

FN-ACT-416



Structural Vulnerability Assessment for St. Kitts and Nevis

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

July 2001

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CONTENTS

1. Executive Summary
2. Introduction
3. The Task
4. Methodology
5. Findings
6. Costing
7. General Recommendations
8. Recommendation for emergency shelters
9. Appendices
 - I Rafter Anchorage Detail
 - II List of Facilities Surveyed
 - III Summary of Relative Vulnerability to Earthquake and to Hurricane
 - IV Recommended Retrofit Action
 - V Facilities Data Collected
 - VI Unit rates for Estimating Costs
 - VII Photographs

1.0 EXECUTIVE SUMMARY

As a part of the Post George Mitigation Project a Total of 94 Government buildings in St Kitts and Nevis were subjected to a structural vulnerability assessment with regard to the hurricane and earthquake hazard. Vulnerability to flooding, storm surge and landslide damage was also identified.

The assessments were made not on the basis of rigorous analysis but rather on vulnerability assessment models previously developed. These models give rough comparisons of the vulnerability of buildings in the same general area.

The study shows up the need for a structured and well-funded approach to regular maintenance of public buildings. Too many of them are less than well kept. The state of disrepair of the class of building called “steel-framed” was most noticeable.

Four of the buildings surveyed were said to be designated emergency shelters. In general, they were found to be either not sufficiently strong or to be operationally deficient in that they did not have the necessary facilities to support the targeted function.

The vulnerability of each building was catalogued and recommendations for retrofitting work to be undertaken were given along with estimated costs. The most frequently observed vulnerability of the buildings was related to the absence of storm shutters to protect the windows.

The Total price tag of the retrofitting recommendations is EC \$5,400,000.

Recommendations for improving the standard of hazard resistant design and construction on the two islands are included in this report.

2.0 INTRODUCTION

The islands of St Kitts and Nevis are located in the northern corner of the Caribbean chain at Latitude 17°25'30" N, Longitude 62°52'00" W and Latitude 17°05'00" N, Longitude 62°31'00" W, respectively.

The islands are of volcanic origin – there is a dormant volcano on each island. Habitation is mostly along the islands' coastal strips which are to a large extent low-lying and sloping gently at first then quite steeply up to the mountains at the center. Parts of these coastal areas are subject to flooding due to storm surge and tsunamis. But the whole landmass of the islands (104 square miles) is even more susceptible to the hazards of earthquake and hurricane.

The Earthquake Hazard

St Kitts and Nevis lie in the zone of highest seismic risk in the Eastern Caribbean where large, shallow earthquakes may be expected due to under-thrusting of the Barracuda Ridge below the Caribbean plate.

Information from Robson's Catalogue indicates that the islands experienced major earthquakes in 1690, 1843 and 1950 which caused major damage. Intensities on the Modified Mercalli Scale were IX, IX and VIII respectively. (See Figure 3a)

The Hurricane Hazard

The islands also lie in the path of North Atlantic hurricanes which every year between June and November sweep through the Caribbean Sea packing devastating winds and torrential rains.

For many years, these islands were said to have a ten percent chance, in any period of 50 years, of experiencing hurricane winds with speeds higher than 120 miles per hour (averaged over 3 seconds). (Caribbean Council of Engineering Organizations). With the introduction of the St Kitts and Nevis Building Code in the last year or so that wind speed has been moved up to 145 miles per hour. This is roughly equivalent to a wind speed of 119 miles per hour when averaged over 60 seconds and represents a shift from a category 2 to a category 3 hurricane on the modified Saffir-Simpson Scale. (See Figure 3b)

In 1928, the islands were struck by a major hurricane. Between 1929 and 1988 the environment was relatively calm. But from 1989 to 1999 six (6) major hurricanes have affected the islands causing severe damage to buildings.

By far the most damage occurred to roofs. The most frequent type of failure observed was the stripping away of the roofing. This included corrugated metal sheeting, asphalt shingles and built-up roofing. Less frequently, the roof failure included loss of the roof decking and the rafters themselves. Typically, the rafter failure occurred at the wall anchorage. Nails and hurricane clips were pulled out. Another kind of rafter failure was also observed. In this case the rafter split along a line through the hole drilled to insert the anchor rod (see Appendix I). The top portion of the rafter was blown away leaving the bottom portion securely in place.

Open verandahs were shown to be very vulnerable. Many of them were demolished. Steel-framed buildings also suffered roof damage. Corrugated metal roof sheets were dislodged and in some cases purlins and rafter overhangs were buckled. Some of these failures occurred because the buildings were poorly maintained. Members were corroded and had lost considerable strength.

Windows were also shown to be weak points in the building envelope. Many let in large amounts of water even if they were not blown out or otherwise damaged by windborne debris.

The Structural Vulnerability Assessment of government buildings in St Kitts and Nevis, as a component of the Post Georges Disaster Mitigation Project, is intended to be a mechanism through which the buildings are examined to identify weaknesses in form, material, construction detailing or maintenance procedures which could contribute to loss in a hazard event.

Once such weaknesses are uncovered, recommendations are made for strengthening the structures and approximate costs are assessed.

The hope is that a phased retrofitting plan will be implemented to address this problem.

3.0 The Task

A total of 92 buildings were identified for the survey, 47 in St Kitts and 45 in Nevis.

These included small essential facilities, such as health centers and police outposts, hospitals, fire stations, primary schools, libraries, broadcasting studios and government ministry

buildings. Among these were five (5) buildings (four in Nevis, one in St Kitts) which were identified as Designated Emergency Shelters.

The buildings were mostly single storey structures, though there were several two-storey ones and three of them were three storeys high. They were typically of concrete and concrete block construction. Some of the older buildings were constructed of unreinforced stone masonry. Pre-engineered, steel-framed buildings were also represented. Some of these carried concrete block wall cladding. Others were clad with metal and still others with a synthetic fibreboard. Roofs were mostly of the light, timber-framed type clad with corrugated metal panels.

A listing of the buildings and their geographic positions is shown at Appendix II.

Each building site was inspected to assess vulnerability to natural hazards such as flooding, landslides, storm surge, hurricane wind and wind blown objects.

For each building, significant data were collected such as age, materials of construction, roof geometry, and structural action.

Building features known to increase or decrease vulnerability to the wind hazard were noted – roof overhangs, open verandahs, rafter-to-wall connection, soffits, and window protection.

The condition of the buildings was also noted.

For each building, its distance from the coast and its elevation above mean sea level were recorded.

Building data collected are shown at Appendix V.

A separate survey of each building was carried out to collect additional information which would allow assessment of vulnerability to damage due to earthquake. This additional information typically included plan dimensions of the buildings and cross-sectional areas of walls and columns.

The five (5) buildings or building complexes identified as Emergency Shelters were further studied to determine their suitability for use as such. Holding capacity and availability of support facilities such as water closets, lavatories, showers, kitchens, potable water storage and delivery systems, electricity-generating equipment were examined, with a view to determining whether each facility should be

- A. declared safe for use during and after a hazard event
- B. declared suitable for use after a hazard event, if serviceable
- C. declared unsuitable for use as an Emergency Shelter

These findings are discussed at Section 7 below.

The assessment of seismic vulnerability was limited to damage due to ground shaking. Damage due to the dramatic effects of liquefaction was not considered. According to records in Robson's Catalogue, liquefaction occurred in Nevis during the 1690 event but there is no record of such occurrences in St Kitts. Assessment of vulnerability to this particular phenomenon which sometimes results from earthquake activity is beyond the scope of this project.

4.0 METHODOLOGY

Assessment Models

Earthquake

Vulnerability to damage due to earthquake was assessed using the procedure developed by A F Hassan and M A Sozen of Purdue University. This procedure is explained in detail in a paper titled "Seismic Vulnerability Assessment of Low-Rise Buildings in Regions with Infrequent Earthquakes" which was published in the Structural Journal of the American Concrete Institute in January, 1997.

It provides a rough comparison of vulnerability to earthquake damage among buildings in the same general area by calculating column indices and wall indices. These indices are ratios of column cross sectional area and wall cross sectional area in each orthogonal direction, to Total floor area. Column and wall indices are then plotted against each other to give a level of vulnerability. For the purposes of this study the plot shown at Figure 4 was constructed. A plot in Zone 5 was considered to indicate high vulnerability (low column and wall indices) while a plot in Zone 1 or Zone 2 was considered to indicate low vulnerability (high column and wall indices). Moderate vulnerability was assigned to buildings which plotted in Zones 3 and 4.

The assessment method was developed for nominally reinforced concrete buildings with unreinforced masonry walls. Equations are not included for modeling reinforced masonry, structural steel columns and their typical portal frame action. Similarly, the method does not allow for modeling the effect of the in-plane wall bracing ordinarily found in steel-framed buildings. In these cases the model gave results which suggested unrealistically low resistance to earthquake.

It was therefore necessary to make adjustments to the model based on the ratios of elastic moduli of concrete and the other materials – reinforced masonry, structural steel, wood. Steel and wood sections were transformed to equivalent concrete sections. This also meant that masonry walls were assigned a strength 3.3 times higher than unreinforced masonry. Further, because the newer engineered buildings were considered to have been detailed in accordance with modern codes for earthquake resistant design reinforced concrete columns in such buildings were assigned twice the strength of older ones. Steel bracing in sidewalls was modeled as reinforced concrete wall.

The method was calibrated against two buildings known to have low vulnerability to earthquake damage. In each case the assessment showed good correlation with designed strength.

Earthquake vulnerability rankings are shown at Appendix III.

Wind

It was intended that vulnerability to the wind hazard be assessed using the WINDRITE computer software owned by the Insurance Institute for Property Loss Reduction.

However, it was found that this software is no longer recommended for use in studies of this nature. The WINDRITE data collection system was therefore used, in part, in compiling notes during the field investigation phase of the work but this software was not used for weighting and manipulating the information to produce a vulnerability ranking.

Instead, vulnerability was determined based on the following building characteristics.

1. poor condition of building generally
2. poor condition of metal roof sheeting
3. roofed with common asphalt shingles or built-up roofing
4. open verandahs
5. roof overhangs exceeding 2 feet where there are no soffits
6. timber rafters anchored with a rod through a hole drilled through them
7. unbraced side walls (steel-framed buildings)
8. unprotected windows

The characteristics were not weighted.

High vulnerability was assigned to buildings exhibiting three or more of the listed characteristics, moderate vulnerability was assigned to buildings exhibiting two of the characteristics and low vulnerability was assigned if the building exhibited not more than one of the listed characteristics.

Since both of the islands are small (69 square miles, 35 square miles), are situated very close to each other (2 miles across the channel) and the buildings are all located on gently sloping ground relatively near to the coast it was felt that variations in exposure and topography are small. These parameters would not therefore be the dominant ones pointing to greater or lesser vulnerability of the buildings.

Wind vulnerability rankings are shown at Appendix III.

Record Drawings and Codes

For the most part the information used in carrying out the vulnerability assessments was collected during on-site surveys of the buildings. Drawings were very seldom available for study.

On-site surveys did not include breaking into ceiling cavities to view rafter-to-wall connections or breaking walls to determine reinforcing details.

Likewise, information about codes used for design purposes was hard to come by.

Holding Capacity of Shelters

Neither the National Emergency Management Agency (NEMA) in St Kitts nor the Office of Disaster Preparedness in Nevis currently list the number of persons which the various emergency shelters are intended to accommodate.

In order to test the adequacy of support facilities at each shelter an estimate was made of the probable maximum number of people who could be accommodated in reasonable comfort. No particular allowance was made for privacy.

Four of the five shelters assessed under this project were located in schools. Half of the Total floor area was therefore earmarked for storage of school furniture and emergency food supplies, for kitchen and bathroom facilities and for daytime interaction between family members. The remaining area was allotted on the basis of fifty-five (55) square feet per person.

Recommendations for construction of additional cooking, bathing and toilet facilities were based on the shelter capacities derived in this way and the provisions of the St Kitts and Nevis Building Code regarding maximum number of persons per fixture.

Stand-by Electricity Generating Capacity

Recommendations for the rating of the generator to be installed at each of the shelters reviewed was based on an allowance of 0.002 KVA per square foot of Total floor area. This would allow for powering lights water pumps and refrigeration equipment but not electric stoves or air-conditioning which put a high demand on the generator.

5.0 FINDINGS

A review of the survey indicates that taken as a group the public buildings in St Kitts and in Nevis are fairly resistant to damage due to the natural hazards of earthquake and hurricane.

As a general observation it could be said that much more attention should be given to regular maintenance of the buildings. More than anything else a hard look needs to be taken at the institutional arrangements now in place for identifying, authorizing, funding and delivering the required maintenance actions.

The deficiency most often observed was lack of protection for windows and equipment access openings in walls. 81 percent of buildings surveyed fell into this category.

In making recommendations for installing storm shutters for the protection of windows it was considered that all types of windows, not only those with glass panels, needed such protection. Metal louvre windows are also vulnerable. Even when they are not smashed by the impact of debris they will let in large amounts of wind driven rain.

The most severe deficiency encountered was the poor state of repair of the class of building called "pre-engineered steel-framed structure". The deficiency was particularly severe where this type of structure also had walls of "cement fibreboard" as opposed to concrete block. The percentage of buildings falling into this category was small (21 percent).

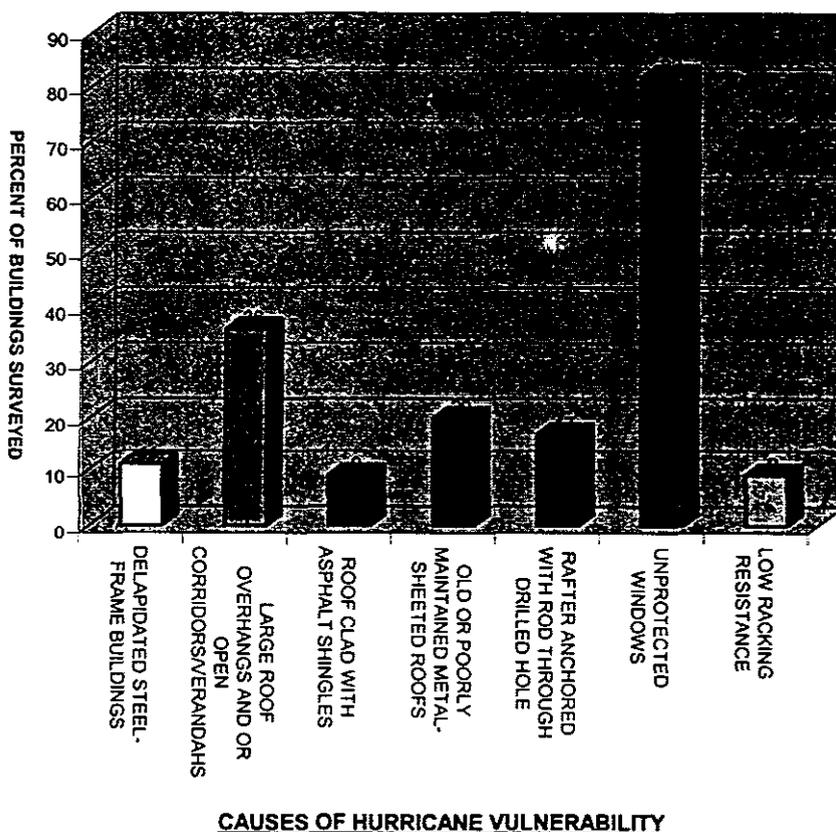
Other notable points of vulnerability were open, roofed corridors where the main roof continues across the exterior wall to form the roof of the corridor (18 percent of the buildings) roof clad with ordinary asphalt shingles which are not rated for installation in high wind areas and buildings with rafters anchored by means of a steel rod passed through a hole drilled in the rafter - a detail which is no longer recommended (10 percent of the buildings).

The Bar Chart below shows the distribution of wind vulnerabilities among the buildings surveyed.

In general, the buildings surveyed showed satisfactory resistance to earthquake. Higher vulnerabilities were noted for masonry or steel-framed buildings with soft interior bracing walls.

The survey of the buildings identified as emergency shelters revealed that as a general rule these buildings do not have a sufficient number of the necessary facilities such as bathroom and kitchens to support this function.

A detailed review of the assessment of each building is given at Appendix IV along with a description of recommended retrofit actions and associated costs.



6.0 COSTING

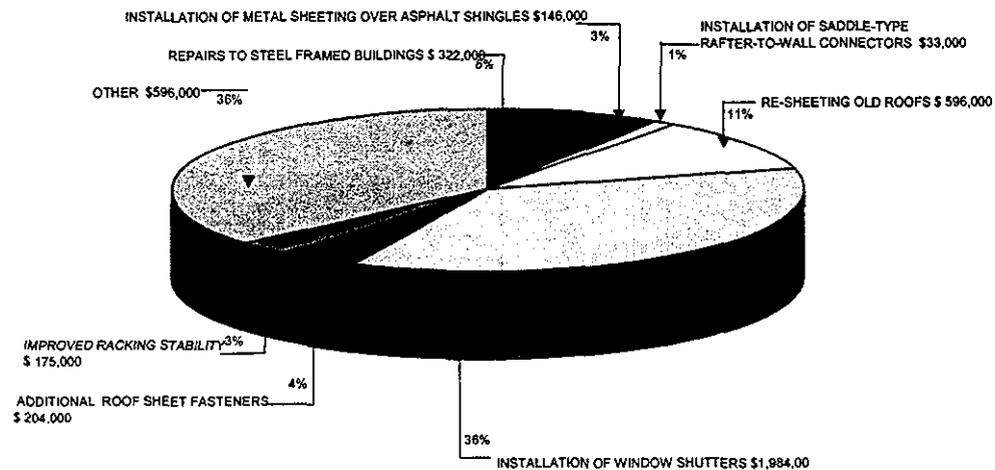
For the most part the estimated costs for implementing the various retrofitting recommendations were worked up from the unit rates shown at Appendix VI.

Some of these rates were adopted from the work previously done by Tony Gibbs, titled *Retrofitting Terms of Reference for Consultants - Standards, Global Estimate*. Where rates were developed by the Consultant, "duty free" pricing was assumed.

For ease of use, and as far as was practical, unit rates were reduced to dollars per square foot of floor area.

The total estimated cost of the recommended retrofitting work is EC \$5,400,000.

The distribution of this amount among the different categories of retrofit action is shown graphically below.



RETROFITTING COST BY CATEGORY
AS A PERCENT OF TOTAL COST (EC \$)

7.0 GENERAL RECOMMENDATIONS

Construction

For new and retrofit work, sheets should be fastened to the roof with galvanized screws instead of nails since screws provide increased holding power. The screws should be complete with neoprene washers and should be driven into the flat troughs of the sheets. Tape sealant should be used at side laps and end laps.

Where the popular 8/3 corrugated sheets are used the screws should be driven into the tops of the corrugations. The screws must therefore be longer to allow for the space between the top of the corrugation and the roof support member. Ideally, this type of sheet should be attached with a special washer which has a head shaped to match this curved surface more

closely. Given the widespread use of this sheet it is recommended that sources of supply for this washer be identified and the washer specified for general use.

In many instances the main roof continues beyond the exterior wall to form the roof of verandah or open-sided corridor. As a mitigative measure consideration might be given to adding soffits below the roof sheets in these areas as opposed to either separating the two roofs or providing more closely spaced roof sheet fasteners.

The same idea might be extended to treat roof overhangs. In all situations, however, the strength of the rafter installation should be sufficient to resist the increased wind pressures which will occur at these locations on the roof.

Material Specifications

Roof sheet material should be 24 gauge galvanized steel with an additional protective coating such as PVF2. Aluminium sheets should be avoided. They must be held down at much closer intervals and in this ocean environment are subject to corrosion - called white rust.

Particular attention should be given to the specifications for procurement of pre-engineered steel buildings. These structures are competitively priced and they can be erected relatively rapidly. However, they are plagued by corrosion problems.

All standard weight steel sections which are exposed to the weather should be hot-dip galvanized with standard coating thickness. Light gauge members, whether exposed or not, should be hot-dip galvanized with extra heavy coating thickness.

The minimum thickness of material in structural sections should be 18 gauge and the minimum thickness of wall panels, trim and flashing should be 24 gauge.

These measures will go a long way toward preventing rapid deterioration of the members in this type of building.

Even the galvanized coating breaks down after about ten years of exposure. An economic analysis should be undertaken to determine whether it would make good sense to specify one of the weathering steels for use in exposed locations in these buildings. This material is quite expensive but it generates a protective coating when exposed to the weather and seals the surface. No maintenance is required and the useful life might be sufficiently long to justify the high first cost.

Training

Continued training sessions for building designers and constructors in the techniques of hazard resistant design and construction should be an important component of the hazard mitigation process.

8.0 RECOMMENDATIONS FOR EMERGENCY SHELTERS

Criteria

Emergency Shelters are categorized as Essential Facilities. Such facilities are expected to survive a hazard event intact so as to be capable of providing logistical support to the nation's response to the event. Their function is to provide temporary housing for citizens whose homes were rendered uninhabitable and who could not be accommodated at the homes of relatives, friends or neighbours.

Shelters should therefore be of robust construction which is resistant to earthquake and hurricane damage; be located in areas which are not prone to flooding either by rain water runoff or by ocean waves; be located within easy reach of the residential areas which they are intended to serve; have adequate support facilities such as toilets and baths, potable water storage, kitchen and independent electricity generating equipment; be such that their use as a shelter for an extended period of time does not put a strain on the community because the facility cannot perform an important function customarily assigned to it in normal times.

Existing Buildings

These buildings should be well-maintained and should have been subjected to hazard mitigation audits and necessary retrofitting action.

This would include attention to important typical detail such as type of roofing material and method of fixing to the roof structure, length of roof overhangs, method by which rafters are fixed to supporting walls. Attention should also be given to the need to protect windows with storm shutters where the windows are not of the new impact-resistant type, to ensure that windows of all types are properly fastened into the walls and that doors can be braced or bolted from the inside.

These measures would go a long way toward reducing the chance that roof and wall envelopes would be breached by hurricane winds.

The hazard mitigation audit should also focus on the buildings' resistance to earthquake.

In general, buildings constructed of any of the usual materials would be acceptable. But since the resistance to induced lateral forces is crucial, shape and form are very important.

It is known that regular shapes will be more resistant to damage than irregular shapes (see Figure 1); that cross walls which brace exterior walls at frequent intervals are important (see Figure 2); that exterior walls which have a large percentage of openings (as for windows and doors) must be stabilized by the frame action of reinforced concrete beams and columns or by the x-bracing used in light steel-framed buildings. Further, it should be checked that all concrete and concrete block walls, whether interior or exterior, are reinforced. It would also be important to ensure that where two-storey buildings are being considered the lower storey is at least as well braced and buttressed by walls and frames as the one above.

Buildings sites which are located within the storm surge zone (say, less than 12 feet above Mean Sea Level) or are located in areas which historically flood in periods of heavy rains should be avoided as far as possible.

School buildings should be selected only as a last resort since it is always desirable to get students back into class as rapidly as possible after a hazard event and this is not consistent with use of the building for housing displaced persons.

New Shelters

When new structures are to be built as emergency shelters all of the considerations noted above should be taken into account. In addition, the forces which the structures are to be designed to resist should be stipulated in the designers' briefs in each case since the level of security required might be above that minimum which is prescribed in the Building Code.

Further, once a potential site has been identified, the foundation soils should be examined to a depth of at least 50 feet. This examination should include a check on whether the soils on the site are potentially liquifiable.

EARTHQUAKE INTENSITY

FIGURE 3a

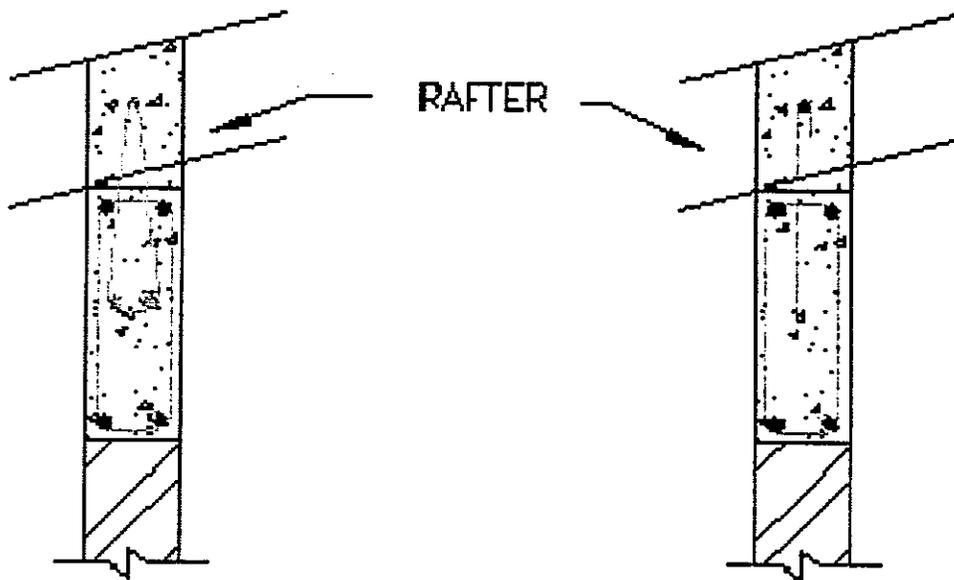
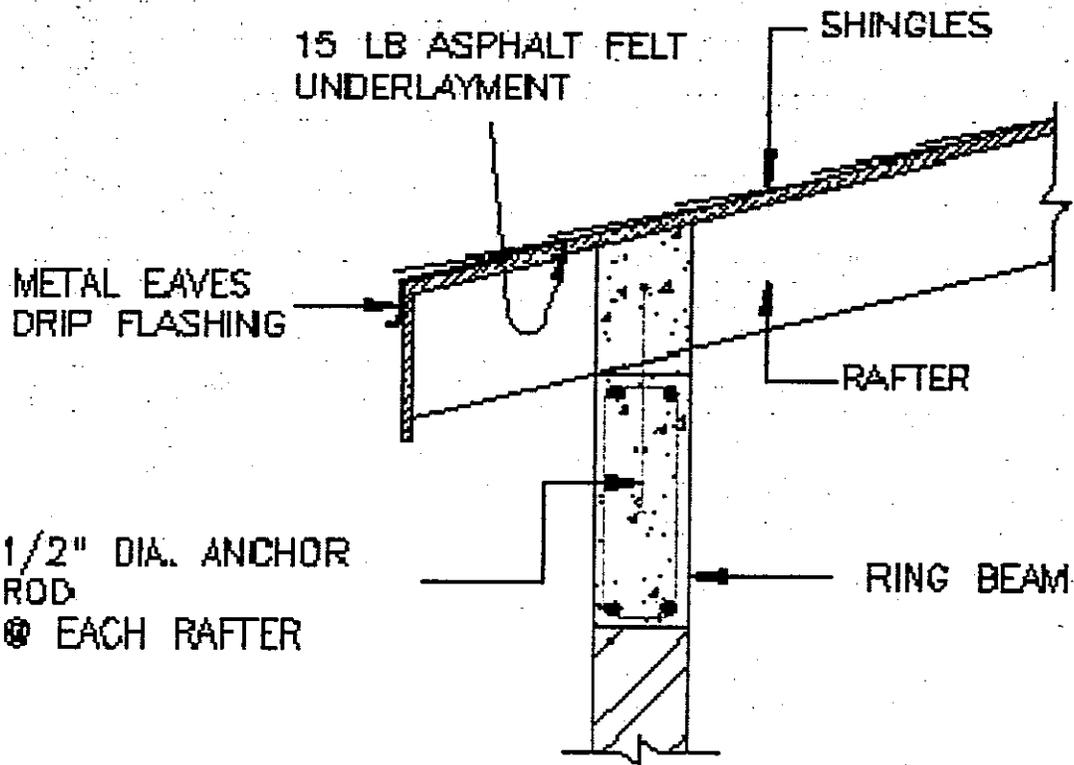
APPROXIMATE MAXIMUM INTENSITY	MODIFIED MERCALLI SCALE
I	Not felt. Marginal and long period effects of large earthquakes.
II	Felt by persons at rest, on upper floors, or favourably placed.
III	Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognised as an earthquake.
Minor VI	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickbacks, books, etc., off shelves. Pictures off walls. Weak plaster and Masonry D cracked.
Damaging VII	Difficult to stand. Noticed by drivers of motorcars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks, fall of plaster, loose bricks, stones, tiles. Some cracks in masonry C. Small slides and caving in along sand or gravel banks. Concrete irrigation ditches damaged.
Destructive	General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. Frame structures, if not bolted, shifted off foundations. Underground pipes broken. Conspicuous cracks on ground.
X	Most masonry and frame structures destroyed with their foundations. Some well built wooden structures and bridges destroyed. Large landslides. Water thrown on banks of canals, rivers, lakes, etc.
Major XII	Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.
Great	

SAFFIR/SIMPSON SCALE (with wind speeds)

FIGURE 3b

Hurricane	mph Basic Wind Speed (1-minute avrg)	Damage
Category 1	74-95	Minimal
Category 2	96-110	Moderate
Category 3	111-130	Extensive
Category 4	131-155	Extreme
Category 5	>155	Catastrophic

APPENDIX 1



WOOD RAFTER ANCHORING PRACTICE
NO LONGER RECOMMENDED DUE TO BAD EXPERIENCE
(WITH RAFTER SPLITTING UNDER HURRICANE WINDS)

APPENDIX II

List of Facilities Surveyed

APPENDIX II

LIST OF FACILITIES SURVEYED

**O A S STRUCTURAL VULNERABILITY ASSESSMENT
ST KITTS ISLAND**

FACILITY		LOCATION			MINISTRY	REMARKS
NUMBER	NAME	TOWN OR VILLAGE	COORDINATES			
			LATITUDE 'N'	LONGITUDE 'W'		
1	Police Station	Basseterre, Central	17°-17'-45"	62°-43'-30"	National Security	
2	Police Station	St. Johnston Village, Basseterre, West	17°-17'-45"	62°-44'-15"		
3	Police Station	Old Road	17°-19'-15"	62°-48'-15"		
4	Police Station	Sandy Point	RENTED PROPERTY			
5	Police Station	St Pauls	17°-24'-15"	62°-50'-30"	National Security	
6	Police Station	Dieppe Bay	ABANDONED			
7	Police Station	Tabernacle	17°-23'-45"	62°-46'-30"	National Security	
7B						
8	Police Station	Cayon	17°-21'-15"	62°-44'-00"		
9	Police Station	Stapleton	17°-19'-30"	62°-43'-45"		
10	Police Station	Frigate Bay	RENTED PROPERTY			
11	Police Training Complex	Basseterre, East	17°-17'-45"	62°-43'-30"	National Security	
11B						
11C						
11D						
12	Fire Station	Basseterre	17°-17'-45"	62°-43'-30"		
13	Arrivals Hall	Port Zante	PRIVATELY OWNED			
14	Administration Building	Port Basseterre	17°-17'-15"	62°-42'-30"		
15	Operations Building	Port Basseterre	17°-17'-15"	62°-42'-30"		
15B						
16	Transit Shed	Port Basseterre	17°-17'-15"	62°-42'-30"		
17	Fire Hall	RLB Int'l Airport	17°-18'-45"	62°-43'-15"		
17B						
18	Customs Shed	RLB Int'l Airport	17°-18'-30"	62°-42'-45"	Finance	
19	Main Building Pogson Hospital	Sandy Point	TO BE RECONSTRUCTED			
20	Main Building Mary Charles Hospital	Molineux	17°-22'-00"	62°-45'-30"	Health	
21	Cardin Home	Basseterre				
21B						
21C						
21D						
22	Coast Guard Station	Bird Rock	17°-17'-15"	62°-42'-30"	Finance	
23	Customs Building, (Administration)	Bird Rock	17°-17'-15"	62°-42'-30"		
24	Customs Warehouse	Bird Rock	17°-17'-15"	62°-42'-30"		
25	Customs Headquarters	Bay Road	17°-17'-30"	62°-43'-30"		
26	Health Centre	Basseterre	17°-17'-30"	62°-44'-00"	Health	
27	Health Centre	Cayon	17°-21'-15"	62°-44'-15"		
28	Health Centre	Molineux	17°-22'-00"	62°-45'-30"		
29	Health Centre	Tabernacle	17°-23'-15"	62°-46'-30"		
30	Health Centre	Saddlers	17°-24'-30"	62°-48'-00"		
31	Health Centre	Dieppe Bay	17°-24'-45"	62°-48'-30"		
32	Health Centre	St Pauls	17°-24'-15"	62°-50'-30"		
33	Health Centre	Sandy Point	17°-21'-30"	62°-51'-00"		
34	Health Centre	Old Road	17°-19'-15"	62°-48'-15"		
35	Health Centre	Ponds Pasture	17°-17'-30"	62°-43'-00"		
36	Post Office	Basseterre	17°-17'-30"	62°-43'-30"	CWPUP	
37	Post Office	Cayon	RENTED PROPERTY			
38	Post Office	Sandy Point	RENTED PROPERTY			
39	Power Station B	Needsmust	17°-18'-30"	62°-42'-45"	CWPUP	
40	Courthouse	Basseterre	17°-17'-45"	62°-43'-15"	Legal Affairs	
41	Gov't Headquarters	Basseterre	17°-17'-45"	62°-43'-30"	Foreign & Home Affairs	
42	Public Market	Bay Road	17°-17'-30"	62°-43'-45"	Agriculture	
43	Radio & TV Studios	Basseterre	17°-18'-00"	62°-44'-00"	Prime Minister	
43B						
44	Defence Force Headquarters	Basseterre	17°-18'-00"	62°-44'-00"	National Security	
44B						
44C						
44D						
44E						
45	Treasury Building	Basseterre	17°-17'-30"	62°-43'-30"		
46	Finance Department	Basseterre	17°-17'-45"	62°-43'-45"	Finance	

APPENDIX II**LIST OF FACILITIES SURVEYED****O A S STRUCTURAL VULNERABILITY ASSESSMENT
ST KITTS ISLAND**

FACILITY		LOCATION			MINISTRY	REMARKS
NUMBER	NAME	TOWN OR VILLAGE	COORDINATES			
			LATITUDE 'N'	LONGITUDE 'W'		
47	Public Works Department	Basseterre	17°-18'-00"	62°-43'-15"	CWPUP	
48	Electricity Department Headquarters	Basseterre	17°-17'-45"	62°-43'-45"		
49	Electricity Billing Department	Basseterre	17°-17'-45"	62°-43'-45"	Communications, Works & Public Utilities	
50	Planning, Trading & Industry	Basseterre	17°-17'-45"	62°-43'-30"	Trade Industry & CARICOM Affairs	
51	Newstead Building	Basseterre	17°-17'-45"	62°-43'-30"	Foreign & Home Affairs	
52	O A S Building	Fortlands	17°-17'-30"	62°-44'-00"		
53	Tourism Centre	Basseterre	17°-17'-30"	62°-43'-30"	Tourism & Environment	
54	Central Marketing Corporation	Basseterre	17°-17'-45"	62°-43'-30"		
55	Ministry of Women's Affairs	Basseterre	17°-17'-45"	62°-43'-30"	Health & Women's Affairs	

APPENDIX II

LIST OF FACILITIES SURVEYED

O A S STRUCTURAL VULNERABILITY ASSESSMENT

NEVIS ISLAND

FACILITY		LOCATION			MINISTRY	REMARKS
NUMBER	NAME	TOWN OR VILLAGE	COORDINATES			
			LATITUDE 'N'	LONGITUDE 'W'		
56	Police Station	Charlestown	17°-08'-15"	62°-37'-45"	Premier	
56B						
57	Police Station	Cotton ground	17°-10'-15"	62°-37'-15"		
58	Police Station	Gingerland	17°-08'-05"	62°-34'-15"		
59	Police Station	New Castle	17°-12'-10"	62°-35'-00"		
60	Alexandra Hospital Main Building	Charlestown	17°-08'-15"	62°-37'-15"		
61	Maternity Block	Charlestown	17°-08'-15"	62°-37'-15"		
62	Operating Theatre	Charlestown	NO ACCESS			
63	Paediatric Ward	Charlestown	17°-08'-15"	62°-37'-15"		
64	Eye Clinic	Charlestown	17°-08'-15"	62°-37'-15"		
65	Health Centre	Charlestown	17°-08'-15"	62°-37'-45"		
66	Health Centre	Brown Hill	17°-07'-15"	62°-36'-00"		
67	Health Centre	Butlers	17°-10'-15"	62°-33'-00"		
68	Health Centre	Combermere	17°-11'-30"	62°-34'-45"		
69	Health Centre	Gingerland	17°-08'-00"	62°-34'-30"		
70	Primary School	Gingerland	17°-08'-00"	62°-34'-15"		
71	Primary School	St James	17°-10'-30"	62°-33'-15"	Premier	
72	Primary School	Charlestown	17°-08'-30"	62°-37'-45"		
72B						
72C						
73	Primary School	St Thomas (Lowlands)	17°-10'-00"	62°-37'-30"		
74	Primary School	Prospect	17°-07'-30"	62°-36'-20"		
75	Primary School	St John's	17°-07'-45"	62°-35'-30"		
76	Fire Hall	New Castle Airport	17°-12'-15"	62°-35'-30"		
77	Fire Station	Charlestown				
78	Courthouse/Library	Charlestown	17°-08'-15"	62°-37'-45"		
79	Public Market	Charlestown	17°-08'-15"	62°-37'-45"	ALLH&T	
80	Administration Building	Charlestown	17°-08'-15"	62°-37'-45"	Premier	
81	Power House	Prospect	17°-07'-30"	62°-36'-40"	CWPUP	
81B						
82	New Castle Pottery	New Castle	17°-12'-00"	62°-34'-45"		
83	Office & Store Room	Prospect	17°-07'-30"	62°-36'-30"	ALLH&T	
84	Department of Agriculture	Prospect	17°-07'-30"	62°-36'-45"		
85	Public Works Department	Charlestown	17°-08'-15"	62°-37'-45"	CWPUP	
85B						
85C						
86	Ministry of Communications	Stoney Grove	17°-07'-45"	62°-37'-00"		
87	Post Office	Charlestown	17°-08'-15"	62°-37'-45"		
88	Infirmary	Charlestown	17°-08'-15"	62°-37'-30"	Premier	
89	Treasury Building	Charlestown	TO BE RENOVATED			
90	Cotton House	Charlestown	17°-08'-15"	62°-37'-45"		
91	CMC Building	Charlestown	17°-08'-15"	62°-37'-45"	Premier	
92	Pump House	Fothergills	17°-08'-30"	62°-33'-45"	CWPUP	
93	Pump House	Stoney Grove	ABANDONED			
94	Repair Shop & Garage	Cades Bay	ABANDONED			
94B						
95	Government Repair Shop	Prospect	17°-07'-30"	62°-36'-45"	Premier	
96	Married Quarters	Belle Vue	TO BE DEMOLISHED			
97	Nurses Quarters	Brown Hill	NO ACCESS			
98	Nurses Quarters	Combermere	17°-11'-30"	62°-34'-45"	Premier	
99	Nurses Quarters	Gingerland	ABANDONED			
100	Nurses Home	Charlestown	17°-08'-15"	62°-37'-15"	Premier	
101	Veterinary Clinic	Prospect	17°-07'-30"	62°-36'-45"	ALLH&T	
102	Doctor's Residence	Charlestown	17°-08'-15"	62°-37'-30"	Premier	
103	Doctor's Residence	Gingerland	ABANDONED			
104	Day Care Centre	Hardtimes	17°-08'-00"	62°-34'-15"		
105	Living Quarters (Officers)	Butlers	17°-10'-15"	62°-34'-00"		
106	Kitchen & Dining Area etc.	Butlers	17°-10'-15"	62°-34'-00"	Premier	
107	Health Centre	Cotton ground	17°-10'-15"	62°-37'-15"		

APPENDIX III

Summary of Relative Vulnerability to Earthquake and to Hurricane

FACILITY WIND AND SEISMIC VULNERABILITY ASSESSMENT

Facility	Facility No.	No. of stories	Total floor area (ft2)	Structure classification	Roof covering	Year built	Relative Vulnerability	
							Wind	Earthquake
Police Station	1	3	28,885	RC	O	1952	L	L
Police Station	2	2	3400	LS	MPS	1972	M	M
Police Station	3	2	3818	RC	MPS	1968	L	L
Police Station	4	RENTED PROPERTY						
Police Station	5	2	3472	LS	MPS	1971	M	M
Police Station	6	ABANDONED						
Police Station	7	1	870	URM	MPS	1950	H	L
	7b	1	1150	LS	MPS	1975	M	H
Police Station	8	2	3400	LS	MPS	1972	L	M
Police Station	9	1	2197	RM	MPS	1973-1983	L	M
Police Station	10	RENTED PROPERTY						
Police Training Complex	11	1	1150	LS	MPS	1972	H	H
	11b	2	5252	LS	MPS	1972	H	H
	11c	1	3161	LS	MPS	1972	H	H
	11d	1	1150	LS	MPS	1972	H	H
Fire Station	12	2	7120	RC	MPS	1968	M	M
Arrivals Hall	13	PRIVATELY OWNED						
Administration Bldg	14	2	5658	RC	AS	1991	H	M
Operations Building	15	1	5016	RM	MPS	1982	M	H
	15b	1	1800	RC	AS	1993	H	M

B

FACILITY WIND AND SEISMIC VULNERABILITY ASSESSMENT

Facility	Facility No.	No. of stories	Total floor area	Structure classification	Roof covering	Year built	Relative Vulnerability	
							Wind	Earthquake
Transit Shed	16	1	16,250	LS	MPS	1986	L	L
Fire Hall	17	1	3788	RC	MPS	1974	L	L
	17b	2	2317	RC	AS	1974	H	L
Customs Shed	18	2	6204	LS	MPS	1974	H	H
Main Building Pogson Hospital	19	TO BE RECONSTRUCTED						
Main Building Mary Charles Hospital	20	1	5559	RM	MPS	1986	M	L
Cardin Home	21	1	2592	RM	MPS	Before 1973	L	L
	21b	1	5178	RM	MPS	Before 1973	L	M
Administration Bldg	22	2	4200	LS	MPS	1987	L	L
Customs Building (Administration)	23	1	12,586	LS	MPS	1977	M	H
Customs Warehouse	24	1	14,070	LS	MPS	1973	H	H
Inland Revenue Dep't	25	SEE FACILITY NO. 36						
Health Centre	26	2	5715	RC	O	1949	L	M
Health Centre	27	1	2499	RM	MPS	2000	L	L
Health Centre	28	1	1038	RM	AS	1952	H	M
Health Centre	29	1	895	RM	MPS	Before 1973	L	M
Health Centre	30	1	1680	RM	AS	1954	H	H
Health Centre	31	1	1159	RM	AS	1973-1983	H	M
Health Centre	32	1	855	RM	MPS	1973-1983	M	L
Health Centre	33	1	1001	RM	MPS	1955	L	L

FACILITY WIND AND SEISMIC VULNERABILITY ASSESSMENT

Facility	Facility No.	No. of stories	Total floor area	Structure classification	Roof covering	Year built	Relative Vulnerability	
							Wind	Earthquake
Health Centre	34	1	860	RM	MPS	1973-1983	M	L
Health Centre	35	1	3400	RC	MPS	1975	H	M
Post Office	36	2	15,871	RC	MPS	1960	L	M
Post Office	37							
Post Office	38							
Power Station B	39	1	22,200	LS	MPS	1972	L	M
Court House	40	2	11,552	RC	MPS	1995	L	L
Gov't Headquarters	41	3	20,310	RC	O	1963/1995	L	L
Public Market	42	1	8340	LS	O	1978	M	H
	43	1	2692	RC	MPS	1958	M	M
Radio & TV Studios	43b	1	4220	RC	MPS	1972	L	L - M
	44	2	6944	RM	AS	1985	H	L
	44b	1	2727	RM	AS	1985	H	L
Defence Force Headquarters	44c	2	4630	RM	MPS	1999	L	L - M
	44d	1	2536	RC	MPS	1969	L	L
	44e	1	2160	RC	MPS	1969	L	L
Treasury Building	45	2	9418	URM	MPS	Before 1973	L	L - M
Finance Department	46	3	9936	RC	MPS/BUG	1973	M	L
Public Works Dep't	47	2	3400	RC	O	1952	L	L
Electricity Dep't Headquarters	48	1	1675	URM	MPS	Before 1973	L	L

FACILITY WIND AND SEISMIC VULNERABILITY ASSESSMENT

Facility	Facility No.	No. of stories	Total floor area	Structure classification	Roof covering	Year built	Relative Vulnerability		
							Wind	Earthquake	
Electricity Billing Department	49	2	9640	RC	O	1973-1983	M	L	
Planning, Trading & Industry	50	3	8556	RC	MPS	1950's	L	L	
Newstead Building	51	3	12,676	RC	O	1996	L	L	
O A S Building	52	1	1966	T	MPS	Before 1973	L	L	
Tourism Centre	53	2	17,402	LS	MPS	DK	L	L	
Central Marketing Corporation	54	1	7575	LS	MPS	1974/1975	M	M	
Ministry of Women's Affairs	55	2	4227	URM	MPS	Before 1973	L	L	
Police Station	56	2	4736	RC	O	1998	L	L	
Police Station	56b	2	4096	URM	MPS	1800's/ 1950's	L	L	
Police Station	57	1	1268	URM	MPS	1950's	M	M	
Police Station	58	1	1512	URM	MPS	1953	L	M	
Police Station	59	2	3472	LS	MPS	1973	H	M	
Alexandra Hospital Main Building	60	2	19,474	RC	MPS/ACS	1951	L	L	
Maternity Block	61	2	6920	RC	MPS	Before 1973	M	M	
Operating Theatre	62	NO ACCESS							
Paediatric Ward	63	1	972	RM	MPS	1996	L	L	
Eye Clinic	64	2	3540	RM	AS	1998	H	L	
Health Centre	65	1	2760	RC	MPS	1940's	L	M	
Health Centre	66	1	1286	RM	MPS	1950/1997	M	L	
Health Centre	67	1	945	URM	MPS	1950's	L	L	

FACILITY WIND AND SEISMIC VULNERABILITY ASSESSMENT

Facility	Facility No.	No. of stories	Total floor area	Structure classification	Roof covering	Year built	Relative Vulnerability	
							Wind	Earthquake
Health Centre	68	1	1369	RM	MPS	DK	L	L
Health Centre	69	1	1468	URM	MPS	1944/1997	L	L
Primary School	70	2	13,080	RC	MPS	1978	H	M
Primary School	71	1	7659	RC	MPS	1979	M	M
Primary School	72	2	6758	RC	MPS	1990	L	L
	72b	1	1950	RC	MPS	1990	L	L
	72c	1	3379	RC	MPS	1990	L	L
Primary School	73	1	10,846	LS	MPS	1970	H	L
Primary School	74	1	9603	LS	MPS	1965	M	H
Primary School	75	2	2530	RM	MPS	+1988	L	M
Fire Hall	76	1	2244	RC	MPS	1985-1988	L	L
	76b	1	855	RM	O	2001	L	L
Fire Station	77	2	1936	RM	MPS	1996	M	L
Court House/Library	78	2	5362	URM	MPS	1877	L	L
Public Market	79	1	3775	RC	MPS/ACS	1940	L	M
Administration Bldg	80	2	1848	RM	MPS	1982	L	L
Power House (2 Buildings)	81	1	5500	HS	MPS	1984	M	L
	81b	1	1200	RM	MPS	1973-1983	M	M
New Castle Pottery	82	1	1316	RM	MPS	1973-1983	H	H
Office & Store Room	83	1	1260	RM	MPS	1973-1983	M	L

22

FACILITY WIND AND SEISMIC VULNERABILITY ASSESSMENT

Facility	Facility No.	No. of stories	Total floor area	Structure classification	Roof covering	Year built	Relative Vulnerability	
							Wind	Earthquake
Dep't of Agriculture	84	2	4708	LS	MPS	2000	L	H
Public Works Dep't	85	1	840	T	MPS	1991/1992	M	L
	85b	1	608	URM	MPS	1800's	H	L
	85c	2	2592	URM	MPS/O	1800's/ 1984/1997	L	L
Ministry of Communications	86	2	9600	RC	MPS	1994	L	M
Post Office	87	2	1989	URM	MPS	Before 1973	L	M
Infirmery	88	1	3626	URM	MPS	Before 1973	L	M
Treasury Building	89	TO BE RENOVATED						
Cotton House	90	1	9715	URM	MPS	DK	L	M
CMC Building	91	2	2068	RC	MPS	DK	L	L
Pump House	92	1	1196	RM	O	1973-1983	L	H
Pump House	93	ABANDONED						
Repair Shop & Garage	94	ABANDONED						
	94b	ABANDONED						
Government Repair Shop	95	1	2900	URM	MPS	1943	M	L
Married Quarters	96	TO BE DEMOLISHED						
Nurses Quarters	97	NO ACCESS						
Nurses Quarters	98	2	704	RM	MPS	Before 1973	M	L
Nurses Quarters	99	ABANDONED						
Nurses Home	100	1	1812	RM	ACS	Before 1973	H	H

FACILITY WIND AND SEISMIC VULNERABILITY ASSESSMENT

Facility	Facility No.	No. of stories	Total floor area	Structure classification	Roof covering	Year built	Relative Vulnerability	
							Wind	Earthquake
Veterinary Clinic	101	1	598	RM	MPS	1973-1983	M	M
Doctor's Residence	102	1	2508	URM	MPS	Before 1973	M	M
Doctor's Residence Main Building	103	ABANDONED						
Day Care Centre	104	1	1650	RM	MPS	After 1983	M	L
Living Quarters (Officers)	105	1	2120	URM	MPS	Before 1973	L	M
Kitchen & Dining Area etc.	106 a	1	1080	URM	MPS	DK	L	M
Health Centre	107	1	871	URM	MPS	Before 1973	L	M

+upper level rebuilt

APPENDIX IV
Recommended Retrofit Action

Facility No. 1

BASSETERRE POLICE STATION

Vulnerability

The vulnerability assessment indicates low vulnerability to both wind and earthquake.

Description

This is a three-storey building constructed of reinforced concrete frame with walls of unreinforced stone masonry and reinforced concrete block. The roof is a flat concrete slab. The windows have no shutters.

Siting

The building is sited on gently sloping ground. It is not subject to flooding. There is no risk of landslide.

Condition

The building is in good condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

Estimated Cost

Storm shutters	\$202,000
Total:	<u>\$202,000</u>

Facility No. 2

ST JOHNSTON VILLAGE POLICE STATION

An Essential Facility

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a two-storey, pre-engineered, steel-framed building with reinforced concrete block walls. The roof is a low-pitched gable which is clad with corrugated metal sheets. Roof overhangs are short.

At the upper level there is a small verandah. The main roof is continuous over the verandah.

The windows do not have protective shutters.

Siting

The building is located on gently sloping ground which is not subject to flooding. There is no landslide risk.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

The roof sheets are more than twenty years old. They should be inspected closely to determine whether all or some of them should be replaced at this time.

In any event roof sheet fastener spacing should be reduced in the area over the verandah.

Estimated Cost

Storm shutters	\$24,000
Additional roof sheeting fasteners	\$5,000
Total:	<u>\$29,000</u>

Facility No. 3

OLD ROAD POLICE STATION

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to hurricane and low vulnerability to earthquake.

Description

This is a two-storey reinforced concrete and concrete block building. The roof profile is a mono-slope of low pitch. Roof overhangs are short and soffited. The roof is framed in wood and clad with corrugated metal sheets. There is a small, roofed verandah which is formed by extension of the main roof. This verandah carries a soffit. There are no protecting window shutters. The garage does not have a door.

Siting

The building is located on gently sloping ground. It is not subject to flooding. It is set back somewhat from the coast but at an elevation of 40 feet above sea level it is not subject to storm surges. There is no landslide risk.

Condition

The building is in good condition.

Retrofit Recommendations

Storm shutters should be fitted over the windows.

The roof sheeting is said to be over 20 years old. Although no leaks were observed it should be inspected in detail to verify integrity of sheeting and fasteners.

Estimated Cost

Storm shutters	\$27,000
Total:	<u>\$27,000</u>

Facility No. 5

ST PAULS POLICE STATION
An Essential Facility

Vulnerability

The vulnerability assessment indicates moderate vulnerability to hurricane and to earthquake.

Description

This is a two-storey, pre-engineered steel-framed building with reinforced concrete walls. Some of the ground floor interior walls are 4 inches thick. The roof is clad with corrugated metal sheets. There is an open, roofed verandah on the upper floor which is formed by an extension of the main roof. This carries a plywood soffit. The windows are not shuttered.

Siting

The building is located at the top of an embankment near to a ghaut. Although there is no risk of flooding it is felt that there is a risk that the building could be damaged by landslide.

Condition

The building is in fair condition. Some of the structural steel components, particularly on the northern side, are beginning to show signs of corrosion.

Retrofit Recommendations

Exposed steel which is deteriorating should be scraped and wire brushed then given 1 coat of rust-inhibiting primer and 2 coats of enamel paint.

The plywood soffit should be checked for integrity and repaired where necessary. Additional roof sheet screws should be inserted at roof overhangs, eaves, ridge and gable end.

Storm shutters should be fitted over the windows.

Resistance to earthquake could be improved by replacing at least two of the 4-inch block walls on the ground floor with 6-inch reinforced block walls. It should be verified that the remaining 4-inch walls are reinforced vertically at intervals not greater than 32 inches. They should be braced at the top.

Estimated Cost

Storm shutters	\$24,000
Additional roof sheet fasteners	\$5,000
Wire-brush and paint steel members	\$7,000
Replace two of the 4" block walls on ground floor with 6" reinforced block walls	\$5,000
Total:	<u>\$41,000</u>

TABERNACLE POLICE STATION

An Essential Facility

There are two buildings on this compound, the Charge Room #7 and the Barracks (#7b).

Vulnerability

The vulnerability assessment indicates the Charge Room #7 has moderate vulnerability to earthquake and moderate vulnerability to hurricane winds. The Barracks (#7b) has vulnerability to earthquake and high vulnerability to hurricane.

Description

Charge Room: This is a small reinforced masonry building with light timber-framed, hip roof. It is clad with corrugated metal sheets.

The windows are shuttered. The rafters are toe-nailed to the wall plate.

Barracks: This is a light, pre-fabricated, steel-framed, single storey building. Exterior walls are made up of steel-edged cement fibreboard panels. The corrugated metal-sheeted roof is supported on steel purlins which frame into steel trusses, which are in turn supported on steel columns.

Siting

Both buildings are sited on gently sloping ground. The site is not prone to flooding. There is no risk of landslide.

Condition

Charge Room: This building is in fair condition.

A section of roof sheeting and the boarding underneath need to be replaced. Several of the window shutters are missing the hooks for securing the windows in the closed position.

Barracks: This building is in poor condition.

The roof sheeting and the steel roof-framing members are in good condition, except for the eave purlins which are so badly corroded that they have no structural integrity. The steel edges to the wall panels on the north or "weather side" of the building are also badly corroded. Where the roof extends over the porch, the roof sheeting is particularly vulnerable to hurricane winds because the ceiling panels were blown out some time ago and have been replaced. The windows are shuttered.

Retrofit Recommendations

Charge Room: Standard hurricane clips should be installed to provide positive tie-down of the rafters. Substandard roof sheeting and roof boarding should be replaced and missing window hooks should be replaced.

Barracks: This building requires major refurbishment. It is recommended that the exterior walls be demolished leaving the steel frames in place. These frames should be wire-brushed and painted, new eave purlins should be installed and then the exterior walls should be rebuilt in reinforced concrete blockwork. New ceilings should be installed as well as permanently hung shutters.

Estimated Cost

7a	
Hurricane clips	\$2,000
Re-sheet existing roof	\$17,000
Replace close boarding	\$9,000
7b	
Demolish exterior walls	\$6,000
Storm shutters	\$8,000
New purlins	\$3,000
Re-sheet existing roof	\$23,000
Wire-brush and paint steel members	\$3,000
construct new exterior walls (reinforced concrete blockwork)	\$26,000
Install new ceilings	\$12,000
Total:	<u>\$109,000</u>

Facility No. 8

CAYON VILLAGE POLICE STATION

An Essential Facility

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a two-storey, pre-engineered, steel-framed building with reinforced concrete walls. The roof is a low-pitched gable which is clad with corrugated metal sheets. Roof overhangs are short.

At the upper level there is a small verandah. The main roof is continuous over the verandah.

The windows have protective shutters.

Siting

The building is located on gently sloping ground which is not subject to flooding. There is no landslide risk.

Condition

The building is in fair condition.

Retrofit Recommendations

The roof sheets are more than twenty years old and some leaks are reported. They should be inspected closely to determine whether all or some of them should be replaced at this time.

In any event roof sheet fastener spacing should be reduced in the area over the verandah.

Estimated Cost

Additional roof sheet fasteners	\$5,000
Total:	<u>\$5,000</u>

Facility No. 9

STAPLETON POLICE STATION

An Essential Facility

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a single storey, reinforced concrete block building. The roof is a well-pitched gable which is clad with corrugated metal sheets. Roof overhangs are short. There is a porch at the front of the building. The roof of the porch is separated from the main roof.

The windows are not shuttered.

Siting

The building is located on sloping ground. It is not subject to flooding. There is no landslide risk.

Condition

The building is in good condition.

Retrofit Recommendations

Storm shutters should be fitted as protection for the windows.

Additional roof sheet fasteners should be installed in the area above the porch and at eave, ridge and gable ends.

Estimated Cost

Storm shutters	\$15,000
Additional roof sheet fasteners	\$6,000
Total:	<u>\$21,000</u>

POLICE TRAINING COMPLEX

An Essential Facility

Vulnerability

The vulnerability assessment indicates high vulnerability to hurricane.

Description

There are four prefabricated buildings on this compound. One of them is a two-storey building. The others are one-storey structures. The structural system comprises light steel roof trusses rigidly connected to steel columns. Steel purlins span between trusses and support corrugated metal roof sheets. The walls are two to three inches thick cement fiberboard panels edged with steel. The exception is ground floor walls of the two-storey building which are 6 inches thick concrete block construction. Windows are unshuttered.

Siting

The buildings are located on flat land which is subject to flooding during heavy rain and is also at risk from storm surge although a recently constructed sea wall does offer some protection. There is no land slide risk.

Condition

The buildings are in poor condition. All of the steel frame members which are exposed to the elements are in urgent need of attention. Some of them, the light gauge purlins, are so badly corroded that they have no remaining structural integrity. They cannot be relied upon to hold the roof sheets in high winds.

The buildings have ceilings which conceal the purlins above. The condition of these members could not generally be determined readily but in at least one location where there are missing ceiling panels there is an interior purlin which has been destroyed by corrosion. The exterior wall panels are deteriorating. Roof sheets are in better condition for the most part.

Retrofit Recommendation

It is recommended that all of the exterior wall panels be removed and discarded. Roof sheets should be removed and all of the purlins should be replaced with Galvanized steel purlins. The exterior walls should then be replaced with reinforced concrete blockwork which should be anchored to the columns. Exposed heavier gauge steel members should be thoroughly wire-brushed and painted with one coat of rust-inhibiting primer and two coats of enamel.

Storm shutters should be installed.

Since the existing roof sheets are more than twenty years old it is recommended that the roof be re-sheeted.

Storm shutters should be installed.

Estimated Cost

Storm shutters	\$65,000
New purlins	\$20,000
Re-sheet existing roof	\$87,000
Wire brush and paint steel members	\$22,000
Construct new exterior walls (reinforced concrete blockwork)	\$151,000
Walls to be demolished	\$32,000
Total:	<u>\$377,000</u>

BASSETERRE FIRE STATION

An Essential Facility

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a 2-story reinforced concrete framed structure with concrete block walls. The roof is sheeted with corrugated metal panels supported on wood trusses. It is protected by a parapet. The upper floor, which accommodates the firemen's quarters, comprises long exterior walls with very few bracing cross walls. The walls are braced instead by reinforced concrete frames spanning across the hall. This system provides adequate transverse lateral stability at this level.

Below this floor, the structure is mostly open-sided and is supported on reinforced concrete columns which resist lateral loads by portal frame action in combination with the floor beams to which they are rigidly connected. This configuration creates a situation where the upper storey is much stiffer in at least one direction than the lower storey.

All other things being equal, this type of structure does not perform as well as the more conventional structures in response to earthquake shaking.

There is no provision for windows to be protected by shutters, whether permanently hung or otherwise.

Siting

The Fire Station is located on flat land near the coast. The site is subject to flooding due to heavy rains. It is subject to storm surge though it is partially protected by a seawall.

Condition

The building is in fair condition

Retrofit Recommendation

To reduce the seismic vulnerability of this building the preferred solution is to construct two reinforced concrete bracing walls between some of the ground floor columns-one per long side.

Permanently hung shutters would need to be installed on the building.

Estimated Cost

Storm shutters	\$50,000
Construct reinforced concrete bracing walls	\$15,000
Total:	<u>\$65,000</u>

Facility No. 14

ADMINISTRATION BUILDING PORT BASSETERRE

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and high vulnerability to hurricane.

Description

This is a two-storey, reinforced concrete structure with reinforced concrete block walls. The roof is a hip framed with light wood rafters and clad with asphalt shingles.

There is a verandah on one side of the building. The main roof extends over the verandah. The windows are not protected by shutters. The rafters are anchored to the wall with a detail which is no longer recommended. See Appendix I.

Siting

The building is located on a small promontory. There is no risk of flooding but there is a risk of landslide.

Condition

The building is in good condition.

Retrofit Recommendations

Shingles on the roof are ordinary shingles which are not rated for hurricane wind resistance.

It is recommended that corrugated metal sheets be installed on wood purlins over the existing shingles.

Saddle type, rafter-to-wall hurricane straps should be installed on each rafter to secure it to the ringbeam.

Storm shutters should be installed to protect the windows.

Estimated Cost

Storm shutters	\$40,000
New metal sheeting over existing asphalt shingles	\$55,000
Saddle-type hurricane straps	\$3,000
Total:	<u>\$98,000</u>

Facility No. 15

OPERATIONS BUILDING PORT BASSETERRE

Vulnerability

The vulnerability assessment indicates high vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a single storey, reinforced masonry building. The roof profile is a hip of low pitch and it is clad with corrugated metal sheets. The roof overhangs a generous corridor which wraps around all four sides of the building. The corridor roof has a soffit.

The windows are not protected by shutters.

Siting

The building is located on flat ground at the toe of an earthen embankment. An open storm water drain runs between the building and the embankment. In a severe rainfall event considerable amounts of silt-laden water will flow over the top of the embankment and eventually fill the drain with sand. The building would then be subject to flooding. There is also a risk of landslide of the embankment material. The building is not likely to be affected by storm surge.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

Additional roof sheet fasteners should be inserted in the area above the corridors and at the ridge.

The ratio of wall opening area to wall area for this building is high. This accounts for the indication of high vulnerability to earthquake. No drawings were available to study. It is likely that there are several reinforced concrete columns or "wall stiffeners", as they are popularly called, built into the wall and these would have the effect of increasing the earthquake resistance of the building.

It is recommended that some effort be made to locate the drawings so that this detail could be verified.

Failing this, selected block wall panels between windows should be replaced with reinforced concrete to provide the increased lateral force resistance.

Estimated Cost

Storm shutters	\$35,000
Additional roof sheet fasteners	\$14,000
Total:	<u>\$49,000</u>

Facility No. 15B

SECURITY BUILDING PORT BASSETERRE

Vulnerability

The vulnerability assessment indicates high vulnerability to earthquake and high vulnerability to hurricane.

Description

This is a two-storey, reinforced concrete building. The lower storey has continuous vent blocks at the top of reinforced concrete block walls. The upper storey is clad with reinforced concrete block work.

There is a light, wood-framed gable roof which is clad with corrugated metal sheets.

There is an open, roofed corridor on one side.

The windows are not protected by shutters. The rafters are anchored to the walls by a detail which is no longer recommended. See Appendix I

Siting

The building is situated on flat land at the toe of an earthen embankment. There is a risk of damage to the building due to landslide. There is no flooding risk and no storm surge risk.

Condition

The building is in good condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

A Saddle-type rafter-to-wall hurricane strap should be installed at each rafter.

Additional roof sheet fasteners should be installed in the corridor area and at eave, ridge and gable end.

Resistance to earthquake could be improved by replacing the lower floor vent block with regular reinforced concrete blockwork.

Estimated Cost

Storm shutters	\$13,000
Saddle-type hurricane straps	\$2,000
Additional roof sheet fasteners	\$5,000
Replace lower floor vent block with reinforced concrete blockwork	\$2,000
Total:	\$22,000

TRANSIT SHED PORT BASSETERRE

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a high-bay, pre-engineered, steel-framed building with reinforced concrete block walls.

The roof profile is twin gables on a good pitch. They are clad with corrugated metal sheets.

There are generous roof overhangs at the eaves and there are ridge ventilators on each roof. There are few windows but there are four large roll-up doors.

Siting

The building is sited on the wharf. It is subject to storm surge. There is no land slide risk.

Condition

The building is in fair condition.

Exposed steel members are under constant corrosion attack and regular maintenance is necessary if this condition is to be held in check. It is observed that several of the original steel members have been replaced with make-shift timber members – obviously because the steel has been lost to corrosion.

Retrofit Recommendations

Additional roof sheet fasteners should be installed at roof overhangs, ridge and gable ends.

Ventilator attachments should be checked to be certain that they are secure.

The large doors should be fitted with auxiliary braces which could be put in place temporarily when the building is being battened down in preparation for hurricane force winds.

The original steel roof members should be replaced.

Estimated Cost

Additional roof sheet fasteners	\$45,000
Fit large doors with auxiliary braces	\$2,000
Replace original steel roof	\$10,000
Total:	<u>\$57,000</u>

Facility No. 17

FIREHALL, RLB AIRPORT

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to hurricane and to earthquake.

Description

This is a reinforced concrete building with concrete block walls. Roof beams are of structural steel and roof cladding is corrugated metal sheets. There is a parapet on 3 sides.

There are no windows. There are 3 large fire engine doors ways but there are no doors.

Siting

The building is situated on gently sloping land. It is not subject to flooding.

There is no landslide risk.

Condition

The building is in excellent condition.

Retrofit Recommendations

Consideration should be given to providing roll-up doors for the garages. These would protect both the roof from higher pressures and the engine from flying debris.

Such doors should be provided with temporary steel braces to reinforce them during the passage of a hurricane.

Estimated Cost

Roll-up doors:	\$36,000
Provide steel braces for doors:	\$2,000
Total:	<u>\$38,000</u>

Facility No. 17 B

FIREHALL BARRACKS – RLB AIRPORT

An Essential Facility

Vulnerability

The vulnerability assessment indicates high vulnerability to hurricane.

Description

This is a two-storey concrete block structure with a light, timber-framed roof which is clad with asphalt shingles. These are ordinary, light shingles which are not rated for resistance to uplift in high wind situations. In a hurricane, the shingles will likely be blown off.

The timber rafters are held down on the concrete ring beam by a steel rod which is threaded through the rafter and anchored in the ring beam. This method of anchoring the rafter is no longer recommended. See Appendix I.

There are no window shutters.

Retrofit Recommendation

It is recommended that corrugated metal sheeting be installed on 2 x 4 wood purlins over the existing shingles.

Other retrofit needs include:

1. installing hurricane clip which will tie the rafter to the face of the concrete ring beam.
2. fabricating and installing window shutters.

Estimated Cost

Install corrugated metal sheeting on 2 x 4 wood purlins over existing asphalt shingles (metal only)	\$20,000
Total:	<u>\$20,000</u>

CUSTOMS SHED
R L BRADSHAW INTERNATIONAL AIRPORT

Vulnerability

The vulnerability assessment indicates high vulnerability to earthquake and high vulnerability to hurricane.

Description

This is a single-storey, pre-engineered steel building with reinforced concrete block walls.

The roof is sheeted with corrugated metal sheets.

The roof overhangs exceeds two feet.

Longitudinal wall X-bracing is not in place

There are no shutters to protect the windows and wall vents.

There are two large roll-up doors on one side of the building.

Siting

The building is situated on flat land which is well drained. There is no risk of flooding. There is no landslide risk.

Condition

The building is in poor to fair condition.

Exposed structural sheet members are corroding. In some cases loss of metal has occurred and the structure is therefore weakened. The roof sheeting has been patched in places. One of the roll-up doors has been damaged – some of the metal slats have been pulled out from the edge frame, thus weakening the door.

Retrofit Recommendations

Storm shutters should be installed to protect the windows. The large wall openings at the front of the building (currently with wire netting across them) need special attention. Hinged shutters and roll-up shutters will not work at these locations. Removable type shutters which can be put in place easily and bolted or braced in position should be considered.

The damaged roll-up door should be replaced. The anchorages of the door guides into the adjacent wall should be examined to ensure that they are adequate. Temporary braces should be fabricated and stored so that they could be put in place across the doors when a hurricane approaches. This would stiffen the doors so that they would be less likely to either buckle or deflect so much that they pull out of the door guides.

Corroded steel members should be replaced. The rest of the exposed steel should be wire-brushed and given one coat of rust inhibiting primer and two coats of enamel paint.

The roof sheeting is of a very distinctive type so the patching has been done with sheets of a different profile. This mismatch increases the potential for leaks and for general weakness in the roof envelope. It is recommended that the building be re-roofed.

Estimated Cost

Storm shutters	\$43,000
New metal sheeting over existing asphalt shingles	\$121,000
Replace damage roll-up door	\$9,000
Fabricate temporary braces for doors	\$500
Replace corroded steel members wire-brush and paint steel members	\$16,000
Total:	<u>\$189,500</u>

Facility No. 20

MARY CHARLES HOSPITAL

An Essential Facility

Vulnerability

This building is in good condition. The vulnerability assessment indicates moderate vulnerability to hurricane winds.

Description

This is a reinforced concrete block building which is 15 years old. The timber rafters are held down on the concrete ring beam by a steel rod which is threaded through the rafter and anchored in the ring beam. This method of anchoring the rafter is no longer recommended. See Appendix I.

Retrofit needs include

1. installing hurricane clips which will tie the rafter to the face of the concrete ring beam.
2. fabricating and installing storm shutters.

Estimated Cost

Install hurricane clips	\$6,000
Fabricated and install storm shutters	\$39,000
Total:	<u>\$45,000</u>

Facility No. 21A

CARDIN HOME WARDS 1&2

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

Each of these two wards is a single storey reinforced concrete building with reinforced concrete block walls. The roofs are well pitched gables, clad with corrugated metal sheets.

Roof overhangs are short. There is an open roofed corridor on one side. The corridor roof is separated from the main roof.

The windows are shuttered.

Siting

The buildings are sited on gently sloping ground which is well drained. There is no risk of flooding.

There is no landslide risk.

Condition

The buildings are in fair condition.

Retrofit Recommendations

Additional roof sheet fasteners should be inserted in the area above the corridors.

Estimated Cost

Additional roof sheet fasteners	\$7,000
Total:	<u>\$7,000</u>

Facility No. 21B

CARDIN HOME WARDS 3&4

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and low vulnerability to hurricane.

Description

Each of these two wards is a single storey reinforced concrete building with reinforced concrete block walls. The roofs are well pitched gables, clad with corrugated metal sheets.

Roof overhangs are short. There is an open roofed corridor on one side. The corridor roof is separated from the main roof.

The windows are shuttered.

Siting

The buildings are sited on gently sloping ground which is well drained. There is no risk of flooding.

There is no landslide risk.

Condition

The buildings are in fair condition.

Retrofit Recommendations

Additional roof sheet fasteners should be inserted in the area above the corridors.

Estimated Cost

Additional roof sheet fasteners	\$14,000
Total:	<u>\$14,000</u>

Facility No. 22

COAST GUARD STATION BASSETERRE

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and to hurricane.

Description

This is a high-bay, steel-framed building with pitched gable roof. Roof and wall cladding is corrugated metal panels. The building is braced longitudinally and transversely. The windows are not protected by shutters.

Siting

The site lies right on the coast and is subject to storm surges. There is little risk of damage due to landslide.

Condition

The building is in good condition.

Retrofit Recommendations

Storm shutters should be fitted over the windows.

Consideration should be given to providing auxiliary metal bracing as temporary reinforcement for the large roll-up door during hurricanes.

Estimated Cost

Storm shutters	\$88,000
Install wind vents	\$37,000
Total:	<u>\$125,000</u>

Facility No. 23

CUSTOMS BUILDING (ADMINISTRATION)

Vulnerability

The vulnerability assessment indicates high vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a single-storey, pre-engineered, steel-framed building with concrete block wall cladding.

The low-slope gable roof is clad with corrugated metal panels. Roof overhangs are short. There is no X-bracing in the plane of the side walls.

There are no window shutters.

Siting

The building is sited on flat land which is well drained. There is no risk of flooding nor of landslide.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

To improve the resistance of the building to horizontal forces consideration should be given to inserting X-bracing in two bays in each side wall.

Estimated Cost

Storm shutters	\$29,000
Add bracing	\$1,000
Total:	<u>\$30,000</u>

CUSTOMS WAREHOUSE

Vulnerability

The vulnerability assessment indicates high vulnerability to both earthquake and hurricane.

Description

This is a light, prefabricated steel building. The main structural elements are rigid frames (rafters and columns rigidly connected together). Steel purlins frame into the rafters and support the corrugated roof sheeting. Standard X-bracing is not in place in the planes of the longitudinal walls. There are no shutters to protect the windows.

Siting

The building is located on a plateau cut into sloping ground. There is some risk of flooding due to storm water runoff flowing down-slope. There is no landslide risk.

Condition

The west section of the building is in good condition.

The roof sheeting on the east section of the building is in poor condition

Retrofit Recommendation

The absence of the X-bracing creates low resistance to racking of the building by horizontal forces, which are generated by hurricane and earthquake. It is recommended that the bracing be replaced. Alternatively, a system of steel bracing wind bents should be installed where X-bracing would disrupt operations in the building.

The east section of the building should be re-sheeted using 24 gauge material.

Storm shutters should be installed.

Estimated Cost

Storm shutters	\$30,000
Re-sheet existing roof	\$261,000
Add X-bracing or wind bent	\$26,000
Total:	<u>\$317,000</u>

Facility No. 26

BASSETERRE HEALTH CENTRE

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to hurricane and moderate vulnerability to earthquake.

Description

This is a two-storey reinforced concrete building with concrete block walls. The roof is a flat concrete slab. There is a considerable area of glass windows which is not protected by shutters.

Siting

The site is well drained and so is the area round about it. Risk of flooding is low. Risk of landslide is also low.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be provided for protection of the windows. Because of the configuration of the panels the shutters may have to be the type which is kept in storage and positioned as necessary when a storm approaches. Alternatively, a type of roll-up metal shutter could be used.

Improved resistance to earthquake could be achieved by replacing say 25% of the interior stud walls with reinforced concrete blockwork.

Estimated Cost

Storm shutters	\$40,000
Replace 25% of interior stud walls with reinforced concrete blockwork	\$18,000
Total:	<u>\$58,000</u>

Facility No. 27

CAYON HEALTH CENTRE

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and to hurricane.

Description

This is a new, single-storey, reinforced concrete block structure. The hip roof is well pitched, is framed in timber and clad with corrugated metal sheets. Roof overhangs are short.

Windows are of the impact resistant type.

Siting

The building is sited on gently sloping land. There are no flooding or landslide risks.

Condition

The building is in excellent condition.

Retrofit Recommendations

NONE.

Estimated Cost

Not Applicable.

Facility No. 28

MOLINEUX HEALTH CENTRE

An essential facility

Vulnerability

The vulnerability assessment indicates that this building has moderate vulnerability to earthquake and high vulnerability to hurricane.

Description

This is a 1038 square foot single-storey, concrete block building with light, timber-framed roof which is clad with asphalt shingles. There are no window shutters.

The shingles are the ordinary, light type. It is unlikely that this material is approved by its manufacturer for installation in high wind areas. There is a real risk that during a hurricane the shingles would be lifted off thus allowing water to enter the building through the roof.

The rafters are pinned to the wall by a detail which is no longer recommended. See Appendix 1.

Siting

The building is sited on gently sloping ground. It is not subject to flooding and there is no risk of landslide.

Condition

The building is in fair condition.

Retrofit Recommendation

It is recommended that corrugated metal sheeting be installed on wood purlins above the asphalt shingles and that saddle-type rafter-to-wall hurricane straps be installed.

It is also recommended that permanently attached window shutters should be installed.

Estimated Cost

Shutters	\$7,000
Install new roof sheets above asphalt shingles	\$23,000
Saddle-type hurricane straps	\$1,000
Total:	<u>\$31,000</u>

TABERNACLE HEALTH CENTRE

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to hurricane and low vulnerability to earthquake.

Description

This building is a single storey, reinforced masonry structure with a timber-framed, gable roof clad with new corrugated metal sheets. Roof overhangs exceed two feet but the sheeting is protected by soffits.

There is no protection for the windows.

Siting

The building is located on gently sloping ground. There is no risk of flooding or of landslide.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

Additional roof sheet fasteners should be inserted at eaves, ridges and gable ends.

Estimated Cost

Storm shutters	\$6,000
Additional roof sheet fasteners	\$3,000
Total:	<u>\$9,000</u>

SADDLERS HEALTH CENTRE

An Essential Facility

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and high vulnerability to hurricane.

Description

This is a one-storey concrete block building with light, timber-framed, roof clad with asphalt tiles.

Siting

The building is located towards the bottom of a slope. There is some risk of flooding due to storm water flowing down-slope. There is no landslide risk.

Condition

The walls are cracked in several places, including one full-height crack at the intersection of 2 interior walls. The roof timber is in good condition but roof leaks have been reported. The windows are not protected by shutters.

The shingles on the roof are ordinary asphalt shingles. It is certain that they are not rated for use in hurricane wind zones. They are likely to be blown off quite easily, which would result in significant leakage.

The rafters are pinned into the tops of the walls using a detail which is no longer recommended. See Appendix 1.

Retrofit Recommendation

It is recommended that corrugated metal sheeting on 2x4 wood purlins be added above the existing shingles. It is recommended that special hurricane clips be installed on the face of the ring beam to anchor the rafters.

The wall cracks should be investigated to verify that they are caused by deficiencies in the system of reinforcing. If so, then the walls would have to be chased at intervals of 32 inches, a reinforcing bar inserted, and the block work made good.

Protective window shutters should be installed.

Estimated Cost

Storm shutters	\$12,000
New metal sheeting over existing shingles	\$33,000
Saddle-type hurricane straps	\$2,000
Wall repair	\$47,000
Total:	<u>\$94,000</u>

Facility No. 31

DIEPPE BAY HEALTH CENTRE

An Essential Facility

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and high vulnerability to hurricane.

Description

This is a single-storey, reinforced concrete block building. The roof is a well-pitched gable framed in wood and clad with asphalt shingles. The roof overhang is short. Rafters are pinned into the wall by a detail which is no longer recommended. (See Appendix I)

The windows are not protected by shutters.

Siting

The building is located on gently sloping ground with little risk of flooding or landslide.

Condition

The building is in fair condition.

Retrofit Recommendations

The asphalt shingles in place on the roof are the ordinary type. They are not rated by the manufacturer for resistance to hurricane wind. It is recommended that corrugated metal roofing be installed on wood purlins above the shingles.

Further, Saddle-type, rafter-to-wall connectors should be installed where each rafter goes through the exterior wall.

Storm shutters should be fitted to protect the windows.

Estimated Cost

Storm shutters	\$8,000
New metal sheeting over existing asphalt shingles	\$23,000
Saddle-type hurricane straps	\$1,000
Total:	<u>\$32,000</u>

Facility No. 32

ST PAULS HEALTH CENTRE

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a single-storey, reinforced concrete block building with a low-pitched, gable roof.

It is framed in timber and clad with corrugated metal panels. The roof overhang is short. The rafters are pinned into the wall by a detail which is no longer recommended. (See Appendix I)

The windows are not protected by shutters.

Siting

The building is located on gently sloping land which is not subject to flooding. There is no risk of landslide.

Condition

The building is in good condition.

Retrofit Recommendations

Saddle-type rafter-to-wall connectors should be installed where each rafter passes through the exterior wall.

Storm shutters should be installed as a protection for the windows.

Estimated Cost

Storm shutters	\$6,000
Saddle-type hurricane straps	\$9000
Total:	<u>\$15,000</u>

Facility No. 33

SANDY POINT HEALTH CENTRE

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and vulnerability to hurricane.

Description

This is a reinforced concrete block building, single-storey with wood-framed gable roof clad with corrugated metal sheets. Roof overhangs are short. There is a porch at the front of the building.

The windows do not have protective shutters.

Siting

The building is located on gently sloping land which is well drained. There is no risk of flooding. There is no risk landslide damage.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

Additional roof sheet fasteners should be inserted in the area over the porch and at eave, ridge and gable ends.

Estimated Cost

Storm shutters	\$7,000
Additional roof sheet fasteners	\$3,000
Total:	<u>\$10,000</u>

OLD ROAD HEALTH CENTRE

An Essential Facility

Vulnerability

The vulnerability assessment indicates moderate vulnerability to hurricane and low vulnerability to earthquake.

Description

This is a single storey building constructed of reinforced concrete block. It has a low-pitched roof, part gable, part mono-slope, framed in wood and clad with corrugated metal panels. Roof overhangs are short. There is an open, front porch over which the main roof extends. Rafters are pinned into the wall by a detail which is no longer recommended. (See Appendix 1)

The windows are not protected by shutters.

Siting

The building is located on gently sloping land. It is near the coast but is not subject to storm surge. There is no flooding risk and no landslide risk.

Condition

The condition of the building is good.

Retrofit Recommendations

It is recommended that saddle-type rafter-to-wall hurricane clips be installed on each rafter where it passes through the wall.

Additional roof sheet fasteners should be installed at eaves, ridge and gable ends and also in the area of the porch.

Wood shutters should be fitted as protection for the windows.

Estimated Cost

Storm shutters	\$6,000
Saddle-type hurricane straps	\$9,000
Additional roof sheet fasteners	\$2,000
Total:	<u>\$17,000</u>

PONDS PASTURE HEALTH CENTRE

An Essential Facility

Also a designated Emergency Shelter

Ranking

In its present configuration, this building is not considered suitable for use as a "front-line" emergency shelter. Its status as such should be discontinued.

The vulnerability assessment indicates moderate vulnerability to earthquake and high vulnerability to hurricane.

Description

The building is 25 years old and is constructed mainly of 6-inch and 4-inch reinforced concrete blockwork. It carries a light, timber-framed gable roof which is clad with corrugated metal sheets. The roof overhang is short and is boarded up - which is an advantage. The windows are not protected by storm shutters

Condition

The physical condition of the building is good.

Siting

The building is sited in a very flat, coastal area which is protected from storm surges by a newly-constructed sea wall which is intended to protect the nearby main coastal road from battering by ocean waves. However, the wall ends a few hundred feet east of the site and storm surge running inland at this point could still affect the building.

Operational Deficiencies

There are adequate toilet and storage facilities inside the building but neither bathing nor kitchen facilities are available. A kitchen cannot be constructed outside because of lack of space around the building. Construction of an attachment on the east side, say, would violate the usual building set-back requirements of the Building Code.

Water storage facilities are not in place, neither is electric power generating equipment.

A diesel-powered electricity generating set, muffled or hooded to reduce noise, can readily be added outside the building.

An elevated water storage tank can also be added.

Physical Deficiencies

The seismic vulnerability assessment indicates that a larger area of stiffening walls is required in each direction (longitudinal and transverse) to provide the building with above-average resistance to earthquake. This would have to be done by rebuilding some of the interior walls up from 4 inches to 8 inches thick.

The wind vulnerability assessment indicates that given the coastal exposure of the building the exterior 6-inches thick, nominally-reinforced concrete block walls will be only marginally secure in

a Category II hurricane. The interior of the building has a ceiling so the size and spacing of rafters and the detail of the rafter tie-down were not apparent. No drawings were available and the ceiling was not opened for this study. However, it is believed that the connection of the timber rafters to the concrete ring beam is by a detail which is no longer recommended (Appendix I) since it has been found, by experience, that under intense roof suction such as occurs during a hurricane, the rafter splits at the point where it is drilled to accept the anchor rod. The top section of the rafter, together with the roof sheeting then blows away leaving the bottom portion of the rafter securely anchored in place.

Retrofit Recommendations

The roof connection deficiency can be addressed by installation of a type of hurricane clip which can be attached to the concrete ring beam.

The wall thickness deficiency can be addressed most readily by increasing the wall thickness by 2 inches of concrete to make 8 inches, while adding another curtain of steel reinforcement within the added 2 inches. The reinforcement can be in the form of welded wire mesh and the concrete can be placed by the shotcrete process.

The windows are not protected by permanently installed shutters. Such protection is recommended.

Estimated Cost

Storm shutters	\$24,000
Saddle type hurricane straps	\$3,000
Build-out walls to 8" thickness	\$84,000
Total:	<u>\$111,000</u>

BASSETERRE POST OFFICE

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a two-storey reinforced concrete building with reinforced concrete block walls. The roof is a low-slope hip which is framed with light wood rafters and clad with corrugated metal sheets. There is no roof overhang.

There are open, roofed corridors on each side. These have concrete roofs.

Siting

The building is located on flat land on the coastline. It is subject to flooding due to torrential rains as a result of outflow from the main flood water channel through the city – College Street. This will happen if the College Street outfall to the sea becomes blocked by sand and debris. The building is also subject to storm surge. There is no landslide risk.

Condition

The building is in good condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

Estimated Cost

Storm shutters	\$111,000
Total:	<u>\$111,000</u>

POWER STATION (BUILDING A and B)

An Essential Facility

Vulnerability

The vulnerability assessment indicates moderate vulnerability to hurricane and low vulnerability to earthquake.

Description

These are two high-bay, steel-framed buildings. The roofs are clad with corrugated metal sheets. There are no overhangs.

In Building A walls are of concrete, others are framed in steel and clad with corrugated metal panels. In Building B, all of the walls are clad with corrugated metal panels.

In each Building there are many windows which are not protected by shutters. There are large doors and small doors in the building envelope.

Siting

The Buildings are located on flat land which is subject to flooding due to storm water runoff from the north and west. A new storm water interceptor drain has recently been constructed and this has effectively dealt with water flowing towards the property.

Still, rain water falling on the property itself occasionally causes flooding problems in the building. Portable pumps are kept at the ready to deal with this situation.

There is no landslide risk.

Condition

The condition of the buildings is poor.

A large section of upper level metal sidewall panels is missing at Building A.

The roof of Building B leaks at the southern end. Several roof sheets may have become loose. Most of the doors on each building are either missing altogether or are in a state of disrepair. This includes large doors 18 feet high by 15 feet wide as well as small doors 8 feet high by 3 feet wide.

Sidewall panels on the southern end of Building B have come loose. Rake flashings are missing from Building B.

Retrofit Recommendations

Early attention should be given to the provision of shutters which could easily be put in place on the approach of a hurricane and removed just as easily afterwards.

Early attention should also be given to replacement of missing or sub-standard doors. The large doors should be fitted with braces which could be placed temporarily to reinforce the door in the event of a hurricane.

Loose roof and sidewall sheets on Building B should be refastened or replaced. The entire roof of Building A and the roof and sidewalls of Building B should be inspected closely to determine whether there are other sheets which should be replaced at this time.

Additional drainage works should be undertaken to divert rainwater which falls in the yard away from the building.

Estimated Cost

Window shutters	\$155,000
New roof and wall sheeting	\$40,000
Doors:	
18ft high x 15ft wide roller-shutter(1 each)	\$17,000
18ft high x 12ft wide roller-shutter(1 each)	\$12,000
8ft high x 4ft wide (2 each)	\$4,000
8ft high x 6ft wide(2 leaves) (1 each)	\$2,000
Drainage works	\$5,000
Total	<u>\$235,000</u>

Facility No. 40

BASSETERRE COURTHOUSE

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a reinforced concrete bearing wall structure. There are two stories plus a basement. The sub-roof is reinforced concrete on metal decking on steel joist. Most of this is covered by a well-pitched hip roof which is framed in structural steel and clad with corrugated metal sheets. The roof overhangs are short and are soffit. There is a small verandah on one side. This also has a soffit. Air conditioning equipment is located on the small section of the flat roof which has no false roof. In this area the concrete roof is covered by a waterproofing membrane which is protected by parapets.

The windows do not have shutter protection.

There is a large roll-up door on one side.

Siting

The building is sited on flat land near the coastline. The lower floor is set several feet off the ground and is not subject to flooding or to storm surges. There is no risk of landslide.

Condition

The building is in excellent condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

Equipment fastenings to the roof should be checked to verify that they remain secure and components of the equipment itself should be checked to ensure that there are no loose parts which could become dislodged during a hurricane and damage the roof covering.

Consideration should be given to providing temporary auxiliary braces for the roll-up door. The braces would reduce deflection of the door which would cause it to pull out of the door guides at the sides of the wall opening. The fastening of the guides to the wall should also be reviewed for adequacy.

Estimated Cost

Storm shutters	\$90,000
Auxiliary braces for roll-up door	\$500
Total:	<u>\$90,500</u>

Facility No. 41

GOVERNMENT HEADQUARTERS BUILDING

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a reinforced concrete Building with reinforced concrete block walls. It is three storeys high. The roof is a flat concrete slab.

Some, but not all of the windows are protected by shutters.

Siting

The building is set on gently sloping ground which is adjacent to a major flood water route through the city. It would be subject to flooding in a severe rainfall event if the lower end of the channel becomes blocked and water spills over into Central Street and Liverpool Row.

Condition

The building is in excellent condition.

Retrofit Recommendations

Storm shutters should be installed to protect the remainder of the windows.

Estimated Cost

Storm shutters	\$142,000
Total	<u>\$142,000</u>

Facility No. 42

PUBLIC MARKET - BASSETERRE

Vulnerability

The vulnerability assessment indicates high vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is an open-sided, single storey, steel-framed structure. The roof is a well-pitched gable clad with corrugated metal sheets. Three of the bays are braced in the plane of the building. There is therefore no longitudinal bracing of the structure.

Siting

The building is located on flat land near the coast. It is not subject to flooding but is subject to storm surges. There is no landslide risk.

Condition

The building is in poor condition. Although the roof sheeting is well preserved the steel supporting structure is corroding. In some places metal loss is actually occurring.

Retrofit Recommendations

Badly corroded members which are cantilevered from the columns should be replaced. The rest of the structure should then be chipped and wire brushed and given one coat of rust inhibiting primer and two coats of enamel paint.

Since X-bracing in the weak plane of the columns would very likely be an inconvenience for persons using the facility, consideration should be given to alternative means of improving the buildings resistance to lateral loads in the longitudinal direction. This could be achieved by welding in reinforcements to induce rigid frame action in the three bays which are braced in the roof.

Estimated Cost

Replace corroded steel members	\$6,000
Wire-brush and paint steel members	\$33,000
Install wind bents	\$44,000
Total:	<u>\$83,000</u>

Facility No. 43B

ZIZ TELEVISION STUDIOS

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a single-storey reinforced concrete building with reinforced concrete block walls. The roof profile is a hip with low slope. It is clad with corrugated metal sheeting. On one section of the building there are short roof overhangs which have a soffit. In other sections of the building the roof sheeting is protected by a parapet.

The windows are shuttered.

Siting

The building is located on gently sloping land which is well drained. There is no flooding. There is no risk of landslide damage.

Condition

The building is in good condition.

Retrofit Recommendations

None necessary

Facility No. 44A

DEFENCE FORCE BARRACKS

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and high vulnerability to hurricane.

Description

This is a two-storey reinforced concrete building with reinforced concrete block walls. It is roofed with a moderately pitched gable which is clad with asphalt shingles. Roof overhangs are short. There are several ridge ventilators on the roof. On one side of the building there is a covered corridor and the main roof extends over this corridor.

The light wood rafters are anchored in the wall using a detail which is no longer recommended. See Appendix I.

Some of the windows have shutters. Most of them do not.

Siting

The building is located on gently sloping ground which is not subject to flooding. There is no landslide risk.

Condition

The building is in fair condition. Some roof leaks are occurring.

Retrofit Recommendations

The building is roofed with ordinary asphalt shingles which are not rated for high wind resistance. Corrugated metal sheeting should be installed over the existing shingles.

Saddle-type rafter-to-wall connectors should be installed on each rafter.

The attachment of the ventilators should be examined to verify that they are secure.

Hinged shutters should be installed as protection for the windows.

Estimated Cost

Storm shutters	\$49,000
New metal sheeting over existing asphalt shingles	\$63,000
Saddle-type hurricane straps	\$4,000
Total:	<u>\$116,000</u>

DEFENCE FORCE BARRACKS

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and high vulnerability to hurricane.

Description

This is a single-storey, reinforced concrete block structure. It is a well-pitched gable roof which is clad with asphalt shingles. The roof overhang is more than two feet. There is a covered corridor on one side of the building. The corridor roof is formed by an extension of the main roof.

The rafters are held down on the wall using an anchoring detail which is no longer recommended. See Appendix I.

The windows have shutters.

Siting

The building is located on gently sloping ground which is not prone to flooding. There is no landslide risk.

Condition

The building is in good condition.

Retrofit Recommendations

The asphalt shingles on this roof are the ordinary kind. They are not rated for hurricane wind uplift. It is recommended that corrugated metal sheets be installed on wood purlins above the existing roofing. Sheet screws should be closely spaced in the area above the corridor.

Saddle-type rafter-to-wall hurricane straps should be installed on the rafters.

Storm shutters should be installed to protect the windows.

Estimated Cost

Storm shutters	\$19,000
New metal sheeting over existing asphalt shingles	\$53,000
Saddle-type hurricane straps	\$3,000
Total:	<u>\$75,000</u>

Facility No. 44C

DEFENCE FORCE BARRACKS

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a two-storey, reinforced concrete block building. The roof is a hip and it is clad with corrugated metal sheets. There are vents in the roof. The roof overhangs are about two feet long but have soffit boards. There is an upstairs verandah over which the main roof extends. This verandah roof has a soffit.

The windows do not have shutters.

Siting

The building is located on gently sloping ground which is not subject to flooding. There is no landslide risk.

Condition

The building is in good condition.

Retrofit Recommendations

Hinged storm shutters should be fitted as protection of the windows.

The installation of the vents should be examined to verify that it is secure.

Additional roof sheet fasteners should be installed at roof overhangs and verandah.

Estimated Cost

Storm shutters	\$32,000
Additional roof sheet fasteners	\$6,000
Total:	<u>\$38,000</u>

DEFENCE FORCE BARRACKS

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a single-storey, reinforced concrete building with reinforced concrete block walls. The roof is a gable, well pitched and clad with corrugated metal sheets. Roof overhangs are short and have soffits.

The windows have no shutters.

Siting

The building is located on gently sloping ground which is not subject to flooding. There is no landslide risk.

Condition

The building is in good condition.

Retrofit Recommendations

Hinged storm shutters should be fitted as protection of the windows.

Estimated Cost

Storm shutters	\$33,000
Total:	<u>\$33,000</u>

Facility No. 45

OLD TREASURY BUILDING

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a two-storey unreinforced stone masonry structure. The roof is a hip and is supported on steel trusses. It is clad with corrugated metal sheets. The roofing is protected by a parapet all around.

There is a roofed corridor on each floor on one side of the building

The windows are not protected by storm shutters.

Siting

The building is sited on flat land on the coast. It is subject to flooding and to storm surges. There is no landslide risk.

Condition

The building is in fair condition.

Retrofit Recommendations

The windows should be fitted with storm shutters. Because of the layout of the windows, a roll-up type of shutter would fit better than a hinged shutter.

Estimated Cost

Storm shutters	\$66,000
Total:	<u>\$66,000</u>

Facility No. 46

FINANCE DEPARTMENT BUILDING

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a three-storey reinforced concrete building with reinforced concrete block walls. The walls are further clad with ship-lapped siding. The windows are not protected by shutters.

One part of the roof is a well-pitched gable clad with corrugated metal sheets. The other section is a flat concrete roof with built-up roofing and gravel laid over it. This roofing is protected by parapets. Overhangs at the gable roof are short.

Siting

The building is located on relatively flat land but it is well drained. There is little risk of flooding. There is no landslide risk.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

Estimated Cost

Storm shutters	\$70,000
Total:	<u>\$70,000</u>

Facility No. 47

PUBLIC WORKS DEPARTMENT

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a two-storey reinforced concrete building with reinforced concrete block walls and a flat, reinforced concrete roof. The windows are not protected by shutters.

Siting

The building is sited on gently sloping ground which is well drained. There is no flooding risk. There is no landslide risk.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

The concrete roof should be sealed. This could be done either by erecting a false, light-weight roof above it, framed with wood and clad with corrugated metal sheets; or by installing insulating board and waterproofing membrane on the concrete surface.

Before either course of action is taken the roof concrete should be broken out at randomly selected points to check that the steel reinforcing bars are largely intact and not corroded.

If there is extensive corrosion of the reinforcing bars more extensive roof repairs would need to be undertaken before the top surface is sealed.

Estimated Cost

Storm shutters	\$24,000
Seal concrete roof	\$17,000
Total:	<u>\$41,000</u>

Facility No. 48

ELECTRICITY DEPARTMENT

Headquarters Building

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a single storey building constructed of reinforced concrete frames with masonry walls. The hip roof is supported on steel trusses and is clad with corrugated metal sheets. Roof overhangs are short and are soffited.

The windows are not protected by storm shutters.

Siting

The building is located on sloping land which is well drained. There is no flooding risk.

There is no risk of landslide.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows and glass-paneled doors.

The roof sheeting is more than twenty years old and some of the sheets have been replaced in recent years.

The roof should be closely inspected to determine whether more of the sheets should be replaced at this time.

Estimated Cost

Storm shutters	\$12,000
Total:	<u>\$12,000</u>

Facility No. 49

ELECTRICITY DEPARTMENT

Billing Section

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a two-storey reinforced concrete building with concrete block walls. The roof construction is concrete on metal decking supported on steel joists. There is a parapet all around.

The windows are not protected by shutters.

Siting

The building is situated on gently sloping ground which is well drained. There is no flooding risk and no landslide risk.

Condition

The building is in fair condition generally, except that the roof leaks in several places.

Retrofit Recommendations

Storm shutters should be installed as protection for the windows.

A water proofing membrane should be laid to seal the roof.

Estimated Cost

Storm shutters	\$68,000
Install water proofing membrane	\$49,000
Total:	<u>\$117,000</u>

Facility No. 50

MINISTRY OF TRADE BUILDING

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a three-storey reinforced concrete building with concrete block walls. The roof is a wood-framed hip of flat slope and is clad with corrugated metal sheets. The roof is protected by parapets on three sides. On the fourth side the roof overhang is short.

Some, but not all of the windows are protected by hinged storm shutters.

Siting

The building is located on sloping ground adjacent to a major flood water route through the city – College street Ghaut. Flooding of the bottom floor could occur in a severe rainfall event if the waterway becomes blocked downstream and water overtops the channel and flows into Central Street. There is no landslide risk.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be installed on the remaining windows.

In as much as the roof sheets are more than twenty years old they should be closely inspected to determine whether they should be replaced at this time.

Estimated Cost

Storm shutters	\$60,000
Total:	<u>\$60,000</u>

Facility No. 51

NEWSTEAD BUILDING

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a three-storey reinforced concrete building with concrete block walls. The roof is a reinforced concrete slab.

There is a verandah on two sides of the building.

The windows are protected by hinged wood shutters.

Siting

The building is situated on gently sloping ground adjacent to a major flood water route through the city – College street Ghaut. Flooding of the bottom floor could occur in a severe rainfall event if the waterway becomes blocked downstream and water overtops the channel and flows into Central Street. There is no landslide risk.

Condition

The building is in excellent condition.

Retrofit Recommendations

None

Estimated Cost

Not Applicable

OAS BUILDING

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a single storey wooden structure with a well pitched gable roof which is clad with corrugated metal sheets. It is founded on stone masonry walls.

Roof overhangs are short. A verandah wraps around three sides of the building.

This roof is separated from the main roof.

The windows are protected by storm shutters.

Siting

The building is located on sloping ground.

The site is not subject to flooding and there is no landslide risk.

Condition

The building is in fair condition.

Retrofit Recommendations

The roof sheets are more than 20 years old. Some of them have been replaced in recent years. It is recommended that a close inspection of the sheets be made to determine whether more of them should be replaced at this time.

Additional roof sheet fasteners should also be replaced in the verandah area, at eaves, ridge and gable ends.

Estimated Cost

Additional roof sheet fasteners	\$5,000
Total:	<u>\$5,000</u>

Facility No. 53

PELICAN MALL

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and

Description

This is a two-storey steel-framed building with concrete and concrete block walls. The roof is a well pitched gable sheeted with corrugated metal panels. There is an integral louvered venting structure which is continuous along the ridge. Roof overhangs are short.

The windows are not protected by shutters.

There are several small roll-up doors on one side of the building.

Siting

The building is located on flat land on the coastline. It is subject to flooding due to torrential rains as a result of outflow from the main flood water channel through the city – College street. This will happen if the College Street outfall to the sea becomes blocked by sand and debris. The building is also subject to storm surge. There is not landslide risk.

Condition

The building is in excellent condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

The fixings of the door guides into the adjacent walls should be inspected and reinforced where necessary.

Additional roof sheet screws should be inserted at eave, ridge and gable ends of the roof.

Estimated Cost

Storm shutters	\$122,000
Additional roof sheet fasteners	\$24,000
Total:	<u>\$146,000</u>

Facility No. 54

CENTRAL MARKETING CORPORATION

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a single storey pre-engineered steel framed structure with reinforced concrete block walls. The roof is a well pitched gable which is clad with corrugated metal panels. There is a low parapet at the gable ends.

Elsewhere the roof overhang is short.

There is a monoslope extension on one side. The roof over the extension has a flatter slope. It is separated from the main roof.

The windows are not protected by shutters.

Siting

The building is located in a flat area near the coastline. It is subject to flooding during heavy rains. It is also subject to storm surge-though the general area is partially protected by a sea wall.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

There are four ventilators on the roof. These represent points where the roof envelope could potentially be breached during a hurricane. These installations should be specifically inspected to verify that the attachments to the roof members are secure and weather tight.

Estimated Cost

Storm shutters	\$53,000
Total:	<u>\$53,000</u>

Facility No. 55

MINISTRY OF HEALTH BUILDING

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a two-storey, two-material building which was typical in the commercial areas of towns and villages many years ago.

The lower storey is constructed of stone masonry; the upper storey is constructed of wood braced studs with ship-lapped wood siding. The roof is configured in two hips, well pitched and clad with corrugated metal sheets. The roof overhangs are short and the front porch has a soffit.

Siting

The building is located in a flat land which is not subject to flooding. There is no landslide risk.

Condition

The building is in *fair condition*.

Retrofit Recommendations

In as much as the roof sheets are more than 20 years it is recommended that a detailed inspection of the roof be carried out with a view to determine whether some or all of the sheets should be replaced at this time.

Estimated Cost

Not Applicable

Facility No. 56A

CHARLESTOWN POLICE STATION EXTENSION

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a two-storey, reinforced concrete structure with reinforced concrete block walls. The roof is a flat concrete slab. The windows are all shuttered.

Siting

The building is located in flat land which drains quite well. There is no risk of landslide.

Condition

The building is in good condition.

Retrofit Recommendations

None

Estimated Cost

Not Applicable

Facility No. 56B

**CHARLESTOWN POLICE STATION
CORE BUILDING**

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a 200 year old, two-storey stone masonry structure. It has a well pitched wood-framed gable roof which is clad with corrugated metal panels. Roof overhangs are very short. The windows are shuttered. There are no open-sided corridors or verandahs.

Siting

The building is located in flat land which drains quite well. There is no risk of landslide.

Condition

The building is in fair condition.

Retrofit Recommendations

None

Estimated Cost

Not Applicable

Facility No. 57

COTTON GROUND POLICE STATION

An Essential Facility

Vulnerability

The vulnerability assessment indicates moderate vulnerability to hurricane and to earthquake.

Description

This is a single storey building constructed of unreinforced masonry with a light, well-pitched, timber-framed roof clad with corrugated metal panels. The roof sheeting is more than 20 years old. It leaks. Roof overhangs are short.

There is an open verandah, which is soffited. The windows are shuttered.

Siting

The site is well drained and there is no risk of landslide.

Condition

The building is in fair condition.

Retrofit Recommendations

The building should be re-sheeted with 24 gauge, galvanized and coated sheets. Roof sheet fasteners should be screws rather than nails and care should be taken to close the fastener spacing in the areas of higher roof section space, dash, space over the verandah and at eaves, ridge and hips.

Resistance to earthquake can be improved by replacing the stud walls with reinforced masonry.

Estimated Cost

Re-sheet existing roof	\$25,000
Replace stud walls with reinforced masonry	\$11,000
Total:	<u>\$36,000</u>

Facility No. 58

GINGERLAND POLICE STATION

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to hurricane and to earthquake.

Description

This is a single storey building constructed of unreinforced stone masonry. The hip roof is well pitched, framed in timber and clad with corrugated metal panels. Roof overhangs are short. Window openings are shuttered. There is an open, roofed porch at the front.

Siting

The site is not subject to flooding or to landslide.

Condition

The building is in good condition.

Recommended Retrofit Action

It is recommended that the spacing of roof sheet fasteners over the porch be examined to verify that such spacing is closed to 6 inches.

Estimated Cost

Not Applicable

NEWCASTLE POLICE STATION

An Essential Facility

Vulnerability

The vulnerability assessment indicates high vulnerability to hurricane and moderate vulnerability to earthquake.

Description

This is a two-storey, prefabricated, steel building with reinforced concrete walls. On the upper floor the interior walls are 4 inches thick. The roof is low pitched and is clad with corrugated metal panels which are 11 to 15 years old. The roof leaks. There is an open, roofed corridor along one side. The windows are not shuttered.

Siting

The site is on flat land set back from the coast. It is below elevation 12 feet above sea level and would be subject to storm surges.

There is no landslide risk.

Condition

The building is in fair condition.

Retrofit Recommendations

Window shutters should be provided.

A full maintenance check should be carried out on the roof to identify areas where sheeting laps may be faulty and these should be sealed and reinforced with additional fasteners.

Additional roof sheet fasteners should also be placed in the area over the corridor. Resistance to earthquake damage could be improved by replacing at least two of the interior 4-inch thick concrete block walls on the upper floor with 6-inch thick reinforced concrete walls.

It should also be verified that the remaining 4-inch walls are reinforced vertically. They should be braced at the top.

Estimated Cost

Storm shutters	\$24,000
Additional roof sheet fasteners:	\$5,000
Replace two of the 4" thick concrete block walls on upper floor with 6" thick reinforced concrete walls:	\$5,000
Brace remaining 4" walls at the top:	\$3,000
Total:	<u>\$37,000</u>

Facility No. 60

MAIN BUILDING AT ALEXANDRA HOSPITAL

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to hurricane and earthquake.

Description

This is a two-storey reinforced concrete building. Wall cladding is of unreinforced stone masonry on the ground floor and concrete block on the upper floor. The hip roof is framed with light wood rafters at close spacing. Roof cladding is asbestos sheeting.

Roof overhang is short.

The open corridors on each side have concrete roofs and the windows are shuttered.

Siting

The site is sloped gently and is well drained. There is no risk of landslide.

Condition

The building is in fair condition. Some of the columns and beams on the ground floor are badly spalled indicating severely corroded reinforcing bars.

Retrofit Recommendations

The building is currently being remodelled and refurbished.

Asbestos roof sheets are being replaced with corrugated metal sheets and saddle type rafter-to-wall hurricane straps are being installed.

The ground floor columns and beams are being repaired.

Estimated Cost

Not Applicable.

MATERNITY BLOCK AT ALEXANDRA HOSPITAL

An Essential Facility

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a two-storey reinforced concrete building with reinforced concrete block walls. The light, timber-framed hip roof is clad with corrugated metal sheets which are said to be more than 20 years old. The windows are not shuttered.

The open corridors are roofed with reinforced concrete slabs.

One half of the ground floor is open, without walls. This represents an unfavorable condition for resistance to earthquake, as the upper storey is much stiffer than the lower one.

Siting

The building is sited on gently sloping land which is well-drained. There is no risk of landslide.

Condition

The building is in fair condition.

A few of the ground floor columns are spalled indicating the presence of corroded reinforcing bars.

Retrofit Recommendations

The windows should be fitted with shutters.

The spalling columns should be broken back to sound concrete, new reinforcing bars should be placed - foundation to beam above -- and concreted in.

A twenty-five foot long by twelve feet high reinforced concrete shear wall should be constructed at the east side of the lower storey to provide additional stiffness.

Estimated Cost

Storm shutters	\$48,000
Concrete shear wall	\$10,000
Column repairs	\$4,000
Total:	<u>\$62,000</u>

Facility No. 63

PAEDIATRIC WARD AT ALEXANDRA HOSPITAL

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and to hurricane.

Description

This is a single storey concrete block building with the light, timber-framed gable roof clad with corrugated metal panels.

The windows are not protected by shutters.

Siting

The site is sloped gently and is well drained. There is no risk of landslide.

Condition

The building is in good condition.

Retrofit Recommendations

Storm shutters should be fitted to the windows.

Estimated Cost

Storm shutters	\$7,000
Total:	<u>\$7,000</u>

Facility No. 64

EYE CLINIC AT ALEXANDRA HOSPITAL

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and high vulnerability to hurricane.

Description

This is a two storey, reinforced concrete block building with light, timber-framed hip roof clad with asphalt shingles. These are high wind resistance.

The roof overhang is short and there are no verandahs. The windows are not protected by shutters. The rafters are pinned into the wall by a detail which is no longer recommended. (See Appendix I).

Siting

The site is sloped gently and is well drained. There is no risk of landslide.

Condition

The building is in good condition – through there are significant roof leaks at the south end of the building.

Retrofit Recommendations

The windows should be fitted with storm shutters.

Saddle type rafter-to-wall hurricane clips should be installed on the rafters.

Corrugated metal roof sheets should be installed over the existing shingles.

Estimated Cost

Storm shutters	\$25,000
New metal sheeting over existing asphalt shingles	\$35,000
Saddle-type hurricane straps	\$2,000
Total:	<u>\$62,000</u>

Facility No. 65

CHARLESTOWN HEALTH CENTRE

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to hurricane and low vulnerability to earthquake.

Description

This is a single storey building with reinforced concrete frames, masonry walls and light, timber framed roof which is clad with corrugated metal panels. Roof overhangs are short and are soffited. There is an open, roofed corridor front and back. The roof over the corridor is of reinforced concrete. The windows are not shuttered.

The site is not subject to flooding and there is no landslide risk.

Siting

The building is in good condition.

Retrofit Recommendations

Storm shutters should be fitted over the windows.

Estimated Cost

Storm shutters	\$19,000
Total:	<u>\$19,000</u>

BROWN HILL HEALTH CENTRE

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a single-storey unreinforced stone masonry building with a recent addition in reinforced masonry. The roof profile is a moderately pitched gable. Roof covering is corrugated metal sheets. The roof overhang is about two feet long and does not have a soffit. There is a porch at the front of the building. The roof over this porch is continuous with the main roof. The porch does not have a soffit.

The windows in the original construction have shutters but those in the recent construction do not.

Siting

The building is sited on gently sloping land. It is not subject to flooding. There is no landslide risk.

Condition

The building is in good condition.

Retrofit Recommendations

The three windows in the new construction should be fitted with storm shutters.

Soffits should be added to the roof overhangs and to the front porch.

Additional roof sheet fasteners should be installed at the porch, roof overhangs, ridge and gable ends.

Estimated Cost

Storm shutters	\$9,000
Additional roof sheet fasteners	\$4,000
Add soffits to roof overhangs and to front porch	\$9,000
Total:	<u>\$22,000</u>

BUTLERS HEALTH CENTRE

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and high vulnerability to hurricane.

Description

This is a single storey building constructed mainly of stone masonry. The roofs are low-pitched, framed from timber and clad with corrugated metal sheeting. The rafters are pinned into the walls using a detail which is no longer recommended. See Appendix 1. The roof overhang exceeds two feet and is not soffit. Most, but not all of the windows are protected by storm shutters. There is an open, roofed verandah at the front of the building.

Siting

The site is not subject to flooding, although there is some evidence of erosion around the foundations. The risk of landslide is remote.

Condition

The condition of the building is good.

Retrofit Recommendations

Saddle type hurricane clips should be inserted to provide more secure anchorage of the rafters to the exterior walls.

Special attention should be paid to the roof overhangs and the verandah roof. It is recommended that soffits be constructed as a means of reducing upward pressure of the roof sheeting itself. In addition, the sheeting should be secured to the roof at closer intervals in these areas.

The remaining unprotected windows should be fitted with shutters.

Estimated Cost

Storm shutters	\$7,000
Saddle-type hurricane straps	\$1,000
Add soffit	\$7,000
Additional roof sheet fasteners	\$3,000
Total:	<u>\$18,000</u>

Facility No. 68

COMBERMERE HEALTH CENTRE

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a single-storey building with a reinforced masonry structure.

The roof profile is a moderately pitched hip and it is clad with corrugated metal sheets. Roof overhangs are short.

The windows do not have shutters.

Siting

The building is located on gently sloping land which is not subject to flooding. There is no landslide risk.

Condition

The condition of the building is good.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

Estimated Cost

Storm shutters	\$10,000
Total:	<u>\$10,000</u>

Facility No. 69

GINGERLAND HEALTH CENTRE

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and to hurricane.

Description

This is a single storey building constructed of stone masonry. The light, timber-framed, hip roof is well-pitched and is clad with new corrugated metal panels. The roof overhangs are short. The windows are not protected by storm shutters.

Siting

The building is sited on gently sloping ground which is not subject to flooding. There is no landslide risk.

Condition

The building is in good condition.

Retrofit Recommendations

Storm shutters should be fitted as protection for the windows.

Estimated Cost

Storm shutters	\$10,000
Total:	<u>\$10,000</u>

Facility No. 70

GINGERLAND PRIMARY SCHOOL

Vulnerability

The vulnerability assessment indicates high vulnerability to hurricane and low vulnerability to earthquake.

Description

This is a complex of two-storey, reinforced concrete and concrete block structures. Roofs are well-pitched gables framed with timber and clad with corrugated metal sheets. Roof overhangs exceed two feet. There are open roofed corridors on one side. These are formed by continuation of the main roof. The metal louver windows are arranged in large groups stretching from column to column. They are not protected by shutters.

Siting

The site is gently sloping. There is some risk of flooding as runoff from heavy rains makes its way downslope. Area drainage to the nearby ghaut is not well developed. There is no risk of landslide.

Condition

The condition of the building is poor. There is extensive corrosion of the metal roof sheets and hurricane clips.

Retrofit Recommendations

The building should be re-roofed using 24 gauge sheets which are galvanized and coated with PVF2 material. Fasteners used should be galvanized screws. Care should be taken to place roof sheet fasteners at closer spacing in areas of high wind uplift such as over the corridors, at roof overhangs, eaves, ridges and at the gable ends. Storm shutters should be fitted over the windows. Because of the particular configuration of the windows, roll-up type metal shutters would be more appropriate than casement type wood shutters.

Estimated Cost

Storm shutters	\$92,000
Re-sheet existing roof	\$127,000
Total:	<u>\$219,000</u>

Facility No. 71

ST JAMES PRIMARY SCHOOL

Vulnerability

The vulnerability assessment indicates moderate vulnerability to hurricane and low vulnerability to earthquake.

Description

This complex comprises several single storey buildings grouped around a courtyard. They are of reinforced concrete and concrete block construction. Roofs are low-pitched gables, timber-framed and clad with corrugated metal panels.

The roof design includes generous overhangs which shade the windows and open, roofed corridors. The corridor roofs are independent of the main roofs which is a mitigating factor. The windows are shuttered.

Siting

The site slopes gently. There is no danger of flooding nor of landslides.

Condition

The building is in fair condition

Retrofit Recommendations

The long roof overhangs at the back of the buildings should be shortened and independent canopies should be constructed over the windows.

Estimated Cost

Cut back roof overhang at back of buildings and make good	\$13,000
Construct independent canopies over the windows	\$16,000
Total:	<u>\$29,000</u>

Facility No. 72

CHARLESTOWN PRIMARY SCHOOL

A Designated Emergency Shelter

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and hurricane.

Description

This complex comprises a two-storey block and two, one storey blocks with a combined floor area of 11,800 square feet. They are reinforced concrete structures with reinforced masonry wall panels. The roofs are light, well pitched, framed with timber and clad with corrugated metal panels.

Siting

The site is easily accessible and is well drained. There are no landslide or erosion risks.

Condition

The buildings are in good condition.

Capacity

When functioning as a shelter the complex would have a capacity of 110 people.

Facilities

Bathrooms are located on each floor of each building. Plumbing fixtures currently in place are listed below.

There is a 130 square-foot kitchen located in one of the single-storey buildings. Fixtures and appliances in place in the kitchen are listed below.

There are two cisterns located under classrooms in one of the single-storey blocks. They are fed by run-off from the roof. Storage capacity is about 56,000 gallons. This is considered adequate. A water pump and pressure tank are in place.

Operational Deficiencies

The pump and pressure tank may not be serviceable. This would need to be checked and the system upgraded as necessary.

There is no stand-by electricity generator.

A generator should be provided and an enclosure built to house it.

Available kitchen space is inadequate. An additional kitchen block of about 240 square-feet in area should be constructed.

Bathing facilities are inadequate. A new 270 square foot block should be constructed to house 8 showers.

There is ample space available for construction of these additional buildings.

Physical Deficiencies

Only some of the windows are protected by storm shutters.

Retrofit Recommendations

Storm shutters should be fitted on the remaining windows and robust tower bolts should be fitted to the doors.

These buildings have exposed, roofed corridors. Additional roof sheet fasteners should be inserted in this area, as well as at ridge and gable of each roof.

Rating

This Facility is rated Category B: for use after a hazard event, if serviceable, at 50% capacity.

Estimated Cost

Storm shutters	\$97,000
Additional roof sheet fasteners	\$9,000
Provide generator	\$45,000
Construct building to house generator	\$12,000
Construct additional kitchen block of 240 square feet	\$36,000
Construct new 270 square foot bathing facilities block (8 showers)	\$50,000
Total:	<u>\$249,000</u>

Facility No. 73

ST. THOMAS (Lowlands) PRIMARY SCHOOL

Vulnerability

The vulnerability assessment indicates high vulnerability to hurricane.

Description

There are three prefabricated buildings on this compound. The structural system makes use of light, steel rigid frames with light gauge steel purlins spanning between frames.

Corrugated steel roof sheets are supported on the purlins. Both exterior walls and interior partitions are formed from corrugated metal panels. Standard X-bracing is positioned in each sidewall of each building.

Siting

The buildings are located on flat land on the coast. The site is subject to storm surge. There is no landslide risk.

Condition

The buildings are in poor condition. All of the exterior steel is in need of urgent attention to arrest corrosion. In some places the roof overhang purlin which must anchor the edge of the roof sheeting in high wind is completely rusted through. There are also rusting problems with rafter overhangs and column bases.

Retrofit Recommendation

Rusted steel members should be replaced and the remainder should be clipped and wire-brushed and given one coat of rust-inhibiting primer and two coats of enamel.

Estimated Cost

Replace corroded steel members	\$7,000
Wire-brush and paint remaining steel members	\$11,000
Total:	<u>\$18,000</u>

Facility No. 74

PROSPCET PRIMARY SCHOOL

A Designated Emergency Shelter

Vulnerability

The vulnerability assessment indicates moderate vulnerability to hurricane and to earthquake.

Description

This single storey building has a floor area of approximately 9,600 square feet. It is constructed of light, pre-engineered steel trusses rigidly connected to steel columns. Wall cladding is of reinforced masonry. The roof has a low pitch and is clad with corrugated metal panels.

Siting

The site is not subject to flooding and there is no landslide risk.

Condition

The building is in good condition.

Capacity

When functioning as a shelter this building would have a capacity of 100 people.

Facilities

2 bathroom blocks, A and B, are located 80 feet away from the building across an open courtyard. Plumbing fixtures currently in place are listed below.

A third bathroom, C, is located within the building across an open courtyard.

There are two water cisterns on the property. They are filled by run-off from the roof. Each one has a storage capacity of about 12,000 gallons. This is considered adequate. One of the cisterns leaks in several places. Gutters and downspouts which take water to the cisterns are either in disrepair or missing altogether.

There is a kitchen measuring 28'x30' located within the building. Fixtures and appliances currently in place are listed below.

Operational Deficiencies

There is no standby electricity generator on the site.

In general, bathing facilities are inadequate. A Total of 6 showers and 3 lavatories should be installed in an additional 200 square foot block to be constructed near the others. The needed space is available.

Plumbing fixtures in bathroom C should be rehabilitated.

The kitchen space is adequate. A second sink should be added.

A generator hut should also be constructed in the general vicinity of the bathrooms.

The leaking cistern should be rehabilitated and the guttering and downspout system should be repaired.

A pumping system should be installed for delivering water from the cisterns at adequate pressures to the fixtures.

Physical Deficiencies

The windows on this building are part metal louvers and part glass panels. The windows are not shuttered.

There is no evidence of bracing rods to provide racking stability of this steel-framed building. Such stability must therefore be provided by the masonry walls. In such a case the details of the connection of the steel columns to the masonry walls are crucial. Drawings of the building were not available and these connection details were not accessible for inspection in the field.

Retrofit Recommendations

It is recommended that protective window shutters be fitted as well as robust tower bolts to the doors.

It is also recommended that steel X-bracing rods be welded into place in at least two bays in each side wall.

This building has open, roofed corridors. It is recommended that additional roof sheet screws be inserted in this area as well as at ridge and gable ends.

Rating

In its present condition this facility is rated Category B: for use after a hazard event, if serviceable, at 50% capacity.

Estimated Cost

Storm shutters	\$67,000
Install robust tower bolts on doors	\$3,000
Additional roof sheet fasteners	\$26,000
Add X-bracing rods in two bays in each side-wall	\$7,000
Install 6 showers and 3 lavatories in a new 200 square foot block	\$40,000
Rehabilitate plumbing fixtures in bathroom C	\$2,000
Add second sink in kitchen	\$600
Construct new generator hut	\$16,000
Rehabilitate leaking cistern and repair downspout and system	\$5,000
Install pumping system on the cisterns	\$14,000
Total:	<u>\$180,600</u>

BATHROOM

SEX	WATER CLOSETS	LAVATORIES	URINALS	SHOWERS	REMARKS
MALE	7	2	1		
FEMALE	3		1	2	
STAFF	2	2		2	

KITCHEN

GAS STOVES	ELECTRIC STOVES	FREEZERS	REFRIGERATORS	DOUBLE SINKS	REMARKS
2		1	1	1	

105

Facility No. 75

ST JOHNS PRIMARY SCHOOL

A Designated Emergency Shelter

Vulnerability

The vulnerability assessment indicates low vulnerability to hurricane and earthquake.

Description

This 2-storey building has a floor area of approximately 2530 square feet. It is constructed of unreinforced and reinforced masonry with light, well-pitched, timber-framed roofs clad with corrugated metal panels. Roof overhangs are short and are soffitted.

Siting

Access to the building is good. It is located near to a water course (ghaut) but there is little risk of flooding. The ghaut is deep and water levels are not expected to get that high. The risk of landslide in the area is low. The banks of the ghaut are heavily vegetated and appear quite stable.

Condition

The building is in good condition.

Capacity

When functioning as a shelter this building would have a capacity of 36 people.

Facilities

A bathroom block is attached on one side of the building. Access is from the yard. Plumbing fixtures currently in place are listed below.

A 182 square-foot kitchen is located on the ground floor of the building. Fixtures and appliances currently in place are listed below.

Operational Deficiencies

There is no cistern or tank for storing water.

There is no stand-by electricity generator.

There are no facilities for bathing.

Physical Deficiencies

The windows are not shuttered.

The structure of the bathroom block is dilapidated. There is extensive full-depth cracking of the walls.

Retrofit Recommendations

Window shutters should be fitted and robust tower bolts should be fitted to doors. The existing bathroom block should be demolished and rebuilt. The new structure should be enlarged to 300 square feet to accommodate at least three showers in addition to fixtures now in place. The roof should be flat and of reinforced concrete construction so that a small generator room could be constructed thereon.

An elevated water tank should be constructed in the southeast corner of the site.

Rating

In its present condition this facility is rated Category C.

Use as a designated Emergency Shelter should be discontinued. This would be expected to be a temporary situation – until such time as the necessary support facilities are put in place.

Estimated cost

Storm shutters	\$17,000
Fit tower bolts to doors	\$1,000
Demolish existing bathroom block	\$15,000
Rebuild (enlarged) bathroom block	\$60,000
Install generator	\$12,000
Construct elevated water tank	\$30,000
Total:	<u>\$135,000</u>

BATHROOM

SEX	WATER CLOSETS	LAVATORIES	URINALS	SHOWERS	REMARKS
MALE	2	1			
FEMALE	3	3			

KITCHEN

GAS STOVES	ELECTRIC STOVES	FREEZERS	REFRIGERATORS	DOUBLE SINKS	REMARKS
1			1	1	

Facility No. 76

FIREHALL, NEWCASTLE AIRPORT

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to hurricane and to earthquake.

Description

This is a reinforced concrete building with concrete block walls. Roof beams are of structural steel and roof cladding is corrugated metal sheets. There is a parapet on 3 sides.

There are not many windows but 2 of them are without shutters. There are also 3 large fire engine doors which are constructed of wood.

Siting

The building is situated on flat, low-lying land near the coast. It is not subject to flooding but would be subject to storm surges.

There is no landslide risk.

Condition

The building is in excellent condition.

Retrofit Recommendations

Protective storm shutters should be provided for installation over the windows when a hurricane approaches. Consideration should be given to providing steel braces for the large doors.

Estimated Cost

Storm shutters	\$16,000
Provide steel braces for large doors	\$ 2,000
Total:	<u>\$18,000</u>

Facility No. 76B

FIREHALL BARRACKS - NEWCASTLE AIRPORT

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to hurricane and to earthquake.

Description

This is a single storey concrete block building with a flat concrete roof. A second storey is to be constructed later. The windows are unprotected.

Siting

The building is situated on flat, low-lying land near to the coast. It is not subject to flooding but would be subject to storm surges.

There is no landslide risk.

Condition

The building is in excellent condition.

Retrofit Recommendations

The windows should be fitted with hurricane shutters.

Estimated Cost

Storm shutters	\$6,000
Total:	<u>\$6,000</u>

Facility No. 77

CHARLESTOWN FIRE STATION

An Essential Facility

Vulnerability

The vulnerability assessment indicates moderate vulnerability to hurricane and low vulnerability to earthquake.

Description

This is a new two-storey, reinforced masonry building with an attached high-bay building of similar construction for housing the fire engine. The gable roofs are well pitched and are clad with corrugated metal panels. The roof overhangs are short. Windows and wall vents are not shuttered. The wall opening which provides access for the fire engine does not have a door of any kind.

Siting

The site is flat but is not subject to flooding. There is no risk of damage by landslide.

Condition

The building is in excellent condition.

Retrofit Recommendations

Windows and vent blocks should be shuttered and a stout roll-up door should be fitted. Often it is found that a large, roll-up door which is rated for hurricane winds cannot be readily sourced. In that event auxiliary metal braces should be fabricated and stored in readiness for use in providing temporary reinforcement to the door.

Estimated Cost

Storm shutters	\$14,000
Install roll-up door	\$17,000
Fabricate auxiliary metal braces	\$500
Total:	<u>\$32,500</u>

Facility No. 78

COURTHOUSE /LIBRARY

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is an old-time, two-storey, unreinforced stone masonry building with 2-foot thick walls. The roof is framed with light timbers and is clad with corrugated metal sheets. The roof overhangs are short and there is a low parapet at each gable. The windows are shuttered.

A wooden clock tower rises perhaps 8 feet from the ridge of the roof.

Siting

The building is situated on flat ground near to the coast. However, the ground floor is set some 4 feet off the ground and would not be subject to storm surges. There is no flooding or landslide risk.

Condition

The condition of the building is good.

Retrofit Recommendations

The roof is said to be more than 20 years old. A close and detailed inspection is indicated. This would reveal any need for replacement of roof sheets or for installation of additional roof sheet fasteners.

The presence of the clock tower represents a point of vulnerability in the roof envelope. The fixing of the tower to the main roof should be examined in detail to ensure its suitability.

A cost estimated is not applicable.

Facility No. 79

CHARLESTOWN PUBLIC MARKET

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a largely open-sided, single-storey structure supported on reinforced concrete columns. The roof is framed with light wood rafters and is clad with corrugated metal sheets.

Siting

The building is located on gently sloping land near the coast. It is not subject to flooding but is at risk from storm surge. There is no landslide risk.

Condition

The condition of the building is fair.

Retrofit Recommendations

The roof sheeting is said to be more than twenty years old. It should be inspected with a view to determine whether some or all of the sheeting should be replaced at this time.

Estimated Cost

Contingency	\$6,000
Total:	<u>\$6,000</u>

Facility No. 80

ADMINISTRATION BUILDING CHARLESTOWN

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to hurricane and low vulnerability to earthquake.

Description

This is a two-storey building constructed of reinforced masonry faced with stone. The roof profile is a low-pitched gable and it is clad with corrugated metal sheets. The roof overhangs exceed two feet in length but they are protected all around by wood soffits. The windows are not protected by shutters.

There is an open, roofed corridor on one side. This is also constructed with a soffit.

Siting

The site is flat but is not subject to flooding. There is no risk of damage due to landslide.

Condition

The building is in excellent condition

Retrofit Recommendations

Storm shutters should be fitted over the windows.

Estimated Cost

Storm shutters	\$13,000
Total:	<u>\$13,000</u>

PROSPECT POWER STATION ENGINE HALL

An Essential Facility

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a high-bay structural steel building with corrugated metal sheets on sidewalls and on the gable roof. Roof overhangs are very short. There are continuous ridge ventilators on the roof. There are three large doorways secured by one roll-up and two sliding doors. The windows do not have shutters.

Siting

The building is sited on gently sloping land which is not flood prone. There is no landslide risk.

Condition

The building is in good condition generally. One small section of metal wall siding is missing from the west wall.

Retrofit Recommendations

Storm shutters should be provided to protect the windows.

All of the doors should be checked for flawless operation and should be repaired where necessary. Removable metal braces should be used to reinforce the roll-up door when hurricane winds are forecast.

The sidewall sheeting should be repaired. The connections of the ventilators to the roof structure should be checked to ensure that it is adequate.

Estimated Cost

Storm shutters	\$5,000
Door repairs	\$5,000
Door braces	\$2,000
Sidewall repair	\$500
Total:	<u>\$12,500</u>

Facility No. 82

NEWCASTLE POTTERY

An Essential Facility

Vulnerability

The vulnerability assessment indicates high vulnerability to earthquake and high vulnerability to hurricane.

Description

This is a single storey, reinforced concrete block building with a light timber-framed roof clad with corrugated metal sheets. There are no interior bracing walls along the 46-foot long sidewalls. Roof overhangs are generous and there is an open, roofed porch. Windows are not protected by shutters.

Siting

The building is situated on flat land set back from near the coast. It is sufficiently high above mean sea level (elevation 25 feet) to be protected from storm surges.

There are no flooding or landslide risks.

Condition

The condition of the building is fair.

Retrofit Recommendations

The plan configuration of this building is such that stability of the long unbraced sidewalls during a hazard event must be dependent on the ability of the roof to transfer lateral loads to the endwalls by diaphragm action. However, there is no roof decking in place to perform this function.

The roof sheets are said to be more than 20 years old.

It is recommended that this building be re-roofed. Once the roof sheets are removed properly fastened plywood decking of appropriate grade and thickness should be installed. Rafter anchorages should also be upgraded as necessary.

The roof overhang should be shortened and decking and sheeting above the porch should be securely fastened.

In general, the new sheets should be of trapezoidal profile and fasteners should be galvanized screws rather than nails.

Storm shutters should be fitted to protect the windows.

Estimated Cost

Storm shutters	\$9,000
Cut back roof overhang and make good	\$6,000
Re-sheet existing roof:	\$26,000
Install roof decking	\$15,000
Total:	<u>\$56,000</u>

OFFICE AND STOREROOM

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a single storey, reinforced concrete building with concrete block walls. The roof is a low-pitched, mono-slope roof framed with light wood rafters and clad with corrugated metal panels. There are no storm shutters to protect the windows.

Siting

The building is located on flat land. It is not subject to flooding and there is no landslide risk.

Condition

The building is in poor condition. The roof is more than 20 years old. It leaks badly. Walls are cracked and are separating from the columns all around.

Retrofit Recommendations

The building should be re-roofed. The opportunity should be taken to shorten the roof overhangs and upgrade the rafter tie-down as necessary.

Cracks in walls should be routed out and repaired with mortar. Also, walls should be anchored to adjoining columns. This should be done by breaking out the wall at 48-inch intervals, drilling the column 4 inches deep and grouting-in a half-inch diameter bar, 12 inches long, using high strength epoxy bonding agent. The wall should then be repaired with concrete.

Storm shutters should be installed as protection for the windows.

Estimated Cost

Storm shutter	\$9,000
Cut back roof overhang and make good, Re-sheet existing roof	\$23,000 (metal sheeting only)
Rout out wall cracks and repair with mortar	\$8,000
Anchor walls to adjoining columns	\$10,000
Total:	<u>\$50,000</u>

Facility No. 84

MINISTRY OF AGRICULTURE BUILDING

Vulnerability

The vulnerability assessment indicates high vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a two-storey, pre-engineered steel-framed building. Walls are four inches thick, prefabricated, composite cement-fibre panels.

The roof is a hip which is clad with corrugated metal sheets. Roof overhangs are about two feet long and are soffited. There is a corridor along one side and the main roof extends to cover the corridor. The corridor roof is also soffited.

The windows do not have shutters.

Siting

The building is located on sloping land which is not prone to flooding. There is no landslide risk.

Condition

The building is in excellent condition.

Retrofit Recommendations

Hinged storm shutters should be installed to protect the windows.

Estimated Cost

Storm shutter	\$33,000
Total:	<u>\$33,000</u>

Facility No. 85A

PUBLIC WORKS DEPARTMENT
ADMINISTRATION OFFICES

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a small, single-storey wood building. Walls are constructed of plywood nailed to studs which are braced at corners. The roof is flat and is clad with corrugated metal sheets. Roof overhangs are short. Wall-to-floor and wall-to-roof anchorages were not determined.

Windows have no shutters.

Siting

The building is sited on gently sloping ground. It is not prone to flooding and there is no landslide risk.

Condition

The building is in dubious condition as there are signs of termite infestation of the framing members.

Retrofit Recommendations

Ceiling and floor should be opened so that wall anchorage could be inspected and confirmed.

Framing members should be inspected by a termite eradicator who should advise on the extent of destruction of the wood.

Shutters should be installed.

Estimated Cost

Storm shutter	\$6,000
Total:	<u>\$6,000</u>

Facility No. 85B

PUBLIC WORKS DEPARTMENT

(STORES SHED)

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and high vulnerability to hurricane.

Description

This is a single storey unreinforced stone masonry structure with a light, wood-framed hip roof which is clad with corrugated metal panels. The roof is not positively anchored on the walls. Roof overhangs are very short. Windows were at one time shuttered.

Siting

The building is sited on gently sloping ground which is not flood prone. There is no risk of landslide.

Condition

The building is in poor condition. The roof sheeting is rusting all over. In some areas the sheet has rusted through and the resulting hole gives rise to leaks. There are cracks in the stonework. Wooden doors and window shutters are in a state of disrepair or are missing altogether.

Retrofit Recommendations

This building should be re-roofed. At the same time a reinforced concrete ring beam should be cast at the top of the wall and the rafters should be secured to it with hurricane clips.

The stonework should be repaired with a cement-sand-lime mortar.

Storm shutters should be installed to protect the windows. New doors should be installed.

Estimated Cost

Storm shutter	\$4,000
Doors	\$1,000
New roof sheeting	\$10,000
Wall repairs and Ring beam	\$5,000
Total:	<u>\$20,000</u>

Facility No. 85C

PUBLIC WORKS DEPARTMENT
WATER DEPARTMENT OFFICES

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a two-storey structure of mixed construction types-unreinforced masonry, reinforced concrete blockwork, reinforced concrete and wood. The upper storey (partial only) is of wood construction and the hip roof over this section is clad with corrugated metal sheets. The roof overhang is short. A reinforced concrete slab roofs the remainder of the lower storey.

The windows do not have shutters.

Siting

The building is sited on gently sloping ground which is not flood prone. There is no risk of landslide.

Condition

The building is in fair condition generally.

The concrete roof is cracked in places and so there are some leaks.

Retrofit Recommendations

Hinged shutters should be installed to protect the windows.

The concrete roof should be sealed.

Estimated Cost

Storm shutter	\$18,000
Sealing roof	\$13,000
Total:	<u>\$31,000</u>

Facility No. 86

MINISTRY OF COMMUNICATIONS BUILDING

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and low vulnerability to hurricane.

Description

This two-storey, reinforced concrete building has reinforced concrete block walls and light, timber-framed roofs clad with corrugated metal sheets.

Roof overhangs are short.

The windows are not protected by shutters.

Siting

The building is located on gently sloping ground. It is not subject to flooding. There is no landslide risk.

Condition

The building is in good condition.

Retrofit Recommendations

Storm shutters should be fitted to protect the windows.

Estimated Cost

Storm shutters	\$67,000
Total:	<u>\$67,000</u>

Facility No. 87

CHARLESTOWN POST OFFICE

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a two-storey building. The lower storey is constructed of stone masonry and concrete block masonry. The upper storey is constructed of braced wood studs with ship-lapped wood siding.

The roof is a well-pitched hip, framed with light wood rafters and clad with corrugated metal sheets. Roof overhangs are short.

A section of the building has a reinforced concrete roof.

Windows are shuttered except at the eastside of the upper floor.

Siting

The building is located on flat land near the coast and near to a major storm water channel. It would be subject to flooding if the channel is over-topped and it is also subjected to storm surges. There is no landslide risk.

Condition

The building is in fair condition.

Cracking was observed at the interface of stone masonry and concrete masonry walls. No leaking was reported.

Retrofit Recommendations

Storm shutters should be provided for the upper level, east side windows – even though the windows are of the awning type.

Estimated Cost

Storm shutters	\$14,000
Total:	<u>\$14,000</u>

Facility No. 88

INFIRMARY, CHARLESTOWN

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a single-storey, unreinforced stone masonry building. The roof is a well-pitched gable framed with light wood rafters and clad with corrugated metal sheets. Roof overhangs are short.

There is an open, roofed verandah on one side. The verandah roof is separated from the main roof. Most of the windows are shuttered.

Siting

The building sits on gently sloping ground which is well drained. There is no risk of landslide.

Condition

The building is in fair condition.

Retrofit Recommendations

The three windows which are not shuttered should be protected with storm shutters.

Additional roof sheet fasteners should be inserted in the area above the verandah.

Estimated Cost

Storm shutters	\$25,000
Additional roof sheet fasteners	\$10,000
Total:	<u>\$35,000</u>

Facility No. 90

COTTON HOUSE

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a single-storey, unreinforced stone masonry building with a light, timber-framed roof. The roof is a well-pitched hip which is clad with corrugated metal sheets. Roof overhangs are short.

The windows and french doors are not protected by shutters.

Siting

The building is on flat land near the coast. There is no risk of flooding or of landslide but the site is subject to storm surges.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be fitted as protection for windows and doors.

In as much as the roof is more than 20 years old it should be inspected closely to determine if it should be re-roofed at this time.

Estimated Cost

Storm shutters	\$68,000
Total:	<u>\$68,000</u>

Facility No. 91

CMC BUILDING

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This reinforced concrete building is essentially single storey but has a small upper floor. The gable roofs are framed from wood and are clad with corrugated metal sheets. The windows are not shuttered.

Siting

The building is located on flat land on the coast. It would be subject to storm surges. There is no landslide risk.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

Estimated Cost

Storm shutters	\$15,000
Total:	<u>\$15,000</u>

Facility No. 92

FOTHERGILLS PUMP HOUSE

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a single-storey, concrete block building with a reinforced concrete roof.

The windows do not have shutters.

Siting

The building is located on sloping land which is not prone to flooding. There is no landslide risk.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be installed as protection for the windows.

Estimated Cost

Storm shutters	\$8,000
Total:	<u>\$8,000</u>

Facility No. 95B

GOVERNMENT REPAIR SHOP (PROSPECT)

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a single storey, unreinforced stone masonry building. Walls are 18 inches thick. The gable roof is well pitched and is clad with corrugated metal sheets. Roof overhangs are short. There is an open, roofed verandah on one side. The roof over the verandah is separated from the main roof. The gable ends, from top of wall to ridge, are constructed of timber and are clad with wood shingles.

A nearby open sided shed forms part of this facility. The construction is not substantial. It should be considered highly vulnerable to hazard events.

Siting

The facility is located on sloping ground. Neither landslide nor flooding is a likely hazard.

Condition

The building is in fair condition.

Retrofit Recommendations

Storm shutters should be installed to protect the windows.

Additional roof sheet fasteners should be installed in the area over the verandah.

Estimated Cost

Storm shutters	\$11,000
Additional roof sheet fasteners	\$4,000
Total:	<u>\$15,000</u>

NURSES QUARTERS

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a single-storey, reinforced concrete building with concrete block walls. The roof is a wood framed mono-slope with a good pitch.

It is clad with corrugated metal sheets. Roof overhangs are short.

The rafters are held in the wall by an anchoring detail which is no longer recommended. See Appendix I.

The windows have no shutters.

Siting

The building is located on gently sloping ground. It is not subject to flooding. There is no landslide risk.

Condition

The building is in fair condition.

Retrofit Recommendations

Hinged storm shutter should be installed as protection for the windows.

The roof sheeting is more than twenty years old. Although no breaks were reported it is recommended that the roof be inspected closely to determine whether the sheeting should be replaced at this time.

Estimated Cost

Storm shutter	\$5,000
Re-sheet existing roof	\$7,000
Total:	<u>\$12,000</u>

Facility No. 100

NURSES HOME

Vulnerability

The vulnerability assessment indicates high vulnerability to earthquake and high vulnerability to hurricane.

Description

This is a single storey, reinforced concrete block structure with light, timber-framed roof. The roof is a well pitched gable which is clad with corrugated asbestos sheets. The roof overhangs are short and the rafters are anchored on the wall by a fixing detail which is no longer recommended. (See Appendix A)

The exterior walls are 4 inches thick. There are no interior bracing walls. There is an open, roofed verandah on one side. This roof is separated from the main roof.

The windows are not protected by shutters.

Siting

The building is sited on flat land which is not subject to flooding. There is no landslide risk.

Condition

The building is in fair condition.

Retrofit Recommendations

In general, four inches thick concrete block construction is not recommended as exterior load bearing walls. Such walls cannot be relied upon to offer the required resistance to earthquake and hurricane wind forces.

Early consideration should be given to building these walls out to at least eight inches thickness. This could be done by installing a curtain of steel mesh reinforcing then adding the concrete thickness by the guniting process.

The open plan configuration of the building is unfavorable. Consideration should be given to redesigning the space so that six-inch thick bracing walls could be added. Failing this, a roof diaphragm would need to be designed to carry horizontal forces to the strengthened end walls. This would involve replacing the roof deck and the sheeting and additional rafters would likely be required.

The windows should be fitted with storm shutters.

Estimated Cost

Storm shutters	\$13,000
Strengthened walls	\$101,000
Roof sheeting	\$21,000
Install roof diaphragm	\$31,000
Total:	<u>\$166,000</u>

Facility No. 101

VETERINARY CLINIC

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This is a single storey, reinforced concrete block building with light, wood-framed gable roof. It is clad with corrugated metal panels. Roof overhangs are about two feet long. There is an open-sided corridor along one side of the building. The main roof continues across the exterior wall to form the roof of the corridor.

The windows have no shutters.

Siting

The building is located on gently sloping land. It is subject to flooding. There is no landslide risk.

Condition

The building is in good condition.

Retrofit Recommendations

The roof overhangs and the corridor roof should be fitted with soffits.

Storm shutters should be installed to protect the windows.

Estimated Cost

Storm shutters	\$4,000
Soffit boards	\$9,000
Total:	<u>\$13,000</u>

Facility No. 102

DOCTOR'S RESIDENCE

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This facility is a single storey unreinforced stone masonry structure. The roof profile is a gable, well pitched and clad with corrugated metal sheets. Roof overhangs are short. There is an open verandah which wraps around 2 sides of the building. The verandah roof is separated from the main roof.

There are outer wooden shutters to protect the glass panelled doors but the metal louvre windows are not fitted with shutters.

Siting

The building is situated on gently sloping land. The site is not subjected to flooding and there is no landslide risk

Condition

The building is in fair condition.

The roof sheeting is over 20 years old and is showing signs of corrosion.

Retrofit Recommendations

Storm shutters should be fitted as protection for the windows. Consideration should be given to replacing the roof sheets, even though no leaks were reported.

Estimated Cost

Storm shutters	\$18,000
New metal sheeting (roof) shingles	\$49,000
Total:	<u>\$67,000</u>

Facility No. 104

DAY CARE CENTRE (HARDTIMES)

Vulnerability

The vulnerability assessment indicates low vulnerability to earthquake and moderate vulnerability to hurricane.

Description

This facility is a single storey reinforced concrete block building with a light, timber-framed gable roof which is clad with corrugated metal sheets. Roof overhangs are short. The rafters are attached to the wall by a fixing detail which is not recommended. (See Appendix I)

The windows are not protected with shutters.

Siting

The building is situated on flat land. It is not subject to flooding. There is no landslide risk.

Condition

The building is in excellent condition.

Retrofit Recommendations

The windows should be fitted with storm shutters. Saddle type rafter-to-wall hurricane straps should be installed at each rafter.

Estimated Cost

Storm shutters	\$12,000
Saddle-type hurricane straps	\$2,000
Total:	<u>\$14,000</u>

Facility No. 105

OFFICERS' LIVING QUARTERS BUTTLERS

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and low vulnerability to hurricane.

Description

This facility is a single storey reinforced concrete block structure with a flat concrete roof.

The windows are not protected with shutters.

Siting

The building is sited on sloping ground. It is not subject to flooding. There is no landslide risk.

Condition

The building is in excellent condition.

Retrofit Recommendations

Hinged storm shutters should be installed to protect the windows.

There is an apparent sag in one part of the roof. No cracking was observed. This should be investigated and remedied by filling out the hollow with concrete screed.

Ponding of water on the roof is undesirable.

Estimated Cost

Storm shutters	\$15,000
Fill hollow in roof with concrete screed	\$1,000
Total:	<u>\$16,000</u>

Facility No. 106

KITCHEN/DINING ROOM BUTLERS

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a single storey unreinforced stone masonry building. The walls are twenty-two inches thick. The mono-slope roof is supported on wood rafters. It is clad with corrugated metal sheets. There are no roof overhangs. The windows are shuttered.

Siting

The building is located on gently sloping ground. There is no risk of flooding and no landslide risk.

Condition

The building is in fair condition.

Retrofit Recommendations

None

Facility No. 107

COTTON GROUND HEALTH CENTRE

Vulnerability

The vulnerability assessment indicates moderate vulnerability to earthquake and low vulnerability to hurricane.

Description

This is a single storey structure with a well-pitched gable roof. Roof cladding is with corrugated metal sheeting. Roof overhangs are short. There are no verandahs.

Walls are 18 inches thick.

Many of the windows have no outer shutters.

Siting

The building is located on flat ground which is not subject to flooding. There is no landslide risk.

Condition

The building is in good condition.

Retrofit Recommendations

Storm shutters should be fitted to protect the windows.

Estimated Cost

Storm shutters	\$6,000
Total	<u>\$6,000</u>

APPENDIX V

Facilities Data Collected

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Instructions for Entering Building Data for Structure Vulnerability Assessment

Column Number	Description	Enter onto Assessment form
1	Facility Number	Number
2	Location	Location
3	Construction Year	Construction Year
4	Elevation	Elevation, in feet above sea level
5	Distance from Coast	Distance in miles
6	Engineering Level Formally engineered Not engineered Don't Know	FE NE DK
7	Code Used ASCE 7 MODEL Don't Know Other	ASCE 7 MODEL DK O
8	Interior Walls Moveable partitions Stud walls Masonry or Concrete walls Fibreboard panel None	Moveable Stud Masonry Fibreboard None
9	No. of stories	No. of stories
10	Class Reinforced Concrete Light Steel Heavy Steel Reinforced Masonry Unreinforced Masonry Timber Other	RC LS HS RM URM T O
11	Age of Roof	Years
12	Roof Geometry Flat Gable Hip Other	Flat Gable Hip O

13	Roof Covering	
	Built Up Roof with gravel	BUG
	Standing Seam Metal Roof	SSMR
	Metal Profiled Sheets	MPS
	Asbestos Cement Sheets	ACS
	Tile Roof	TR
	Timber Shingles	TS
	Asphalt Shingles	AS
	Other	O
14	Roof Decking	
	Cast-in-place concrete slab	CS
	Pre-cast Concrete	PC
	Metal Deck	MD
	Wood Battens	WB
	Plywood	PW
	Wooden Planks	WP
	Other	O
15	Roof Framing	
	Reinforced Concrete	RC
	Steel Beam	SB
	Steel Truss	ST
	Open-Web Steel Joist	OWSJ
	Tapered Steel Beam	TSB
	Wood Truss	WT
	Wood Beam or Rafter	WBR
	Other	O
16	Wall Framing	
	Reinforced Concrete	RC
	Steel	STL
	Reinforced Masonry	RM
	Unreinforced Masonry	URM
	Wood	WD
	Other	O
17	Cladding	
	Reinforced Concrete Block	RCB
	Unreinforced Masonry	URCB
	Precast Concrete Elements	PCE
	Stone Panels	SP
	Metal Panels	MP
	Wood	WD
	Other	O

18	Roof-Frame Connection	
	Yes	Y
	No	N
	Don't Know	DK
19	Percent Of Wall Area	Percentage
20	Window Protection	
	Yes	Y
	No	N
	Don't Know	DK
21	Roof / Wall Area	Ratio
22	Surrounding Terrain	
	Coastal	C
	Open Field	OF
	Town	TW
23	Topography	
	Essentially Flat	FL
	Hillside or Ridge	HR
	Cliff	CL
24	Debris Hazard	
	Yes	Y
	No	N
25	Storm Surge Hazard	
	Yes	Y
	No	N
26	Landslide Hazard	
	Yes	Y
	No	N
27	Rating	
	High	H
	Moderate	M
	Low	L

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country: St Kitts and Nevis - St Kitts Island
 Engineer:
 Date:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Facility No.	Location	Year Built	Elev (feet)	Distance from coast (Mile)	Eng Level	Code Used	Interior Walls	No. of Stories	Class	Age of Roof (Yrs)	Roof Geometry	Roof Covering	Roof Decking
1	B'terre, Central	1952	20'	0.2	FE	MODEL	MASONRY	3	RC	>20	FLAT	O	CS
2	B'terre, West	1972	300'	0.7	FE	MODEL	MASONRY	2	LS	>20	GABLE	MPS	O
3	Old Road	1968	40'	0.11	FE	MODEL	MASONRY	2	RC	>20	O	MPS	WB
4	Sandy Point												
5	St Pauls	1971	200'	0.6	FE	MODEL	MASONRY	2	LS	>20	GABLE	MPS	O
6	Dieppe Bay												
7	Tabernacl	1950	200'	0.5	DK	DK	MASONRY	1	URM	>20	HIP	MPS	WP
7B		1975	200'	0.5	FE	MODEL	STUD	1	LS	>20	GABLE	MPS	O
8	Cayon	1972	350'	0.7	FE	MODEL	MASONRY	2	LS	>20	GABLE	MPS	O
9	Stapleton	1973-1983	600'	2.3	NE	MODEL	MASONRY	1	RM	5 to 10	HIP	MPS	PW
10	Basseterre												
11		1972	8'	0.1	FE	MODEL	FIBREBOARD	1	LS	>20	GABLE	MPS	O
11B	Basseterre	1972	8'	0.1	FE	MODEL	FIBREBOARD	2	LS	>20	GABLE	MPS	O
11C		1972	8'	0.1	FE	MODEL	FIBREBOARD	1	LS	>20	GABLE	MPS	O
11D		1972	8'	0.1	FE	MODEL	FIBREBOARD	1	LS	>20	GABLE	MPS	O
12	Basseterre	1968	8'	0.1	FE	MODEL	MASONRY	2	RC	11 to 15	GABLE	MPS	O

RENTED PROPERTY

ABANDONED

RENTED PROPERTY

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country: St Kitts and Nevis - St Kitts Island
 Engineer:
 Date:

Facility No.	15		16	17	18	19	20	21	22	23	24	25	26	27
	Roof Framing	Roof/Wall Area												
1	RC	URM	RC	URM	Y	21 to 60	N	0.49:1 to 0.25:1	TW	IRR	Y	N	N	L
2	SB	RCB	STL	RCB	Y	21 to 60	N	<0.25:1	TW	IRR	Y	N	N	M
3	WBR	RCB	RC	RCB	Y	21 to 60	N	<0.25:1	TW	FL	Y	N	N	L
4	RENTED PROPERTY													
5	SB	RCB	STL	RCB	Y	21 to 60	N	<0.25:1	TW	IRR	Y	N	Y	M
6	ABANDONED													
7	WBR	URM	RC	URM	Y	21 to 60	Y	<0.25:1	TW	FL	Y	N	N	II
7B	ST	O	STL	O	Y	21 to 60	N	<0.25:1	TW	FL	Y	N	N	M
8	SB	RCB	STL	RCB	Y	21 to 60	Y	<0.25:1	TW	IRR	Y	N	N	L
9	WBR	RCB	RM	RCB	Y	21 to 60	N	<0.25:1	TW	IRR	Y	N	Y	L
10	RENTED PROPERTY													
11	SB	RCB	STL	RCB	Y	21 to 60	N	<0.25:1	TW	FL	Y	Y	N	II
11B	ST	O	STL	O	Y	21 to 60	N	<0.25:1	TW	FL	Y	Y	N	II
11C	ST	O	STL	O	Y	21 to 60	N	<0.25:1	TW	FL	Y	Y	N	II
11D	ST	O	STL	O	Y	21 to 60	N	<0.25:1	TW	FL	Y	Y	N	II
12	WT	RCB	RC	RCB	Y	21 to 60	N	<0.25:1	TW	FL	Y	Y	N	M

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country: St Kitts and Nevis - St Kitts Island

Engineer:

Date:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Facility No.	Location	Year Built	Elev (feet)	Distance from coast (Mile)	Eng Level	Code Used	Interior Walls	No. of Stories	Class	Age of Roof (Yrs)	Roof Geometry	Roof Covering	Roof Decking
PRIVATELY OWNED													
13	Port Zante												
14	Port Basseterre	1991	25'	0	NE	MODEL	MASONRY	2	RC	5 to 10	IHP	AS	PW
15	Port Basseterre	1982	13'	0	FE	MODEL	MASONRY	1	RM	16 to 20	IHP	MPS	O
15B		1993	13'	0	DK	DK	MASONRY	2	RC		IHP	AS	WP
16	Port Basseterre	1986	10'	0	FE	MODEL	NONE	1	LS	16 to 20	GABLE	MPS	O
17	RLB Int'l Airport	1974	130'	1	FE	MODEL	MASONRY	1	RC	11 to 15	GABLE	MPS	O
17B		1974	130'	1	DK	DK	MASONRY	2	RC	>20	IHP	AS	PW
18	RLB Int'l Airport	1974	130'	1	FE	MODEL	NONE	1	LS	>20	GABLE	MPS	O
TO BE RECONSTRUCTED													
19	Sandy Point												
20	Molineux	1986	380'	0.8	FE	MODEL	MASONRY	1 1/2	RM	16 to 20	IHP	MPS	WB
21	Basseterre	Before 1973	100'	0.4	DK	MODEL	MASONRY	1	RM	5 to 10	FLAT/GABLE	MPS	PW
21B		Before 1973	100'	0.4	DK	MODEL	MASONRY	1	RM	5 to 10	FLAT/GABLE	MPS	PW
22	Bird Rock	1987	20'	0	FE	MODEL	MASONRY	2	LS	11 to 15	GABLE	MPS	O

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country: St Kitts and Nevis - St Kitts Island
 Engineer:
 Date:

Facility No.	15		16	17	18	19	20	21	22	23	24	25	26	27
	Roof Framing	Roof Framing												
	P	S	Wall Framing	Cladding	Rf-Frame Connection	% of wall area covered by glass, mesh, vent flocks	Window Protection	Roof/Wall Area	Surrounding Terrain	Topography	Debris Hazard	Storm Surge Hazard	Landslide Hazard	Rating
13	PRIVATELY OWNED													
14	WBR		RC	RCB	Y	21 to 60	N	<0.25:1	C	IIR	Y	N	Y	II
15	O		RM	RCB	DK	21 to 60	N	0.49:1 to 0.25:1	C	FL	Y	N	Y	M
15B	WBR		RC	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	OF	FL	Y	N	Y	II
16	SB		STL	RCB	Y	21 to 60	N	<0.25:1	C	FL	N	Y	N	L
17	RC		RC	RCB	Y	21 to 60 / 60	N	0.49:1 to 0.25:1	OF	HR	Y	N	N	L
17B	WBR		RC	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	OF	FL	Y	N	N	II
18	ISB		STL	RCB	Y	6 to 20	N	0.49:1 to 0.25:1	OF	FL	Y	N	N	II
19	TO BE RECONSTRUCTED													
20	WBR		RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	OF	IIR	Y	N	N	M
21	RC		RM	RCB	Y	21 to 60	Y	0.49:1 to 0.25:1	TW	FL	Y	N	N	L
21B	RC		RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	TW	FL	Y	N	N	L
22	SB		STL	MP	Y		N	0.49:1 to 0.25:1	C	FL	Y	N	N	L

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country:		St Kitts and Nevis - St Kitts Island											
Engineer:													
Date:													
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Facility No.	Location	Year Built	Elev (feet)	Distance from coast (Mile)	Eng Level	Code Used	Interior Walls	No. of Stories	Class	Age of Roof (Yrs)	Roof Geometry	Roof Covering	Roof Decking
23	Bird Rock	1977	75'	0.1	FE	O	MASONRY	1	LS	>20	GABLE	MPS	O
24	Bird Rock	1973	60'	0.1	FE	MODEL	STUD / MASONRY	1	LS	5 to 10	FLAT / GABLE	MPS	MD
25	Bay Road	SEE FACILITY NO. 36											
26	Basseterre	1949	40'	0.1	FE	MODEL	STUD	2	RC	>20	FLAT	O	CS
27	Cayon	2000	450'	0.7	FE	MODEL	MASONRY	1	RM	<5	HIP	MPS	O
28	Molineux	1952	400'	0.9	DK	DK	MASONRY	1	RM	5 to 10	HIP	AS	PW
29	Tabernacle	Before 1973	200'	0.5	DK	DK	MASONRY	1	RM	11 to 15	GABLE	MPS	WB
30	Saddlers	1954	100'	0.2	NE	DK	MASONRY	1	RM	5 to 10	GABLE / HIP	AS	PW
31	Dieppe Bay	1973 - 1983	50'	0.1	NE	DK	MASONRY	1	RM	<5	GABLE	AS	PW
32	St Pauls	1973 - 1983	170'	0.4	NE	DK	MASONRY	1	RM	5 to 10	GABLE	MPS	PW
33	Sandy Point	1955	80'	0.10	NE	DK	MASONRY	1	RM	16 to 20	GABLE	MPS	PW

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country: St Kitts and Nevis - St Kitts Island

Engineer:

Date:

Facility No.	15		16	17	18	19	20	21	22	23	24	25	26	27
	Roof Framing P	Roof Framing S	Wall Framing	Cladding	Ri-Frame Connection	% of wall area covered by glass, mesh vent blocks	Window Protection	Roof/Wall Area	Surrounding Terrain	Topography	Debris Hazard	Storm Surge Hazard	Landslide Hazard	Rating
23	SB		STL	RCB	Y	6 to 20	N		C	FL	Y	N	Y	M
24	STL		RM	RCB	Y	6 to 20	N		C	FL	Y	N	N	H
25	SEE FACILITY NO. 36													
26	RC		RC	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	TW	HR	Y	N	N	L
27	WBR		RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	TW	HR	Y	N	N	L
28	WBR		RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	TW	HR	Y	N	N	H
29	WBR		RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	TW	FL	Y	N	N	L
30	WBR		RM	RCB	Y	21 to 60	N	<0.25:1	TW	HR	Y	N	N	H
31	WBR		RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	OF	FL	Y	N	N	H
32	WBR		RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	OF	FL	Y	N	N	M
33	WBR		RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	TW	HR	Y	N	N	L

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country: St Kitts and Nevis - St Kitts Island

Engineer:

Date:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Facility No.	Location	Year Built	Elev (feet)	Distance from coast (Mile)	Eng Level	Code Used	Interior Walls	No. of Stories	Class	Age of Roof (Yrs)	Roof Geometry	Roof Covering	Roof Decking
34	Old Road	1973 - 1983	35'	0.1	DK	DK	MASONRY	1	RM	5 to 10	GABLE	MPS	PW
35	Ponds Pasture	1975	8'	0	DK	DK	MASONRY	1	RC	>20	GABLE	MPS	PW
36	Basseterre	1960	10'	0	FE	MODEL	MASONRY	2	RC	11 to 15	HIP	MPS	WB

RENTED PROPERTY

37	38	39	40	41	42	43	43B	44	44B	44C	44D	44E
Location	Year Built	Elev (feet)	Distance from coast (Mile)	Eng Level	Code Used	Interior Walls	No. of Stories	Class	Age of Roof (Yrs)	Roof Geometry	Roof Covering	Roof Decking
Cayon												
Sandy Point												
Needsmust	1972	75'	0.8	FE	MODEL	NONE	1	LS	>20	GABLE	MPS	O
Basseterre	1995	8'	0.1	FE	MODEL	MASONRY	2	RC	5 to 10	HIP	MPS	MD
Basseterre	1963 / 1995	15'	0.1	FE	MODEL	MASONRY	3	RC	>20	FLAT	O	CS
Basseterre	1978	10'	0	FE	MODEL	NONE	1	LS	>20	GABLE	O	O
Basseterre	1958	155'	0.5	FE	MODEL	MASONRY	1	RC	<5 / >20	HIP	MPS	WB
Basseterre	1972	155'	0.5	FE	MODEL	MASONRY	1	RC	>20	HIP	MPS	WB
Basseterre	1985	155'	0.5	FE	ASCE7	MASONRY	2	RM	11 to 15	GABLE	AS	PW
Basseterre	1985	155'	0.5	FE	ASCE7	MASONRY	1	RM	11 to 15	GABLE	AS	PW
Basseterre	1999	155'	0.5	FE	ASCE7	STUD	2	RM	<5	HIP	MPS	MD
Basseterre	1969	155'	0.5	DK	ASCE7	MASONRY	1	RC	5 to 10	GABLE	MPS	PW
Basseterre	1969	155'	0.5	DK	ASCE7	MASONRY	1	RC	5 to 10	GABLE	MPS	PW

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country:	St Kitts and Nevis - St Kitts Island
Engineer:	
Date:	

Facility No.	15		16	17	18	19	20	21	22	23	24	25	26	27
	Roof Framing	Wall Framing												
	P	S				% of wall area covered by glass, mesh, vent blocks	Window Protection	Roof/Wall Area	Surrounding Terrain	Topography	Debris Hazard	Storm Surge Hazard	Landslide Hazard	Rating
34	WBR		RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	TW	FL	Y	N	N	M
35	WT		RC	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	OF	FL	Y	Y	N	II
36	WBR		RC	RCB	Y	21 to 60	N	<0.25:1	OF	FL	Y	Y	N	L

RENTED PROPERTY

RENTED PROPERTY														
RENTED PROPERTY														
39	SB		STL	MP	Y	6 to 20	N	0.49:1 to 0.25:1	TW	FL	Y	N	N	L
40	ST		RC	RCB	Y	6 to 20	N	<0.25:1	TW	FL	Y	Y	N	L
41	RC		RC	RCB	Y	21 to 60	Y	<0.25:1	TW	FL	Y	N	N	L
42	SB		STL	O	Y	>60	N/A	>5:1	C	FL	Y	Y	N	M
43	WBR		RM	RCB	Y	6 to 20 / 0 to 5	Y	0.49:1 to 0.25:1	TW	FL	Y	N	N	M
43B	WDR		RC	RCB	Y	6 to 20 / 0 to 5	Y	0.49:1 to 0.25:1	TW	FL	Y	N	N	L
44	RC		RM	RCB	Y	6 to 20	N	0.49:1 to 0.25:1	OF	FL	Y	N	N	H
44B	RC		RM	RCB	Y	6 to 20	N	0.49:1 to 0.25:1	OF	FL	Y	N	N	H
44C	ST		STL	RCB	Y	6 to 20	N	0.49:1 to 0.25:1	OF	FL	Y	N	N	L
44D	RC		RC	RCB	Y	6 to 20	N	0.49:1 to 0.25:1	OF	FL	Y	N	N	L
44E	RC		RC	RCB	Y	6 to 20	N	0.49:1 to 0.25:1	OF	FL	Y	N	N	L

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country:		St Kitts and Nevis - St Kitts Island													
Engineer:															
Date:															
1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Facility No.	Location	Year Built	Elev (feet)	Distance from coast (Mile)	Eng Level	Code Used	Interior Walls	No. of Stories	Class	Age of Roof (Yrs)	Roof Geometry	Roof Covering	Roof Decking		
45	Basseterre	Before 1973	10'	0	FE	MODEL	STUD	2	URM	>20	HIP	MPS	O		
46	Basseterre	1973	20'	0.1	FE	MODEL	MOVEABLE	3	RC	>20	FLAT/GABLE	MPS/BUG	CS/PW		
47	Basseterre	1952	30'	0.3	FE	MODEL	MASONRY	2	RC	>20	FLAT	O	CS		
48	Basseterre	Before 1973	35'	0.1	FE	MODEL	STUD	1	URM	>20	HIP	MPS	O		
49	Basseterre	1973-1983	35'	0.1	FE	MODEL	MASONRY	2	RC	>20	FLAT	O	CS		
50	Basseterre	1950's	20'	0.1	FE	MODEL	MASONRY / STUD	3	RC	>20	HIP / FLAT	MPS	CS / PW / WP		
51	Basseterre	1996	20'	0.1	FE	MODEL	MASONRY	3	RC	5 to 10	FLAT	O	CS		
52	Forlands	Before 1973	50'	0.1	DK	MODEL	STUD	1	T	>20	GABLE	MPS	WP		
53	Basseterre		10'	0	FE	MODEL	MASONRY / STUD	2	LS	11 to 15	GABLE	MPS	O		
54	Basseterre	1974 / 1975	10'	0	FE	ASCE7	MASONRY	1	LS	5 to 10	FLAT / GABLE	MPS	MD		
55	Basseterre	Before 1973	20'	0.15	DK	MODEL	STUD	2	URM	>20	HIP	MPS	O		

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country:		St Kitts and Nevis - St Kitts Island												
Engineer:														
Date:														
Facility No.	15 Roof Framing		16 Wall Framing	17 Cladding	18 Rf-Frame Connection	19 % of wall area covered by glass, mesh, vent blocks	20 Window Protection	21 Roof/Wall Area	22 Surrounding Terrain	23 Topography	24 Debris Hazard	25 Storm Surge Hazard	26 Landslide Hazard	27 Railing
	P	S												
45	ST		URM	SP	Y	21 to 60	N	<0.25:1	C	FL	Y	Y	N	L
46	RC		RC	RCB	Y	21 to 60	N	<0.25:1	TW	FL	Y	N	N	M
47	WBR		RC	RCB	Y	21 to 60	N	<0.25:1	TW	FL	Y	N	N	L
48	ST		RC	URM	Y	21 to 60	N	0.49:1 to 0.25:1	TW	FL	Y	N	N	L
49	RC		RC	RCB	Y	21 to 60	N	<0.25:1	TW	FL	Y	N	N	M
50	RC		RC	RCB	N	6 to 20	Y		TW	FL	Y	N	N	L
51	RC		RC	RCB	Y	21 to 60	N	<0.25:1	TW	FL	Y	N	N	L
52	WBR		WD	WD	Y	21 to 60	Y	0.49:1 to 0.25:1	C	HR	Y	N	N	L
53	ST		STL	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	C	FL	Y	Y	N	L
54	ST		STL	RCB	Y	6 to 20	N		TW	FL	Y	Y	N	M
55	WBR		URM	SP	Y	21 to 60	Y	<0.25:1	TW	FL	Y	N	N	L

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country:		St Kitts and Nevis - Nevis Island											
Engineer:													
Date:													
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Facility No.	Location	Year Built	Elev (feet)	Distance from coast (Mile)	Eng Level	Code Used	Interior Walls	No. of Stories	Class	Age of Roof (Yrs)	Roof Geometry	Roof Covering	Roof Decking
56	Charlestown	1998	15'	0.1	FE	MODEL	MASONRY	2	RC	<5	FLAT	O	CS
56B		1800's / 1950's	15'	0.1	DK	MODEL	MASONRY	2	URM	<5	GABLE	MPS	WP
57	Cotton Ground	1950's	120'	0.6	NE	MODEL	MASONRY / STUD	1	URM	>20	HIP	MPS	WP
58	Gingerland	1953	725'	1.8	NE	MODEL	MASONRY / STUD	1	URM	>20	HIP	MPS	WP
59	New Castle	1973	10'	0.3	FE	MODEL	MASONRY	2	LS	11 to 15	GABLE	MPS	O
60	Charlestown	1951	150'	0.6	FE	MODEL	MASONRY	2	RC	>20	HIP	MPS / ACS	O
61	Charlestown	Before 1973	135'	0.6	FE	MODEL	MASONRY	2	RC	>20	HIP	MPS	WB
62	Charlestown	NO ACCESS											
63	Charlestown	1996	135'	0.6	FE	MODEL	MASONRY	1	RM	5 to 10	GABLE	MPS	WB
64	Charlestown	1998	135'	0.6	FE	MODEL	MASONRY	2	RM	5 to 10	HIP	AS	PW
65	Charlestown	1940's	15'	0.2	DK	MODEL	MASONRY	1	RC	>20	HIP	MPS	WP
66	Brown Hill	1950 / 1997	390'	1.6	DK	MODEL	MASONRY	1	RM	<5	GABLE	MPS	PW / WP
67	Butlers	1950's	160'	0.3	DK	MODEL	MASONRY	1	URM	<5	GABLE	MPS	WP
68	Combermere		145'	0.7	DK	DK	MASONRY	1	RM	<5	HIP	MPS	PW
69	Gingerland	1944 / 1997	725'	1.8	DK	DK	MASONRY	1	URM	<5	GABLE	MPS	PW

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country: St Kitts and Nevis - Nevis Island
Engineer:
Date:

Facility No.	15		16	17	18	19	20	21	22	23	24	25	26	27
	Roof Framing	Wall Framing												
	P	S		Cladding	Rc-Frame Connection	% of wall area covered by glass, mesh, vent blocks	Window Protection	Roof/Wall Area	Surrounding Terrain	Topography	Debris Hazard	Storm Surge Hazard	Landslide Hazard	Rating
56	RC		RC	RCB	Y	0 to 5	N	<0.25:1	TW	FL	Y	Y	N	L
56B	ST		URM	SP	Y	6 to 20	Y	<0.25:1	TW	FL	Y	Y	N	L
57	WBR		URM	SP	Y	21 to 60	Y	<0.25:1	OF	FL	Y	N	N	M
58	WBR		URM	SP	Y	21 to 60	Y	<0.25:1	TW	FL	Y	N	N	L
59	SB		STL	RCB	Y	21 to 60	N	<0.25:1	OF	FL	Y	Y	N	H
60	WBR		RC/URM	RCB/SP	N	21 to 60	Y	<0.25:1	TW	FL	Y	N	N	L
61	WBR		RC	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	TW	FL	Y	N	N	M
62	NO ACCESS													
63	WBR		RC/RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	TW	FL	Y	N	N	L
64	WBR		RC/RM	RCB	Y	21 to 60	N	<0.25:1	TW	FL	Y	N	N	H
65	WBR		RC	RCB	Y	21 to 60	N	<0.25:1	TW	FL	Y	N	N	L
66	WBR		RC	RCB/SP	Y	21 to 60	Y	0.49:1 to 0.25:1	OF	FL	Y	N	N	M
67	WBR		URM	SP	Y	21 to 60	Y	0.49:1 to 0.25:1	TW	FL	Y	N	N	L
68	WBR		RM	RCB	Y	21 to 60	N		OF	FL	Y	N	N	L
69	WBR		RC/URM	SP	Y	21 to 60	N	0.49:1 to 0.25:1	TW	FL	Y	N	N	L

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country:		St Kitts and Nevis - Nevis Island											
Engineer:													
Date:													
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Facility No.	Location	Year Built	Elev (feet)	Distance from coast	Eng Level (Mile)	Code Used	Interior Walls	No. of Stories	Class	Age of Roof (Yrs)	Roof Geometry	Roof Covering	Roof Decking
70	Gingerland	1978	750'	1.9	FE	MODEL	MASONRY	2	RC	11 to 15	GABLE	MPS	WB
71	St James	1979	200'	0.5	FE	MODEL	MASONRY	1	RC	>20	GABLE	MPS	PW / WB
72	Charlestown	1990	50'	0.2	FE	MODEL	MASONRY	2	RC	11 to 15	GABLE	MPS	PW
72B		1990	50'	0.2	FE	MODEL	MASONRY	1	RC	11 to 15	GABLE	MPS	PW
72C		1990	50'	0.2	FE	MODEL	MASONRY	1	RC	11 to 15	GABLE	MPS	PW
73	St Thomas	1970	100'	0.2	FE	MODEL	METAL	1	LS	>20	GABLE	MPS	O
74	Prospect	1965	350'	1.5	FE	MODEL	STUD	1	LS	5 to 10	GABLE	MPS	O
75	St John	+1988	725'	1.9	DK	DK	STUD	2	RM	11 to 15	GABLE	MPS	PW
76	New Castle	1985-1988	10'	0.3	FE	MODEL	MASONRY	1	RC	11 to 15	GABLE	MPS	O
76B		2001	10'	0.3	DK	DK	MASONRY	1	RM	<5	FLAT	O	CS
77	Charlestown	1996	15'	0.1	DK	DK	MASONRY	2	RM	5 to 10	GABLE	MPS	PW
78	Charlestown	*1877	10'	0	DK	DK	MASONRY	2	URM	>20	GABLE	MPS	WP / CS
79	Charlestown	1940	8'	0	DK	DK	MASONRY	1	RC	5 to 10 / >20	GABLE	MPS / ACS	PW / WP
80	Charlestown	1982	15'	0.1	FE	MODEL	MASONRY	2	RM	>20	GABLE	MPS	WB

re-built 1877
 *re-roofed 1997
 +upper level rebuilt

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country:		St Kitts and Nevis - Nevis Island													
Engineer:															
Date:															
Facility No.	15		16	17	18	19	20	21	22	23	24	25	26	27	
	P	S	Roof Framing	Wall Framing	Clauding	Rf-Frame Connection	% of wall area covered by glass, mesh, vent blocks	Window Protection	Roof/Wall Area	Surrounding Terrain	Topography	Debris Hazard	Storm Surge Hazard	Landslide Hazard	Rating
70	WBR		RC	RCB	Y	21 to 60	N	<0.25	TW	FL	Y	N	N	H	
71	WBR		RC	RCB	Y	21 to 60	Y	0.49:1 to 0.25:1	OF	FL	Y	N	N	M	
72	WBR		RC	RCB	Y	21 to 60	Y/N	<0.25:1	TW	FL	Y	N	N	L	
72B	WBR		RC	RCB	Y	21 to 60	Y/N	<0.25:1	TW	FL	Y	N	N	L	
72C	WBR		RC	RCB	Y	21 to 60	Y/N	<0.25:1	TW	FL	Y	N	N	L	
73	TSP		STL	MP	Y	21 to 60	N	<0.25:1	C	FL	Y	Y	N	H	
74	ST		STL	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	OF	FL	Y	N	N	M	
75	WBR		RM	RCB/SP	Y	21 to 60	N	<0.25:1	TW	FL	Y	N	N	L	
76	RC		RC	RCB	Y	21 to 60 / >60	N	0.49:1 to 0.25:1	C	FL	Y	N	N	L	
76B	RC		RM	RCB	Y	6 to 20	N	0.49:1 to 0.25:1	C	FL	Y	N	N	L	
77	WBR		RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	TW	FL	Y	N	N	M	
78	WBR		RC/URM	SP	Y	21 to 60	Y	0.49:1 to 0.25:1	TW	FL	Y	N	N	L	
79	WBR		RC	O	Y	>60	N	>5:1	C/TW	FL	Y	Y	N	L	
80	WBR		RM	RCB/SP	Y	21 to 60	N	<0.25:1	TW	FL	Y	N	N	L	

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country:		St Kitts and Nevis - Nevis Island											
Engineer:													
Date:													
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Facility No.	Location	Year Built	Elev (feet)	Distance from coast (Mile)	Eng Level	Code Used	Interior Walls	No. of Stories	Class	Age of Roof (Yrs)	Roof Geometry	Roof Covering	Roof Decking
81	Prospect	1984	250'	1.3	FE	MODEL	NONE	1	HS	16 to 20	GABLE	MPS	O
81B		1973 - 1983	250'	1.3	NE	DK	MASONRY	1	RM	>20	GABLE	MPS	PW
82	New Castle	1973 - 1983	25'	0.3	DK	DK	MASONRY	1	RM	>20	GABLE	MPS	WB
83	Prospect	1973 - 1983	250'	1.2	DK	DK	MASONRY	1	RM	>20	GABLE	MPS	WB
84	Prospect	2000	260'	1.3	FE	MODEL	STUD	2	LS	<5	HIP	MPS	O
85	Charlestown	1991/2	135'	0.6	NE	DK	STUD	1	T	11 to 15	FLAT	MPS	O
85B		1800's	135'	0.6	NE	DK	NONE	1	URM	>20	HIP	MPS	O
85C		1800's 1984 1997	135'	0.6	NE	DK	MASONRY	2	URM	5 to 10	FLAT / HIP	MPS / O	CS / PW
86	Stoney Grove	1994	85'	0.6	NE	O	STUD	2	RC	5 to 10	HIP	MPS	PW
87	Charlestown	Before 1973	10'	0	DK	DK	MASONRY / STUD	2	URM	>20	FLAT / HIP	MPS	WP
88	Charlestown	Before 1973	135'	0.6	DK	DK	MASONRY	1	URM	>20	GABLE	MPS	WB
89	Charlestown	TO BE RENOVATED											
90	Charlestown	DK	10'	0	DK	DK	MASONRY	1	URM	>20	HIP	MPS	O
91	Charlestown	DK	10'	0	DK	DK	MASONRY	2	RC	>20	GABLE	MPS	PW
92	Fothergills	1973 - 1983	560'	1.3	DK	DK	MASONRY	1	RM	>20	FLAT	O	CS

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country: St Kitts and Nevis - Nevis Island
 Engineer:
 Date:

Facility No.	15		16	17	18	19	20	21	22	23	24	25	26	27
	Roof Framing	Cladding												
81	SB	MP	STL	MP	Y	6 to 20	N	<0.25:1	OF	FL	Y	N	N	M
81B	WBR	RCB	RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	OF	FL	Y	N	N	M
82	WBR	RCB	RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	C	FL	Y	N	N	II
83	WBR	RCB	RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	OF	FL	Y	N	N	M
84	TSP	O	STL	O	Y	21 to 60	N	<0.25:1	OF	FL	Y	N	N	L
85	WBR	O	WD	O	DK	0 to 5	Y	0.49:1 to 0.25:1	TW	FL	Y	N	N	M
85B	WBR	O	URM	O	N	0 to 5	N	0.49:1 to 0.25:1	TW	FL	Y	N	N	II
85C	RC	RCB/SP	O/WD	RCB/SP	Y	0 to 5 / 6 to 20	N	<0.25:1	TW	FL	Y	N	N	L
86	WBR	RC	RC	RCB	N	21 to 60	N		OF	HR	Y	N	N	L
87	RC	RCB/URM/WD	RM/URM/WD	RCB/URM/WD	Y	21 to 60	Y	<0.25:1	TW	FL	Y	Y	N	L
88	WBR	URM	URM	URM	Y	21 to 60	Y	<0.25:1	TW	FL	Y	N	N	L
89	WT													
90	WBR	URM	URM	SP	Y	6 to 20	N		TW	FL	Y	Y	N	L
91	WBR	RM	RM	RCB/URM	Y	6 to 20	N		C	FL	Y	Y	N	L
92	RC	RM	RM	RCB	Y	21 to 60	N	0.49:1 to 0.25:1	TW	FL	Y	N	N	L

TO BE RENOVATED

PGDM - Structural Vulnerability Assessment - Wind Hazard

Country: St Kitts and Nevis - Nevis Island
Engineer:
Date:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Facility No.	Location	Year Built	Elev (feet)	Distance from coast (Mile)	Eng Level	Code Used	Interior Walls	No. of Stories	Class	Age of Roof (Yrs)	Roof Geometry	Roof Covering	Roof Decking
93	Stoney Grove												
94	Cades Bay												
94B													
95	Prospect	1943	250'	1.2	DK	DK	MASONRY	1	URM	>20	GABLE	MPS	WB
96	Belle Vue												
97	Brown Hill												
98	Combermere	Before 1973	145'	0.7	DK	DK	MASONRY	1	RM	>20	GABLE	MPS	WB
99	Gingerland												
100	Charlestown	Before 1973	135'	0.6	DK	DK	MASONRY	1	RM	>20	GABLE	ACS	WB
101	Prospect	1973 - 1983	250'	1.2	DK	DK	MASONRY	1	RM	>20	GABLE	MPS	O
102	Charlestown	Before 1973	135'	0.6	DK	DK	STUD	1	URM	>20	GABLE	MPS	WP
103	Gingerland												
104	Hardtimes	After 1983	725'	1.8	DK	DK	MASONRY	1	RM	16 to 20	GABLE	MPS	PW
105	Butlers	Before 1973	700'	1.4	DK	DK	MASONRY	1	URM	>20	GABLE	MPS	WP
106	Butlers	DK	700'	1.4	DK	DK	MASONRY	1	URM	>20	O	MPS	WB
107	Butlers	Before 1973	110'	0.6	DK	DK	MASONRY	1	URM	>20	GABLE	MPS	WP

ABANDONED

ABANDONED

TO BE DEMOLISHED

ABANDONED

ABANDONED

ABANDONED

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Facility No.	15 Roof Framing		16 Wall Framing	17 Cladding	18 Rf-Frame Connection	19 % of wall area covered by glass, mesh, vent blocks	20 Window Protection	21 Roof/Wall Area	22 Surrounding Terrain	23 Topography	24 Debris Hazard	25 Storm Surge Hazard	26 Landslide Hazard	27 Rating
	P	S												
93	ABANDONED													
94	ABANDONED													
94B	ABANDONED													
95	WBR		URM	URM	Y	21 to 60	N	0.49:1 to 0.25:1	OF	IIR	Y	N	N	M
96	TO BE DEMOLISHED													
97	NO ACCESS													
98	WBR		RC	RCB	Y	21 to 60	N	<0.25:1	OF	FL	Y	N	N	M
99	ABANDONED													
100	WBR		RM	RCB	Y	21 to 60	N	<0.25:1	TW	FL	Y	N	N	II
101	WBR		RM	RCB	Y	21 to 60	N	<0.25:1	OF	FL	Y	N	N	M
102	WBR		URM	URM	Y	21 to 60	N	<0.25:1	TW	FL	Y	N	N	M
103	ABANDONED													
104	WBR		RC	RCB	Y	21 to 60	N	<0.25:1	TW	FL	Y	N	N	M
105	WBR		URM	URM	Y	21 to 60	N	<0.25:1	OF	FL	Y	N	N	L
106	WBR		URM	URM	DK	21 to 60	Y	0.49:1 to 0.25:1	OF	FL	Y	N	N	L
107	WBR		URM	URM	Y	21 to 60	Y	<0.25:1	OF	FL	Y	N	N	L

APPENDIX VI

Unit Rates for Estimating Costs

UNIT RATES FOR ESTIMATING COST

<u>Item</u>	<u>Estimate Cost EC \$</u>
Storm Shutters	\$7.00/sf
New metal sheeting over existing asphalt shingles	\$20.00/sf
Saddle-type hurricane straps	\$1.00/sf of floor area
Additional roof sheet fasteners	\$2.75./sf of floor area
Cut back roof overhang and make good	\$40.00/lin. ft
Re-sheet existing roof	\$.20.00./sf
Add soffits	\$53.00/lf
Replace corroded steel members	\$100/lin. ft
Wire-brush and paint steel members	\$3.00/sf, \$4.00/sf
Add X-bracing or wind bent	\$1,860/bay
Steel Roll-up Doors	
18' high x 15' wide	\$17,000
18' high x 12' wide	\$12,000
Hinged Steel Doors	
4' wide x 8' high	\$1,750
3' wide x 8' high	\$1,750
6' wide x 8' high (2 leaves)	\$4,000