FINAL DRAFT PRELIMINARY ASSESSMENT

SITE ASSESSMENT REPORT FLAMINGO BAY ARMY TEST AREAS, WATER ISLAND, VI

Prepared for
U.S. Department of the Interior
Bureau of Reclamation
Denver Federal Center
Denver, Colorado

July 17, 2001

URS

8181 E. Tufts Avenue
Denver, Colorado 80237

68-FUSBR285.00

DERP - Fort Segarra

United States Department of the Interior

BUREAU OF RECLAMATION
Commissioner's Office
PO Box 25007
Denver Federal Center
Denver, Colorado 80225-0007

IN REPLY REFER TO:

D-8160
PRJ-8.10

JUL 27 2001

Mr. Robert Bridgers
US Army Corps of Engineers
Jackson District
400 West Bay Street
Jacksonville FL 32232-0019

Subject: Flamingo Bay Test Areas (Former Fort Segarra, Water Island, Virgin Islands)

Dear Mr. Bridgers:

Enclosed is a document entitled "Site Assessment Report - Preliminary Assessment," prepared by the U.S. Department of the Interior (DOI) for the Flamingo Bay Army Test Areas, formerly known as Fort Segarra, Water Island, U.S. Virgin Islands. This document was sent to EPA Region 2, on July 17, 2001, as a "draft-final" document to be finalized upon receipt of EPA comments. DOI prepared this document in response to the listing of the facility by the U.S. Environmental Protection Agency (EPA) on the Federal Agency Hazardous Waste Compliance Docket 65 Federal Regulations 36994 (June 12, 2000). DOI also prepared this document in response to the request made by Robert Wing of the Federal Facilities Section of EPA Region 2, that DOI prepare a preliminary assessment report relative to non-munitions waste, and consistent with EPA Guidance.

As you can see from appendices to the enclosed report, DOI has computed a Hazard Ranking Score (HRS) for the site consistent with EPA guidance. The HRS score falls far short of the threshold for listing the site on the National Priorities List. In addition, I note that EPA guidance for conducting preliminary assessments provides, that scores of less than 28.50 generally give rise to a "no further remedial action planned (NFRAP)" recommendation without further investigation. DOI believes that, given the very low potential for risk relative to non-munitions waste at this site, indicated by the HRS score and consistent with EPA guidance, no further investigation for non-munitions waste is required. Discussion with and comments from EPA relative to the report will determine the type, if any, and extent of any recommended sampling plan prepared for the site.

I hope this information is helpful. In addition, I note, that nothing in the EPA report alters or affects the obligation of the Army to conduct a further investigation for the presence of munitions, or the approach identified by the Army in its conceptual work plan for further site investigation for munitions. DOI commits to work with the Army to ensure that any risk associated with the potential presence of munitions at the site is fully assessed, and addressed as necessary.

Please call me ((303) 445-2181) if you have any questions or concerns about this matter.

Sincerely,

Margaret A. Lake

Margaret Lake, Chemist
Bureau of Reclamation
Technical Service Center

Enclosures

cc: D-8170 (MAAG)
(w/o encl)

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INTRODUCTION

The U.S. Environmental Protection Agency (EPA) listed the Flamingo Bay Army Test Areas (See Figures 1 and 2) on the Federal Agency Hazardous Waste Compliance Docket pursuant to Section 120(c)of CERCLA on June 12, 2000. This listing was prompted by the Army's Site Characterization Report indicating the possible present of chemical warfare agents at this site. The docket is a listing of sites that are federally owned or operated that manage hazardous waste or at which hazardous substance may have been released into the environment. EPA is required to evaluate all docket sites to determine whether they pose a risk to human health and/or the environment and for possible listing on the National Priorities List (NPL).

One of the first steps in EPA's site evaluation process is the Preliminary Assessment (PA). The PA is a limited-scope investigation with the goal of collecting readily available information through a records search, site reconnaissance and environs reconnaissance. The PA is designed to distinguish between sites that pose little or no threats to human health and the environment and sites that require further investigation. The Flamingo Bay Army Test Area is owned by the United States and is under the jurisdiction, custody, and control of the U.S. Department of Interior (Interior). As such, Interior contracted with URS Corporation (URS) to assist in preparation of the PA.

The site and environs reconnaissance was conducted by URS personnel and officials from Interior and the Bureau of Reclamation during the first week of May 2001. Interior has prepared this PA to meet its CERCLA 120 (c) requirements. In addition, this PA was prepared because Interior plans to transfer these properties to the Virgin Islands government. Prior to that transfer there is an obligation to meet the transfer requirements defined at CERCLA 120(h). The completion of this PA assists in addressing this requirement as well.

The focus of this PA was on any possible non-munitions hazardous substances activities associated with the site that may have occurred following the Department of Defense's departure from the site in 1952. Because the Site is a Formerly Utilized Defense Site, the Army is also required under the Defense Environmental Restoration Program to investigate and remediate contamination related to the Army's past activities at the site during the period 1948 to 1952. This document was prepared in accordance with EPA's *Guidance for Performing Preliminary Assessments Under CERCLA,* dated September 1991 and presents a summary of the findings associated with the May 2001 site visit. The format of this document follows the format of EPA Region II's PA/Scoresheets.

SITE ASSESSMENT REPORT
PRELIMINARY ASSESSMENT

Flamingo Bay Army Test Areas

PART I: SITE INFORMATION

1. **Site Name**: Flamingo Bay Army Test Areas
   Former Ft. Segarra, Water Island, VI 00802

2. **County** – NA **County Code** – NA **Congressional District**: VI, At Large

3. **CERCLIS ID NO.** VI0000591875

4. **Block No.** Not Applicable **Lot. No.** Not Applicable

5. **Latitude** - 18° 18' 37.2'' **Longitude** - 64° 57' 28.7''
   USGS Quadrangle Map – Central St. Thomas

6. **Approximate size of site** – 258,012 square feet

7. **Owner** The property is currently owned by the United States and under the jurisdiction, custody and control of the:

   U.S. Department of Interior
   1849 C Street NW
   Washington, DC 20240

   Prior to 1952, the property was under the jurisdiction, custody, and control of the Department of Defense.

8. **Operator** Same as Owner

9. **Type of Ownership** – Federal

10. **Owner/Operator Notification on File** – Not Applicable

11. **Permit Information** – Not Applicable

12. **Site Status** – Active

Portions of Test Areas 4 and 5 are still used by the local homeowner's association, the Water Island Civic Association (WICA). Abandoned vehicles are currently being stored in Test Area 4.

Similarly, Test Area 5 is being used by WICA. A solid Waste Transfer Station has been established in Test Area 5 as a collection area for household trash, landscaping wastes, and construction debris. The Virgin Islands Department of Public Works administers this

Transfer Station. Roll-off bins are used to hold household trash. Separate staging areas have been established for residents of Water Island to store car batteries and used oil. Construction debris and landscaping waste are stored uncontained. On a monthly basis, a trash collection service picks up the waste for disposal off the island.

The Flamingo Bay Landfill is currently not in use. A fence has been placed around Flamingo Bay Landfill to restrict Water Island resident's access to the area. However, approximately 180 feet, along the southeastern side of the landfill, is currently not enclosed with a fence.

13. Years of Operation: 1948-2001

14. Identify the types of waste sources.
(a) Waste Sources

Waste Unit No.	Waste Source Type	Facility Name for Unit
1	Landfill	Flamingo Bay Landfill
2	Waste Pile	Test Area 4
3	Waste Pile	Test Area 5

(b) Other Areas of Concern

No other areas of concern were observed during the site visit.

15. Regulatory History of Site (including the scope and objectives of any previous response actions, investigations, and litigation by state, local and federal agencies.)

15.1 Site History

The United States acquired Water Island in 1944 from the East Asiatic Company, Ltd., Denmark. Water Island was purchased by the U.S. Government in 1944 to establish a fort to protect the Roosevelt Roads Naval Station in Puerto Rico. Water Island was to be the main defense battery, with secondary defense batteries located on St. Thomas. From 1944 to 1952, Water Island was under the jurisdiction of the Department of Defense (DOD) and was used for military purposes. The Army began the constructed Fort Segarra on the island soon after it was purchase. Approximately 33 structures were constructed on Water Island for this purpose including gun emplacements, bunkers, barracks, and support facilities. The fort was never completed, however, due to the end of World War II. Consequently, neither the guns nor explosive munitions were ever delivered to Fort Segarra.

However, the Army also used the island as a base for the San Jose Project. The purpose of the San Jose project was to determine the effectiveness of chemical munitions and

defenses in jungle terrain, and the effects on chemical munitions of storage in tropical climates. A number of tests of persistent and lethal chemical agents were performed on Water Island. Attempts at extensive testing were frustrated by lack of approved test plans, lack of material, lack of time or lack of funds.

File records documented that five tests were conducted on Water Island. Although documentation does not exist, it is believed that an additional two tests were also conducted on the island. Of the five tests documented for Water Island, three involved the static firing of chemical munitions and two were surveillance tests to determine property changes in bombs subjected to the tropical environment.

In May of 1950, the Army announced the cancellation of the San Jose Project and the transfer of its functions to the CEBAR Proving Grounds (now Dugway Proving Grounds) in Utah. Project personnel began terminating activities immediately and the project was completely shut down by September 1950.

Water Island was transferred to the Department of the Interior (Interior) in 1952 and leased for two 20-year terms to a corporation, Water Island, Inc, for the construction of a resort complex. The corporation, as the master leaseholder, subsequently granted more than 140 separate subleases. Many of these subleaseholders built homes on the island.

During the early 1990s, Interior proposed to transfer most of the property on Water Island to the leaseholders. Regulations promulgated by EPA, as well as internal Interior policy as set forth in its Departmental Manual part 602 DM2, required that Interior ascertain the presence or potential presence of hazardous substances on property intended for sale or transfer. In addition, CERLCA section 120(h) imposes environmental assessment obligations on federal agencies when they transfer property to third parties.

In June 2000, the U.S. Environmental Protection Agency (EPA) listed the Flamingo Bay Army Test Areas, Former Fort Segarra, Water Island, VI on the Federal Agency Hazardous Waste Compliance Docket (docket) pursuant to Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). 65 Federal Register 36997 (June 12, 2000).

As a docket site, a Preliminary Assessment (PA) is required to be submitted to EPA so that a determination can be made whether the site is a potential National Priorities List (NPL) candidate. Interior, with jurisdiction custody and control of the site, is required to provide information to EPA on any other types of possible hazardous waste activities that may have occurred following the Army's departure from the site. In addition, since Interior would like to transfer these sites to the Virgin Islands (VI) government, it is Interior's goal to thoroughly evaluate these properties to ensure compliance with appropriate transfer requirement under CERCLA Section 120 (h).

15.2 Previous Investigations

15.2.1 Ebasco Environmental's Archive Search Report (July 1991)

In 1991, the U.S. Army Corps of Engineers hired Ebasco Environmental (Ebasco) to conduct an archive search to find and evaluate available information related to the San Jose Project in the U.S. Virgin Islands. Specifically, Ebasco was to review the data to determine if the sites used by the San Jose Project in the U.S. Virgin Islands are potentially contaminated by conventional or special (chemical) ordnance or explosive wastes.

According to the records uncovered by Ebasco, only a limited number of tests were completed. The tests that were identified as associated with Test Areas 4 and 5 are described below:

Static Test of M 70 Bomb (HD Filled).

In early 1949, an AN-M70 (a 115-pound (lb) bomb filled with distilled mustard) was tested in Areas 4 and 5. The M70 bomb is 51.5 inches long and 8 inches in diameter, with an 11-inch fin span. This type of mustard is a relatively pure liquid that produces blisters on skin when there is liquid contact, and, if inhaled in sufficient quantities, "burns" the lungs and produces choking or "chemical pneumonia." In this test, the bombs were supported in a vertical or near vertical position just at the ground surface and detonated remotely. The intention was to simulate detonation at ground surface after being dropped from an airplane.

Static Test of Single E-23 Smoke Pot, HD Filled, In the Open.

This test was performed in the summer of 1949 in Test Area 4. Smoke pots are used primarily to obscure the battlefield from enemy observation and to deceive the enemy about real intentions. Smoke can also be used to disseminate chemical agents to produce casualties in downwind areas. The E-23 smoke pots are 5-gallon steel containers, 13 inches high and 12 1/16 inches in diameter. The purpose of the test was to determine the dosage produced in the field, the rate of dose created, the degree of decomposition loss in the smoke pot, and the overall efficiency of agent dissemination from static firing of the smoke pot.

Static Test of Single E-23 Smoke Pot, GA Filled, In the Open.

Through its archive search, Ebasco was not able to specifically identify the exact locations where this test was conducted. However, the test described below was conducted as part of the San Jose Project on Water Island and could have taken place in Area 4 or Area 5.

GA is a lethal nerve agent first produced by Germany during World War II. It is a non-persistent agent. This agent can be inhaled or absorbed through the skin and inhibits cholinesterase activity in the body. The report of this test could not be found; however, monthly progress reports indicate tests took place in November and December of 1949.

A subsequent study conducted by the U.S. Army Chemical Material Destruction Agency in 1993 identified an additional test that may have been conducted in Test Area 4. This test is described as a Test of a Single E-23 Smoke Pot, HQ-filled. HQ is a combination of sesquimustard and Mustard, toxic vesicants. However, this potential test activity was not discovered by Ebasco during its Archive Search Study.

In May of 1991, Ebasco, as part of its archives search project, conducted a site inspection of Water Island. The following excerpts describe their observations regarding Flamingo Bay Landfill and Test Areas 4 and 5.

Flamingo Bay Warehouse and Trash Dump

A metal warehouse was constructed near the deep-water dock by the Water Isle Hotels and Beach Clubs for storage of vehicles and materials. The warehouse was constructed on an area filled in for this purpose. A salt pond located south of the warehouse was excavated to form a landfill. However, in 1966 during the excavation operations two objects that resembled bombs were unearthed. Mr. Couter, a Water Isle employee, reported that hotel employees were removing "elephant muck" from the site with a dragline when the bombs were located. The Naval Explosive Ordnance Detachment was contacted to remove the bombs and dispose of them. The Detachment identified the objects as a 500 lb M70 and an M78 500 lb bomb. Hotel employees were instructed by the Detachment not to dig in the immediate area the bombs were discovered, and the area was filled in and covered with borrowed soil to a depth of about three feet. Debris and scrap materials have been subsequently deposited on the site.

Test Area No. 4

This area is located to the south and southwest of the Flamingo Bay Harbor. The site straddles the road that comes from the main dock. The area north of the road is relatively clear of debris, however, the area south of the road is an island junkyard with approximately 50 abandoned vehicles.

Test Area No. 5

This area is located south and southeast of the Flamingo Bay Harbor and is south of the road that comes from the main dock. This area was used to accumulate and burn debris from Hurricane Hugo. There was a substantial amount of metallic debris on the ground.

15.2.2 U.S. DOI, Water Island U.S. Virgin Islands Title Transfer, Final Environmental Assessment and Findings of No Significant Impact (May 1996)

Before title to Water Island could be transferred, an environmental study was completed in accordance with the National Environmental Policy Act of 1969 (NEPA) to determine if any significant impacts would result from the termination of federal jurisdiction and ownership. Interior prepared the Environmental Assessment in 1996. As part of its assessment, Interior conducted a site inspection of the Flamingo Bay Landfill and Test Areas 4 and 5. Excerpts from their field inspections are provided below:

Flamingo Bay Landfill

The landfill is the location where two military bombs where discovered during mucking operations by the master lessee in 1966. In 1991, Ebasco gave the area a risk assessment code of 1 because of the possibility of munitions being present. The landfill was fenced as a result. The area inside the enclosure contained abandoned vehicles and some discarded construction materials.

Test Area 4

Test Area 4 was heavily overgrown with a low canopy of bushes and scrubs, with the only open areas created by the open dump and the road leading to the warehouse. An examination of the former test area during the site reconnaissance did not reveal any physical anomalies associated with burial sites (i.e., depressions, mounds, etc.), signs of stressed vegetation, or barren ground surfaces.

A large portion of the test area was excavated when Water Island, Inc., dredged the entrance to Flamingo Bay Marina. Presently, residents of the island use the southern end of the site as an open dump. The dump contains household trash, abandoned automobiles, construction debris, appliances, a tanker trailer, paint cans, car batteries, gas cans, an approximately 3,000-gallon tank full of unknown liquid, and solvent containers.

Test Area 5

The area appeared to have undergone extensive excavation and grading. The site was predominantly vegetated by grasses, with isolated patches of bushes, shrubs, and barren ground. The patches of barren ground exposed cropping out bedrock and did not appear to be caused by contamination. The site contains several scattered piles of construction debris, including corrugated boards (potential asbestos containing material), corrugated metal roofing material, and several empty rusted 55- gallon drums. Other debris included a car battery and a gas tank from an automobile. A large concrete structure that reportedly was erected and used by the hotel to make concrete was also present at this site.

The site also contains the burn pit excavated by the former master lessee to dispose of debris generated by Hurricane Hugo in 1989. The dimensions of the burn pit measured approximately 20 feet side by 100 feet long. The pit was surrounded by dense vegetation and appeared to contain standing water. Access to the bottom of the pit could not be gained and, consequently, the appearance and condition of the water could not be assessed. There were no signs of obvious contamination (i.e., stressed vegetation, barren spots, or stains). A car battery was the only indication of potentially hazardous substances at the site.

15.2.3 MTA, Inc. Phase I Remedial Investigation (RI) Report Site in the U.S. Virgin Islands and Puerto Rico (January 1996)

MTA was contracted by the Army Corps of Engineers to perform site characterization and debris removal operations at Former Fort Segarra, Water Island. Its observations related to the landfill and test areas are summarized below:

Flamingo Bay Landfill

MTA personnel discovered a vented one (1) ton container that appeared to be from the San Jose Project. In addition, a local worker told the U.S. Army Corps of Engineers site representative that he was present during demobilization of the San Jose Project in 1950 and saw projectiles buried in what is now a linear depression which looks like a covered ditch. The technical Escort Unit took a soil sample from the one (1) ton container. All samples from this site produced negative results.

Magnetometer sweeps gave an almost continuous "ring off" which indicates a large number of anomalies in this area. MTS also found what appeared to be numerous buried automobiles which earlier investigations reported were used as fill for the extension of the shoreline in the 1960's.

Test Area 4

MTS conducted a surface investigation of the Test Area that is located between the road from the main dock and the shoreline. The area was relatively clear of debris and heavy vegetation. Magnetometer sweeps indicated some anomalies but did not give indications of any buried munitions or munitions related materials.

MTA had to clear the heavy debris and 78 junk vehicles that were located south of the road. The debris and vehicles were transported off of Water Island and disposed of at the St. Thomas public landfill. Automotive fluids were drained and batteries removed prior to transport. These hazardous materials were shipped off-site and managed in accordance with applicable environmental regulations.

The surface investigation of the area of test area 4 south of the road indicated large number of anomalies of a suspicious nature that may be buried munitions or munitions materials. In addition, MTA found an eight (8) foot diameter circular area that was sunken and had no vegetation growing in it. Magnetometer reading indicated almost a continuous response in the circular area.

Test Area 5

MTA had to remove substantial heavy tropical vegetation and consolidate approximately 90 cubic yards of household debris prior to performing the surface investigation. The surface sweeps indicated a large number of anomalies, a subset of which may be classified as suspect buried munitions or munitions material.

15 a) Is the site or any waste sources subject to the Petroleum Exclusion? Identify petroleum products and by products that justify this decision.

This site is not subject to the petroleum exclusion because EPA's current interpretation of the petroleum exclusion is for a release or threatened release involving **solely** crude oil, fraction of crude oil, or refined crude oil products. The potential exists for releases of hazardous substance, such as metals contamination, as well as petroleum products at this site.

15 b) Are pesticides produced and stored on site? Does the facility apply pesticides (Federal Insecticide, Fungicide, and Rodenticide Act) to any part of the property?

There is no evidence that pesticides were produced, stored, or applied to the landfill or test area sites.

15 c) Is the site or any waste source subject to RCRA Subtitle C?

This site is not subject to RCRA subtitle C. The types of sites subject to RCRA subtitle C include:

- Facilities that treated, stored, or disposed of RCRA hazardous waste since November 19, 1980.
- Facilities that currently have a RCRA Part B Operating permit or post-closure permit.
- Facilities that filed a RCRA Part A application.
- Facilities that were Non-or late filers.

The Flamingo Bay landfill and test areas do not meet any of the criteria listed above. Any waste generated since 1980 would have been associated with the hotel and resident activities. Household generated waste is exempt from RCRA subtitle C regulation. Any

hotel generate waste would likely be considered "conditionally exempt small quantity generated."

15 d) Is the site or any waste source maintained under the authority of the Nuclear Regulatory Commission (NRC)?

There is no indication that radioactive materials or wastes were every present at the landfills or test areas. The site is not maintained under the authority of the NRC.

16. Information Available from:

Contact – Ms. Helen Shannon, USEPA **Telephone Number:** (212) 637-4260

Preparers- Ms. Margaret Lake, Bureau of Reclamation **Telephone Number**: (303) 445-2181

Ms. Lisa Millet, URS Corporation **Telephone Number**: (303) 740-2780

PART II: WASTE SOURCE INFORMATION

Waste Unit Number 1: Flamingo Bay Landfill

Source Type: Landfill

Description:

1. **Describe the types of containers, impoundments or other storage systems (i.e., concrete lined surface impoundments) and any labels that may be present.**

The landfill is approximately 88,650 square feet in size. During the May 2001 Preliminary Assessment (Assessment), most of the landfill was enclosed by an eight foot high chain link fence. Access is normally gained through a gate, which is locked. However, fencing did not enclose approximately 180 feet, along the southeastern side of the landfill. The surface of the landfill area is densely vegetated with a low canopy of grasses, bushes and shrubs. (See Photograph Nos. 1-5). A perimeter survey of the landfill was conducted following the road that runs around the landfill. From the road, the following items were identified in the landfill area: a large truck, cars, miscellaneous construction debris, empty oil cans, and an abandoned chiller unit. There was no evidence of stained soils or stressed vegetation.

2. **Describe the physical condition of the containers or storage systems (i.e., rusted and/or bulging metal drums).**

The landfill was a trench and fill operation that did not include engineering controls (liners, leachate collection systems, cap or cover). In addition, there were no containers observed in the landfill area. The items observed in the landfill were simply stored on the ground surface.

3. **Describe any secondary containment that may be present (e.g., drums on concrete pads in buildings or above ground tanks surrounded by berms).**

There was no secondary containment observed in the landfill area.

Hazardous Substances/Physical State

No hazardous substances were observed in the landfill area.

PART II: WASTE SOURCE INFORMATION (continued)

Waste Unit Number 2: Test Area 4

Source Type: Waste Pile

Description:

1. **Describe the types of containers, impoundments or other storage systems (i.e., concrete lined surface impoundments) and any labels that may be present.**

Test Area 4 is approximately 52,800 square feet in size. Test Area 4 was heavily overgrown with a low canopy of bushes and shrubs, with the only open areas created by the open vehicle storage areas and the road leading to the abandoned cars. During the May 2001 Preliminary Assessment (Assessment), approximately 86 abandoned vehicles were being stored. (See Photograph Nos. 6-11). Most of the vehicles had belonged to island residents. There was one tanker truck that Mr. Coutier, a former hotel employee and current resident, indicated was used to supply water to the hotel. The area was surveyed by walking among the abandoned vehicles. Island residents indicated that they typically drain the fluids and remove the batteries prior to abandoning the cars. There were no batteries in the car inspected. In addition, there were no drips or leaks of fluids observed from the vehicles. Finally, there was no evidence of stained soils or stressed vegetation.

2. **Describe the physical condition of the containers or storage systems (i.e., rusted and/or bulging metal drums).**

There were no containers observed in Test Area 4. The cars were simply parked on the ground surface.

3. **Describe any secondary containment that may be present (e.g., drums on concrete pads in buildings or above ground tanks surrounded by berms).**

There was no secondary containment observed in the Test Area.

Hazardous Substances/Physical State

No hazardous substances were observed in the Test Area.

PART II: WASTE SOURCE INFORMATION (continued)

Waste Unit Number 3: Test Area 5

Source Type: Waste Pile

Description:

1. **Describe the types of containers, impoundments or other storage systems (i.e., concrete lined surface impoundments) and any labels that may be present.**

Test Area 5 is approximately 116,562 square feet in size. Test Area 5 was heavily vegetated with grasses and a low canopy of bushes and shrubs. The trash collection activities and the road leading to the trash storage areas created the only open areas. During the May 2001 Preliminary Assessment (Assessment), the following items were observed in Test Area 5: several roll-off bins used to collect household trash from island residents, appliances, a pallet storing car batteries, a 55-gallon drum and other small containers storing used oil, uncontainerized landscaping debris and construction debris. (See Photograph Nos. 12-16). All non-hazardous construction debris from the demolition of the former hotel was disposed of in Test Area 5. There was no evidence of stained soils or stressed vegetation in Test Area 5.

2. **Describe the physical condition of the containers or storage systems (i.e., rusted and/or bulging metal drums).**

The roll-off containers used to collect household trash are in good condition. The containers holding used oil were also free from rust, bulges, or dents. No leaks were observed from the car batteries and the used oil containers.

3. **Describe any secondary containment that may be present (e.g., drums on concrete pads in buildings or above ground tanks surrounded by berms).**

There was no secondary containment observed in the Test Area.

Hazardous Substances/Physical State

The hazardous substances observed in the Test Area are the used oils and the car batteries.

PART III: SAMPLING RESULTS

Existing Analytical Data

There is no existing groundwater, soil, sediment, surface water, air or waste sampling analysis for the landfill or either test areas.

PART IV: HAZARD ASSESSMENT

Groundwater Route

1. Describe the likelihood of a release of contaminant(s) to the groundwater as follows: observed release, suspected release, or none. Identify contaminants detected or suspected and provide a rationale for attributing them to the site. For observed releases, define the supporting analytical evidence and relationship to background.

Suspected releases are assumed for the landfill and the two test areas. Based on information contained in the Ebasco reports and the DOI Environmental Assessments hazardous substances such as used oil, car batteries, and abandoned vehicles were deposited on the three source areas. Given the shallow depth to ground water (from 0 to 10 feet below ground level) it is likely that groundwater could be impacted with metals and hydrocarbon contaminants.

Reference Nos. 1, 3, and 4

2. Describe the aquifer of concern; include information such as depth, thickness, geologic composition, areas of karst terrain, permeability, overlying strats, confining layers, interconnections, discontinuities, depth to water table, and groundwater flow direction.

Available information was reviewed to assess whether potentially contaminated ground water beneath Water Island, specifically from the southern part of the island, could be a threat to the groundwater aquifer currently being used as a potable water supply on the nearby island of St. Thomas.

Water Island is on the eastern portion of the Greater Antilles submarine shelf, which many geologists believe is an extension of the Rocky-Andes mountain chain. The island is of volcanic origin and is comprised of undeformed and metamorphosed Cretaceous volcanic and volcanic sedimentary rocks. In general, rocks of volcanic origin dominate the center of the island, while the perimeter of the island is comprised of sedimentary rocks.

Little is known about groundwater conditions on Water Island. The island reportedly was named because potable water in the form of shallow freshwater ponds was used by early sailors. Some of the freshwater and occasional saltwater ponds have apparently been backfilled by construction, dredging and landfilling operations over the years. The depth to groundwater at Water Island is reported to range from 0 feet below ground surface at the salt water ponds to over 10 feet below ground surface. In general, groundwater exists in residual soil as well as underlying fractured bedrock of volcanic origin. Because of unreliable groundwater supplies, the US military and other island residents, both

historically and at present, obtained drinking water by collecting rainfall and storing it in cisterns. Therefore, groundwater on Water Island is not used as a source of drinking water. Nor is groundwater used for any other purposes on the island.

As is typical of smaller islands in the Caribbean, Water Island likely hosts a shallow freshwater aquifer of limited horizontal (i.e., areal extent of the island) and vertical extent. These shallow aquifers are recharged directly from precipitation falling on the landmass and infiltrating into underlying strata. The freshwater aquifer is usually relatively thin and is underlain by saltwater saturated rocks. The topography of Water Island is hilly to mountainous with ground surface elevations ranging from sea level to 290 feet above mean sea level. A bedrock ridge trends generally from north to south through the central part of the island. Accepted groundwater hydrology principles would suggest that shallow groundwater underlying Water Island (freshwater component) likely flows from areas of higher topography to low areas. In the case of Water Island, one would expect shallow groundwater to flow toward the east, east of the ridgeline and generally to the west, west of the ridgeline. The shallow fresh groundwater probably then discharges into the surrounding ocean.

Since Water Island is separated from St. Thomas by an ocean channel, there is little likelihood that the aquifer supplying St. Thomas is hydraulically connected to the shallow fresh water aquifer underlying Water Island. Furthermore, the direction of shallow groundwater flow in the southern part of Water Island is expected to be to the west-southwest and east-southeast away from the island of St. Thomas located to the north.

Reference Nos. 1, 3, 4, 12, and 13

3. What is the depth from the lowest point of waste disposal/storage to the highest seasonal level of the saturated zone of the aquifer of concern?

The depth to groundwater at Water Island is reported to range from the surface to greater than 10 feet below ground surface. Given that waste may have been deposited by the Army and former hotel to fill in wetland areas, it is possible that the waste is present in the zone of saturation.

Reference Nos. 1, 3, and 4

4. What is the permeability value of the least permeable continuous intervening stratum between the ground surface and the top of the aquifer of concern?

As stated above, the depth to groundwater at Water Island is reported to range from the surface to greater than 10 feet below ground surface. As such, there may be no intervening stratum between the ground surface and the groundwater.

Reference Nos. 1, 3, and 4

5. What is the net precipitation at the site (inches)?

The average annual rainfall in St. Thomas is from 41 to 42 inches per year.

Reference No. 1

6. What is the distance to and depth of the nearest well that is currently used for drinking purpose?

There are no drinking water wells on the island. Island residents collect rainwater in cisterns as their source of drinking water. When rainfall amounts are too small to fulfill water needs, residents ship water to the island by barge from St. Thomas.

Reference Nos. 3 and 4

7. If a release to groundwater is observed or suspected, determine the number of people that obtain drinking water from wells that are documented or suspected to be actually contaminated by hazardous substance(s) attributed to an observed release from the site.

As stated above, there are no drinking water wells on the island. Island residents collect rainwater in cisterns as their source of drinking water. When rainfall amounts are too small to fulfill water needs, residents ship water to the island by barge from St. Thomas.

Reference Nos. 3 and 4

8. Identify the population served by wells located within 4 miles of the site that draw from the aquifer of concern.

There are no populations within 4 miles of the site that draw from the aquifer of concern.

Reference Nos. 3 and 4

State whether groundwater is blended with surface water, groundwater or both before distribution.

Not applicable since groundwater is not used as a source of drinking water on Water Island.

Reference Nos. 3 and 4

Is a designed well head protection area within 4 miles of the site?

There are no well head protection areas within 4 miles of Water Island.

Reference No. 5

9. Identify any of the following resource uses of groundwater within 4 miles of the site (i.e., commercial livestock water, ingredient in commercial food preparation, supply commercial aquculture, supply for major, or designated water recreation areas, irrigation of commercial food or commercial forage crops)

The groundwater on Water Island is not used for any of the uses listed above. There are currently no active wells to access ground water on the island.

Reference No. 4

Surface Water Route

10. Describe the likelihood of a release of contaminant(s) to surface water as follows: observed release, suspected release, or none. Identify contaminants detected or suspected and provide a rationale for attributing them to the site. For observed release, define the supporting analytical evidence and relationship to background.

Given the close proximity of the landfill and test areas to Flamingo Bay and the fact that the waste materials were stored in waste piles, it is possible that a release of contaminants to the bay has occurred. Potential contaminants that could have made their way into the bay include metals and hydrocarbons.

Reference No. 3 and 4

11. Identify the nearest down slope surface water. If possible, include a description of possible surface drainage patterns from the site.

Flamingo Bay is the nearest down slope surface water from the landfill and test areas.

Reference No. 3

12. What is the distance in feet to the nearest down slope surface water? Measure the distance along a course that runoff can be expected to follow.

Flamingo Bay is as close as 200 feet to the landfill and test areas.

Reference No. 3

13. Identify all surface water body types within 15 downstream miles.

The ocean is the only surface water body type within 15 miles of Water Island.

Reference No. 3

14. Determine the 2 year, 24 hour rainfall (in inches) for the site.

The 2 year, 24 hour rainfall for the site is 4.3 inches.

Reference No. 8

15. Determine the size of the drainage area (acres) for sources at the site.

The size of the drainage area is 26 acres. This is the drainage area that contributes to all three sources (landfill and two test areas).

Reference No. 3

16. Describe the predominant soil group in the drainage area.

The predominant soil types on Water Island are clay loams, gravelly clay loams, and gravelly clays belonging to the Cramer Series. These soils are typically associated with rocks of volcanic origin and are found along the ridgeline and hillslopes. In addition, minor amounts of silty clay loams, silty loams, and sands of the Jaucas Series can be found in the low lying areas. The depth to bedrock ranges from 0 to over 60 feet. The permeability of the soil units ranges from a low of 4.2E-5 to a high of 4.4E-3 cm/sec. The available water capacity ranges from a low of 0.10 to a high of 0.20 inches/inch of soil.

Reference Nos. 1, 4, and 13

17. Determine the type of floodplain that the site is located within.

The Federal Emergency Management Agency (FEMA) has designated the southeastern portion of the landfill as Zone A and A8. The remainder of the landfill area and Test Areas 4 and 5 are designated as Zone C.

Zone A is defined as an area of 100-year flood. Zone A8 is defined as an area of 100-year flood with a base elevation of 8 feet. Zone C is defined as an area of minimal flooding.

Reference No. 9

18. Identify drinking water intakes in surface waters within 15 miles downstream of the point of surface water entry. For each intake, identify the name of the surface water body in which the intake is located, the distance in miles from the point of surface water entry, population served and stream flow at the intake location.

Intake	Distance	Population Served	Type of Intake
Crown Bay		49,000	Ocean
Ritz Carlton		300	Ocean
Secret Harbor		300	Ocean

Reference No. 7

19. Identify fisheries that existing within 15 miles downstream of the point of surface water entry.

There are no fisheries within 15 miles of Water Island.

Reference No. 5 and 6

20. Identify surface water sensitive environments that exist within 15 miles of the point of surface water entry.

Environment	Water Body	Flow	Wetland Frontage
Coral Reef	Ocean	NA	NA
Sea Grass Beds	Ocean	NA	NA
St. John Island	Ocean	NA	NA

Other than St. John Island National Park there are no federally protected sensitive environments within 15 miles of Water Island. However, the following environments were identified by U.S. Fish and Wildlife as being worthy of protection. The fringing coral reefs extend around the south and east shores of Water Island from just west of Flamingo Point east to Sand Bay.

Sea Grass beds are present on both the east and west sides of Water Island. The beds occur in Limestone Bay, Sprat Bay, and Banana Bay on the east side of the island. The Sea Grass is more abundant on the west side of Water Island. On the west side of the island the sea grass is present in Ruyter Cove, Elephant Bay, and Providence Point.

Reference No. 4 and 5

21. If a release to surface water is observed or suspected, identify any intakes that are or may be actually contaminated by hazardous substance(s) attributed to an observed release from the site.

Although the assumption has been made that contaminants from the site have entered Flamingo Bay, the dilution of the contaminants in the ocean waters would make it highly unlikely that these contaminants would be detected in the ocean intakes that are used to supply part of the drinking water on St. Thomas. In addition, the ocean water is treated with reverse osmosis units prior to use. It is likely that any contaminants would be removed in this treatment process.

Reference No. 3

22. Identify whether the surface water is used for any of the following purposes, such as irrigation of commercial food or commercial forage crops, watering of commercial livestock, commercial food preparation, recreation, and potential drinking water supply.

The ocean is used as a recreation resource. There are several beaches on Water Island. In addition to the three drinking water intakes already existing on St. Thomas, it is possible that future intakes could be installed. However, water extracted from the ocean for drinking water purposes would need to be desalinated prior to use.

Reference No. 3 and 7

Soil Exposure Pathway

23. Determine the number of people that occupy residences or attend school or day care on or within 200 feet of observed contamination.

There are no schools or day care facilities on Water Island. There are approximately 5 homes just south of the landfill and test areas. Approximately 20 residents are located within 200 feet of the source areas. However, no areas of observed contamination were identified during the site inspection.

Reference No. 3

24. Determine the number of people that regularly work on or within 200 feet of observed contamination.

No one works within 200 feet of the source areas.

Reference No. 3 and 4

25. Identify terrestrial sensitive environments on or within 200 feet of observed contamination.

No terrestrial sensitive environments exist within 200 feet of the source areas.

Reference No. 3 and 4

26. Identify whether there are any of the following resource uses, such as commercial agriculture, silviculture, livestock production or grazing within an observed or suspected soil contaminated area.

There are no such resource uses on Water Island.

Reference No. 3

Air Pathway

27. Describe the likelihood of release of hazardous substance to air as follows: observed release, suspected release or none. Identify contaminants detected or suspected and provide a rationale for attributing them to the site. For observed releases, define the supporting analytical evidence and relationship to background.

A release of hazardous substances to the air may have occurred in the 1948-1950 time frame when the Army was active with the San Jose Project on Water Island. However, the chemicals released to the atmosphere during the test would not be expected to still be present today. The current uses of the landfill and test areas would not result in a release of hazardous substance to the air.

Reference No. 3

28. Determine populations that reside within 4 miles of the site.

Distance	Population
>0-1/4 mile	30
>1/4-1/2 mile	40
>1/2 – 1 mile	70
>1-2 miles	32
>2-3 miles	13,000
>3-4 miles	28,000

Reference No. 11

29. Identify the sensitive environments, including wetlands and associated wetlands acres, within 4 miles of the site.

Distance	Wetland Acreage	Environment
>0-1/4 mile	NA	Coral Reef at Flamingo Point
>1/4-1/2 mile	1.78 acres	Salt Pond at Limestone Bay
	NA	Coral Reef at Limestone Bay
>1/2 – 1 mile		Sea Grass in Druif Bay
>1-2 miles	0.98 acres	Salt Pond at Sands Bay
	1.38 acres	Salt Ponds on Sprat Point
	NA	Sea Grass in Elephant Bay
	NA	Sea Grass at Carolina Point
	NA	Sea Grass on Ruyter Cove
	NA	Sea Grass at Banana Point
>2-4 miles		None Identified
>3-4 miles		None Identified

Reference No. 4

30. If a release to air is observed or suspected, determine the number of people that reside or are suspected to reside within the area of air contamination from the release.

A release to the air was not observed and is not suspected.

Reference No. 3

31. If a release to air is observed or suspected, identify any sensitive environments, listed above in question No. 29, that are or may be located within the area of air contamination from the release.

A release to the air was not observed and is not suspected.

Reference No. 3

SUMMARY AND CONCLUSIONS

Since the 1940's the Flamingo Bay landfill and Test Areas 4 and 5 have undergone both military and civilian uses. The landfill and test areas were first used in association with the San Jose Project. The U.S. Army conducted the San Jose Project on Water Island to determine the effectiveness of chemical munitions and defenses in jungle terrain and the effects on chemical munitions storage in tropical climates. This project was conducted on Water Island from 1948 until 1950.

During the mid-1960's two bombs (similar to the types used during the San Jose Project) were unearthed in the landfill indicating that the Army used this area for disposal purposes. Hotel operators subsequently used the landfill to dispose of hotel generated wastes.

A limited number of tests associated with the San Jose Project were conducted in Test Areas 4 and 5. These chemical weapons tests and experiments included chemical agent such as mustard and tabun. Later, these two areas were used by the hotel operators and island residents for disposal sites for items such as abandoned vehicles, construction debris, landscaping debris, and household generated trash and waste. Currently, Test Area 4 is being used to store approximately 86 abandoned vehicles. Test Area 5 is being used as a solid waste transfer station for the island.

A variety of visual site inspections and investigation of these three properties have been conducted by the U.S. Army and Interior since the early 1990s. None of the inspections identified obvious signs of contamination (i.e., discoloration of soils, stressed vegetation, odors, or adverse health effects of island residents). To date, no soils or groundwater samples have been collected and analyzed to determine whether hazardous substance have been released to the environment.

In completing, the PA Scoresheets, assumptions were made that releases of contaminants to groundwater and nearby surface water (ocean) have occurred. These assumptions were made to evaluate the potential "worst-case" scenario. Even using these worst case assumptions, the score for this site is an 11. There are two factors that mitigate the potential risks associated with these properties. The first factor is that the groundwater is not used as a source of drinking water on the island. In fact, ground water is not used at all since there are no active wells on the island. The second factor is that the closest surface water is the ocean. Both ground water and surface water run-off discharge to the ocean. Because these waters discharge to the ocean, the dilution of any possible contaminants from Water Island is expected to be significant. Therefore, it is unlikely that any potential contaminants from the landfill or test areas would adversely impact human health or the environment.

REFERENCES

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3. URS. May 2001. Preliminary Assessment site visit to Water Island, U.S. Virgin Islands.

4. U.S. Department of Interior. May 1996. Water Island U.S. Virgin Islands Title Transfer. Final Environmental Assessment and Finding of No Significant Impact.

5. Personal Communication. May 14, 2001. Mr. Jonnzie Hodge, U.S. Virgin Island Government, Department of Planning and Natural Resources.

6. Personal Communication. May 14, 2001. Mr. Stevie Henry, University of the Virgin Islands, Conservation Department.

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8. Personal Communication. June 15, 2001. Ms. Lesley Tarleton Julian, National Oceanic and Atmospheric Administration.

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11. U.S. Department of Commerce. Economic and Statistics Administration, Bureau of the Census. 1990. Population and Housing Unit Counts. Virgin Islands of the United States.

12. Donnelly, Thomas. May 1959. Geology of St. Thomas and St. John, Virgin Islands. Dissertation presented to the faculty of Princeton University in candidacy for the Degree of Doctor of Philosophy.

13. Dynamac Corporation. 1993. Level One and Level Two Site Survey Environmental site Assessment, Water Island, U.S. Virgin Islands.

This report was prepared and reviewed by the undersigned individuals.

Prepared by:

Margaret A. Lake

Margaret Lake,
US Bureau of Reclamation

Peer Reviewed by:

Mark Vandeberg

Mark Vandeberg
US Bureau of Reclamation

Prepared by:

Lisa A. Millet

Lisa A. Millet
URS Corporation

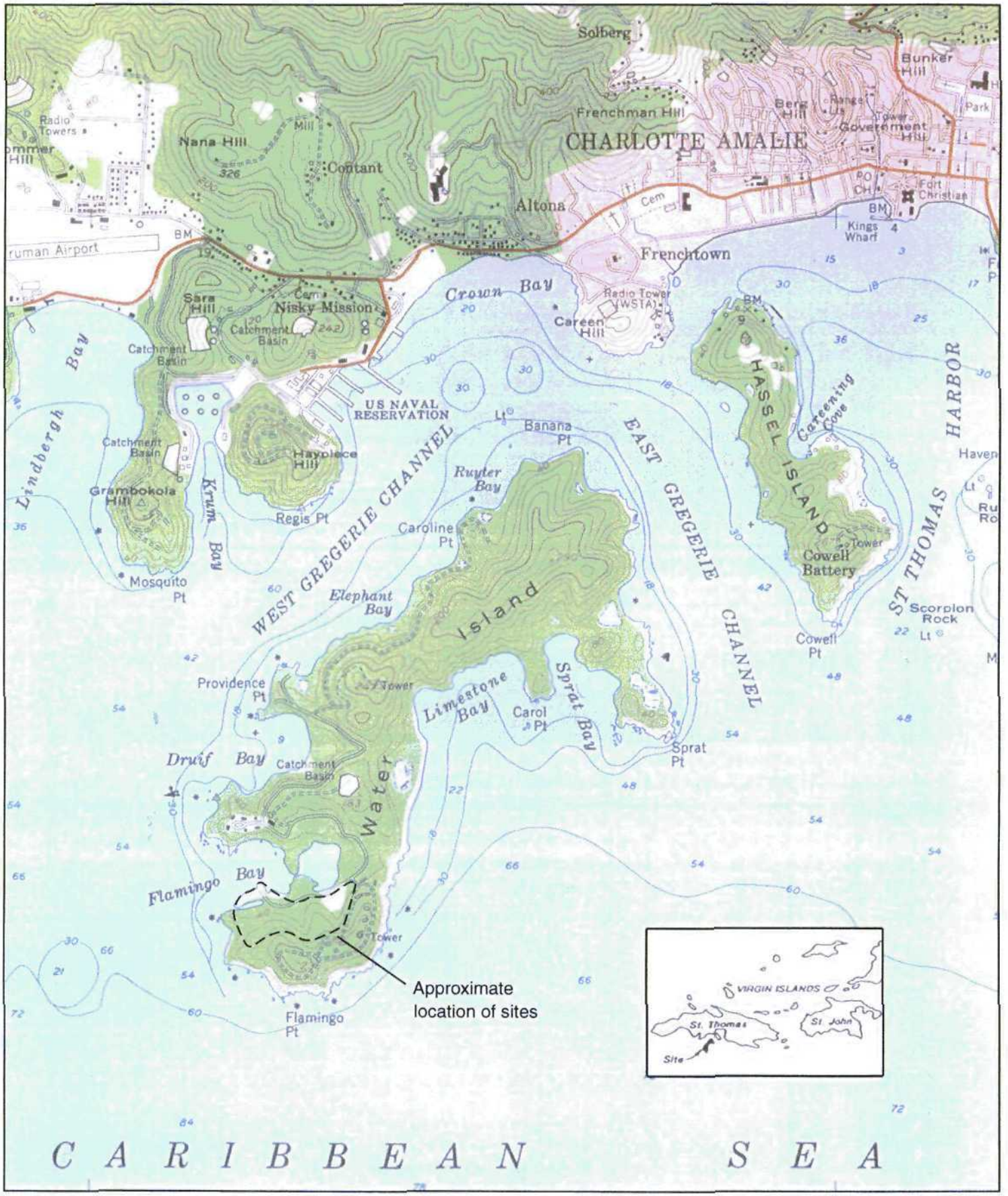
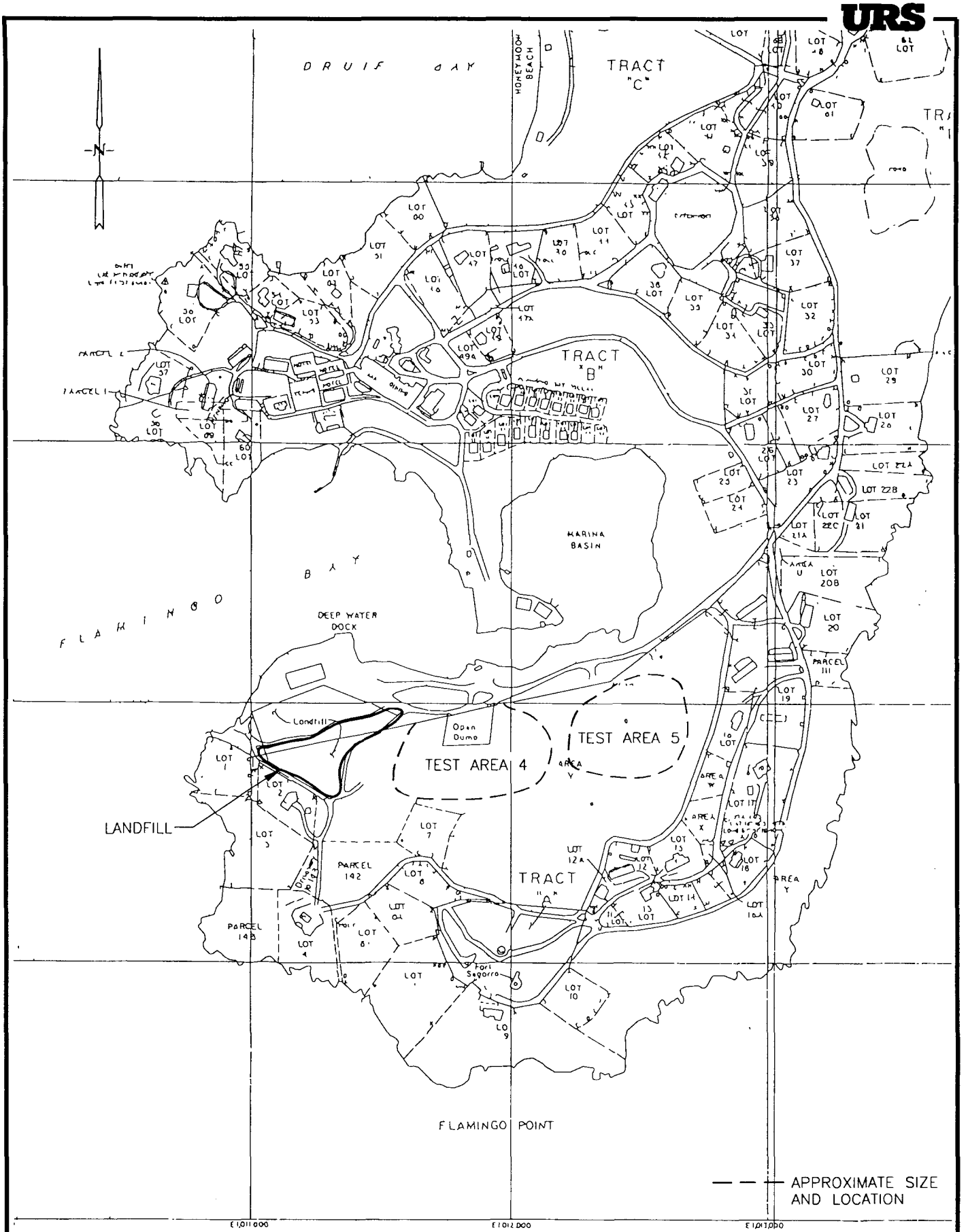


Figure 1:
Site Location Map



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Prepared by :	L.A.C.
Date :	7/12/01

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SCALE IN FEET

FIGURE 2
SOURCE AREA MAP

SAM

APPENDIX A
SITE RECONNAISSANCE PHOTOGRAPHS

Photo 1 – Debris in the southern portion of the landfill.

Photo 2 – Debris in the southern portion of the landfill.

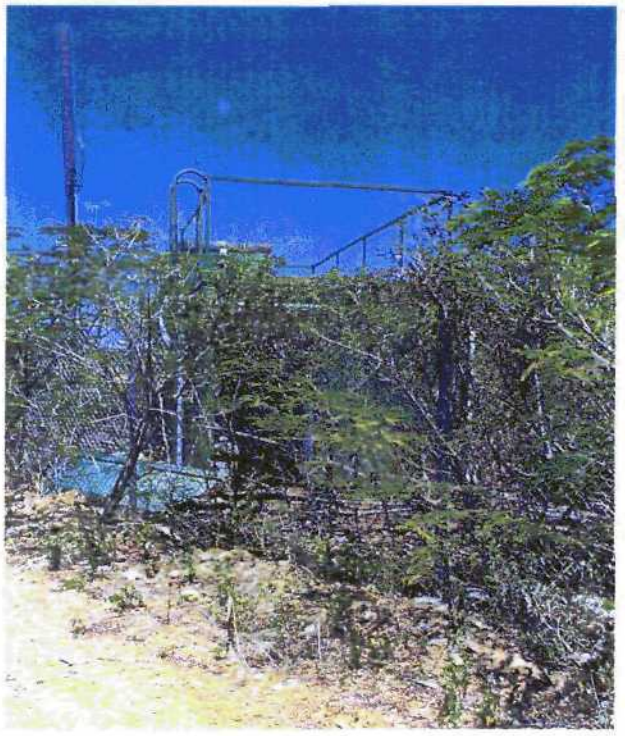


Photo 3 – Abandoned equipment in the eastern area of the landfill

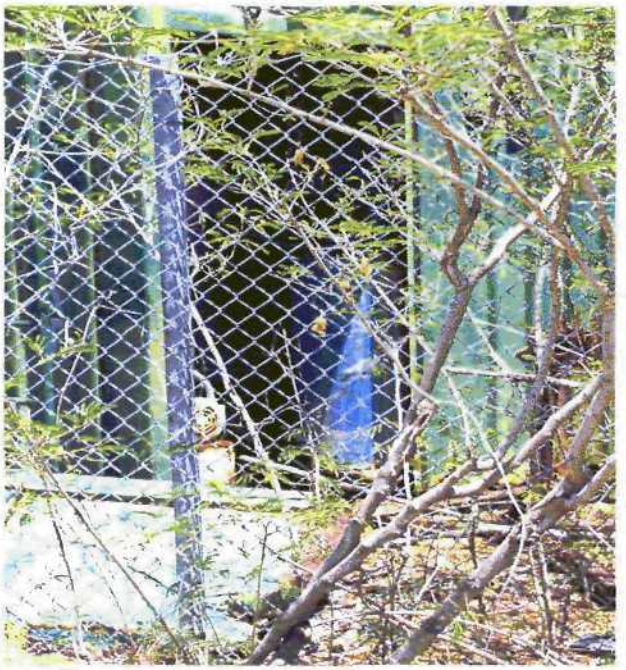


Photo 4 – Abandoned Equipment on eastern portion of landfill.

Photo 5 – Debris on Northern edge of landfill.

Photo 6 – View of Cars in Test Area 4.

Photo 7 – Abandoned Cars in Test Area 4.

Photo 8 - .Abandoned Cars in Test Area 4.

Photo 9 – Abandoned Cars in Test Area 4.

Photo 10 – Abandoned Tanker Truck in Test Area 4.

Photo 11 – Abandoned Tanker in Test Area 4.

Photo 12 – Roll-off Bins for Collection of Household Trash in Test Area 5.

Photo 13 – View of Construction Debris in Test Area 5.

Photo 14 – View of Construction Debris in Test Area 5.

Photo 15 – View of Construction Debris in Test Area 5.

Photo 16 – View of Construction Debris in Test Area 5.

APPENDIX B
PA SCORESHEETS

OMB Approval Number: 2050-0095
Approved for Use Through: 4/95

PA-Score

PA Scoresheets

Site Name: Flamingo Bay Army Test Areas
CERCLIS ID No.: VI0000591875
Street Address: Former Ft. Segarra
City/State/Zip: Water Island, VI 00802

Investigator: Lisa Millet
Agency/Organization: URS Coporation
Street Address: 8181 E. Tufts Avenue
City/State: Denver, CO

Date: 5/17/01

WASTE CHARACTERISTICS

Waste Characteristics (WC) Calculations:

1 Flamingo Bay Landfil	Landfill	Ref:	3	WQ value	maximum
Area	8.86E+04 sq ft			2.61E+01	2.61E+01
Ref:					
2 Test Area 4	Pile	Ref:	3	WQ value	maximum
Area	5.28E+04 sq ft			4.06E+03	4.06E+03
Ref:					
3 Test Area 5	Pile	Ref:	3	WQ value	maximum
Area	1.17E+05 sq ft			8.97E+03	8.97E+03
Ref:					

WQ total 1.31E+04

** Only First WC Page Is Printed ** | Waste Characteristics Score: WC = 100

Ground Water Pathway Criteria List
Suspected Release

Are sources poorly contained? (y/n/u)	Y
Is the source a type likely to contribute to ground water contamination (e.g., wet lagoon)? (y/n/u)	Y
Is waste quantity particularly large? (y/n/u)	Y
Is precipitation heavy? (y/n/u)	Y
Is the infiltration rate high? (y/n/u)	Y
Is the site located in an area of karst terrain? (y/n)	N
Is the subsurface highly permeable or conductive? (y/n/u)	Y
Is drinking water drawn from a shallow aquifer? (y/n/u)	N
Are suspected contaminants highly mobile in ground water? (y/n/u)	Y
Does analytical or circumstantial evidence suggest ground water contamination? (y/n/u)	N

Other criteria? (y/n) N

SUSPECTED RELEASE? (y/n) Y

Summarize the rationale for Suspected Release:

Water Island is volcanic in origin. It has a shallow soil of the Cramer gravelly clay loam variety, a dense, semiarid vegetation and rather steeply sloping terrain.

Little is know about groundwater conditions on Water Island. The Island reportedly was named because of potable water in the form of shallow freshwater ponds was used by early sailors. The depth to groundwater at Water Island is reported to rance from the surface to about 10 feet below ground suface. Groundwater exists in residual soils as well as underlying fractured bedrock of volcanic origin.

As is typical of smaller islands in the Caribbean, Water Island likely hosts a shallow freshwater aquifer of limited horizontal (i.e., real extent of the island) and vertical extent. These shallow aquifers are recharged directly from precipitation falling on the landmass and infiltrating into underlying strata. The freshwater aquifer is usually relatively thin and is underlain by saltwater saturated rocks.

The topography of Water Island is hilly to mountainous with ground
Ref: 1,2,6, 12, and 13

Ground Water Pathway Criteria List
Primary Targets

Is any drinking water well nearby? (y/n/u)	N
Has any nearby drinking water well been closed? (y/n/u)	N
Has any nearby drinking water well user reported foul-testing or foul-smelling water? (y/n/u)	N
Does any nearby well have a large drawdown/high production rate? (y/n/u)	N
Is any drinking water well located between the site and other wells that are suspected to be exposed to a hazardous substance? (y/n/u)	N
Does analytical or circumstantial evidence suggest contamination at a drinking water well? (y/n/u)	N
Does any drinking water well warrant sampling? (y/n/u)	N
Other criteria? (y/n)	N
PRIMARY TARGET(S) IDENTIFIED? (y/n)	N

Summarize the rationale for Primary Targets:

Residents of Water Island collect rain water in cisterns to supply drinking water. There are currently no ground water wells in use on the island.

Ref: 2 and 3

GROUND WATER PATHWAY SCORESHEETS

Pathway Characteristics		Ref.
Do you suspect a release? (y/n)	Yes	
Is the site located in karst terrain? (y/n)	No	
Depth to aquifer (feet):	10	2
Distance to the nearest drinking water well (feet):	0	2

LIKELIHOOD OF RELEASE	Suspected Release	No Suspected Release	References
1. SUSPECTED RELEASE	550		
2. NO SUSPECTED RELEASE		0	
LR =	550	0	

Targets

TARGETS	Suspected Release	No Suspected Release	References
3. PRIMARY TARGET POPULATION 0 person(s)	0		
4. SECONDARY TARGET POPULATION Are any wells part of a blended system? (y/n) Y	0	0	
5. NEAREST WELL	0	0	
6. WELLHEAD PROTECTION AREA None within 4 Miles	0	0	
7. RESOURCES	5	0	
T =	5	0	

WASTE CHARACTERISTICS

WC =	100	0

GROUND WATER PATHWAY SCORE:	3

Ground Water Target Populations

Primary Target Population Drinking Water Well ID	Dist. (miles)	Population Served	Reference	Value
None				
*** Note : Maximum of 5 Wells Are Printed ***			Total	

Secondary Target Population Distance Categories	Population Served	Reference	Value
0 to 1/4 mile	0		0
Greater than 1/4 to 1/2 mile	0		0
Greater than 1/2 to 1 mile	0		0
Greater than 1 to 2 miles	0		0
Greater than 2 to 3 miles	0		0
Greater than 3 to 4 miles	0		0
		Total	0

Apportionment Documentation for a Blended System

Surface Water Pathway Criteria List
Suspected Release

Is surface water nearby? (y/n/u)	Y
Is waste quantity particularly large? (y/n/u)	Y
Is the drainage area large? (y/n/u)	Y
Is rainfall heavy? (y/n/u)	Y
Is the infiltration rate low? (y/n/u)	Y
Are sources poorly contained or prone to runoff or flooding? (y/n/u)	Y
Is a runoff route well defined(e.g.ditch/channel to surf.water)? (y/n/u)	N
Is vegetation stressed along the probable runoff path? (y/n/u)	N
Are sediments or water unnaturally discolored? (y/n/u)	N
Is wildlife unnaturally absent? (y/n/u)	N
Has deposition of waste into surface water been observed? (y/n/u)	N
Is ground water discharge to surface water likely? (y/n/u)	Y
Does analytical/circumstantial evidence suggest S.W. contam? (y/n/u)	N
Other criteria? (y/n) N	
SUSPECTED RELEASE? (y/n)	Y

Summarize the rationale for Suspected Release:

Flamingo Bay, as close as 200 feet to the landfill and test areas, is the nearest down slope surface water. The ocean is the only surface water body type within 15 miles of Water Island.

The 2 year, 24 hour fainfall for the site is 4.3 inches.

The size of the drainage area is 26 acres. This is the drainage area that constributes to all three sources.

The predominant soils are clay loams, and gravelly clays belonging t
o
the Cramer Series. These soils are typically associated wi
th rocks of volcanic orgigin and are found along the ridgeline and hillslopes. In addition, minor amounts of silty clay loams, silty loams. and sands of the Jaucas Series can be found in the low lying reas. the depth to bedrock ranges from 0 to 60 feet. the
Ref: 1,2,3,5,6,8,9

Surface Water Pathway Criteria List
Primary Targets

Is any target nearby? (y/n/u) If yes: Y
- Y Drinking water intake
- N Fishery
- Y Sensitive environment

Has any intake, fishery, or recreational area been closed? (y/n/u) N

Does analytical or circumstantial evidence suggest surface water contamination at or downstream of a target? (y/n/u) N

Does any target warrant sampling? (y/n/u) If yes: N
- N Drinking water intake
- N Fishery
- N Sensitive environment

Other criteria? (y/n) N

PRIMARY INTAKE(S) IDENTIFIED? (y/n) N

Summarize the rationale for Primary Intakes:

St. Thomas uses rainwater, ground water, and an ocean intake to supply drinking water to the island population. The population of St. Thomas is approximately 49,000.

VI Water and Power Authority have an intake on Crown Bay which is approximately 2 miles from the sources.

Secret Harbor Beach Resort is approximately 7 miles east of the sources. It has an ocean intake for water. The Resort has 60 suites and 4 room.

The Ritz Carlton is located approximately 8 mile east of the sources. It has an ocean intake that supplies water to 152 rooms.

Ref: 5

continued -------

continued -------

Other criteria? (y/n) N

PRIMARY FISHERY(IES) IDENTIFIED? (y/n) N

Summarize the rationale for Primary Fisheries:

Other criteria? (y/n) N

PRIMARY SENSITIVE ENVIRONMENT(S) IDENTIFIED? (y/n) N

Summarize the rationale for Primary Sensitive Environments:

A portion of St. John Island is a U.S. federally protected National Park. The National Park on St. John Island is located approximately 13 miles east of Water Island.

This is the only sensitive area identified within 15 miles of Water Island.

Ref: 7

SURFACE WATER PATHWAY SCORESHEETS

Pathway Characteristics		Ref.
Do you suspect a release? (y/n)	Yes	
Distance to surface water (feet):	200	3
Flood frequency (years):	1-10	2
What is the downstream distance (miles) to: a. the nearest drinking water intake? b. the nearest fishery? c. the nearest sensitive environment?	 2.0 N.A. N.A.	6

LIKELIHOOD OF RELEASE	Suspected Release	No Suspected Release	References
1. SUSPECTED RELEASE	550		
2. NO SUSPECTED RELEASE		0	
LR =	550	0	

Drinking Water Threat Targets

TARGETS	Suspected Release	No Suspected Release	References
3. Determine the water body type, flow (if applicable), and number of people served by each drinking water intake.			
4. PRIMARY TARGET POPULATION 0 person(s)	0		
5. SECONDARY TARGET POPULATION Are any intakes part of a blended system? (y/n): N	1	0	
6. NEAREST INTAKE	0	0	
7. RESOURCES	5	0	
T =	6	0	

Drinking Water Threat Target Populations

Intake Name	Primary (y/n)	Water Body Type/Flow	Population Served	Ref.	Value
1 Crown Bay	N	Coastal,ocean,Gr.Lake	49000	5	0
2 Secret Harbor	N	Coastal,ocean,Gr.Lake	300	5	0
3 Ritz Carlton	N	Coastal,ocean,Gr.Lake	300	5	0

Total Primary Target Population Value	0
Total Secondary Target Population Value	1

*** Note : Maximum of 6 Intakes Are Printed ***

Apportionment Documentation for a Blended System

Human Food Chain Threat Targets

TARGETS	Suspected Release	No Suspected Release	References
8. Determine the water body type and flow for each fishery within the target limit.			
9. PRIMARY FISHERIES	0		
10. SECONDARY FISHERIES	0	0	
T =	0	0	

Human Food Chain Threat Targets

Fishery Name	Primary (y/n)	Water Body Type/Flow	Ref.	Value
None				

Total Primary Fisheries Value	0
Total Secondary Fisheries Value	0

*** Note : Maximum of 6 Fisheries Are Printed ***

Environmental Threat Targets

TARGETS	Suspected Release	No Suspected Release	References
11. Determine the water body type and flow (if applicable) for each sensitive environment.			
12. PRIMARY SENSITIVE ENVIRONMENTS	0		
13. SECONDARY SENSITIVE ENVIRONS.	0	0	
T =	0	0	

Environmental Threat Targets

Sensitive Environment Name	Primary (y/n)	Water Body Type/Flow	Ref.	Value
1 St. John Island	N	Coastal,ocean,Gr.Lake	7	0

Total Primary Sensitive Environments Value 0
Total Secondary Sensitive Environments Value 0

*** Note: Maximum of 6 Sensitive Environments Are Printed ***

Surface Water Pathway Threat Scores

Threat	Likelihood of Release(LR) Score	Targets(T) Score	Pathway Waste Characteristics (WC) Score	Threat Score LR x T x WC / 82,500
Drinking Water	550	6	100	4
Human Food Chain	550	0	100	0
Environmental	550	0	100	0

SURFACE WATER PATHWAY SCORE: 4

Soil Exposure Pathway Criteria List
Resident Population

Is any residence, school, or daycare facility on or within 200 feet of an area of suspected contamination? (y/n/u)	Y
Is any residence, school, or daycare facility located on adjacent land previously owned or leased by the site owner/operator? (y/n/u)	Y
Is there a migration route that might spread hazardous substances near residences, schools, or daycare facilities? (y/n/u)	N
Have onsite or adjacent residents or students reported adverse health effects, exclusive of apparent drinking water or air contamination problems? (y/n/u)	N
Does any neighboring property warrant sampling? (y/n/u)	N
Other criteria? (y/n)	N
RESIDENT POPULATION IDENTIFIED? (y/n)	N

Summarize the rationale for Resident Population:

Several homes are located just south of the landfill and test areas. The homes are located at a higher elevation from the potential sources. Furthermore, at the time of the site inspection the landfill and test areas were well vegetated. There does not appear to be any surface contamination to which residents might be exposed.

Miscellaneous debris was observed in the landfill area at the time of the site inspection. This debris included: old vehicles, construction debris, household trash, etc.

Test area 4 is located in the southwest end of Water Island. During the time of the site visit approximately 86 abandoned vehicles were being stored. A limited site walk through did not reveal any leaking fluids from the vehicles.

Test area 5 is currently used as a staging area for Water Island trash collection. Several large roll-off bins are used to collect homeowners trash. Used oil and car batteries were being collected separately. Construction debris from the demolition of the hotel is also stored in the area. Landscaping debris was also present at the time of the site visit.

Ref: 3

SOIL EXPOSURE PATHWAY SCORESHEETS

Pathway Characteristics		Ref.
Do any people live on or within 200 ft of areas of suspected contamination? (y/n)	No	3
Do any people attend school or daycare on or within 200 ft of areas of suspected contamination? (y/n)	No	3
Is the facility active? (y/n):	Yes	3

LIKELIHOOD OF EXPOSURE	Suspected Contamination	References
1. SUSPECTED CONTAMINATION LE =	550	

Targets

2. RESIDENT POPULATION 0 resident(s) 0 school/daycare student(s)	0	3
3. RESIDENT INDIVIDUAL	0	
4. WORKERS None	0	3
5. TERRES. SENSITIVE ENVIRONMENTS	0	
6. RESOURCES	0	
T =	0	

WASTE CHARACTERISTICS

WC = 100

RESIDENT POPULATION THREAT SCORE: 3

NEARBY POPULATION THREAT SCORE: 1

Population Within 1 Mile: 1 - 10,000

SOIL EXPOSURE PATHWAY SCORE: 4

Soil Exposure Pathway Terrestrial Sensitive Environments

Terrestrial Sensitive Environment Name	Reference	Value
None		
Total Terrestrial Sensitive Environments Value		

*** Note : Maximum of 7 Sensitive Environments Are Printed ***

Air Pathway Criteria List
Suspected Release

Are odors currently reported? (y/n/u)	N
Has release of a hazardous substance to the air been directly observed? (y/n/u)	N
Are there reports of adverse health effects (e.g., headaches, nausea, dizziness) potentially resulting from migration of hazardous substances through the air? (y/n/u)	N
Does analytical/circumstantial evidence suggest release to air? (y/n/u)	N
Other criteria? (y/n) N	
SUSPECTED RELEASE? (y/n)	N

Summarize the rationale for Suspected Release:

There were no sources of air contaminants observed during the site visit. Nor were any mentioned during the previous investigation conducted at the site.

There are no current reports of odors or adverse health associated with these sources.

Ref: 3

AIR PATHWAY SCORESHEETS

Pathway Characteristics		Ref.
Do you suspect a release? (y/n)	No	
Distance to the nearest individual (feet):	200	3

LIKELIHOOD OF RELEASE	Suspected Release	No Suspected Release	References
1. SUSPECTED RELEASE	0		
2. NO SUSPECTED RELEASE		500	
LR =	0	500	

Targets

TARGETS	Suspected Release	No Suspected Release	References
3. PRIMARY TARGET POPULATION 0 person(s)	0		
4. SECONDARY TARGET POPULATION	0	8	
5. NEAREST INDIVIDUAL	0	20	
6. PRIMARY SENSITIVE ENVIRONS.	0		
7. SECONDARY SENSITIVE ENVIRONS.	0	0	
8. RESOURCES	0	5	
T =	0	33	

WASTE CHARACTERISTICS

WC =	0	100

AIR PATHWAY SCORE:	20

Air Pathway Secondary Target Populations

Distance Categories	Population	References	Value
Onsite	0		0
Greater than 0 to 1/4 mile	30		1
Greater than 1/4 to 1/2 mile	40		1
Greater than 1/2 to 1 mile	70		0
Greater than 1 to 2 miles	32		0
Greater than 2 to 3 miles	13000		4
Greater than 3 to 4 miles	28000		2
	Total Secondary Population Value		8

Air Pathway Primary Sensitive Environments

Sensitive Environment Name	Reference	Value
None		
Total Primary Sensitive Environments Value		

*** Note : Maximum of 7 Sensitive Environments Are Printed***

Air Pathway Secondary Sensitive Environments

Sensitive Environment Name	Distance	Reference	Value
None			
Total Secondary Sensitive Environments Value			

SITE SCORE CALCULATION	SCORE
GROUND WATER PATHWAY SCORE:	3
SURFACE WATER PATHWAY SCORE:	4
SOIL EXPOSURE PATHWAY SCORE:	4
AIR PATHWAY SCORE:	20
SITE SCORE:	11

SUMMARY

1. Is there a high possibility of a threat to any nearby drinking water well(s) by migration of a hazardous substance in ground water? No

   If yes, identify the well(s).

   If yes, how many people are served by the threatened well(s)? 0

2. Is there a high possibility of a threat to any of the following by hazardous substance migration in surface water?
   A. Drinking water intake No
   B. Fishery No
   C. Sensitive environment (wetland, critical habitat, others) No

   If yes, identity the target(s).

3. Is there a high possibility of an area of surficial contamination within 200 feet of any residence, school, or daycare facility? No

   If yes, identify the properties and estimate the associated population(s)

4. Are there public health concerns at this site that are not addressed by PA scoring considerations? No

   If yes, explain:

REFERENCE LIST

1. Ebasco Environmental. July 1991. Archives Search Report on the San Jose Project in the U.S. Virgin Islands. Prepared for the U.S. Army Corps of Engineers, Huntsville Division.

2. U.S. Department of the Interior, Bureau of Reclamation. May 1996. Water Island U.S. Virgin Islands Title Transfer. Final Environmental Assessment and Findings of No Significant Impact.

3. URS Corporation. May 2001. Site Visit

4. U.S. Army ENgineering Division. January 1996. Site Characterization, Former Fort Segarra, USVI, MTA Inc. Huntsville, Alabama

5. Personal Communications. May 2001. Miko Quetel and Claude MacBean, VI Water and Power Authority.

6. Personal Communicaitons. May 2001. Mr. Johnzie Hodge, Virgin Island Governmental Department of Planning and Natural Resources.

7. Personal Communications. May 2001. Mr. Stevie Henry, University of the Virgin Islands, Conservation Department.

8. Personal Communications. June 2001. Ms. Lesley Tarleton Julian, National Oceanic and Atmospheric Administration.

9. Personal Communication. June 2001. Ms. Iris Delgado, Federal Emergency Management Agency, Caribbean Division Office.

10. Parsons Engineering Science, Inc. January 2001. Engineering Evaluation /Cost Analysis. Former Fort Segarra, Water Island, VI.

11. U.S. Department of Commerce. Econcomic and Statistics Administration, Bureau of the Census. 1990. Population and Housing Unit Counts. Virgin Islands of the United States

12. Donnelly, Thomas. May 1959. Geology of St. Thomas and St. John, Virgin Islands. Dissertation presented to the faculty of Princeton University in candidacy for the Degree of Doctor of Pholosophy.

13. Dynamac Corporation. 1993. Level One and Level Two Site Survey Environmental Site Assessment, Water Island, U.S. Virgin Islands.

APPENDIX C
REFERENCE MATERIALS

ARCHIVES SEARCH

REPORT

THE SAN JOSE PROJECT

in the

U.S. VIRGIN ISLANDS

PREPARED FOR
U.S. ARMY CORPS OF ENGINEERS
HUNTSVILLE DIVISION

JULY 1991

PRPARED BY

EBASCO ENVIRONMENTAL
A Division of EBASCO SERVICES INCORPORATED, HUNTSVILLE, AL

MTA, Inc.
688 Discovery Drive
Huntsville, Alabama 35806

Remediation of Sites in the U.S. Virgin Islands and Puerto Rico
Contract DACA87-92-D-0147
Delivery Order 0003

SITE CHARACTERIZATION
FORMER FORT SEGARRA, U.S.V.I.

PHASE I REMEDIAL INVESTIGATION (RI) REPORT

January 19, 1996

U.S. Army Engineering and Support Center
ATTN: CEHNC-CT-D (A. Prince)
P.O. Box 1600
Huntsville, Alabama 35807-4301

Water Island
U.S. Virgin Islands
Title Transfer

Final Environmental Assessment
and
Finding of No Significant Impact

May 1996

United States Department of the Interior
Bureau of Reclamation

for the

Office of Insular Affairs

Phone Call Memorandum

URS Greiner Woodward Clyde

8181 E. Tufts Avenue
Denver, Colorado 80237
TEL: (303) 694-2770 FAX: (303) 694-3946

DATE: 5/14/01

PROJECT: Water Island P.A.

BY: Lauren Clubb

SUBJECT: St. Thomas & Area Sensitive Environments

PARTY CONTACTED: Johnnzie Hodge, Dept. of Planning & Nat Resources

COPIES: 1

PHONE NO: (340) 774-3320

CC:

Johnnzie Hodge stated that as far as sensitive areas on St Thomas, there is one area - Villa Olago, which is a historic place. However Villa Olago is not federally protected. Villa Olago is located approximately 1/2 mile from Water Island.

St. John Island is a federally protected National Park that is approximately 13 miles from Water Island. Johnnzie Hodge also stated that a small portion of St. Thomas serves as the National Park Headquarters.

Phone Call Memorandum

URS Greiner Woodward Clyde

8181 E. Tufts Avenue
Denver, Colorado 80237
TEL: (303) 694-2770 FAX: (303) 694-3946

DATE: 5/14/07

PROJECT: Water Island P.A.

BY: Lauren Clubb

SUBJECT: St. Thomas Water Intake

PARTY CONTACTED: Miko Quetel
Virgin Islands Water & Power Authority

COPIES: 1

PHONE NO: (340) 774-3552

CC:

Mr. Quetel stated that there is an ocean water intake in Crown Bay directly across from Water Island.

Mr Quetel also stated that hotels on the east end of St. Thomas take water from the ocean.

Phone Call Memorandum

URS Greiner Woodward Clyde

8181 E. Tufts Avenue
Denver, Colorado 80237
TEL: (303) 694-2770 FAX: (303) 694-3946

DATE: 5/16/01

PROJECT: Water Island P.A.

BY: Lauren Clubb

SUBJECT: St. Thomas H2O Intake

PARTY CONTACTED: Claude MacBean
VI Water & Power Authority: Plant Ops

COPIES: 1

PHONE NO: (340) 774-8170

CC:

Mr. MacBean stated that the drinking water from St. Thomas is provided through the desalinization of ocean water. An intake is located in Crown Bay that serves the entire St. Thomas Population.

Mr. MacBean stated that reverse osmosis is not used anywhere on the Island.

Mr. MacBean stated that the large holding tanks located in Limberg Bay are used for water storage. Water is pumped into the holding tanks from the Crown Bay plant.

Phone Call Memorandum

URS Greiner Woodward Clyde

8181 E. Tufts Avenue
Denver, Colorado 80237
TEL: (303) 694-2770 FAX: (303) 694-3946

DATE: 5/14/01

PROJECT: Water Island P.A.

BY: Lauren Clubb

PARTY CONTACTED: Stevie Henry
University of Virgin Islands

PHONE NO: (340) 693-1033

SUBJECT: Aquaculture/ Fisheries

COPIES: 1

CC:

- Stevie Henry stated that he does not know or is not aware of any aquaculture that occurs on the south side of St. Thomas.

- He also stated that Great St. James Cay and Little St. James Cay are protected fisheries, but there are far east of Water Island.

Department of Commerce

NOAA/NWS

OFFICE OF HYDROLOGY

TRANSMITTAL COVER SHEET

DATE: June 15, 2001 TIME: 15:22 EDT

Originator's Name: Lesley Tarleton Julian

Mail Routing Code: W/OHD13

Originator's Telephone: (301) 713-1669 x109

FAX: (301) 713-0963

Addressee's Name: Scott Randall

Mail Routing Code: URS

Addressee's Telephone: (303) 740-2686

FAX: (303) 740-2650

Remarks:

Attached 2y 24hr return frequency information for Virgin Islands from TP 42 (1961). Title page included. Hope this helps.

Lesley

U.S. DEPARTMENT OF COMMERCE
LUTHER H. HODGES, *Secretary*
WEATHER BUREAU
F. W. REICHELDERFER, *Chief*

TECHNICAL PAPER NO. 42

Generalized Estimates of Probable Maximum Precipitation and Rainfall-Frequency Data for Puerto Rico and Virgin Islands

for Areas to 400 Square Miles, Durations to 24 Hours, and Return Periods from 1 to 100 Years

Prepared by

Cooperative Studies Section

Hydrologic Services Division

U.S. Weather Bureau

for

Engineering Division

Soil Conservation Service

U.S. Department of Agriculture

WASHINGTON, D.C.
1961

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. - Price 50 cents

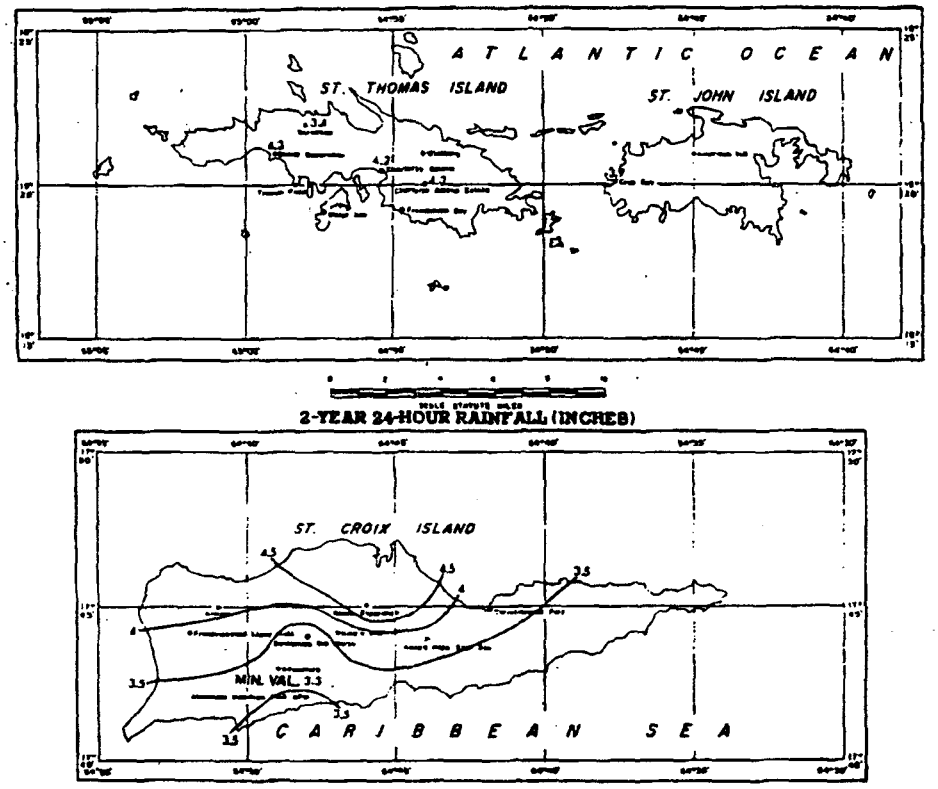


FIGURE 4-99.—2-yr. 24-hr. rainfall for Virgin Islands (in.).

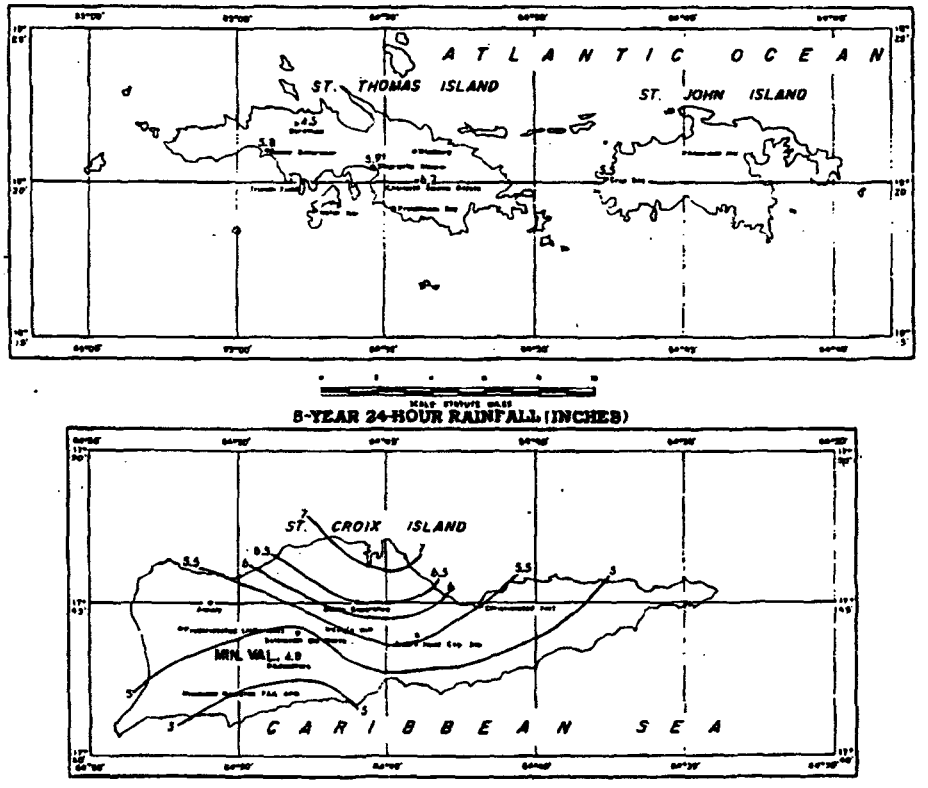
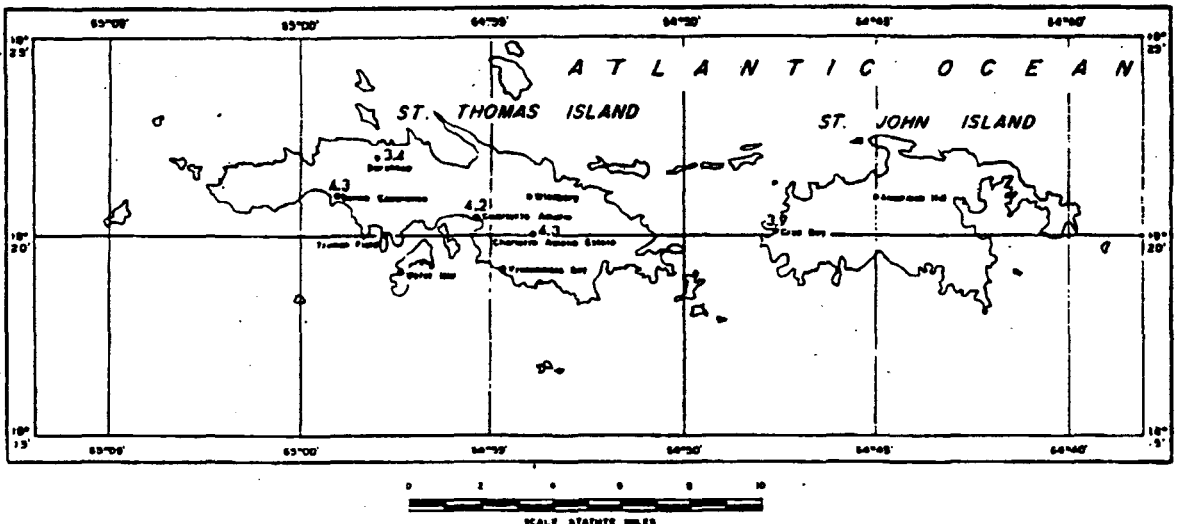


FIGURE 4-100.—5-yr. 24-hr. rainfall for Virgin Islands (in.).



2-YEAR 24-HOUR RAINFALL (INCHES)

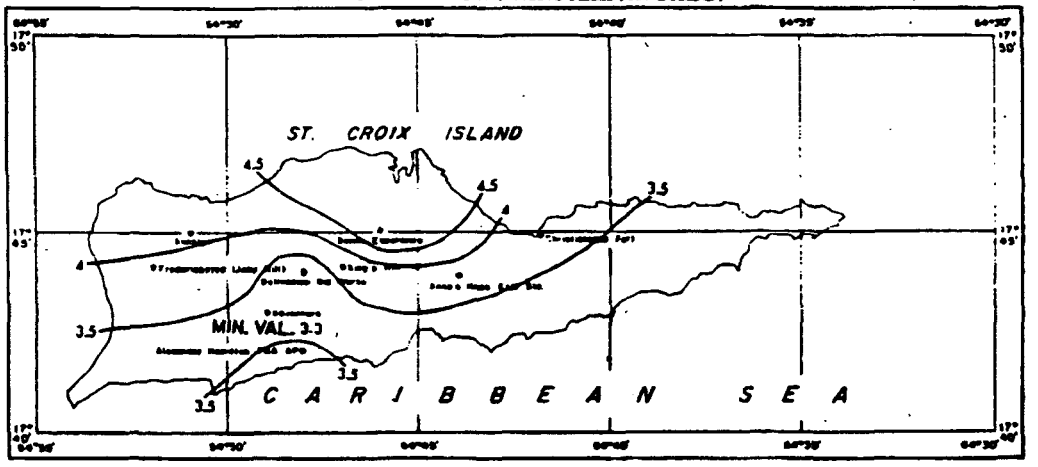
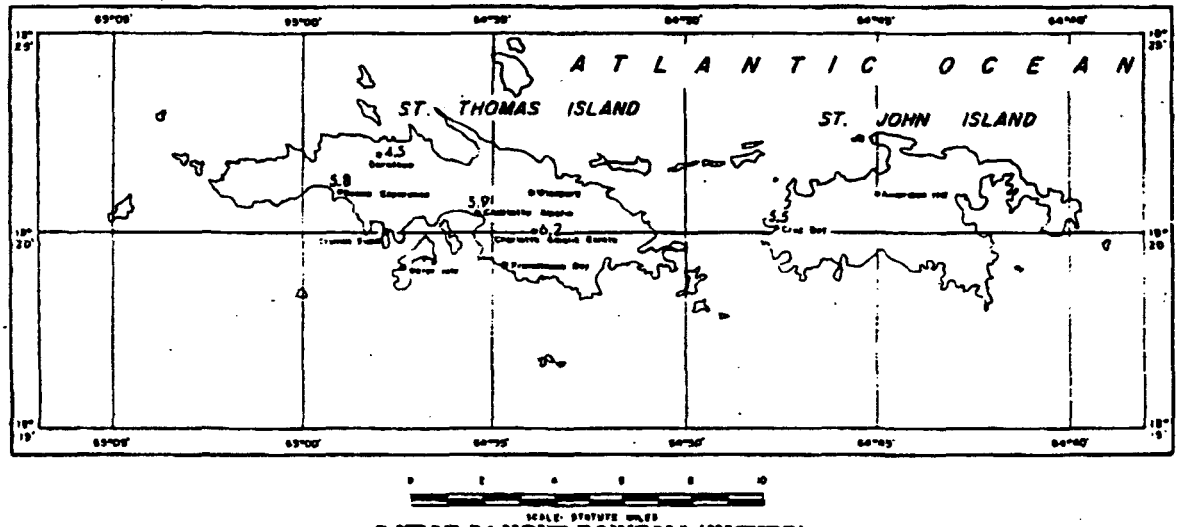
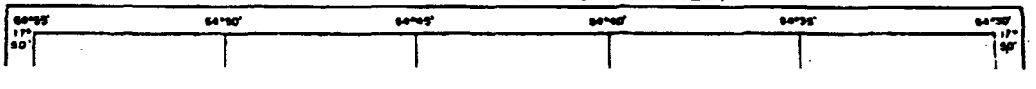


FIGURE 4–99.—2-YR. 24-HR. RAINFALL FOR VIRGIN ISLANDS (IN.).



5-YEAR 24-HOUR RAINFALL (INCHES)



FEDERAL EMERGENCY MANAGEMENT AGENCY

Caribbean Division Office
P.O. Box 70105
San Juan, Puerto Rico 00936-8105

New SanJuan Office Building
159 Chardón Avenue, 6th Floor
Hato Rey, P. R. 00918

Fax No.: (787) 296-3642
Voice: (787) 296-3500

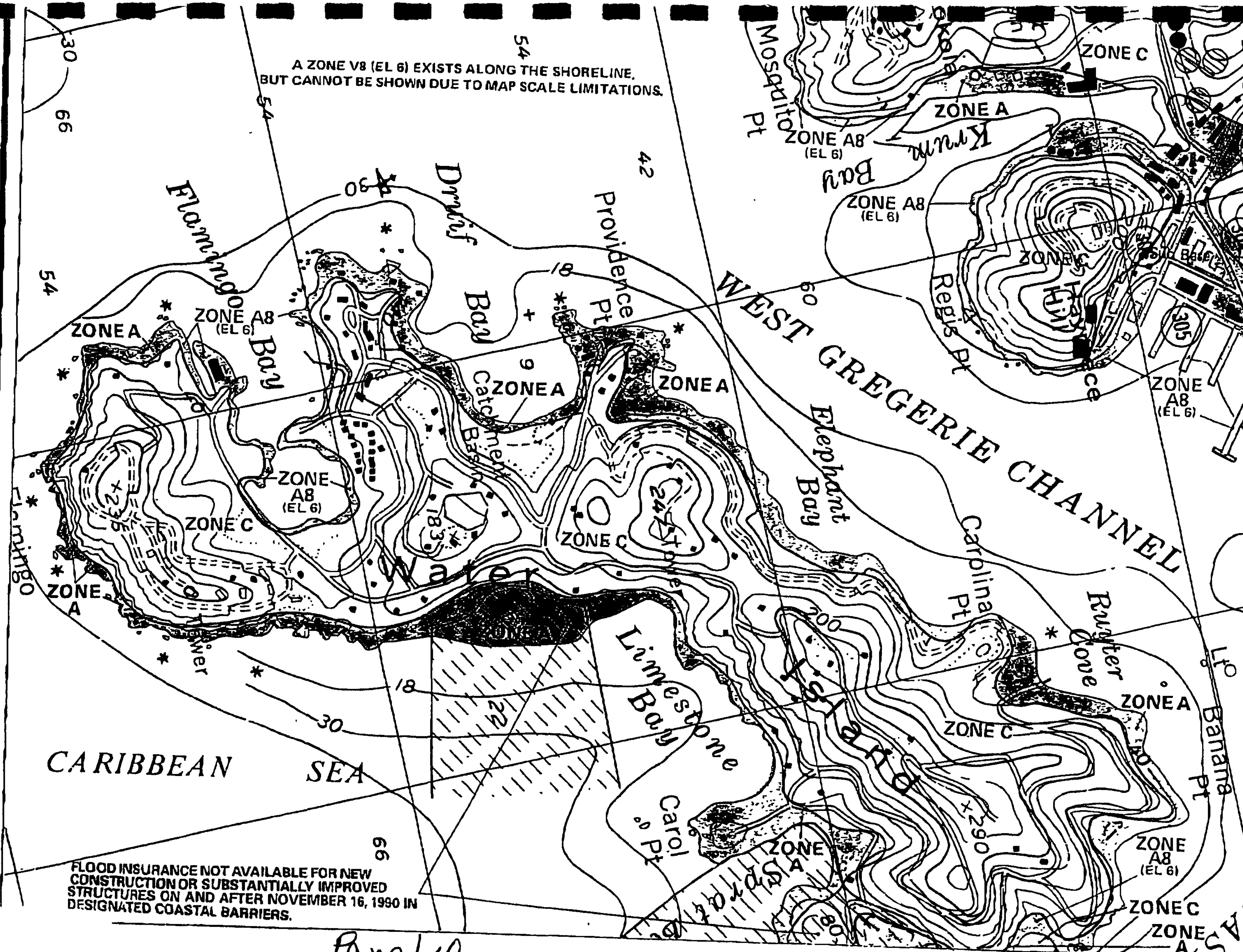
FAX TO:	FROM:
Scot Randon	Iris Delgado
SUBJECT:	**DATE:**
FIRM - VI	June 15, 01
FAX NUMBER:	**NUMBER OF PAGES, INCLUDING COVER:**
(303) 740-2650	3

COMMENTS:

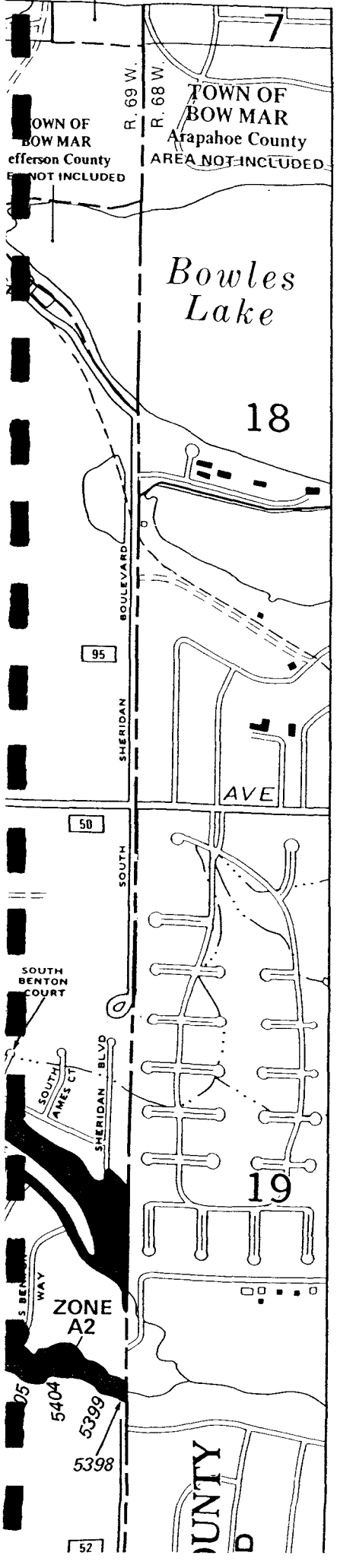
See enclosed copy of FIRM near Flamingo Bay.

Iris

Revised: 3/01


A ZONE V8 (EL 6) EXISTS ALONG THE SHORELINE, BUT CANNOT BE SHOWN DUE TO MAP SCALE LIMITATIONS.
FLOOD INSURANCE NOT AVAILABLE FOR NEW CONSTRUCTION OR SUBSTANTIALLY IMPROVED STRUCTURES ON AND AFTER NOVEMBER 16, 1990 IN DESIGNATED COASTAL BARRIERS.
WEST GREGERIE CHANNEL
CARIBBEAN SEA
Water Island
Flamingo Bay
Druif Bay
Providence Pt
Elephant Bay
Carolina Pt
Limestone Bay
Carol Pt
Ruyter Cove
Banana Pt
Mosquito Pt
Krum Bay
Regis Pt
Catchment Basin
ZONE A
ZONE A8 (EL 6)
ZONE C

Panel 10



100-Year Flood Boundary	
500-Year Flood Boundary	
Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevation in Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7×
Zone D Boundary	
River Mile	•M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

This map is for use in administering the National Flood Insurance Program, it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.

Areas of special flood hazard (100-year flood) include Zones A, A1-30, AE, AH, AO, A99, V, V1-30 AND VE.

Certain areas not in the Special Flood Hazard Areas (zones A and V) may be protected by flood control structures.

Coastal base flood elevations apply only landward of the shoreline shown on this map.

For adjoining map panels, see separately printed Index to Map Panels.

INITIAL IDENTIFICATION:
NOVEMBER 22 1974

FLOOD HAZARD BOUNDARY MAP REVISIONS:

JULY 5, 1977

FLOOD INSURANCE RATE MAP EFFECTIVE:
AUGUST 5, 1986

FLOOD INSURANCE RATE MAP REVISIONS:

Map revised July 4, 1989 to change base flood elevations and special

U.S. Department of Commerce
Economics and Statistics Administration
BUREAU OF THE CENSUS

CENSUS '90

1990 CPH-2-55

1990 Census of
Population and Housing

Population and Housing Unit Counts

Virgin Islands of the United States

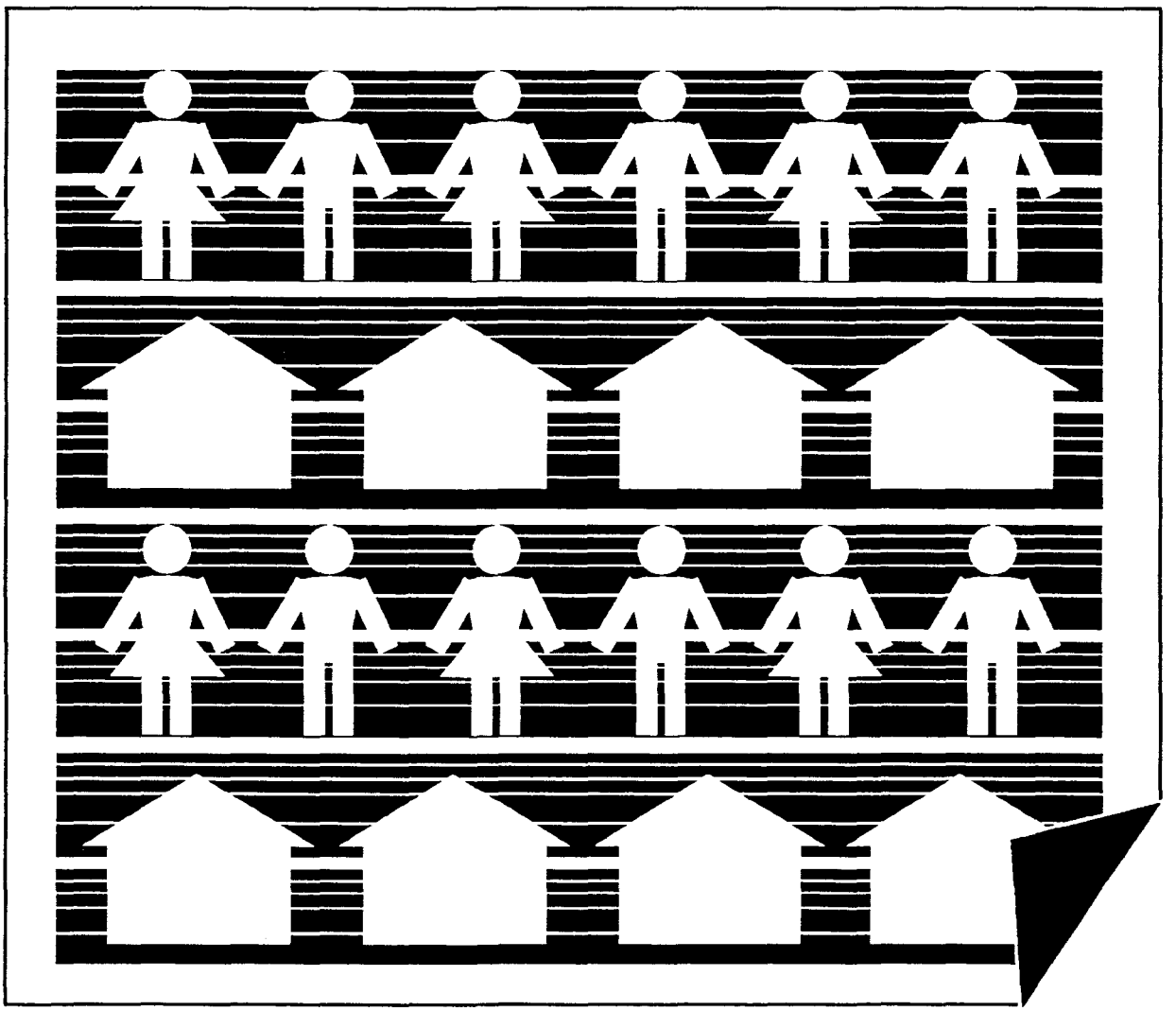


Table 8. Population and Housing Units, 1970 to 1990; Area Measurements and Density: 1990

[For information concerning historical counts, see "User Notes." Density is computed using land area. For definitions of terms and meanings of symbols, see text]

Virgin Islands Island Census Subdistrict Place	Population			Housing units			1990 area measurements				1990 density			
							Total area		Land area		Population per—		Housing units per—	
	1990	1980	1970	1990	1980	1970	Square kilometers	Square miles	Square kilometers	Square miles	Square kilometer	Square mile	Square kilometer	Square mile
Virgin Islands	**101 809**	**96 569**	**62 468**	**39 290**	**33 548**	**20 814**	**1 910.1**	**737.5**	**346.4**	**133.8**	**293.9**	**760.9**	**113.4**	**293.6**
St. Croix Island	50 139	49 725	31 779	18 937	16 893	10 299	861.6	332.6	214.7	82.9	233.5	604.8	88.2	228.4
Anna's Hope Village subdistrict	3 663	3 287	...	1 378	1 108	...	25.6	9.9	25.5	9.8	143.6	373.8	54.0	140.8
Christiansted town (pt.)	9	10	(NA)	3	(NA)	(NA)	–	–	–	–	–	–	–	–
Christiansted subdistrict	3 199	3 413	...	1 378	1 490	...	2.1	.8	2.1	.8	1 523.3	3 998.8	656.2	1 722.5
Christiansted town (pt.)	2 546	2 904	(NA)	1 032	(NA)	(NA)	1.3	.5	1.3	.5	1 958.5	5 092.0	793.8	2 064.0
East End subdistrict	1 740	1 648	...	1 143	971	...	34.8	13.4	33.2	12.8	52.4	135.9	34.4	89.3
Frederiksted subdistrict	4 066	3 948	...	1 493	1 416	...	4.7	1.8	3.7	1.4	1 098.9	2 904.3	403.5	1 066.4
Frederiksted town	1 064	1 046	1 531	501	553	(NA)	.4	.2	.4	.2	2 660.0	5 320.0	1 252.5	2 505.0
Frederiksted Southeast CDP	3 002	2 902	...	992	863	...	4.3	1.7	3.3	1.3	909.7	2 309.2	300.6	763.1
Northcentral subdistrict	5 495	5 771	...	2 242	1 797	...	32.9	12.7	32.6	12.6	168.6	436.1	68.8	177.9
Northwest subdistrict	4 828	5 714	...	1 724	1 745	...	54.5	21.0	47.2	18.2	102.3	265.3	36.5	94.7
Grove Place CDP	2 655	3 599	...	811	947	...	4.3	1.7	4.3	1.7	617.4	1 561.8	188.6	477.1
Sion Farm subdistrict	11 883	12 563	...	4 759	4 338	...	24.5	9.5	24.1	9.3	493.1	1 277.7	197.5	511.7
Christiansted town (pt.)	–	–	(NA)	–	(NA)	(NA)	–	–	–	–	–	–	–	–
Southcentral subdistrict	7 425	6 314	...	2 344	1 897	...	34.4	13.3	32.3	12.5	229.9	594.0	72.6	187.5
Southwest subdistrict	7 840	7 067	...	2 476	2 131	...	16.9	6.5	14.1	5.5	556.0	1 425.5	175.6	450.2
St. John Island	3 504	2 472	1 729	1 920	1 110	680	237.7	91.8	50.8	19.6	69.0	178.8	37.8	98.0
Central subdistrict	621	246	...	326	155	...	44.8	17.3	36.4	14.1	17.1	44.0	9.0	23.1
Cruz Bay CDP (pt.)	–	...	...	–	...	...	.1	–	–	–	–	–	–	–
Coral Bay subdistrict	363	256	...	199	124	...	5.0	1.9	5.0	1.9	72.6	191.1	39.8	104.7
Cruz Bay subdistrict	2 469	1 928	...	1 367	807	...	14.9	5.7	7.0	2.7	352.7	914.4	195.3	506.3
Cruz Bay CDP (pt.)	2 466	1 928	...	1 366	807	...	14.9	5.7	7.0	2.7	352.3	913.3	195.1	505.9
East End subdistrict	51	42	...	28	24	...	5.0	1.9	2.4	.9	21.3	56.7	11.7	31.1
St. Thomas Island	48 166	44 372	28 960	18 433	15 545	9 835	810.9	313.1	80.9	31.2	595.4	1 543.8	227.8	590.8
Charlotte Amalie subdistrict	20 589	19 304	...	7 648	6 703	...	8.8	3.4	8.2	3.2	2 510.9	6 434.1	932.7	2 390.0
Charlotte Amalie town	12 331	11 842	12 220	4 741	4 322	3 976	3.0	1.2	3.0	1.2	4 110.3	10 275.8	1 580.3	3 950.8
Charlotte Amalie East CDP	2 836	2 636	...	951	753	...	.5	.2	.5	.2	5 672.0	14 180.0	1 902.0	4 755.0
Charlotte Amalie West CDP (pt.)	5 422	4 898	...	1 956	1 649	...	5.2	2.0	4.6	1.8	1 178.7	3 012.2	425.2	1 086.7
East End subdistrict	5 927	4 722	...	2 647	2 218	...	24.2	9.3	14.0	5.4	423.4	1 097.6	189.1	490.2
Northside subdistrict	6 404	5 730	...	3 149	2 410	...	32.4	12.5	27.8	10.7	230.4	598.5	113.3	294.3
Southside subdistrict	4 868	4 450	...	1 759	1 486	...	11.0	4.2	10.9	4.2	428.3	1 111.4	161.4	418.8
Tutu subdistrict	9 084	8 939	...	2 542	2 241	...	4.0	1.6	4.0	1.5	2 271.0	6 056.0	635.5	1 694.7
Anna's Retreat CDP	9 084	8 939	...	2 542	2 241	...	4.0	1.6	4.0	1.5	2 271.0	6 056.0	635.5	1 694.7
Water Island subdistrict	172	152	...	165	133	...	8.1	3.1	2.6	1.0	66.2	172.0	63.5	165.0
Charlotte Amalie West CDP (pt.)	–	...	...	–	...	...	1.0	.4	–	–	–	–	–	–
West End subdistrict	1 322	1 075	...	523	354	...	13.6	5.3	13.4	5.2	98.7	254.2	39.0	100.6

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GEOLOGY OF ST. THOMAS AND ST. JOHN, VIRGIN ISLANDS

By
Thomas Wallace Donnelly

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