



St. Kitts and Nevis Hazard Vulnerability Assessment: Final Report

Post-Georges Disaster Mitigation Project
in Antigua & Barbuda and St. Kitts & Nevis

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Note from the Author

To define the appropriate reporting and technical methodology to use in the Hazard Vulnerability Assessment, three main topics were taken into consideration:

- 1) To create a user-friendly and effective method integrating GIS map layers and the critical facilities database.
- 2) To use software tools commonly used by any government office (e.g. excel, access, dbase, etc), helping at the same time in reducing implementation cost and training efforts.
- 3) To set the standards in the Hazard Vulnerability Assessment methodology and promote the use in the Caribbean region in future hazard vulnerability assessment projects.

After taking into consideration the work of other consultants in charge of running PGDM assessment in other countries in the region, especially Eva Hodgkinson-Chin in Antigua and Barbuda, it was decided that the same approach in technology and reporting structure will contribute to set the standards for future Hazard Vulnerability Assessment in the region.

The technical module of this report is covered in another document named "*FINAL Procedure Documentation GIS Database integration Ms. Access 2000 and Arc View 3.2 for Hazard Vulnerability Assessment*", which includes the developing a database in Ms Access for the critical facilities, and the link to the Arc View 3.2 project that processed the hazard vulnerability maps and the spatial analysis involved in the method and was used in the Assessment report.

Finally, regarding the vulnerability assessment, it is important to stress that it was undertaken for some of the existing facilities, and that new development on vacant or agricultural lands (e.g. new hotel resorts, and other projects) should take into account the hazard information used in this report to reduce the vulnerability of that development as well as for hazard mitigation purposes.

Acknowledgments

The preparation of the PGDM Hazard Vulnerability Assessment report which will contribute in best disaster mitigation policies in the Caribbean region, had required the cooperation and inputs of different sectors of the local government, international institutions, and local/international consultants.

In particular I will like to thanks for the cooperation, support and assistance during the project to:

- The Unit for Sustainable Development and the Environment of the OAS, in particular to Mr. Steven Stichter - Project Coordinator for the Post Georges Disaster Mitigation Project.

- Government of St. Kitts & Nevis, for putting at my disposition all hardware and software resources from both GIS Units at the Physical Planning Division (SKT), and the Physical Planning & Development (NVS).

At the same time I will like to thanks for giving me the opportunity to do pioneering work in the development of the National Geographical Information System for the Federation of St. Kitts and Nevis, as well as mapping on the PGDM.

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In particular, thanks to the director Mr. Kenneth Parker, that have supported my efforts with his guidance, leadership, and patience while conducting all PGDM Guidance Committee sessions, who, without his personal and professional commitment, the output of the project would have severely be affected in quality and approach.

Finally, the Vulnerability Hazard Assessment and its output have been enhanced thanks to all the team members cooperation, and it is expected that the information provided will be use as a tool for decision making, and enabled others to develop a best disaster mitigation policies.

PART I – PROJECT AND METHODOLOGY

1.0 Introduction

1.1 Post Georges Disaster Mitigation Program

The Post Georges Disaster Mitigation (PGDM) program is one of three components of The Hurricane Georges Reconstruction and Recovery in the Eastern Caribbean program. The PGDM is responsible for implementing the disaster mitigation capacity building component and seeks to reduce the vulnerability of population and economic activities to natural hazards. Towards this end, the PGDM includes a hazard vulnerability assessment component.

1.2 Hazard Vulnerability Assessment Project

The Hazard Vulnerability Assessment Project consists of an assessment of the hazards to which St. Kitts and Nevis are prone and the vulnerability of critical facilities and resources to the hazards. To conduct this assessment the project consisted of the following activities:

- Hazard identification and prioritization
- Hazard analysis
- Facility and resource identification and vulnerability assessment

1.2.1 Hazard Identification and Prioritization

Hazard identification and prioritization was conducted during a Hazard Mapping Prioritization Workshop in St. Kitts during September 2000¹. The workshop produced a list of six hazards, which are listed in order of priority below:

- Winds / Hurricanes
- Drought (Nevis only)
- Storm Surge
- Floods
- Coastal Erosion
- Inland Erosion (St. Kitts only)

¹Rogers, C. 2000. Hazard Mapping / Vulnerability Assessment Prioritization Workshop Report. <http://www.oas.org/pgdm>

1.2.2 Hazard Analysis

Specialists in the areas of wind, storm surge, drought, flooding and erosion were contracted to study the vulnerability of the Federation of St. Kitts and Nevis to the hazards and produce detailed reports and hazard vulnerability zone maps. The vulnerability categories used for the maps produced were “No vulnerability”, “Low”, “Moderate”, “High” and “Very high”. These reports and maps are available at <http://www.oas.org/pgdm>.

Hazard vulnerability maps were produced for the following hazards:

- Wind
- Storm surge
- Waves
- Drought (Nevis only)
- Flooding
- Inland erosion (St. Kitts only)
- Coastal erosion

Wind, storm surge and waves are caused by hurricane and tropical storm activity and are closely related. The TAOS model was used to generate the vulnerability maps. Drought was analyzed on the basis of watersheds and considered environmental, meteorological, hydrological, infrastructural, human and land use factors. Flooding considered factors such as slopes, drainage, ratio of watershed area to flood plain and run-off rates and potential. The Hurricane Lenny rainfall event was used as the basis for classification of flood hazards. Inland erosion examined sheet and rill erosion, gullying and landslides. Coastal Erosion (‘coastal erosion’ refers to beach erosion in this assessment) considered only those beaches that are monitored by The Fisheries Division of St. Kitts and Nevis, the Department of Environment, the Physical Planning Division (SKT) and Physical Planning and Development (NVS).

1.2.3 Facility and Resource Identification and Assessment

The process of facility and resource identification and assessment consisted of the definition of the facilities and resources to be considered, data collection, data automation and finally vulnerability assessment. The facilities and resources to be considered were identified with the assistance of the Physical Planning Division (PPD), the National Emergency Management Agency (NEMA) and the Post-Georges Guidance Committee.

The resources included in the assessment were constrained by the availability of digital mapped resource data. All digital maps were digitized from the scratch and have been added to the National GIS database. A hard copy map of St. Kitts & Nevis (1983) provided by the PPU, was used as the main source map for digitizing of coverages.

Critical facilities were defined as the following:

- Any facilities that functioned as a shelter
- Hospitals and clinics
- Government administrative buildings
- Airports, Sea ports
- Power, Water and Telecommunication Installations
- Oil and Gas Companies
- Protective Services

Survey data on the disaster history (DH), structural (S) and operational vulnerability (O) did not exist for the facilities included in this assessment. Individual government agencies provided information regarding their facilities included in this Facility Vulnerability Assessment.

A workshop was organized in Nevis, with representatives of the different offices of the Federation (PPD, NEMA, PWD, and members of the PGDM Guidance Committee), to assign the DH, S and O values for each facility considered for the Assessment.

The Data was collated, coded and entered into a database that was then integrated into a Geographic Information System (GIS). The categories for each of the vulnerability assessment factors and their codes are indicated in Table 1.

Table 1 – Vulnerability Assessment, Description and Score

Vulnerability	Description	Score
Damage History	None	0
	Minor	1
	Moderate	2
	Repetitive / Significant	3
Structural Vulnerability	Exceeds code	0
	Meets code	1
	Don't meet code	2
	Known deficiencies	3
Operational Vulnerability	No Effect	0
	Minimal	1
	Significant	2
	Life Threatening	3

1.3 Methodology

1.3.1 Theory

The vulnerability assessment process was established by Dr. Casandra Rogers and presented at the Hazard Mapping Prioritization Workshop in St. Kitts during September 2000. The methodology as set out in the workshop consists of the following steps:

1. Identification and prioritization of hazards
2. Creation of an inventory of critical facilities
3. Assessment of each facility in terms of damage history, structural vulnerability and operational vulnerability for each hazard identified.
4. The creation of hazard specific vulnerability zone maps
5. The locational assessment of facilities within hazard zones
6. The calculation of a total facility vulnerability score (FVS) for each facility and each hazard.

The vulnerability assessment process is defined by the formula:

$$FVS = (L+V)HPS$$

Where “FVS” is the Facility Vulnerability score, “L” is the Locational Vulnerability, “V”² is the Facility Vulnerability and “HPS” is the Hazard Priority Score.

As previously indicated, the workshop generated a priority listing of the five hazards and the hazards were weighted from 1 to 5 to generate a Hazard Priority Score (HPS) as listed below. These are the values utilized in this assessment. The Wave hazard generated by storms was assumed to have a value of “1” as it was not considered separately by the workshop.

Table 2 – Hazard Priority Scores (HPS)

Hazard	HPS (St. Kitts)	HPS (Nevis)
Winds / Hurricanes	5	5
Drought (Nevis only)	-	1
Storm Surge	2	2
Floods	4	3
Coastal Erosion	3	4
Inland Erosion (St. Kitts only)	1	-

² “V” is defined as the total of the damage history, structural vulnerability and operational vulnerability scores.

1.3.2 Automation

The Vulnerability Assessment Project automates the procedure established by Dr. Rogers. It is automated within a GIS environment to allow for the integration and analysis of data with hazard mapping. The system is designed within Microsoft Access™ and ArcView 3.2™. It consists of a Microsoft Access™ database and an ArcView 3.2™ project for each island.

The Microsoft Access™ database stores the facility data collected by PGDM Committee and calculates the “V” of each facility for each hazard. A table consisting of the hazard specific “V” scores is linked to each ArcView 3.2™ project. The ArcView 3.2™ project consists of digital maps and linked data tables.

Maps on the following features were integrated into the project to identify the features vulnerable to hazards:

- Critical facilities
- Roads
- Settlements
- Corals
- Topography
- Drainage
- Land Use / Land Cover

The GIS facilitates the overlay of hazard maps on the location of features and critical facilities. Visual interpretation determines which features are located in the various hazard zones. Spatial and tabular manipulations in the GIS identify facilities in each hazard zone and calculate the “FVS” of each facility.

1.4 Format of Analysis

The analysis considers St. Kitts and Nevis separately. It considers each hazard and the features and facilities that are most vulnerable to the hazard. The vulnerability of features is indicated by their location in high and very high hazard zones. The vulnerability of facilities is indicated by the value of their “FVS”. Table 3 indicates the highest possible “FVS” for each hazard type. “FVS” are ranked and the facilities with the highest scores

are indicated. A FVS was considered high if it was more than 50% of the total possible value.

When using cumulative "Total FVS", a facility with a Total FVS higher than 70% of the total possible was considered high.

A listing of each facility by type, hazard and FVS is attached at Appendix 1 (St. Kitts) and Appendix 2 (Nevis).

Table 3- Highest Possible Facility Vulnerability Score

Hazard	H FVS St. Kitts	H FVS Nevis
Wind / Hurricane	50	45
Drought (NVS)	-	6
Storm Surge	20	14
Floods	44	30
Coastal Erosion	30	24
Inland Erosion (SKT)	9	-
Maximum FVS	153	119

To identify facilities most vulnerable to all hazards the Total FVS was calculated and the facilities noted. The Total FVS values were used to create a map to easily identify total FVS "hotspots" and density zones ranked according to FVS of each facility.

PART II – ST. KITTS

2.0 St. Kitts - Hurricanes and Storms

2.1 Hazard Zones

Three hazards related to hurricanes and storms were studied: wind, storm surge and waves. Storm surge and waves are dependent upon wind for their generation and the hazards are closely related. Table 4 indicates the categories used to zone these hazards. It indicates the lower and upper bounds of each of the categories and provides a reference for the hazard maps produced. Table 5 describes the Saffir / Simpson Hurricane Scale, it can be used to convert the categories and bounds in Table 4 to measurements and damage estimates.

Table 4 – Wind, Waves and Storm Surge Hazard Categories

HAZARD LEVEL	Description	Lower Bound winds (m/sec)	Upper Bound winds (m/sec)	Lower Bound surge (m)	Upper Bound surge (m)	Lower Bound waves (m)	Upper Bound waves (m)
0	none	0	17	0.0	0.1	0.0	0.1
1	low	17	43	0.1	0.5	0.1	1.0
2	moderate	43	50	0.5	1.5	1.0	1.5
3	high	50	59	1.5	3.0	1.5	2.0
4	very high	59	100	3.0	100.0	2.0	100.0

Source: Wagenseil, R. 2001. Wind and Storm Surge Technical Report. <http://www.oas.org/pgdm>.

2.2 Wind

2.2.1 Wind Zones

Map 1 indicates the vulnerability of St. Kitts to winds by the return periods of 10 years, 25 years, 50 years and 100 years. The 10-year return period subjects the entire island to low vulnerability that is of the tropical storm and hurricane category 2 wind strength. Minimal damage would be expected.

The 25-year return period would generate low vulnerability at the northeast of the island, and moderate vulnerability (wind strengths of category 2 and 3, moderate/extensive damage) would be expected in the center of the island and above 500 feet.

The Basseterre area shows low vulnerability and Frigate Bay moderate vulnerability. The Southeast Peninsula (SEP) shows moderate vulnerability except for the Cades Bay, Sandbank Bay and the Caribbean side, which show low vulnerability.

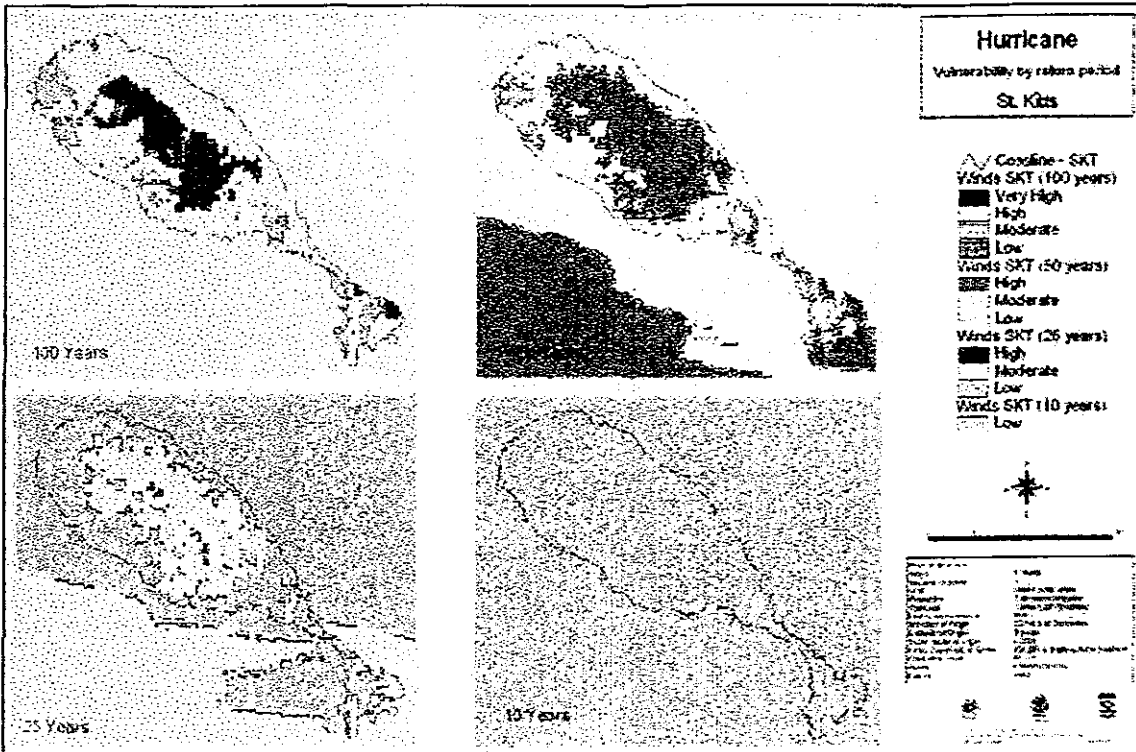
Also some pockets of high vulnerability (wind strength of category 3 and 4) exist above the 1,500 feet. Extensive / extreme damage would be expected in these areas. The main water intake, "Lodge," is located in this high vulnerability zone.

For the 50-year return period most of St. Kitts is in the Moderate vulnerability zone, except for some pockets at the northeast and in the SEP. High vulnerability would be expected above the 500 contour, as well as in Frigate Bay area and the SEP.

The 100-year storm would place most of the island within the high vulnerability zone, including the northeast, Frigate Bay, and some pockets of the SEP. Very high vulnerability would be expected above 1000 feet, as well as in the Canada area. In these high vulnerability areas, storm winds of category 4 and 5 winds strength would be expected, resulting in extreme or catastrophic damage.

Table 5- Saffir/ Simpson Hurricane Scale

Category	Pressure millibars	Wind				Storm Surge meters	Damage
		m/s	kph	mph	knots		
0 Tropical Storm	>= 995	17 - 32	61 - 119	38 - 74	34 - 63	0.5 - 1.2	Some
1 Hurricane	980 - 995	33 - 42	119 - 153	74 - 95	64 - 82	1.2 - 1.5	Minimal
2 "	965 - 979	43 - 49	154 - 177	96 - 110	83 - 95	1.6 - 2.4	Moderate
3 "	945 - 964	49 - 58	178 - 209	111 - 130	96 - 113	2.5 - 3.6	Extensive
4 "	920 - 944	58 - 69	210 - 249	131 - 155	114 - 135	3.7 - 5.4	Extreme
5 "	< 920	> 69	> 249	> 155	> 135	> 5.4	Catastrophic

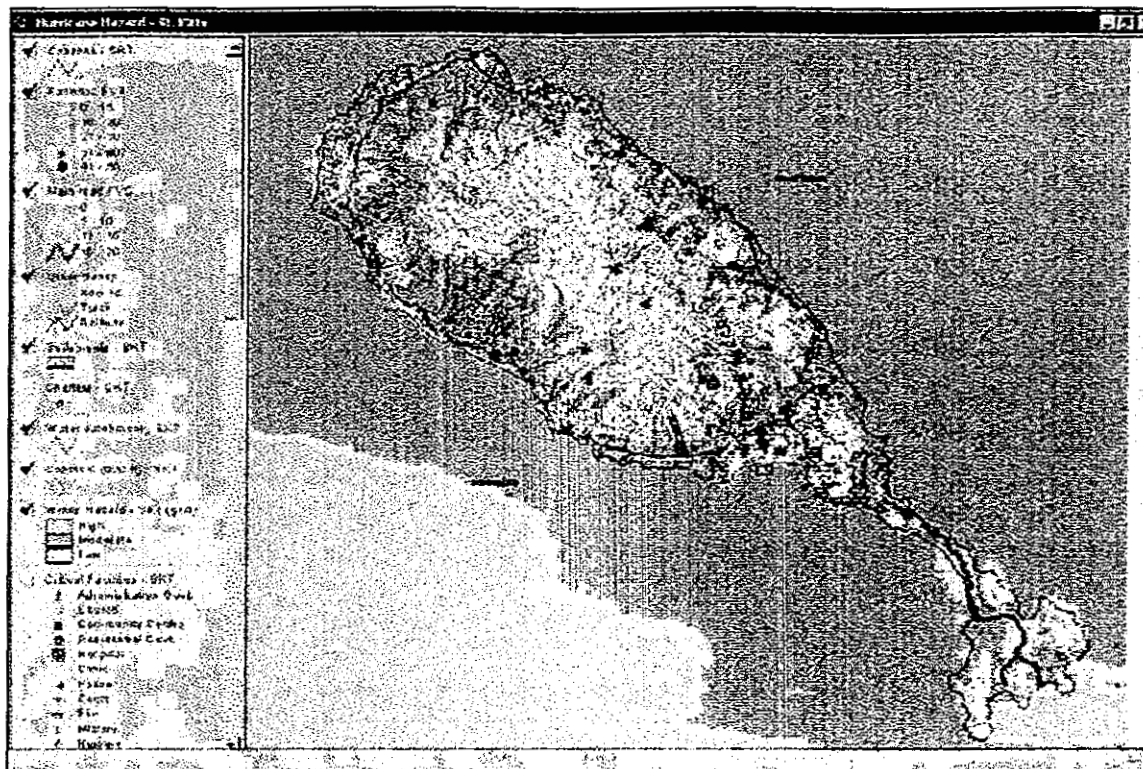


Map 1- St. Kitts Wind / Hurricane Vulnerability by Return Period

The long-term vulnerability is similar to the 50-year storm. As Map 2, indicates the central and eastern districts of the island are within the moderate vulnerability zone. The western section of the island is low and some sections of the southern range are within a high vulnerability zone.

2.2.2 Wind FVS

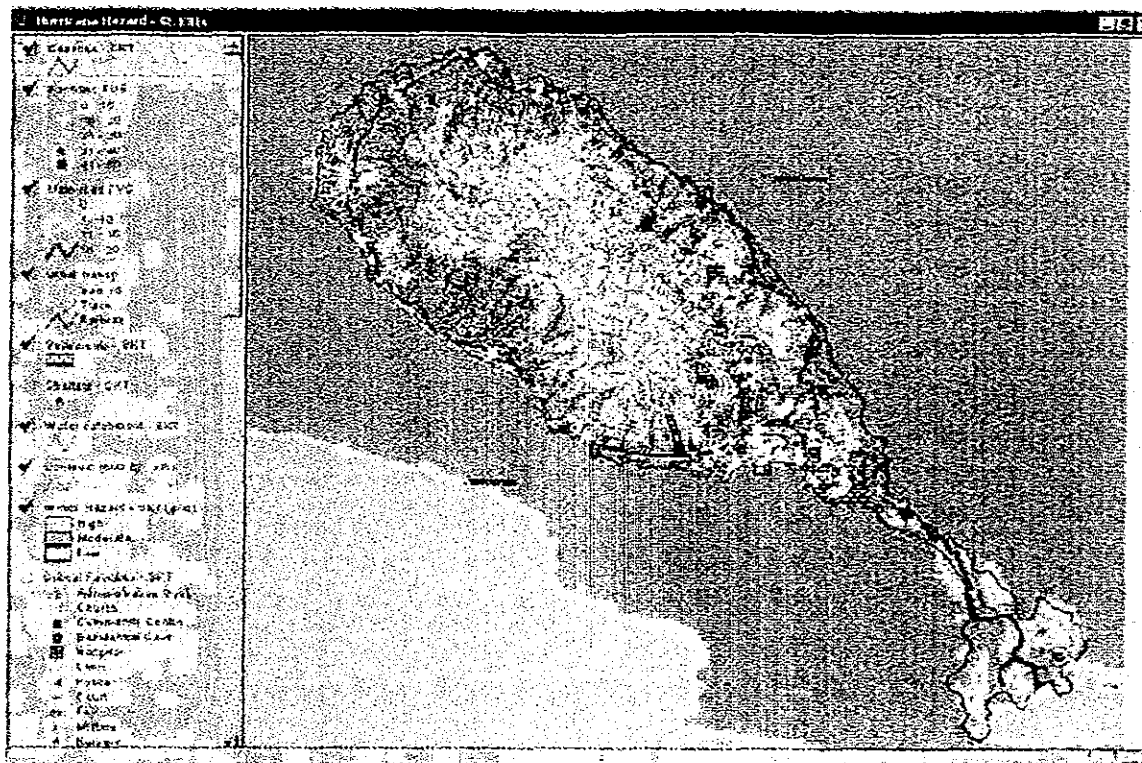
Map 2 indicates the distribution of facilities by wind FVS and the long-term vulnerability to wind. It indicates that facilities with the higher FVS are fairly evenly distributed throughout urban areas of Basseterre, Cayon, Mansion, Verchilds, and Sandy Point. Map 3 indicates the location of facilities which have an FVS of more than 50% of the possible wind FVS (50). They are clustered around Basseterre and scattered evenly around the island.



Map 2- St. Kitts Long Term Vulnerability to Hurricane / Wind and Facility FVS

The analysis reveals that several key critical facilities have extremely high FVS. The facilities and their FVS are listed below:

Attributes of Critical Facilities - SKT					
Fac. Type	Fac. Class	NAME	LOCATION	WIND	State
Education	Secondary	Washington Archibald High	Payon Range	50	0
Education	Secondary	Cayon High	Cayon	50	0
Community	Community Centre	Warner Park	Baseterre	45	0
Protective	Police	Police Station	Cayon	45	0
Medical Facilities	Hospital	Popson Hospital	Saddlers Point	45	0
Protective	Police	Police Training Complex	Baseterre	45	0
Education	Secondary	Sandy Bay High	Sandy Bay	45	0
Government	Storage	Customs Shed	BLEB Int'l Airport	45	0
Education	Secondary	Hasselard High	Baseterre	45	0
Education	Secondary	Vachide High	Vachide	45	0
Government	Storage	Abbalon	Baseterre	40	0
Utilities	Water	Water Intake Point 1	Point	40	0
Utilities	Water	Water Intake Stonefort	Stonefort	40	0
Community	Church	Thorn Brook Church	Palmer Point	40	1
Protective	Police	Police Station	Stabroek	40	0
Utilities	Water	Water Intake Lodge	Lodge	40	0
Infrastructure	Sea Port	Deep Water Port	Bird Rock	40	0
Community	Community Centre	New Barracks	Cayon Hill	40	1
Protective	Police	Police Station	St Pauls	40	0



Map 3. St. Kitts Facilities with Wind FVS Greater than 25

In addition, several Shelters with FVS of 30 or above are listed below in Figure 1.

Attributes of Critical Facilities - SKT						
BIS/CEDA	FAC Type	FAC Class	NAME Fac	LOCATION	WIND FVS	Shelter
10704	Community	Community Centre	Pavilion	Molineux	30	1
10702	Community	Church	Estridge Moravian Church School	Mansion	35	1
10802	Community	Community Centre	Pavilion	St. Mary Play Field	30	1
10504	Community	Community Centre	New Pavilion	Cleverly Hill	40	1
10402	Community	Community Centre	Pavilion	Verchilds Pature	30	1
10206	Education	Nursery	Moravian Church Pre-School	Victoria Road	30	1
10303	Community	Church	Trinity Anglican Church	Palmetto Point	40	1

Figure 1. St. Kitts Shelters with Wind FVS of 30 or greater.

2.2.3 Feature Vulnerability to Wind

In the long term most of St. Kitts is moderately vulnerable to winds. The high vulnerability zones consist largely of forest reserves, sugar cane fields, and scrubs lands. Also there is a concentration of facilities with high FVS in the area of Basseterre, Cayon, Sandy Point, and the Port area.

2.3 Storm Surge

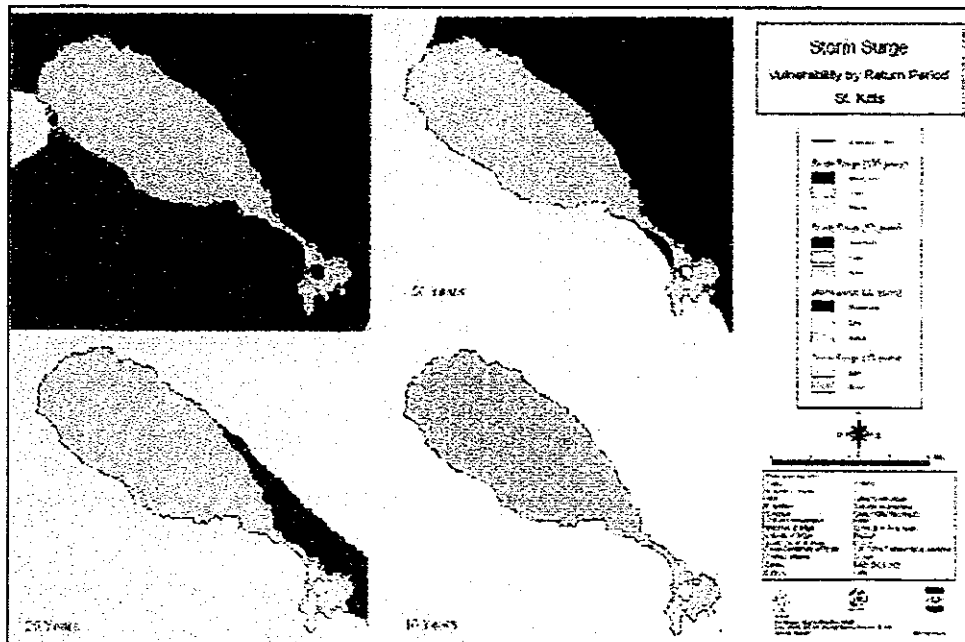
2.3.1 Storm Surge Zones

The 10-year return period shows the entire coast would have very low or no vulnerability, with the exception of the Dieppe Bay/Dowson's Ghaut, Grange Bay, North Friars Bay, the southwest of SEP (including Mayors; Bay and the salt ponds), South Friars Bay and the Basseterre waterfront, which would have low storm surge vulnerability. It would be similar to that experienced in a tropical storm with some damage and surge to the heights of 0.1 to 0.5 meters.

The 25-year return period would place most of the coast, except for the northeast coast, in a moderate vulnerability storm surge zone (from Mosquito Bay up to Hermitage Bay) with surge varying between 0.5 and 1.5 meters with minimal damage. Also, two pockets of moderate vulnerability storm surge show at the northeast and south of the Great Salt pond.

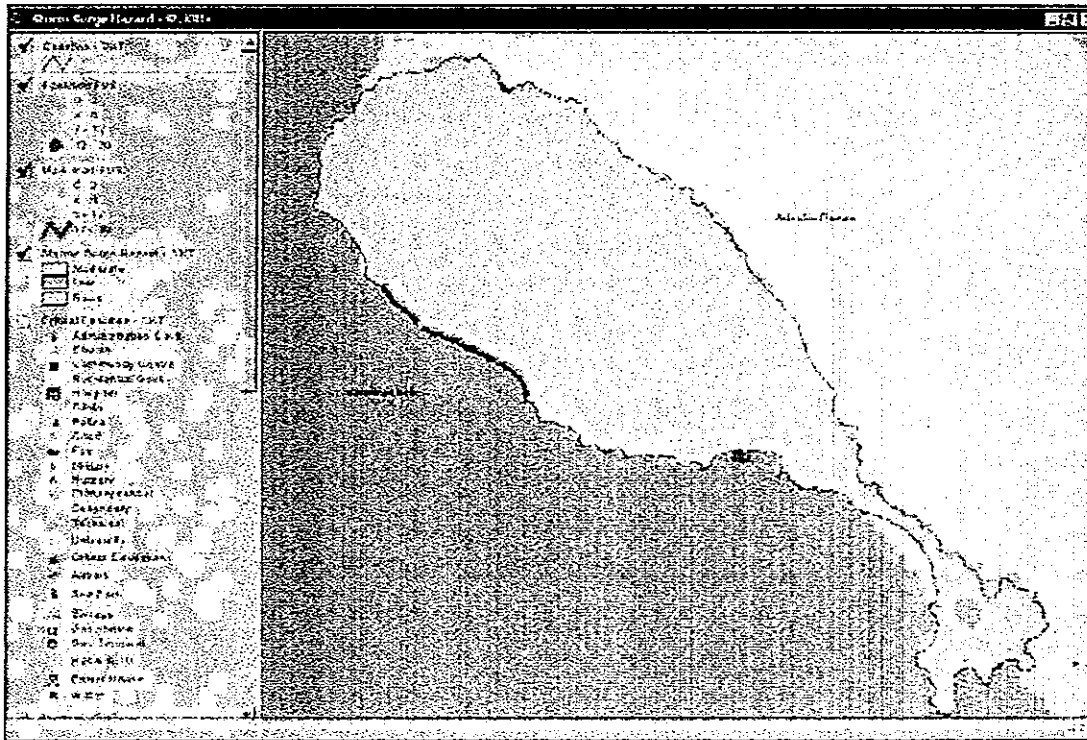
The 50-year return period shows the Atlantic coast with moderate vulnerability storm surge, as well from South Friars Bay up to Frigate Bay and the salt ponds of the SEP, the sea would also surge in the Factory Tank area. The Basseterre waterfront would expect a low vulnerability storm surge. The rest of the coastline would expect none/very low vulnerability storm surge.

The 100-year return period would expose the entire coastline to a moderate vulnerability storm surge, with the exception of Pump Bay.



Map 4- St. Kitts Storm Surge Vulnerability by Return Period

The long-term vulnerability of St. Kitts to storm surge is identical to the 50-year storm: the Atlantic coast has moderate vulnerability to storm surge, as does the coastline from South Friars Bay up to Frigate Bay and the salt ponds, and a pocket in the Factory Tank area. Basseterre's waterfront has a low vulnerability storm surge. The rest of the Caribbean coastline would expect no/very low vulnerability to storm surge.



Map 5- St. Kitts Long Term Vulnerability to Storm Surge and FVS

2.3.2 Storm Surge FVS

Two facilities have an FVS of more than 18 at Port Zante (Arrivals Hall and pier). Also two segments of the Main Road show a high Surge FVS: Brimstone Hill to Old road (14), and Parsons to Saddlers (16). Map 5 indicates these locations.

Six of these facilities have a Surge FVS higher than 10 and are shown in Figure 2.

Also two different areas show facilities with high Surge FVS:

- Basseterre: the Deep Water port, the Pelican Mall, and the Social Security Building
- Half Way Tree: the Half Way Tree Pre-School.

In addition the shelter "Church of God" at Half Way Tree indicates a Surge FVS of 6, as well as the Public Market, the Petroleum Terminals of Shell and Texaco, Academy Pre-School, Turcker-Clarke primary school, and the Newtown Health Centre in the Basseterre area.

Facility Type	Facility Name	NAME_FAC	LOCATION	FVS	Count
Government	Admiral's Hall	Admiral's Hall	Fort Charles	301	0
Infrastructure	Sea Point	SEA POINT	Bird Rock	318	0
Infrastructure	Sea Point	SEA POINT	Bird Rock	12	0
Government	Administration	PERFORMA	Basseterre	101	1
Education	Primary	ELWAZA HIGH SCHOOL	Half Way Tree	10	0
Government	Secondary	SOCIAL SECURITY TRAINING	Basseterre	10	0
Health Facility	CHC	NEW GUINEA HOSPITAL	Basseterre	6	0
Education	Primary	LUCKY ELDER	New Guinea	6	0
Government	Storage	WINGS MARKET	Basseterre	6	0
Education	Primary	ACADEMY FREE SCHOOL	Half Way Tree	6	0
Utility	Powerline	TESALCO TOWER	Basseterre	6	0
Utility	Powerline	SHELL TOWER	Basseterre	6	0
Religious	Church	CHURCH OF GOD	Half Way Tree	6	1

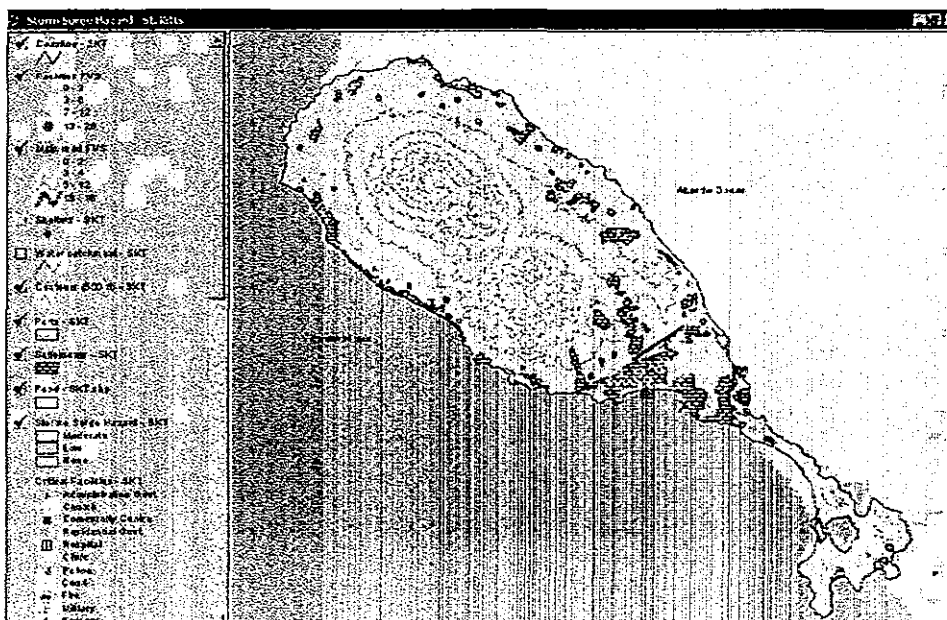
Figure 2- St.Kitts Facilities with High Storm Surge FVS

Is it important to mention that this assessment did not include Tourist facilities. A large number of hotels, especially in the Atlantic coast, are located within a moderate storm surge vulnerability zone (e.g. Frigate Bay area). It is recommended that a new assessment should be run that will include tourist facilities.

2.3.3 Feature Vulnerability to Storm Surge

Most of the coastal features of St. Kitts are vulnerable to moderate and low storm surge. All the piers are vulnerable to moderate storm surge, as are two portions of the main road: - Brimstone Hill/Old Road: Fort Charles, Old Road Bay, and Half Way Tree. - Parsons/Saddlers: Sandy Bay.

The following settlements are most likely to have a low vulnerability to storm surge: North of Dieppe Bay Town, South of Frigate Bay, Bird Rock south, Basseterre's water front, Fort Charles, Half Way Tree and New Guinea.



Map 6- St. Kitts Feature Vulnerability to Storm Surge

2.4 Waves

2.4.1 Wave Zones

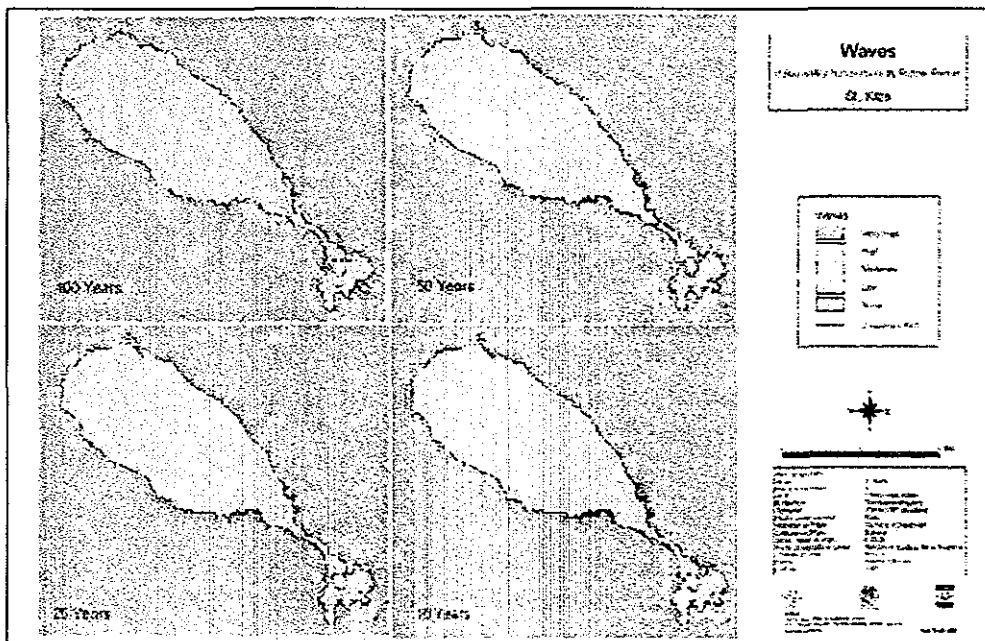
Map 7 indicates the vulnerability of St. Kitts to the various storm return periods. The 10-year return period indicates, in general, high wave vulnerability and very high wave vulnerability all along the Atlantic and Caribbean coastline.

The Caribbean coast: Intrusion of waves are shown in Basseterre waterfront, Port Zante and the Deep Water Port area, a very high wave vulnerability (with areas of high and moderate vulnerability) area covers south Frigate Bay and the SEP.

The Atlantic coast: Intrusion of waves are shown in Dieppe Bay town as well as in Half Moon Bay, with a mix of very high and high wave vulnerability.

Very high vulnerability zones will experience waves between 2.0 and 10.0 meters. High zones will have waves between 1.5 and 2.0 meters. Moderate vulnerability zones can expect waves between 1.0 and 1.5 and low vulnerability zone will have waves below 1.0 meters.

The 25-year, 50-year, and the 100-year wave return periods show identical results to the 10-year period, except for the South Friar Bay, where very high wave vulnerability is indicated for the 50/100-year return period.



Map 7- St. Kitts Wave Vulnerability by Return Period

3.0 St. Kitts –Flooding

3.1 Flood Zones

Cooper³ indicates that the data required for traditional floodplain mapping was not available for St. Kitts. As a result, the flood analysis “was restricted first to identifying the areas that would generally flood and then to further categorize these areas according to rough estimates of the flood levels expected within the areas”. Areas prone to flooding were identified as those with gentle slopes, poor drainage, large ratios of watershed area to flood plain, rapid run-off to flood plain with high run-off potential.

The hazard category was determined by the water depth of each flood plain on the basis of the Hurricane Lenny rainfall event, using the classification indicated in Table 6. Cooper indicates that this method of categorization provides a measure of the magnitude of flooding to be expected from such an event and provides a measure of the severity of flooding among the identified zones.

Table 6. Flood Plain Water Depth and Hazard Category

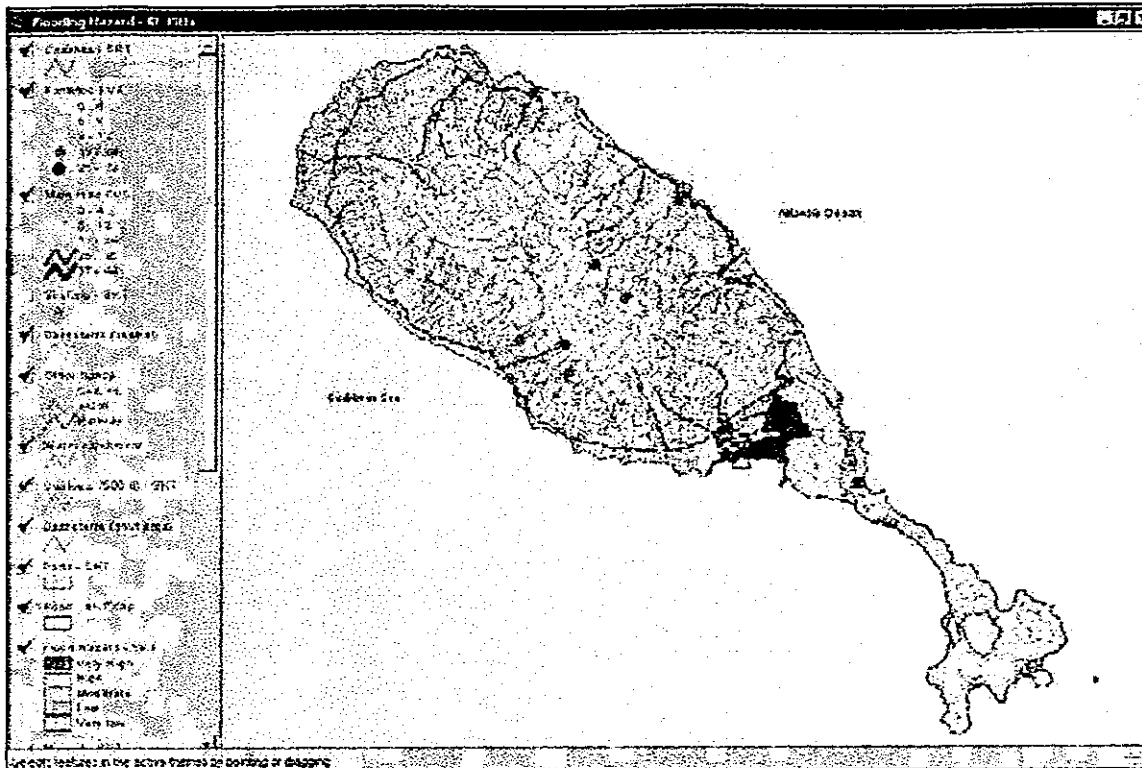
Water Depth (mm)	Hazard
>1200	Very High
1200-600	High
600-300	Moderate
300-100	Low
<100	Very Low

3.2 Flood FVS

Map 13 indicates the distribution of flood zones and the Facility FVS. The zone of very high vulnerability to flooding is to the northeast of Basseterre. Most of the island has been categorized as a very low flood vulnerability zone.

Figure 3 lists the facilities with high Flood FVS (32). Five shelters are included on the list: Hope Chapel, Rivers of Living Water Church, Church of God, Day Care Centre, Seventh Day Adventist Church.

Other facilities in Basseterre area with high FVS includes: Power Stations B, Police Training Complex , Police Station (Frigate Bay), Fire Station, five of the six main water intakes, six boreholes, Shell Terminal, Social Security Building, PPD, the Public Market, Cemaco, Gas station Shell, and the Newtown Health Centre.



Map 13. St. Kitts Flood Vulnerability Zones and Facility FVS

NAME/FAC	FAC Type	Fac Class	LOCATION	Flood Fvs	Shells
Police Training Complex	Protective	Police	Basseterre	32	0
Social Security building	Government	Administration	Basseterre	32	0
Public Market	Government	Storage	Basseterre	29	0
SHELL Terminal	Utilities	Petroleum	Basseterre	29	0
Physical Planning, Development	Government	Administration	Basseterre	24	0
Industrial Site day Care	Education	Nursery	Industrial Site	23	0
St. Theresa Convent	Education	Primary	East Independence Square	23	0
SHELL Pond Rd.	Utilities	Gas	Basseterre	23	0
Water Intake Wingfield	Utilities	Water	Wingfield	23	0
School Meats building	Government	Storage	?	23	0
Water Intake Franklands	Utilities	Water	Franklands	23	0
Water Intake Stonefort	Utilities	Water	Stonefort	23	0
Saddlers Health Centre	Medical Facilities	Clinic	Saddlers	23	0
Water Intake Philips	Utilities	Water	Philips	23	0
R.L.B Airport	Utilities	Water	Conaree	23	0
St. Theresa Convent High	Education	Secondary	East Independence Square	23	0
Police Station	Protective	Police	Figate Bay	23	0
Factory Shells	Government	Storage	Basseterre	23	0
CEMACO	Government	Storage	Basseterre	23	0
Conaree	Utilities	Water	Conaree	23	0
1-47	Utilities	Water	Basseterre Valley	23	0
Ponds#2	Utilities	Water	Basseterre Valley	23	0
1-41	Utilities	Water	Basseterre Valley	23	0
1-49	Utilities	Water	Newton Ground	23	0
Church of God	Community	Church	Westbourne Street	23	1
Newton Health Centre	Medical Facilities	Clinic	Basseterre	23	0
Seventh Day Adventist Church	Community	Church	Wellington Road	23	1
Day Care Centre	Education	Nursery	Figate Bay Road	23	1
Water Intake Lodge	Utilities	Water	Lodge	23	0
Fire Station	Protective	Fire	Basseterre	23	0
Hops Chapel	Community	Church	George Street	23	1
Treasury Building	Government	Administration	Basseterre	23	0
Power Station B	Utilities	Electricity	Headonrust	23	0
Rivers of Living Waters Christ	Community	Church	Southwell Industrial Park	23	1

Figure 3a. St. Kitts Facilities with High Flood FVS

³ Cooper, V. 2001, Flood Methodology Notes. Email .

3.3 Feature Vulnerability to Floods

The following portions of the transportation network are showing high FVS

Attributes of Main road FVS			
FAC Type	FAC Class	NAME FAC	FVS
Infrastructure	Roads	Ponds Rd.	44
Infrastructure	Roads	College Ghaut (Lower)	44
Infrastructure	Roads	College Ghaut (Upper)	44
Infrastructure	Roads	Keys - Cayon	36
Infrastructure	Roads	Bay rd. (Circus - Fishing Complex)	32
Infrastructure	Roads	Bay rd. (War Memorial - Circus)	32
Infrastructure	Roads	Fort Thomas - War Memorial	32
Infrastructure	Roads	Parsons - Saddlers	24
Infrastructure	Roads	Christ Church - Mansio	24

Figure 3b. St. Kitts Transportation network with High Flood FVS

These include: Key to Cayon and the crossing area of Wash Ghaut and Cayon River. Along Christ Church to Mansion, Parson to Saddlers (Lavington Ghaut, Linches Ghaut, Pogsons Ghaut). Along Fort Thomas road up to New Town, Ponds road, and Upper and lower College street Ghaut.

Very high flooding vulnerability zones cover urban areas, southeast of Basseterre, Pond Estate, Kit Stoddart's, up to Needsmust Estate, as well as sugar fields.

High flooding vulnerability zones exist in urban areas, Conaree, Canada Estate, as well as in the Dump site, sugar cane field, others agricultural areas and scrubs.

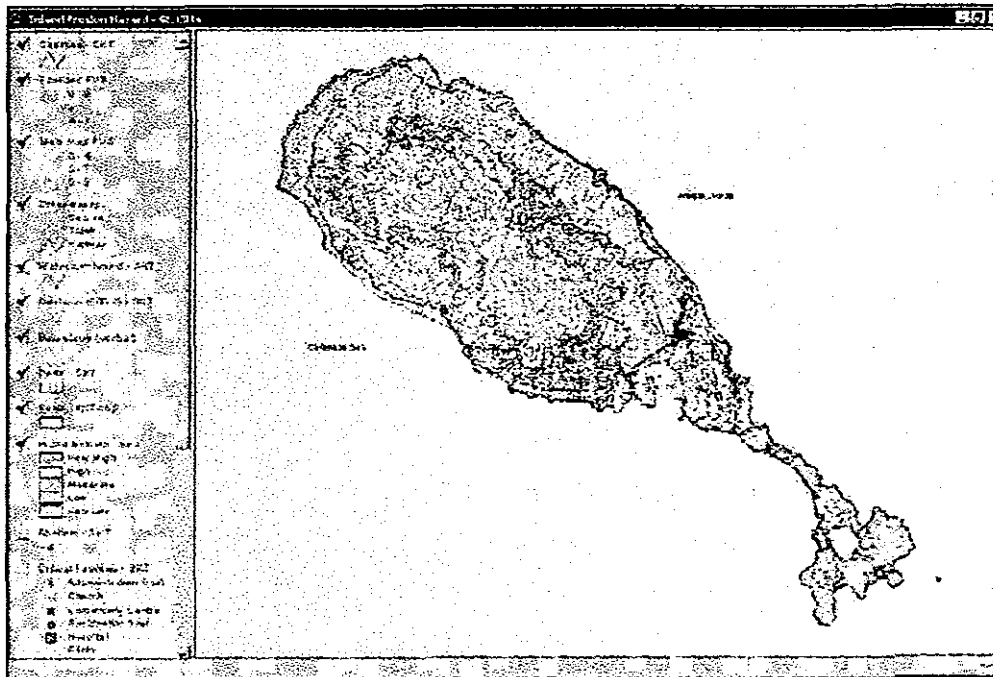
Moderate flooding vulnerability zones covers the Tourist facilities at north Frigate Bay, center Basseterre Bay road area and sugar fields.

Low flooding vulnerability zones exist around the island including, Half Way Tree, Sandy Point, Fig Tree Village, Newton Ground, Dieppe Bay town, and Parson ground, as well as sugar cane fields and scrubs.

Basseterre area: Social Security building, JNF General Hospital, and the Abbatoir.

Trinity area: Bronte Welsh School and Ross University.

Also six Shelters show a high FVS for inland erosion.



Map 15. St. Kitts Location of Facilities with high FVS

FAC TYPE	Fac Class	NAME FAC	LOCATION	Lat	Long
Utilities	Water	Water Intake Phillips	Phillips	7	0
Government	Administration	Social Security building	Basseterre	6	0
Utilities	Water	Water Intake Wingfield	Wingfield	6	0
Community	Church	Seventh-Day Adventist Church	Phillips	6	1
Utilities	Water	Water Intake Lodge	Lodge	6	0
Utilities	Water	Water Intake Franklands	Franklands	6	0
Utilities	Water	Water Intake Stonefort	Stonefort	6	0
Utilities	Water	Stonefort	Stone Fort	5	0
Utilities	Gas	SHELL Buckleys	Buckleys	5	0
Utilities	Water	Orton's	Orton's	5	0
Government	Storage	Abbatoir	Basseterre	5	0
Utilities	Water	1-51	La Guerite	5	0
Utilities	Gas	TEXACO Buckleys	Buckleys	5	0
Utilities	Water	Sir Gilles	Sir Gilles	5	0
Education	Primary	Bronte Welsh	Trinity	5	0
Community	Community Centre	Eastern Benevolent Society Building	Camps	5	1
Community	Community Centre	Community Centre	Palmetto Point	5	1
Medical Facilities	Hospital	JNF General Hospital	Basseterre	5	0
Education	University	Ross University	Trinity	5	0
Community	Church	Trinity Anglican Church	Palmetto Point	5	1
Protective	Police	Police Station	Old Road	5	0
Government	Residential	Estate House	Phillips Estate	5	1
Government	Residential	Estate House	Stonefort Estate	5	1

Figure 4a. St. Kitts Facilities high Erosion FVS (>4)

4.3 Feature Vulnerability to Inland Erosion

The majority of the zones with high and very high vulnerability to inland erosion primarily cover sugar cane fields and agriculture.

FAC Type	Fac Dis	NAME FAC	IE FVS
Infrastructure	Roads	Stonefort	9
Infrastructure	Roads	College Ghaut (Lower)	8
Infrastructure	Roads	College Ghaut (Upper)	8
Infrastructure	Roads	SEP rd. (Friar's Bay)	7
Infrastructure	Roads	Phillips	7
Infrastructure	Roads	Keys - Cayon	6
Infrastructure	Roads	Christ Church - Mansio	6
Infrastructure	Roads	Brimstone Hill - Old Road	6
Infrastructure	Roads	SEP rd. (Mayor's Bay)	6

Figure 4b. St. Kitts Transportation network with high FVS (>4)

Settlement name	Settlement type
Sir Gillies Estate	Estate
Fig Tree	Village
Farm Estate	Estate
Phillips Village	Village
Sandy Point	Town
Cayon	Town
Keys	Village
Bayford's	Town
Ogee's	Village
Canada Estate	Estate
Wingfield Manor Estate	Estate
Fountain Estate	Estate
Old Road	Town
St. Peters	Town
Milken Estate	Estate
Basseterre	Capital
Matingley Heights	Village
Shadwell Estate	Estate
Challengers	Village
Olivees Village	Village
Boyd's Estate	Estate
Trinity	Village
Dewars	Village
West Farm Estate	Estate
Boyd's	Village
Frontier Village	Village
Garvey's Estate	Estate
Camps	Estate

Figure 4c. St. Kitts Settlements w/ high vulnerability inland erosion.

The condition of the following roads are adversely affected by erosion:

A segment of the Main road shows the highest FVS (9) at Stone Fort Ghaut area, and in Upper and Lower College Street in Basseterre. The SEP road at Friar's Bay, and Mayor's Bay, also Phillips Village road, Nicola Town to Mansion Village, in the area of Old Road Town also have high FVS values.

Some highly populated settlements such as Basseterre, Sandy Point, and Cayon are located within or expanding towards areas of very high or high vulnerability to inland erosion.

Figure 4c lists all the towns, villages, and estates located in zones of very high or high vulnerability to inland erosion.

5.0 St. Kitts - Beach Erosion

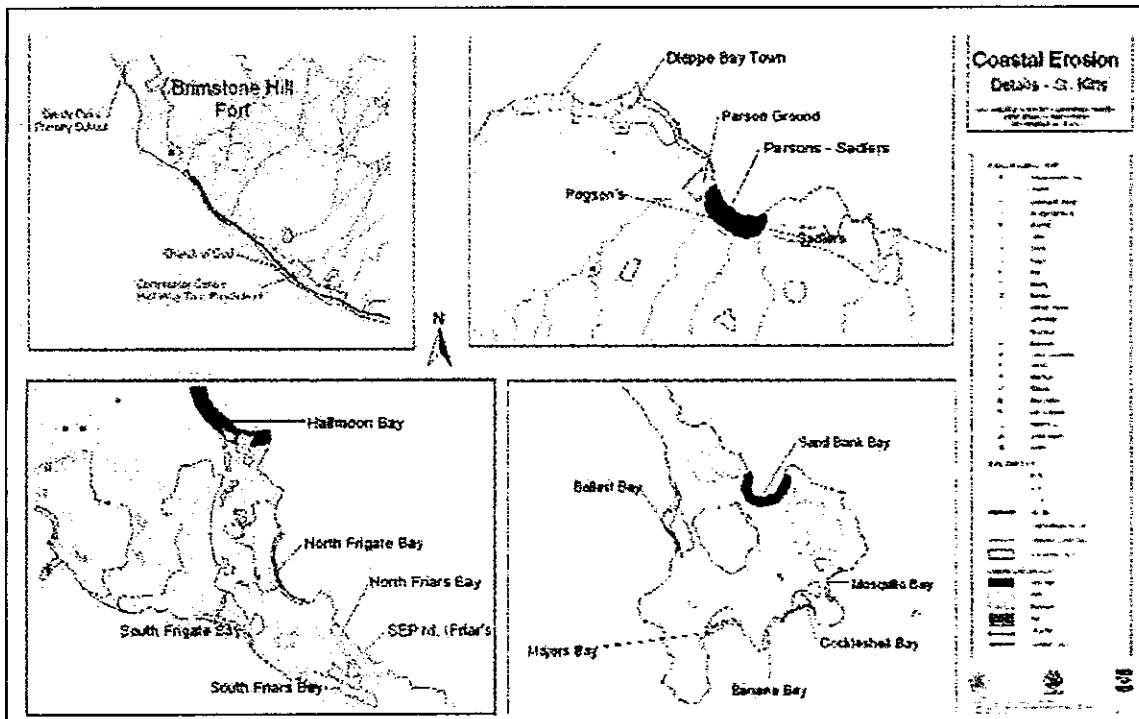
5.1 Beach Erosion Zones

⁵Beach erosion zones are established with the beach setbacks recommended by the Department of Environment and applied to the beaches monitored by the Fisheries Division of St. Kitts & Nevis.

Setback distance is calculated for a return period of 50 years, the buffer areas around beach segments shows relative beach erosion hazard zones used in the maps.

The Fisheries Division and the Physical Planning Division monitor the beach profiles on 21 beaches in St. Kitts on a quarterly basis. Emphasis is placed on beach changes and data has been collected since 1993. Most of the monitored beaches in St. Kitts are categorized as medium to very high erosion zones.

On the Atlantic coast, five out of six beaches have a high and very high hazard rates. Seven out of nine beaches in the Caribbean coast have a low or very low hazard rating.



Map 16. Facilities Most Vulnerable to Beach Erosion in St. Kitts

⁵ Edsel B. Daniel, 2001, "An Assessment of Coastal Erosion in St. Kitts and Nevis", <http://www.oas.org/pgdm>

5.2 Beach Erosion FVS

Only three facilities have a FVS of more than 50% of total possible score (12). These facilities are: The Half Way Tree School, the Sandy Point Primary school, and the church shelter, Church of God at Half Way Tree.

FAC Type	Fac Class	NAME FAC	LOCATION	Score	Status
Education	Nursery	Half Way Tree Pre-School	Half Way Tree	12	0 ▲
Community	Church	Church of God	Half way Tree	9	1
Education	Primary	Sandy Point	Sandy Point	6	0 ▼

Figure 5a. St. Kitts Facilities high Erosion FVS (>6)

Although only three facilities had shown figures over the FVS break point, a future assessment should include existing Tourism facilities as well a new projects (e.g. hotels), as many tourist facilities are located within the coastal erosion hazard zones.

Three segments of the Main Road show the highest Beach Erosion FVS: Parsons to Saddler, Brimstone Hill to Old Road (Brimstone Hill area), and the SEP road at Friar's Bay. Map 16 indicates Facilities and the Beach Erosion FVS.

FAC Type	Fac Class	NAME FAC	Score
Infrastructure	Roads	Parsons - Saddlers	30 ▲
Infrastructure	Roads	Brimstone Hill - Old Road	24
Infrastructure	Roads	SEP rd (Friar's Bay)	12 ▼

Figure 5b. St. Kitts Transportation network with high FVS (>12)

5.3 Feature Vulnerability to Beach Erosion

The areas affected by the beach erosion zones are generally tourism development areas such as Half Moon Bay, Frigate Bay, Major's Bay, Mosquito Bay, and Banana Bay.

Urban areas, such as Basseterre and Dieppe Bay Town, have a high vulnerability to beach erosion; Sandy Point has a low vulnerability, and Parsons Ground has a very high beach erosion vulnerability.

Other features identified as having very high vulnerability are sugar cane fields (Parson Ground, Pogson) and scrubs.

PART III – NEVIS

6.0 Nevis - Hurricanes and Storms

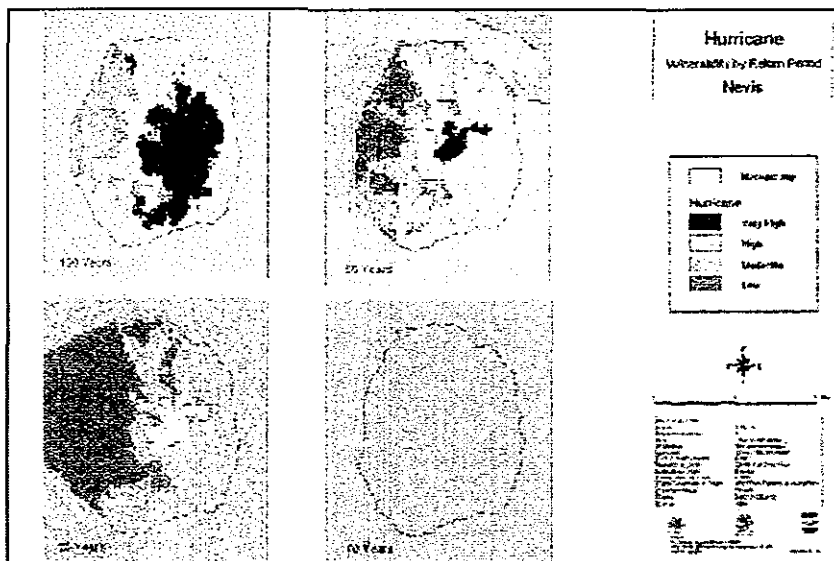
6.1 Wind

6.1.1 Wind Zones

Map 17 indicates the expected vulnerability to winds of Nevis for various return periods. The 10-year storms are predicted to place Nevis in an area of low vulnerability with winds between 17 and 43 meters/second.

The 25-year storm will subject most of the island to moderate vulnerability to wind-related hazards. Moderate winds are between 43 and 50 meters / second and would be categorized as a category 2 hurricane. The west coast, Newcastle area, and some pockets at the north and south fall into a low vulnerability zone. High vulnerability to winds shows above the 1000 foot contour. High winds would be of category 3 hurricane force and extensive damage could be expected.

The 50-year storm would place most of Nevis into a zone of high vulnerability to winds. Moderate and Low wind vulnerability are shown at the west and north of the island. A zone of very high vulnerability to winds exists above the 1000 foot contour. Category 4/5 hurricane force winds and extreme/catastrophic damage could be expected.

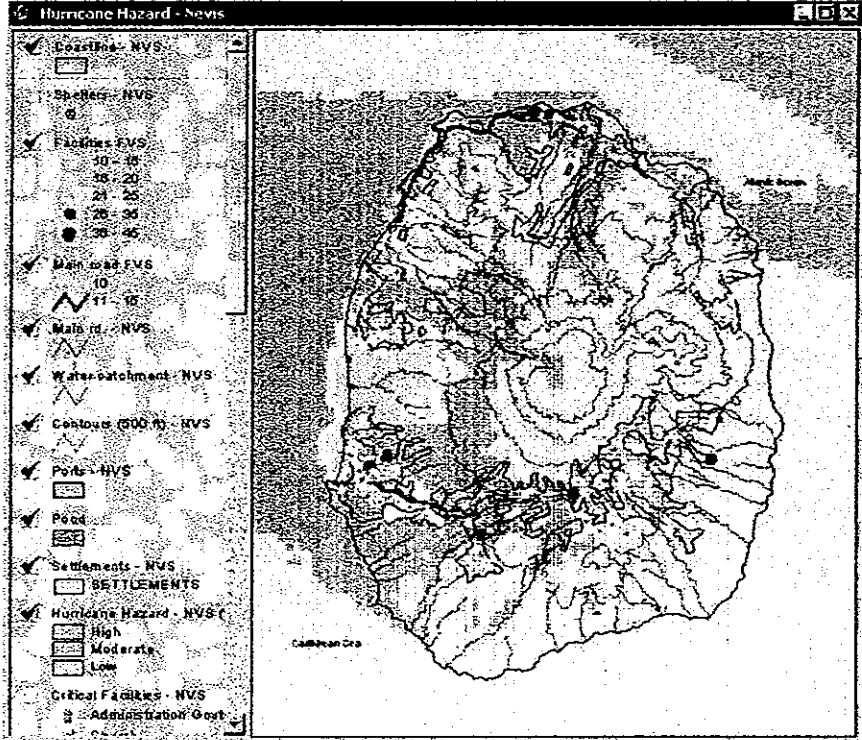


Map 17. Nevis Wind Vulnerability By Return Interval

For the 100-year storm period, all the area along the coastline (from Mosquito Bay up to Fort Charles) moving to the highlands, would be subject to high vulnerability to winds.

The rest of the coastal lowlands would be vulnerable to Moderate wind hazard. Areas above 500 feet in elevation would be vulnerable to very high wind hazards.

The long-term vulnerability of Nevis is shown on Map 18. It is similar to the 50-year return storm without very high wind vulnerability above the 1000 foot contour.



Map 18. Nevis Long Term Wind Vulnerability

6.1.2 Wind FVS

Map 19 selects all the facilities that have an FVS greater than 22.

ID	TYPE	CLASS	NAME	LOCATION	FVS	STATUS
NVGB1030	Government	Residential	Doctor's Residence	Gingerland	45	0.000000
20102	Community	Community Centre	Grove Park Pavilion	Charlestown	40	1.000000
20303	Community	Community Centre	Community Centre Hardtimes	Hard Times	35	1.000000
NVS	Infrastructure	Airport	International Airport	Newcastle	35	0.000000
NVHL03	Medical Facilities	Clinic	Brown Hill Health Centre	Brown Hill	35	0.000000
NVHL01	Medical Facilities	Hospital	Alexandra General Hospital	Charlestown	30	0.000000
20305	Community	Community Centre	Community Centre - Hickmans	Hickmans	30	1.000000
NVGB1000	Government	Residential	Nurses Home	Charlestown	30	0.000000
NVGB0507	Utilities	Gas	DELTA Market Shop	Market Shop	25	0.000000
NVGB0580	Protective	Police	Police Station	Gingerland	25	0.000000
20302	Community	Church	Westspan Holiness Church - B	Bucks Hill	25	1.000000
20301	Community	Church	Ebenezer Church of God - Old	Old Manor	25	1.000000
NVED0095	Education	Nursery	Butlers Pre-school	Butlers	25	0.000000
20401	Community	Church	Seventh Day Adventist Church	Butlers	25	1.000000
NVED024	Education	Primary	St James Primary School	Butlers	25	0.000000
NVED098	Education	Nursery	Gingerland Pre-school	Gingerland	25	0.000000
NVED116	Education	Primary	Gingerland Primary School	Gingerland	25	0.000000
NVED120	Education	Secondary	Gingerland Secondary School	Gingerland	25	0.000000
NVED094	Education	Nursery	Brown Hill Pre-school	Brown Hill	25	0.000000
20405	Community	Church	Methodist Church Hall - Fount	Fountain	25	1.000000
NVGB0960	Government	Residential	Married Quarters	Belle Vue	25	0.000000
20304	Community	Church	Calvary Baptist Church - Rawle	Hard Times	25	1.000000
20207	Community	Church	Church of God - Cox Village	Cox Village	25	1.000000
NVGB0920	Utilities	Water	Pump House	Fothergill	25	0.000000

Figure 6a. Nevis Facilities with Wind FVS (>22)

As Map 19 indicates, most of the features on the west side have a moderate or low vulnerability to wind. The features on the east side have high vulnerability to winds.

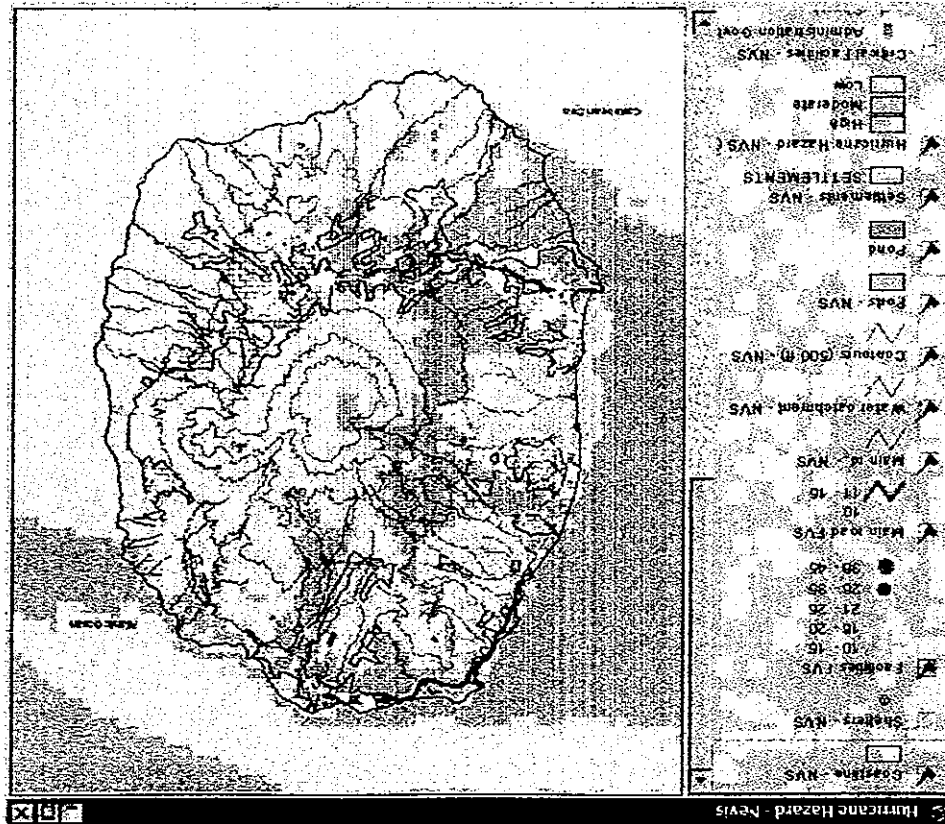
6.1.3 Feature Vulnerability to Wind

Figure 6b. Nevis Shelters with Winds FVS (>22)

Year	Fac Type	Fac Name	Name Fac	Fac Elevation	Year
20102	Community	Community Centre	Grove Park Pavilion	Charlestown	40
20303	Community	Community Centre	Community Centre Hardiness	Hard Times	35
20305	Community	Community Centre	Community Centre - Hickmans	Hickmans	30
20302	Community	Church	Westeyan Holness Church - B	Bucks Hill	25
20301	Community	Church	Ebenezer Church of God - Old	Old Manor	25
20401	Community	Church	Seventh Day Adventist Church	Butlers	25
20405	Community	Church	Methodist Church Hall - Fourka	Fourka	25
20304	Community	Church	Calvary Baptist Church - Rawle	Hard Times	25
20207	Community	Church	Church of God - Cox Village	Cox Village	25

In addition, several shelters had FVS of 22 or above are listed below in Figure 6b.

Map 19. Nevis Facilities with Wind FVS Greater than 22



The above areas include grazing, rough grazing, coconut plantation, settlements and forest reserve.

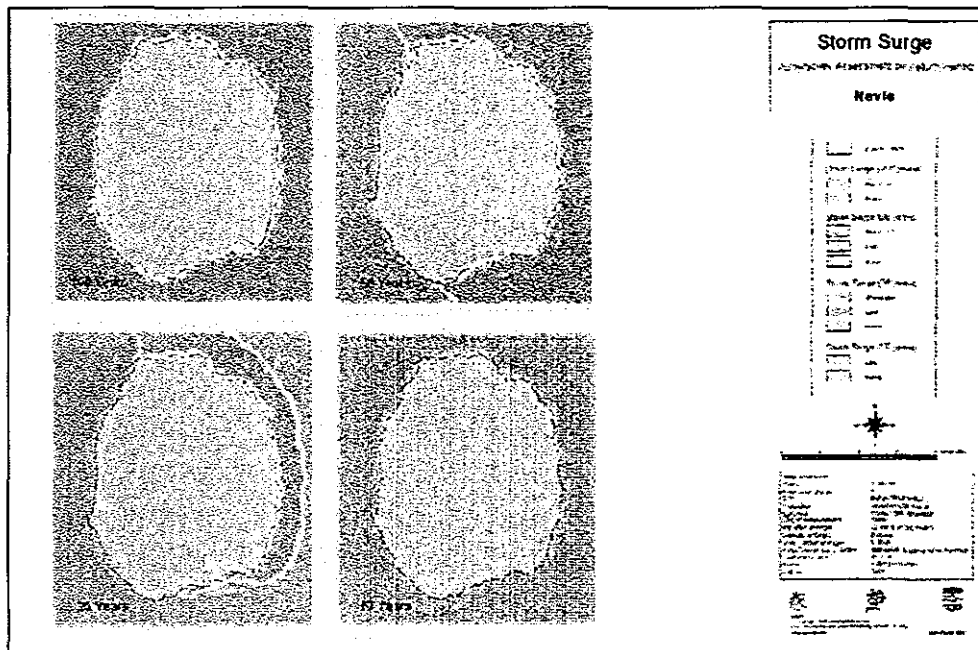
6.2 Storm Surge

6.2.1 Storm Surge Zones

Map 20 indicates the storm surge vulnerability of Nevis for the 10-year, 25-year, 50-year and 100-year storm. The 10-year storm places all Nevis under no (or very low) storm surge vulnerability. Exceptions are the Deep Water port, Charlestown port and Fort Charles, which have low storm surge vulnerability. In these areas, the surge can be expected to a range between 0.1 and 0.5 meters and some damage would be expected.

The 25-year storm places the Atlantic coast from Hurricane hill up to south of White Hall Estate in a moderate storm surge vulnerability zone. The surge that can be expected range between 0.5 and 1.5 meter and some minimal damage would be expected. The rest of the Caribbean coastline shows low storm surge vulnerability.

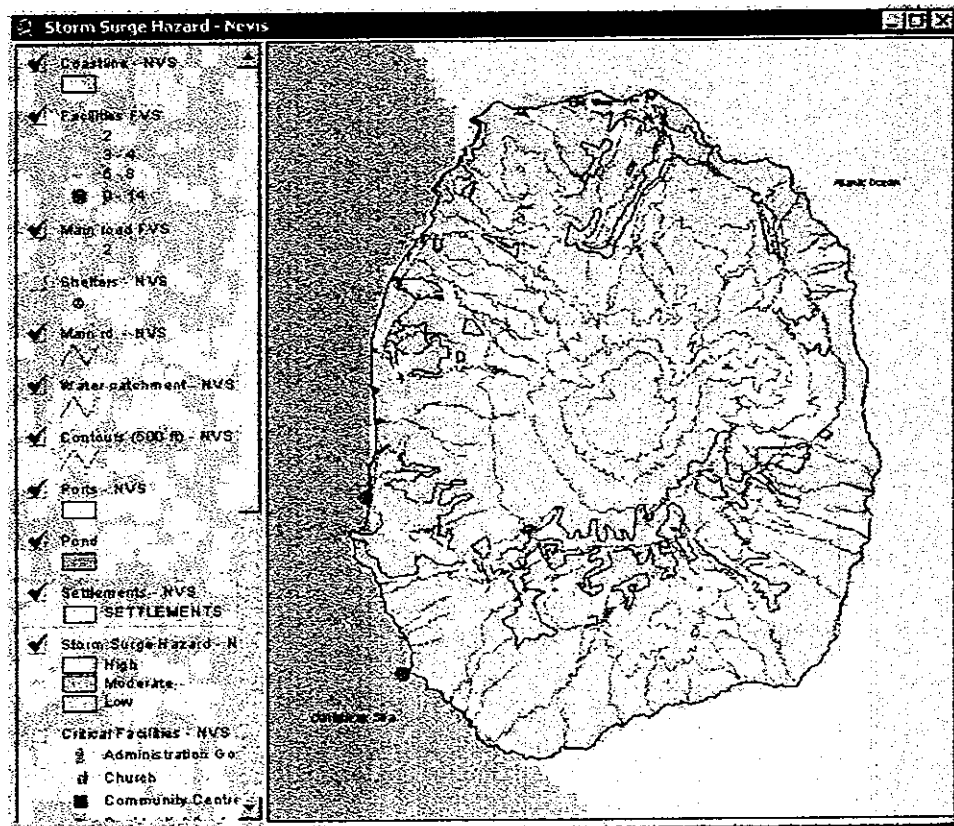
The 50-year storm places the Atlantic coast from Mosquito Bay up to south of Dogwood Estate in a zone of moderate storm surge vulnerability. The rest of the Caribbean coastline shows a low storm surge vulnerability



Map 20-. Nevis Storm Surge by Return Period

The 100-year storm places the coastal zone under moderate storm surge vulnerability.

Map 21 indicates the expected long-term vulnerability of Nevis to storm surge. The Atlantic coast of the island has a moderate vulnerability, and the Caribbean low storm surge vulnerability.



Map 21. Nevis Long Term Vulnerability to Storm Surge

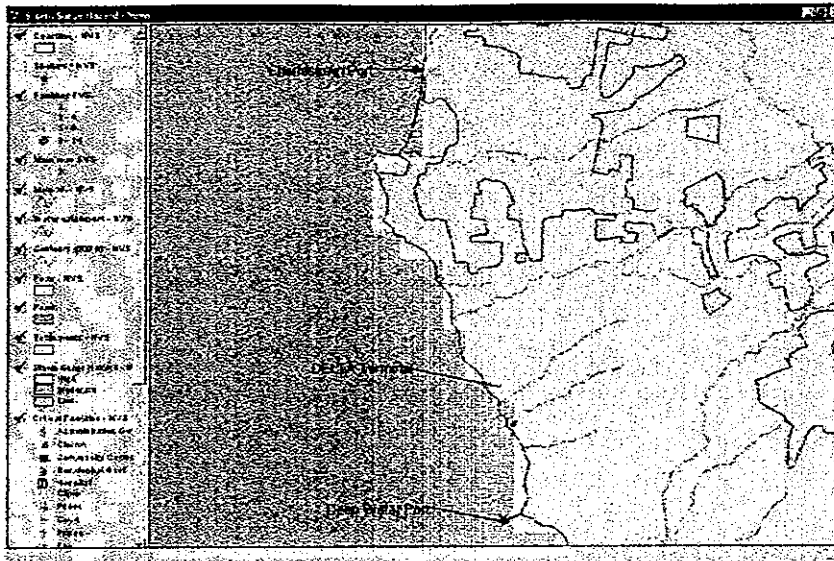
6.2.2 Storm Surge FVS

The Facilities with the highest FVS are along the Caribbean coast.

GIS CODE	FAC Type	Fac Class	NAME Fac	LOCATION	SSURGE FVS	Sh
NVGB0900	Government	Storage	Cotton House	Charlestown	8	0 ▲
CRL	Infrastructure	Sea Port	Charlestown Port	Charlestown	12	0
DWP	Infrastructure	Sea Port	Deep Water Port	Long Point	14	0 ▼

Figure 7. Nevis Facilities with Storm Surge FVS (>7)

Map 22 indicates that the facilities are Deep Water port, Charlestown port, and the Cotton House (Charlestown) with FVS of 14, 12 and 8 respectively.



Map 22 – Nevis Facilities with Highest Storm Surge FVS

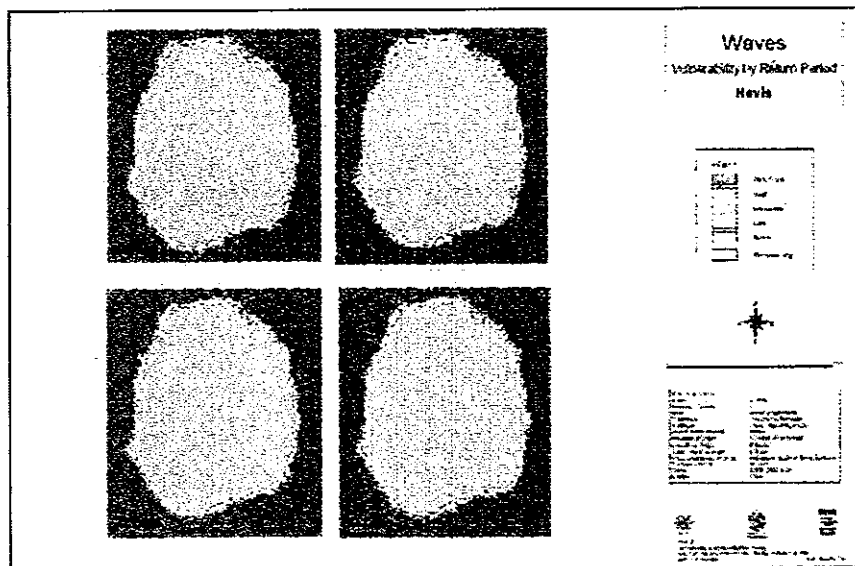
6.2.3 Feature Vulnerability to Storm Surge

The two sea ports, coconut plantations, grazing, bushed grassland, and bush-land can be expected to be affected by storm surge in the long term.

6.3 Waves

6.3.1 Wave Zones

Map 23 indicates the vulnerability of Nevis to waves for each storm return period.



Map 23. Nevis Wave Vulnerability by Return Period

The 10-year storm is predicted to subject Nevis coast to moderate and low vulnerability to waves (waves of 0.1 to 1.5 meters.) Exceptions are the Deep Water port, with very

high vulnerability (waves of more than 2 meter high) and Charlestown Seaport, Delta Terminal, and Shell Terminal with High wave storm vulnerability (waves of 1.5 to 2 meter high).

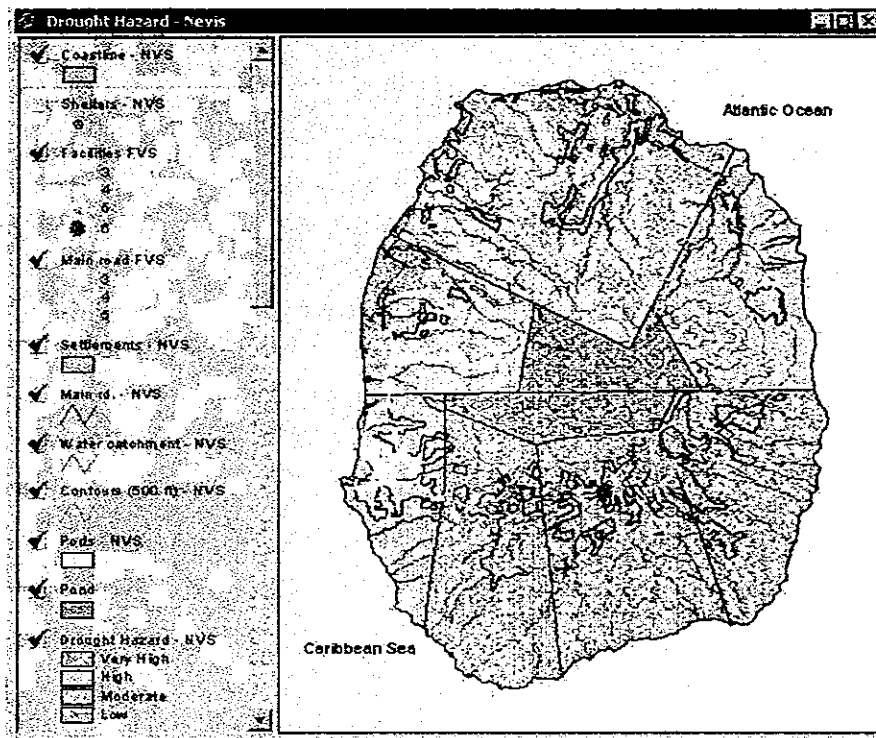
The 25-year and 50-year wave storm shows not much change from the 10-year period storm.

The 100-year storm would generate a very high wave vulnerability zone in the area of Charlestown Seaport, and Deep Water Port, the coastal zone at Dogwood Estate, and the costal zone at Indian Castle Estate.

7.0 Nevis - Drought

7.1 Drought Zones

⁶Nevis was divided into 9 sectors that were ranked as low, moderate, high, and very high vulnerability.



Map 25a. Nevis Drought Vulnerability Zones and Facility FVS

Map 25a indicates the drought vulnerability zones for Nevis. The central mountain area has the lowest vulnerability to drought. Moderate risk areas include the northwest and

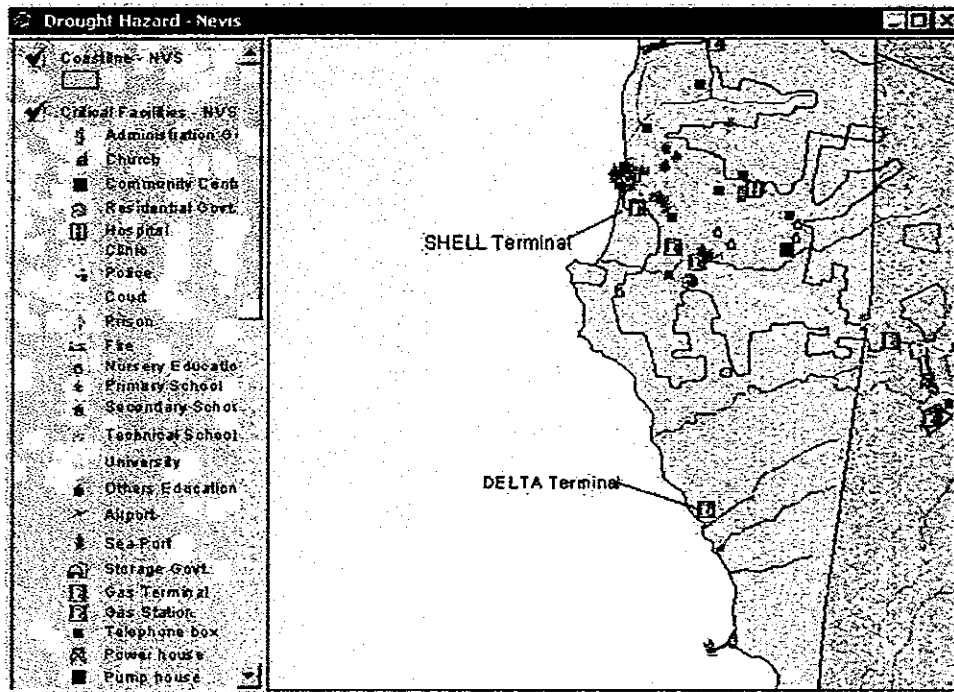
⁶ Ivor Jackson, 2001, 'Nevis Drought Assessment and Mapping', <http://www.oas.org/pgdm>

north of Nevis. Areas of high vulnerability to drought includes the areas of Charlestown (up to Long Point) and the Buttlers/Mannings water zone at the east side of the island. The south and southeast is considered to have a very high vulnerability to drought.

7.2 Drought FVS

All the facilities under consideration are into the upper 50% of the highest FVS range (6). The facility with the highest drought FVS is the Doctor's residence at Gingerland, the rest with FVS (5) are located at the south and southeast of the island. Facilities with FVS (4) are clustered in Charlestown area (including Shell Terminal), Long Point (including Delta Terminal), and at the east side of the island along the main road. The north west and west of the island has the facilities with lowest FVS (3).

The Main road segments under consideration shows the highest FVS from Charlestown to Stony Ground. The segment Newcott to Jessup shows an FVS (4), and the Cades Bay to Newcastle FVS (3).



Map 25b. Nevis Facilities with high Drought FVS (>2)

7.3 Feature Vulnerability to Drought

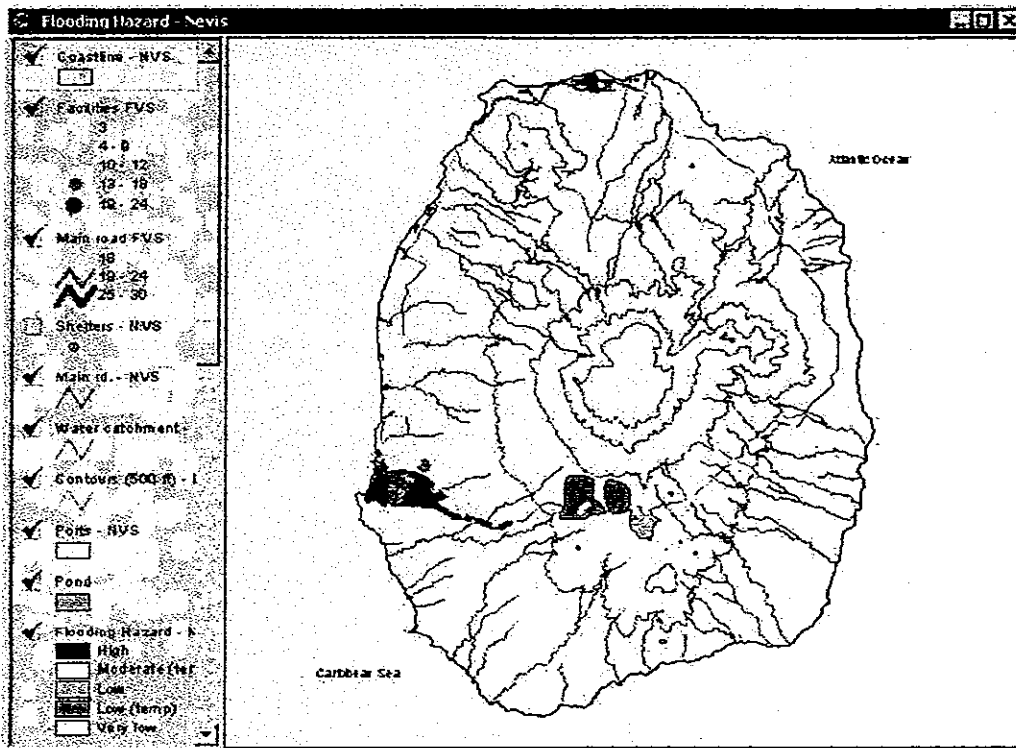
Most of the development in Nevis occurs within the zone of high and very high drought vulnerability.

8.0 Nevis - Flooding

8.1 Flood Zones

Map 26 indicates the flood vulnerability zones for Nevis. A very low vulnerability zone with three small low vulnerability zones,⁷ two have been described as “Low temp” having only temporary problems (Brown Pasture and Hermitage areas), primarily caused by careless construction, and Pond Hill area shows a low (permanent) flood vulnerability. A moderate (temp) flood vulnerability zone exists at Newcastle airport.

Charlestown area shows a high vulnerability to floods along the Bath Ghaut.



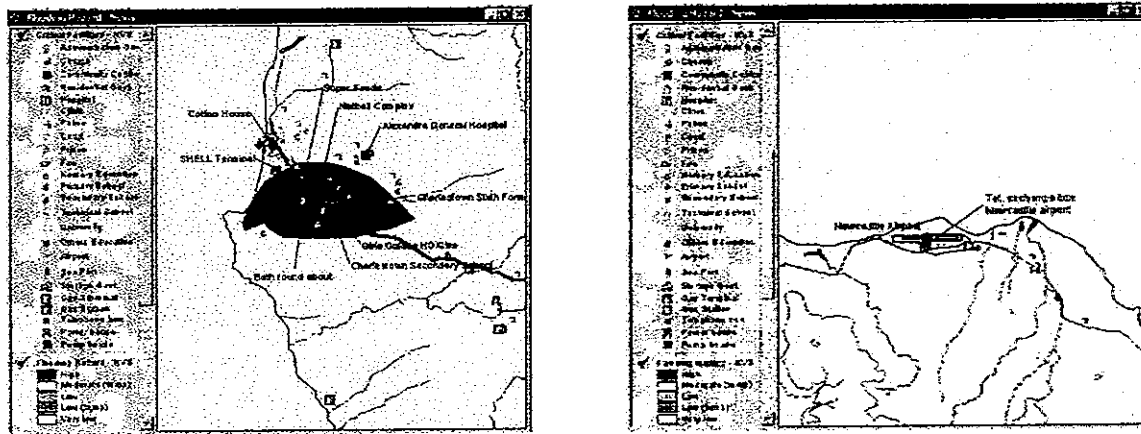
Map 26 Nevis Flood Vulnerability Zones

8.2 Flood FVS

Map 27 indicates the distribution of facility flood FVS. The facility with the Highest FVS (24) is Newcastle airport within a zone of Moderate vulnerability to flooding. Most of the facilities with high FVS (>14) are clustered within Charlestown zone within the zone of high vulnerability to flooding.

⁷ Vincent Cooper, 2001, Flood Methodology Notes. Email

The main road segment under consideration in this assessment, Charlestown to Stony Grow, shows the highest road FVS (30) in a zone of high vulnerability to flooding. Jones Estate to Newcastle shows an FVS (24) within the zone with moderate vulnerability to flooding. Newcott to Jessup and Cades Bay to Newcastle has an FVS (18) in zone of very low vulnerability to flood.



Map 27 Nevis Facilities with high Flood FVS

Fac Type	Fac Class	NAME/Fac	LOCATION	FLOOD FVS	STATUS
Infrastructure	Airport	International Airport	Newcastle	24	0
Utilities	Telecommunication	Bath round about	Bath round	18	0
Utilities	Telecommunication	Super Foods	Super Foods	18	0
Community	Community Centre	Netball Complex	Charlestown	18	1
Education	Others Education	Girls Guides HD/Qtrs	Stoney Growe	18	1
Utilities	Telecommunication	Newcastle Airport	Newcastle	15	0
Medical Facilities	Hospital	Alexandra General Hospital	Charlestown	15	0
Education	Technical	Charlestown Sixth Form College	Charlestown	15	0
Education	Secondary	Charlestown Secondary School	Charlestown	15	0
Government	Storage	Colton House	Charlestown	15	0
Utilities	Petroleum	SHELL Terminal	Charlestown	15	0

Figure 8- Nevis Facilities with High Flood FVS(>14)

8.3 Feature Vulnerability to Flooding

The town of Charlestown is the most significant feature vulnerable to flooding on the Island of Nevis, along with some areas with coconut trees and cultivated crops. In Grassing areas are subjected to low flood vulnerability in the areas of Brown Pasture, Hermitage, and Pond Hill.

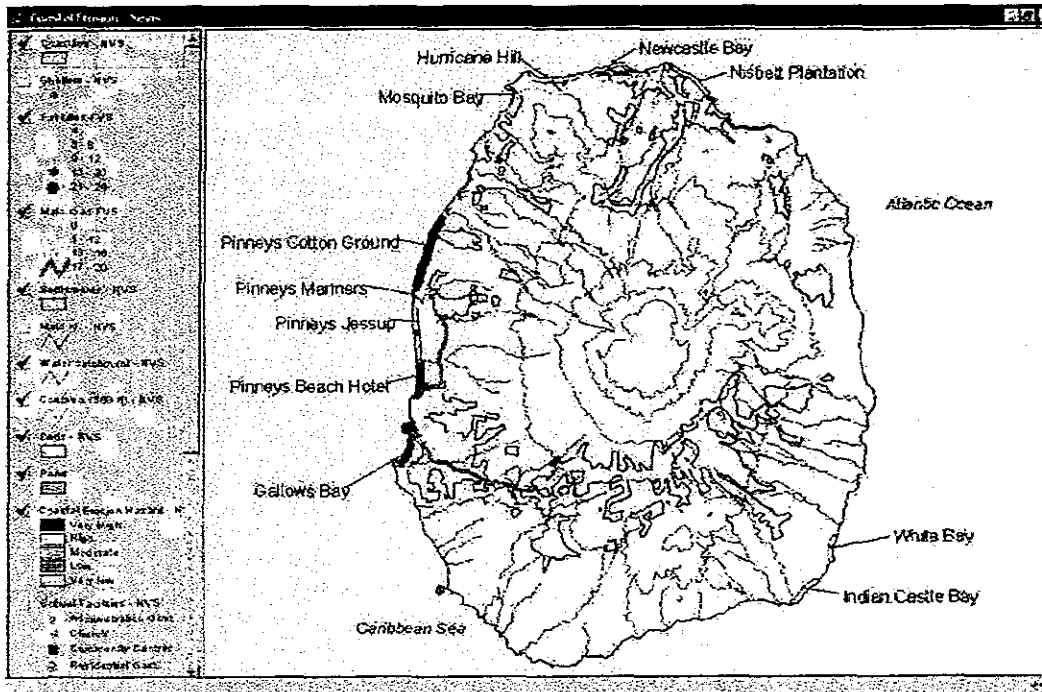
9.0 Nevis - Beach Erosion

9.1 Beach Erosion Zones

Fourteen beaches have been monitored quarterly in Nevis since 1991 by the Fisheries Division.

The coastal areas with very high, high, and moderate vulnerability are located along the west coast (Caribbean) especially Pinneys Beach, as well as the north, and southeast of the island. Mariners Inn, and Mosquito Bay has very low vulnerability to beach erosion, as does Haul Bay in the Atlantic side.

Map 29 shows Nevis Beach Erosion Zones and Facility Vulnerability.



Map 29 Nevis Beach Erosion Zones and Facility Vulnerability

9.2 Beach Erosion FVS

Seven Facilities in Nevis shows a high beach erosion FVS (>11). Most of them are located in Charlestown area.

It is recommended that in the future a hazard vulnerability assessment should include hotels and tourism facilities, as many if them are located in areas of very high and high vulnerability to beach erosion.

Attributes of Critical Facilities - NVS					
Fac Type	Fac Class	NAME Fac	LOCATION	LEBOS FVA	State
Infrastructure	Sea Port	Charlestown Port	Charlestown	24	0
Government	Storage	Cotton House	Charlestown	20	0
Infrastructure	Sea Port	Deep Water Port	Long Point	20	0
Utilities	Telecommunication	Barclays bank	Barclays bank	20	0
Government	Administration	CMC Building	Charlestown	20	0
Government	Storage	Public Market	Charlestown	20	0
Utilities	Petroleum	SHELL Terminal	Charlestown	12	0

Figure 9- Nevis Facilities with High Beach Erosion FVS(>11)

9.3 Feature Vulnerability to Beach Erosion

Beaches themselves are the features at risk from erosion.

Regarding the main road segment under consideration in this assessment, Charlestown to Stony Grow (in Charlestown port) and Newcott to Jessup (Pinneys Beach) show the highest road FVS (20), falling in a zone of very high vulnerability beach erosion. Jones Estate to Newcastle (Seahaven Estate) shows an FVS (16) within the zone of high vulnerability, and Cades Bay to Newcastle (Beach Club, and Cades Bay) shows an FVS (12) while crossing zone of low, and moderate beach erosion vulnerability.

PART IV - SUMMARY

10.0 Summary

10.1 Cumulative Vulnerability

Cumulative vulnerability attempts to consider the total vulnerability of facilities and areas to hazards to determine which facilities and areas are the most vulnerable. The cumulative vulnerability of facilities is the “Total FVS” of all hazard types.

E.g.:

St. Kitts: [Total FVS]=[Wind FVS + S Surge FVS + C Erosion FVS + I Erosion FVS + Flood FVS]

Nevis: [Total FVS]=[Wind FVS + S Surge FVS + C Erosion FVS + Drought FVS + Flood FVS]

The “Total V” value of facilities considers their cumulative (for all hazards) damage history (DH), structural (S) and operational vulnerability (O).

E.g.

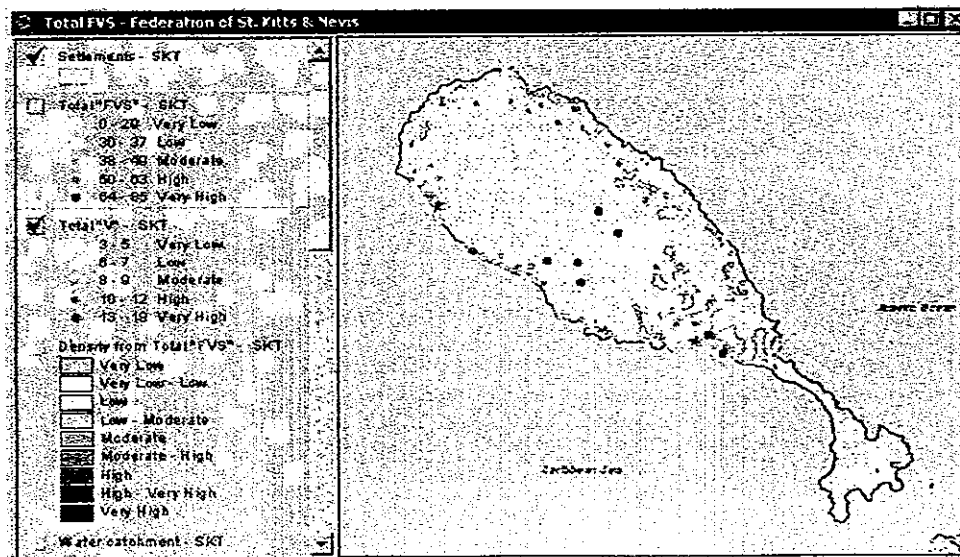
St. Kitts: [Total V]=[Wind V + S Surge V + C Erosion V + I Erosion V + Flood V]

Nevis: [Total V]=[Wind V + S Surge V + C Erosion V + Drought V + Flood V]

10.2 St. Kitts

10.2.1 Facilities

An examination of the total “V” value of facilities (Map 30) reveals that the facilities with the highest scores (highest vulnerable) are clustered in Basseterre area, and in major towns around the island. Also is to be mentioned that five (out of six) main water intakes are included in the highest scores.



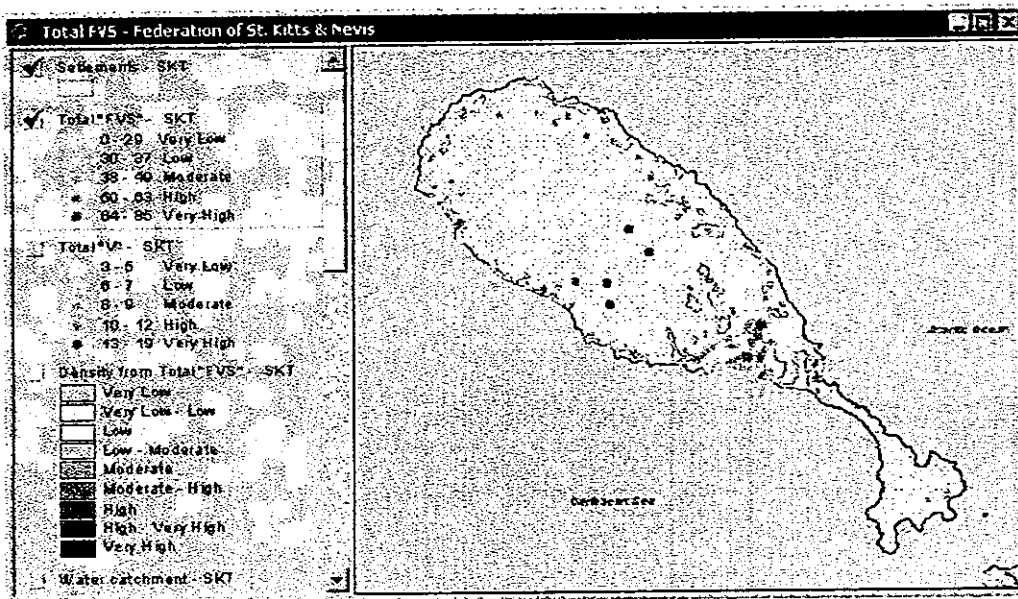
Map 30. Total “V” of Facilities in St. Kitts

Map 31 indicates that the distribution of the total FVS scores is consistent with the distribution of the “V” scores.

Figure 10 lists the facilities which have a Total FVS of more than 70% of the possible Total FVS (84).

Attributes of Total "FVS" - SKT						
Fac ID	Fac Type	Fac Class	NAME - FAC	LOCATION	FVS	Score
SKGB0110	Protective	Police	Police Training Complex	Basseterre	85	0
SKW101	Utilities	Water	Water Intake Philips	Philips	72	0
SKW102	Utilities	Water	Water Intake Lodge	Lodge	71	0
SKW106	Utilities	Water	Water Intake Stonefort	Stonefort	71	0
SKGB1170	Government	Storage	Public Market	Basseterre	68	0
SKW105	Utilities	Water	Water Intake Franklands	Franklands	66	0
SKGB1160	Government	Administration	Social Security building	Basseterre	66	0
SKGB1250	Government	Storage	Factory Shells	Basseterre	63	0
SKED110	Education	Secondary	Washington Archibald High	Taylor's Range	62	0
SKED111	Education	Secondary	Cayon High	Cayon	62	0
SKW104	Utilities	Water	Water Intake Wingfield	Wingfield	61	0
SKP	Infrastructure	Sea Port	Deep Water Port	Bird Rock	60	0
SKGS01	Utilities	Petroleum	SHELL Terminal	Basseterre	59	0

Figure 10. St.Kitts with high Total FVS(>58)

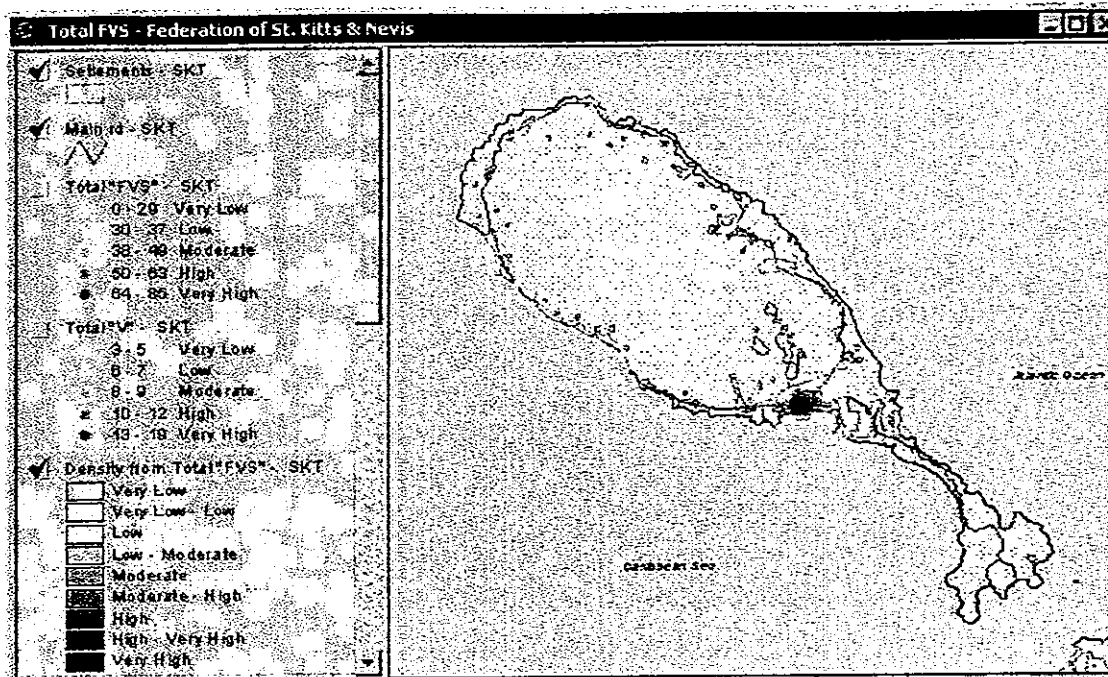


Map 31. Total FVS of Facilities in St. Kitts

Map 32 visually represents density zones of facilities have the highest FVS values.

This method is only for visual impact as it allows “hotspots” to be easily seen.

It shows how the vulnerability of the facilities is related to developing areas (Basseterre, Sandy Point, Cayon and St. Pauls).

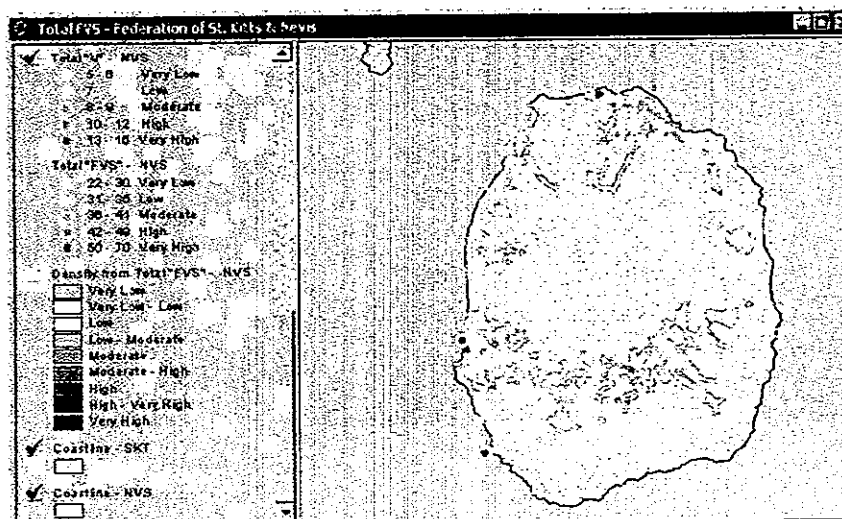


Map 32. Facility "FVS" Hotspots in St. Kitts

10.3 Nevis

10.3.1 Facilities

An examination of the total "V" value of facilities (Map 33) reveals that the facilities with the highest scores (highest vulnerability) are clustered in Charlestown area, and in mayor settlements around the island. Also is to be mentioned that seaports, airport, Shell Terminal, Alexandra General Hospital, are included in the highest "V" scores.



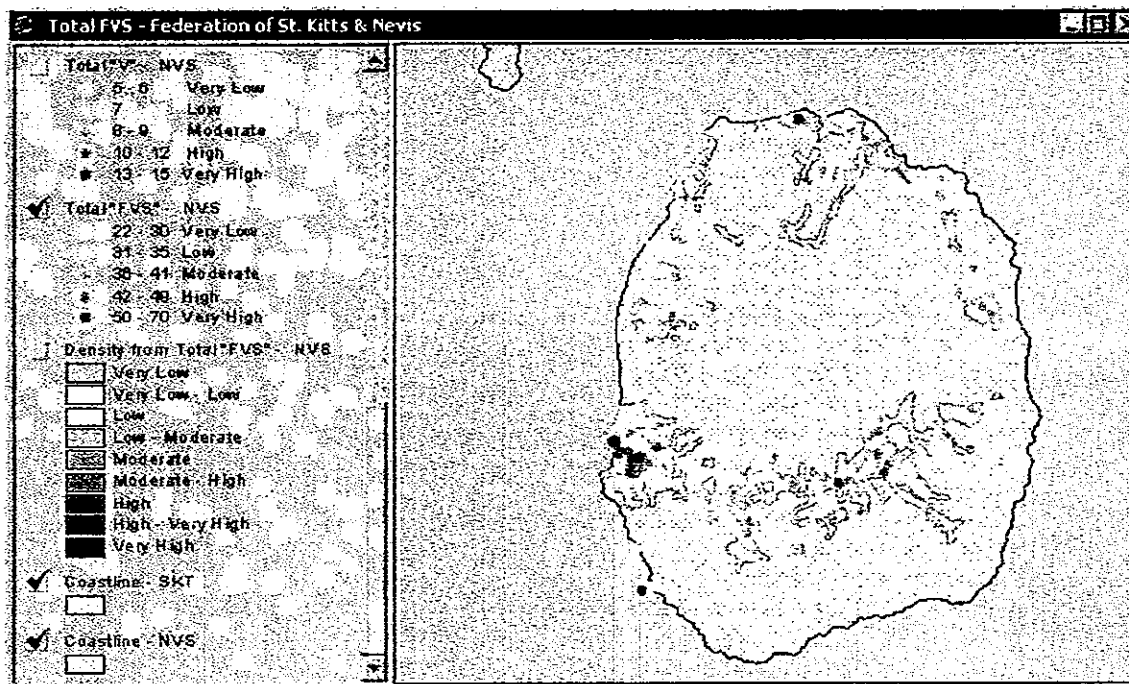
Map 33. Total "V" of Facilities in Nevis

Map 34 reveals that the facilities with the highest scores are clustered in Charlestown area, and in mayor towns around the island.

Figure 11 lists the facilities that have a Total FVS of more than 70% of the possible Total FVS (70).

Attributes of Total "FVS" - NVS						
Facility	FAC Type	FAC Class	NAME - FAC	LOCATION	TOTAL FVS	STATUS
NVS	Infrastructure	Airport	Newcastle Airport	Newcastle	70	0
NVGB1030	Government	Residential	Doctor's Residence	Gingerland	63	0
NVGB0900	Government	Storage	Cotton House	Charlestown	62	0
20102	Community	Community Centre	Grove Park Pavilion	Charlestown	62	1
DWP	Infrastructure	Sea Port	Deep Water Port	Long Point	56	0
NVHL01	Medical Facilities	Hospital	Alexandra General Hospital	Charlestown	55	0
NVGB0790	Government	Storage	Public Market	Charlestown	54	0
CRL	Infrastructure	Sea Port	Charlestown Port	Charlestown	53	0
NVGS02	Utilities	Petroleum	SHELL Terminal	Charlestown	52	0
NVHL03	Medical Facilities	Clinic	Brown Hill Health Centre	Brown Hill	49	0
20303	Community	Community Centre	Community Centre Hard Times	Hard Times	49	1

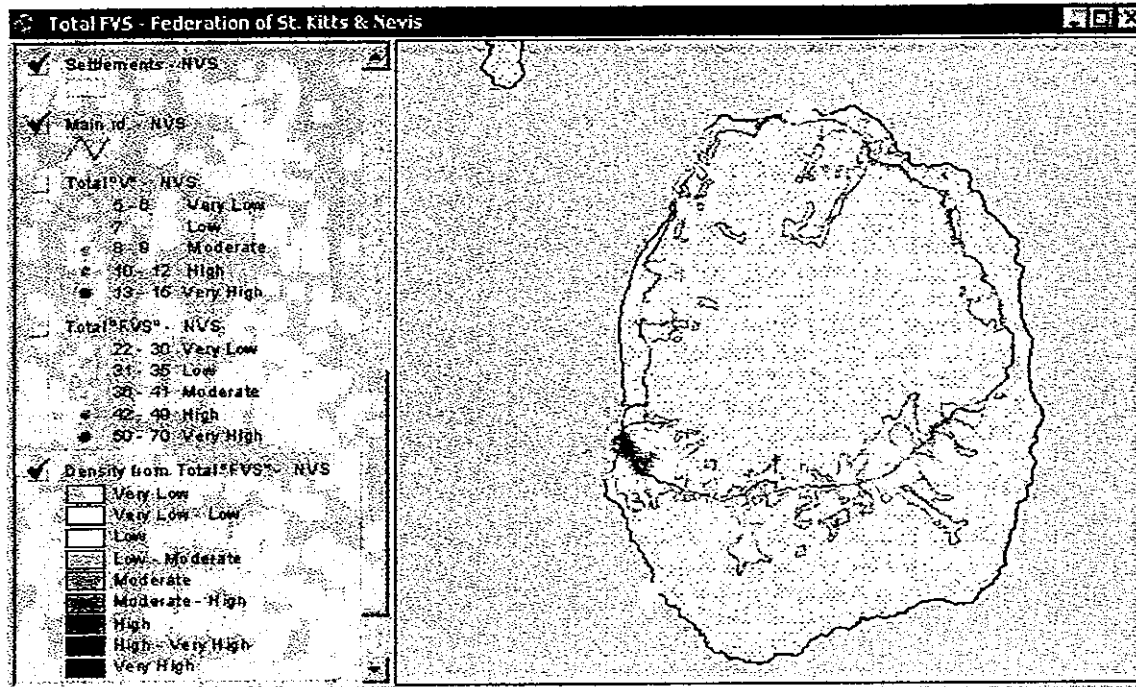
Figure 11. Nevis facilities with high Total FVS(>48)



Map 34 Total FVS of Facility in Nevis

Map 35. Visually represents density zones were facilities have the highest FVS values.

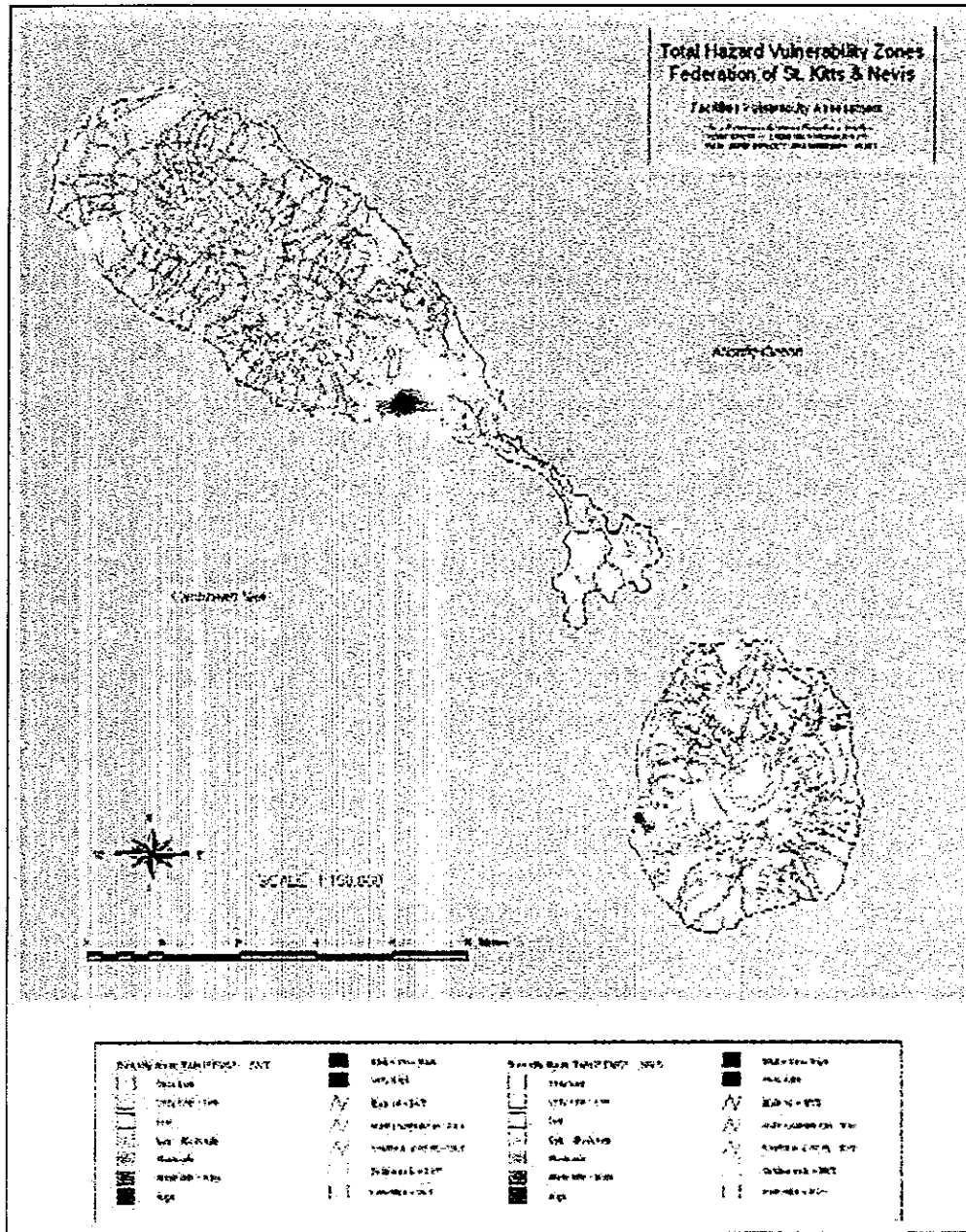
It shows how the vulnerability of the facilities is related to developing areas (Charlestown, Market Shop, Prospect and Newcastle).



Map 35 Facilities FVS Hotspots in Nevis

10.4 Hazard Zones in the Federation of St. Kitts & Nevis

Map 36 is the product of using the Total FVS of each facility to indicate density of facilities with high FVS. This hazard vulnerability zones are generated from all hazard vulnerability maps. The resulting density values are divided into equal classes, and ranked.



Map 36. Total Hazard Vulnerability Zones in St. Kitts & Nevis

The map shows how the density of critical facilities with high FVS are concentrated in developed areas of the Federation, such as Charlestown and Basseterre, increasing the overall vulnerability of the facilities to the different hazard considered during the PGDM

Hazard vulnerability assessment. This reinforces the need for disaster mitigation programs that will help to reduce the FVS in urban areas, such as improving the standards used for building while ensuring that the new development is directed to low-hazard areas.

10.5 Final Conclusions

1. In St. Kitts and Nevis, population and development to date have been concentrated in urban areas.
2. The urban centers are currently the most vulnerable areas to hazard, especially hurricanes.
3. This implies that disaster vulnerability reduction is critical for the future development of St. Kitts and Nevis.
4. Without this emphasis, the entire critical effort at sustainability can be destroyed with one or two major disasters.
5. This also implies that, in addition to the Building Code, which is currently in production, mitigation plans should be developed and implemented in all aspect of the public sector investments and infrastructure programming. The importance of this recommendation is highlighted by the recent destruction of the facilities at Port Zante, and its effect on the cruise and tourism industries.

Appendix 1

St. Kitts Facilities by Type and Hazard FVS

Appendix 2

Nevis Facilities by Type and Hazard FVS

Appendix 3

St. Kitts FVS and Critical Facilities layout (scale: 1:90,000)

Appendix 4

Nevis FVS and Critical Facilities layout (scale: 1:50,000)

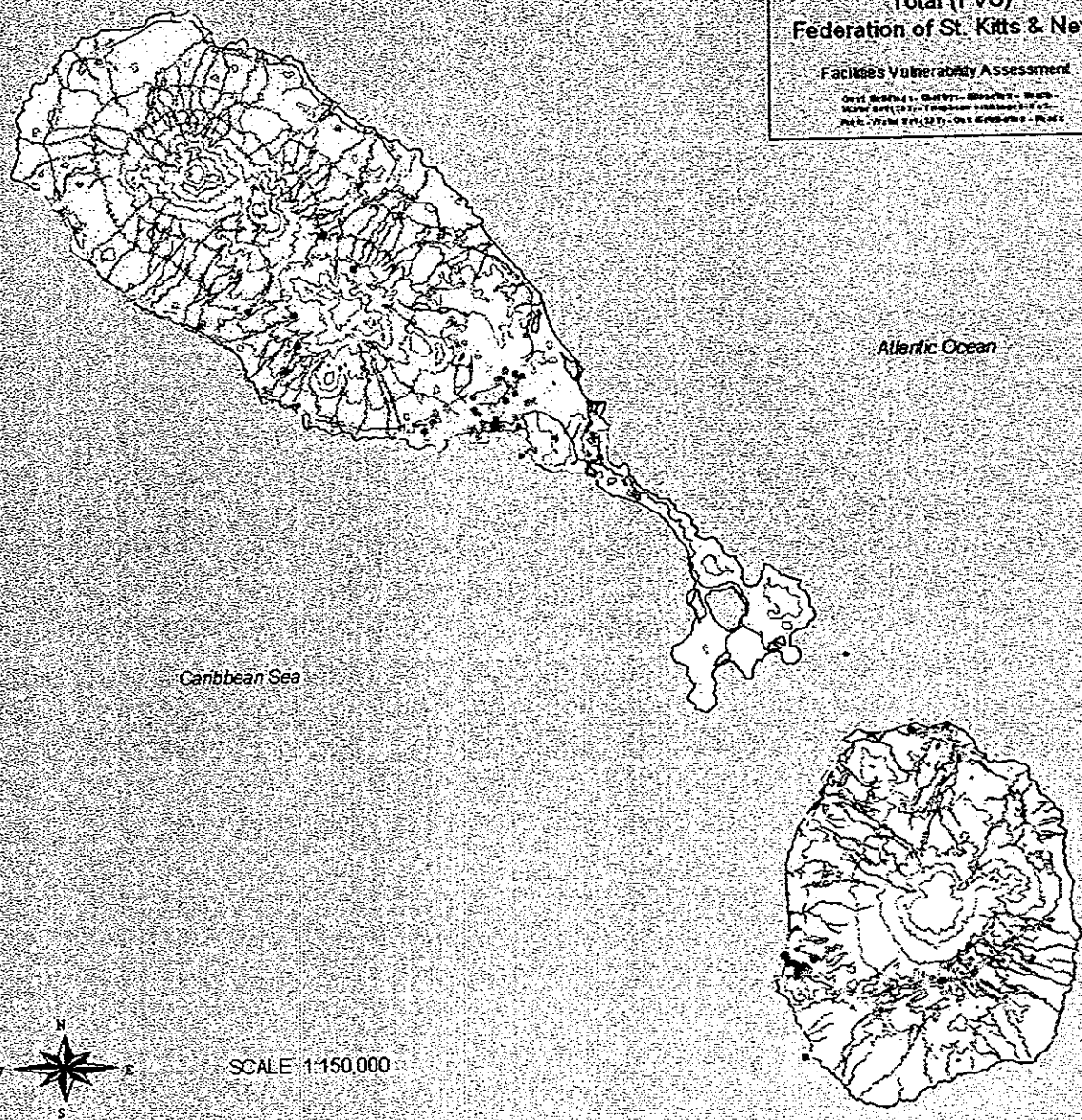
Appendix 5

FVS Hotspot Federation of St. Kitts & Nevis layout (scale: 1:150,000)

**Facility Vulnerability Scores
Total (FVS)
Federation of St. Kitts & Nevis**

Facilities Vulnerability Assessment

Ordnance Survey - OSDB - OSDB/01 - 01/01 - 01/01 - 01/01 - 01/01
 OSDB/01/01/01 - OSDB/01/01/01 - OSDB/01/01/01 - OSDB/01/01/01 - OSDB/01/01/01
 OSDB/01/01/01 - OSDB/01/01/01 - OSDB/01/01/01 - OSDB/01/01/01 - OSDB/01/01/01



Total FVS - Federation of St. Kitts & Nevis					
Total "FVS" - SKT		Main rd - SKT	Total "FVS" - NVS		Main rd - NVS
0 - 29 Very Low		Water catchment - SKT	22 - 30 Very Low		Water catchment - NVS
30 - 37 Low		Contours (500 ft) - SKT	31 - 35 Low		Contours (500 ft) - NVS
38 - 49 Moderate		Settlements - SKT	36 - 41 Moderate		Settlements - NVS
50 - 63 High		Coastline - SKT	42 - 49 High		Coastline - NVS
64 - 85 Very High			50 - 70 Very High		

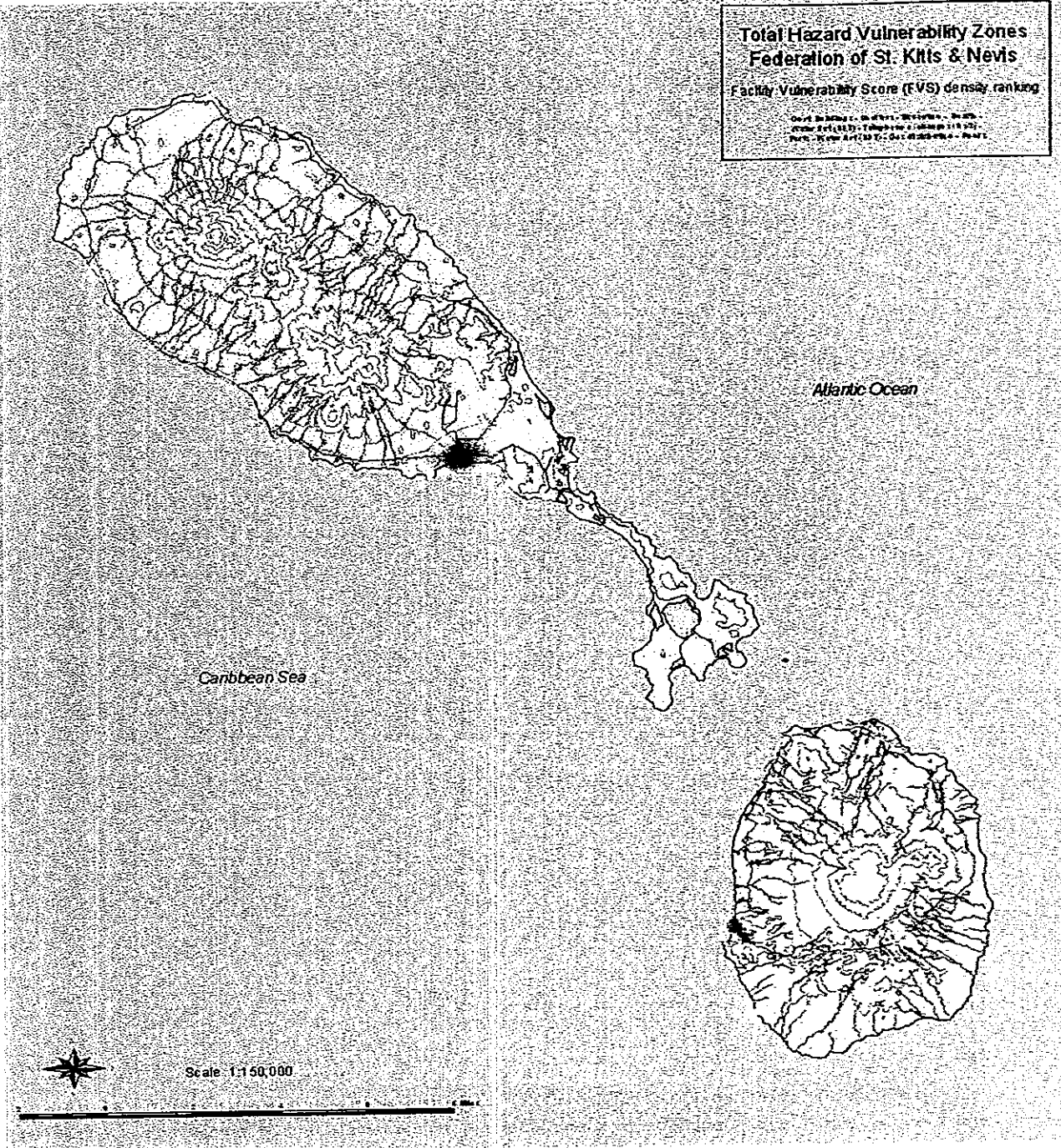
Base map source	1:25000
Scale	1:25000
Number of sheets	1
Grid	British West Indies
Projection	Transverse Mercator
Spheroid	Clarke 1880 (modified)
Unit of measurement	Metre
Meridian of Origin	62 West of Greenwich
Latitude of Origin	Equator
Scale factor at origin	0.9996
False Coordinate of Origin	400000 m Easting Nil m Northing
Cartour Interval	50 feet
Series	E803 (DOS 349)
Edition	1904

Project:
 Post-Disaster Reconstruction (PDR)
 OAS - USAID, GIS Unit, Physical Planning & Development - NEVIS
 www.oas.org/ppdm



**Total Hazard Vulnerability Zones
Federation of St. Kitts & Nevis**
Facility Vulnerability Score (FVS) density ranking

Map by James C. DeGroot, Ph.D., GIS Unit, PGDM - St. Kitts
© 2005 by U.S.A.I.D. - Physical Planning & Development - NEVIS
Project: Post-Disaster Mitigation - PGDM



Density from Total "FVS" - SKT		Density from Total "FVS" - NVS	
Very Low	High - Very High	Very Low	High - Very High
Very Low - Low	Very High	Very Low - Low	Very High
Low	Main rd. - SKT	Low	Main rd. - NVS
Low - Moderate	Water catchment - SKT	Low - Moderate	Water catchment - NVS
Moderate	Contours (500 ft) - SKT	Moderate	Contours (500 ft) - NVS
Moderate - High	Settlements - SKT	Moderate - High	Settlements - NVS
High	Coastline - SKT	High	Coastline - NVS

Base map source:
Scale: 1:25,000
Number of sheets: 1
Grid: British West Indies
Projection: Transverse Mercator
Spheroid: Clarke 1880 (Modified)
Units: meters
Meridian of Origin: 62 West Greenwich
Latitude of Origin: Equator
Scale factor of Origin: 0.9995
Contour interval: 50 feet
Series: 1984

Project:
Post-Georges Disaster Mitigation (PGDM)
OAS - USAID, GIS Unit, Physical Planning & Development - NEVIS
www.oas.org/pgdm



Appendix 1 – St. Kitts Facilities by Type and Hazard FVS

St. Kitts

Facility Vulnerability Analysis

Summary

FAC_Type	Fac_Class	FAC_ID	NAME_FAC	LOCATION	FVS break points:					Total FVS
					>24 WIND	>4 I.EROS	>9 S.SURGE	>21 FLOOD	>14 C.EROS	
Community	Church	SKFC107	Redeemed Baptist Church	Upper Cayon	25					37
Community	Church	SKFC066	Anglican Church Building	Victoria Road	25					36
Community	Church	SKFC099	Estridge Moravian Church	Mansion	25					37
Community	Church	SKFC064	Hope Chapel	George Street	25					51
Community	Church	SKFC076	Trinity Anglican Church	Palmetto Point	40	5				54
Community	Church	SKFC098	Estridge Moravian Church School	Mansion	35					47
Community	Church	SKFC065	Rivers of Living Waters Christian Centre	Southwell Industrial Park	25					53
Community	Church	SKFC101	Seventh-Day Adventist Church	Phillips		6				35
Community	Community Centre	SKFC100	Pavillion	Molineux	30					42
Community	Community Centre	SKFC079	Pavillion	Verchilds Pasture	30					42
Community	Community Centre	SKFC074	Eastern Benevolent Society Building	Camps		5				29
Community	Community Centre	SKFC075	Community Centre	Palmetto Point		5				29
Community	Community Centre	SKFC087	New Pavillion	Cleverly Hill	40					52
Community	Community Centre	SKFC105	Pavillion	St. Mary Play Field	30					42
Community	Community Centre	SKFC054	Warner Park	Basseterre	45					56
Community	Community Centre	SKFC109	Community Centre	Conaree	25					37
Education	Nursery	SKFC071	Moravian Church Pre-School	Victoria Road	30					41
Education	Nursery	SKFC141	Half Way Tree Pre-School	Half Way Tree			10		12	44
Education	Nursery	SKFC137	Slack's Pre-School	New Pond Site	30					42
Education	Nursery	SKFC059	Day Care Centre	Frigate Bay Road	25					53
Education	Others Education	SKFC070	Women's Training Centre	Connell Street	25					43
Education	Others Education	SKFC068	Old Girl Guides Building	Freeman's Village	25					43
Education	Primary	SKFC121	Edger T. Morris	Tabernacle	25					37
Education	Primary	SKFC129	Saddlers	Saddlers	35					47
Education	Primary	SKFC125	Sandy Point	Sandy Point	25					39
Education	Primary	SKFC120	Deanne-Glasford	St. Peters	30					42
Education	Primary	SKFC181	George Moody Stuart	Basseterre	30					42
Education	Primary	SKFC117	Cayon Primary	Cayon	25					37
Education	Primary	SKFC116	Bronte Welsh	Trinity		5				29
Education	Secondary	SKFC073	AVEC Building	Washington Archibald	25					37
Education	Secondary	SKFC158	Sandy Point High	Sandy Point	45					56
Education	Secondary	SKFC156	Washington Archibald High	Taylor's Range	50					62
Education	Secondary	SKFC155	Basseterre High	Basseterre	45					56
Education	Secondary	SKFC159	Verchilds High	Verchilds	45					37
Education	Secondary	SKFC157	Cayon High	Cayon	50					62
Education	University	SKFC152	Ross University	Trinity		5				34
Government	Administration	SKFC020	Customs Adm. Building	Bird Rock	30					42
Government	Administration	SKFC013	Arrivals Hall	Port Zante	25		20			53
Government	Administration	SKFC037	Pelican Mall	Basseterre	30		10			48
Government	Administration	SKFC048	Social Security building	Basseterre		6	10	32		66
Government	Administration	SKFC028	Gov't Headquarters	Basseterre	25					43
Government	Administration	SKFC029	Treasury Building	Basseterre	30					56
Government	Administration	SKFC032	Electricity Department HQ	Basseterre	25					35
Government	Administration	SKFC033	Electricity building	Basseterre	25					43
Government	Administration	SKFC036	O A S building	Fortlands	30					40

FAC_Type	Fac_Class	FAC_ID	NAME_FAC	FVS break points:						Total
				LOCATION	>24 WIND	>4 I.EROS	>9 S.SURGE	>21 FLOOD	>14 C.EROS	
Government	Administration	SKFC038	Ministry of Health & Environment	Basseterre	25					35
Government	Administration	SKFC039	Community Affairs	Basseterre	25					36
Government	Administration	SKFC034	Physical Planning, Development bank	Basseterre	25			24		55
Government	Administration	SKFC030	Finance Department	Basseterre	30					40
Government	Residential	SKFC081	Estate House	Stonefort Estate	25	5				39
Government	Residential	SKFC102	Estate House	Phillips Estate		5				34
Government	Storage	SKFC049	Public Market	Basseterre	30			28		68
Government	Storage	SKFC021	Customs Warehouse	Bird Rock	30					42
Government	Storage	SKFC018	Customs Shed	RLB Int'l Airport	45					57
Government	Storage	SKFC023	Post Office	Basseterre	25					35
Government	Storage	SKFC057	Factory Shells	Basseterre	35					63
Government	Storage	SKFC022	Customs Headquarters	Bay Road	30					42
Government	Storage	SKFC050	Abbatolr	Basseterre	40	5				54
Government	Storage	SKFC047	School Meals building	Basseterre	30					58
Infrastructure	Airport	SKFC237	International Airport ILS (aproach)	Camps		5				29
Infrastructure	Airport	SKFC215	International Airport	Golden Rock	35					45
Infrastructure	Roads	SKFC233	Bay rd. (War Memorial - Circus)				12	32		67
Infrastructure	Roads	SKFC220	Ponds Rd.					44		67
Infrastructure	Roads	SKFC234	Bay rd. (Circus - Fishing Complex)				12	32		67
Infrastructure	Roads	SKFC227	Christ Church - Mansio			6		24		50
Infrastructure	Roads	SKFC236	College Ghaut (Lower)			8		44		75
Infrastructure	Roads	SKFC222	Stonefort			9				33
Infrastructure	Roads	SKFC235	College Ghaut (Upper)			8		44		75
Infrastructure	Roads	SKFC232	Fort Thomas - War Memorial				12	32		67
Infrastructure	Roads	SKFC230	SEP rd. (Mayor's Bay)	Mayor's Bay		6				33
Infrastructure	Roads	SKFC231	SEP rd. (Friar's Bay)	Friar's Bay		7			12	46
Infrastructure	Roads	SKFC228	Keys - Cayon			6		36		62
Infrastructure	Roads	SKFC226	Phillips			7				40
Infrastructure	Roads	SKFC225	Parsons - Saddlers				16	24	30	88
Infrastructure	Roads	SKFC223	Brimstone Hill - Old Road			6	16		27	76
Infrastructure	Sea Port	SKFC217	Deep Water Port	Bird Rock	40		12			60
Infrastructure	Sea Port	SKFC218	Port Zante	Basseterre			18			41
Medical Facilities	Clinic	SKFC166	Newtown Health Centre	Basseterre	25					56
Medical Facilities	Clinic	SKFC170	Old Road Health Centre	Old Road	30					41
Medical Facilities	Clinic	SKFC169	Sandy Point Health Centre	Sandy Point	30					41
Medical Facilities	Clinic	SKFC168	Cayon Health Centre	Cayon	30					42
Medical Facilities	Clinic	SKFC173	Molineux Health Centre	Molineux	25					37
Medical Facilities	Clinic	SKFC172	St Peter Health Centre	St Peters	25					37
Medical Facilities	Hospital	SKFC164	Mary Charles Hospital	Molineux	25					37
Medical Facilities	Hospital	SKFC163	JNF General Hospital	Basseterre	35	5				49
Medical Facilities	Hospital	SKFC165	Pogson Hospital	Sandy Point	45					56
Protective	Fire	SKFC017	Fire Hall	RLB Int'l Airport	25					37
Protective	Fire	SKFC012	Fire Station	Basseterre	25					52
Protective	Military	SKFC028	Defence Force HQ	Basseterre	30					42
Protective	Police	SKFC009	Police Station	Stapleton	35					47
Protective	Police	SKFC011	Police Training Complex	Basseterre	45			32		85
Protective	Police	SKFC008	Police Station	Cayon	45					57

FAC_Type	Fac_Class	FAC_ID	NAME_FAC	FVS break points:						Total
				LOCATION	>24 WIND	>4 I.EROS	>9 S.SURGE	>21 FLOOD	>14 C.EROS	
Protective	Police	SKFC005	Police Station	St Pauls	40					52
Protective	Police	SKFC003	Police Station	Old Road	30	5				44
Protective	Police	SKFC002	Police Station	St. Johnston Village, Bass.	30					41
Protective	Police	SKFC010	Police Station	Frigate Bay	25					52
Protective	Police	SKFC007	Police Station	Tabernacle	40					52
Utilities	Gas	SKFC182	TEXACO Buckleys	Buckleys	25	5				39
Utilities	Gas	SKFC185	TEXACO Key	Keys Village	30					42
Utilities	Gas	SKFC183	SHELL Buckleys	Buckleys	25	5				39
Utilities	Gas	SKFC184	SHELL Sandy Point	Sandy Point	25					37
Utilities	Petroleum	SKFC178	SHELL Terminal	Basseterre				28		59
Utilities	Telecommunication	SKFC027	Radio & TV Studios	Basseterre	30					42
Utilities	Water	SKFC201	Conaree	Conaree	25					53
Utilities	Water	SKFC196	17168	Basseterre Valley	25					53
Utilities	Water	SKFC210	St.Paul's#2	St.Pauls	25					37
Utilities	Water	SKFC197	17533	Newton Ground	25					53
Utilities	Water	SKFC208	Profit	Profit	25					37
Utilities	Water	SKFC213	Godwins	Godwins Ghaut	25					37
Utilities	Water	SKFC200	Taylor's	Taylor's	25					37
Utilities	Water	SKFC206	Mansion	Mansion	25					37
Utilities	Water	SKFC193	Water Intake Lodge	Lodge	40	6				71
Utilities	Water	SKFC203	18629	La Guerite	25	5				39
Utilities	Water	SKFC214	Stonefort	Stone Fort	25	5				39
Utilities	Water	SKFC205	Lodge#2	Lodge Estate	25					37
Utilities	Water	SKFC207	Tabernacle	Tabernacle	25					37
Utilities	Water	SKFC212	Sir Gilles	Sir Gilles		5				34
Utilities	Water	SKFC211	Orton's	Orton's		5				34
Utilities	Water	SKFC191	Water Intake Phillips	Phillips	40	7				72
Utilities	Water	SKFC188	Water Intake Wingfield	Wingfield	30	6				61
Utilities	Water	SKFC190	Water Intake Franklands	Franklands	35	6				66
Utilities	Water	SKFC192	Water Intake Stonefort	Stonefort	40	6				71
Utilities	Water	SKFC185	16072	Basseterre Valley	25					37
Utilities	Water	SKFC202	R.L.B Airport	Conaree	25					53
Utilities	Water	SKFC204	Lodge#1	Lodge Village	25					37
Utilities	Water	SKFC209	St.Paul's#1	St.Pauls	25					37

FVS break points: Facility Vulnerability Score (FVS) rated with more than the 50% of the possible hazard's FVS

$$FVS = (L+V) HPS$$

"FVS" Facility Vulnerability Score

"L" Locational Vulnerability

"V" Vulnerability Score $V = DH + S + O$

"HPS" Hazard Priority Score.

Appendix 2 – Nevis Facilities by Type and Hazard FVS

Nevis

Facility Vulnerability Analysis

Summary

FAC_Type	Fac_Class	FAC_ID	NAME_FAC	LOCATION	FVS break points:					Total FVS
					>22 WIND	>2 DROU	>6 S.SURGE	>14 FLOOD	>11 C.EROS	
Community	Church	NVFC056	Zion Chapel (Emmaus)	Webb's Ground		5				34
Community	Church	NVFC063	Wesleyan Holiness Church	Cotton Ground		3				32
Community	Church	NVFC041	Roman Catholic Hall	Craddock Road		4				28
Community	Church	NVFC067	Wesleyan Holiness Church - Barnes Ghaut	Barnes Ghaut		3				32
Community	Church	NVFC066	New Testament Church of God Jessups	Jessups Village		3				22
Community	Church	NVFC062	Methodist Church Hall -Cotton Ground	Cotton Ground		3				27
Community	Church	NVFC061	Methodist Church Hall - Fountain	Fountain	25	3				37
Community	Church	NVFC059	Rehoboth Church Of God - Liburd Hill	Liburd Hill		3				32
Community	Church	NVFC057	Seventh Day Adventist Church - Butlers	Butlers	25	4				38
Community	Church	NVFC054	Caivary Baptist Church - Rawlins	Hard Times	25	5				45
Community	Church	NVFC052	Wesleyan Holiness Church - Buck Hill	Bucks Hill	25	5				39
Community	Church	NVFC065	Church Of God of Prophecy	Jessups Village		3				27
Community	Church	NVFC051	Ebenezer Church of God - Old Manor	Old Manor	25	5				39
Community	Church	NVFC050	Church of God - Cox Village	Cox Village	25	5				39
Community	Church	NVFC048	Anglican Church Fig Tree	Church Ground		5				29
Community	Church	NVFC058	Church of God - Brick Kiln	Brick Kiln		4				33
Community	Community Centre	NVFC039	Grove Park Pavillion	Charlestown	40	4				62
Community	Community Centre	NVFC042	Community Centre	Bath Village		4				28
Community	Community Centre	NVFC045	Community Centre	Brown Hill		5				40
Community	Community Centre	NVFC038	Netball Complex	Charlestown		4		18		43
Community	Community Centre	NVFC055	Community Centre - Hickmans	Hickmans	30	5				44
Community	Community Centre	NVFC047	Sport Complex	Church Ground		5				29
Community	Community Centre	NVFC053	Community Centre Hardtimes	Hard Times	35	5				49
Education	Nursery	NVFC082	St.Thomas Pre-school	Lowlands		3				27
Education	Nursery	NVFC084	Vern N Llew Pre-school	Charlestown		4				28
Education	Nursery	NVFC078	Charlestown Pre-school	Charlestown		4				42
Education	Nursery	NVFC074	Brown Hill Pre-school	Brown Hill	25	5				39
Education	Nursery	NVFC073	Maude Smith Pre-school	Butlers		4				33
Education	Nursery	NVFC069	Charlestown Preparatory School	Charlestown		4				28
Education	Nursery	NVFC080	Newcastle Pre-School	Newcastle		3				32
Education	Nursery	NVFC081	Newcastle Pre-school	Newcastle		3				32
Education	Nursery	NVFC083	Stepping Stone Nursery	Charlestown		4				37
Education	Nursery	NVFC075	Butlers Pre-school	Butlers	25	4				38
Education	Nursery	NVFC079	Learning Center	Charlestown		4				28
Education	Nursery	NVFC078	Gingerland Pre-school	Gingerland	25	5				39
Education	Others Education	NVFC043	Girls Guides HD/Qtrs	Stoney Grove		4		18		38
Education	Primary	NVFC049	St. Johns Primary School (Bottom floor)	Brown Pastures		5				37
Education	Primary	NVFC070	Combermere Primary School	Combermere		3				32
Education	Primary	NVFC040	Charlestown Primary School	Charlestown		4				28
Education	Primary	NVFC044	Prospect School - Staff Room	Brown Hill		5				29
Education	Primary	NVFC048	St. Johns Primary School (Top floor)	Brown Pastures		5				37
Education	Primary	NVFC077	Charlestown Preparatory School	Charlestown		4				28
Education	Primary	NVFC088	Charlestown Primary School	Charlestown		4				28
Education	Primary	NVFC087	St.Thomas Primary School	Lowlands		3				27
Education	Primary	NVFC071	St.James Primary School	Butlers	25	4				38

FAC_Type	Fac_Class	FAC_ID	NAME_FAC	LOCATION	FVS break points:					Total
					>22	>2	>6	>14	>11	
Education	Primary	NVFC086	St. John Primary School	St. John		5				37
Education	Primary	NVFC072	Prospect Primary School	Prospect		5				34
Education	Primary	NVFC085	Gingerland Primary School	Gingerland	25	5				39
Education	Primary	NVFC064	Anglican School Hall - Lowlands	Lowlands		3				32
Education	Secondary	NVFC088	Charlestown Secondary School	Charlestown		4		15		40
Education	Secondary	NVFC089	Gingerland Secondary School	Gingerland	25	5				42
Education	Secondary	NVFC090	Lyn Jeffers Secondary School	Charlestown		4				36
Education	Technical	NVFC091	Charlestown Sixth Form College	Charlestown		4		15		40
Education	University	NVFC092	University of the Americas	Potworks		3				32
Government	Administration	NVFC037	Long Point Port	Long Point		4				28
Government	Administration	NVFC018	Treasury Building	Charlestown		4				28
Government	Administration	NVFC030	Ministry of Youth & Sports	Charlestown		4				33
Government	Administration	NVFC014	Department of Agriculture	Prospect		5				34
Government	Administration	NVFC020	CMC Building	Charlestown		4			20	44
Government	Administration	NVFC010	Adm. Building	Charlestown		4				42
Government	Administration	NVFC035	Charlestown Sea Port	Charlestown		4				25
Government	Administration	NVFC016	Ministry of Communications	Stoney Grove		4				28
Government	Administration	NVFC015	Public Works Department	Charlestown		4				28
Government	Administration	NVFC036	Newcastle Airport	Newcastle		3				33
Government	Residential	NVFC029	Nurses Home	Charlestown	30	4				43
Government	Residential	NVFC031	Doctor's Residence	Gingerland	45	6				63
Government	Residential	NVFC025	Married Quarters	Belle Vue	25	4				47
Government	Storage	NVFC009	Public Market	Charlestown		4			20	54
Government	Storage	NVFC024	Government Repair Shop	Prospect		5				34
Government	Storage	NVFC012	New Castle Pottery	New Castle		3				32
Government	Storage	NVFC019	Cotton House	Charlestown		4	8	15	20	62
Government	Storage	NVFC017	Post Office	Charlestown		4				28
Government	Storage	NVFC023	Repair Shop & Garage	Cades Bay		3				27
Infrastructure	Airport	NVFC143	International Airport	Newcastle	35	3		24		70
Infrastructure	Roads	NVFC148	Stony Grove - Charlestown			5		30	20	72
Infrastructure	Roads	NVFC148	Cades Bay - Jones Estate			3		18	12	50
Infrastructure	Roads	NVFC147	Newcott - Jessup			4		18	20	54
Infrastructure	Roads	NVFC149	Jones Estate - Newcastle			3		24	16	60
Infrastructure	Sea Port	NVFC144	Charlestown Port	Charlestown		4	12		24	53
Infrastructure	Sea Port	NVFC145	Deep Water Port	Long Point		4	14		20	56
Medical Facility	Clinic	NVFC097	Butlers Health Centre	Butlers		4				33
Medical Facility	Clinic	NVFC094	Charlestown Health Centre	Charlestown		4				23
Medical Facility	Clinic	NVFC098	Comberre Health Centre	Comberre		3				32
Medical Facility	Clinic	NVFC099	Cotton Ground Health Centre	Cotton Ground		3				27
Medical Facility	Clinic	NVFC096	Gingerland Health Centre	Gingerland		5				34
Medical Facility	Clinic	NVFC095	Brown Hill Health Centre	Brown Hill	35	5				49
Medical Facility	Hospital	NVFC093	Alexandra General Hospital	Charlestown	30	4		15		55
Protective	Court	NVFC002	Magistrate House	Charlestown		4				33
Protective	Court	NVFC008	Courthouse/Library	Charlestown		4				28
Protective	Fire	NVFC008	Fire Hall	New Castle Airport		3				38
Protective	Fire	NVFC007	Fire Station	Charlestown		4				33
Protective	Police	NVFC001	Police Station	Charlestown		4				33

FAC_Type	Fac_Class	FAC_ID	NAME_FAC	FVS break points:					Total	
				LOCATION	>22 WIND	>2 DROU	>6 S.SURGE	>14 FLOOD		>11 C.EROS
Protective	Police	NVFC004	Police Station	Gingerland	25	5				39
Protective	Police	NVFC003	Police Station	Cotton ground		3				32
Protective	Police	NVFC005	Police Station	New Castle		3				32
Protective	Prison	NVFC034	Prison Farm	Maddens		4				33
Utilities	Electricity	NVFC011	Power House (2 buildings)	Prospect		5				34
Utilities	Gas	NVFC106	DELTA Jessup	Jessups Village		3				29
Utilities	Gas	NVFC112	SHELL Loyd Powell	Bath Village		4				39
Utilities	Gas	NVFC113	SHELL Reliable Motors	Charlestown		4				44
Utilities	Gas	NVFC110	Govt.Garage	Prospect		5				36
Utilities	Gas	NVFC111	DELTA Noel	Farm Estate		5				31
Utilities	Gas	NVFC105	SHELL Pinney	Pinney		4				30
Utilities	Gas	NVFC108	DELTA Skittl	Newcastle		3				40
Utilities	Gas	NVFC107	DELTA ENF	Cotton Ground		3				29
Utilities	Gas	NVFC109	DELTA Market Shop	Market Shop	25	5				41
Utilities	Gas	NVFC114	DELTA Stanley	Fig Tree		5				36
Utilities	Petroleum	NVFC103	DELTA Terminal	Low Ground		4				35
Utilities	Petroleum	NVFC104	SHELL Terminal	Charlestown		4		15	12	52
Utilities	Telecommunication	NVFC136	Church Ground	Church Ground		5				35
Utilities	Telecommunication	NVFC128	Mem's Pizzeria	Mem's Pizzeria		5				35
Utilities	Telecommunication	NVFC115	Rambury X	Rambury X		4				38
Utilities	Telecommunication	NVFC117	Newcastle X	Newcastle X		3				37
Utilities	Telecommunication	NVFC139	Newcastle Pottery	Newcastle		3				33
Utilities	Telecommunication	NVFC140	Methodist Church Liburd Hill	Liburd Hill		3				33
Utilities	Telecommunication	NVFC142	Butlers	Butlers		4				39
Utilities	Telecommunication	NVFC130	Bottom Zion Hill	Zion Hill		5				40
Utilities	Telecommunication	NVFC131	Fenton Hill	Fenton Hill		5				40
Utilities	Telecommunication	NVFC137	Hanleys rd.	Hanleys rd.		5				40
Utilities	Telecommunication	NVFC133	Rawlins	Rawlins		5				40
Utilities	Telecommunication	NVFC134	Chicken stone	Chicken stone		5				40
Utilities	Telecommunication	NVFC129	JNC Senior Home Prospect rd.	Prospect rd.		5				35
Utilities	Telecommunication	NVFC116	Market Shop X	Market Shop X		5				44
Utilities	Telecommunication	NVFC122	Bottom Craddock rd.	Craddock rd.		4				34
Utilities	Telecommunication	NVFC138	Newcastle Airport	Newcastle		3		15		39
Utilities	Telecommunication	NVFC141	Jones Estate	Jones Estate		3				28
Utilities	Telecommunication	NVFC118	JNC Cotton Ground	Cotton Ground		3				33
Utilities	Telecommunication	NVFC119	JNC Jessups	Jessups		3				28
Utilities	Telecommunication	NVFC135	Strikers car rental	Strikers rental		5				35
Utilities	Telecommunication	NVFC121	New Cut rd.	New Cut rd.		4				29
Utilities	Telecommunication	NVFC124	Barclays bank	Barclays bank		4			20	45
Utilities	Telecommunication	NVFC123	JNC Govt. rd. & Rd. to RMD	Govt. rd.		4				29
Utilities	Telecommunication	NVFC125	Super Foods	Super Foods		4		18		43
Utilities	Telecommunication	NVFC127	Top of Govt. rd.	Govt. rd.		4				29
Utilities	Telecommunication	NVFC128	Bath round about	Bath round		4		18		43
Utilities	Telecommunication	NVFC132	Market Shop	Market Shop		5				40
Utilities	Telecommunication	NVFC120	Four Season Clarke Estate	Four Seasons		3				28
Utilities	Water	NVFC021	Pump House	Fothergills	25	5				39
Utilities	Water	NVFC022	Pump House	Stoney Grove		4				37

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				FVS break points:	>22	>2	>6	>14	>11	Total
FAC_Type	Fac_Class	FAC_ID	NAME_FAC	LOCATION	WIND	DROU	S.SURGE	FLOOD	C.EROS	FVS

FVS break points: Facility Vulnerability Score (FVS) rated with more than the 50% of the possible hazard's FVS

$$FVS = (L+V) HPS$$

"FVS" Facility Vulnerability Score

"L" Locational Vulnerability

"V" Vulnerability Score $V = DH + S + O$

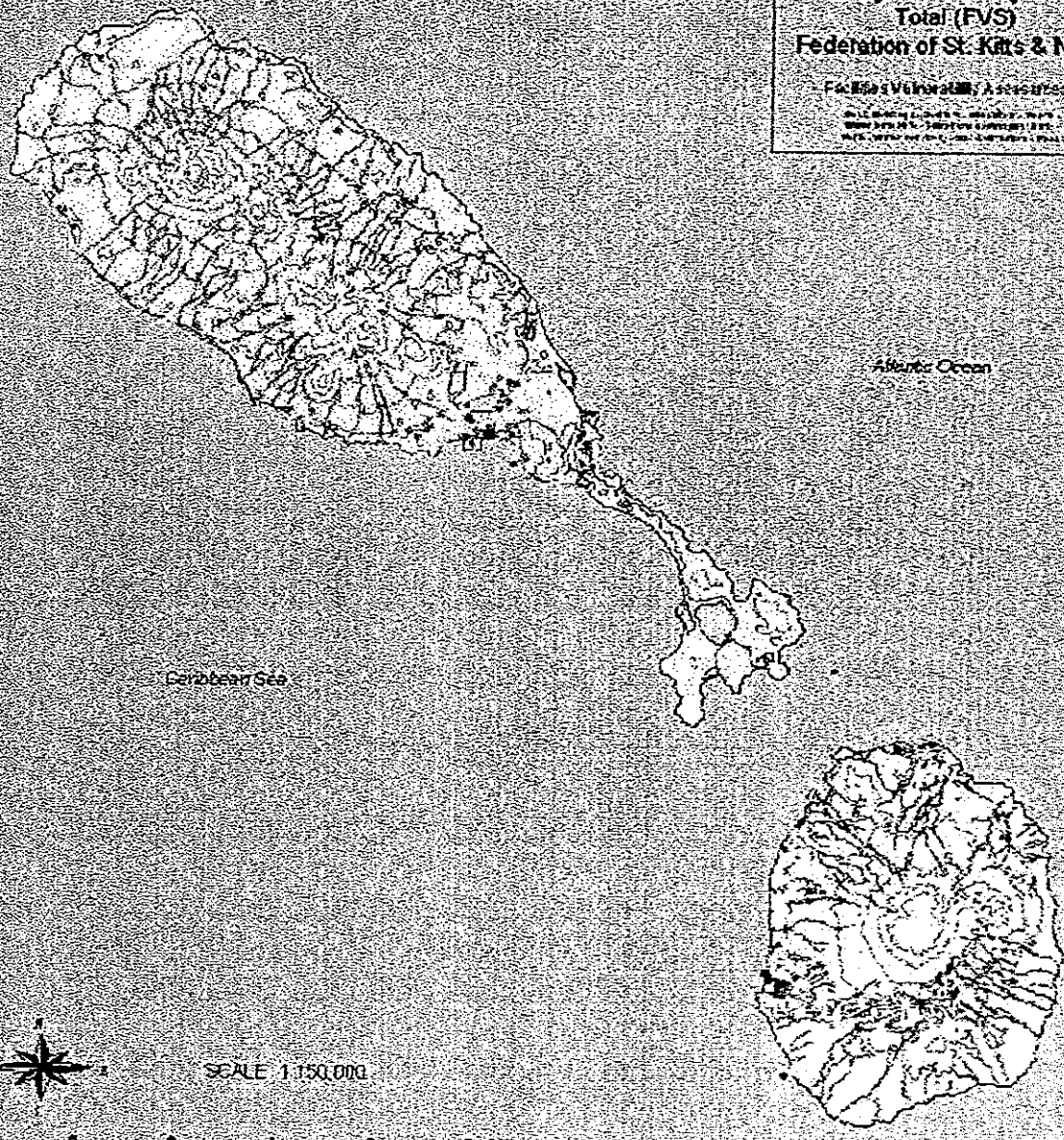
"HPS" Hazard Priority Score.

Appendix 3 – St. Kitts and Nevis FVS and Critical Facilities layout

**Facility Vulnerability Scores
Total (FVS)
Federation of St. Kitts & Nevis**

Facility Vulnerability Assessment

Dr. J. M. ...
...
...
...



Total FVS - Federation of St. Kitts & Nevis

Total 'FVS' - SKT	Symbol	Category	Total 'FVS' - NVS	Symbol	Category
0 - 20	Very Low	Water catchment - SKT	22 - 30	Very Low	Water catchment - NVS
30 - 37	Low	Coastline - SKT	31 - 36	Low	Coastline - NVS
38 - 45	Moderate	Settlement - SKT	37 - 41	Moderate	Settlement - NVS
46 - 53	High	Coastline - SKT	42 - 49	High	Coastline - NVS
54 - 65	Very High		50 - 73	Very High	

Map projection	1:250,000
Scale	1:250,000
Number of sheets	1
Grid	Duff-Ward miles
Projection	Transverse Mercator
Contour	Contour 100 (Meters)
Unit of measurement	Meters
Minimum of digit	82 West of Greenwich
Latitude of origin	Equator
False easting of origin	500,000
False northing of origin	500,000 Easting with Hobbs
Central meridian	50 West
Scale	8000 (DMS 310)
Year	1994

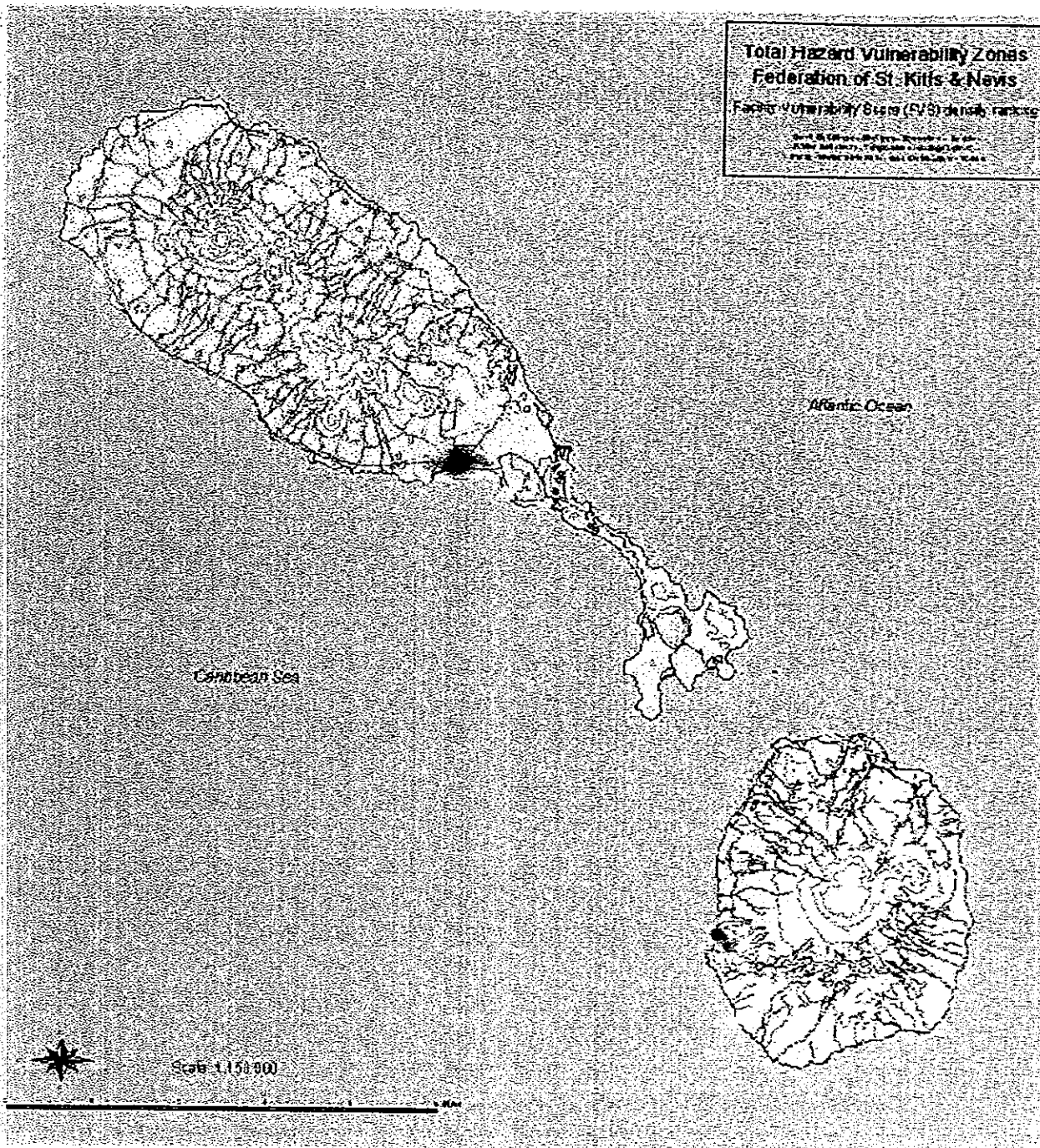
Project:
Post-Disaster Reconstruction (PDR)
DAS - US AID, G.E. Unit, Physical Planning & Development - MSNC
#07081.014-010



Appendix 4 – FVS Hotspot Fed. of St. Kitts & Nevis layout

**Total Hazard Vulnerability Zones
Federation of St. Kitts & Nevis**
Factor Vulnerability Signs (FVS) density ranking

Scale: 1:150,000
Projection: UTM
Datum: WGS 84
Units: Meters



Density from Total FVS*, SKT		Density from Total FVS**, NYS	
	Very Low		Very Low
	Very Low - Low		Very Low - Low
	Low		Low
	Low - Moderate		Low - Moderate
	Moderate		Moderate
	Moderate - High		Moderate - High
	High		High
	Water catchment - SKT		Water catchment - NYS
	Coastline (500 m) - SKT		Coastline (500 m) - NYS
	Settlements - SKT		Settlements - NYS
	Coastline - SKT		Coastline - NYS

Base map source:
Scale: 1:250,000
Number of sheets: 1
Grid: British World Index
Projection: Transverse Mercator
Datum: 1983 (Modified)
Units: meters
Meridian of Origin: 02 West Greenwich
Latitude of Origin: Equator
Scale factor at origin: 0.9999
Central meridian: 00 West
Datum: 1984

Project:
Post Disaster Character Mapping (PDCM)
DAB - USAID, GIS Unit, Physical Planning & Surveying Unit - NYS
KAA/025/01/01/00