagoons & ponds	terrestrial McKinnons Pond	observed breeds Antigua
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SCOLOPACIDAE - snipes and sandpipers

<u>Gallinago gallinago</u>	common snipe	FW marshed	Hansons Bay	observed
<u>Actitis macularia</u>	spotted sandpiper	vicinity of water		expected(all year)
<u>Tringa melanoleuca</u>	greater yellow-legs	SW/FW ponds & lagoons	Hansons Bay	expected(all year)
<u>Tringa flavipes</u>	lesser yellowlegs	FW/SW ponds & lagoons		observed
<u>Calidris minutilla</u>	least sandpiper	FW lakes & ponds	Cove Lagoon	observed
<u>Calidris pusilla</u>	semipalmated sandpiper	beaches/lagoons/mangroves	expected	
<u>Calidris mauri</u>	western sandpiper	beaches		expected(Jul-Mar)
<u>Crocethia alba</u>	sanderling	beaches/lagoons		expected(all year)
<u>Limnodromus griseus</u>	American dowitcher	coastal/lagoons		expected(Jul-Jun)

Micropalama himantrpus stilted sandpiper borders of lagoons expected(Jul-May)

LARIDAE - gulls & terns

Larus atriculla laughing gull coastal colonies/terrestrial observed
Sterna hirundo common tern coastal areas colonies/small cays expected(all year)
Sterna dougallii roseate tern coastal areas possible breeds Antigua expected
Sterna anaethetus bridled tern pelagic expected
Sterna fuscata sooty tern pelagic terrestrial/remote islets observed
Sterna albifrons least tern coast/lakes/lagoons beaches above high water expected(Apr-Oct)
Thalasseus maximus royal tern seashore small cays expected
Anous stolidus brown noddy pelagic expected

COLUMBIDAE - Pigeons and Doves

Columba leucocephala white-crowned pigeon low woodlands trees cays or
mangroves reported/Bond
Columba squamosa scaly-naped pigeon woodland trees mod. elevation reported/Bond
Zenaida aurita Zenaida dove ground dove coastal observed
Columbina passerina common ground dove open country ground shrubbery observed
Geotrygon montana ruddy quail dove humid forest undergrowth possible
Geotrygon mystacea bridled quail dove dense forest undergrowth expected

CUCULIDAE - cuckoos & anis

Coccyzus minor mangrove cuckoo mangrove swamps & woodlands reported/Bond

<u>Coccyzus americanus</u>	yellow-billed cuckoo	low scrub and woodlands	trees	possible
STRIGIDAE - owls				
<u>Tyto alba</u>	burrowing owl	scrub/thickets	burrows in banks	now extinct
CAPRIMULGIDAE - nightjars				
<u>Caprimulgus carolinensis</u>	chuck-will's widow	woodland		Barbuda
APODIDAE - swifts				
<u>Chaetura martinica</u>	Lesser Antillean swift	forested mountains	hollow tree or cave	possible
<u>Cypseloides niger</u>	black swift	forested hills & mtns	cliff or revine	expected(Mar-Sep)
TROCHILIDAE - Hummingbirds				
<u>Sericotes holosericeus</u>	green-throated Carib	low elevations		expected
<u>Orthorhyncus cristatus</u> expected	Antillian crested hummingbird		lowlands	
<u>Eulampis jugularis</u>	purple-throated Carib	mountain forests		reported/Bond
ALCEDINIDAE - kingfishers				
<u>Ceryle alcyon</u>	belted kingfisher	coast/rivers/lakes/lagoons		expected
TYRANNIDAE -Flycatchers				
<u>Elaenia martinica</u>	Caribbean elaenia	forest/woodland/scrub	shrub/tree	reported
<u>Tyrannus dominicensis</u>	gray kingbird	mountains	trees/shrubs	reported
<u>Myiarchus stolidus</u>	stolid flycatcher	woodland/mangrove	tree cavities	reported/Bond
MIMIDAE - mockingbirds & thrashers				
<u>Margarops fuscatus</u>	pearly-eyed thrasher	forested areas/scrub	cup shaped in tree	reported

VIREONIDAE - vireos

Vireo altiloquus black-wiskered vireo wooded areas/mangroves pendant cup tree reported

PARULIDAE - wood warblers

Protonotaria citrea prothonotary warbler possible(Aug-Apr)

Dendroica petechia yellow warbler mangrove swamps cup in bush or tree observed

Dendroica caerulescens black-throated blue warbler possible

Dendroica coronata myrtle warbler possible

Dendroica virens black-throated green warbler
possible

Dendroica adelaidae Adelaide's warbler lowland thickets shrub/tree Barbuda

COREREBIDAE - honeycreepers

Coereba flaveola Bananaquit widespread tree/side entrance observed

THRAUPIDAE - tanagers

Euphonia musica blue-hooded euphonia thick mountain forest tree among vines reported/Bond

ICTERIDAE - orioles or troupials

Molothrus bonariensis glossy cowbird open lowlands/semi-arid parasitic expected

Quiscalus lugubris Carib grackle settled districts
Hansons Bay observed

Icterus icterus troupial woodland/mangrove island nester reported/Bond

FRINGILLIADAE - Finches, sparrows & buntings

Sicalis luteola yellow grass finch open fields ground possible

Loxigilla noctis Lesser Antillian bullfinch dry-scrub

bush or tree	reported/Bond		
<u>Tiaris bicolor</u>	black-headed grassquit	open areas	reported
<u>Pheucticus ludovicianus</u>	rose-breasted grosbeak		Barbuda
HIRUNDINIDAE - Swallows			
<u>Progne dominicensis</u>	Caribbean martin		reported

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- Harris, D.R. 1963. Plants, animals and man in the outer Leeward Islands, West Indies: An ecological study of Antigua, Barbuda and Anguilla. PhD Dissert. Univ. of Calif. Berkeley. p. 298.
- Raffaele, H. A. 1983. A guide to the birds of Puerto Rico and the Virgin Islands. Fondo Educativo Interamericano. San Juan. p. 255.

Status Key:

- Observed: those birds observed and identified during surveys on July 19-22, 1987 and September 5, 1987.
- Reported: those birds reported in the literature as having been observed in Antigua, author also reported.
- Expected: those birds that are expected to be transient or residents of Antigua at some period during the year. They are reported in the literature as common to the Lesser Antilles. Also noted is the time of year they are expected to be seen.
- Possible: those birds that may be seen in Antigua as they are known to pass by the area on their migration routes.